IDENTIFYING KEYS FOR SUCCESSFUL DEVELOPMENT AND THEIR IMPLICATIONS FOR GREENHOUSE GAS EMISSIONS

A Thesis

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by

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SUMMARY OF QUALIFICATIONS

- International energy/environment/climate change problem mitigation professional with twelve years' experience as an electric power engineer specializing in climate change mitigation through renewable energy promotion, cleaner and more environmentally sound technologies, and energy development in both the public and private sectors
- Achieving successful processing and implementation of TAs and Loans in the Asian Development Bank for environmental safeguards, cleaner production, energy efficiency improvement, and renewable energy promotion in developing countries
- Technical expertise with actual experiences and skills in (i) cleaner technologies such as waste-to-power plant management, waste water management plant constructions, compound fertilizer production from wastes, gas turbine power plant construction, heat supply system upgrades and fossil fuel power plant rehabilitation; (ii) renewable energies such as hydroelectric, solar, biomass power, and power generation using methane fermentation; and (iii) energy efficiency improvement such as power transmission and distribution system constructions
- Excellent project management skills from design to implementation, supervision and evaluation in the power industry
- Extensive technical support experience in biomass power projects
- Outstanding academic knowledge with three master's degrees covering a broad range of environmental issues; currently enrolled in a PhD program at the Fletcher School of Law and Diplomacy, USA
- Publication of papers regarding climate change mitigation and renewable energy application from Harvard Law School
- Developed multiple innovative patented waste-to-power management technologies
- Extensive work in developing countries such as Afghanistan, Pakistan, Uzbekistan, Kazakhstan, India, Sri Lanka, Nepal, Bhutan, Maldives, Bangladesh, Thailand, Myanmar, Indonesia, and China (PRC); proven ability to manage cross-cultural teams
- Skills in coordinating workshops and organizing presentations

EDUCATION

The Fletcher School of Law and Diplomacy, Tufts University, U.S.A.
PhD Candidate (Doctor of Philosophy in International Relations), completion expected in 2018

The Fletcher School of Law and Diplomacy/Department of Urban and Environmental Policy and Planning (UEP), Tufts University, U.S.A.
Dual Master's Degree (Master of Arts in Law & Diplomacy from Fletcher and Master of Arts from UEP), 2005
Fields of Study: International Environment and Resource Policy; Development Economics
Certificate: Sustainable Development; Organized an awareness-raising event on the environment sponsored by the City of Medford, Massachusetts (The Medford Energy Task Force): *Faith & Environmental Stewardship: What Is the Link?*

Sophia University Graduate School, Department of Science and Engineering, Japan
Master's in Engineering. Concentration in Mechanical Engineering, 1991
Thesis: *A Consideration About Global Environmental Problems*

Sophia University, Japan

Bachelor's in Engineering. Concentration in Mechanical Engineering, 1989

PROFESSIONAL EXPERIENCE

ASIAN DEVELOPMENT BANK (2005-Present), PHILIPPINES
Senior Environment Specialist (Level 5), Urban and Social Sectors Division, East Asia Department, 2016-Present
Quality and timely technical advice to project teams for project processing and monitoring as well as quality inputs for project documents related to environment safeguards and climate change mitigations and adaptations. The following projects are examples:
1) Hunan Xianjiang River Watershed Existing Solid Waste Comprehensive Treatment, 2) Hebei Elderly Care Service System Development, 3) Xinjiang Changji Integrated Urban-Rural Infrastructure Demonstration, 4) Heilongjiang Coal Rich Cities Redevelopment, 5) Xinjiang Hetian Comprehensive Urban Development and Environmental Improvement, 6) Guangxi Modern TVET Development Demonstration Program ***China (PRC)***
7) UB Urban Services and Ger Areas Development Program Tranche 2, 8) Affordable Housing Project ***Mongolia***

Senior Safeguard Specialist (Environment) (Level 5), Private Sector Transaction Support Division, Private Sector Operations Department, 2014-2016
- Quality and timely technical advice to operation divisions and clients for project processing and monitoring as well as quality inputs for project documents related to environment safeguards and climate change mitigations and adaptations. The following projects are examples:

1)150 MW Burgos Wind Farm ***Philippines***
2) Connectivity Infrastructure Development Project ***Myanmar***
3) Toll Roads Upgrade and Climate Change Adaptation ***Indonesia***

Environment Specialist (Level 4), Energy Division, South Asia Department, 2008-2014
- Sector and environmental analysis to support loan processing, evaluation and design of potential energy efficiency components for climate change mitigation, evaluation of potential for carbon financing. The following projects are examples:

1) Himachal Pradesh Clean Energy Development Investment, 2) Assam Energy Efficiency Enhancement Project, 3) Integrated Renewable Energy Development ***India***
4) Tanahu Hydroelectric Project, 5) Power Sector Development Project, 6) West Seti Hydro Power project ***Nepal***
7) Clean Fuel Development ***Bangladesh***
8) Preparing the Rural Renewable Energy Development Project ***Bhutan***
- Prepare TA papers and inception report; initiate consultant recruitment for Energy Efficiency ***Sri Lanka***
- Division representative for renewable energy, energy efficiency and climate change working groups and environment community of practice

Energy Specialist (Level 4), Infrastructure Division, Central and West Asia Department, 2006- 2008
- Responsible for implementation of the following TAs as the project officer: identify needs of the government, manage schedules and scopes of the TAs in detail, supervise consultants, and review and appraise reports and achievements. The following projects are examples:

1) Small to Medium-Sized Hydro, 2) Natural Gas Development, 3) Establishing a Gas Regulatory Framework, 4) Institutional Strengthening for the Gas Sector, 5) Improving Capacity of Afghanistan Electricity Authority, 6) Capability Building for Reconstruction and Development (Energy Sector), and responsible for implementation of the following loans as the project officer－support the government in implementing the projects appropriately by instructing contractors and consultants: 1) Emergency Infrastructure Rehabilitation & Reconstruction (power transmission line constructions, and gas well and pipeline rehabilitations), 2) Power Transmission & Distribution Project ***Afghanistan***
- Responsible for processing the following TA as the project officer－identify needs of the government at the design stage: Rural Renewable Energy Development Project using run-of-the-river hydro ***Uzbekistan***

• Processed a loan as a team member (engineering aspects)—identify needs of the government, and manage procurement, schedule and scope of the loan at the fact-finding and appraisal stage: Power Transmission Enhancement (transmission system efficiency upgrades) ***Pakistan***

Energy Specialist (Level 4), Energy Division, East and Central Asia Department, 2005-2006

• Processed a loan as a team member (engineering aspects)—identify needs of the government, and manage procurement, schedule and scope of the loan at the fact-finding and appraisal stage: Inner Mongolia Autonomous Region Environmental Improvement (heat supply system, gas transmission, and waste water management plant construction) ***China (PRC)***

• Provided technical support to private sector financing projects—identify needs of the government and assess the project feasibilities: 1) Coal Thermal Power Plant Rehabilitations, 2)Power Transmission System Upgrades ***Kazakhstan***

• Feasibility assessment of an investment proposal in a private energy market fund in its technical aspects: Investment for Biomass Power Projects ***Thailand***

• Evaluated the status of technology development for underground coal gasification project proposal ***Kazakhstan***

GEF/UNDP/DOE CBRED PROJECT (July-September, 2004) PHILIPPINES

Philippines: Capacity Building to Remove Barriers to Renewable Energy Development

Consultant/Intern

• Responsible for making recommendations of biomass power promotion strategy in the Philippines for the government with the Department of Energy

THE CLIMATE GROUP (June-July, 2004) ENGLAND

Business Associate/NGO for Climate Change Mitigation

Consultant/Intern

• Responsible for disseminating and marketing climate change mitigation work in the Japanese donor community and the private sector

J-POWER — former ELECTRIC POWER DEVELOPMENT CO. LTD., (1991-2002)
JAPAN

Special public corporation of the Japanese Ministry of Economy, Trade and Industry.

Deputy Manager of International Power Development Office, International Activities Department, 2001-2002

• Provided engineering support for a waste-to-power project ***Singapore***

• Managed Independent Power Producer (IPP) projects, including construction (rice husk incineration) and planning (rubber wood incineration) of bio-mass power projects, construction of a gas turbine power project, and planning of a coal thermal power plant—provide technical advisory to the project and instruct contractor ***Bangkok, Roi-et, Rayong, Thailand***

Deputy Manager of Thermal Recycle Business Group, New Business Department, 1999-2001

• Created the Waste-to-Power Promotion Manual with a grant from the Japanese government

• Organized presentations to educate government officials at various municipalities in Japan for waste-to-power promotion

• Developed and successfully tested a pioneering waste incineration method using petroleum coke

• Surveyed and simulated systems for promoting power generation using methane fermentation from livestock

• Started development of compound fertilizer by mixing coal ashes and residue produced by methane fermentation

• Investigated technology and institutional arrangement of waste-to-power plants
England, Germany, Netherlands, and Denmark

Member of Maintenance Group, Isogo Coal Thermal Power Station, 1996-1999
Yokohama, Japan

• Managed ash treatment systems, removed blockages in underground pipes that had been problematic for 20 years

• Commended for improving safety of ash treatment crane, ash settling pond and central operation room

- Selected as a trainee in the 6-month Coal Engineer Training Course by New Energy and Industrial Technology Development Organization (NEDO) that included a survey of coal industries
Indonesia, Australia and Japan

Member of Operation Group, Isogo Coal Thermal Power Station, 1991-1996
Yokohama, Japan

- Operated 2×265MW coal thermal power stations as a boiler, turbine, and electricity operator
- Remote monitoring of the operation of Onikoube geothermal power plant

LICENSES, PATENTS AND PUBLICATIONS

- IDEAS (International Development, Environment And Sustainability) Online Journal, Issue 1 Alternative Energy, *Rice Husk Power in Thailand with Japanese Investment,* 2007 http://fletcher.tufts.edu/ierp/ideas/pdfs/issue1/ShotaroSasakiFullpaper.pdf, http://fletcher.tufts.edu/ierp/ideas/pdfs/issue1/SasakiShotaroformat.pdf
- PON (Program on Negotiation at Harvard Law School) Books, Papers on International Environmental Negotiation Volume 14, *Post Kyoto Protocol: Global Consensus Building toward Setting a Long-Term* CO_2 *Emissions Target,* 2005 http://www.pon.org/downloads/ien14_8Sasaki.pdf, http://www.pon.org/downloads/ien14_1introduction.pdf
- Asian Development Bank*, Handbook on Construction Techniques: A Practical Field Review of Environmental Impacts in Power Transmission / Distribution, Run-of-River Hydropower and Solar Photovoltaic Power Generation Projects*, 2015 https://www.adb.org/sites/default/files/institutional-document/179895/handbook-construction-techniques.pdf
- The 12th Japan Society of Waste Management Experts Research Presentation: *Recycling Investigation of the Melted Slag in a Generating Electricity from Waste-to-Power Project*, 2001
- New Energy and Industrial Technology Development Organization (NEDO), *Waste-to-Power Promotion Manual,* 2000
- Applied Patent: *The Incineration Method of Waste*, 1999
- Certificate of First Class Boiler and Turbine Chief Engineer, 1999
- Handling License of Dangerous Objects, 1995
- Professional Teaching License for Technical High School, 1991

LANGUAGES

- Japanese (native); English (proficient)

ABSTRACT

In recent decades, international environmental policy and development scholars argue that (i) countries act by following their near-term national interests in this physically limited earth, (ii) population and stresses on environment accompanying development are increasing globally, (iii) development is the most prioritized issue over environmental problem mitigations for both developed and developing countries, and (iv) development and environment need to both be sustainable for developing countries to succeed.

Those arguments became the motivation of this dissertation, which is “To learn from successful developing countries that achieved both lower GHG emissions per capita (GHGpc) and improved development 1990-2010.” Therefore this dissertation asks “What factors determine whether developing countries achieve lower GHG emissions while meeting their development goals?” Hypotheses that were tested were (i) National policy initiatives, strategies and changes in practices were effective in the successful countries; (ii) Responses to external factors were effective in the successful countries; (iii) Financing by development agencies was effective in the successful countries; and (iv) The mix of economic activities at different stages of development lead to success in the successful countries.

Development was measured by the three components of the Human Development Index (HDI). GHG emissions were analyzed using a modified Kaya identity. The findings were compared with insights from 83 in-country development experts.

The quantitative data analysis found that many poor countries in the world were successful in increasing their HDI and decreasing GHGpc during 1990-2010. Among them in Asia, Myanmar and Nepal were recognized as very successful countries, and Mongolia and Bangladesh as successful countries.

From the qualitative data analysis, this dissertation finds that Myanmar was very successful because of its effective forestry policy regulations that reduced GHGs from land use, change and forestry (LUCF), and its shift away from agriculture and forestry into other natural resources and tertiary industries. Nepal was very successful because its policy regulations effectively improved HDI health and income parameters and reduced GHGs from LUCF, while it transitioned out of

forestry and gained remittances from overseas workers and the service sector. The dissertation also finds that Mongolia was a successful country because donors' support during the economic crisis had the positive consequence of reducing GHG emissions through technical modernization, and that Bangladesh was successful because its policy regulations effectively improved its HDI parameters while domestic natural gas replaced higher emitting coal.

The findings suggest a positive possibility that if a developing country can find alternative ways to generate income, it can encourage a shift out of agriculture and forestry sectors, from which many developing countries release the majority of GHGs. There is also a negative outcome if their reliance on exports of natural resources or their reliance on remittances from overseas workers increase, then GHGs in other countries may increase where those natural resources are consumed, or in the countries where the overseas workers work.

It is also demonstrated that development of the four successful countries were consistent with many of the Sustainable Development Goals (SDGs) even though they were created five years after the study period. The following countries, however, did not move forward on (i) GHG related goals for Bangladesh, (ii) health and education related goals for Myanmar, and (iii) health and education related goals for Mongolia. Nepal was the only country to meet all those goals in Asia. Therefore, to achieve SDGs it is recommended that Bangladesh should improve GHG emission reduction, Myanmar should improve health and education, Mongolia also should improve health and education, and Nepal should continue its current practices in the upcoming decade.

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My profound gratitude goes to Professor Rappaport for encouraging me and inspiring me throughout the process, particularly for the qualitative analysis . Since I took her course at UEP in 2003, she always kindly provided me constructive advices respecting my opinions by her gentle and noble way.
I am greatly indebted to Professor Tanaka for helping me to organize my immature quantitative data analysis even during his precious sabbatical leave period. His kind participation into my Ph.D. committee providing me advices from his academic experiences gave me enormous comforts to move forward through the process.

Dr. Jenifer Burckett-Picker played a crucial role in facilitating my Ph.D. progress through her excellent management of the Ph.D. program, and in continuing to provide kind encouragements in her very patient way all through my 8 years since I started my Ph.D. study since 2010. Without her supports and cares, I could not reach to this point.

I am thankful for the financial support from the Fletcher School, which made my Ph.D. study possible. I also want to show my appreciations to my professors, belated Professor Emeritus Hidetaro Nakayama, and Professor Emeritus Kunio Hayashi in Sophia University, Japan for giving me opportunities to be interested into environmental problem mitigations as my lifework even though the problem was not getting much attention at that time around 1990 when I was studying there for my bachelor and master of engineering.

I also want to express my appreciations to J-Power (EPDC) where I was working for giving me the chance to study away from my work for my dual masters degree program when I was still a young engineer who could not return much benefits to the company.

Asian Development Bank also kindly gave me the opportunity to go for the Ph.D. program having a special leave from my work, for which I really appreciate.

If I were not able to get the friendly participations by those professional experts in the field of environment and development into my survey consuming their valuable time to write me their precious experiences and knowledges, this dissertation could not be much meaningful, for those I really want to tell my thank you.

Thank you to my parents, my deceased father Masaya and my beloved mother Yoshiko. Without their guidance, I was not able to even start heading to this achievement.

Thank you to Dr. Kiyoshi Taniguchi, Ms. Maribeth Frondoza, Mr. Henry Custodio, and Mr. Zandro Racoma for helping me while I have been continuing my study in the Philippine to finalize my dissertation.

Finally, this dissertation is dedicated to my son, Seiryo, hoping that the world can be a better one where countries will be able to collaborate together combatting various difficult issues including environmental problem mitigations for his generation and his next generations.

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List of Acronyms

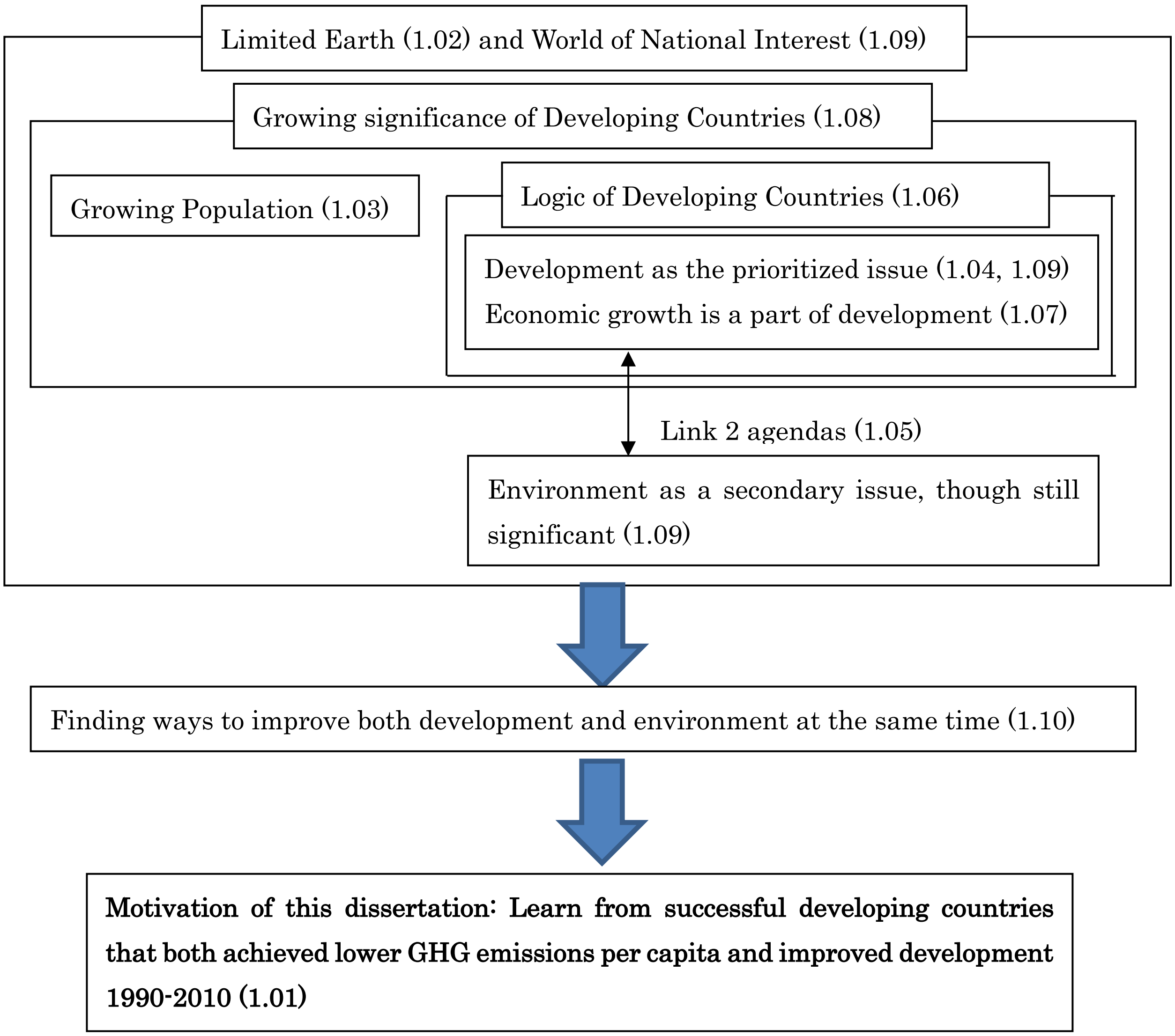
ASEAN	Association of Southeast Asian Nations
BNP	Bangladesh Nationalist Party
CA	Constituent Assembly
CAIT	Climate Analysis Indicators Tool
CAR	Central African Republic
CCMT	Climate change mitigation technology
CH_4	Methane
CO_2	Carbon Dioxide
EKC	Environmental Kuznets Curve
ESI	Environmental Sustainability Index
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHGpc	Greenhouse Gas Per Capita
GNI	Gross National Income
GNIpc	Gross National Income Per Capita
HFC	Hydrofluorocarbons
HDI	Human Development Index
IEA	International Energy Agency
IPAT	Impact = Population*Affluence*Technology
IPCC	Intergovernmental Panel on Climate Change
LUCF	Land-use change and forestry
LULUCF	Land-use, land-use change, and forestry
MPRP	Mongolian People’s Revolutionary Party
N_2O	Nitrous Oxide
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PFCs	Perfluorocarbons
SF_6	Sulphur Hexafluoride
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER 1. PROBLEM STATEMENT

1.1. Motivation of this Dissertation: To Contribute to Mitigating the Problems Faced by the World Today

When US President Trump said, “In order to fulfill my solemn duty to protect America and its citizens, the United States will withdraw from the Paris Climate Accord” (Conca 2017), he was not expressing a new idea. Countries in general tend to prioritize their own short-term benefit over the environment. Although the US is one of the richest countries on earth, it does the same. Poorer countries cannot be blamed, therefore, for prioritizing their development over protecting the environment. Even in other rich countries in which economic gaps are widening, the frustrations of poorer people make politicians hesitant to propose policies that prioritize the environment over development, which includes economic growth. They need to attract votes by promising short-term rather than long-term achievements, since elections occur every several years, while the benefits from environmental improvements take longer than several decades to materialize. When the whole world is considered, current human activities are extensive enough to put great pressure on the environment; if they continue unabated, the limited capacity of the earth to support life will be exceeded. This situation is all the more critical because the pressure is increasing: developing countries find it difficult to pursue environmental sustainability and development as they seek to provide better and more comfortable lives for their citizens. At the same time, their population is increasing at an uncontrolled rate. This clearly illustrates that the world situation has changed from the time when development activities were conducted by only a small part of the world's population. Thus, the development models that were used in industrialized and developed countries in the past cannot be used by developing countries today. To illustrate this situation more clearly, Figure 1 summarizes the relationship among the problems that have motivated this dissertation. In sections 1.2-1.9, these problems are further clarified, and explain and justify the motivation of this dissertation.

Figure 1. Summary of the Motivation of this Dissertation.[1]



1.2. Problem 1: A Perennial Problem on our Limited Earth

In the past, when the world's population was smaller, collective human actions had relatively little impact on the environment. Using fossil fuels as a major

[1] Only selected figures are in the main document for readers' conveniences. All figures are in appendix.

energy source was once considered ideal because their advantages, such as easy handling and efficiency in transforming carbon into heat, were greater than their disadvantages, such as the damaging and harmful by-product emissions. When the collective human actions were very small on the big earth, these emissions were diluted to negligible levels. However, at present, the magnitude and scale of the use of fossil fuels and of the other GHG-emitting activities conducted by humans are great enough to alter the global climate, as described in the Intergovernmental Panel on Climate Change (IPCC) reports.

To give an example, in the past, the practice of using nitrogen fertilizers was considered acceptable and even beneficial. However, nitrogen fertilizer inputs now exceed natural flows, and the capacity of the soil to absorb residuals thereby altering the natural flows of nutrients in the soil, air and water. After consumption activities, including the consumption of energy produced by nuclear power, there are fewer places to dump waste or dispose of unwanted by-products so as not to affect people or damage the environment.

If the consumption pattern of developed countries is used in developing countries, the results can be disastrous (Goldemberg 1998). Some studies even suggest that human activities are already consuming 25-40% of the global natural carrying capacity (Daly and Kenneth 1993). The ecological footprint was one hectare per capita in 1900, but by 1991, it had increased to 4.6 hectares per capita (von Weizsäcker, Lovins and Lovins 1997). The non-renewable resources of oil and gas made up 63% of primary energy sources in 2016, and these reserves are likely to be depleted in the not so distant future. The world was consuming 7.3 billion tons of coal per year by 2016, up from 3.1 billion tons in 1973. While this is more than a doubling in 43 years, it is a decline form the peak that occurred in 2013 (International Energy Agency 2017).

It is undoubtedly true that it is impossible to achieve unlimited growth in a limited space (Hardin 1968). Technology can improve efficiency and lower emissions, but since it is not magic, it cannot transform limited entities into unlimited ones.

1.3. Problem 2: Pressures from Population Increase

The human population is growing, and the bulk of this growth is located in poor countries. The absolute number of people in developing countries is huge, and in many of these developing countries, the population is increasing steeply (Goodland 1992). Increasing amounts of energy and natural resources are needed to sustain this growth (Reddy 2000). Some propose that the steep curve of the population increase must be reduced to curb this growth. However, in many countries, cultural, ideological, religious and political factors oppose population control, management or reduction. In fact, population control is taboo in many countries (Stockholm 1972). Many developing countries in particular are not ready to accept the population control concept, which seems to threaten basic sovereignty and cultural values. The question is whether the limited natural ecosystem and the current production and consumption methods and systems used by developed countries can feed the growing world population (Cohen 2005). To satisfy these needs using current assumptions, global economic activity must increase to 5 to 10 times larger (Goodland 1992).

1.4. Problem 3: Increasing Environmental Pressures from Developing Countries

For developing countries, the appropriate approach initially seemed to be to follow the development trajectories of developed countries. It is now apparent, however, that the methods used by developed countries in the past cannot be imitated by developing countries without exceeding the earth's limitations.

The limited capacity of the earth to sustain life, the increasing human population and the need for development in developing countries put great pressure on the environment. According to Rockstrom et al. (2009), the world is approaching, if not already exceeding, its limits in multiple ecosystem services. The recent report from the Intergovernmental Panel on Biodiversity and Ecosystem Services finds that three-quarters of land area is degraded, reducing the economic production globally by 10 per cent, and along with climate change is adversely affecting 3.2 billion people. They project that if current trends continue, degradation could reach 95% of land by 2050 (IPBES 2018).

Environmental problems spread beyond political and national borders, regardless of the sources of the pollution. Moreover, the goals and policies of developing countries are different from those of developed countries (World Development Report 2010). Nowadays, in developed countries, environmental protection and sustainability receives high priority in most economic activities, while economic development comes first in developing countries (Najam 2004). Differences in environmental protection create distortions in competition through international trade. Growth and development is the primary objective of the 70% of the world's population that lives in developing countries (Goldemberg 1998, 26). To illustrate, South Africa clearly states, as a matter of policy, that it prioritizes development over the environment (Sachs 2002). In China (PRC), the government considers economic growth necessary for domestic political reasons (Lewis and Gallagher 2011). It is apparent that the top priorities of these countries are to increase their own national power and to improve their level of development (Jaffe 2004). Therefore, it is reasonable to conclude that the pressure imposed by developing countries, with their increasing population, is becoming a critical factor in determining the sustainability of the planet in the near future.

1.5. Problem 4: Linkages Between Development and the Environment

It is predicted that in the future, it will be very difficult, if not impossible, for countries, including currently developing countries, to consume and use resources at the same rate that developed countries have done in the past. At the same time, the need for development in developing countries is no longer negligible. Poor people need national economic development to bring them out of poverty, with the assumption that the benefits of growth will directly accrue to them, or at least trickle down to them. In this regard, both environmental sustainability and pursuing development are important (Stockholm 1972). This statement has two implications. One is that poverty reduction cannot be expected without concern for ecological systems and biological diversity (Sachs 2002) because the earth has limitations, as mentioned above. The other is that development can help improve environmental quality (Stockholm 1972). The latter, a belief held by many developing countries (Our Common Future 1987), supports the Environmental Kuznets Curve (EKC) theory. A modification of the "development-leading-to-higher-emissions" model is the EKC, which argues that human activities performed in the pursuit of growth and development result in increases in certain pollutants at low-income levels (Grossman and Krueger 1991, 1995). The EKC is the theoretical basis for proceeding on this assumption, because development policies in developing countries are strongly influenced or trapped by the EKC theory. As a result, planners, politicians and policy makers are discouraged from making efforts to stabilize or reduce GHG emissions. The validity of this proposition will be tested in this dissertation. The linkage between economic development and environment can mean that the environment gets lost in the shuffle. This linkage, however, also offers an opportunity, because issue linkages can be "crucial to the success of negotiations" (Susskind and Najam 2004).

Among many environmental issues, when it comes to climate change, it is also usually considered normal when countries hesitate to take climate change mitigation actions for fear of losing or reducing their development opportunities, since emissions of GHG are often related to economic activities. After all, it has recently been recognized that the climate change agenda cannot be discussed without concern for development (Stern 2006). This means that when the climate change agenda is related to the development agenda, it becomes more important to the world, and particularly to developing countries. It is therefore difficult to make climate a direct driver of policy strategic planning for many countries (Mertz, Halsnæs and Olesen 2009) because, for developing countries, climate change is not a priority issue. It is not usually considered to be among individual countries' environmental problems (Gallagher 2006 and World Development Report 2010). However, is it also recognized that development and climate change must be discussed together (Sachs 2002) because development will never be successfully achieved unless countries work together to develop climate change mitigation measures (World Development Report 2010). The World Bank has recently made addressing climate change a priority for development. If the issue is not addressed, the climate of the future will undo much of the development work to date and cause major suffering in many countries (World Bank 2012).

The question remains: how should the climate change agenda be related to the development agenda? Low-emission systems, which mean high-efficiency systems and new technologies, are required for development in developing countries because they ensure the effective use of resources. It has been pointed out that it is essential for development to be resilient to climate change, and development (including growth and prosperity) cannot be achieved in cases in which climate change levels are dangerously high (World Development Report 2010). According to Stern (2006), if climate change mitigation measures are not considered, there will be a higher risk of disadvantaging development in the future. Some climate change measures, particularly adaptations like infrastructure improvements, urban planning, insurance for natural disasters, social benefit packages, and the like, are thought to be beneficial for development even if climate change does not occur.

It is also noteworthy that for governments, climate change is not the only agenda that involves uncertainty in the decision-making process. Military spending and investments are also decided in spite of major uncertainties (World Development Report 2010). In this sense, incorporating climate change into current development planning may be the best option (Dasgupta 2007).

Moreover, an effective environmental regime is one that cares about development and removes the opposition between the environment and equity

(World Development Report 2010). Internationally organized actions for climate change mitigation are also needed for development (World Development Report 2010). The implementation of such international cooperation depends on actions taken by individual nations (World Development Report 2010). It is critical to make development resilient to climate change and to seek growth and prosperity without causing dangerous climate change (World Development Report 2010). In this regard, to involve developing countries in environment conservation efforts, regional poverty reduction must be linked to natural resource conservation (Chester and Moomaw 2008). Adaptation measures to mitigate climate change can be included in development projects (World Development Report 2010) that address regional poverty reduction because development efforts generally improve the capacity for adaptation (Mertz, Halsnæs and Olesen 2009). Many issues in developing countries can be mitigated by existing technologies (Holdren 2008), although the costs of some technologies may be burdensome for developing countries (although the cost of zero carbon technologies is falling rapidly); international development supports can therefore be expected to make a contribution. In any case, it is impossible to discuss environmental problem mitigation without linking it to the development agenda. Environmental policy will never be able to move forward as long as development is not linked to the environment (Najam 2004).

1.6. Problem 5: The Logic of Developing Countries

Following the second view expressed in 1.5, that development will improve environmental quality (a view that is strongly influenced by EKC theory), it is believed that development in developing countries cannot be neglected because development itself will eventually mitigate environmental problems in developing countries (Stockholm 1972, Principle 117). The logic of EKC is that when incomes are low, consumption will never be sacrificed; instead, the reduction of environmental degradation will be sacrificed. Therefore, since environmental protection is assumed to be a “luxury good,” it is only when there is high income that consumption can be deprioritized in favor of protecting environmental goods and services. The EKC claims that policies that promote economic growth will eventually bring environmental improvement (Moomaw 1997). Developing countries take every opportunity to espouse the need for development in international environmental meetings (Sachs 2002). In Stockholm in 1972, developing countries united for the first time as a collective power and argued that environmental protection should not be used to stall economic development. Rio, in 1992, was held at the end of the Cold War. It also coincided with North-South tension over development and the environment, with the North arguing for the urgency of environmental protection and the South advocating poverty reduction. Nonetheless, at Rio ‘92, environment and development were complementary, rather than contradictory, categories. In fact, the official name of the UN Conference on Environment and Development (UNCED) was chosen after it had been decided that environment and development complemented each other. Rio’s most important legacy was the global agreements that defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland et al. 1987). These agreements emphasized the strong connection between environmental quality and a sustainable economy and society and were seen as a major step in resolving the conflict between the environment and development. Even though the direct achievements of UNCED Rio were disappointing, its fruits are the indirect outputs: the increase in interest in the environment and development because of UNCED and the enhanced importance attributed to the views of developing countries in setting global environmental policy (Najam 2004).

1.7. Problem 6: Economic Growth as a Necessary Part of Development

At UNCED, governments agreed on a broad concept of development as sustainable development, which means the improvement of conditions for both present and future generations that include not only the economy, but also society and the environment (Holdren 2008). However, in practice many development agencies assume that human well-being is connected to economic development and that development has the same meaning as economic growth (Najam et al. 2011). The recognition that economic growth is needed for environmental improvement is now at the center of sustainable development (Stern 1997). In this regard, economic development is a necessary condition for quality of life in the present and future, particularly for developing countries. Both social and economic development are needed (Stockholm 1972). In the past, continuous development by the North was not linked to environmental policy, since development was also the highest priority for developed countries (Sachs 2002). In 1992, then-U.S. President George H. W. Bush claimed that the American lifestyle was not negotiable. Even though the U.S. is one of the most developed countries in the world, Bush's claim is similar to those made by developing countries that prioritize human wellbeing over the environment (Moomaw and Papa 2012). This logically justifies the claim by developing countries that their right to economic growth is not negotiable (Najam et al. 2011). In this regard, the degree of development should be evaluated using both social and economic factors.

1.8. Problem 7: Growing Contributions of Developing Countries

The developed countries' share in the accumulated responsibility for emissions is two-thirds of the total, and their energy consumption per capita is five times higher than that of developing countries. Developing countries, however, produce more than half of energy-related emissions and will bear a projected 90% of the responsibility in the next 20 years. The responsibility of developing countries for emissions is increasing, not only for CO_2 but also for total GHGs (World Development Report). Seventy-four percent of the primary energy increases from now on will come from developing countries (IEA 2007). Coal and oil consumption in China (PRC) and increases in GHGs per capita and GHGs per GDP will be the main concerns of the future (Lewis and Gallagher 2011). It is estimated that CO_2 emissions per capita in China (PRC) will catch up with those of developed countries, while emissions from Russia will also increase (IEA 2007). It is also estimated that even if emissions from developed countries were zero, emission reductions from developing countries would also be needed to avoid an unsustainable climate system (World Development Report 2010). However, the rapid population increases forecast in developing countries will make it very difficult to achieve this. If the world fails to involve developing countries in actions aimed at emission reductions, developed countries will be justified in fearing that the problem may become one of unfair competition (Meckling and Gu 2009).

Many developing countries prefer to build a coalition of winners rather than to be separated because of their differences that place them at a disadvantage in the international order. Therefore, the developing countries of the Global South will play an important role in future global environmental policy, as the coalition claims that development is its priority. Environmental mitigation measures cannot succeed without the support of developing countries.

1.9. Problem 8: The Environmental Problem as a Global Agenda

Compared to the need for increasing national power and development, measures to mitigate environmental problems are seldom prioritized because governments think they can adapt to environmental problems later, after increasing their national power and level of development. They do not want to argue about what is not yet certain to happen. It is assumed that mitigating environmental problems now might disturb the acquisition of national power and the development process. Moreover, countries assume that increasing national power and development will be necessary to achieve the economic potential to adapt to climate change.

Climate change is an example of an environmental problem that involves uncertainties. In this regard, it will be difficult to prioritize the mitigation of climate change in this world of national interests where each country seeks to improve its national power and development and expects to bring improved economic and social conditions and political stability. Ethics can contribute little to motivating climate change mitigation actions insofar as (i) climate change is seen as a crisis of the long-term future and (ii) climate change mitigation actions are not believed to bring economic advantages.

However, this does not mean that climate change issues are an insignificant agenda for the world. Klare (2001) stated that races to obtain resources such as oil, water, and minerals will cause conflicts, as well as result in environmental problems. Therefore, such races have a strong connection to national security. Klare added that international conflicts will be aggravated by population increase and climate change. When the damages caused by population increase and climate change become greater, it will be very difficult for policy makers to avoid social problems, reductions in development potential and conflicts. The conflicts may originate in developing countries (Homer-Dixon 1991), which constitute a majority that is broadly spread out across the world. For this reason, climate change mitigation must be addressed by the world as an agenda related to national security. CO_2 control in particular will not happen immediately in developing countries, since controls of more toxic emissions are prioritized as a local issue in these countries (Moomaw 1997). Traditional development depended on energy from combusting fossil fuels, which leads to climate change. If fossil fuels cannot be utilized because they cause climate change, developing countries cannot follow the development path of developed countries.

1.10. Problems to Be Addressed

The problems presented in Sections 1.2 to 1.9, which serve as the motivations of this dissertation, are illustrated in Figure 1. It would be useful to present a case of successful mitigation of these problems that simultaneously sustains the environment and improves the development level of a developing country, especially because a majority of the world population is expected to live in developing countries in the coming decades. It is now recognized that (i) human activities are causing environmental pressures on the limited carrying capacity of the earth, but (ii) the need for development in developing countries (iii) with increasing populations is also growing. This means, as explained above, that the needs of developing countries cannot be met by following the development path used by currently developed countries. Therefore, it is important to identify successful developing countries in recent history to identify ways to improve the living standards of the world's poorest without sacrificing the environment. Here, "successful developing countries" are countries that have improved both their level of development and their environmental performance. In this dissertation, improvements in the level of development will be indicated by the Human Development Index (HDI), and improvements in environmental performance will be indicated by greenhouse gas emissions per capita (GHGpc). These indicators have been chosen because HDI is currently a globally recognized parameter that quantifies countries' levels of development and living standards. Most policy makers all over the world believe that it is necessary to sacrifice climate change mitigation to achieve economic development. It may be because development is believed to bring well-being and happiness to people particularly in poor countries.

As of now, there is no globally and academically trusted indicator to show level of well-being and happiness other than HDI. For example, there are 17 Sustainable Development Goals (SDGs), but there is no comprehensive indicator that measures levels of achievement toward the goals. HDI considers only 3 measures, education, health, and income, which is a limitation of HDI as an indicator to show the level of well-being and happiness. However, still this is the best measure available. The climate change impact produced by emissions from each country's GHGs, not only from CO2, is also one of the clearest parameters that show risk to the environment. Total GHG emissions differ according to the size of the country; therefore, GHGpc emissions are an appropriate parameter for use in discussing multiple countries. Moreover, considering that the population of developing countries is increasing, when the goal is to reduce the total emissions produced by a country, reducing GHGpc is generally a step taken before reducing the country's total GHG emissions.

It is often assumed that developing countries facing uncontrollable population increases and huge pressures from their citizens' desire to achieve higher levels of development will find it almost impossible to improve their environmental performance. Improving climate change indicators seems especially difficult, since these indicators are connected to many economic activities. However, as shown in

Chapter 4, when the trajectories of relations between the indicator of development and GHGpc are observed, it is found that significant numbers of developing countries improved both their development and environmental indicators between 1990 and 2010. Therefore, it is important to analyze these successful developing countries to identify ways to improve the living standards of the poor while minimizing environmental damage.

This dissertation investigates the relationship between GHGpc and HDI using trajectory data from 1990-2010. These data are used to test the EKC, and it is found that the EKC was not applicable to the actual historical trajectory, as Moomaw and others have shown. In this study, the relationship between GHGpc and HDI in developing countries over time is examined in light of the theoretical EKC, and it is concluded that the EKC is not valid as a general theory. The environment does not always have to be victimized when development is prioritized, and thus there is no magical income that will stop environmental degradation, as is assumed by the EKC theory. This dissertation then goes on to analyze, as its original contribution, what happened in the "successful development" accomplished by some of the Asian developing countries in the period. To gain insight into the underlying factors that account for their trajectories of development, multiple methods are used: (i) designating successful developing countries in Asia, (ii) examining GHG components and emitter industries, (iii) examining HDI components, (iv) examining the contribution of technology using the modified KAYA Identity, and (v) examining the development of aid effectiveness. In order to determine why specific patterns are observed, experts in these countries have been consulted about these explanations to confirm or question the insights.

CHAPTER 2. RESEARCH QUESTION AND HYPOTHESIS

2.1. Research Questions

To begin to improve the living standards of poor countries, which is one of the most significant challenges for humanity's future, it is important to identify successful developing countries that have improved both their level of development and their environmental performance. In this dissertation, "successful developing countries" are defined as countries that showed improvements in development indicators, namely HDI, while also increasing their population and decreasing their GHGpc. As will be discussed later in detail, during the period 1990-2010, more low-income countries exhibited this pattern of "successful development" than did middle-income countries, as shown in Figure 37. This raises the interesting question of what factors determine the path of GHG emissions during the development process.

Based on this observation, this dissertation's central question is: What factors determine whether developing countries achieve lower GHG emissions while meeting their development goals?

2.2. Hypotheses

Four factors are used to build hypotheses in response to this question, because it can be assumed that such success may be affected by (i) internal driving forces such as policy initiatives, (ii) external driving forces that cannot be controlled by the country, (iii) help from others, such as donor support, and/or (iv) fundamental changes at the domestic level. Accordingly, the four hypotheses are as follows:

(i) National policy initiatives, strategies and changes in practices were effective in the successful countries;

(ii) Responses to external factors were effective in the successful countries;

(iii) Financing by development agencies was effective in the successful countries;

(iv) The mix of economic activities at different stages of development worked effectively in the successful countries. The type of economic activity (service industry, heavy industry, agriculture etc.) and the technologies used. The type of economic activity and the technologies used and adopted determines the type of GHG emitted (CO_2, methane etc.). Emissions depend upon the mix of economic activities and the type of GHG emitted by different sectors in each country. Changing economic activities as development proceeds may alter the amount and type of GHG emissions.

CHAPTER 3. METHODOLOGY (STRATEGY FOR ANALYSIS)

The strong message from Moomaw and Unruh (1997) for policy makers is that environmental improvement can be achieved without sacrificing economic growth, as politics assumes, even though it will not be achieved automatically. This means that there are opportunities to increase both development and environmental protections. In this dissertation, we will examine the trajectories of Asian countries between 1990 and 2010 to identify successful developing countries that have achieved both development and environmental improvements. We will examine whether or not these earlier accomplishments are consistent with specific Sustainable Development Goals (SDGs) that are to be achieved between 2015 and 2030.

In this regard, this dissertation does the following strategy for analysis:

(i) Analyzes empirical findings from historical development and emission patterns for 130 countries in the world from 1990-2010 (analysis based on past historical trajectories);

(ii) Analyzes quantitative data from countries that showed "successful development" in their historical trajectories;

(iii) Analyzes in detail the successful countries in Asia;

(iv) Analyzes responses by experts to questionnaires (a qualitative approach); and

(v) Tests hypotheses generated by the quantitative and the qualitative approaches.

These steps are explained below in detail.

(i) Analyzes empirical findings from historical development and emission patterns for 130 countries in the world from 1990-2010 (analysis based on facts shown in historical trajectories): An initial examination of data from 130 countries showed that many low-income countries with population increases exhibited improvements in their environmental indicator (GHGpc), while also improving their development indicator (HDI). Chapter 4, which is devoted to step (i), shows historical proof of this finding. Chapter 4 will also provide the new historical evidence that a significant number of developing countries achieved improvement in development (HDI) while they also experienced an improved environmental indicator (GHGpc).

(ii) Analyzes quantitative data from countries that showed "successful development" in their historical trajectories: In step (ii), specific countries that showed “successful development” are identified along with the specific factors that may have contributed to the observed outcome. Four types of countries are observed: (a) countries that were successful in improving both the environmental indicator and the development indicator (GHGpc reduced and HDI increased); (b) countries whose HDI improved but failed to improve the environmental indicator (GHGpc), (c) countries whose environmental indicator (GHGpc) improved but failed to improve the development indicator, and (d) countries that were unsuccessful in improving both the environmental indicator (GHGpc) and the development indicator (HDI).

If a developing country merely followed the path that developed countries followed in the past, countries that achieved higher development increased their GHGpc. It is expected that the trajectories of countries of type (a) will reveal interesting insights into a more sustainable development process, since a significant number of developing countries decreased their GHGpc while their HDI increased, as shown later. The GHGpc can be decreased by a rapid population increase, which is common in developing countries (this looks like a “dilution” of GHGs caused by the population increase). If during this period, however, such developing countries simply followed the path that developed countries followed in the past, the per capita wellbeing should have declined also; thus, HDI should not have improved. A mediating factor may be found that differentiates the country types.

(iii) Analyzes in detail the successful countries in Asia: An examination of the successful countries through steps (iii), (iv) and (v) produces insight into the factors behind successful development. In this step, efficient-energy-consumption technology is the focus because developing countries that achieved an improvement in HDI or GDPpc with a decrease of GHGpc may have done so through technological improvements: without efficiency improvements or low-emission technologies, the successes may not have taken place. Moreover, some efficient-energy-consumption technology improvements may be caused intentionally by policies, while others may be caused unintentionally by policies that are not aimed at reducing GHG emissions, or by structural changes in society. Technology is analyzed taking into consideration EKC, IPAT, and Kaya Identity. The dissertation determines whether other factors play a role, considering, for instance whether the observed reductions in GHGs result from increased foreign aid, or changes in the types of gases that make up total GHG are caused by changes in economic activities or technologies as a country develops. The relative importance of foreign aid, economic structure (and hence which GHGs are emitted in what amounts) and policy-induced emission trajectories are different for each country.

(iv) Analyzes responses by experts to questionnaires (a qualitative approach): After the data analysis in steps (i)–(iii), the results are examined in light of professional insights from experts. The experts have varied expertise and experience in the field of development and the environment. The questionnaires have been carefully designed for the countries that showed successful development, based on the results of the data analysis.

(v) Tests hypotheses generated by the quantitative and the qualitative approaches: The final part of the dissertation tests the hypotheses generated by the findings achieved in the steps up to (iv). This will show what happened in 1990-2010 to produce successful development in Asia. The conclusion suggests ways to achieve the success that appears difficult to achieve in poor countries if the EKC theory is assumed to be valid.

Details of methods in each step are embedded in each of upcoming chapters.

CHAPTER 4. EMPIRICAL FINDINGS FROM HISTORICAL DEVELOPMENT AND EMISSION PATTERNS

This chapter is devoted to an analysis of data on the historical trajectory of the relationship between development indicator (the HDI in this dissertation) and the environmental indicator (the climate change indicator, which is GHG emissions per capita in this dissertation). Figure 2 provides a snapshot of GHG emissions per capita (GHGpc)[2] and the HDI of 180 countries for 2010. It demonstrates that countries emit various levels of GHGpc, even though they may have similar levels of HDI.[3] The data include land use change[4] and GHGs (heat trapping GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and industrial gases (PFC, HFC, SF_6)).

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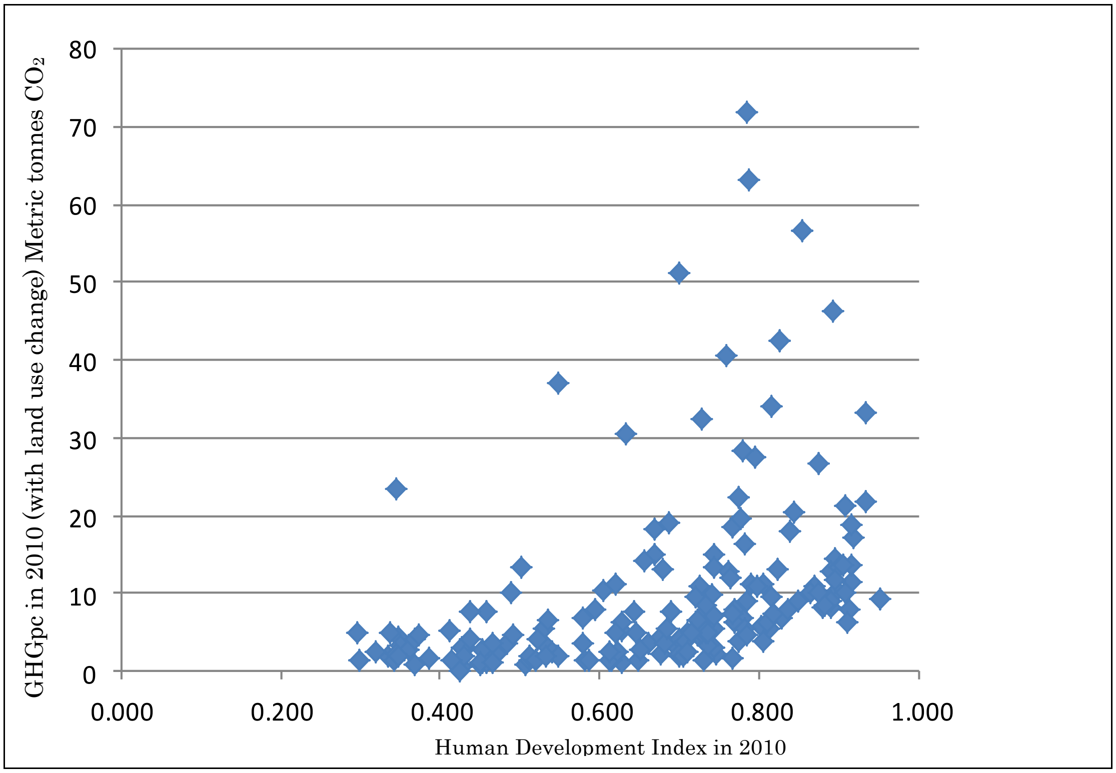
[2] GHG per capita data are available at the CAIT provided by the World Resources Institute, even though the data UNDP's International Human Development Indicators do not provide useful data for 1990-2000 for most countries. (http://hdrstats.undp.org/en/indicators/96606.html)

[3] The Human Development Index (HDI) is a composite statistic of life expectancy, education, and income indices used to rank countries into four tiers of human development. It is a tool developed by the United Nations to measure and rank countries' levels of social and economic development based on four criteria: life expectancy at birth, mean years of schooling, expected years of schooling and gross national income per capita. The HDI makes it possible to track changes in development levels over time and to compare development levels in different countries. (SOURCE: UNDP)

[4] Land use, land-use change, and forestry (LULUCF) means "A greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities." (2017/08/05, UNFCCC, Glossary of climate change acronyms and terms, http://unfccc.int/essential_background/glossary/items/3666.php#L)

Figure 2. GHG Emissions per capita and HDI of 180 countries in 2010.



SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

HDI is a composite statistic of the health, education, and income indices used to rank countries on the basis of three characteristics of human development (UNDP 2012). When the relationship between development and environment is examined, HDI can be used as the most general indicator accepted internationally. In fact, these four indicators (health, education, income and GHGpc) are linked to almost half of the 17 sustainable development goals (SDGs) for transforming our world (UN DSPD 2018). The health indicator is related to GOAL 2: Zero Hunger, GOAL 3: Good Health and Well-being, and GOAL 6: Clean Water and Sanitation. The education indicator is related to GOAL 4: Quality Education. The income indicator is related to GOAL 1: No Poverty, and GOAL 8: Decent Work and Economic Growth. The GHGpc indicator is related to GOAL 7: Affordable and Clean Energy, and GOAL 13: Climate Action.

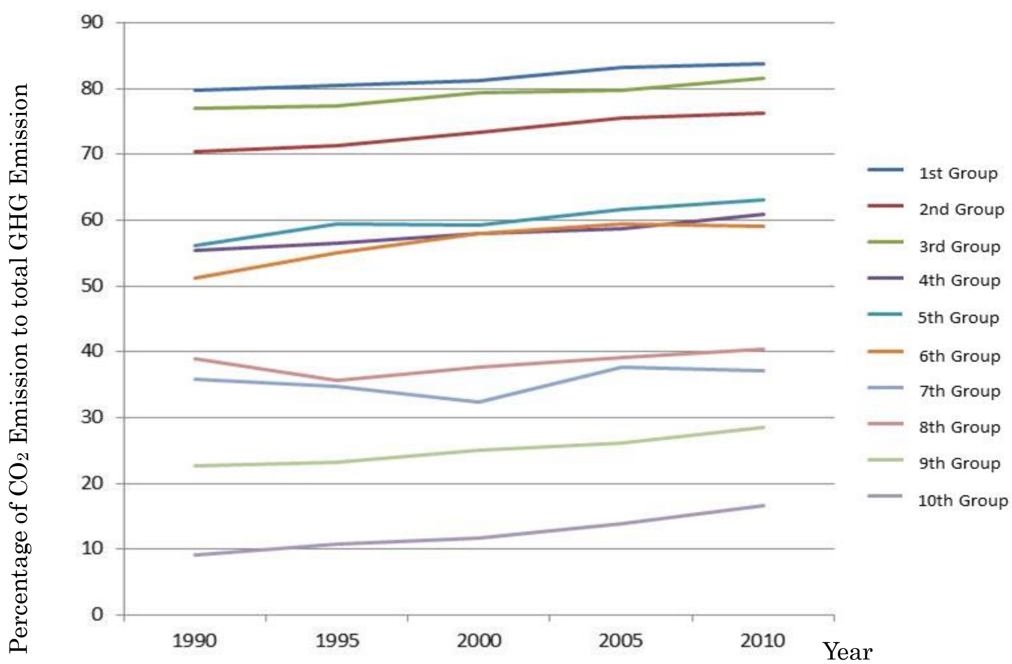
There are 130 countries for which data for both HDI and GHGpc are available for the period of 1990-2010. The countries were divided into ten groups[5] based on their incomes in the starting year, i.e., the Gross National Income per capita (GNIpc) in 1990 (Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)). Those ten groups were defined from 1st Group as the highest GNIpc group to 10th Group as the lowest GNIpc group.[6] As mentioned in section 1.8, developing countries emit more than half of energy-related emissions in the world and will bear a projected 90% of the responsibility for additional emissions in the next 20 years. Emissions and the responsibility of developing countries for emissions are increasing, not only of CO_2 but also of total GHGs (World Development Report 2010).

[5] Dividing 130 countries into 10 groups was chosen as a convenient option that will provide advantages to find out how trajectories were in such as Figure 3, Figure 15, and Figure 37.

[6] GNIpc averages of each group in 1990 are; (1st group) $25,700, (2nd group) $$15,519, (3rd group) $6,589, (4th group) $2,974, (5th group) $2,132, (6th group) $1,348, (7th group) $823, (8th group) $616, (9th group) $391, and (10th group) $215.

It is found that CO_2 emissions do not constitute a significant portion of the total GHGs in poorer developing countries, in contrast to emissions in developed countries, where CO_2 is the major climate change contributor. While CO_2 constitutes more than 70-80% of the GHG emissions from the rich country groups, CO_2 constitutes less than 20-40% of the GHG emissions from the poor country groups as shown in Figure 3. The percentages are the 100-year global warming potential percentage for the total GHGs. Therefore, it is important to analyze trends of GHG emissions that include gases other than CO_2.

Figure 3. Trajectory of CO2 ratio among GHGs[7]



SOURCE: Climate Analysis Indicators Tool (CAIT) 2.0. ©2014. Washington, DC: World Resources Institute)

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7 The grouping has been done from the richest to the poorest at the year of 2010 where each group has 13 countries.

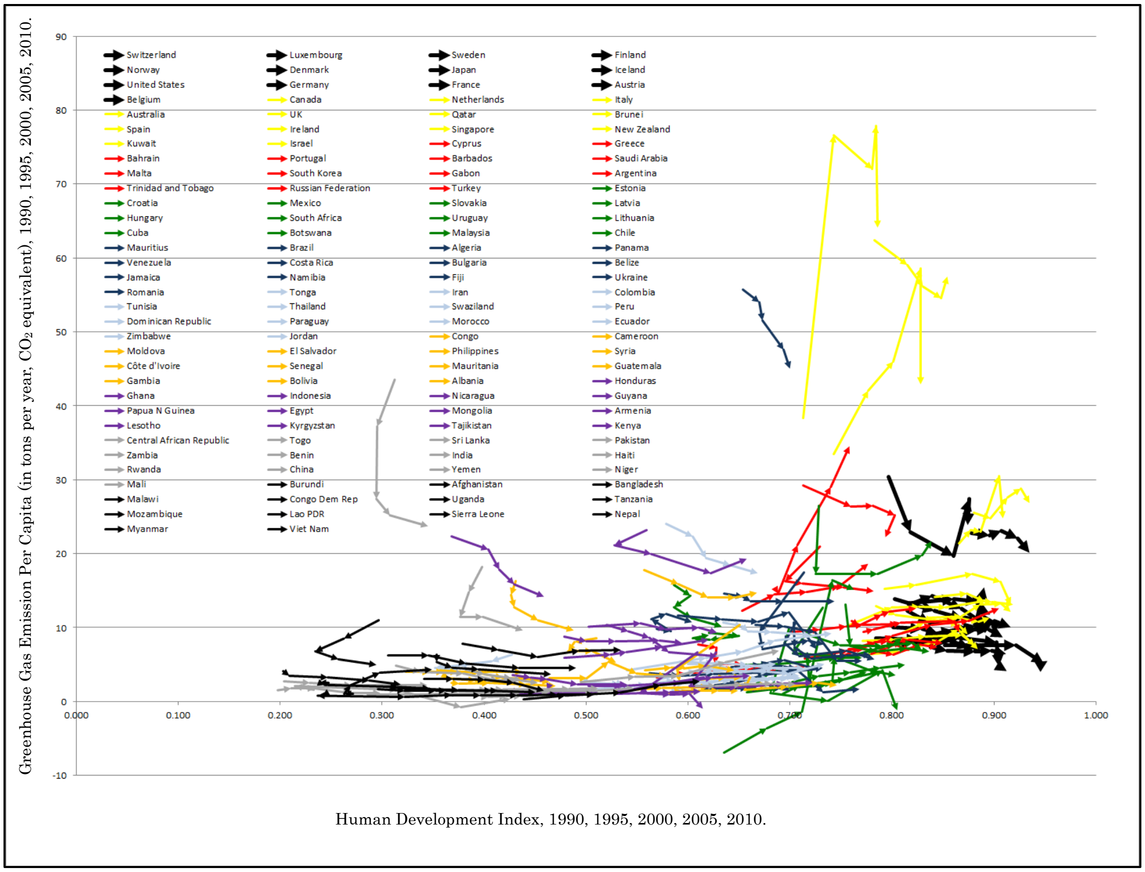
An initial analysis of the cross-country data of the 130 countries for 1990-2010 showed various trajectory of the GHGpc relative to HDI (Figure 4– Figure 13) (Appendix 1) from the group of countries with the highest GNIpc to the lowest GNIpc. Unlike snapshots from a particular year, changes over time can show how countries dealt with development and GHGpc in successful or unsuccessful ways. Some countries were successful in drastically improving HDIs while they decreased GHGpc. Others were unsuccessful in that they did little to improve HDIs but drastically increased GHGpc.

The period 1990-2010 is of particular interest because the world became conscious of GHG emissions and climate change during this era, beginning in 1990, when the IPCC's first report was issued, and continuing through 1992, when the UNFCCC was adopted; 1997, when the Kyoto Protocol was agreed upon; and 2005, when it entered into force. The first commitment period of the Kyoto Protocol was from 2008 to 2012.

4.1. General Findings from the Historical Trajectories

Figure 14 shows an overview of the trajectories of the 130 countries divided into 10 income groups (GNI), along the HDI and GHGpc dimensions between 1990-2010.

Figure 14. Greenhouse Gas Emissions Per Capita b Human Development Index, 1990-2010 (by individual countries)[8]



SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

As expected, country groups with high GNIpc occupy the "high HDI–high GHGpc" areas, while country groups with low GNIpc occupy the "low HDI–low

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8 This table is difficult to understand in details, therefore enlarged figures for each of 10 groups are given in Appendix 2 (Figure 16-25)

GHGpc" areas. However, there are a few outlier countries within specific groups. The Central African Republic (CAR), which belongs to the 9th group (light gray), for example, has an average HDI level that is similar to that of the other 9th group countries, but its average GHGpc emissions are higher. Another outlier, this time belonging to the 5th group (dark blue), is Belize. Like CAR, Belize's average HDI is similar to that of the other 5th group countries, but its average GHGpc emissions level is also higher than that of the other countries in the group. Interestingly, the 2nd group of countries (yellow) displays a distinct pattern. As illustrated in the chart, the countries' average HDIs are all between 0.80 and 0.88, but the average GHGpc emission levels are widely dispersed. Italy and Spain produce less than 10 tons of GHGpc per year, while Qatar, Brunei Darussalam and Kuwait, which also belong to the 2nd group, produce much higher GHGpc per year as industrial producers of oil and gas. The other countries in the group have varying levels of GHGpc emissions per year.

As can be observed in Figure 15, the areas enclosed by each group of trajectories in Figure 14 line up from left to right, with richer country groups occupying higher HDI regions and poorer country groups occupy lower HDI regions. There seems to be no such grouping or trends for GHGpc, some groups exhibit wide variability, spreading their GHGpc from low to high, while other groups have a narrower range in their GHGpc.

Figure 15. Greenhouse Gas Emissions Per Capita by Human Development Index (by income groups), 1990–2010.

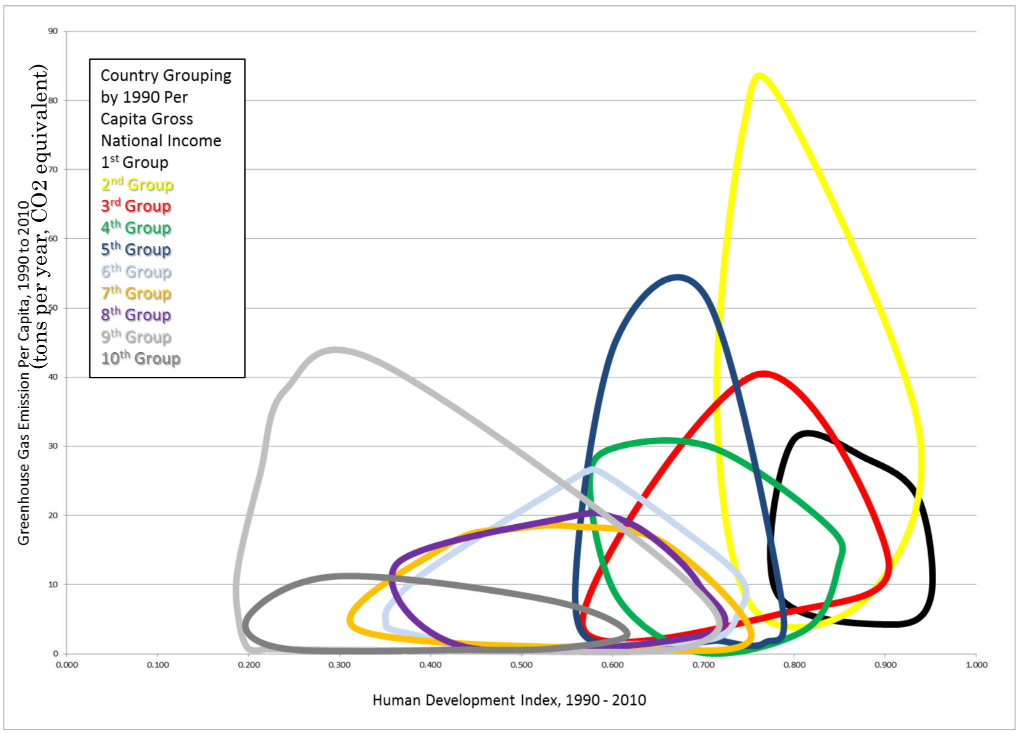


Figure 16 - Figure 25 (Appendix 2) are expanded versions of Figure 4 through Figure 13. (Appendix 1) from the highest GNIpc country group to the lowest GNIpc country group. These figures show more clearly each country's trajectory. Most of the countries showed an improvement in HDI from 1990 to 2010, while only a few showed a decrease in HDI during certain periods. Some of these changes seem to have been caused by civil wars and conflicts. However, regardless of the GNIpc values used for the grouping, some countries experienced a decrease in GHGpc from 1990 to 2010.

Detailed analysis revealed that many different trajectories are found. They are (i) Figure 26 and Figure 27 show, continuous improvement of HDI with a slight and significant decrease of GHGpc, (ii) Figure 28 and Figure 29 show, continuous improvement of HDI with a significant and slight increase or no change of GHGpc, (iii) Figure 30, 31 and Figure 32 show, U-shaped slopes, (iv) Figure 33 and 34 show, L-shaped slopes, (v) Figure 35 shows, the slopes of former USSR-member countries, and (vi) Figure 36 shows, the slopes of the G8 countries. The countries corresponding to each shape are listed with the figures (Figure 26-36) (Appendix 3).

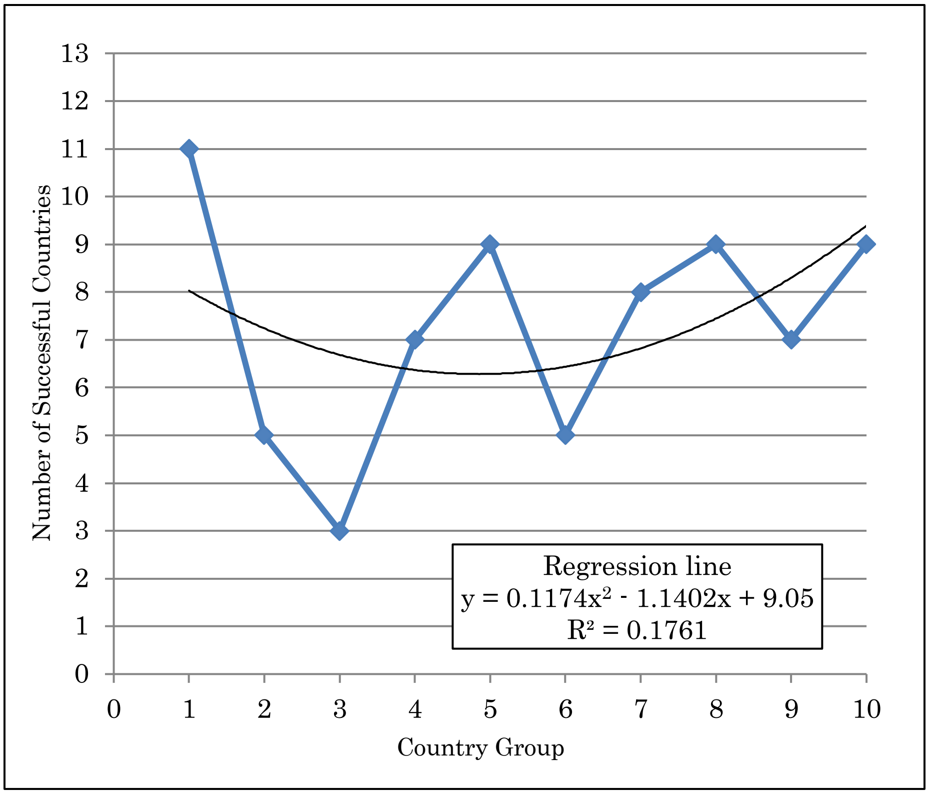
Countries showed different types of trajectories during the period. Therefore, it is necessary to analyze individual countries to determine the factors that account for each trajectory. Throughout this dissertation, "successful countries" are defined as the countries that successfully improved GHGpc while also improving HDI. Similarly, "successful development" is defined as development that happened with improved HDI and GHGpc.

Table 1 in Appendix 4 shows the regression lines of each country in country group 1 in Figure 4 (and Figure 16), which are the trajectories of the relation between HDI and GHGpc in 1990-2010. As the table shows, the regression line of

Switzerland has a slope of -8.9497, which means that Switzerland reduced 8.9497kg of GHGpc while it increased 1 unit of HDI throughout this period. The table shows that eleven countries (Switzerland, Luxembourg, Sweden, Norway, Denmark, Japan, Iceland, United States, Germany, France and Belgium) were successful in group 1.

Similarly, Table 2 to Table 10 (Appendix 4) shows the regression lines of each country for each income group. As shown in Table 11 (Appendix 4), Group 1 had 11 successful countries, and groups 2 to 10 had 5, 3, 7, 9, 5, 8, 9, 7 and 9 successful countries, respectively. So, 73 of the 130 countries, or 56% were successful in increasing their HDI and decreasing their GHGpc. This U-shaped trend of the number of successful countries in each income group is shown in Figure 37. The fit to a quadratic regression line is not very strong.

Figure 37. Number of Successful Countries per Country Income Group, 1990–2010.[9]



This means that approximately as many low-income countries as high-income countries showed "successful development." This is counter to expectations of traditional development economics and the Environmental Kuznets curve that rich countries can successfully reduce their GHGpc while they improved HDI while poor countries faced difficulty in reducing their GHGpc while improving HDI.

However, the actual trajectory from 1990 to 2010 shows that many poor

[9] The standard error is 0.76, and it means statistically insignificant. This might be because there are only 10 samples.

countries reduced GHGpc while improving HDI. One possible explanation is that GHGpc reduction was caused by rapid population increases in developing countries, since GHGpc goes down when the rate of population growth is faster than the rate of increase in GHG emissions, which looks like a dilution by population increase. However, if this were happening in poor countries, it is unlikely that HDI would also improve, because a rapid increase in the population would slow the increase in the country's per person share of wealth, which would also slow HDI improvement, since GHG emissions can represent increased human activity and energy use that contribute to a country's wealth per person. Meaning to say, when the regression is analyzed, it shows that dilution by population increase is not a fundamental reason, because if it were, then the dilution by population increase would also have diminished HDI improvement.

It is therefore important to understand what happened in the developing countries that showed "successful development." In the end, a country's total GHG emissions might increase. However, with the rapid population increases that are occurring in developing countries, it will be impossible to reduce the total emissions of poor countries without finding a way to decrease GHGpc. In this regard, it is essential to identify the reasons for this trajectory, focusing on GHGpc.

4.2. CO_2 Was Not the Main Source of GHG Emissions from Developing Countries

Figure 3 showed the trajectory of CO_2 out of the total GHG emissions of the 10 groups. Many past analyses have focused on CO_2, and this focus has produced conflict in international negotiations, since CO_2 is a by-product of fossil fuel, the major source of energy, which is a backbone of economic activity. Because it is generally assumed that energy production is the most important ingredient for development, it is difficult for countries (especially developing countries) to commit to reducing CO_2 emissions, which they equate with reducing energy production and hence slowing down their economic development therefore fail to expand the percent of the population having access to infrastructure. However, the trajectory in Figure 3 shows that in developing countries, even though CO_2 was more significant in 2010 than in 1990, CO_2 has never been a main component of GHGs. CO_2 ratios in the four groups of lower-income countries never reached 50% of GHGs in the period under study, and the ratios of the 7 groups of lower-income countries never reached 70% of GHGs. In this regard, it is supposed that reducing GHGs other than CO_2 in developing countries can be an effective means of future climate change mitigation. Such reductions may occur by efficiency gains in activities that emit these gases or by transitions to a different industry that releases different GHGs. The fact that CO_2 was not the main source of GHG emissions from developing countries is another important issue to investigate.

4.3. Evaluation of Success by Rate (Steepness), Improvement in HDI, and Improvement in GHGpc

The findings in Figure 37 offered a good starting point: there were as many low-income countries that showed "successful development" as high-income countries. However, the graph in the figure shows only a bimodal evaluation of countries as "successful" or "unsuccessful" and thus gives no details about what happened in these countries.

Increasing HDIs and decreasing GHGpcs are counted as aspects of success. For example, the slope of $\triangle$GHGpc/$\triangle$HDI shows success because the slope of $\triangle$GHGpc/$\triangle$HDI indicates efficiency, which is the value of the decreasing GHGpc while increasing one unit of HDI. However, a question emerges: even if the slope is very steep (meaning that this parameter indicates that the country was effective at reducing GHGpc while increasing HDI), if the absolute value of the increase in HDI is very small, we do not know whether the country did a better job than another country that increased HDI significantly with a less steep slope. Therefore, to provide various ways of evaluating success, five parameters were used: (i) the regression line's slope of △GHGpc/△HDI throughout the period of 1990-2010, (ii) the absolute value of △HDI through the period of 1990-2010, (iii) the ratio of the increased HDI value from 1990-2010 compared to the HDI value in 1990, (iv) the absolute value of △GHGpc through the period of 1990-2010, and (v) the ratio of the decreased GHGpc value from 1990-2010 to the GHGpc value in 1990. These parameters were picked up as preliminary parameters to evaluate the success of these countries. Table 12 shows the results of using these parameters. Blue means that the countries are in groups 7-10 (low-income), green means that the countries are in groups 3-6 (middle-income), and white means that countries are in groups 1 and 2 (High income).

Table 12. Parameters for evaluating successfulness (ordered by the slope of △GHGpc/△HDI)[10]

	COUNTRY	SLOPE of trendline	HDI absolute value of increase (decrease)	HDI ratio of increase (decrease)	GHGpc absolute value of increase (decrease)	GHGpc ratio of increase (decrease)	Original Group
1	Belize	-228.200	0.046	0.071	-10.618	-0.190	5
2	Central African Republic	-145.220	0.032	0.103	-19.884	-0.455	9
3	Papua New Guinea	-98.129	0.090	0.246	-8.230	-0.366	8
4	Brunei Darussalam	-92.870	0.071	0.091	-5.087	-0.081	2
5	Botswana	-88.555	0.047	0.080	-5.688	-0.358	4
6	Cameroon	-84.354	0.057	0.132	-6.730	-0.410	7
7	Paraguay	-76.781	0.090	0.155	-6.665	-0.276	6
8	Bahrain	-58.695	0.081	0.114	-7.001	-0.239	3
9	Zambia	-55.965	0.040	0.099	-8.538	-0.467	9
10	Panama	-52.336	0.105	0.157	-4.695	-0.449	5
11	Gabon	-50.922	0.066	0.108	-3.578	-0.455	3
12	Luxembourg	-48.472	0.078	0.098	-6.516	-0.214	1
13	Slovakia	-47.682	0.082	0.109	-6.335	-0.480	4
14	Honduras	-41.041	0.109	0.209	-4.198	-0.403	8
15	Sweden	-40.205	0.090	0.109	-4.218	-0.500	1
16	Denmark	-39.400	0.083	0.101	-2.299	-0.175	1
17	United States	-38.675	0.057	0.065	-2.600	-0.114	1
18	Bulgaria	-34.249	0.075	0.106	-4.391	-0.406	5
19	United Kingdom of Great Brit	-34.103	0.090	0.115	-3.743	-0.288	2
20	Costa Rica	-34.014	0.105	0.158	-2.559	-0.612	5
21	Congo	-32.615	0.019	0.038	-3.350	-0.385	7
22	Germany	-31.605	0.114	0.142	-3.829	-0.275	1
23	Romania	-31.261	0.077	0.108	-5.136	-0.469	5
24	Bolivia	-30.774	0.111	0.199	-3.176	-0.178	7
25	Latvia	-30.591	0.106	0.152	-11.037	-1.108	4
26	Mongolia	-26.754	0.098	0.175	-3.902	-0.168	8
27	Togo	-24.679	0.071	0.186	-1.790	-0.403	9
28	Norway	-23.452	0.100	0.117	-2.066	-0.271	1
29	Iceland	-22.839	0.086	0.105	-3.070	-0.249	1
30	Brazil	-22.027	0.136	0.230	-4.485	-0.386	5
31	Russian Federation	-20.288	0.052	0.071	-6.123	-0.290	3
32	Ecuador	-19.262	0.085	0.134	-1.753	-0.162	6
33	United Republic of Tanzania:	-16.985	0.112	0.318	-2.586	-0.403	10
34	Benin	-15.935	0.118	0.377	-1.977	-0.402	9
35	Netherlands	-14.525	0.077	0.091	-0.921	-0.065	2
36	Mauritania	-14.423	0.108	0.302	-1.552	-0.361	7
37	Hungary	-13.373	0.115	0.161	-2.241	-0.241	4
38	Swaziland	-13.139	-0.001	-0.001	0.084	0.036	6
39	Mozambique	-12.676	0.115	0.570	-1.806	-0.433	10
40	Belgium	-12.389	0.080	0.098	-1.429	-0.108	1
41	Nepal	-12.343	0.117	0.343	-1.574	-0.497	10
42	France	-12.219	0.107	0.136	-1.151	-0.133	1
43	Jordan	-12.012	0.107	0.181	-1.218	-0.222	6
44	Myanmar	-11.279	0.185	0.606	-1.785	-0.280	10
45	Estonia	-10.955	0.110	0.151	-4.846	-0.182	4
46	Rwanda	-10.641	0.193	0.828	-1.282	-0.778	9
47	Ghana	-10.461	0.112	0.262	-1.184	-0.326	8
48	Armenia	-10.268	0.095	0.151	-4.151	-0.610	8
49	Croatia	-9.903	0.087	0.122	-2.983	-0.455	4
50	Switzerland	-8.950	0.071	0.085	-0.866	-0.117	1

10 Only selected tables are in the main document for readers' convenience. All tables are in appendix.

51	Venezuela (Bolivarian Repub	-7.431	0.108	0.170	-0.996	-0.068	5
52	Côte d'Ivoire	-7.039	0.067	0.186	-0.447	-0.120	7
53	Sierra Leone	-6.553	0.099	0.399	-0.736	-0.283	10
54	Guyana	-5.676	0.125	0.250	-0.756	-0.074	8
55	Colombia	-5.585	0.114	0.191	-0.522	-0.101	6
56	Niger	-5.182	0.100	0.506	-0.374	-0.227	9
57	Ireland	-4.875	0.124	0.156	-2.045	-0.134	2
58	Nicaragua	-4.606	0.115	0.239	-0.870	-0.098	8
59	Lao People's Democratic Rep	-4.448	0.155	0.409	-0.870	-0.110	10
60	Uganda	-4.232	0.144	0.473	-0.712	-0.347	10
61	Mali	-3.389	0.141	0.689	-0.533	-0.188	9
62	Senegal	-3.144	0.102	0.278	-0.405	-0.156	7
63	Kenya	-2.366	0.048	0.105	-0.456	-0.247	8
64	Lithuania	-2.079	0.077	0.106	-4.176	-0.326	4
65	Lesotho	-1.743	-0.022	-0.046	0.180	0.155	8
66	Japan	-1.681	0.072	0.086	-0.302	-0.033	1
67	Albania	-1.359	0.084	0.127	-1.152	-0.345	7
68	Malawi	-1.279	0.118	0.399	-0.188	-0.108	10
69	Jamaica	-1.009	0.085	0.133	-0.215	-0.046	5
70	Namibia	-0.755	0.034	0.060	0.990	0.101	5
71	Afghanistan	-0.533	0.122	0.495	-0.344	-0.269	10
72	Italy	-0.355	0.110	0.143	-0.632	-0.076	2
73	Gambia	-0.295	0.114	0.353	-0.017	-0.004	7
74	Fiji	0.986	0.085	0.138	-0.144	-0.085	5
75	Bangladesh	1.008	0.147	0.406	0.159	0.180	10
76	Syrian Arab Republic	1.177	0.088	0.158	0.032	0.007	7
77	Sri Lanka	2.215	0.098	0.161	0.126	0.057	9
78	Pakistan	2.400	0.129	0.335	0.333	0.214	9
79	Haiti	2.864	0.051	0.127	0.105	0.151	9
80	Yemen	2.968	0.180	0.629	0.517	0.526	9
81	Philippines	3.501	0.068	0.116	0.302	0.240	7
82	Guatemala	3.578	0.115	0.247	0.249	0.076	7
83	Algeria	4.088	0.148	0.262	0.565	0.144	5
84	Peru	4.309	0.114	0.185	0.713	0.161	6
85	El Salvador	4.522	0.150	0.285	0.671	0.419	7
86	Greece	4.542	0.094	0.122	-0.116	-0.012	3
87	India	4.656	0.137	0.334	0.719	0.604	9
88	Malta	5.297	0.087	0.115	0.212	0.030	3
89	South Africa	5.911	0.000	0.000	-0.403	-0.043	4
90	Tunisia	6.114	0.157	0.285	0.911	0.390	6
91	Egypt	8.746	0.158	0.315	1.302	0.582	8
92	Turkey	8.917	0.146	0.257	1.516	0.448	3
93	Mexico	9.166	0.117	0.178	0.950	0.189	4
94	Argentina	10.895	0.104	0.148	1.077	0.114	3
95	Morocco	12.031	0.146	0.332	1.871	1.805	6
96	Tajikistan	12.618	-0.003	-0.005	-1.957	-0.580	8
97	Dominican Republic	12.942	0.113	0.193	1.447	0.856	6
98	Cuba	13.864	0.094	0.139	-0.069	-0.017	4
99	Vietnam	14.603	0.172	0.393	2.487	6.390	10
100	Portugal	16.720	0.103	0.144	1.096	0.185	3
101	Thailand	17.425	0.116	0.205	2.103	0.682	6
102	Indonesia	17.460	0.141	0.294	2.419	0.401	8
103	Spain	18.043	0.128	0.170	0.950	0.153	2
104	New Zealand	18.876	0.082	0.098	0.771	0.068	2
105	Tonga	18.897	0.052	0.080	0.929	0.347	6
106	Israel	19.538	0.087	0.107	2.151	0.233	2
107	Cyprus	19.629	0.070	0.090	1.377	0.210	3
108	Kyrgyzstan	19.807	0.005	0.009	-7.661	-1.126	8
109	Chile	20.980	0.110	0.157	2.371	0.881	4
110	Singapore	22.039	0.136	0.180	3.455	0.334	2

111	China, People's Republic of	22.346	0.194	0.392	4.333	1.614	9
112	Mauritius	23.531	0.106	0.170	2.369	1.039	5
113	Zimbabwe	23.975	-0.052	-0.123	-1.963	-0.307	6
114	Austria	24.798	0.095	0.119	2.600	0.321	1
115	Democratic Republic of the C	25.035	-0.001	-0.005	-5.958	-0.539	10
116	Iran, Islamic Republic of	25.855	0.201	0.372	4.999	1.152	6
117	Ukraine	29.552	0.019	0.026	-9.777	-0.557	5
118	Uruguay	33.890	0.093	0.134	2.802	2.542	4
119	Barbados	34.722	0.063	0.083	1.734	0.159	3
120	Burundi	38.499	0.077	0.282	3.237	2.662	10
121	Republic of Korea (South)	39.978	0.156	0.208	6.614	1.079	3
122	Republic of Moldova	42.301	0.002	0.003	-7.139	-0.683	7
123	Finland	42.848	0.089	0.111	5.475	0.544	1
124	Saudi Arabia	44.341	0.123	0.189	6.370	0.516	3
125	Australia	50.171	0.055	0.062	1.249	0.049	2
126	Canada	143.850	0.043	0.050	3.287	0.153	2
127	Malaysia	195.330	0.128	0.201	21.982	-3.226	4
128	Qatar	199.190	0.084	0.114	9.410	0.280	2
129	Trinidad and Tobago	267.170	0.073	0.107	19.256	1.249	3
130	Kuwait	356.630	0.073	0.103	25.656	0.667	2

Table 13 to Table 16 (Appendix 5) show the same values used in Table 12, but while Table 12 is ordered by parameter (i), the regression line's slope of △GHGpc/△HDI from 1990-2010; Table 13 is ordered by parameter (ii), the absolute value of △HDI through the period of 1990-2010; Table 14 is ordered by parameter (iii), the ratio of increased HDI values from 1990-2010 compared to the HDI value in 1990; Table 15 is ordered by parameter (iv), the absolute value of △GHGpc through the period of 1990-2010; and Table 16 is ordered by parameter (v), the ratio of change in GHGpc values from 1990-2010 to the GHGpc value in 1990.

An additional set of three parameters, similar to those used for HDI in (i), (ii) and (iii) above, were added that are related to GNIpc: (vi) the regression line's slope of △GHGpc/△GNIpc throughout the period 1990-2010, (vii) the absolute value of △GNIpc from 1990-2010, and (viii) the ratio of increased GNIpc values from 1990-2010 to the GNIpc value in 1990. This choice was made because GNIpc is one of three components that build HDI, along with education and health parameters. Therefore, if a country has a totally different ranking when evaluated by HDI as compared to when it is evaluated by GNIpc, we can conclude that the country's improved HDI was influenced by education and/or health, and not primarily by economic development. Table 17 to Table 19 (also in Appendix 5) show the results of the GNIpc parameters (vi), (vii) and (viii).

Table 20 shows the results of the parameter rankings of the middle- and low-income Asian countries, summarizing Table 12 to Table 19. As can be seen here, the rankings of many countries in parameters (i), (ii) and (iii) are significantly different from the rankings in parameters (vi), (vii) and (viii). For example, the ranking of Bangladesh in parameter (ii) was 13th. Its ranking in parameter (iii) was 10th in the world, while its ranking in parameter (vii) was 105th, and its ranking in parameter (viii) was 56th in the world. This means that during the period under study, Bangladesh's GNI did not improve markedly, but its residents' lives became significantly better because of improvements in other factors such as education and health. Therefore, it is necessary to evaluate countries' development by considering not only economic aspects, but also other factors (education and health) that enrich people's lives.

Table 20. Parameter Orders of Developing Countries in Asia

COUNTRY	Original Group	Parameter (i)	Parameter (ii)	Parameter (iii)	Parameter (iv)	Parameter (v)	Parameter (vi)	Parameter (vii)	Parameter (viii)
			HDI		GHGpc			GNIpc	
		HDIvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	**GNIpcvsGHGpc SLOPE** of trendline	absolute value of increase (decrease)	ratio of increase (decrease)
Afghanistan	10	71	28	7	73	44	120	120	114
Bangladesh	10	75	13	10	85	98	110	105	56
China, People's Republic of	9	111	2	14	122	126	124	59	1
India	9	87	19	20	95	117	118	94	29
Indonesia	8	102	17	25	115	110	122	74	12
Kyrgyzstan	8	108	123	123	7	2	28	115	117
Lao People's Democratic Republic	10	59	10	9	60	65	45	97	9
Malaysia	4	127	24	41	129	1	128	48	39
Mongolia	8	26	64	52	27	57	19	88	38
Myanmar	10	44	4	4	47	40	17	98	3
Nepal	10	41	31	18	49	12	7	108	51
Pakistan	9	78	22	19	90	102	115	103	75
Philippines	7	81	104	84	89	104	84	79	40
Republic of Korea (South)	3	121	9	39	126	123	104	27	37
Sri Lanka	9	77	65	57	84	86	79	83	7
Tajikistan	8	96	128	127	44	8	108	104	97
Thailand	6	101	33	40	111	119	116	65	43
Vietnam	10	99	6	13	116	130	126	93	2

4.4. Identifying Successful Countries: Trajectories of Asian Countries

From this section onward, this dissertation focuses on discussions about and comparisons of Asian countries, as most of the developing countries that have achieved "successful development" are either in Asia or Africa. Much more data are available for the Asian countries from 1990 through 2010 than for the African countries.

The trajectories of the Asian countries are shown in Figure 38 and Figure 39. In Figure 39, for convenience in comparison, all of the trajectories were set to start from 0 as shown in the X- and Y-axes.

Figure 38. Trajectories of Asian Countries.

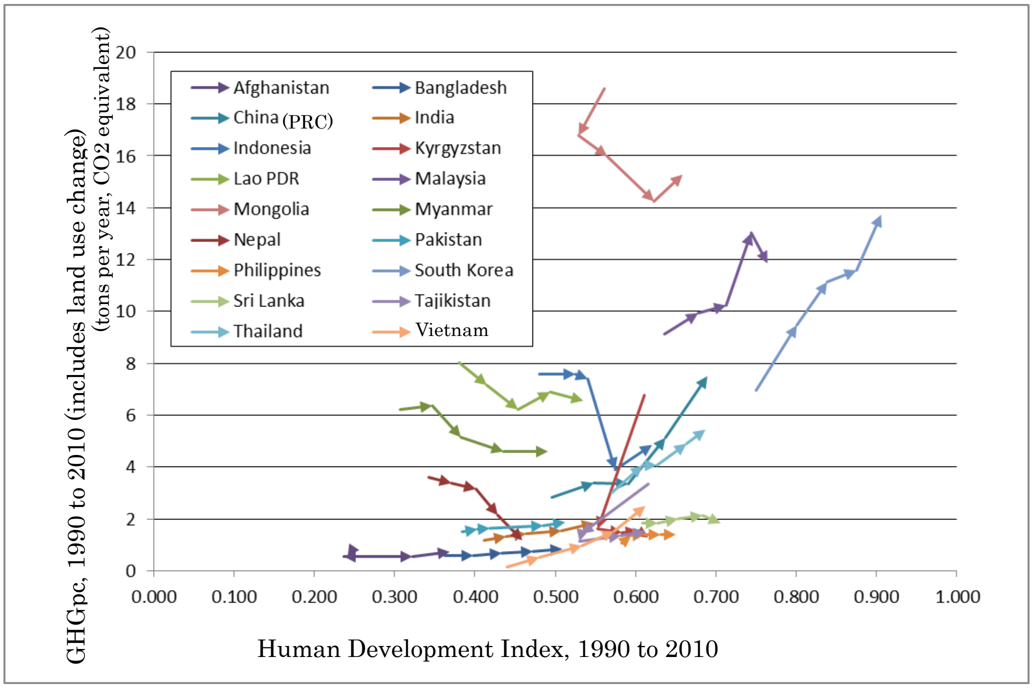


Figure 39. Relative Trajectories of Asian Countries (starting from 1990 as zero).

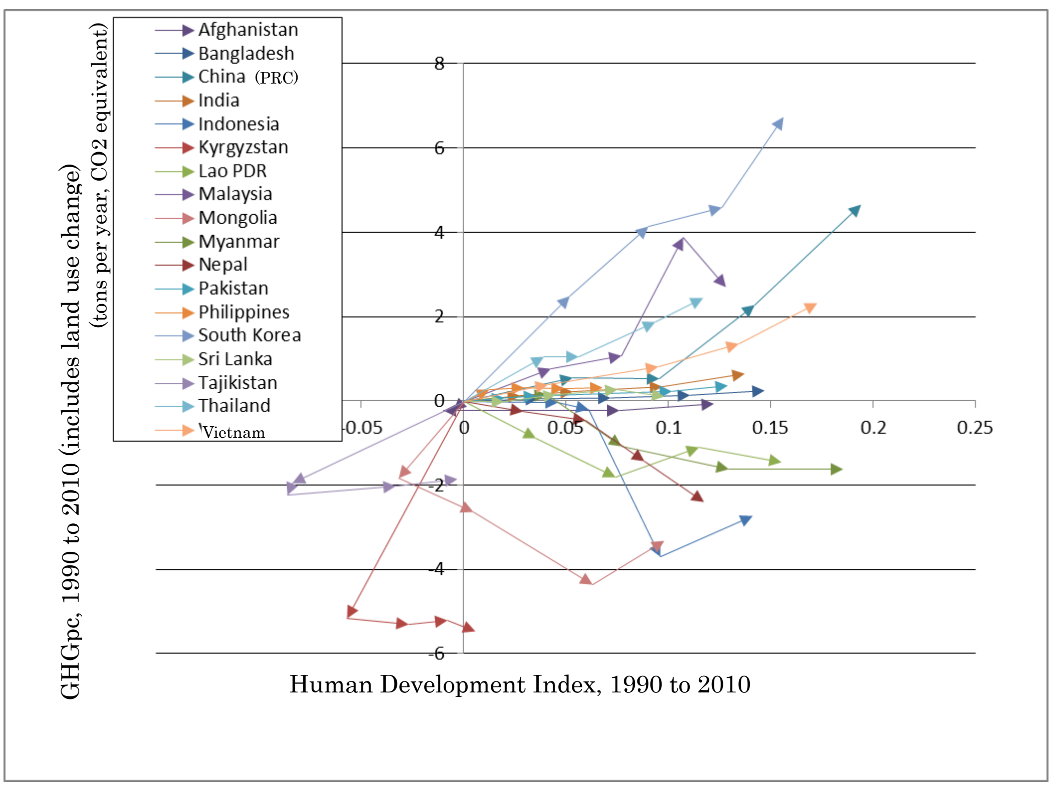


Table 20 shows the results of the parameters' rankings of the middle- and low-income Asian countries found in Appendix 5 (Table 12 through Table 19). Table 21(a) shows the evaluation of the results from Table 20.

For all of the five preliminary parameters ((i) the regression line's slope of △GHGpc/△HDI through the period 1990-2010, (ii) the absolute value of △HDI from 1990-2010, (iii) the ratio of increased HDI value from 1990-2010 to the HDI value in 1990, (iv) the absolute value of △GHGpc from 1990-2010, and (v) the ratio of the decreased GHGpc value from 1990-2010 to the GHGpc value in 1990) and the three secondary parameters ((vi) the regression line's slope of △GHGpc/△GNIpc from 1990-2010, (vii) the absolute value of △GNIpc from 1990-2010, and (viii) the ratio of increased GNIpc value from 1990-2010 to the GNIpc value in 1990), the top 30 successful countries are marked by ○. (The top 10 countries are marked by ◎.) For parameter (i), the countries ranked #31 to #73 are marked by △ because the slope of these countries was negative, which means they decreased GHGpc and increased HDI.[11] The countries ranked #74 to #130 are

[11] There are a few exceptional countries that did not improve HDI between 1990 and 2010: South Africa, Zimbabwe, Swaziland and the Democratic Republic of the Congo. South Africa's HDI gradually improved between 1990 and 1995, declined significantly up to 2005, then improved slightly in 2010 but was still lower than its 1990 levels. Zimbabwe experienced a steady decline in HDI from 1990 up to 2005, then gradually improved until 2010, but is still lower than its 2005 levels. Swaziland's HDI declined from 1990 to 2005, then slightly improved in 2010 but is still lower than its 1990 levels. The Democratic Republic of the Congo experienced a decline in HDI from 1990 to 2000 and then gradually increased

marked by × because the slopes of these countries were positive, which means they increased GHGpc and increased HDI. For parameter (ii), the countries ranked #31 to #61 are marked by △ because the absolute increase of HDI was greater than 0.1 from the top country down to #61, which means they showed comparatively large HDI improvements among the 130 countries. The countries ranked #62 to #130 are marked by × because they showed comparatively small HDI improvements among the total 130 countries. For parameter (iii), the countries ranked #31 to #51 are marked by △ because the ratio of the increased HDI value was greater than 15% from the top country down to #51 meaning that they showed comparatively large HDI improvements among the total 130 countries. The countries ranked #52 to #130 are marked by × because the ratio of the increased HDI value was less than 15%, which means they showed comparatively small HDI improvements among the total 130 countries. For parameter (iv), the countries ranked #31 to #80 are marked by △ because the slope from the top country to country #80 was negative, which means these countries did a very good job of reducing GHGpc. The countries ranked #81 to #130 are marked by × because they increased GHGpc during that period. For parameter (v), the countries ranked #31

from 2000 to 2010, but its HDI is still lower than its 1990 levels.

to #78 are marked by △ because the slope from the top country to country #80 was negative, which means these countries showed comparatively large GHGpc improvements among the total 130 countries. For parameter (vi), the countries ranked #31 to #67 are marked by △ because the slope of these countries was negative from the top country down to #67, which means they decreased GHGpc and increased GNIpc. The countries ranked #68 to #130 are marked by × because the slopes of these countries were positive, which means they increased GHGpc and increased GNIpc. For parameter (vii), the countries ranked #31 to #93 are marked by △ because the absolute increase in GNIpc was greater than $1000 from the top country down to #93, which means they showed comparatively large GNIpc improvements among the total 130 countries. The countries ranked #94 to #130 are marked by × because they showed comparatively small GNIpc improvements among the total 130 countries. For parameter (viii), the countries ranked #31 to #62 are marked by △ because the ratio of increased GNIpc value was greater than 60% from the top country down to #62, which means they showed comparatively large GNIpc improvements among the total 130 countries. The countries ranked #63 to #130 are marked by × because the ratio of increased GNIpc value was less than 60%, which means they showed comparatively small GNIpc improvements among the total 130 countries.

Since it was very difficult to understand the data shown by the original rakings, this evaluation classified the original rankings into 4 groups to more readily compare performances of each country. However, in this case, it is unclear whether these evaluations are entirely appropriate. While some evaluations are based on observable facts (whether the slope is positive or negative, such as in parameters (i) and (vi), and increases or decreases, such as in parameters (iv) and (v) and thus can be deemed objective and fair, it seems arbitrary to set thresholds of 0.1 for parameter (ii), 15% for parameter (iii), \$1000 for parameter (vii), and 60% for parameter (viii). In this way, for example, Afghanistan can be evaluated both as a successful HDI country (improving very well) and as unsuccessful GNIpc country (not improving well), which means the increased HDI in Afghanistan can be attributed to the other two HDI social parameters, health and education. However, when the countries marked × under parameters (ii) and (iii) are counted, they number only 5, while 9 countries are marked × under parameter (vii) and 4 countries are marked × under parameter (viii). In these circumstances, the status of Afghanistan is unclear.

Because of this concern, a revised evaluation table is shown as the table below Table 21(b) In this table, parameters (ii), (iii), (vii) and (viii) each have five countries marked with ×. The number 5 was chosen since at first parameters (ii) and (iii) in Table 21(a) had five countries, so the adjustment in the revised evaluation table was made by simply adjusting parameters (vii) and (viii). In this way, the evaluation was revised to improve its comparative capability.

Table 21(a). Evaluation of Parameter Orders of Developing Countries in Asia

COUNTRY	Original Group	Parameter (i)	Parameter (ii)	Parameter (iii)	Parameter (iv)	Parameter (v)	Parameter (vi)	Parameter (vii)	Parameter (viii)
			HDI		GHGpc			GNIpc	
		HDIvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	**GNIpcvsGHGpc SLOPE** of trendline	absolute value of increase (decrease)	ratio of increase (decrease)
Afghanistan	10		○	◎			x	x△	x
Bangladesh	10	x	○	◎	x	x	x	x	
China, People's Republic of	9	x	◎	○	x	x	x	△	◎
India	9	x	○	○	x	x	x	x	○
Indonesia	8	x△	○	○	x△	x△	x△		○
Kyrgyzstan	8	x	x	x△	◎	◎	○	x△	x△
Lao People's Democratic Republic	10		◎	◎		△		x△	◎△
Malaysia	4	x△	○		x△	◎△	x		
Mongolia	8	○△	x△	x	○△		○		△
Myanmar	10		◎	◎			○	x	◎
Nepal	10			○		○	◎	x△	△
Pakistan	9	x	○	○△	x	x	x	x	x△
Philippines	7	x	x	x	x	x	x	△	
Republic of Korea (South)	3	x	◎		x△	x	x	○	
Sri Lanka	9	x	x△	x△	x	x	x	△	◎△
Tajikistan	8	x	x	x		◎	x	x△	x
Thailand	6	x			x	x	x		
Vietnam	10	x	◎	○	x	x	x		◎
	Evaluation Thresholds	**1-73 minus slope**	**1-61 more than 0.1 increase**	**1-51 more than 15% increase**	**1-80 decrease**	**1-78 minus**	**1-67 minus slope**	**1-93 more than $1000 increase**	**1-62 more than 60% increase**
		74-130 x	62-130 x	52-130 x	81-130 x	79-130 x	68-130 x	94-130 x	63-130 x
		31-73	31-61	31-51	31-80	31-78	31-67	31-93	31-62
		11-30 ○	①1-30	①1-30	①1-30	①1-30	①1-30	①1-30	①1-30
		1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎

Table 21(b). Revised Evaluation of Parameter Orders of Developing Countries in Asia (adjusting parameters (vii) and (viii).

COUNTRY	Original Group	Parameter (i)	Parameter (ii)	Parameter (iii)	Parameter (iv)	Parameter (v)	Parameter (vi)	Parameter (vii)	Parameter (viii)
			HDI		GHGpc			GNIpc	
		HDIvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	**GNIpcvsGHGpc SLOPE** of trendline	absolute value of increase (decrease)	ratio of increase (decrease)
Afghanistan	10		○	◎			x	x△	x
Bangladesh	10	x	○	◎	x	x	x	x△	x
China, People's Republic of	9	x	◎	○	x	x	x	△	◎
India	9	x	○	○	x	x	x		○
Indonesia	8	x△	○	○	x△	x△	x△	△	○
Kyrgyzstan	8	x	x	x△	◎	◎	○	x△	x△
Lao People's Democratic Republic	10		◎	◎		△		△	◎△
Malaysia	4	x△	○		x△	◎△	x	△	
Mongolia	8	○△	x△	x	○△		○		△
Myanmar	10		◎	◎			○	△	◎
Nepal	10			○		○	◎	x△	△
Pakistan	9	x	○	○△	x	x	x		x△
Philippines	7	x	x	x	x	x	x	△	
Republic of Korea (South)	3	x	◎		x△	x	x	○	
Sri Lanka	9	x	x△	x△	x	x	x	△	◎△
Tajikistan	8	x	x	x		◎	x	x△	x
Thailand	6	x			x	x	x		
Vietnam	10	x	◎	○	x	x	x		◎

4.5. Trajectories of Asian Countries During the Period

Following these revised evaluations in Table 21(b), the countries in the table were compared and observations were recorded.

Afghanistan: This country was in the poorest group. The country did not show successful performances in parameters (i) or (vi), and it performed worse than others in parameters (vii) and (viii). It showed better performances in parameters (ii) and (iii), particularly in the parameter (iii). The country reduced its GHGpc, as shown in parameters (iv) and (v). The regression line's slope (i) was negative and GHGpc went down, but HDI went up, indicating an inconsistency. In actuality, during this period, GHGpc showed neither a significant increase nor a significant decrease after the period 1990 to 1994.

These observations imply that Afghanistan improved its development level significantly during this period, but the improvement was caused not by economic development, but by social factors.

Bangladesh: This country was in the poorest group. The country did not show successful performances in parameters (i), (vi), (vii), or (viii). It performed better than others in parameters (ii) and (iii), particularly in parameter (iii). The country increased its GHGpc, as shown in parameters (iv) and (v).

These observations imply that Bangladesh, like Afghanistan, improved its development level significantly during the period, but mainly through improvements in social aspects. During the period under study, GHGpc did not show an improvement.

China (PRC): This country was in the second-poorest group. It did not show successful performances in parameters (i) and (vi). It performed better than others in parameter (vii) and especially in parameter (viii). It also performed better than others in parameters (ii) and (iii), particularly in parameter (ii). The country increased its GHGpc, as shown in parameters (iv) and (v).

These observations imply that China (PRC) improved its development level significantly during this period, and that economic development was a strong force behind this improvement. During this period, GHGpc did not show improvement. In this regard, the observations indicate that the country followed the traditional model that is explained by EKC logic (developing countries sacrifice the environment while they seek economic development).

India: This country was in the second-poorest group. The evaluations of its parameters are very similar to those of China (PRC) (worse than China (PRC) in parameters (ii) and (viii); the other parameters show same results as those of

China (PRC)). Therefore, the observations indicate that India also followed the traditional EKC model.

Indonesia: This country was in the third-poorest group. The country did not show successful performances in parameters (i) and (vi). It also performed better than others in parameters (ii), (iii), (vii) and (viii). Indonesia decreased its GHGpc, as shown in parameters (iv) and (v).

These observations imply that Indonesia improved its development level during this period, including its economic development. During this period, GHGpc did not show an improvement.

Kyrgyzstan: This country came from the third-poorest group. It did not show a successful performance in parameters (i), (ii), (iii), (v), (vii) or (viii), while it reduced its GHGpc, as shown in parameters (iv).

This observation implies that Kyrgyzstan experienced a setback in development during this period, with weakened economic activity. This decline in economic activity may explain its reduced GHGpc.

Lao People's Democratic Republic (PDR): This country was in the poorest group. The evaluations of the parameters are very similar to those of Indonesia (most of the parameters were better than Indonesia's). Therefore, this implies that

Lao PDR, like Indonesia, improved its development level during this period, including its economic development. Although GHGpc went down between 1990 and 2000, it went up again between 2001 and 2010.

Malaysia: This country, a middle-income country, was in the fourth-richest group. The evaluations of the parameters are very similar to those of China (PRC) and India. These observations indicate that the country also followed the traditional model explained by EKC logic.

Mongolia: This country was in the third-poorest group. It showed very poor performances in parameters (ii) and (iii). Moreover, it performed worse than others in parameters (v), (vii) and (viii), but better than others in parameters (i), (iv) and (vi). Mongolia decreased its GHGpc, as shown in parameters (iv) and (v).

This implies that Mongolia experience a setback in development during this period, though it also experienced improvement in economic activity. This means that despite the economic improvement, Mongolia had a significant decline in social aspects. With the exception of this significant decline in social aspects, Mongolia is similar to Indonesia and Lao PDR.

Myanmar: This country was in the poorest group. The evaluations of the parameters are the same as those of Lao PDR and very similar to those of Indonesia.

This implies that Myanmar, like Indonesia and Lao PDR, improved its development level, including its economic development. During this period, GHGpc also showed an improvement.

Nepal: This country was in the poorest group. The evaluations of the parameters are very similar to those of Indonesia, Lao PDR and Myanmar. (Nepal showed comparative weakness in its economic development in parameter (vii).) This implies that Nepal, similar to Indonesia, Lao PDR and Myanmar, improved its development level during this period. During this period, GHGpc also showed an improvement.

Pakistan: The country was in the second-poorest group. The evaluations of the parameters are very similar to those of China (PRC), India, and Malaysia. The observations indicate that the country also followed the traditional model explained by EKC logic.

Philippines: This country was in the fourth-poorest group. It did not show a successful performance in parameter (i), (ii), (iii), (iv), (v) or (vi). It performed better than others in parameters (vii) and (viii).

This implies that the country did not improve its development level during this period, even though a certain level of economic development occurred. This indicates that the country experienced a decline in social aspects. During the period, GHGpc did not show an improvement, which may be caused by the increased economic development activities. The observation indicates that the country followed the traditional model explained by EKC logic.

Republic of Korea (South): This country, a middle-income country, was in the third-richest group. The evaluations on the parameters are very similar to those of China (PRC), India, and Malaysia. The observation indicates that the country also followed the traditional model explained by EKC logic.

Sri Lanka: This country was in the second-poorest group. The evaluations of the parameters are very similar to those of the Philippines. The observation indicates that the country also followed the traditional model explained by EKC logic.

Tajikistan: This country was in the third-poorest group. The evaluations of the parameters are very similar to those of Kyrgyzstan. The country showed poor performances in parameters (i), (ii), (iii), (vi), (vii) and (viii), while it reduced its GHGpc, as shown in parameters (iv) and (v).

This implies that the country experienced a setback in its development during this period, including weakened economic activity. This may account for its reduced GHGpc.

Thailand: This country, a middle-income country, was in the sixth-richest group (fifth-poorest group). The evaluations on the parameters are very similar to those of China (PRC), India, and Malaysia. The observation indicates that this country also followed the traditional model explained by EKC logic.

Vietnam: This country was in the poorest group. The evaluation of the parameters is very similar to those of China (PRC), India, Malaysia, and the Republic of Korea (South). This observation indicates that this country also followed the traditional model explained by EKC logic.

Based on these observations, these Asian countries can be divided into 6 groups. Bangladesh and Thailand are similar and thus are in the same group.

(i) Group A (Afghanistan): This country improved HDI not through income improvement while decreasing emissions.

(ii) Group B (Bangladesh): This country improved HDI not through income improvement while increasing emissions.

(iii) Group C (China (PRC), India, Malaysia, Pakistan, Republic of Korea (South), Thailand, Vietnam): These countries follow the traditional model of development explained by EKC logic: countries sacrifice the environment while they seek economic development.

(iv) Group D (Indonesia, Lao PDR, Myanmar, Nepal): These countries did not follow the traditional model, because they simultaneously improved both the environment parameters and the development parameters.

(v) Group E (Kyrgyzstan, Tajikistan): These countries experienced a setback in development during this period, with weakened economic activity that may have related to reduced GHGpc.

(vi) Group F (Mongolia): This country experienced a setback in the development during this period characterized by improvements in economic activity and a significant decline in social aspects. It also reduced its GHGpc. If the country did not have a significant decline in social aspects, it would belong in Group C.

(vii) Group G (the Philippines, Sri Lanka): These countries did not improve their development level during this period, even though a certain level of economic development occurred. During this period, GHGpc did not show an improvement. These observations indicate that the countries followed the traditional model explained by EKC logic.

This grouping shows that some of the countries such as the ones in the

Group C and D had similar trajectories with other countries in the same group, while some countries in other groups (Group A, B, E, F, and G) had different specific trajectories. Observing multiple parameters allowed for various ways of evaluating success. However, as mentioned at the beginning of this chapter, a question still remains. Even if the slope is very steep (meaning that the country efficiently reduced GHGpc while increasing HDI), if the absolute value of the increase in HDI is very small, we do not know whether the country did a better job than another country that significantly increased HDI with a mildly negative slope or even with a positive slope. Consequently, the next section compares the success of these Asian countries' development.

4.6. Defining Success Among Asian Countries

Table 21(b) shows the success of each Asian country by global parameters. However, when the parameters of these Asian countries are evaluated against those of other countries across the world, it is still difficult to compare them. For example, considering parameters (i) and (vi), 13 of the 18 Asian countries are categorized as unsuccessful countries. Using parameter (v), 12 of the 18 Asian countries are categorized as unsuccessful countries. Few differences are found among the countries categorized in the same group. Therefore, an attempt is made here to classify Asian countries by analyzing the parameters in detail.

Evaluation of parameter (i): slope of the HDI vs. GHGpc trend line:

Figure 40 visualizes the values of parameter (i) (slope of the HDI vs. GHGpc trend line). When the graph is enlarged, it becomes as shown in Figure 41. There are four groups, as shown in Figure 42. Figures 40-42 are in Appendix 6. The group in green is defined as ◎VERY SUCCESSFUL; the group in blue is defined as ○ SUCCESSFUL; the group in yellow is defined as △MARGINAL; and the group in red is defined as ×UNSUCCESSFUL. This is summarized in Table 22. In this way, those evaluations for Asian countries had been revised, and now they are distinguishable. (Only the evaluations for Malaysia and Republic of Korea stayed as they were).

Table 22. Evaluation of the parameter (i) slope of the HDI vs GHGpc trend line

I	J	K	L	M	N
	original group	HDIvs.GHGpc slope	Evaluation in the world	Evaluation in Asia	
Afghanistan	10	71	△	◎	very successful
Bangladesh	10	75	×	○	successful
China (PRC)	9	111	×	△	marginal
India	9	87	×	○	successful
Indonesia	8	102	×	△	marginal
Kyrgyzstan	8	108	×	NA	
Lao PDR	10	59	△	◎	very successful
Malaysia	4	127	×	×	unsuccessful
Mongolia	8	26	○	◎	very successful
Myanmar	10	44	△	◎	very successful
Nepal	10	41	△	◎	very successful
Pakistan	9	78	×	○	successful
Philippines	7	81	×	○	successful
Republic of Korea	3	121	×	×	unsuccessful
Sri Lanka	9	77	×	○	successful
Tajikistan	8	96	×	NA	
Thailand	6	101	×	△	marginal
Vietnam	10	99	×	△	marginal

Evaluation of parameter (ii): absolute value of HDI increase: Figure 43 visualizes the values of parameter (ii) (the absolute value of the HDI increase). When the graph is enlarged, it becomes as shown in Figure 44. There are four groups, as shown in Figure 45. In this way, the group in green is defined as ◎VERY SUCCESSFUL; the group in blue is defined as ◯SUCCESSFUL; the group in yellow is defined as △MARGINAL; and the group in red is defined as ×UNSUCCESSFUL. (Figure 43, Figure 44, and Figure 45 are in Appendix 6).

4.7. Evaluation of the HDI Increase Standard Deviation Score

When the evaluation of parameter (ii) was implemented, a question arose: what was the driver of each country's HDI increase? In response, the analysis below was implemented.

Table 23 shows which HDI components were the highest, middle and lowest in 1990, 2000, 2005 and 2010 (the data for 1995 are not available). However, this table does not tell us which component was the major driver of HDI improvement during the period 1990-2010. Therefore, Table 24 added a column on the right to show which component improved the most, the least and in the middle. This leads to an interesting observation. For example, in Afghanistan in 1990, the biggest component was Income, the next was Health, and the smallest was Education. In 2000, 2005 and 2010, the order was Health, Education, and Income, from top to bottom. However, during this period, the Education component showed the biggest increase, while the Income component showed the smallest increase. This means that that Afghanistan's HDI improvement was driven by Education. However, here another question emerges. Thirteen Asian countries out of 18 had Education at the top. Does this mean that Education was the major component of HDI improvement in Asia? To answer this question, other countries in the world were checked in the same way (the color green on the right-hand column shows countries that had Education at the top).

Table 24. Orders of HDI component improvement for each Asian country

		Index Value Order				Order of Improvement
		1990	2000	2005	2010	1990-2010
ASIAN COUNTRIES						
Afghanistan	1	Income	Health	Health	Health	Education
	2	Health	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Bangladesh	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
China (PRC)	1	Health	Health	Health	Health	Income
	2	Education	Income	Income	Education	Education
	3	Income	Education	Education	Income	Health
India	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Income
	3	Education	Education	Income	Income	Health
Indonesia	1	Health	Health	Health	Health	Education
	2	Education	Income	Income	Education	Health

	3	Income	Education	Education	Income	Income
Korea	1	Health	Education	Education	Education	Education
	2	Education	Health	Health	Health	Health
	3	Income	Income	Income	Income	Income
Kyrgyzstan	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Health
	3	Income	Income	Income	Income	Income
Lao	1	Health	Health	Health	Health	Health
	2	Income	Income	Income	Income	Education
	3	Education	Education	Education	Education	Income
Malaysia	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Income
	3	Education	Education	Education	Education	Health
Mongolia	1	Health	Health	Education	Education	Education
	2	Education	Income	Health	Health	Income
	3	Income	Education	Income	Income	Health
Myanmar	1	Health	Health	Health	Health	Income
	2	Education	Education	Income	Income	Education
	3	Income	Income	Education	Education	Health
Nepal	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Health
	3	Income	Income	Income	Income	Income
Pakistan	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Philippines	1	Health	Health	Health	Health	Income
	2	Education	Education	Education	Education	Health
	3	Income	Income	Income	Income	Education
Sri Lanka	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Health
Tajikistan	1	Education	Health	Health	Health	Health
	2	Health	Education	Education	Education	Education
	3	Income	Income	Income	Income	Income

Thailand	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Education	Income
	3	Education	Education	Education	Income	Health
Vietnam	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Health

Table 25, Table 26, Table 27, and Table 28 in Appendix 7 show the results for African countries, OECD countries, Latin American countries, and other countries, respectively. These results show that regardless of area and wealth, the majority of countries have Education at the top (deep and pale green). The summary is shown in Table 29. This may be caused by one of two reasons: (1) during this period, all over the world, Education was the real driver of HDI improvement, or (2) the current HDI emphasizes the impact of Education too much. However, there is no tool that can prove that either (1) or (2) is the case. Moreover, it is beyond the scope of this dissertation to examine whether the current calculation of HDI is too biased toward the Education component.

Table 29. Summary of HDI component improvement (from Tables 24-28)

Asian	education	13	Latin	education	17	Arab	education	6
	health	2		health	5		health	2
	income	3		income	3		income	0
African	education	29	Ex USSR	education	4	pacific	education	2
	health	3		health	2		health	0
	income	2		income	0		income	1
OECD	education	26	OTHER EUROPE (NON-OECD)	education	5	non agri south asia	education	2
	health	2		health	1		health	0
	income	0		income	0		income	0

Accordingly, to define how strongly each country's component improved, standard deviation scores for the Education, Health, and Income components were calculated for all the countries. In this way, it becomes clear how much better/worse the country's education component is than the world average. Since each component is independent from the others, it is not necessary to worry about the possibility that the current HDI emphasizes the impact of Education too much (case (2)).

Please note that the focus here is on how the countries improved HDI during the period, and not on the specific level in each year. It is readily apparent that developed (rich) countries have high HDI levels, while developing (poor) countries do not. This project is concerned with what strides countries made toward increasing HDI during the period under study. Even poor countries have the potential to make significant improvements. The standard deviation score is defined as follows:

$$Standard\ deviation\ score\ of\ the\ Education\ component\ increase\ for\ each\ county$$

$$= \left[\frac{(Education\ component\ increase\ of\ the\ country - average\ of\ Education\ component\ increase)}{standard\ variation\ of\ Education\ component\ increase}\right] *$$

(Equation 1)

World average of Education component increase = 0.152

World average of Health component increase = 0.069

World average of Income component increase = 0.052

Standard variation of Education component increase in the world = 0.087

Standard variation of Health component increase in the world = 0.065

Standard variation of Income component increase in the world = 0.058

Thus, for example, (standard deviation score of Education component increase for Afghanistan) = ((0.356-0.152)/0.087)*10+50 = 73.44.

After calculating all of the standard deviation scores, the order of the components for each country in Asia, Africa, OECD, Latin America, and other areas was revised as shown in Table 30, Table 31, Table 32, Table 33, and Table 34, respectively (Appendix 8).

While the original bare HDI had education as the driver of improvement during the period in the majority of countries, regardless of their location, when the standard deviation score is introduced to define the real driver of the improvement. For example, the original HDI showed that in Asia, 13 countries had Education as the driver of the HDI increase. However, when the standard deviation score was introduced, only 4 countries had Education as the driver of the HDI increase. Thus, the original HDI showed that 104 countries out of the total 130 countries had the Education component as the driver of their HDI improvements (17 countries had Health, and 9 had Income), while the standard deviation score showed that 53 countries out of 130 had the Education component as the driver of their HDI improvement (34 countries had Health, and 44 had Income). The summary is shown in Table 35.

Table 35. Summary of revised largest HDI component improvement (from Table 30-34)

		original	standard deviation scores
Asian	education	13	4
	health	2	5
	income	3	9

		original	standard deviation score
Latin	education	17	5
	health	5	9
	income	3	11

		original	standard deviation score
ARAB STATES	education	6	2
	health	2	3
	income	0	3

		original	standard deviation score
African	education	29	19
	health	3	6
	income	2	9

		original	standard deviation score
Ex USSR	education	4	4
	health	2	1
	income	0	1

		original	standard deviation score
PACIFIC	education	2	2
	health	0	0
	income	1	1

		original	standard deviation score
OECD	education	26	14
	health	2	9
	income	0	5

		original	standard deviation score
OTHER EUROPE (NON-OECD)	education	5	2
	health	1	0
	income	0	4

		original	standard deviation score
NON-AGRICULTURAL SOUTHEAST ASIA	education	2	0
	health	0	1
	income	0	1

If we rely upon the original HDI component improvement, then Asia appears to be driven by (1) education, then (2) income and (3) health; Latin America appears to be driven by (1) education, then (2) health and (3) income; Africa also appears to be driven by (1) education, (2) health and (3) income; and OECD countries' group appears to be driven by (1) education and (2) health.

However, when we look at the standard deviation score of HDI component improvements, we find that Asia was strongly driven by (1) income, (2) health, then (3) education; Latin America was driven by (1) income, (2) health, then (3) education; Africa was driven strongly by (1) education, (2) income, then (3) health, and OECD countries' group was driven by (1) education, (2) health, then (3) income. The revised order of the HDI components and the sum of the three standard deviation scores for the Asian countries are shown in Table 36 and the sums of the three scores of each country are visualized in Figure 46. When the graph is enlarged, it becomes as shown in Figure 47. Four groups are identified, as shown in Figure 48. Figures 46–48 are in Appendix 9. In this way, the group in green is defined as ◎VERY SUCCESSFUL, the group in blue is defined as ○SUCCESSFUL, the group in yellow is defined as △MARGINAL, and the group in red is defined as ×UNSUCCESSFUL.

Table 36. Revised order of the HDI components and the sum of the 3 components

ASIAN COUNTRIES	1990-2010 Order of components	Values	Value-Average	Standard Scores	Revised order of components	Sum of 3 components
Afghanistan	Education	0.356	0.203	73.44837	Education	169.51
Afghanistan	Health	0.169	0.100	65.33259	health	
Afghanistan	Income	-0.060	-0.112	30.73269	income	
Bangladesh	Education	0.217	0.064	57.41612	Health	179.81
Bangladesh	Health	0.145	0.076	61.658	Income	
Bangladesh	Income	0.114	0.062	60.74002	Education	
China (PRC)	Income	0.275	0.223	88.50543	income	196.80
China (PRC)	Education	0.206	0.053	56.13354	education	
China (PRC)	Health	0.083	0.014	52.16531	health	
India	Education	0.193	0.040	54.6372	Income	176.35
India	Income	0.142	0.090	65.56879	Health	
India	Health	0.109	0.040	56.14611	Education	
Indonesia	Education	0.128	-0.025	47.15549	Income	160.19
Indonesia	Health	0.103	0.034	55.22747	Health	
Indonesia	Income	0.097	0.045	57.80827	Education	
Republic of Korea	Education	0.178	0.025	52.92709	Income	177.17
Republic of Korea	Health	0.139	0.070	60.73935	Health	
Republic of Korea	Income	0.130	0.078	63.49932	Education	
Kyrgyzstan	Education	0.028	-0.125	35.61227	health	112.32
Kyrgyzstan	Health	0.011	-0.058	41.14154	education	
Kyrgyzstan	Income	-0.032	-0.084	35.56146	income	
Lao PDR	Health	0.196	0.127	69.4665	Health	185.82
Lao PDR	Education	0.167	0.014	51.64451	Income	
Lao PDR	Income	0.137	0.085	64.70651	Education	
Malaysia	Education	0.167	0.014	51.64451	income	159.19
Malaysia	Income	0.106	0.054	59.36038	education	
Malaysia	Health	0.057	-0.012	48.1845	health	
Mongolia	Education	0.244	0.092	60.62257	Education	175.27
Mongolia	Income	0.109	0.057	59.87774	income	

ASIAN COUNTRIES	1990-2010 Order of components	Values	Value-Average	Standard Scores	Revised order of components	Sum of 3 components
Mongolia	Health	0.100	0.031	54.76814	health	
Myanmar	Income	0.245	0.193	83.33175	Income	186.44
Myanmar	Education	0.150	-0.002	49.72064	Health	
Myanmar	Health	0.091	0.022	53.39017	Education	
Nepal	Education	0.239	0.086	59.98128	health	181.41
Nepal	Health	0.186	0.117	67.93542	education	
Nepal	Income	0.072	0.020	53.49688	income	
Pakistan	Education	0.167	0.014	51.64451	Education	152.96
Pakistan	Health	0.076	0.007	51.09355	health	
Pakistan	Income	0.053	0.001	50.22021	income	
Philippines	Income	0.054	0.002	50.39267	Income	132.51
Philippines	Health	0.046	-0.023	46.50032	Health	
Philippines	Education	0.028	-0.125	35.61227	Education	
Sri Lanka	Education	0.128	-0.025	47.15549	Income	159.01
Sri Lanka	Income	0.123	0.071	62.29213	Health	
Sri Lanka	Health	0.066	-0.003	49.56247	Education	
Tajikistan	Health	0.060	-0.009	48.64383	health	102.51
Tajikistan	Education	-0.044	-0.197	27.2755	education	
Tajikistan	Income	-0.084	-0.136	26.59375	income	
Thailand	Education	0.261	0.109	62.54644	Education	168.64
Thailand	Income	0.102	0.050	58.67055	income	
Thailand	Health	0.052	-0.017	47.41896	health	
Vietnam	Education	0.220	0.068	57.8009	income	178.97
Vietnam	Income	0.169	0.117	70.2251	education	
Vietnam	Health	0.075	0.006	50.94044	health	

In Table 37, the ◎, ○, △, and × in the column for HDI absolute value (column Q) were replaced by scores (a score of 3 was given to ◎, a score of 2 was given to ○, a score of 1 was given to △, and a score of 0 was given to

×). The column for HDI ratio increase (column U) was treated in the same way. In the column showing HDI evaluation by absolute value and ratio of increase (column V), the countries with the total score of 6 or 5 as the sum of column Q and U were evaluated as “very successful,” those with a score of 4 or 3 were evaluated as “successful,” those with a score of 2 or 1 were evaluated as “marginal,” and those with a score of 0 were evaluated as “unsuccessful.” In this way, all of the groups were balanced to contain 3 to 5 countries (4 countries were Very successful, 4 countries were Successful, 5 countries were Marginal, and 3 countries were Unsuccessful; thus, 8 countries were in the top 2 categories of Very successful and Successful, while the other 8 countries were in the bottom 2 categories of Marginal and Unsuccessful). In the same way, in column W, the countries with a total score of 6 or 5 as sum of column R and column U were evaluated as “very successful,” those with a score of 4 or 3 were evaluated as “successful,” those with a score of 2 or 1 were evaluated as “marginal,” and those with a score of 0 were evaluated as “unsuccessful”; the evaluations of the other 11 countries did not change. In this way, all of the groups were balanced to contain 3 to 5 countries (3 countries were Very successful, 5 countries were Successful, 5 countries were Marginal, and 3 countries were Unsuccessful; thus, 8 countries were in the top 2 categories of Very successful and Successful, while the other 8 countries were in the bottom 2 categories of Marginal and Unsuccessful)

Table 37. Scoring on HDI parameters

	O	P	Q	R	S	T	U	V	W	
	HDI absolute value	World	Asia	HDI standard deviation	HDI ratio of increase	World	Asia	HDI evaluation by absolute value and ratio of increase	HDI evaluation considering HDI standard deviation and ratio of increase	
Afghanistan	28	○	△1	△1	7	◎	◎3	successful4	4	successful
Bangladesh	13	○	○2	○2	10	◎	○2	successful4	4	successful
China (PRC)	2	◎	◎3	◎3	14	○	○2	very successful5	5	very successful
India	19	○	○2	○2	20	○	△1	successful3	3	successful
Indonesia	17	○	○2	×0	25	○	△1	successful3	1	insufficient
Kyrgyzstan	123	×	NA	NA	123	×	NA			
Lao	10	◎	○2	◎3	9	◎	○2	very successful5	5	very successful
Malaysia	24	○	△1	×0	41	△	×0	marginal1	0	unsuccessful
Mongolia	64	×	×0	○2	52	×	×0	unsuccessful0	2	marginal
Myanmar	4	◎	◎3	◎3	4	◎	◎3	very successful6	6	very successful
Nepal	31	△	△1	○2	18	○	△1	marginal2	3	successful
Pakistan	22	○	△1	×0	19	○	△1	marginal2	1	marginal

Philippines	104	×	×0	×0	84	×	×0	unsuccessful0	0	unsuccessful
Korea	9	◎	○2	○2	39	△	×0	marginal2	2	marginal
Sri Lanka	65	×	×0	×0	57	×	×0	unsuccessful0	0	unsuccessful
Tajikistan	128	×	NA	NA	127	×	NA			
Thailand	33	△	△1	△1	40	△	×0	marginal1	1	marginal
Vietnam	6	◎	◎3	○2	13	○	○2	very successful5	4	successful

Rather than using the evaluation by absolute HDI value and HDI ratio of increase (column V), it is appropriate to use the evaluation that considers the HDI standard deviation and ratio of increase (column W), because the standard deviation score properly describes improvements in each country's HDI component. When the HDI standard deviation and ratio of increase (column W) are applied to the HDI parameter evaluation, the results from the absolute HDI value and HDI ratio of increase (column V) become different in 5 countries. Indonesia goes from successful to marginal, Malaysia goes from marginal to unsuccessful, Mongolia goes from unsuccessful to marginal, Nepal goes from marginal to successful, and Vietnam goes from very successful to successful.

4.8. Evaluation of the GHGpc Absolute Value Increase

Figure 49 shows the values of parameter (iv), the GHGpc absolute value increase. When the graph is enlarged, it becomes as shown in Figure 50. Four groups are identified, as shown in Figure 51. Figures 49-51 are in Appendix 10. In this way, the group in green is defined as ◎VERY SUCCESSFUL, the group in blue is defined as ◯SUCCESSFUL, the group in yellow is defined as △ MARGINAL, and the group in red is defined as ×UNSUCCESSFUL.

4.9. Evaluation of the Ratio of GHGpc Increase

Figure 52 shows the values of parameter (v), the ratio of GHGpc increases. When the graph is enlarged, it becomes as shown in Figure 53. Four groups are identified, as shown in Figure 54. In this way, the group in green is defined as ◎ VERY SUCCESSFUL, the group in blue is defined as ◯SUCCESSFUL, the group in yellow is defined as △MARGINAL, and the group in red is defined as UNSUCCESSFUL. (Malaysia went from negative emissions to positive emissions, so it is in the UNSUCCESSFUL group.)

4.10. Total Evaluation of GHGpc Parameters

In Table 38, as done in columns V and W, the ◎, ○, △, and × in the column for GHGpc absolute value increases (column Z) were replaced by scores (a score of 3 was given to ◎, a score of 2 was given to ○, a score of 1 was given to

△, and a score of 0 was given to ×). The column for the GHG ratio of increase (column AC) was treated in the same way. In column AD, the countries with a total score of 6 (no country had the total score of 5) as the sum of columns Z and AC were evaluated as "very successful," those with a score of 4 were evaluated as "successful," those with a score of 3, 2 or 1 were evaluated as "marginal," and those with a score of 0 were evaluated as "unsuccessful." In this way, all of the groups were balanced to contain 3 to 5 countries (5 countries were Very successful, 4 countries were Successful, 4 countries were Marginal, and 3 countries were Unsuccessful; thus, 9 countries were in the top 2 categories of Very successful and Successful, while the other 7 countries were in the bottom 2 categories of Marginal and Unsuccessful).

Table 38. Total evaluation of GHGpc parameters

I	X	Y	Z	AA	AB	AC	AD
	GHGpc absolute value increase	World	Asia	GHG ratio of increase	World	Asia	Total evaluation of GHGpc parameters
Afghanistan	73	△	◎	44	△	◎	very successful 6
Bangladesh	85	×	○	98	×	○	successful 4
China (PRC)	122	×	×	126	×	×	unsuccessful 0
India	95	×	○	117	×	△	marginal 3
Indonesia	115	×	△	110	×	△	marginal 2
Kyrgyzstan	7	◎	NA	2	◎	NA	
Lao PDR	60	△	◎	65	△	◎	very successful 6
Malaysia	129	×	×	1	◎	×	unsuccessful 0
Mongolia	27	○	◎	57	△	◎	very successful 6
Myanmar	47	△	◎	40	△	◎	very successful 6
Nepal	49	△	◎	12	○	◎	very successful 6
Pakistan	90	×	○	102	×	○	successful 4
Philippines	89	×	○	104	×	○	successful 4
Republic of Korea	126	×	×	123	×	×	unsuccessful 0
Sri Lanka	84	×	○	86	×	○	successful 4
Tajikistan	44	△	NA	8	◎	NA	
Thailand	111	×	△	119	×	△	marginal 2
Vietnam	116	×	△	130	×	×	marginal 1

CHAPTER 5. IDENTIFYING SUCCESSFUL COUNTRIES

The results show that the slope of the HDI vs. GHGpc trend line (Table 22) and the total evaluation of GHGpc parameters (Table 38) are very similar, since 12 countries out of 15 effective countries had the same results. Moreover, out of these countries, only India showed the opposite tendency positive (successful) HDI in slope while GHGpc is negative (marginal)). Therefore, considering all 3 parameters (the trend line, the total evaluation of HDI parameters, and the total evaluation of GHGpc parameters) will exaggerate these 2 similar results (the trend line and the total GHGpc evaluation) in the final evaluation. Thus, after confirming that the results of the evaluation of the slope and GHGpc showed almost the same tendency, the final evaluation is done by considering only the results of the total HDI evaluation and the total GHGpc evaluation. These 2 scores in column W and column AD are added to obtain the final total scores shown in Table 39. Since no country has a total score of 7, this number becomes the threshold dividing success from failure. However, Afghanistan and Lao PDR are excluded from the evaluation because of a lack of information (information related to the upcoming analysis using KAYA identity was not available for these countries). The results are shown in Table 40. Myanmar, with 12 points, and Nepal, with 9 points, are recognized as very successful countries. Myanmar was very successful because of its very successful HDI and GHGpc. Nepal was very successful because of its very successful GHGpc. Bangladesh and Mongolia received 8 points, and thus are recognized as successful countries. Bangladesh was successful because of its very successful HDI and GHGpc. Mongolia was successful because of its very successful GHGpc. The trajectories of these 2 very successful and 2 successful countries are shown in Figure 55. In Figure 56, for convenience of comparison, all of the trajectories are set to start from 0 on the X-axis and the Y-axis.

Table 39. Final total scores to identify successful countries[12]

Countries	HDI score	GHG score	Total
Bangladesh	4	4	8
China (PRC)	5	0	5
India	3	3	6
Indonesia	1	2	3
Malaysia	0	0	0
Mongolia	2	6	8
Myanmar	6	6	12
Nepal	3	6	9
Pakistan	1	4	5
Philippines	0	4	4

[12] Afghanistan, Kyrgyzstan, Lao PDR, and Tajikistan were excluded from the table because of insufficient data for the comparison.

Countries	HDI score	GHG score	Total
Republic of Korea	2	0	2
Sri Lanka	0	4	4
Thailand	1	2	3
Vietnam	4	1	5

Table 40. Identifying successful countries

Countries	HDI score	HDI evaluation	GHG score	GHG evaluation	Total	Remarks (Regarding DLHE groups, please refer Section 5.1)
Bangladesh	4	successful	4	successful 4	8	Successful because of both of successful HDI and GHG (DLHE (new CO_2); CO_2 newly rising recently)
China (PRC)	5	very successful	0	unsuccessful 0	5	Unsuccessful because of unsuccessful GHG (DLHE (dom CO_2); dominated by CO_2)
India	3	successful	3	marginal 3	6	Unsuccessful because of marginal GHG (DLHE (dom CO_2); dominated by CO_2)
Indonesia	1	marginal	2	marginal 2	3	Unsuccessful because of marginal HDI and GHG (DLHE (LUCF); dominated by LUCF)
Malaysia	0	unsuccessful	0	unsuccessful 0	0	Unsuccessful because of unsuccessful HDI and GHG (DLHE (LUCF-+); LUCF drastic increased)
Mongolia	2	marginal	6	very	8	Successful because of

Countries	HDI score	HDI evaluation	GHG score	GHG evaluation	Total	Remarks (Regarding DLHE groups, please refer Section 5.1)
				successful 6		very successful GHG even though HDI was marginal (Non DLHE (LUCF); dominated by LUCF)
Myanmar	6	very successful	6	very successful 6	12	Very Successful because of very successful HDI and GHG (Non DLHE (reform); emissions dropped because of the military era)
Nepal	3	successful	6	very successful 6	9	Very Successful because of very successful GHG (Non DLHE (Agri&LUCF); dominated by agriculture and LUCF
Pakistan	1	marginal	4	successful 4	5	Unsuccessful because of marginal HDI (DLHE (dom CO_2); dominated by CO_2)
Philippines	0	unsuccessful	4	successful 4	4	Unsuccessful because of unsuccessful HDI (DLHE (dom CO_2); dominated by CO_2)
Republic of Korea	2	marginal	0	unsuccessful 0	2	Unsuccessful because of both marginal HDI and unsuccessful GHG (DLHE (dom CO_2); dominated by CO_2)

Countries	HDI score	HDI evaluation	GHG score	GHG evaluation	Total	Remarks (Regarding DLHE groups, please refer Section 5.1)
Sri Lanka	0	unsuccessful	4	successful 4	4	Unsuccessful because of unsuccessful HDI (DLHE (yet CO_2); CO_2 increased but not much)
Thailand	1	marginal	2	marginal 2	3	Unsuccessful because of both marginal HDI and EKC (DLHE (dom CO_2); dominated by CO_2)
Vietnam	4	successful	1	marginal 1	5	Unsuccessful because of marginal GHG (DLHE (new CO_2); CO_2 rising recently)

Figure 55. Trajectories of Very Successful and Successful Asian Countries.

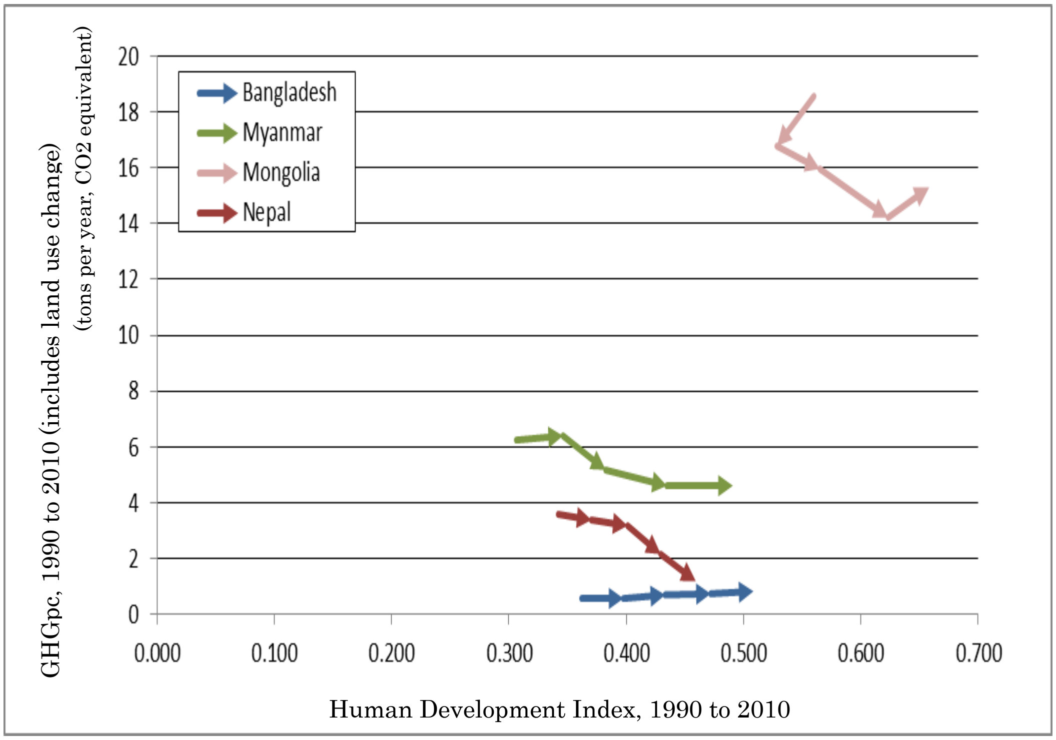
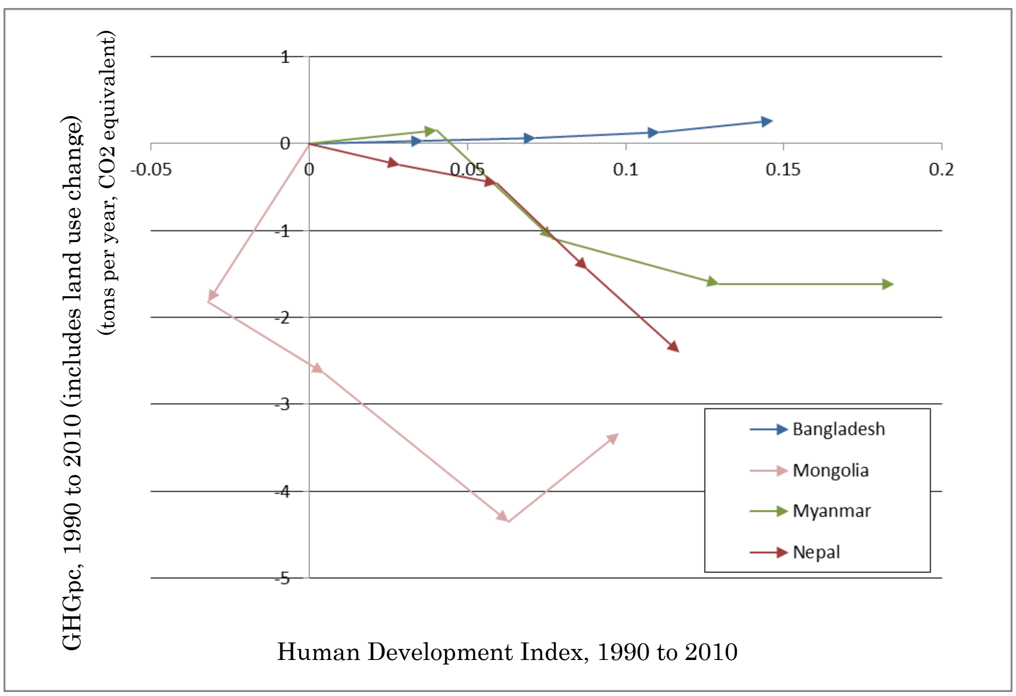


Figure 56. Relative trajectories of Very Successful and Successful Asian Countries (starting from 0).



5.1. Identifying Asian Countries in the EKC group

A version of the "development-leading-to-higher-emissions" model fits the first half of the EKC's inverted U shape. EKC logic argues that human activities performed in the pursuit of growth and development result in increases in certain pollutants at low-income levels, but the pollutants eventually decrease as incomes rise (Grossman and Krueger 1991, 1995) The EKC logic is the theoretical basis for proceeding on this assumption, because development policies in developing countries are strongly influenced by this logic. As a result, planners, politicians and policy makers are discouraged from making efforts to stabilize or reduce CO_2 emissions. However, there is some question whether this logic applies to carbon dioxide at all (Moomaw and Unruh 1998).

In Moomaw and Unruh (1998), an example of the relationship between historical events and CO_2 emissions was presented. The key point made in the study was that the EKC cannot and should not be generalized. It is important to recognize that development is not a necessary or sufficient justification for CO_2 emission increases (Chandler, 2000). EKC does not explain CO_2 emissions. Evidence shows that CO_2 can be reduced without disturbing or damaging economic growth, like any other pollutant. It is not necessarily the case, as EKC implies, that economic growth causes an increase in CO_2. Rather, economic growth can eventually reduce emissions (Moomaw and Unruh 1997). The relationship between GHGpc and income was explored by Moomaw and Tullis (1994) who used a development plane defined by these two variables to demonstrate that the trajectory of the development path through time differed among countries. They also examined the relative contribution of the three terms of the IPAT relationship (Ehrlich and Holdren 1971) to GHGpc for many countries (1999). Not all countries show the same trajectory, and it is not true that all countries must follow the process of increasing CO_2 emissions as income increases (Anadon and Holdren 2009). Historical events may be the driving force for the change, rather than income (Moomaw and Unruh 1998; Unruh and Moomaw 1998). In some cases, energy intensity is lowered by oil shocks. In cases in which historical events cause the change, decision-making and events are more important than incomes. Rather than relying on generalizations like the EKC model, it may be more useful to track the history of each country (America's Energy Future 2009; Moomaw and Tullis 1994 and 1999).

These historical events (and the decision-making processes that accompany them) may promote technical improvements that bring greater efficiency. Even when economic growth is found to be related to emission improvement, it cannot be assumed that this improvement occurred automatically. If it did happen automatically, then the reason may be that dirty technology was replaced by clean technology (Orban 2008).

The EKC has its share of proponents and critics. As discussed earlier, the EKC postulates that once a country achieves a certain level of national income, the environment is expected to improve as well, and that the initial degradation of the environment is not always the result of economic growth. While EKC supporters argue that nations can prosper enough to solve environmental problems, critics of EKC argue that as economic growth is achieved and sustained, improvement of the environment becomes difficult. Kidd (2009) surmised that although having high standards of living with a clean environment is possible, the opposite can also be true: the environment may further degrade despite economic development until the earth's carrying capacity is reached.

However, some authors argue that the EKC has complications. Recent studies have suggested the following: (i) the EKC's inverted U-shaped curve can be applied to only certain environmental problems (Stern 2004; Dasgupta et al. 2002); (ii) the total impact may increase at a certain range of incomes, but there are insufficient studies on this matter; (iii) institutional change and technology are the most important factors (Ferrini 2012); and (iv) historical events cause drastic changes (Moomaw and Unruh 1998; Stern 1997).

Additionally, some pollutants and emissions show an N-shaped curve instead of the reversed U-shape (IAE 2007). A more comprehensive analysis of the data demonstrates that pollution reduction will not happen automatically even if growth happens. Moreover, cases in the future will not necessarily be the same as cases in the past. This means that whether a case can fit with EKC logic or not depends on its specifics (Shaffer 2009). Growth makes environmental costs increase faster than the speed of the growth itself, which means that growth may not improve environmental conditions but may even worsen them (Ostrom 1990). In initial observations conducted for this dissertation, data from 130 countries showed that many low-income countries improved GHG emissions per capita while they improved HDI, which contradicts the EKC model.

Barquin (2006) argued that if it is possible to prove the existence of EKC models, then their utility as instruments of economic policy is debatable. The paper proposed that a “scale effect” should be considered when looking at the causal relationship between economic growth and pollution emissions. This effect occurs when development causes an increase in the use of natural resources, and an increase in production and income also increases the consumption of raw materials, garbage generation and amount of pollution produced. Accordingly, a cleaner energy that increases the demand for a good can also generate more contamination. To illustrate, Barquin demonstrated that the introduction of motor vehicles was, in comparison with the steam locomotive, a cleaner form of transport. But the automobile's affordability and market accessibility caused more damage to the environment than would have been generated by the steam locomotive because so many of the automobiles were put into use (as seen in Roca and Padilla 2003, 74-75).

Interestingly, while many authors have criticized the reliability of the EKC, few have offered alternative methodologies for examining the causal relationship between economic growth and emissions levels. Brock and Taylor (2010), like others, criticized the EKC model by pointing out that pollution data, like GHGs per capita, is an unreliable measure. Models of threshold effects, according to them, do not consider the timing of pollution policies. In most countries, emissions are produced in proportion to economic output, and when aggressive regulation is imposed, the emissions-to-output-ratio significantly declines. However, the available data on emissions are inconsistent with this assumption: the emissions per unit output typically declines well before any reduction in aggregate emissions. Also, while increasing returns to emission abatement may be important in some industries, a large portion of emissions come from diffuse sources such as cars, houses and individual consumptive activities.

To illustrate further, Brock and Taylor (2010) presented a simple growth and pollution model to investigate the relationship between growth and emissions. The model shows that although emissions rise with output growth, they eventually go down with ongoing technological progress. If rapid growth overwhelms the emission-reducing impact of technological progress, emission levels rise, but as countries mature and approach their balanced growth path, economic growth slows and the effect of emissions is now overwhelmed by the impact of technological progress in abatement. The result is that emission levels decline. This interplay of diminishing returns and technological progress, according to Brock, generates a time series data of increasing and decreasing emissions as income per capita grows.

Finally, in a study conducted by Raymond (2004), the theoretical arguments presented in Arrow (1995), which stated that EKC relationships are unlikely to hold for intergenerational environmental problems, were confirmed.

Using the Environmental Sustainability Index (ESI), a comprehensive summary of environmental quality and conditions in 140 countries was developed. This provided new dependent variables showing causal relationships between sustained growth and environmental impact. The results suggest that EKC may be an inadequate guide for environmental policy.

It has been argued that while higher income is significantly associated with improvements in welfare within national borders, evidence of an actual EKC trend in country data is lacking. Moreover, per capita income shows a negative relationship with indicators of international environmental impacts, such as GHG emissions. Raymond argued that it is unlikely that growth and development will improve temporal environmental impacts rather than spatial impacts, such as biodiversity loss or growing stress on ecological systems. Table 41 presents a summary of the major arguments presented by each author on the EKC.

Table 41. Summary of Authors' EKC Arguments

Author	Claims Against EKC	Indicators
Stern (2006) and Dasgupta (2007)	• EKC can be applied to only some environmental problems.	
Chandler (2000)	• Development is not a necessary or sufficient justification for CO_2 emission-increases.	CO_2
Moomaw and Unruh (1997)	• EKC cannot and should not be generalized. • Historical events may be the driving force for the change, but not income. • EKC does not fit with CO_2 emissions. • Economic growth does not necessarily cause an increase in CO_2; rather, economic growth can eventually reduce emissions .	CO_2
IEA (2007)	• Some pollutants and emissions show an N-shaped curve.	Emissions
Barquin (2006)	• A "scale effect" should be considered. • If it is possible to prove the existence of EKC models, then their utility as instruments of economic policy is debatable.	Impacts by Motor Vehicles
America's Energy Future (2009)	• Generalizations like the EKC model should not be relied upon. • It is important to track the history of each country because development policies in developing countries are strongly influenced or "trapped" by the EKC theory.	
Orban (2008)	• Even if a case in which economic growth is related to an emission improvement is found, there is no reason to believe that such improvement occurs automatically. • If it can happen automatically, then it may be a case wherein dirty technology is	Dirty Technology

Author	Claims Against EKC	Indicators
	replaced by clean technology.	
Kidd (2009)	• Although having high standards of living with a clean environment is possible, the opposite is also true. • The environment may further degrade, despite economic development, until the earth's carrying capacity is reached.	Environmental Degradation
Ferrini (2012)	• Institutional change and technology are the most important items.	
Shaffer (2009)	• Pollution reduction will not happen automatically even if growth happens. • Cases in the future will not necessarily be the same as cases in the past. • Whether a case can fit with EKC or not depends on the specifics of the case.	
Ostrom (1990)	• Growth makes environmental costs increase faster than the speed of the growth itself. • Growth may not improve environmental conditions but may even worsen it.	Worsening of Environmental Conditions
Brock and Taylor (2010)	• Pollution data, like GHG per capita, are unreliable measures. • Models of threshold effects do not consider the timing of the pollution policies imposed. • Emissions are produced in proportion to economic output; when aggressive regulation is imposed, emissions-to-output-ratio drastically decline.	Greenhouse Gas
Raymond (2004)	• While higher income is significantly associated with improvements in welfare, evidence of an actual EKC trend in country data is lacking. • Per capita income shows a negative	Greenhouse Gas

Author	Claims Against EKC	Indicators
	relationship with indicators of international environmental impacts such as GHG emissions.	

A version of the "development-leading-to-higher-emissions" model fits with the first half of the EKC's reversed U shape. EKC logic argues that human activities performed in the pursuit of growth and development result in increases in certain pollutants at low-income levels, but then result in decreases at some point as incomes rise (Grossman and Krueger 1991, 1995). As a result, planners, politicians and policy-makers are discouraged from making efforts to stabilize or reduce CO_2 emissions.

The "development-leading-to-higher-emissions" (DLHE) group is composed of countries whose CO_2 steadily increased during the period 1990–2010. They will heretofore be called the "DLHE countries." As recognized already, the 10 unsuccessful countries were:

(i) Pakistan, the Philippines, and Sri Lanka: unsuccessful DLHE countries because of unsuccessful HDI.

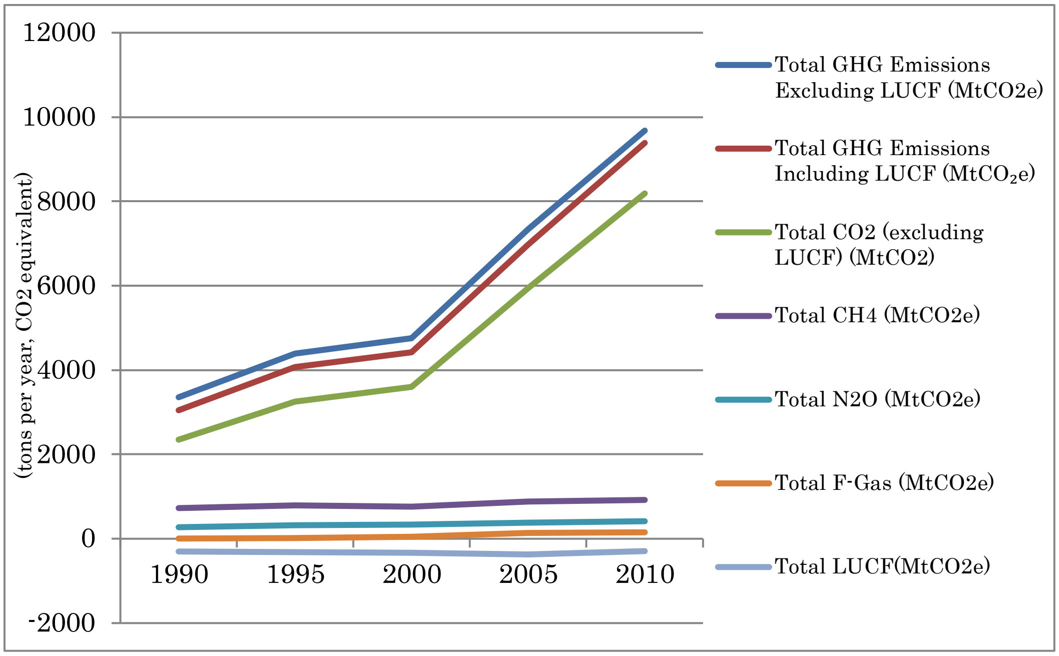
(ii) Vietnam, India, and China (PRC): unsuccessful DLHE countries because of unsuccessful GHG emissions.

(iii) Thailand, Indonesia, Malaysia and Republic of Korea: unsuccessful DLHE countries because of both unsuccessful HDI and unsuccessful GHG emissions.

In addition, Bangladesh, a successful country, also showed DLHE trajectory (did not pause its CO_2 increase during the period).

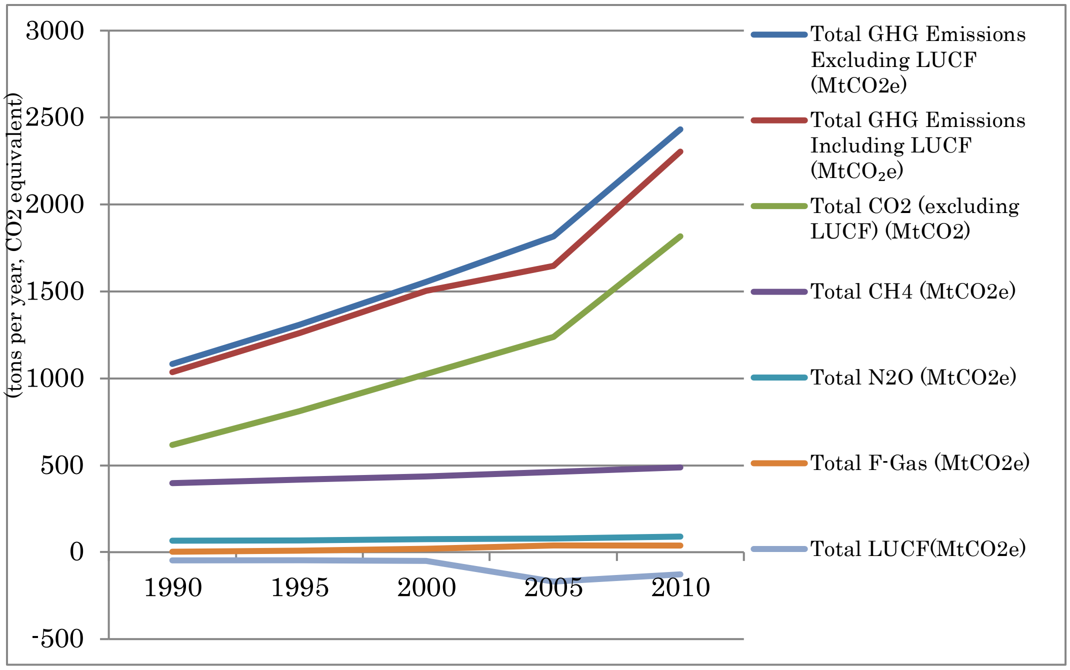
China (PRC). CO_2 grew to make up 87% of GHG. In 2010, 80% of the CO_2 (since it came mostly from the fossil fuel energy sector) was produced by electricity/heat and manufacturing/construction (See Figure 57).

Figure 57. Trajectories of GHGs (China (PRC))



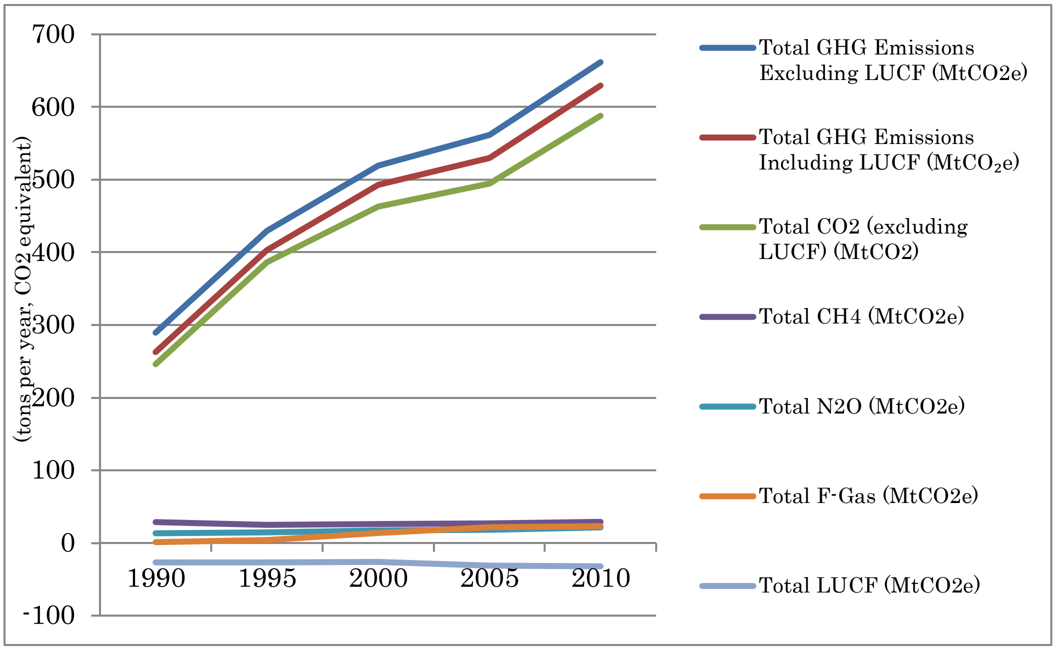
India: CO_2 increased to make up 79% of GHG. In 2010, 74% of the CO_2 (since it came mostly from the energy sector) was produced by electricity/heat and manufacturing/construction. This trajectory is exactly the same as China (PRC)'s, although China (PRC) started to speed up the domination in 2000, while India started in 2005 (See Figure 58).

Figure 58. Trajectories of GHGs (India).



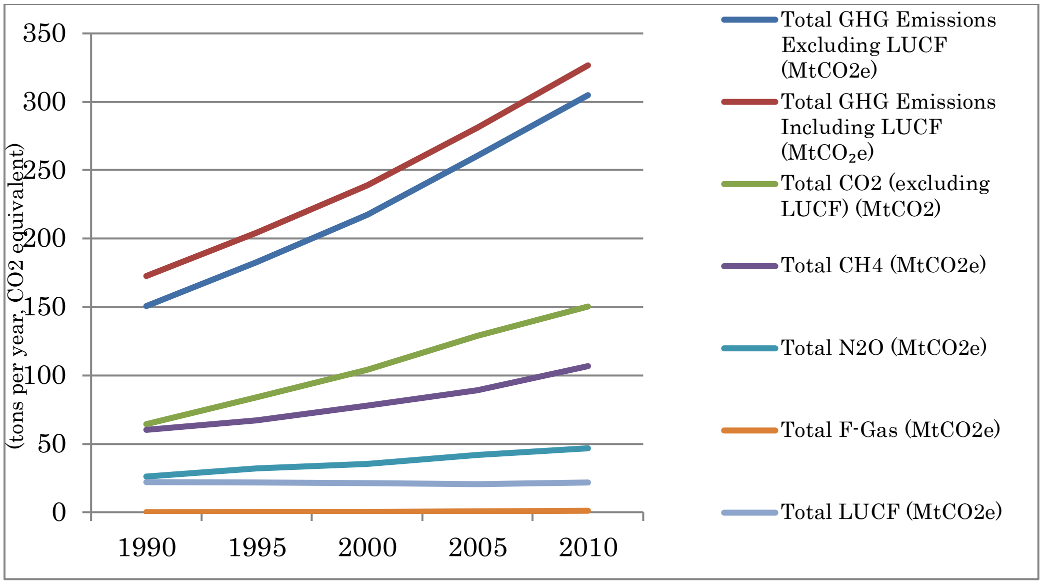
Republic of Korea: Throughout the period, CO_2 increased to make up more than 93% of GHG. In 2010, 87% of CO_2 (since it was mostly from the energy sector) was produced by electricity/heat (55%), manufacturing/construction (17%), and transport (15%). This trajectory is very similar to those of China (PRC) and India. However, China (PRC) started to speed up the domination in 2000 and India started in 2005, but the Republic of Korea had already started before 1990. While China (PRC) and India had the agriculture sector as the second contributor, in the Republic of Korea, the agriculture sector was a very insignificant contributor (See Figure 59).

Figure 59. Trajectories of GHGs (Republic of Korea).



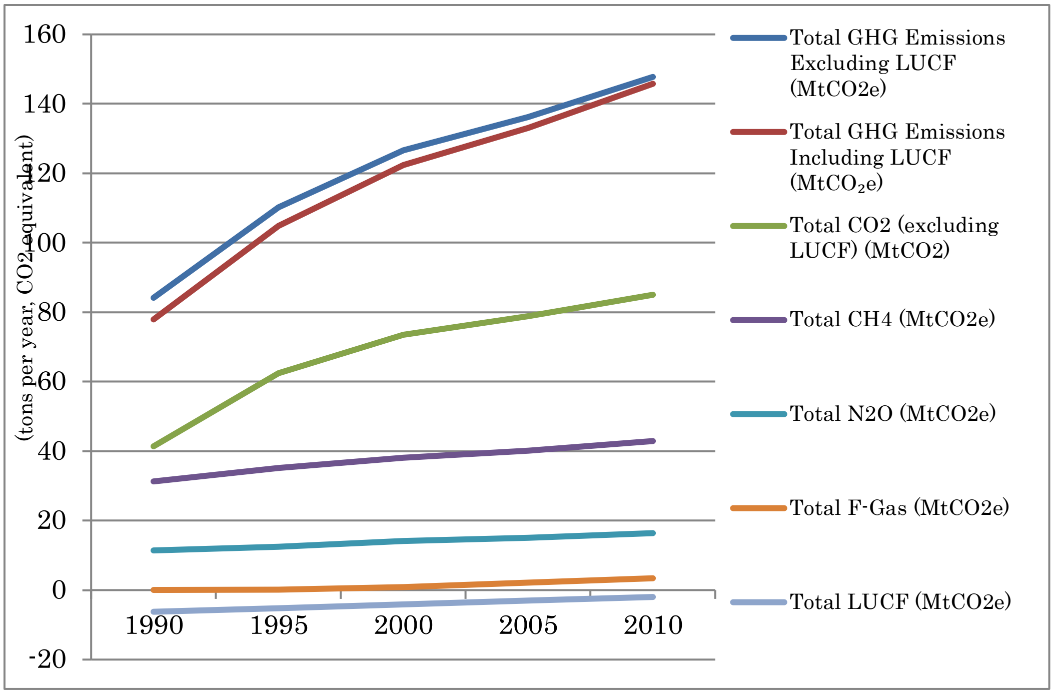
Pakistan: Throughout the period, CO_2 increased to make up 46% of GHG. In 2010, 77% of the CO_2 (since it came mostly from the energy sector) was produced by electricity/heat, manufacturing/construction, and transport. This trajectory is very similar to those of China (PRC), India, and the Republic of Korea. In Pakistan, CH_4 from agriculture is still a significant gas among GHG emissions (See Figure 60).

Figure 60. Trajectories of GHGs (Pakistan).



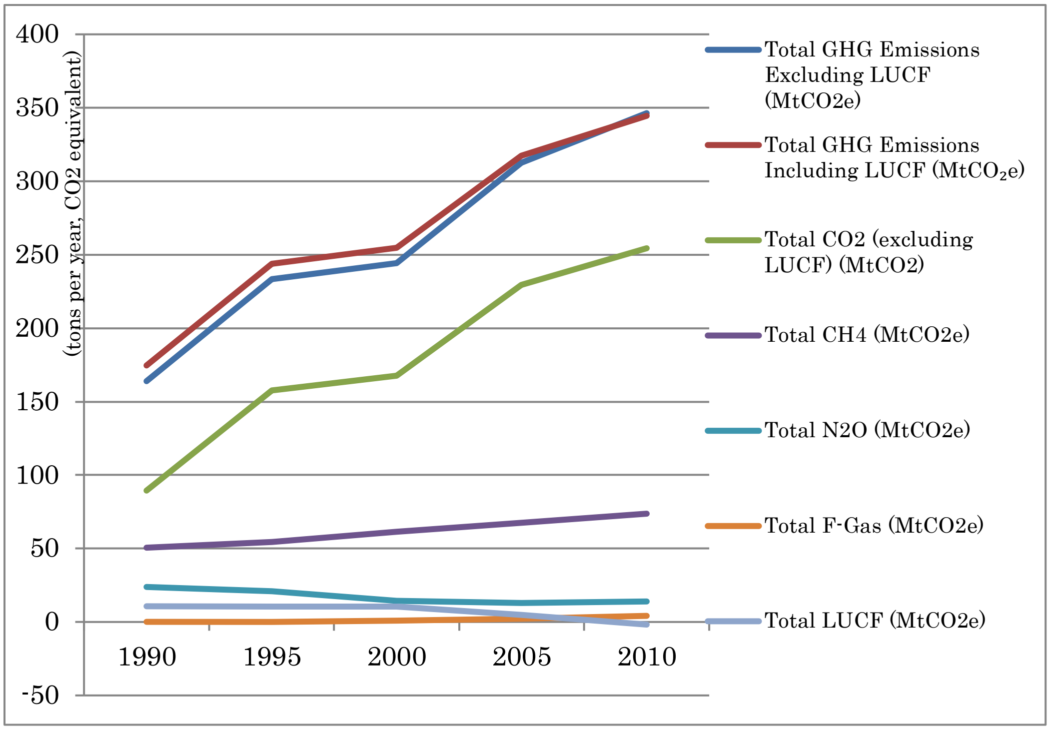
Philippines: Throughout the period, CO_2 increased to make up around 50-60% of GHG. In 2010, 86% of the CO_2 (since it came mostly from the energy sector) was produced by electricity/heat (42%), manufacturing/construction (29%), and transport (16%). This trajectory is very similar to those of China (PRC), India, the Republic of Korea, and Pakistan. In the Philippines, CH_4 from agriculture is still a significant gas among GHG emissions. CO_2 emissions from transport are higher than those from manufacturing/construction. This may result from geological reasons: the Philippines is made up of many small islands that are not suitable for trains (See Figure 61).

Figure 61. Trajectories of GHGs (Philippines).



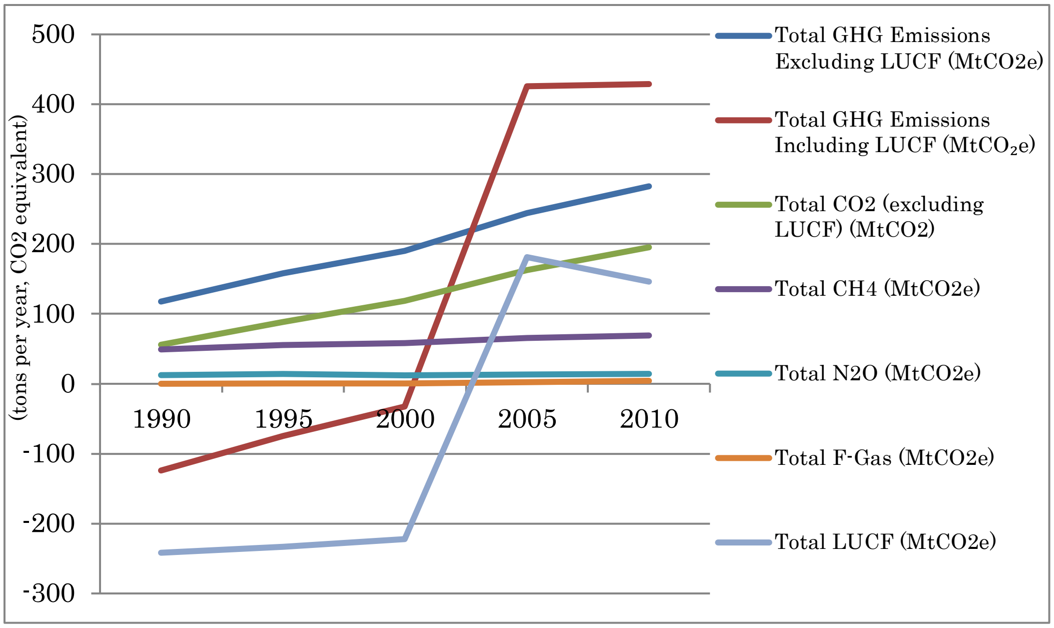
Thailand: Throughout the period, CO_2 increased to make up more than 50% of GHG. In 2010, 87% of the CO_2 was produced by electricity/heat (39%), manufacturing/construction (26%), and transport (22%). This trajectory is very similar to those of China (PRC), India, the Republic of Korea, Pakistan, and the Philippines. In Thailand, CH_4 from agriculture is still a significant gas among GHG emissions (See Figure 62).

Figure 62. Trajectories of GHGs (Thailand).



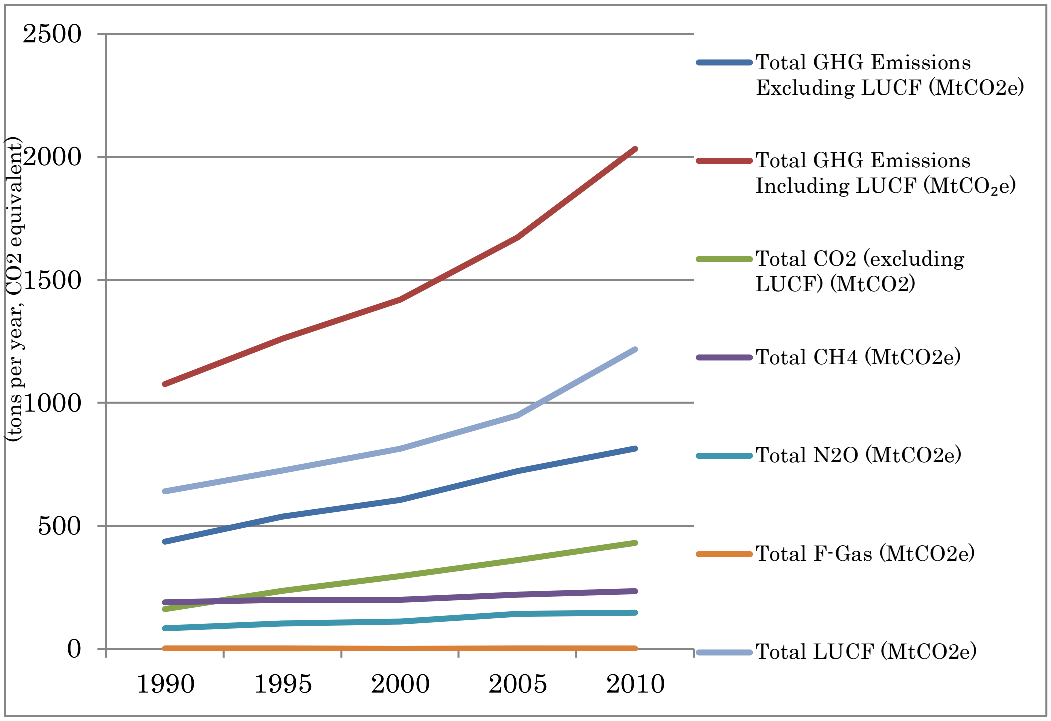
Malaysia: Other than the drastic change in LUCF which is supposed to be the result of massive deforestation and the planting of palm oil plantations, the emissions showed the typical CO_2-energy-led trajectory (See Figure 63).

Figure 63. Trajectories of GHGs (Malaysia).



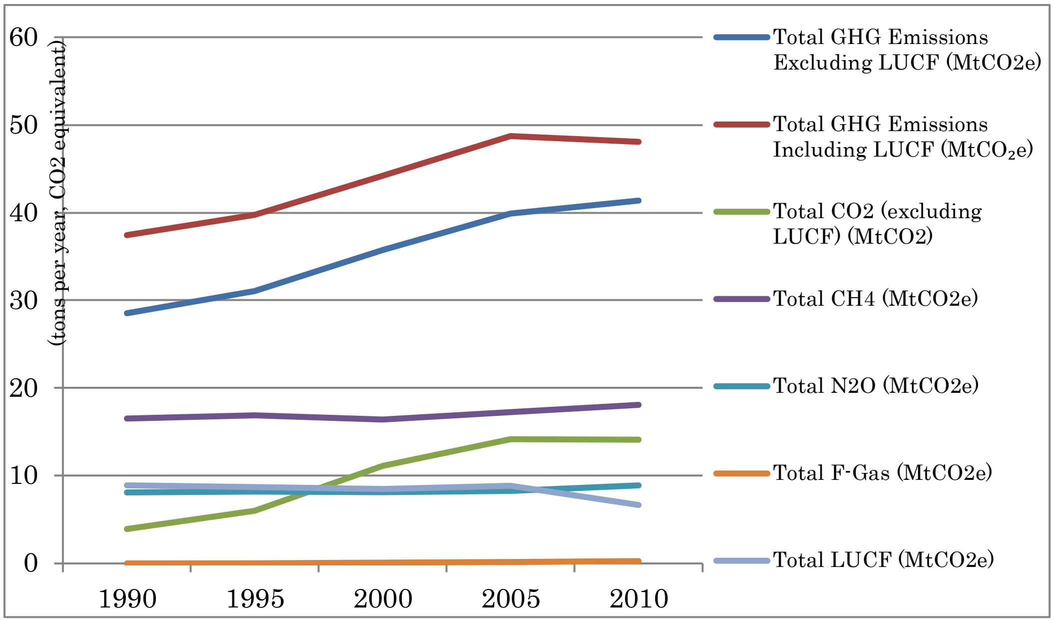
Indonesia: Total GHG emissions almost doubled during the period because of increases in all GHG gases. The all-time main source was LUCF, which made up more than half of the contributions, while CO_2 from the energy sector and CH_4 from agriculture also increased. CH_4 from agriculture and LUCF were the main sources in 1990. The main emitter of CO_2 from the energy sector was electricity/heat (See Figure 64).

Figure 64. Trajectories of GHGs (Indonesia).



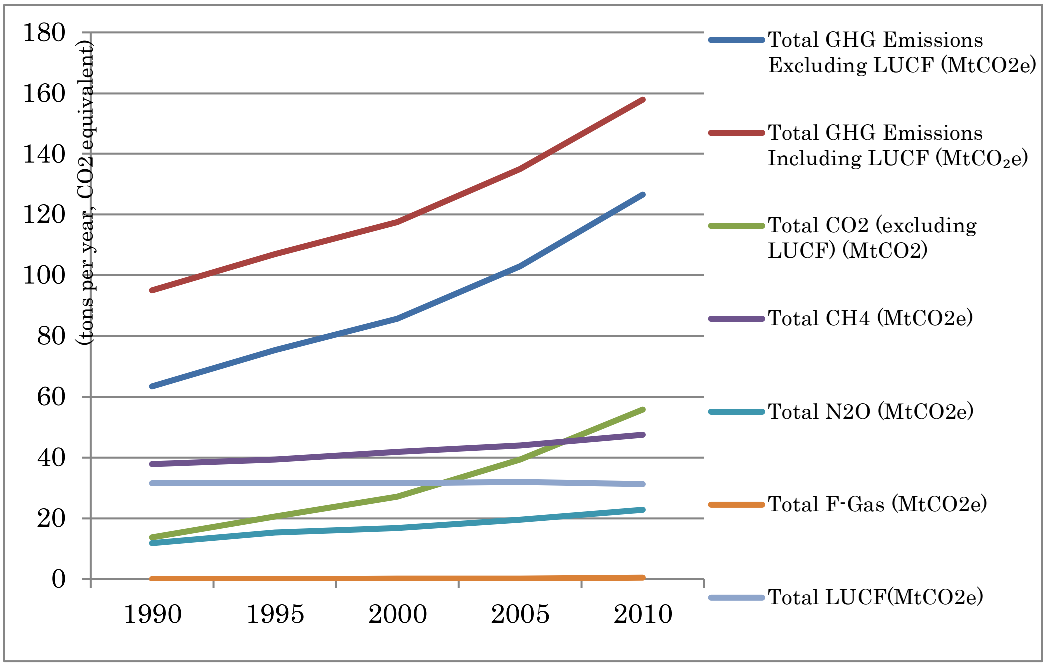
Sri Lanka: CH_4 was the biggest contributor throughout the period and was stable through the period. N_2O and LUCF were other significant gases, ranked 2-4, and they were also stable. While other gases were more or less stable, only CO_2 showed a remarkable increase, which brought it up from 4th to 2nd position because of increases in CO_2 emissions from transportation, electricity/heat, and other fuel combustion (other than CO_2) (See Figure 65).

Figure 65. Trajectories of GHGs (Sri Lanka).



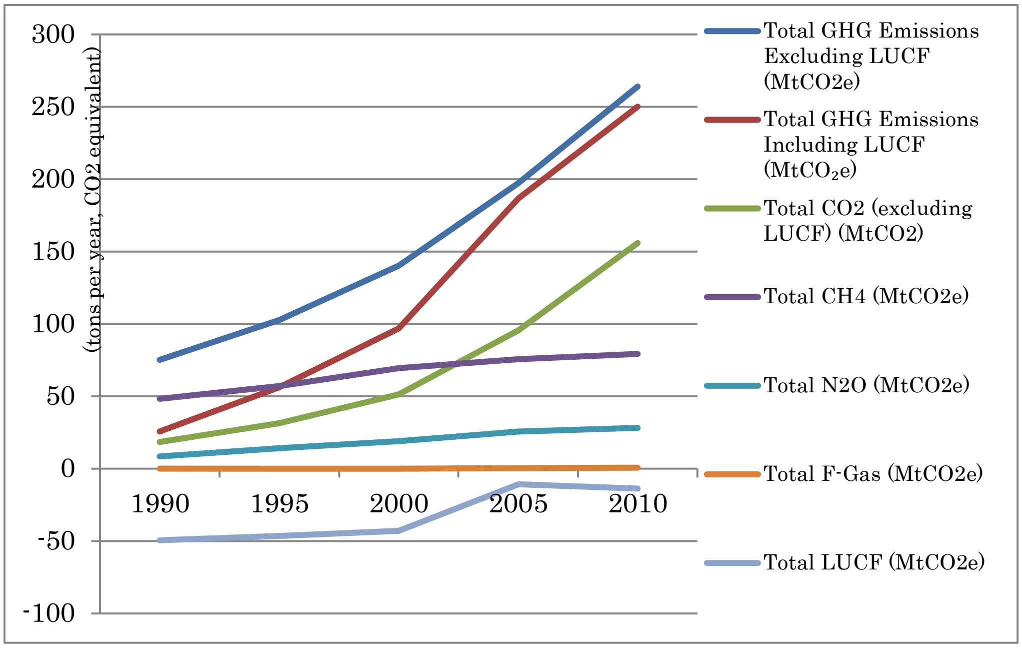
Bangladesh: The main source became CO_2 from the energy sector, including electricity/heat, manufacturing/construction, transportation and other fuel combustion, even though CH_4 from agriculture and LUCF were the main sources in 1990. The main emitter of CO_2 from the energy sector was electricity/heat (See Figure 66).

Figure 66. Trajectories of GHGs (Bangladesh).



Vietnam: The main source was CO_2 from the energy sector, including manufacturing/construction, electricity/heat, transportation and other fuel combustion, even though CH_4 from agriculture was the main source until 2000. The main emitters of CO_2 from the energy sector were manufacturing/construction and electricity/heat. LUCF was an absorber throughout the period, but the amount of absorption drastically decreased in 2005 (from 40s to 10s Mt CO_2e) (See Figure 67).

Figure 67. Trajectories of GHGs (Vietnam).



The analysis is summarized in Table 42 and these 11 countries are divided into 5 groups that are revised and clearer groupings improved from the initial groupings shown in section 4.5:

1. DLHE (CIKPPT): China (PRC), India, the Republic of Korea, Pakistan, the Philippines, and Thailand, where CO_2 dominated GHG emissions (See Figures 57 – 62).
2. DLHE (Malaysia): Malaysia, where LUCF rapidly changed from negative emissions to positive emissions (See Figure 63)
3. DLHE (Indonesia): Indonesia, where LUCF dominated GHG emissions (See Figure 64).

4. DLHE (Sri Lanka): Sri Lanka, where CO_2 increased rapidly but did not yet dominate GHG emissions (See Figure 65).
5. DLHE (BV): Bangladesh and Vietnam, where CO_2 increased greatly and became the leading GHGs (See Figure 66 and Figure 67).

Considering the characteristics of each group, they are renamed as follows to be convenient for summarizing the results in Figure 70.

1. DLHE (CIKPPT) is renamed DLHE(domCO_2)
2. DLHE (Malaysia) is renamed DLHE(LUCF-+)
3. DLHE (Indonesia) is renamed DLHE(LUCF)
4. DLHE (Sri Lanka) is renamed DLHE(not yetCO_2)
5. DLHE (BV) is renamed DLHE (newCO_2)

In addition, other successful countries are named as follows:

Mongolia: NonDLHE (LUCF) = emissions were dominated by LUCF

Myanmar: NonDLHE (reform) = emissions decreased during the reform

Nepal: NonDLHE (Agri&LUCF) = emissions were dominated by agriculture and LUCF.

Table 42. Summary of Identifying DLHE Countries

DLHE countries	DLHE groups	Analysis summary
Bangladesh	DLHE(newCO_2)	1. The main source became CO_2 from energy sector including electricity/ heat, manufacturing/ construction, transportation and other fuel combustion even though once CH_4 from agriculture and LUCF were the main sources in 1990. 2. Main emitter of CO_2 from energy sector has become electricity/ heat.
China (PRC)	DLHE(domCO_2)	CO_2 increased to dominate 87% of GHG and 80% of the CO_2 in 2010 (since most of them are from energy sector) is dominated by electricity/ heat and manufacturing/ construction.
India	DLHE(domCO_2)	1. CO_2 increased to dominate 79% of GHG and 74% of the CO_2 (since most of them are from energy sector) in 2010 is dominated by electricity/ heat and manufacturing/ construction. 2. This is exactly the same trajectory with China (PRC) while China (PRC) started the speed up of the domination from 2000 while India started from 2005
Indonesia	DLHE(LUCF)	1. Total GHG emission became almost double during the period because of increases of all GHG gasses. 2. The all-time main source had been LUCF which dominated more than half of the contribution while CO_2 from energy sector and CH_4 from

DLHE countries	DLHE groups	Analysis summary
		agriculture also increased. 3. Once CH4 from agriculture and LUCF were the main sources in 1990.2. Main emitter of CO2 from energy sector has become electricity/ heat.
Malaysia	DLHE(LUCF-+)	Other than the drastic change of LUCF, the emission showed the typical CO2-energy lead trajectory.
Mongolia	Successful as NonDLHE (LUCF)	LUFC had been the dominating gas through 1990-2005. All other GHG emissions had been stable or even decreased from 1990 till 2000, then they (CO2, CH4, and N2O) started increase from 2005 because of agriculture sector and electricity/ heat, manufacturing/ construction, and other fuel combustion.
Myanmar	Very successful as NonDLHE (reform)	1. CO2 was not significant through the period (less than 5% all through the period). 2. LUCF, CH4, and N2O, and agriculture sector were significant contributors, but emission increases were not remarkable after drastic drop through 1995-2000. This period was in its military rule heading to the democratic reforms happened from 2011.
Nepal	Very successful as NonDLHE (Agri&LUCF)	1. CO2 was not significant through the period (less than 10% all through the period). 2. LUCF, CH4, and agriculture sector were significant contributors.

DLHE countries	DLHE groups	Analysis summary
Pakistan	DLHE(domCO2)	1. Through the period, CO2 increased to occupy 46% of GHG and 77% of the CO2 (since most of them are from energy sector) in 2010 is dominated by electricity/ heat, manufacturing/ construction, and transport. 2. This is a very similar trajectory with China (PRC), India, and Korea.3. Pakistan still has CH4 from agriculture as a significant source.
Philippines	DLHE(domCO2)	1. Through the period, CO2 increased to occupy round 50-60% of GHG and 86% of the CO2 (since most of them are from energy sector) in 2010 is occupied by electricity/ heat (42%), manufacturing/ construction (29%), and transport (16%). 2. This is a very similar trajectory with China (PRC), India, Korea, and Pakistan. 3. Philippines still has CH4 from agriculture as a significant source. 4. CO2 emission from transport is higher than manufacturing/ construction in Philippines. It maybe result from geological reason when Philippines are made by many small islands where cannot be suitable for trains.
Korea	DLHE(domCO2)	1. Through the period, CO2 increased to keep its domination above 93% of GHG and 87% of the CO2 (since most of them are from energy sector) in 2010 is dominated

DLHE countries	DLHE groups	Analysis summary
		by electricity/ heat (55%), manufacturing/ construction (17%), and transport (15%). 2. This is a very similar trajectory with China (PRC) and India while China (PRC) started the speed up of the domination from 2000 while India started from 2005, but Korea started already before 1990. 3. While China (PRC) and India had agriculture sector as the 2nd contributor, in Korea, agriculture sector was very insignificant.
Sri Lanka	DLHE(not yetCO2)	1. CH4 had been the biggest contributor through the period while it was also stable through the period. N2O and LUCF hand been also other significant gases ranked 2-4 through the period, however they were also stable. 2. While other gasses were more or less stable, Only CO2 showed remarkable increase which bring it up from 4th position to 2nd position because of increases by CO2 emissions from transportation, electricity/ heat, and other fuel combustion (other than CO2).
Thailand	DLHE(domCO2)	1. Through the period, CO2 increased to keep its domination above 50% of GHG and 87% of the CO2 in 2010 is dominated by electricity/ heat (39%), manufacturing/ construction (26%), and transport (22%).

DLHE countries	DLHE groups	Analysis summary
		2. This is a very similar trajectory with China (PRC), India, Korea, Pakistan, and Philippines. 3. Thailand still has CH4 from agriculture as a significant source
Vietnam	DLHE(newCO2)	1. The main source became CO2 from energy sector including manufacturing/ construction, electricity/ heat, transportation and other fuel combustion even though once CH4 from agriculture was the main source until 2000. 2. Main emitter of CO2 from energy sector has become manufacturing/ construction and electricity/ heat. 3. LUCF had been an absorber through the period but the amount of absorption drastically decreased in 2005 (from 40s to 10s MtCO2e).

5.2. Significant Contribution of Technology in the I=PAT Formula and KAYA Identity

While the EKC does not seem to describe the environmental impacts of development due to its limitations, i.e., its focus on emissions, multiple other theories and principles have been used to describe this causal relationship. One is the I=PAT formula (Ehrlich and Holdren 1971), which illustrates how anthropogenic factors impact the environment. I is the dependent variable and stands for environmental impact; P stands for population; A stands for affluence, which represents the average per capita income of a population; and T stands for technology, which represents the environmental impact intensity or environmental impact per unit of goods and services. It is widely accepted that growth in population, affluence, and technology are each responsible for environmental problems (Kates 2000). Population and affluence usually increase over time and the technology factor can lower impact intensity by increasing production or utility efficiency, thereby reducing its multiplier effect on the equation.

Kates added that while the population factor can be easily understood and is often predictable, consumption needs to be examined further, and technology is even more complicated because it can be both a problem and a solution. The author argued that technology can cause pollution problems but that the development of new technologies can also abate them. This view is shared by the World Bank (2003), which stated that while T has decreased its impact in recent years, P and A have continuously increased, which offsets the balance, causing I to continue to increase steadily.

In this regard, the I=PAT formula emphasizes how the effects of multiple drivers of environmental change are multiplicative, but interactive—population growth, for instance, depends on the level of affluence and choice of technology

(Rosa and Dietz 2012). This significant contribution of technology, as compared to the other two factors, was further recognized in Holdren (2000), who stated that technological improvements can reduce the impact per dollar of GDP more rapidly than can population and affluence. As if supporting Kates, Holdren added that this is due to technology's potential to reduce the amount of energy needed and the level of materials consumed for economic activities. In recent years, P and A have been increasing in most developing countries. Thus, if I is ever to be reduced, only T can make it possible. Moreover, the technology component in the I=PAT formula is further divided into two components: a specific technology's contribution to overall GDP (T/GDP) and the amount of GHG emissions per unit of technology utilization (GHG/T).

The Kaya Identity, developed by Yoichi Kaya in 1993, provides a look at the GHG contribution of specific technologies and serves as a measure of the relative contribution of that technology to the economy. In detail, the Kaya Identity separates the Technology factor in the IPAT equation into energy use per unit of GDP, and carbon emissions per unit of energy consumed. To date, the Kaya identity has been applied only to energy and pollution or carbon dioxide emissions (Sustainability Dictionary 2017).

5.3.Technology Transfer/Adoption vis-à-vis Environmental Innovation

While the I-PAT Formula and KAYA Identity showed the significant contribution of technology to overall environmental impacts, this section discusses how various technologies transferred/adopted into developing countries relate to development and environmental innovations in these countries. The assumption is that when a new technology is transferred/adopted into a developing country, new, emerging and improved environmental policies are also adopted in response to the new technology. Policy reforms and institutional innovations occur. However, studies suggest that environmental innovations are sometimes challenged, both at the level of the company that transferred/adopted the technology and at the policy level, by the developing countries that receive the new technology.

The above premise is based on Everett Rogers' 1962 book *Diffusion of Innovations*, which stated that innovation, communication channels, time, and social systems influence the spread of new ideas, including technology. Rogers surmised that a specific innovation must be widely adopted in order to be sustainable, and, as Orr (2003) put it, people will adopt an innovation if it will enhance their utility. This premise holds true for technology adoption, wherein people accept a new technology if they believe that it is far better than the previous one, even if they are used to it.

Moreover, technology diffusion does not follow a single uniform pattern. Grubler (2003) argued that diffusion happens taking over a longer period in the areas where the technology originated, and faster in areas where diffusion was introduced later. In the former, referred to as “innovation centers,” the level of adoption is higher than in the latter, referred to as “catch-up regions,” where diffusion times are shorter but adoption levels are also generally lower.

The question remains: if technology can be transferred/adopted and diffused, can something that is not tangible yet equally important for developing countries to achieve development also be adopted? This refers to environmental innovations leading to policy. In Hallila (2007), the understanding of adoption and the diffusion of environmental innovations were examined along with the processes involved. The empirical results show that to address the less successful environmental innovations, three factors must be considered: realism while evaluating one’s own innovation, access to capital, and utilization of networks.

This finding was supported in Ugaglia (2013), which studied environmental innovations by focusing on the case of pesticide reduction in the wine sector. The study developed a model to analyze the determinants of environmental innovations in grape production and observed that environment-friendly agricultural and production practices did not spread as expected. After using different models to address the problem, the results indicated that the would-be adopters did not have an incentive to change crop protection methods because they faced a technological lock-in toward pesticides; that is, they were so dependent on pesticide use that they were unable to switch to new technologies without incurring substantial costs. Pesticides also bring the benefits of increasing returns to scale. Moreover, new knowledge and skills are needed to adopt the environmental innovation being introduced. Therefore, the paper argued, innovation processes can be a complex phenomenon wherein recipients need to search for new resources that they do not normally have. However, situations can be different for countries adopting new technologies for the first time, which is often the case in developing countries.

There are, however, studies that show the successful adoption of an environmental innovation after a new technology was introduced. In Hascic (2010), some evidence on the diffusion of climate change mitigation technologies (CCMT) and their positive links to policy innovations was presented. By simply examining patent counts on a variety of technologies from various countries over a period of 30 to 35 years, it was discovered that the rate of innovation accelerated for many CCMTs. Since the data also show that different countries exhibit different types of CCMT innovations, the study concluded that one important determinant of innovation is a country's general innovative capacity. A country with a high rate of innovation was also seen as more innovative in CCMTs. This finding was supported in Johnson (2010), which examined diffusion mechanisms, market factors, social characteristics and political elements that facilitate or complicate dissemination. This study stated that many of the challenges to technology innovation and dissemination are found in eco-innovations and argued that since environmental issues tend to be local in nature, local knowledge and solutions are required. Adoption is facilitated by environmental feasibility and by cultural and political acceptance. Johnson added that like many new technologies, environmental innovations usually require significant support, training and assistance, and concluded that it is essential to consider the skills required for the continued use and repair of new technologies at the very onset of adoption.

The barriers faced by developing countries in technology transfer/adoption and environmental innovations were further discussed in Ockwell et al. (2010), which outlined policy considerations and mechanisms for overcoming barriers. A major finding is that the majority of existing policy mechanisms do not recognize the importance of developing indigenous eco-innovation capabilities among developing countries. According to the paper, such capabilities are essential to facilitating the diffusion of existing eco-innovations and sustainable economic development based on the adoption of environmentally sound technologies. Moreover, policy improvement is needed to respond to context-specific technological and cultural requirements. This role of policy in environmental innovation was further explored in Iida and Takeuchi (2008), which investigated how environmental and trade policies affect the transfer/adoption of environmental technology in a two-country model that includes the transfer/adoption of global pollution. After the trade policies were compared, the results indicated that although free trade lowers environmental regulation, it is still preferable when the evaluation of the environmental damage is high. Moreover, the paper argued that when a country cares less about the environmental damage caused by technology transfer/adoption, free trade is Pareto improving. However, if the developing country's concern is high enough to lead it to implement environmental protection, free trade is not preferred.

In a related study, Johnstone (2010) focused on innovation and technology transfer in air pollution abatement, wastewater effluent treatment, solid waste management, and climate change mitigation. The paper described the trends in innovative activity related to selected areas of pollution abatement and control technologies and its transfer internationally. It was discovered that market-based instruments, like environmental taxes and permits, can induce innovation and that by encouraging potential innovators to allocate resources to identify the best way of achieving a given environmental objective, policy flexibility can provide incentives for innovation.

Despite the many challenges faced by developing countries in technology transfer/adoption and diffusion, it is still not safe to conclude that technology, in general, is difficult to transfer/adopt. Most of the above-mentioned cases involved movement from north to south, and the barriers identified were concentrated along that line. However, a recent study suggested that technology transfer now also occurs in the north-to-south-to-north, south-to-south, and south-to-north directions, and the ensuing innovation is no longer a local process, but rather happens on a global scale (Gallagher 2013). To assess this premise, Gallagher examined the dynamics of clean-energy technology transfer in selected countries that are emerging as major GHG emitters. Aside from highlighting the new multi-directional nature of technology transfer, the paper concluded that policy-induced markets are crucial for cleaner energy technology innovations, that these innovations take place in private markets, that there is no “great wall” to block the global diffusion of cleaner energy technologies, and that if there were such a wall, it could be scaled. Access to these technologies, with their intellectual properties, is not actually a barrier and can be achieved.

It is hoped that the studies presented in this literature review provide a better understanding of the causal relationships between the pursuit of development, specifically technology transfer/adoption, and the environment, including policy reforms in environmental innovation. Table 43 presents the major arguments about technology transfer/adoption.

Table 43. Major Arguments about Technology Transfer / Adaptation

Author	Claims about Technology Transfer/Adoption
Orr (2003)	• People will adopt an innovation if it will enhance their utility. • People will accept a new technology if they believe that it is far better than the previous one.
Grubler (2003)	• Diffusion happens taking over a longer period where the technology originated, and more quickly in areas where diffusion was introduced later.

Author	Claims about Technology Transfer/Adoption
Halila (2007)	• To address the less successful environmental innovations, three factors must be considered: 1) realism while evaluating one's own innovation, 2) access to capital, and 3) utilization of networks.
Ugaglia (2010)	• Innovation processes can be a complex phenomenon wherein recipients need to search for new resources that they do not normally have. • Situations can be different for countries adopting new technologies for the first time, which is often the case in developing countries.
Hascic (2010)	• An important determinant of innovation is a country's general innovative capacity.
Johnson (2010)	• Since environmental issues tend to be local in nature, local knowledge and solutions are required. • It is essential to consider the skills required for the continued use and repair of new technologies at the very onset of adoption.
Ockwell (2010)	• The majority of existing policy mechanisms do not recognize the importance of developing indigenous eco-innovation capabilities among developing countries. • Policy improvement is needed to respond to context-specific technological and cultural requirements.
Iida and Takeuchi (2010)	• Although free trade lowers environmental regulation, it is still preferable when the evaluation of the environmental damage is high. • When a country cares less about the environmental damage caused by technology transfer, free trade is Pareto improving. • If the developing country's concern is high enough to conduct environmental protection, free trade is not preferred.

Author	Claims about Technology Transfer/Adoption
Johnstone (2010)	• Market-based instruments can induce innovation and by encouraging potential innovators to allocate resources to identify the best way of achieving a given environmental objective, and policy flexibility can provide incentives for innovation.
Gallagher (2013)	• Technology transfer also occurs in the north-to-south-to-north, south-to-south, and south-to-north directions, and the ensuing innovation is no longer a local process, but rather happens on a global scale.

5.4. Modified KAYA Identity Analysis to Classify Asian Countries

The original Kaya identity is expressed in the form:

$$F = P * \frac{G}{P} * \frac{E}{G} * \frac{F}{E}$$

Equation 2

where:

F is CO_2 emissions from human sources
P is population
G is GDP
E is energy consumption

Therefore,

$$CO2\ emissions = population * GDP\ per\ capita * \frac{energy\ consumption}{GDP} * \frac{CO2\ emission}{energy\ consumption}$$

Equation 3

When IPAT (Impact= Population* Affluence* Technology) is applied to this case,

$$CO2\ emission = Population * GDP\ per\ capita * Technology$$

Equation 4

Therefore, KAYA identity divides Technology into two parts composed of E/G*F/E, which is (energy consumption/GDP CO_2 emission/energy consumption).

Energy consumption/GDP measures how efficient technology can be by calculating the energy consumption necessary to produce one unit of GDP.

CO_2 emission/energy consumption measures the carbon intensity of a technology

Therefore,

Original KAYA:

$$CO2\ emissions = population * GDP\ per\ capita * \frac{energy\ consumption}{GDP} * \frac{CO2\ emission}{energy\ consumption}$$

Equation 5

Modified KAYA to replace GDP with HDI:

$$GHG = population * HDI/* \frac{Energy\ consumption/_{P}}{HDI} * \frac{GHG}{Energy\ consumption}$$

Equation 6

Since in the trajectory chapter, the variables focused upon were GHG per capita and HDI, the equation can be

$$\frac{GHG}{P} = HDI * \frac{Energy\ consumption/_{P}}{HDI} * \frac{GHG}{Energy\ consumption}$$

Equation 7

Here, (i) (Energy consumption/P)/HDI is the per capita energy intensity per HDI, which means the amount of energy per capita when a unit of HDI is improved. The original KAYA identity used energy consumption/GDP, which shows how technology can be efficient by calculating the energy consumption necessary to produce one unit of GDP.

Therefore, this time the part shows how technology can be efficient by calculating the energy consumption necessary to produce P*HDI (the country's sum of HDI).

(ii) GHG/Energy consumption is the GHG intensity, which means the amount of

GHG emissions when a unit of energy is consumed.

The original KAYA identity used CO_2 emission/energy consumption which shows the technology used to minimize CO_2 emissions while the same amount of energy is consumed.

Therefore, this time the part shows the technology used to minimize GHG emissions while the same amount of energy is consumed.

The results of calculating the components are summarized in Table 44. Three groups of EC/P/HDI are found, as shown in Figure 68 in Appendix 10. In this way, the group in green is defined as EFFECTIVE; the group in yellow is defined as MEDIOCRE; and the group in red is defined as INEFFECTIVE.

Table 44. Results of the modified KAYA components

	EC/P/HDI		GHG/EC
	Inc LUCF		IncLUCF
Bangladesh	1.220342554	Bangladesh	0.687602
China (PRC)	1.76216565	China (PRC)	1.065681
India	1.234507137	India	0.973882
Indonesia	1.228497755	Indonesia	0.88128
Korea	1.9285229	Korea	0.892447
Malaysia	1.807640544	Malaysia	-1.02547
Mongolia	0.694556378	Mongolia	1.020018
Myanmar	0.661971424	Myanmar	0.677007
Nepal	0.886428895	Nepal	0.422825
Pakistan	0.945294841	Pakistan	0.961876
Philippines	0.840646913	Philippines	1.321341
Sri Lanka	1.266671455	Sri Lanka	0.71909
Thailand	1.980593465	Thailand	0.704873
Vietnam	1.797389532	Vietnam	2.950999

Similarly, three groups of GHG/EC are found, as shown in Figure 69. In this way, the group in green is defined as EFFECTIVE, the group in yellow is defined as MEDIOCRE, and the group in red is defined as INEFFECTIVE. (In Malaysia, GHG emissions changed from negative to positive, so it is in the INEFFECTIVE group). A summary of the countries and their order is shown in Table 45. Figure 68 and Figure 69 and Table 45 are included as Appendix 10. Conversely, a summary of each country's results is shown in Table 46.

Table 45. Summary of the groups and their orders

EC/P/HDI			GHG/EC		
EFFECTIVE	2	Mongolia	EFFECTIVE	3	Bangladesh
	1	Myanmar		2	Myanmar
	4	Nepal		1	Nepal
	5	Pakistan		5	Sri Lanka

	3	Philippines		4	Thailand
MEDIOCRE	6	Bangladesh	MEDIOCRE	11	China (PRC)
	8	India		9	India
	7	Indonesia		6	Indonesia
	9	Sri Lanka		7	Korea
INEFFECTIVE	10	China (PRC)		10	Mongolia
	13	Korea		8	Pakistan
	12	Malaysia	INEFFECTIVE	14	Malaysia
	14	Thailand		12	Philippines
	11	Vietnam		13	Vietnam

Table 46. Each country's result of modified KAYA components

EC/P/HDI			GHG/EC	
Nepal	EFFECTIVE	4	EFFECTIVE	1
Myanmar	EFFECTIVE	1	EFFECTIVE	2
Bangladesh	MEDIOCRE	6	EFFECTIVE	3
Mongolia	EFFECTIVE	2	MEDIOCRE	10
Vietnam	INEFFECTIVE	11	INEFFECTIVE	13
China (PRC)	INEFFECTIVE	10	MEDIOCRE	11
India	MEDIOCRE	8	MEDIOCRE	9
Korea	INEFFECTIVE	13	MEDIOCRE	7
Malaysia	INEFFECTIVE	12	INEFFECTIVE	14
Thailand	INEFFECTIVE	14	EFFECTIVE	4
Indonesia	MEDIOCRE	7	MEDIOCRE	6
Pakistan	EFFECTIVE	5	MEDIOCRE	8
Philippines	EFFECTIVE	3	INEFFECTIVE	12
Sri Lanka	MEDIOCRE	9	EFFECTIVE	5

Finally, all the results of the data analysis can be gathered into one figure. The results, including all of the above three observations on (i) success, (ii) the identification of the EKC groups, and (iii) the evaluation by the modified KAYA identity, are shown in Figure 70. In Figure 70, the parenthesis shows the three HDI components (standard deviation) of education, health, and income and the modified KAYA parameters (energy consumption per person per HDI (EC/P/HDI) and GHG per energy consumption (GHG/EC)) with their evaluations and rankings.

For example, “Myanmar (50,53,83/186, EC/P/HDI Effective (#1), GHG/EC Effective (#2))” shows that Myanmar’s HDI components indicated by standard deviations among Asian countries were (i) education = 50, (ii) health = 53, and (iii) income = 83. The total was 186. This means that Myanmar’s education showed average improvement when compared to that of other Asian countries; its health improved a little more than average; and its income showed a significant improvement. Since income was the driver of its HDI improvement, Myanmar is in the “income” box under “very successful” among the HDI categories. Moreover, Myanmar showed an effective EC/P/HDI and was the best of the Asian countries; GIG/EC was also effective and was the second best among the Asian countries.

Figure 70. Final Results of Evaluation of Each Asian Country

		HDI (education, health, income)											
		very successful			successful			marginal			unsuccessful		
		Education	Health	Income	Education	Health	Income	Education	Health	Income	Education	Health	Income
GHG	very successful			Myanmar (50,53,83/186, EC/P/HDI effective(#1), GHG/EC effective(#2)), NonDLHE(reform)		Nepal (60,68,53/181, EC/P/HDI effective(#4), GHG/EC effective(#1)), NonDLHE(Agri&LUCF)		Mongolia (61,55,60/175, EC/P/HDI effective(#2), GHG/EC mediocre(#10)), NonDLHE(LUCF)					
	successful					Bangladesh (57,62,61/180, EC/P/HDI mediocre(#6), GHG/EC effective(#3)), DLHE(newCO2)		Pakistan (52,51,50/153, EC/P/HDI effective(#5), GHG/EC mediocre(#8)), DLHE(domCO2)					Philippines (36,47,50/133, EC/P/HDI effective(#3), GHG/EC ineffective(#12)),DLHE(domCO2) Sri Lanka (47,50,62/159,EC/P/HDI mediocre(#9), GHG/EC effective(#5)),
	marginal						Vietnam(58,51,70/179, EC/P/HDI ineffective(#11), GHG/EC ineffective(#13)), DLHE(newCO2) India (55,56,66/176, EC/P/HDI mediocre(#8), GHG/EC mediocre(#9)), DLHE(domCO2)	Thailand (63,47,59/169, EC/P/HDI ineffective(#14), GHG/EC effective(#4)), DLHE(domCO2)		Indonesia (47,55,58/160, EC/P/HDI mediocre(#7), GHG/EC mediocre(#6)), DLHE(LUCF)			
	unsuccessful			China(PRC)(56,52,89/197, EC/P/HDI ineffective(#10), GHG/EC mediocre(#11)), DLHE(domCO2)						Korea(53,61,63/177, EC/P/HDI ineffective(#13), GHG/EC mediocre(#7)), DLHE(domCO2)			Malaysia (52,48,59/159, EC/P/HDI ineffective(#12), GHG/BC ineffective(#14)), DLHE(LUCF-+)

Very successful countries (Myanmar and Nepal): Myanmar was identified as a very successful country because it showed (i) very successful improvement in HDI and (ii) very successful improvement in GHG emissions, with (iii) the driver of the HDI improvement being income improvement, and because (iv) GHG emissions improved because of effective EC/P/HDI and effective GHG/EC. Nepal was also identified as a very successful country because it showed (i) successful improvement in HDI and (ii) very successful improvement in GHG emissions, with

(iii) the driver of the HDI improvement being health improvement, and because (iv) GHG emissions improved because of effective EC/P/HDI and effective GHG/EC.

Successful countries (Mongolia and Bangladesh): Mongolia was identified as a successful country because it showed (i) marginal improvement in HDI but (ii) very successful improvement in GHG emissions, with (iii) the driver of the HDI improvement being education improvement, and because (iv) GHG emissions improved because of effective EC/P/HDI, while GHG/EC was not impressive. Bangladesh was identified as a successful country because it showed (i) successful improvement in HDI and (ii) successful improvement in GHG emissions, with (iii) the driver of the HDI improvement being health improvement, and because (iv) GHG emissions improved because of effective GHG/EC, while EC/P/HDI was not impressive.

Unsuccessful DLHE countries because of unsuccessful HDI (Pakistan, the Philippines, and Sri Lanka): Pakistan was identified as an unsuccessful DLHE country because of unsuccessful HDI since it showed (i) marginal improvement in HDI with (ii) successful improvement in GHG emissions; (iii) the driver of the HDI improvement was education improvement, and (iv) GHG emissions improved because of effective EC/P/HDI, while GHG/EC was not impressive. The

Philippines was identified as an unsuccessful DLHE country because of unsuccessful HDI since it showed (i) marginal improvement in HDI with (ii) successful improvement in GHG emissions; (iii) the driver of the HDI improvement was income improvement, and (iv) GHG emissions improved because of effective EC/P/HDI, while GHG/EC was ineffective. Sri Lanka was identified as an unsuccessful DLHE country because of unsuccessful HDI since it showed (i) marginal improvement in HDI with (ii) successful improvement in GHG emissions; (iii) the driver of the HDI improvement was income improvement, and (iv) GHG emissions improved because of effective GHG/EC, while EC/P/HDI was not impressive.

Unsuccessful DLHE countries because of unsuccessful GHG (Vietnam, India, and China (PRC)): Vietnam was identified as an unsuccessful DLHE country because of unsuccessful GHGs since it showed (i) successful improvement in HDI with (ii) marginal improvement in GHG emissions; (iii) the driver of the HDI improvement was income improvement, and (iv) GHG emissions improved marginally because of ineffective EC/P/HDI and GHG/EC. India was identified as an unsuccessful DLHE country because of unsuccessful GHGs since it showed (i) successful improvement in HDI with (ii) marginal improvement in GHG emissions;

(iii) the driver of the HDI improvement was income improvement, and (iv) GHG emissions improved marginally because of unimpressive EC/P/HDI and GHG/EC. China (PRC) was identified as an unsuccessful DLHE country because of unsuccessful GHGs since it showed (i) very successful improvement in HDI with (ii) marginal improvement in GHG emissions; (iii) the driver of the HDI improvement was income improvement, and (iv) GHG emissions did not improve because of ineffective EC/P/HDI, while GHG/EC was not impressive.

Unsuccessful DLHE countries because of a lack of success in both HDI and GHGs (Thailand, Indonesia, Malaysia, the Republic of Korea): Thailand was identified as an unsuccessful DLHE country because of its lack of success in both HDI and GHGs, since it showed (i) marginal improvement in HDI and (ii) marginal improvement in GHG emissions. (iii) The driver of the HDI improvement was education improvement, and (iv) GHG emissions improved marginally because of ineffective EC/P/HDI, while GHG/EC was effective. Indonesia was identified as an unsuccessful DLHE country because of its lack of success in both HDI and GHGs, since it showed (i) marginal improvement in HDI and (ii) marginal improvement in GHG emissions. (iii) The driver of the HDI improvement was income improvement, and (iv) GHG emissions improved marginally because of unimpressive EC/P/HDI and GHG/EC. Malaysia was identified as an unsuccessful DLHE country because of its lack of success in both HDI and GHGs, since it showed (i) marginal improvement in HDI and (ii) unsuccessful improvement in GHG emissions. (iii) The driver of the HDI improvement was income improvement, and (iv) GHG emissions did not improve because of ineffective EC/P/HDI and GHG/EC. The Republic of Korea was identified as an unsuccessful DLHE country because of unsuccessful GHGs, since it showed (i) marginal improvement in HDI with (ii) marginal improvement in GHG emissions. (iii) The driver of the HDI improvement was income improvement, and (iv) GHG emissions did not improve because of ineffective EC/P/HDI, while GHG/EC.

CHAPTER 6. PROFILE REVIEW OF THE SUCCESSFUL COUNTRIES

This section gives more detailed observations regarding the very successful countries (Myanmar and Nepal) and the successful countries (Mongolia and Bangladesh). The discussion will cover what happened in these countries to lead them to success during this period.

6.1. Overview of Countries

6.1.1. Myanmar

Myanmar's overview, based on the data analysis, is as follows:

1. The HDI improvements by standard deviation scores were (i) education = 50, (ii) health = 53, and (iii) income = 83, for a total of 186.
2. The indicators given by the modified KAYA analysis were EC/(P*HDI) Effective(#1), GHG/EC Effective(#2)).
3. The country was classified as Non-DLHE(reform), and GHG emissions decreased during the period.
4. The country was classified as a very successful country because of both its very successful HDI improvement and its GHGpc improvement.
5. CO_2 was not significant in the period (less than 5% of GHG throughout the period).

6. LUCF, CH_4, N_2O, and the agriculture sector were significant contributors, but emission increases were not remarkable after a drastic drop in 1995-2000. During these years, Myanmar was in a period of military rule; democratic reforms occurred beginning in 2011.

Myanmar's remarkable improvement in HDI during the period was achieved mainly by an income increase (see Figure 71 and Figure 72 in Appendix 11).

When we look at Myanmar's GHGpc achievement, its success appears to come from the KAYA components (see Figure 73 and Figure 74 in Appendix 11). Myanmar was categorized in the group of effective countries (in fact, it was the best in Asia) for EC/(P*HDI) (0.66), and also in the group of effective countries (in fact, it was the second best in Asia) for GHG/EC (0.68).

This information means that (i) Myanmar was very effective at increasing HDI as a nation to consume less energy, and (ii) Myanmar was able to emit fewer GHGs while consuming less energy because of technology choices.

Another observation is that Myanmar improved both of the parameters of EC/(P*HDI) and GHG/EC; GHGpc also decreased at a similar rate.

The GHGpc decrease in Myanmar was essentially caused by the reduction of GHGs in this period that occurred because of the reductions of LUCF and the gases from agriculture (CH_4 and N_2O), while the population increased (see Figure 75, Figure 76, Figure 77 and Figure 78 in Appendix 11).

EC/(P*HDI) decreased since the energy consumption increased relatively little during the period, while the population and the HDI both increased.

GHG/EC also became smaller since GHGs decreased during the period while energy consumption increased, because GHG emissions in Myanmar during the period were not linked to or strongly influenced by the energy sector. Figures 71–78 are included in Appendix 11.

6.1.2. Nepal

Nepal's overview, based on the data analysis, is as follows:

1. The HDI improvements by standard deviation scores were (i) education = 60, (ii) health = 68, and (iii) income = 54, for a total of 181.
2. The indicators given by the modified KAYA analysis were EC/(P*HDI) Effective(#4), GHG/EC Effective(#1)).
3. The country was classified as Non-DLHE(Agri&LUCF), and GHG emissions were dominated by agriculture and LUCF during the period.
4. The country was classified as a very successful country because of its very

successful GHGpc improvement and its successful HDI improvement.

5. CO_2 was not significant in this period (less than 10% of GHGs throughout the period).
6. LUCF, CH_4, and the agriculture sector were significant contributors.

Nepal's remarkable HDI improvement during the period was achieved mainly through an improvement in health (see Figure 79 and Figure 80 in Appendix 12). There were four other countries in which the social component (education or health) was the driver of the development: Thailand (Income = 59, Education = 63, Health = 47), Bangladesh (Income = 61, Education = 57, Health = 62), Mongolia (Income = 60, Education = 61, Health = 55), and Pakistan (Income = 50, Education = 52, Health = 51). Other than Nepal, one other country had Health as the driver (Bangladesh), while the other countries had Education as the driver (Thailand, Pakistan, Mongolia). Nepal, Bangladesh and Mongolia, however, were the only successful countries. Bangladesh, Mongolia, and Pakistan, but not Thailand, did not actually have an outstanding component, since the gaps between the top component and the bottom component are equal to or less than 6, while Nepal's health component and Thailand's education component were much bigger than the other two components. (Nepal's Health component was 68, which was 8 points higher than its Education component and 15 points higher than its Income component, and Thailand's Education component was 63, which was 4 points higher than its Income component and 16 points higher than its Health component). This type of improvement put Nepal in a special position as a very successful country, since Thailand was not categorized as a successful country. There was no successful country in which the Education component was the driver of development, but this does not mean that Education was not needed for success, since Nepal, Mongolia and Bangladesh also recorded high Education component improvements.

As seen in the final result map, a difference between Nepal's development and the other countries' development came from the GHGpc or HDI trajectory, since Nepal was categorized as a very successful country for GHGpc and as a successful country for HDI, while some of the others scored as successful on HDI but unsuccessful on GHGpc (Sri Lanka), or scored as successful on HDI but marginal on GHGpc (India, Vietnam).

When we attempt to discover why Nepal had very successful GHGpc, the reason turns out to lie in the KAYA components (see Figure 81 and Figure 82 in Appendix 12). While Nepal was categorized in the group of effective countries (fourth in Asia) for EC/(P*HDI) (0.89), and also in the group of effective countries (in fact, it was the best in Asia) for GHG/EC (0.42) when they were calculated with the total GHG emissions including LUCF (Mt CO_2e), the categorization of Nepal's GHG/EC becomes different when they are calculated with the total GHG emissions excluding LUCF (see Figure 83 and Figure 84 in Appendix 12). The value of GHG/EC went down from 0.42 to 0.87 which was the best in Asia out of 14 countries (see Figure 46). This shows that Nepal's very successful performance on GHGpc was achieved by a GHG reduction caused by the reduction of GHGs from LUCF, starting in 2000 (see Figures 85-88 in Appendix 12). In Myanmar, it was also observed that the GHGs from LUCF dropped during the period, but not as great an extend as did those in Nepal. No other country showed a similar trajectory.

The GHGpc decrease in Nepal was clearly caused by the reduction of GHGs in this period that occurred because of the reductions of LUCF, while the population increased. EC/(P*HDI) became smaller since energy consumption increased little during the period, while its population and HDI both increased.

GHG/EC also became smaller since GHGs decreased during the period because of the large decrease in GHGs from LUCF while energy consumption increased. GHG emissions in Nepal during the period were not linked to or strongly influenced by the energy sector because the GHG increase from the energy sector was not influenced by emissions from electricity/heat, as was the case in China (PRC) and other countries. As pointed out above in the observation for Myanmar (see Figure 89 in Appendix 12), electricity in Nepal is mainly sourced from hydropower. Figures 79-89 are included as Appendix 12.

6.1.3. Mongolia

Mongolia's overview from the data analysis is as follows:

1. The HDI improvements by standard deviation scores were (i) education = 55, (ii) health = 61, and (iii) income = 60, for a total of 175.
2. The indicators given by the modified KAYA analysis were EC/(P*HDI) Effective(#2), GHG/EC Mediocre(#10)).
3. The country was classified as Non-DLHE(LUCF), and GHG emissions were dominated by LUCF.
4. The country was classified as a successful country because of its very successful GHGpc improvement, even though its HDI improvement was marginal.
5. LUFC was the dominant source of its GHG emissions from 1990-2005. All other GHG emissions were stable or even decreased between 1990 and 2000.

6. CO_2, CH_4, and N_2O started to increase in 2005 because of the agricultural sector, electricity/heat, manufacturing/construction, and other fuel combustion.

As seen in the final result map, Mongolia's trajectories showed that it was in the very successful group for GHGpc but in the marginal group for HDI improvement. This means that Mongolia's success came mainly from the very successful track record of its GHGpc. Figure 90, Figure 91, Figure 92, Figure 93, Figure 94, Figure 95 in Appendix 13 show that during the period, little change related to GHG emissions occurred in Mongolia. From 1990 to 2005, the GHG emissions actually decreased because of the decrease in CO_2 produced by the energy industry (because of the decrease from manufacturing/heat), and starting in 2005, CO_2, CH_4, and N_2O increased because of the increases in the agriculture and energy sectors (because of the increases from electricity/heat and manufacturing/construction). In the end, the total emissions in 2010 were almost the same as the emissions in 1990. LUCF was the dominant source of emissions and remained stable during the period. These facts mean that while GHG emissions stayed the same, the population increased, and therefore GHGpc went down (see Figure 96 and Figure 97 in Appendix 13). HDI improved during the period, with the education and income components as its drivers, but the country was categorized in the marginal HDI improvement group – it did not show as significant an improvement as did Myanmar and Nepal. Figures 90-97 are in Appendix 13.

When it comes to the modified KAYA parameters, EC/(P*HDI) was Effective (#2), which is reasonable since energy consumption did not increase during the period, while the population increased and HDI increased mildly and insignificantly. Its GHG/EC was in the Mediocre group (#10)). It went up (worsened) from 1990 to 2000, and then went down to the same value in 2010. This happened because of the decrease in energy consumption, as mentioned above, due to a decrease in manufacturing/construction.

We can conclude that Mongolia's success was caused by the lack of change in emissions (they went down from 1990 to 2005 and recovered from 2005 to 2010), while HDI slightly but marginally increased.

6.1.4. Bangladesh

Bangladesh's overview, based on the data analysis, is as follows:

1. The HDI improvements by standard deviation scores were (i) education = 57, (ii) health = 62, and (iii) income = 61, for a total of 180.
2. The indicators given by the modified KAYA analysis were EC/(P*HDI)

Mediocre (#6), GHG/EC Effective (#3)).

3. The country was classified as DLHE(new CO_2), and its CO_2 emission had recently been rising.
4. The country was classified as a successful country because of both its successful HDI and GHG.
5. The main source of emissions was CO_2 from the energy sector, including electricity/heat, manufacturing/construction, transportation and other fuel combustion, even though CH_4 from agriculture and LUCF were the main sources in 1990.
6. The main emitter of CO_2 from the energy sector was electricity/heat.

Bangladesh was successful because it was in the successful improvement group for both HDI and GHGpc. Bangladesh's improvement in HDI during the period was achieved mainly through income and health increases (see Figure 98 and Figure 99 in Appendix 14). This type of balanced improvement (the small gap between the top and bottom HDI components is as small as 6) was only observed in Bangladesh, Mongolia, and Pakistan, but Bangladesh's HDI improvement was bigger than those of Mongolia and Pakistan. (Bangladesh was in the successful improvement group, while Mongolia and Pakistan were in the marginal improvement group.) As seen in the final result map, Bangladesh's HDI improvement was the same as Nepal's, but Bangladesh was worse than Nepal when it came to GHGpc improvement. Compared with Mongolia, Nepal had better HDI improvement but worse GHGpc improvement. Bangladesh showed better improvements in Income and Health than Mongolia, and its income component was even better than Nepal's.

As for its GHGpc trajectory, Bangladesh had similar continuous increases in GHGs and population until 2000, but starting in 2000, the speed of the increase in GHGs became faster than the increase in the population, and therefore GHGpc worsened (see Figure 100 and Figure 101 in Appendix 14).

Bangladesh's EC/(P*HDI) was in the Mediocre group (#6) and its GHG/EC was in the Effective group (#3). Its EC/(P*HDI) was mediocre, while its GHG/EC showed an effective result. These facts mean that (i) the energy consumption increase was not great enough to improve the country's HDI (Bangladesh needed more energy to improve its HDI), but (ii) the energy was consumed in an efficient way as regards the emission of GHGs (Bangladesh was efficient in emitting GHGs by consuming smaller amounts of energy).

Another observation is that while Bangladesh's GHGpc and EC/(P*HDI) stayed the same from 1990 to 2000, they went up from 2000 to 2010 in almost the same ratio. This means that a change occurred that sped up GHG emissions and energy consumption around 2000. In contrast, GHG/EC continuously improved from 1990 to 2010.

Regarding the change around 2000, while the emissions from LUCF slowly and mildly decreased through the period, those gases – CO_2, CH_4 and N_2O – increased. CO_2 in particular increased at a faster pace starting in 2000 (see Figure 102 and Figure 103 in Appendix 14). The majority of this CO_2 increase came from the energy industry, while the increases in CH_4 and N_2O came from agriculture (see Figure 104 in Appendix 14). The majority of the CO_2 from the energy industry came from electricity/heat, and the sudden increase in CO_2/the energy industry in 2000 was linked to the sudden increase in GHGs from electricity/heat (see Figure 105 in Appendix 14). However, the parameters related to HDI did not respond to this sudden increase around 2000. Figures 98-105 are included in Appendix 14.

6.2. Findings from Comparisons

In this section, we will compare countries with each other and with China (PRC) by analyzing the components of HDI, GHGpc, and the Kaya identity to clarify what were the keys of their differences.

Myanmar's standard deviation scores of the HDI improvement for the components were Income = 83, Education = 53, Health = 50. However, this type of improvement was not enough to make Myanmar a very successful country, since similar improvement was also observed in China (PRC) (Income = 89, Education = 56, Health = 52). As seen in the final result map (Figure 70), the difference between Myanmar's development and China (PRC)'s came from the GHGpc trajectory, since Myanmar was categorized as a very successful country for both HDI and GHGpc, while China (PRC) was categorized as a very successful country for HDI but unsuccessful country for GHGpc.

When we look at the difference in GHGpc, they can be attributed to the range in the modified KAYA components (see Figure 73, and Figure 74 for Myanmar, and Figure 106 and Figure 107 for China (PRC)). Myanmar was categorized in the group of effective countries, with a score for EC/(P*HDI) of 0.66 was the best in Asia. In the group of effective countries with a score for GHG/EC of 0.68 was the second best in Asia. China (PRC) was categorized in the group of ineffective countries with a score for EC/(P*HDI of 1.76, it ranked 10th in Asia. In the group of mediocre countries with a score for GHG/EC of 1.07, it ranked 11th in Asia.

These facts mean that (i) while Myanmar was efficient at increasing HDI as a nation while consuming relatively little energy, China (PRC) needed to consume much more energy to increase its HDI; and (ii) Myanmar was efficient at emitting relatively low amounts of GHGs by consuming energy while China (PRC) emitted high levels of GHGs by consuming energy.

Another observation is that while Myanmar improved both the parameters of EC/(P*HDI) and GHG/EC, and its GHGpc went down in almost the same ratio (see Figure74), China (PRC) worsened for each of the parameters, particularly EC/(P*HDI). EC/(P*HDI) was modestly effective through 1990-2000, but from 2000 to 2010, it worsened significantly. GHGpc seems to have worsened because of this parameter (see Figure 107).

The GHGpc decrease in Myanmar was essentially caused by the reduction of GHGs because of the reductions of LUCF and the gases from agriculture (CH_4 and N_2O) while the population increased (see Figure 73, Figure 75, and Figure 77).

EC/(P*HDI) became smaller, since energy consumption increased relatively little during the period, while Myanmar's population and HDI both increased (see Figure 73 and Figure 77).

GHG/EC also became smaller, since GHGs decreased during the period while energy consumption increased, since GHG emissions in Myanmar during the period were not linked to or strongly influenced by the energy sector.

From these observations, three questions emerge:

(i) What differences in China (PRC) between 1990-2000 and 2000-2010 explain why the EC/(P*HDI) in China (PRC) suddenly worsened in the second decade?

(ii) Why was Myanmar's HDI, particularly its income component, able to increase with decreasing agricultural emissions (CH4 and N2O) and with decreasing LUCF, and with little increase from the energy and industrial sectors?

(iii) Are any salient observations found when these two countries and others are compared?

Mongolia, Pakistan, and Philippines were in the effective group with Myanmar for EC/(P*HDI), but GHG/EC became worse in the countries in the mediocre group (Mongolia, Pakistan and China (PRC)) and in the ineffective group (the Philippines). Bangladesh, Sri Lanka, and Thailand were in the effective group with Myanmar for GHG/EC, but EC/(P*HDI) became worse in the mediocre group

(Bangladesh and Sri Lanka) and in the ineffective group (Thailand, China (PRC)).

Regarding question (i), clear differences between 1990-2000 and 2000-2010 are found in the trajectory of China (PRC) (see Figure 108, Figure 109, Figure 110, Figure 111, Figure 112, and Figure 113 in Appendix 15). From year 2000, CO_2 drastically increased because of large increases in the emissions from the energy and industrial process sectors. The increase in emissions from the energy sector was caused by greater use of electricity/heat and manufacturing/construction. The same trajectory was also observed in Bangladesh (from 2000), India (from 2005), Indonesia (from 1990), the Republic of Korea (from 1990), Malaysia (from 1990), Pakistan (from 1990), the Philippines (from 1990, from electricity/heat and transport instead of manufacturing), Sri Lanka (from 1995, from electricity/heat and transport instead of manufacturing), Thailand (from 1990), and Vietnam (from 2000). These are all DLHE countries, and all except Bangladesh showed "unsuccessful development.".

Regarding question (ii), it is necessary to do a deeper and more detailed assessment of Myanmar's development through the period. This assessment will be done later in section 6.4.1.

Regarding question (iii), the two tables below compare these two groups of the countries. Table 47 compares Myanmar, Mongolia, Pakistan, and the Philippines, the countries that showed effective results in terms of EC/(P/*HDI). Table 48 compares Myanmar, Bangladesh, Sri Lanka, and Thailand, which showed effective results in terms of GHG/EC.

Table 47. Myanmar, Mongolia, Pakistan and Philippines' Successfulness

Countries	Development Indicator	GHGpc	EC/(P*HDI)	GHG/EC	Type
Myanmar (very successful)	50,53,83/186 Very successful	Very successful	Effective	Effective	Reform
Mongolia (successful)	61,55,60/175 Marginal	Very successful	Effective	Mediocre	Non DLHE (LUCF)
Pakistan (unsuccessful by HDI)	52,51,50/153 Marginal	Successful	Effective	Mediocre	DLHE (domCO_2)
Philippines (unsuccessful by HDI)	36,47,50/133 Unsuccessful	Successful	Effective	Ineffective	DLHE(domCO_2)

Table 48. Myanmar, Bangladesh, Sri Lanka and Thailand Successfulness

	Development Indicator	GHGpc	EC/(P*HDI)	GHG/EC	Type
Myanmar (very successful)	50,53,83/186 Very successful	Very successful	Effective	Effective	Reform
Bangladesh (successful)	57,62,61/180 Successful	Successful	Mediocre	Effective	DLHE (new CO_2)

Sri Lanka (unsuccessful by HDI)	47,50,62/159 Unsuccessful	Successful	Mediocre	Effective	DLHE (yet CO_2)
Thailand (unsuccessful by both)	63,47,59/169 Marginal	Marginal	Ineffective	Effective	DLHE (domCO_2)

In the group of effective countries with regard to EC/P/HDI, Myanmar proved to be a very successful country, Mongolia was a successful country, and Pakistan and the Philippines were unsuccessful countries. This means that even though the parameter including HDI (EC/(P*HDI)) was "Effective" for all of these countries, their development indicators varied from "Very successful" for Myanmar to "Unsuccessful" for the Philippines. This occurred because energy consumption (EC) was not linked to the countries' total development (P*HDI). This tells us that while CO_2 emissions are linked to energy consumption, it is possible that in developing countries where CO_2 was not a major contributor among GHGs and energy consumers were not major contributors to GHG emissions, increasing fossil fuel derived energy consumption was not a backbone of their development as population grew.

In the meantime, while EC/(P*HDI) was "Effective" for all of these countries, GHG/EC varied from "Effective" in Myanmar to "Ineffective" in the Philippines, and GHGpc also varied from "Very successful" in Myanmar and

Mongolia to “Successful” in Pakistan and the Philippines. This seems to indicate that the total energy consumption including fossil fuel consumptions increases when the population increases.

In the group of effective countries on GHG/EC, Myanmar ended up a very successful country, Bangladesh was a successful country, and Sri Lanka and Thailand were unsuccessful countries. This means that even though the parameter including GHG (GHG/EC) was “Effective” for all of these countries, the GHGpc indicators for these four countries varied from “Very successful” in Myanmar to “Marginal” for Thailand. This was because the total energy consumption including fossil fuel consumptions was not linked to population growth. Even though it was observed from a comparison of Myanmar, Mongolia, Pakistan, and the Philippines that there seems to be a tendency for the total energy consumption including fossil fuel consumptions to increase when the population increases, the comparison of Myanmar, Bangladesh, Sri Lanka, and Thailand tells us that even though their populations increased, some countries were able to maintain a favorable GHG/EC. This tells us that while CO_2 emissions are linked to energy consumption, it was possible that in developing countries where CO_2 was not a major contributor to

GHGs and energy consumers were not major contributors to GHG emissions, increased fossil fuel consumption was not a backbone of their development.

In the meantime, while GHG/EC was “Effective” for all of these countries, EC/(P*HDI) varied from “Effective” in Myanmar to “Ineffective” in Thailand. The development indicator also varied from “Very successful” in Myanmar to “Unsuccessful” in Sri Lanka, but it was not linked to EC/(P*HDI), since Sri Lanka was “Unsuccessful” for the development indicator but “Mediocre” for EC/(P*HDI), while Thailand was “Marginal” for the development indicator but “Ineffective” for EC/(P*HDI). This demonstrated that when the population increased, the total energy consumption including fossil fuel consumptions was not linked to its development.

6.3. What Happened in the Successful Countries During the 1990-2010 Period?

In this section, efforts will be done to find out what kind of historical events and policy changes happened corresponding to those trajectories found by those data analysis to find out background stories of the successes.

6.3.1. Myanmar

According to the BBC News website (*Myanmar profile – Timeline*, 1942-

2016 2017), Myanmar's history can be divided into 15 periods as follows:

(i) Japanese occupation (1942-1947)

(ii) Independence (1948-1960)

(iii) One-party, military-led state (1962-1982)

(iv) Riots and repression (1987-1989)

(v) Thwarted elections (1990-1997)

(vi) Release of pro-democracy supporters (1998-2001)

(vii) Conflicting signals (2002-2004 May)

(viii) New capital (2004 October-2007 June)

(ix) Public unrest (2007 August-2008 April)

(x) Cyclone (2008 May-2009 May)

(xi) Aung San Suu Kyi trial (2009 August-2011 January)

(xii) Junta retires to wings (2011 March-2012 January)

(xiii) Partly-free elections held (2012 April-2012 September)

(xiv) Foreign ties (2012 November-2015 February)

(xv) Peace hopes (2015 March–recent (2016 March))

The research period from 1990 to 2010 corresponds to the period (v)-(xi).

To explain in more detail, the research period is divided into four periods: Period

#1 (1990-1994), Period #2 (1995-1999), Period #3 (2000-2004), and Period #4 (2005-2010), in addition to Period #0 (before 1990) and Period #5 (after 2010), as shown in Figure 114.

Appendix 16 details notable events in Myanmar during each period. As summarized in the Table 49, before the start of the research period in 1990, the country lacked political stability and peace. During Periods #1 and #2 (1990-1999), some indications of political stability (movement in the direction of democracy) were observed. Stability and peace were not completely achieved until 2010, when this study focused. The ODA was also stagnant during the research period and never returned to the level of ODA given during the period from 1986 to 1990, as the table shows, even though the ODA given during Period #4 went up. This rise in Period #4 is presumably linked to the cyclone that hit in 2008 (see Table 50).

This information shows that Myanmar's (i) political instability, (ii) slow movement toward democracy, and (iii) stagnant ODA during the research period of 1990-2010 did not have a negative impact on "successful development" in Myanmar. This means that Myanmar's "successful development" was achieved without (i) political stability, (ii) democracy, or (iii) leapfrogging toward a low-carbon society made possible by drastic imports of state-of-the-art technologies from developed countries.

During the research period (1990-2010), Myanmar's remarkable improvement in HDI was achieved mainly through an income increase. In the meantime, the GHGpc decrease in Myanmar was largely caused by the reduction of GHGs in this period that occurred because of the reductions of emissions from LUCF and the gases from agriculture CH_4 and N_2O, even as the population increased. The decreased emissions from LUCF may be a result of laws and rules related to forestry through during the period 1992-95.[13] These data showed that sector activities in Myanmar shifted out of agriculture and forestry without damaging its economy.

Questions

From these observations, a question emerges: Why was Myanmar's HDI, particularly its income component, able to increase while its sector activities shifted away from agriculture and forestry (CH_4 and N_2O, and with decreasing LUCF) with little increase in CO_2 from the energy and industrial sectors, and also without political stability, peace or increased ODA? This question will be addressed in chapter 7.7.

[13] The Forest Law (1992), Myanmar Forest Policy, Forest Rules, Community Forestry Instruction (1995)

6.3.2. Nepal

According to the BBC News website (*Nepal profile – Timeline*, 1950-2016 2017), Nepal's history can be divided into 13 periods as follows:

(i) Absolute monarchy (1950-1972)

(ii) Multi-party politics (1980-1991)

(iii) Political instability (1994-2000)

(iv) Palace massacre (2001 June-2001 November)

(v) Emergency (2001 November-2003 January)

(vi) End of truce (2003 August-2004)

(vii) Absolute monarchy restored (2005-2006 May)

(viii) Peace deal (2006 november-2007 January)

(ix) Maoists join government (2007 April-2007 September)

(x) End of monarchy (2007 December-2008)

(xi) Maoists leave government (2009 May-2009 December)

(xii) Impasse over constitution (2010-2015 April)

(xiii) Landmark constitution (2015 September-recent (2016 August))

The research period from 1990 to 2010 corresponds to the period (ii)-(xii).

To explain in more detail, the research period is divided into four periods: Period #1 (1990-1994), Period #2 (1995-1999), Period #3 (2000-2004), and Period #4 (2005-2010), with two additional periods: Period #0 (before 1990) and Period #5 (after 2010), as shown in Figure 115. Appendix 17 details notable events in Nepal during each period.

As summarized in the Table 51, before the start of the research period in 1990, the country lacked political stability and peace. This instability continued throughout the research period (1990-2010) and is ongoing today. The ODA was also stagnant during the research period, and no significant increase was observed during the period (see Table 50).

This information shows that Nepal's (i) political instability, (ii) social unrest, and (iii) stagnant ODA during the research period did not have a negative impact on "successful development" in Nepal. This means that Nepal's "successful development" was achieved without (i) political stability, (ii) peace, or (iii) leapfrogging toward a low carbon society made possible by imports of state-of-the-art technologies from developed countries.

During the research period, Nepal's remarkable improvement in HDI was achieved mainly by a health improvement that started in 2005 and a modest income component improvement. In the meantime, Nepal's very successful performance on GHGpc was caused by the reduction of GHG from LUCF starting in 2000, while the population increased. The sudden decrease in emissions from LUFC may be a result of the establishment of laws and rules related to forestry through the period 1976-2003. These data showed that sector activities in Nepal shifted out of forestry around 2000 without damaging its economy.

Questions

From these observations, a question emerges: Why was Nepal's HDI, particularly its health and income components, able to improve while sector activities shifted away from forestry without political stability, peace or increased ODA? This question will be addressed in chapter 7.7.

6.3.3. Mongolia

According to the BBC News website (*Mongolia profile – Timeline*, 1267-2016 2017), Mongolia's history can be divided into 13 periods as follows:

(i) Mongol warrior: Genghis Khan (1267-1380)

(ii) Manchu rule (1636-1727)

(iii) First Soviet satellite state (1911-1920)

(iv) Religion (1921-1924)

(v) Purges (1928-1939)

(vi) Capital: Ulan Bator (1939)

(vii) International recognition (1945-1963)

(viii) Soviet buffer against China (PRC) (1966-1986)

(ix) Democracy (1990-1993)

(x) Ex-president Bagabandi (1996-2004 January)

(xi) Power-sharing (2004 June-2007)

(xii) State of emergency (2008-2010)

(xiii) Gobi Desert development (2011- recent (2016 June)

The research period from 1990 to 2010 corresponds to the periods (ix)-(xii). To explain in more detail, the research period is divided into four periods: Period #1 (1990-1994), Period #2 (1995-1999), Period #3 (2000-2004), and Period #4 (2005-2010), with two additional periods: Period #0 (before 1990) and Period #5 (after 2010), as shown in Figure 116.

Appendix 18 details notable events in Mongolia during each period.

As summarized in the Table 52, before the start of the research period in 1990, the country lacked political stability and peace. Throughout the research period (1990-2010), some indications of political stability were observed. A peaceful society was maintained during most of the research period, with the exception of the riot that occurred in 2008. One remarkable issue observed was that the ODA increased significantly during Period #1 compared with Period #0 and maintained this high level through Period #4, shown in Table 50. This high level of ODA is not presumed to be linked to the support for extreme weather in 2001 and 2010.

Mongolia's (i) political instability and (ii) social unrest during 1990-2010 did not have a negative impact on "successful development" in Mongolia. This means that Mongolia's "successful development" was achieved without (i) political stability or (ii) peace. It is possible that a leapfrog toward successful development was caused by (i) a large increase in ODA that improved education through Periods #3 and #4 and (ii) decreased GHG emissions from the energy sector through Periods #1 and #2, particularly from manufacturing/construction, by the introduction of state-of-the-art technologies.

Mongolia's success was caused by the unchanged emissions (which went down from 1990 to 2005 and recovered from 2005 to 2010), while its HDI slightly but marginally increased. Between 2000-2005, HDI, particularly the income component, did not improve significantly, but maintained a stable level. (Another driver of HDI, the education component, decreased until 2000.)

During the research period, some improvements were observed: (i) education improved throughout the period 2000-2010, and (ii) GHG emissions from the energy sector decreased throughout the period 1990-2000, particularly from manufacturing/construction, due to the introduction of state-of-the-art technologies from developed countries through ODA.

<u>Questions</u>

From these observations, three questions emerge:

Question 1. Why was Mongolia's HDI, particularly its income component, able to maintain steady improvement with decreased GHG emissions from the energy sector, particularly from manufacturing/construction, throughout the period 1990-2000, while the population increased and there was no political stability?

Question 2. Did the introduction of leapfrogging technology happen because of a large increase in ODA since 1990?

Question 3. If manufacturing/construction through ODA was a salient factor, did the donor place high priority on (i) education improvement, (ii) decreased GHG emissions from the energy sector, and/or (iii) decreased GHG emissions from manufacturing/construction innovations? These questions will be addressed in chapter 7.7.

6.3.4. Bangladesh

According to the BBC News website (*Bangladesh profile – Timeline*, 1971-2016 2017), Bangladesh's history can be divided into eight periods as follows:

(i) Independence (1971-1981)

(ii) Ershad era (1982-1991)

(iii) Awami League returns (1996-2001 July)

(iv) Coalition government (2001 September-2006 February)

(v) Political crisis (2006 October-2008 November)

(vi) Awami League win (2008 December-2009 February)

(vii) Bangladesh at 40 (2009 October-2013 May)

(viii) Jamaat-e-Islami trials (2013 July- recent (2016 March))

The research period from 1990 to 2010 corresponds to periods (ii)-(vii). To explain in more detail, the research period is divided into four periods: Period #1 (1990-1994), Period #2 (1995-1999), Period #3 (2000-2004), and Period #4 (2005-2010), with two additional periods: Period #0 (before 1990) and Period #5 (after 2010), as shown in Figure 117.

Appendix 19 details notable events in Bangladesh during each period.

As summarized in the Table 53, before the start of the research period in 1990, the country lacked political stability and peace. This instability continued throughout the research period and is ongoing today. ODA was also stagnant during the research period and never returned to the level of ODA given during the period from 1986 to 1990, as the table shows (see Table 50).

This information shows that Bangladesh's (i) political instability, (ii) peace, and (iii) stagnant ODA during the research period (1990-2010) did not have a negative impact on "successful development" in Bangladesh.

Bangladesh shows a very well-balanced improvement in HDI (the gap between its top and bottom HDI components is as small as 5) with an improvement in GHGpc. In the meantime, energy was consumed in an efficient way with regard to the emission of GHGs. These accomplishments were achieved without damaging the economy and without stability, peace or increased ODA.

In the meantime, Bangladesh had continuous increases in GHGs and population until 2000, but starting in 2000, the rate of increase in GHGs was greater than the rate of increase of the population; therefore, GHGpc worsened. This means that a change occurred that increased both GHG emissions and energy consumption around 2000.

Around 2000, emissions from LUCF slowly and modestly decreased, but all other sources of CO_2, CH_4 and N_2O increased, particularly CO_2, at higher rate starting in 2000. A majority of this CO_2 increase came from the energy and industry sectors, while the increases in CH_4 and N_2O came from agriculture. The abrupt increase from the CO_2/energy industry in 2000 was linked to growth in the electricity/heat sector, but no changes in HDI took place during this time.

It was also observed that (i) the energy consumption increase did not improve HDI, but (ii) Bangladesh became efficient in its emissions of GHG per energy usage.

Questions

From these observations, three questions emerge:

Question 1. Was the balanced development that happened in Bangladesh planned/intended/controlled, or simply a matter of good fortune without plan/intention/control?

Question 2. If it was not planned/intended/controlled, did the development that happened in Bangladesh beginning in 2005 follow the pattern of China (PRC) and India, where prioritized development meant sacrificing the environment?

Question 3. If the development was planned/intended/controlled, what policy goals were established and what policy measures were taken to achieve this outcome in the absence of political stability, peace, and increased ODA? These questions will be addressed in chapter 7.7.

CHAPTER 7. EXPERTS' VIEWS TO SUPPLEMENT THE DATA ANALYSIS

7.1. Background

The above data analysis in Chapter 5 found that among the 14 Asian countries studied, Myanmar and Nepal showed very successful development during the research period (1990-2010). Myanmar's performances in HDI and in GHGpc were both categorized as very successful, and Nepal's performance in HDI was categorized as successful and in GHGpc was categorized as very successful. Bangladesh and Mongolia also showed successful development during the research period. Bangladesh's performances in HDI and in GHGpc were categorized as successful, and Mongolia's performance in HDI was categorized as marginal but in GHGpc was categorized as very successful.

The results of the data analysis have already shown substantial key issues, as indicated by the bullet points on events in these countries that influenced their success, as observed in the quantitative analysis. However, the quantitative metrics do not fully explain how and why each country's successful development occurred, as the quantitative data analysis cannot show the mechanisms of the key issues, the possible relationships among them, or whether they were fundamentally and sustainably successful. For example, Myanmar's HDI, particularly its income component, increased while its sector activities shifted away from agriculture and forestry with little increase in CO_2 from the energy and industrial sectors, and without political stability, peace or increased ODA. The data analysis, however, could not clarify how Myanmar recovered from the loss of the income benefits from agriculture and forestry it had once enjoyed. Without such a recovery, Myanmar would not have been able to increase its HDI, particularly its income component. Similarly, Nepal's HDI, particularly its health and income components, improved while its sector activities shifted away from forestry without political stability, peace or increased ODA. The data analysis, however, could not clarify how Nepal recovered from the loss of the income benefits from forestry; without such a recovery, Nepal would not have been able to increase its HDI.

For this reason, it is important to use other methods to understand how and why some countries achieved the successes observed in the data. Therefore, a qualitative analysis was performed by posing questions to experts in the fields of development and the environment. The questions were posed through a survey.

7.2. Objective

The objective of the survey was to obtain the insights from country experts that could be helpful in answering the questions raised by the data analysis.

7.3. Subject Population

The present study obtained the views of 83 experts in the fields of the environment and development.[14] While some of the participants were from academia, the majority were officers currently working in intergovernmental development support agencies, mainly the Asian Development Bank, former officers of the Asian Development Bank, or its consultants. The Asian Development Bank is a globally recognized organization working for environmental improvement and development. It was established more than 50 years ago, and its work covers this study's research period and the countries studied. Therefore, it was one of the most appropriate available information sources for the research.

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[14] More than 90 experts were initially contacted, then around 10 experts declined to provide their views. A total of 83 experts completed the survey including 20 experts who were requested to participate in the survey by the initial contacts.

7.4. Recruitment Process

All of the survey participants are/were working professionally or academically in the fields of development and the environment, and/or are/were working for projects conducted by intergovernmental development support agencies. The recruitment process was as follows. (i) First, a list of potential participants was established using the author's personal connections gained through his 11 years' professional experiences at the Asian Development Bank. The author intentionally did not use any prescreening criteria when preparing this list. This is because experts' experiences cannot be accurately judged by their current title or status. (ii) The next step was to call or visit the potential participants whenever possible, explaining the survey and asking if they could participate. Emails were sent to potential participants who were difficult to visit or call. Moreover, it was explained during the call, visit or email that anonymity would be offered in the questionnaires and would be respected. (iii) After participants showed interest in the questionnaire, emails containing more specific consent information and the technical questionnaires were sent to them. Potential participants were allowed to withdraw from the survey even after the technical questionnaires were sent if they found that the questions were not relevant to them. More than 10 experts opted out of the survey in this way after receiving the questionnaires. They made this choice because they found they could not answer any of the questions posed, which is a reasonable indication that the questions were sufficiently difficult to answer even for globally recognized so-called experts in the development and environment fields or that some of them do not take the opportunity to consider the meaning of sustainable development through their actual practice.

7.5. Consent Process

As mentioned above, through visits, calls, and emails, the potential participants were asked to join the survey. After they showed interest in the questionnaire, emails containing more specific consent information and the technical questionnaires were sent to them. The experts also were informed of their right not to answer questions if they did not want to, as indicated in the questionnaires attached. Their preferences as regards anonymity were fully respected.

7.6 A Description of How the Research Was Conducted

The visits, calls, and emails to the experts were made in August–October

2017 after the Tufts IRB approval was given for this survey. Upon their acceptance, the questionnaires were sent to them by email, also in August–October 2017. The 83 responses were provided in August–December 2017.

The questionnaires sent to the experts are attached as Appendix B. These include the introduction, findings, data analysis, and questions. The summaries of responses from experts are in Tables 54-61.

7.7 Analysis of Responses from Experts

83 experts provided valid responses to the questionnaire. The list of these experts is attached (Appendix C). The responses are summarized and analyzed below. Many of the responses provided multiple answers to the questions. Therefore, even though the total number of the experts who responded was 83, the sum of the responses to each question is not necessarily 83.

The analysis of the responses was not conducted following the number of choices of possible answers to the questions, since a popular answer was not necessarily the right answer to the question. Instead, the analysis was performed by considering how well the answers matched the data analysis, the historical facts, and the author's professional experiences in these countries. This choice was made because of some limitations discovered with the survey: some of the responses indicated misinterpretations of the questions' meanings, and other responses discussed the countries outside the research period of 1990-2010.

As another limitation, the possibility that the data were unreliable was pointed out when the analysis of the experts for Myanmar differed from the analyses for other countries (Nepal, Bangladesh, and Mongolia). Five experts indicated that they did not trust the data themselves. One expert wrote,

> I think Myanmar is a case where indicators based on statistical data will be misleading. Data is untrustworthy because until recently the regime was secretive and what data was produced was to verify performance goals (where they existed) or to divert attention from areas of exploitation. Their purpose was rarely to give a true picture of the development parameter being reported on.

Others wrote,

> We know that there are huge gaps between the official stats and what happened in the field" and "Myanmar is [a] late comer to accurate reporting on global indices. I personally wouldn't judge any improvements in indices as an improvement on the ground per se.

Similarly, another opinion was,

> The result is actually interesting since, I had an impression that Myanmar's growth was slow during the period of international economic sanctions. If there was high-income growth notwithstanding low foreign direct investment FDI and ODA, this may be partially explained by the convergence theory, i.e. Myanmar's growth was higher just because its starting income level was very low. Growth theories (generally speaking) predict low income economies to grow faster than middle/high income countries.

Since Myanmar was a closed country controlled by the military, it seemed reasonable that more experts for Myanmar would feel this doubt compared to experts for other countries. Since the experts' on-the-ground experiences led them to feel such doubt, it is important to note that the data cannot be assumed to be trustworthy in the details. However, although the data might not be right in every detail, and Myanmar, like many other countries, was subject to such doubt, analyzing data obtained from authorities could be the first step that should be taken since at least it can be expected to show a rough trajectory.

Moreover, it is important to mention here that some experts did not agree when Mongolia was labeled a successful country. An expert stated, "I am not sure if you can evaluate the Mongolian case as successful," and another also wrote,

> Successful development' should also consider one criterion that is debt of a country [sic]. Without this criterion, Mongolia seemed successful in terms of development. However, most of Mongolians very concern [sic] with regard to the det [sic] obtained by various governments that were changing during this period accumulated over time since 1990.

In fact, the data analysis categorized Mongolia in the insufficient group for HDI improvement but in the good group for GHGpc performance. Therefore, these negative views make sense that they do not agree Mongolia is one of successful countries, but when Mongolia was compared with other Asian developing countries, the data analysis also showed it still did better than many less successful countries.

What follows is the qualitative analysis of the responses provided by experts in the questionnaires. Their insights will help explain the quantitative data analysis and help to test the original four hypotheses for each of the four countries and help answer the research question. The observations on the successful countries indicate the possibilities and limitations that developing countries face in seeking to improve HDI without increasing GHG emissions.

The types of information that was requested help to provide an explanation of observed trends in GHG and HDI. In order to understand patterns of change in GHGs, the following information was requested:

(i) Shift in economic activity during the period,

(ii) Change in financing by development agencies during the period,

(iii) Change in GHGs and their sources during the period, and

(iv) Any other changes that occurred during the period,

To understand patterns of change in HDI the following information was requested:

(i) Change in education indicator and reasons of the change,

(ii) Change in health indicator and reasons of the change,

(iii) Change in income indicator and reasons of the change,

(iv) Change in financing by development agencies during the period, and

(v) Any other changes that occurred during the period.

7.7.1. Experts' Responses to the Question Related to Myanmar

From the data analysis, one question remains: "Why was Myanmar's HDI, particularly its income component, able to increase while sector activities shifted out of agriculture and forestry with little increase in CO_2 from the energy and industrial sectors, and also without political stability, peace or increased ODA?" This question is reasonable because if this shift out of agriculture and forestry happened without a successful transfer to other profitable activities in Myanmar that do not emit GHGs, income could not be increased. Therefore, this question was posed to the experts. Comparing their twelve views (i)-(xii) with the quantitative data analysis, provided insights as to what accounted for the observed trends that are summarized in Table 63 with reasons for the analysis.

Empty circles mean the observations were not consistent (poor fit) with the data analysis, the historical facts, and the author's professional experiences in Myanmar, half full circles mean they showed some consistency (partial fit), and full circles mean they were very consistent (excellent fit) with the data analysis, the historical facts, and the author's professional experiences Myanmar.

Table 63. Evaluation of expert responses for Myanmar

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Secondary and tertiary industries		This view does not precisely fit the data because (i) GHG emissions did not increase in CO2 from the energy and industrial sectors during the research period, and (ii) until the research period ended in 2010, there does not appear to have been sufficient political stability and peace to bolster the tourism industry. Moreover, some of the experts seemed to be confused about the research period (1990-2010) and discussed times outside the research period.
(ii) Foreign direct investment		Foreign direct investment in the private sector increased during the research period. This can also conceivably explain why some of the tertiary industries, including the service industries, became the receivers of labor that shifted out of primary industry and became income generators that replaced primary industry, since such investment supported labor-intensive sectors, the telecom sector, real estate, etc.
(iii) Agriculture production increased		one of these experts did not discuss the research period, and the view of the other expert does not fit the data analysis for this period
(iv) Military regime		Controlling by military regime can explain why Myanmar's development was stable not much to be disturbed during the period, but this cannot provide a clear answer to the question itself.
(v) Trading (exports of natural		The experts wrote that "The export of natural resources increased (natural gas, mineral, and oil)" for "trading with neighboring countries, such as China (PRC) and Thailand." This fact answered the

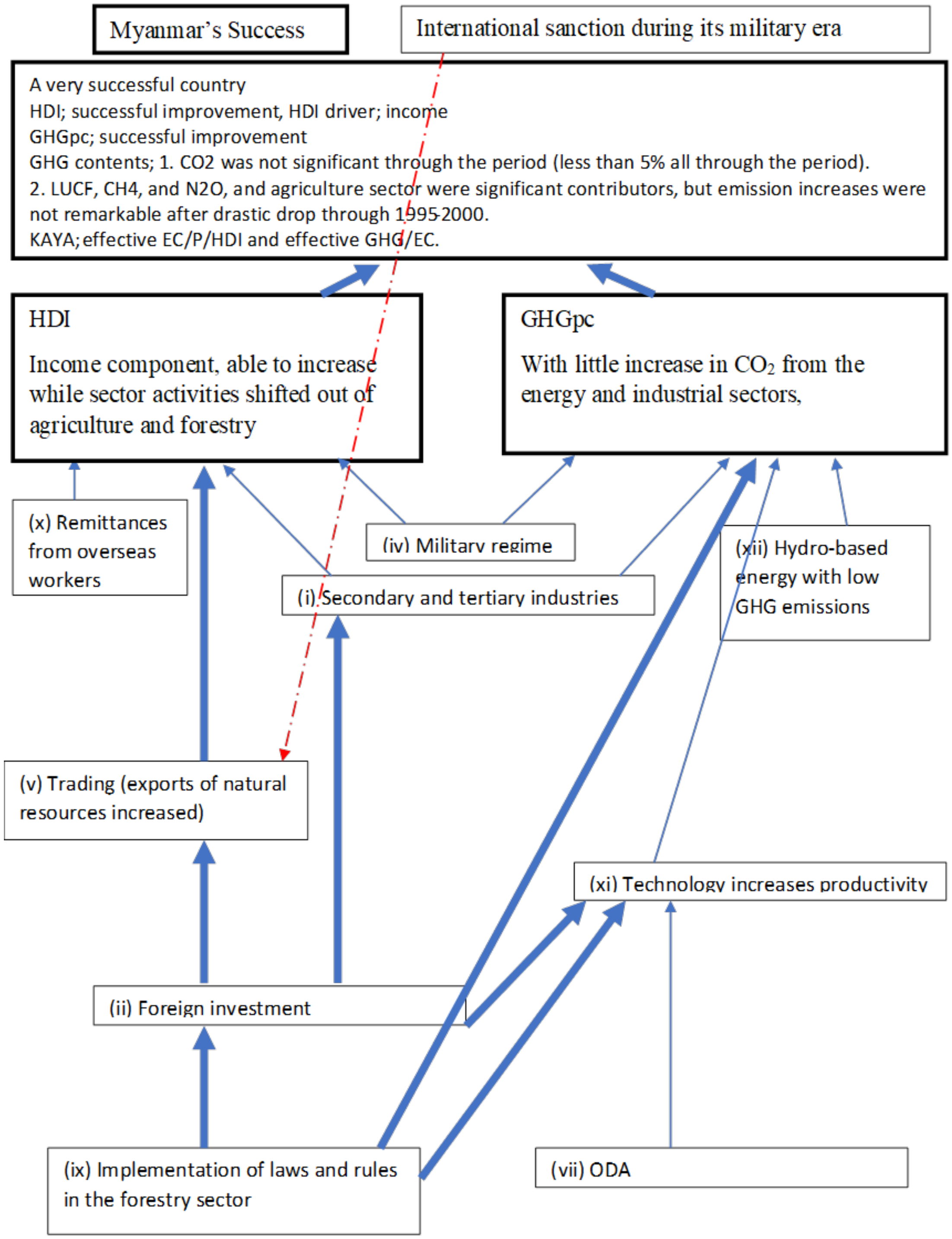
Items Raised by Experts	Fit	Evaluation of expert responses
resources increased)		question because the CO2 produced by the combustion of oil and gas was not counted as emissions from Myanmar. It should be noted that this income increase was not a very environmentally friendly improvement, as it produced emissions outside Myanmar.
(vi) Special Economic Zones (SEZs)	○	The first SEZ in Myanmar was built in 2012-15 and so was outside the research period. Therefore, this cannot be the answer to the question.
(vii) ODA	◐	While the data analysis did not observe much quantitative increase in total ODA during the period, these experts indicated the possibility of qualitative improvement caused by the ODA even though the amount was not significant. The researcher cannot find any reasons to exclude this possibility. At the same time, this explanation seems too weak to have produced Myanmar's success, which was the most significant success in Asia during this period.
(viii) Better education system	○	The question specifically asks about the improvement of the income component among the three HDI indicators. In addition, the benefits achieved by education improvement (which produces responsive citizens) cannot provide a tangible answer to the question itself.
(ix) Implementation of laws and rules in the forestry sector	●	The implementation of laws and rules in the forestry sector, which can create conditions that are more favorable for receiving FDI, improved the efficiency of forestry and agriculture, which may have reduced emissions from these sectors or caused inefficient activities to be phased out of these sectors.
(x) Remittances from overseas	◐	While several experts pointed out this explanation for Nepal, only one response from a Myanmar

Items Raised by Experts	Fit	Evaluation of expert responses
		expert raised the issue of remittances from overseas workers. While remittances could have been one of the reasons the income component improved without increasing GHGs, their significance in Myanmar was not as great as in Nepal (More people gave this answer for Nepal).
(xi) Technology increases productivity		Two experts highly evaluated the benefits provided by technology improvements. These two experts indicate two different possibilities. One indicated that ODA and FDI expedited technology improvements in efficiency, while another indicated that the implementation of laws and rules in the forestry sector increased the efficiency of the forestry industry and, as a result, freed up additional labor that shifted to other industries.
(xii) Hydro-based energy with low GHG emissions		the additional energy needs produced by the shift out of the agriculture and forest industries were met by non-GHG-emitting sources, namely hydropower. But this cannot provide a clear answer to the question itself.

We now have a clearer view of what happened in Myanmar during the research period of 1990-2010 to produce the successful development shown by the data analysis. This clearer view is visually displayed in Figure 118 where thicker solid arrows mean an excellent fit, thinner solid arrows mean partial fit, and the red dash-dot arrow means no influence.

Myanmar's HDI income component was able to increase partially because of remittances from overseas workers, but mainly because exports of natural resources (natural gas, minerals, and oil) to neighboring countries such as China (PRC) and Thailand increased. Even without political stability, peace or increased ODA, FDI in the private sector was steadily encouraged during the period. This can also conceivably explain why some of tertiary industries, including the service industries, became the receivers of labor shifting out of primary industry and replaced primary industry as income generators, since such investment supported the labor-intensive sectors, the telecom sector, real estate, etc. Sector activities started to shift out of agriculture and forestry because of the implementation of laws and rules in the forestry sector that may have created favorable conditions for receiving FDI. The resulting improved efficiency of forestry and agriculture may have reduced emissions from these sectors or caused inefficient activities to be phased out of the sectors. Some of the tertiary industries, including service industries, together with natural resource exporting activities, then became the receivers of labor shifting out of primary industry and replaced primary industry as income generators. Little increase in CO_2 from energy and industrial sectors occurred because (i) the additional energy needs produced by the shift out of agriculture and forest industries were covered by non-GHG-emitting sources, namely hydropower, (ii) ODA and FDI expedited technology improvements that increased efficiency, and (iii) laws and rules in the forestry sector were implemented that increased the efficiency of the forestry industry and as a result freed up additional labor that shifted to other industries. In Myanmar's case, the increase of capital inflow could happen without political stability or peace because "international sanctions were taken seriously by only a few donor countries, and the sanction regime was not effective".

Figure 118. Summary of factors influencing successful development for Myanmar.



7.7.2. Experts' Responses to the Question Related to Nepal

After the data analysis, a question remains: "Why was Nepal's HDI, particularly its health and income components, able to improve while sector activities shifted out of forestry without political stability, peace or increased ODA?" This question is reasonable because if this shifting out of forestry happened without successful transfers to other profitable activities in Nepal that do not emit GHGs, income could not be increased. This question was therefore posed to the experts. Considering all nineteen of the expert responses (i)-(xix) and the data analysis, all of the responses were evaluated for fit with the data for Nepal as shown in Table 64 with reasons for the analysis.

Table 64. Evaluation of expert responses for Nepal

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Remittances from Nepalese working abroad		36 of them raised this possibility, including 17 Nepalese experts. While popular answers are not necessarily correct, among all the questions for the four successful countries, this answer was given by the greatest number of experts.
(ii) Increased migration		While (i) refers to Nepalese working abroad, this reason refers to migration within the country from rural to urban areas that simultaneously happened along the significant labor flaw moved abroad. Therefore, this reason is counted in addition to (i).

Items Raised by Experts	Fit	Evaluation of expert responses
(iii) Service sector	●	According to eleven experts "Adventure tourism over the last 2-3 decades" "is the main source of revenue in the country, and foreign exchange."
(iv) Increasing health facilities/ Increased or continuous government and donor funding for maternal health and female community health volunteers	●	Eighteen experts mentioned That donor and government funding and ODA, with technological innovations, improved/ increased health facilities including primary care and community health centers, government and private hospitals and doctors, and female community health volunteers.
(v) Increased access to health services due to improved transportation and communication services	◖	Three experts mentioned improved rural roads, transportation and communication services as a reason for the improved health parameter.
(vi) Support from various development partners	◖	While the data analysis showed that ODA did not increase during the research period, 11 experts highly evaluated the positive impacts provided by support from donors, regardless of the amount. "It is experienced that ODAs support was significant even when the state of political stability and peace was fragile in Nepal."
(vii) Government investment and efforts	●	In addition to support from various development partners, nine experts (including one negative view) mentioned government investment as the reason for the success. Two experts focused particularly on the government's efforts to achieve an inclusive growth. Government efforts

Items Raised by Experts	Fit	Evaluation of expert responses
		were beneficial for clean energy improvement, education through programs such as literacy improvement, for improving heath by better insurance policy, child mortality and clean water, and income poverty reduction. Education indirectly helped to improve health.
(viii) Awareness-raising campaigns/ activities		This can be treated as one of the government efforts mentioned above, designated by 11 experts as a remarkable issue. Those campaigns and activities became beneficial for improving health of rural people. In addition, one expert mentioned growing awareness of climate as one of the main reasons for the reduction of GHG.
(ix) Laws and rules related to forests in the legal sense		Their views supported the validity of the finding in the data analysis, clarifying one of the reasons activities shifted out of Nepal's forestry business. Concern for flooding, landslides and earthquakes enhanced forest conservation and land regulation, then those helped GHG emission reductions and management of forest resources.
(x) Community forestry		As in (x), one of the findings from the data analysis was supported by 12 experts: "The sudden decrease in emissions from LUFC may have been a result of the establishment of laws and rules related to forestry throughout the period 1976-2003." Ten experts focused particularly on the benefits derived from the establishment of community forestry as the core policy which contributed to forest conservation and income generation activities.
(xi) Alternative energy options		Ten experts mentioned the promotion of alternative energy options in Nepal. These experts, rather than answering the question directly, cited it as the reason for Nepal's good

Items Raised by Experts	Fit	Evaluation of expert responses
		performance in GHGpc because it carried the possibility of contributing to a reduction in wood consumption (which means shifting out of forestry). Some of them particularly mentioned the in-house usage of fuel that induces smoke pollution.
(xii) Education		Education and media including adult literacy and awareness programme contributed health improvements, and also better education contributed young people to get rid of forestry business.
(xiii) Pervasive NGO involvement		Nepal has been "the darling of the NGO community" and significant contributions were done by healthcare and hospitals partnering with NGOs/INGOs and by shifting out of forestry due to the promotion of renewable technology by different INGOs/NGOs.
(xiv) Change in agriculture		3 experts raised (i) growth of the agriculture sector, and (ii) reductions in fertilizer use and other agricultural efficiency improvements contributed CH4 and N2O reduction which shows up in the LUCF accounting but it did not show a perfect fit with the trajectories.
(xv) Military conflict ended		Starting of a new era of peace in 2005-06 may account for most of the health and income improvements, but the trajectories did not show much differences before and after 2005.
(xvi) Composition of exported goods		India where is a Nepal's major trading partner changed their needs for imported goods from Nepal. They need less woods and more textiles including carpets.

Items Raised by Experts	Fit	Evaluation of expert responses
(xvii) Small-scale entrepreneurship/ income-generating activities at the local level		Small scale entrepreneurships/ local resources base enterprises resulted increase the income
(xviii) Limiting livestock activities		Improved productivity of animals reduced GHGs emission per unit animal products
(xix) Empowering the most marginalized in society		In Nepal, the greater attention has been given to promote empowerment of the most marginalized group for poverty reduction.

We now have a clearer view of what happened in Nepal during the research period of 1990-2010 to produce the successful development shown by the data analysis. This clearer view is visually displayed in Figure 119.

The data analysis in conjunction with historical events indicated that Nepal's improvement in HDI was achieved mainly through health and income increases. In the meantime, the GHGpc decrease in Nepal was essentially caused by GHG reduction from LUCF starting in 2000, even while the population increased. The decreased emissions from LUFC may be a result of the establishment of laws and rules related to forestry throughout the period 1976-2003.

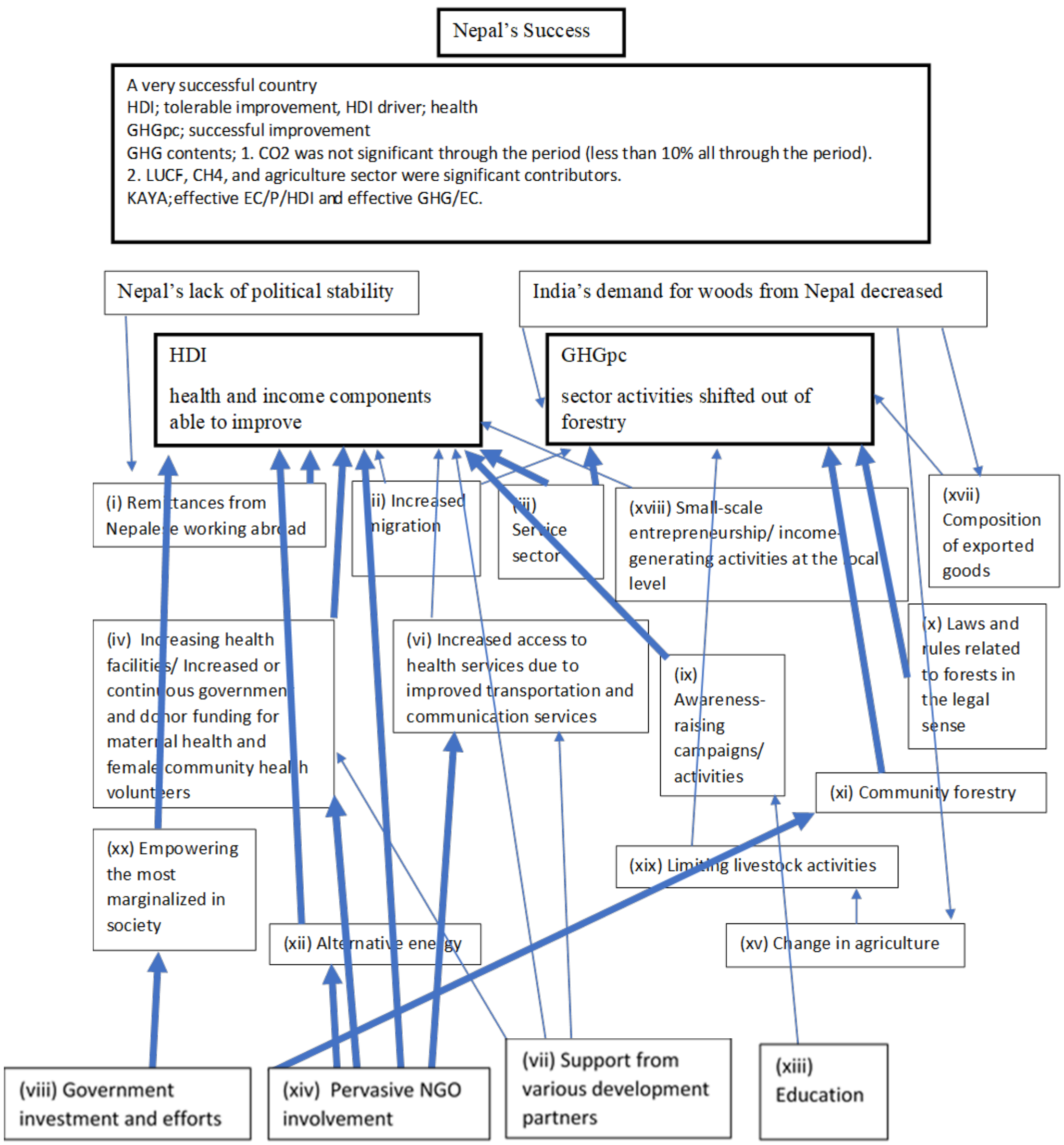
These data showed that sector activities in Nepal shifted out of forestry around 2000 without damaging its economy. Moreover, Nepal's successful development was achieved without (i) political stability, (ii) peace, or (iii) increased ODA.

As the reasons for Nepal's successful development, experts mentioned 22 issues and items. This result indicates that there was a broader background behind Nepal's success compared to other countries. Nepal's HDI income component was able to increase significantly because of remittances from overseas workers; this explanation was given by 36 experts, including 17 Nepalese experts. The remittances were accelerated by the domestic situation, which was characterized by a lack of political stability and peace. At the same time, domestic migration from rural areas to urban areas also occurred. The increased income generated by this phenomenon contributed to improving health conditions and to decreasing the workforce in rural areas that were once utilized for agriculture and forestry. While the HDI income component improved because of the remittances from overseas workers, domestically Nepal also had the advantage of being able to promote income-generating activities at the local level/in the service sector, particularly tourism, which absorbed workers who had once worked in agriculture and forestry.

At the same time, because of the Nepalese government's efforts to enhance inclusive growth and empower the most marginalized in society, and because of direct and indirect support from various NGOs and multiple governmental donors/development partners (such as the construction of rural roads to access health facilities), health care services improved in both quality and quantity. For example, community health volunteers were successfully introduced. (While the data analysis did not show that the ODA amounts significantly increased, their efficient qualitative contributions cannot be denied.) Moreover, awareness-raising campaigns/activities as a part of a government-sponsored education program also worked well to improve health conditions.

The GHG reduction from LUCF that was observed in the data can be explained by the good functioning of the laws and rules related to forests in the legal sense. The establishment of community forestry as a core policy of Nepalese government was a particularly good match for the income needs of local communities because it allowed them to sustain their forests. These movements also made it difficult for those who wished to enter the industry to do business. Health conditions also improved because of the decrease in fuel wood consumption due to the introduction of alternative energy options, such as improved cooking stoves, solar home systems and micro-hydro, which NGOs helped to provide. For historical and geographical reasons, Nepal maintains significant trade connections with India. India's demand for wood from Nepal decreased, which helped to reduce GHGs from LUCF. It was believed that India might want other goods from Nepal, such as small agri-based products. (Agriculture improved its efficiency over the course of the period and caused a reduction in livestock activities.) This is the background of the sector activities that started to shift out of forestry. In the meantime, CO_2 from the energy and industrial sectors increased only slightly. All these changes took place without political stability or peace.

Figure 119. Summary of factors influencing successful development for Nepal



7.7.3. Experts' Responses to the Questions Related to Mongolia

After this data analysis, three questions remain: Question 1: "Why was Mongolia's HDI, particularly its income component, able to maintain steady improvement with decreased GHG emissions from the energy sector throughout the period 1990-2000, particularly from manufacturing/construction, while the population increased and there was no political stability?” Question 2: “Did the introduction of leapfrogging technology happen because of a large increase in ODA since 1990?” Question 3: “If manufacturing/construction through ODA was a salient factor, did the donor place a high priority on (i) education improvement, (ii) decreased GHG emissions from the energy sector, and/or (iii) decreased GHG emissions from manufacturing/construction innovations?”

These questions are reasonable because HDI was maintained even while GHG emissions decreased. Furthermore, only Mongolia among the four successful countries showed such drastic changes in ODA during the period. Considering all of the expert responses (i)-(xii) and the data analysis, all of those items were evaluated for fit with the data for Mongolia as shown in Table 65 with reasons for the analysis.

Table 65. Evaluation of expert responses for Mongolia

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Socialist regime	◖	Two experts cited the socialist regime as the answer to the question, looking at it from different angles. One expert treated it from a positive angle, explaining that the restrictions imposed by the

Items Raised by Experts	Fit	Evaluation of expert responses
		socialist regime produced “green development,” while the other treated it from a negative angle, saying that the withdrawal of Soviet support for the country had led to a slowdown in the economy and the industrial sector, and therefore a fall in related emissions. Considering that the withdrawal of Soviet support happened just before the research period began in 1990, the view that a slowdown in the economy and the industrial sector caused a fall in related emissions makes sense. However, this is not enough to explain why the HDI income component was able to maintain steady improvement with decreased GHG emissions.
(ii) Growth of the service sector and private- and public-sector trading	●	These responses by the experts are consistent with the findings: HDI’s income component was able to maintain steady improvement with decreased GHG emissions because mining and some service sectors were expanding with little increase in GHGs while revenue increased. However, the reason this transition happened is not clear.
(iii) Efficiency and technology	●	These views indicate that before the research period, the technology used in the energy and manufacturing sectors introduced to Mongolia by the USSR was less efficient, and it was improved by modernization. ODA seem to have been helpful in this modernization.
(iv) Opening up the economy	●	After the withdrawal of the socialist regime, the opening up of the economy to private sector participation can explain why HDI’s income component maintained steady improvement. It is necessary, however, to learn the details of what happened.

Items Raised by Experts	Fit	Evaluation of expert responses
(v) Non-GHG-emitting production	◖	Such production may have been happening at that time, but the question was about decreased GHG emissions from the energy sector but not from production, so this answer does not perfectly fit as the answer to the question.
(vi) Sparsely populated country so did not fit with large-scale manufacturing and the energy industry	◖	It can modestly justify the finding of "decreased GHG emissions from the energy sector throughout the period 1990-2000," since the centralization in Ulaanbaatar of the population along with the population increase is assumed to have started in this period.
(vii) Emergence of a democratic system	◖	It is reasonable to think that the emergence of a democratic system created favorable conditions for investment in Mongolia that explain why HDI's income component maintained steady improvement, but it does not show a clear justification for the decreased GHG emissions from the energy sector in 1990-2000.
(viii) Majority of industrial enterprises went bankrupt	◖	This explanation points to the negative view of the socialist regime. While it explains the decreased GHG emissions as in (i), it cannot adequately explain why the HDI income component was able to maintain steady improvement.
(ix) International bilateral and multilateral donor organization	●	Observing the data that show that ODA amounts for Mongolia increased during the period, this high evaluation of ODA fits with the finding that the income component maintained steady improvement with decreased GHG emissions from the energy sector in 1990-2000.
(x) Exports of coal (and	●	This can reasonably explain why Mongolia's HDI, particularly its income component, was able to

Items Raised by Experts	Fit	Evaluation of expert responses
minerals) for which GHG emissions are reported in the country of final use		maintain steady improvement with decreased GHG emissions from the energy sector throughout the period 1990-2000, since the exports did not increase GHG emissions from Mongolia.
(xi) Severe weather and climate	◖	This may explain the lack of increase in GHG emissions (although during the winter, coal incineration could have increased for heating purposes), but it does not explain why Mongolia's HDI, particularly its income component, was able to maintain steady improvement.
(xii) Overseas remittances	◖	This can be part of the reason for the increase in income while GHG emissions decreased; it was also applicable to Myanmar and Nepal. However, remittances cannot be a major or obvious reason for the trajectory found by the data analysis. Actually, remittances in Mongolia in 2009 was only 4.9% of GNI, while remittances in Nepal was 23.3% of GNI.

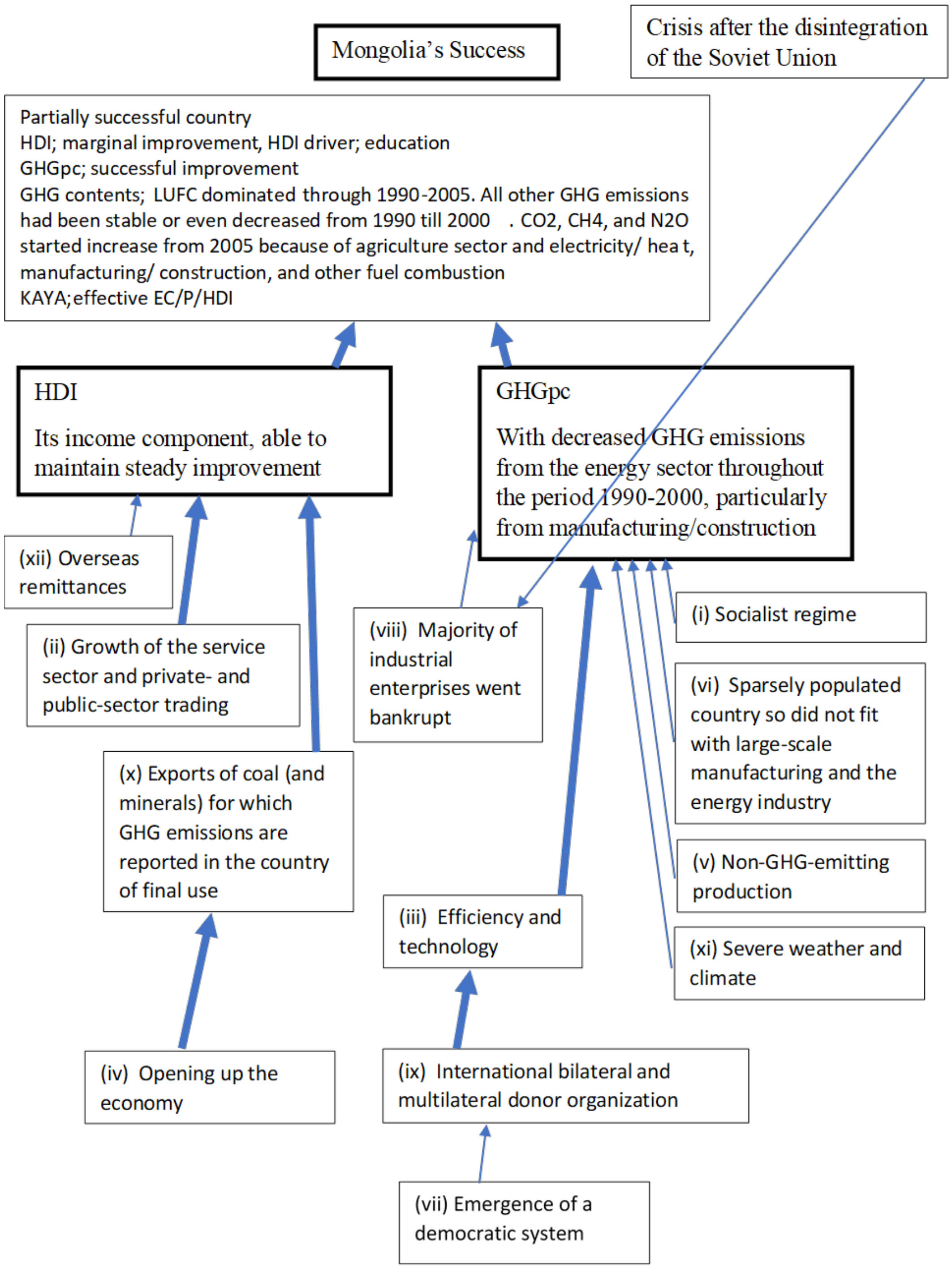
We can now more clearly see what happened in Mongolia to produce the successful development shown by the data analysis. This clearer view is visually displayed in Figure 120.

These views allow us to answer the question: "Why was Mongolia's HDI, particularly its income component, able to maintain steady improvement with decreased GHG emissions from the energy sector throughout the period 1990-2000, particularly from manufacturing/construction, while the population increased and there was no political stability?" The data analysis showed that Mongolia's HDI, particularly its income component, was able to maintain steady improvement with decreased GHG emissions from the energy sector throughout the period 1990-2000. The experts' inputs indicated that the GHGpc decrease in Mongolia through 1990-2000 was essentially caused by the slowdown in the economy and the industrial sector when the majority of industrial enterprises were bankrupted after the withdrawal of the socialist regime. The income component was able to maintain steady improvement thanks to (i) overseas remittances (partially), (ii) expansion in mining and some service sectors, (iii) exports of coal and other minerals.

During the recovery period after the disintegration of the Soviet Union, the democratic system that emerged set up favorable conditions for an increase in ODA since 1990 observed in the data, and this increase improved the efficiency of the technologies used in Mongolia's energy and manufacturing sectors, replacing the old and non-efficient technologies brought by the Soviets with more modern technologies, even they incurred higher costs for achieving higher efficiencies and improved environmental management that will be a part of project cost supported or covered by the ODA. The introduction of advanced technologies was welcomed by Mongolians, since “Mongolians place a high value on obtaining the latest technologies and wish to keep up with global trends.” Therefore, private sector investors during the process of recovery from the crisis in the 1990s also preferred advanced technologies. With this support from ODA, the opening up of the economy to private sector participation can explain why HDI’s income component maintained steady improvement, since opening up also allowed for the expansion of the export of mining resources and the service sector.

Additionally, as found in question 1, during the recovery period, the democratic system that emerged set up favorable conditions for increases in ODA, which improved the efficiency of the technology used in Mongolia’s energy and manufacturing sectors by replacing old, non-efficient technology brought by the Soviets with modern technology. Thus, donors did not place a high priority on decreasing GHG emissions, but a decrease was a positive side effect of their support for the country’s technological modernization.

Figure 120. Summary of factors influencing successful development for Mongolia.



7.7.4. Experts' Responses to the Questions Related to Bangladesh

After the data analysis, three questions remain: (Question 1) "Was the balanced development that happened in Bangladesh planned/intended/controlled, or simply the result of good fortune without plan/intention/control?" (Question 2) "If it was not planned/intended/controlled, is the development in Bangladesh that began in 2005 likely to follow the pattern of China (PRC) and India, where prioritized development sacrificed the environment?" and (Question 3) "If the development was planned/intended/controlled, what policy goals were established and what policy measures were taken to achieve this outcome while there was no political stability, peace, or increased ODA?"

These questions are reasonable because, among the successful countries, only Bangladesh achieved a well-balanced improvement in HDI (the gap between its top and bottom HDI components was small). The abrupt increase in the CO_2/energy industry in 2000 was linked to growth in the electricity/heat sector, which can be seen as the beginning of tracing the trajectories of China (PRC) and India. Therefore, the questions were posed to the experts. Considering all of the eight expert responses (i)-(viii) and the data analysis, all of those items were evaluated for fit with the data for Bangladesh as shown in Table 66 with reasons for the analysis.

Table 66. Evaluation of expert responses for Bangladesh

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Local development	●	Local development was enhanced "through micro-credit, gramin development bank (sic), Mohammad Yunus, and Noble Laurette on Economics (sic)."
(ii) Foreign investments	●	Government successfully provided better condition for foreign firms and investments on the textile and garment subsector as well as oil and gas exploration, construction of natural gas pipelines and power stations that did not produce much GHG to accommodate needs by increased population.
(iii) Improvement in the standard of living and poverty reduction	●	It was during this period that a Poverty Reduction Strategy Paper (PRSP), which is a development strategy document, allowed market mechanism as a driving force of development in Bangladesh. Government prioritized to improve the minimum living standard from the areas of health care, quality of education, social security, and strong social safety programs targeting the poor.
(iv) Job generation and low labor costs/ Supporting export-oriented industry and the private sector	●	The policies of supporting export-oriented manufacturing and private sector such as textiles jobs (garments sector) that came along with job generation by low wages. Even without political stability, the economy generally still can be improved in a certain level.
(v) Support from development partners	●	The financial sector reform supported by development partners was one of the best in the region and supported proper capital allocation to which private

Items Raised by Experts	Fit	Evaluation of expert responses
		sector has responded positively then promoted foreign investments.
(vi) Planning and execution	●	"Despite political confusion, Bangladesh has maintained a reasonable level of planning and execution in all sectors, starting from proper planning in education/health, energy, transport sectors."
(vii) Other		One expert mentioned each of the following: capacity development and skills training, formal or informal laws and rules (community-based institutions and indigenous knowledge and practices), and proper planning.

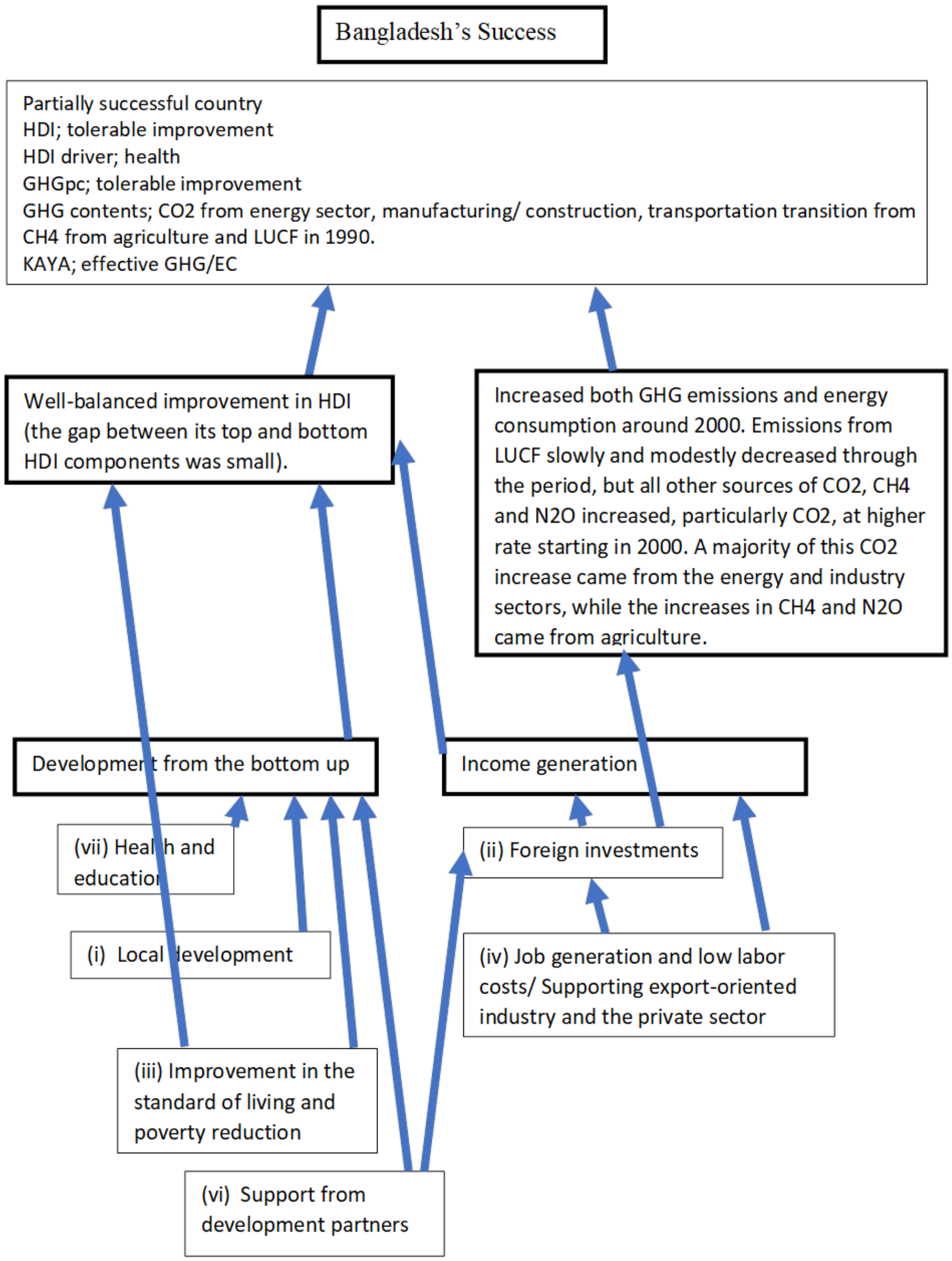
We can now more clearly see what happened in Bangladesh to produce the successful development shown by the data analysis. This clearer view is visually displayed in Figure 121.

These views allow us to answer the question: "Was the balanced development that happened in Bangladesh planned/intended/controlled, or simply the result of good fortune without plan/intention/control?" The data analysis showed that Bangladesh's improvement in HDI was achieved by a well-balanced improvement in HDI (the gap between its top and bottom HDI components was small) throughout the period 1990-2000. The majority of the experts supported the idea that the success was caused by numerous government programs that were designed/planned/intended/controlled, since the country needed to cope with a rapid population increase. Bangladesh also learned from the past and from neighboring countries, and private sector businesses responded positively to the programs designed. The experts' view was that even the lack of political stability and peace did not present a serious barrier to the sustainable and continuous implementation of carefully designed policies. As reasons to explain why the success was not the result of the government's programs, (i) corruption, (ii) NGOs' remarkable activities, and (iii) the natural gas exploitation boom that happened during the period were cited.

We also now have a clearer answer to the question: "If it was not planned/intended/controlled, is the development in Bangladesh that began in 2005 likely to follow the pattern of China (PRC) and India, where prioritized development sacrificed the environment?" The pessimistic view expressed by eight experts (that Bangladesh will follow the pattern of sacrificing the environment) is based on the fact that Bangladesh's domestic natural gas, which has been sustaining its clean development, is almost depleted, and therefore it will start relying on large-scale coal thermal power plants to meet the needs that will come along with its ongoing population increase. In the meantime, another eight experts provided the optimistic view that Bangladesh will not follow the pattern of sacrificing the environment. Their views are based on the beliefs that (i) Bangladesh's awareness of the environment is high, (ii) Bangladesh's income increase will not be energy-driven, and (iii) development donors are environment-conscious. However, their view seems outdated in the sense that it is based on their understanding that Bangladesh can continue to use its domestic natural gas. Justification (iii) might be true when it comes to avoiding air pollution, water contamination, and noise, and to promoting safety management and protecting biodiversity, but it is questionable how donors can help reduce the GHGs emitted by the newly planned coal thermal plants.

We now have a clearer answer to the question: "If the development was planned/intended/controlled, what policy goals were established and what policy measures were taken to achieve this outcome while there was no political stability, peace, or increased ODA?" These six items (except "(vii) others") can be fundamentally divided into two groups: development from the bottom up and income generation. These groups can be regarded as the two main pillars of Bangladesh's policy measures to improve its HDI parameters. Regarding development from the bottom up, (vi) planning and execution supported (i) local development and (iii) improvement in the standard of living and poverty reduction. (v) Support from development partners promoted this policy intention. In the meantime, regarding income generation, (ii) favorable conditions for foreign investment, (iv) efforts at job generation and low labor costs/ supporting export-oriented industries and the private sector were effective for this pillar. (v) Support from development partners also promoted this policy intention. Finally, (iv) job generation and low labor costs/ supporting export-oriented industries and the private sector worked as a binding for these two pillars.

Figure 121. Summary of factors influencing successful development for Bangladesh.



7.7.5. Factors Cited as Reasons for Their Success

Table 62 summarizes the factors mentioned as the reasons for each country's success. Based on the analyses done above, the impacts of the factors on the countries' HDI and GHGpc were divided into three levels: Empty circles mean they did not fit, half full circles mean they showed some level of fit, and full circles mean they were major items for their success as indicated in Table 63 through Table 66. In Table 67, those three levels of evaluations are further divided into the fitting with their HDI success and the fitting with their GHGpc success depending on characters of each item.

Table 67. Evaluations of expert responses by degree of fit with HDI and GHGpc goals by the four successful countries

Items Raised by Experts	Myanmar		Nepal		Mongolia		Bangladesh	
	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc
ODA	◐	◐	●	○	●	●	●	○
Remittances/ migration	◐	○	●	○		○		
Trading	●	○	○	◐	●	●	●	○
Secondary/tertiary/service/ local level industries	◐	○	●	○				
Better education	○	○	◐	○			●	○
Laws and rules	●	●	○	●				

Items Raised by Experts	Myanmar		Nepal		Mongolia		Bangladesh	
	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc
Renewable energies/ Non-GHG-emitting productions	○	◐	●	●	○	◐		
Technology/productivity	◐	◐			●	●		
Foreign investment	●	○					●	○
Empowerment of the most marginalized/ improvement in the standard of living/ Local development			●	○			●	○
Agriculture production/ Change in agriculture/ Limiting livestock activities	○	○	○	◐				
Military regime	◐	○						
Improving access to health services			●	○				
Government investment			●	○				
Awareness-raising campaigns			●	◐				

Items Raised by Experts	Myanmar		Nepal		Mongolia		Bangladesh	
	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc
Community forestry			◐	●				
Pervasive NGO involvement			●	○				
End to military conflict/ Opening up the economy			○	○	●	○		
Socialist regime/ Enterprises went bankrupt/ Emergence of democracy					◐	◐		
Geological reasons					○	◐		
Job generation							●	○

As observed in the table, a single factor was common to all four countries: *ODA/international bilateral and multilateral donor organization/support from development partners.* Its impact on HDI and GHGpc ranged from None to Major. Two other factors, (i) remittances and (ii) trading, were cited in the analysis of three countries. Remittances had a particularly significant impact on Nepal's HDI, while trading had a particularly significant impact on Myanmar's and Bangladesh's HDI. Another six factors were cited in the analysis of two countries: (i) secondary/tertiary/service industries, (ii) better education, (iii) the implementation of laws and rules, (iv) technology/productivity, (v) foreign investment, and (vi) empowerment of the most marginalized/improvement in the standard of living. The secondary/tertiary/service industries had a particularly significant impact on Nepal's HDI; the implementation of laws and rules had a particularly significant impact on Myanmar's HDI and GHGpc and on Nepal's GHGpc; technology/productivity had a particularly significant impact on Mongolia's HDI and GHGpc; foreign investment had a particularly significant impact on Myanmar's HDI and on Bangladesh's HDI; empowerment of the most marginalized/improvement in the living standard had a particularly significant impact on Bangladesh's HDI, and better education had no or only a minor impact on Myanmar and Nepal. Another four factors appeared only in the Myanmar analysis; 14 factors appeared only in the Nepal analysis; eight factors appeared only in the Mongolia analysis; and three factors appeared only in the Bangladesh analysis.

7.7.6. Consistency with SDGs

Table 63 to Table 66 in Section 7.7.1 and 7.7.2 examine whether or not these earlier accomplishments by very successful and successful countries are consistent with specific SDGs that are to be achieved between 2015 and 2030. The four indicators that are health, education, income and GHGpc are linked to almost half of the 17 SDGs because the health indicator is related to GOAL 2: Zero Hunger, GOAL 3: Good Health and Well-being, and GOAL 6: Clean Water and Sanitation. The education indicator is related to GOAL 4: Quality Education. The income indicator is related to GOAL 1: No Poverty, and GOAL 8: Decent Work and Economic Growth. The GHGpc indicator is related to GOAL 7: Affordable and Clean Energy, and GOAL 13: Climate Action.

Table 68 shows SDG goals that are addressed by the items raised by experts as keys to the successes observed in Myanmar, Nepal, Bangladesh, and Mongolia as summarized in Table 62. This table shows that, among 22 items raised by experts, 15 address SDG goals. The goals related to health were addressed by two items, GOAL 2: Zero Hunger which was related to "Empowerment of the most marginalized/ Improvement in the standard of living/local development" and GOAL 3: Good Health and Well-being which was related to "Increasing health facilities/ Increased or continuous government and donor funding for maternal health and female community health volunteers / Government and donor funding for health/ Access to health services by improved transportation and communication services.” The goal related to education GOAL 4: Quality Education was addressed by two items, “Good education” and “Awareness-raising campaigns.” The goals related to income were addressed by 8 items, GOAL 1: No Poverty which was related with two items that were “Empowerment of the most marginalized/ improvement in the standard of living/ Local development” and “Military regime” and GOAL 8: Decent Work and Economic Growth which was related to 6 items that were “Remittances/ Increased migration”, “Trading/ Composition of exported goods/ Exports of coal (and minerals)”, “Secondary/tertiary/service industries/ Income-generating activities at local level”, “Foreign investment”, “ End to military conflict/ Opening up the economy”, and “Job generation.” The goals related to GHGpc were addressed by 5 items, GOAL 7: Affordable and Clean Energy which was related to two items that were “Alternative energy options / Hydro-based energy with low GHG/Non-GHG-emitting productions” and “Technology/productivity”, and GOAL 13: Climate Action which was related to three items that were “Technology/productivity”, “Agriculture production/ Change in agriculture/ Limiting livestock activities” and “Community forestry”.

Table 68. Relations between the Items raised by Experts and SDG Goals

Items Raised by Experts	SDG Goals	Related Countries
ODA	NA	Myanmar Nepal Mongolia Bangladesh
Remittances/ migration	GOAL 8: Decent Work and Economic Growth	Myanmar Nepal Mongolia
Trading	GOAL 8: Decent Work and Economic Growth	Myanmar Nepal Mongolia Bangladesh
Secondary/tertiary/service/ local level industries	GOAL 8: Decent Work and Economic Growth	Myanmar Nepal
Better education	GOAL 4: Quality Education	Nepal Bangladesh
Laws and rules	NA	Myanmar Nepal
Renewable energies/ Non-GHG-emitting productions	GOAL 7: Affordable and Clean Energy	Myanmar Nepal Mongolia
Technology/productivity	GOAL 7: Affordable and Clean Energy GOAL 13: Climate Action	Myanmar Mongolia
Foreign investment	GOAL 8: Decent Work and Economic Growth	Myanmar Bangladesh
Empowerment of the most marginalized/ improvement in the standard of living/ Local development	GOAL 1: No Poverty GOAL 2: Zero Hunger	Nepal Bangladesh
Agriculture production/ Change in agriculture/ Limiting livestock activities	GOAL 13: Climate Action	Nepal

Items Raised by Experts	SDG Goals	Related Countries
Military regime	GOAL 1: No Poverty	Myanmar
Improving access to health services	GOAL 3: Good Health and Well-being	Nepal
Government investment	NA	Nepal
Awareness-raising campaigns	GOAL 4: Quality Education	Nepal
Community forestry	GOAL 13: Climate Action	Nepal
Pervasive NGO involvement	NA	Nepal
End to military conflict/ Opening up the economy	GOAL 8: Decent Work and Economic Growth	Mongolia
Socialist regime/ Enterprises went bankrupt/ Emergence of democracy	NA	Mongolia
Geological reasons	NA	Mongolia
Job generation	GOAL 8: Decent Work and Economic Growth	Bangladesh

The countries' performance in terms of relative success in meeting those goals is visualized in Table 69 combining the analysis on Table 67 and Table 68. Those empty, half full, and full circles in the table show evaluations based on the information given by Figure 118 to Figure 121 in Section 7.7.1-4 that illustrated outcomes in the four successful countries. They are moving in a direction that is consistent with the SDGs even though the SDGs were not formulated until five years after, the time period that was studied in this dissertation. These countries, however, did not move forward on (i) GHG related goals for Bangladesh, (ii) health and education related goals for Myanmar, and (iii) health and education related goals for Mongolia. Nepal was the only one of the four that was meeting all of those goals.

Table 69. Relations between the Successes and SDG Goals

SDGs	Bangladesh (HDI; tolerable improvement driven by health GHGpc; tolerable improvement)	Myanmar (HDI; successful improvement driven by income GHGpc; successful improvement)	Mongolia (HDI; marginal improvement driven by education GHGpc; successful improvement)	Nepal (HDI; tolerable improvement driven by health GHGpc; successful improvement)
Goals related to Health				
GOAL 2: Zero Hunger	●	○	○	●
GOAL 3: Good Health and Well-being	○	○	○	●
GOAL 6: Clean Water and Sanitation	NA	NA	NA	NA
Goal related to Education				

GOAL 4: Quality Education	●	○	○	●
Goals related to Income				
GOAL 1: No Poverty	●	◐	○	●
GOAL 8: Decent Work and Economic Growth	●	●	●	●
Goals related to GHGpc				
GOAL 7: Affordable and Clean Energy	○	◐	●	●
GOAL 13: Climate Action	○	◐	●	●

CHAPTER 8. CONCLUSIONS

8.1 Validity of the Original Four Hypotheses for the Successful Four Countries

Each question and its answer are reviewed below.

(i) National policy initiatives, strategies and changing practices were effective in the successful countries;

In Myanmar's case, YES, (i) laws and rules related to forestry in 1992-95 decreased the emissions from LUCF, and (ii) the implementation of laws and rules in the forestry sector created favorable conditions for receiving FDI and improved the efficiency of forestry and agriculture, which may have reduced emissions from these sectors or caused inefficient activities to be phased out of the sectors.

In Nepal's case, YES, national policy initiatives, strategies and changing practices worked well to improve HDI health and income indicators and the GHGpc indicator. These initiatives, strategies and practices included (i) enhancing inclusive growth, (ii) empowering the most marginalized in society, (iii) expanding health care services, (iii) introducing community health volunteers, (iv) conducting awareness-raising campaigns/activities, (v) implementing laws and regulations related to forests practices, and (vi) establishing community forestry.

In Mongolia's case, NO, in neither the data analysis nor the experts' inputs were proof observed that national policy initiatives, strategies or changing practices worked effectively to produce success.

In Bangladesh's case, YES, the success was caused by numerous government programs that were designed/planned/intended/controlled since the country needed to cope with its rapid population increase and because it had learned from the past and from neighboring countries. Bangladesh's policy measures to improve its HDI parameters had two fundamental pillars. One was development from the bottom up, and the other was income generation. Regarding development from the bottom up, (vii) the strengthening of health and education supported (i) local development and (iii) improvement in the standard of living and poverty reduction. (vi) Support from development partners promoted this policy intention. In the meantime, regarding income generation, (ii) favorable conditions for foreign investment, (iv) efforts at job generation and low labor costs/ supporting export-oriented industries and the private sector was effective for this pillar. (vi) Support from development partners also promoted this policy intention. Finally, (iv) job generation and low labor costs that supported export-oriented industries and the private sector connected these two pillars. The lack of political stability and peace indicated by the data analysis did not present a serious barrier to the sustainable and continuous implementation of carefully designed policies.

(ii) Responses to external factors were efficient in the successful countries;

NO, in Myanmar's case. There was no difference observed in the emissions before and after its acceptance of the Kyoto Protocol, and the international sanctions during the military era was not a significant barrier to Myanmar's development. In Myanmar's case, the increase in capital inflow occurred without political stability or peace, since "international sanctions were taken seriously by only a few donor countries, and the sanction regime was not effective" as an expert explained.

YES, to a certain extent in Nepal's case. No difference was observed in the emissions before and after Nepal's acceptance of the Kyoto Protocol. The establishment of laws and rules related to forests took place before this acceptance. However, one of the reasons for Nepal's diminishing forestry was India's decreasing demand for wood; therefore, Nepal responded to the external factor by adjusting its sector activity, reducing GHGs from LUCF. Moreover, NGOs' vigorous activities generated improvements in health and a reduction in wood consumption that also contributed to GHG reductions from LUCF.

NO, in Mongolia's case. After the disintegration of the Soviet Union, the majority of industrial enterprises went bankrupt, which can be counted as an external factor. It cannot be said, however, that Mongolia effectively responded to this external factor.

NO, in Bangladesh's case. Its natural gas usage and depletion can be treated as an external factor. This is because Bangladesh's energy supply, which strongly influenced the GHGpc parameter, was affected by the availability of natural gas. However, starting in 2000, the rate of increase in GHGs became faster, particularly in CO_2 from the energy and industry sectors. The abrupt increase in CO_2 from the energy industry in 2000 was linked to growth in the electricity/heat sector. Thus, it cannot be said that Bangladesh effectively responded to this external factor.

(iii) Financing by development agencies was effective in the successful countries;

We can say this was "somewhat" true in Myanmar's case, but the phenomenon was not clearly observed. The quantity of the ODA did not show any significant increase, although some qualitative benefits influenced by the ODA cannot be denied, considering these experts' inputs. ODA and FDI expedited technology improvements in efficiency.

We can also say this was "somewhat" true in Nepal's case, but the phenomenon was not clearly observed. The quantity of the ODA did not show any significant increase, although some qualitative benefits influenced by the ODA cannot be denied, considering these experts' inputs. Donors' direct and indirect support and the government's efforts to promote health care services worked well during the research period.

YES, in Mongolia's case. At the very beginning of the research period, as discussed above, Mongolia's priority was recovery from its crisis after the disintegration of the Soviet Union. In the data analysis, a large increase in ODA was observed after 1990. Despite the lack of political stability, the democratic system that emerged set up favorable conditions for an increase in ODA. This ODA was originally intended to support Mongolia during the economic crisis, and the projects supported by ODA involved energy-efficient advanced technologies, although they came with higher costs. It is important to keep noting this because ODA projects unintentionally brought such high efficiency which can contribute to lower GHG emission technology that could not be introduced without ODA projects since such environmentally better but higher cost cleaner energy technologies are required to be applied but covered by donors' supports. The donors did not place a high priority on decreasing GHG emissions, but this decrease was a positive side effect of their support for the country's technical modernization.

We can say this was "somewhat" true in Bangladesh's case, but the phenomenon was not clearly observed because the quantity of ODA did not show any significant increase, although the qualitative benefits of the ODA cannot be denied, considering these experts' inputs. Support from development partners was helpful for realizing Bangladesh's policy intentions: (i) development from the bottom up and (ii) income generation.

(iv) The mix of economic activities at different stages of development worked efficiently in the successful countries.

YES, in Myanmar's case, since the data analysis showed that sector activities shifted out of agriculture and forestry without damaging its economy. Myanmar's HDI income component was able to increase mainly because the exports of natural resources to neighboring countries increased. Such activities were made possible by FDI in the private sector, which was steadily encouraged during the period. Some of the tertiary industries became the receivers of labor and replaced primary industry as income generators. Little increase in CO_2 from the energy and industrial sectors occurred because (i) the additional energy needs produced by the shift out of the agriculture and forest industries were met by non-GHG-emitting sources, namely hydropower, (ii) ODA and FDI expedited technology improvements in efficiency, and (iii) the implementation of laws and rules in the forestry sector increased the efficiency of the forestry industry and as a result freed up additional labor that shifted to other industries.

YES, in Nepal's case, since the data analysis showed that sector activities in Nepal shifted out of forestry without damaging its economy. Nepal's HDI income component was able to increase mainly because of remittances from overseas workers. Activities at the local level and in the service sector, particularly tourism, became the receiver of labor shifting out of forestry. CO_2 from fuel wood consumption increased little because of (i) the introduction of alternative energy options such as improved cooking stoves, solar home systems and micro-hydro, and (ii) the implementation of laws and rules in the forestry sector increased the efficiency of the forestry industry and as a result freed up additional labor that shifted to other industries.

NO, in Mongolia's case, since the data analysis and the inputs from the experts did not show that sector activities in Mongolia shifted drastically.

NO, in Bangladesh's case, since the data analysis and the inputs from experts did not show that sector activities in Bangladesh shifted drastically while the textile and garment subsector grew up to a certain extent.

These conclusions were divided into three levels: Empty circles mean they did not fit the hypothesis, half full circles mean they showed somewhat fitting with the hypothesis, and full circles mean they fit the hypothesis, and they are summarized in Table 70.

Table 70. Validity of the Original Four Hypotheses for the Successful Four Countries

Groups	Countries	Hypotheses 1	Hypotheses 2	Hypotheses 3	Hypotheses 4
Very successful	Myanmar	● (GHGpc)	○	◐	● (From agriculture and forestry to experts in natural resources and tertiary industries)
	Nepal	● (HDI health and income and GHGpc)	● (India's demand)	◐	● (From forestry to remittances from overseas

					workers and the service sector)
Successful	Mongolia	○	○	● (GHGpc)	○
	Bangladesh	● (Improve HDI)	○	◐	○

8.2 Answering to the Research Question

The original motivation of this dissertation was the following: if "successful development" in poor countries (countries that simultaneously improved both the development indicator (HDI) and the environmental indicator (GHGpc)) is observed in the data, it is essential to learn about climate change mitigation from such countries, because poor countries in general desire to develop economically and socially even as they experience rapid population growth. Consequently, the research question, "What factors determine whether developing countries achieve lower GHG emissions while meeting their development goals?," was examined with four hypotheses. The answers obtained from data analysis and experts' views are:

(i) National policy initiatives, strategies and changing practices were effective in Myanmar, Nepal and Bangladesh. In Myanmar, Implementation of laws and rules in the forestry sector was effective at reducing GHGpc. In Nepal, these new practices improved the HDI health and income indicators as well as reduced GHGpc. These initiatives, strategies and practices included (i) enhancing inclusive growth, (ii) empowering the most marginalized in society, (iii) expanding health care services, (iii) introducing community health volunteers, (iv) conducting awareness-raising campaigns/activities, (v) implementing laws and rules related to forests in the legal sense, and (vi) establishing community forestry. In Bangladesh, they were effective at improving Bangladesh's policy measures to improve its HDI parameters. These initiatives, strategies and practices included (i) Local development, (ii) Providing a better condition for foreign investments, (iii) Improvement in the standard of living and poverty reduction, (iv) Job generation and low labor costs/ Supporting export-oriented industry and the private sector, and (vi) Planning and execution.

(ii) The responses to external factors were effective only in Nepal. Nepal successfully reduced GHG emissions from LUCF by responding to India's needs rather than looking for other buyers of its wood, which was also a timely move linked to its national policy initiatives to sustain its forestry.

(iii) Financing by development agencies was clearly effective in Mongolia and somewhat effective in the other three countries. The quantity of the ODA did not show any significant increase in these three countries, although some qualitative benefits of the ODA appear to be likely. In Mongolia, a large increase in ODA was observed after 1990. This ODA was intended to support Mongolia during the economic crisis after the disintegration of the Soviet Union. The donors did not place a high priority on decreasing GHG emissions, but this decrease was a positive side effect of their support for the country's technical modernization.

(iv) The mix of economic activities at different stages of development worked effectively in Myanmar and Nepal. Myanmar was successful at shifting away from agriculture and forestry, moving to reliance on experts in natural resources and on tertiary industries to maintain the increase in its HDI income parameter. Nepal was successful at shifting away from forestry, moving to a reliance on remittances from overseas workers and on the service sector to maintain the increase in its HDI income and health parameters.

Myanmar, was one of the two very successful countries because of its effective forestry policy regulations that reduced GHGs from LUCF, and its shift away from agriculture and forestry into other natural resources and tertiary industries. Nepal, the other very successful country, succeeded because its policy regulations effectively improved HDI health and income parameters and reduced GHGs from LUCF, while it transitioned out of forestry and gained remittances from overseas workers and the service sector.

These observations on the two very successful countries indicate the possibilities and limitations that developing countries face in seeking to improve HDI without increasing GHG emissions. The possibility is that if a developing country can find some other ways to generate income, it can regulate to shift out of agriculture and forestry, which release GHGs. The limitation is that the stories behind these cases might not reveal a reduction of GHGs. It cannot contribute to a real climate change mitigation even if the reduction of GHGs domestically happens if the emissions are transferred from one country's ledger to another. For example, Myanmar increased its reliance on exports of natural resources that might increase GHGs in other countries where they are consumed, and Nepal increased its reliance on remittances from overseas workers, who might be increasing GHGs in the countries where they work. Mongolia was a successful country because donors' support during the economic crisis had the positive side effect of reducing GHG emissions through technical modernization. This effect could be duplicated in other developing countries that use donor support to recover from crises. Bangladesh was a successful country because it implemented policies that effectively improved its HDI parameters. It may also be enjoying success in part because of the availability of domestic natural gas.

In this regard, answers for the research question "What factors determine whether developing countries achieve lower GHG emissions while meeting their development goals?" are (i) National policy initiatives, strategies and changing practices that were effective in three out of the four successful countries, (ii) The responses to external factors was effective in one country, (iii) Financing by development agencies was clearly effective in one country and also likely effective in other three countries, and (iv) Change in the mix of economic activities was effective in two out of the four successful countries.

8.3 Summary of findings and possible future research

- Finding #1: the surprising trajectory of the successful nations

This dissertation started from my finding that more than half of 130 countries (73) followed a trajectory from 1990-2010 which was successful in increasing their HDI and decreasing GHGpc. The most interesting fact to be found here was, while it can be readily assumed that rich countries were able to achieve this success using their economic power and advanced technologies, a number of poor countries also achieved this success. Twenty-six of the 52 richer countries were successful, but also 33 of the 52 poorer countries showed a similar trajectory. This actual trajectory proves that EKC theory does not universally apply to the relationship between the development indicator (HDI) and the climate change indicator (GHGpc). This is a very significant finding because most policy makers all over the world trust that it is necessary to sacrifice climate change mitigation to achieve development. This assumption causes them to give low priority to actions that address climate change. Therefore, this finding can encourage those policy makers to include addressing climate as part of their development agenda.

- Finding #2: Components of HDI

Thirteen Asian countries out of 18 had Education as their most improved HDI component during 1990-2010. However, when all other country groups in the world were examined, the results show that regardless of area and wealth, the majority of countries have Education at the top. This may be attributed to one of two reasons: (1) during this period, all over the world, Education was the real driver of HDI improvement, or (2) the current HDI emphasizes the impact of Education too much.

However, there is no available tool that can demonstrate whether (1) or (2) is the case. Moreover, it is beyond the scope of this dissertation to examine if the current calculation of HDI is too biased toward the Education component. Therefore, in this dissertation, standard deviation score was introduced to find out which HDI component became drivers of each country's development. If one only used the component values of HDI, 104 countries out of the total 130 countries had the Education component as the driver of their HDI improvements (17 countries had Health, and 9 had Income). Using the standard deviation score showed that 53 countries out of 130 had the Education component as the driver of their HDI improvement (34 countries had Health, and 44 had Income). In Asia, out of 14 countries that were used for the evaluations, 3 countries had the Education component as the driver of their HDI improvement (2 countries had Health, and 9 had Income).

These results demonstrate that improvements of Education component were significant for all countries in the world, while improvements of the Income component was important for Asian countries during the period of 1990-2010. The situation among the four successful Asian countries differed. Myanmar's driver was strong improvement of the Income component but Nepal's driver was very strong improvement of the Health component, while neither Bangladesh nor Mongolia showed any dominant component.

- Finding #3: Shift in GHGs as development progressed

Many past analyses have focused on CO_2, and this has produced strong disagreements in international negotiations since CO_2 is a by-product of fossil fuel, the major source of energy and the backbone of economic activity. Because it is generally assumed that energy production is the most important ingredient for development, it is difficult for countries (especially developing countries) to commit to reducing CO_2 emissions, since they equate that with reducing energy production and slowing their economic development. However, the development trajectories show that even though fossil fuel CO_2 was more significant in 2010 than in 1990, in developing countries, it has never been the main GHG. This finding suggests that reducing GHGs other than CO_2 in developing countries can be an effective means for future climate change mitigation. Such reductions may occur by efficiency gains in activities that emit these gases or by transitions to a different industry that releases different GHGs with lower Global Warming Potentials.

- Finding #4: The modified Kaya identity

The two very successful countries, Myanmar and Nepal, were both very effective in reducing both EC/P/HDI and GHG/EC, and there was no other Asian countries that achieved this. This means those two countries were the only countries that consumed energy very efficiently as they improved HDI, and also the energy used by them emitted relatively less GHG.

One of the two successful countries, Bangladesh was effectively reduced GHG/EC while the country was mediocre for reducing EC/P/HDI. Other than Bangladesh, only Sri Lanka accomplished this. Another of the two successful countries, Mongolia was effective for reducing EC/P/HDI while the country was mediocre for GHG/EC. Other than Mongolia, only Pakistan accomplished this. The Philippines was the only other country that effectively reduced EC/P/HDI, but the country was ineffective for lowering GHG/EC. Thailand was the only country to lower GHG/EC effectively, but the country was ineffective in reducing EC/P/HDI.

The modified Kaya identity demonstrates the important factors that the very successful and successful countries utilized.

- Finding #5: Path to a successful development outcome (The answers to the research question)

The quantitative analysis and qualitative interviews with experts from multiple countries demonstrates that there is no single way for a country to reach a successful Sustainable development outcome. National policy guidance was highly effective for Myanmar to improve GHGpc, for Nepal to improve HDI health and income, and GHGpc and for Bangladesh to improve HDI. External factors influenced Nepal to reduce GHGs from LUFC, but not because of a pressure from the international community or taking on commitments to the Kyoto Protocol. Instead, it successfully adjusted to the reduction in demand for its forest product in India. Financing by development agencies was apparently effective for Mongolia's success. Actually, this single factor was the only one common to all four countries. Its importance is less clear in the other three countries' successes according to the experts who evaluated the benefits from international aid. Changes in the mix of economic activities were very effective for Myanmar to improve GHG and HDI together with the shift from agriculture and forestry it shifted to exports of natural resources and tertiary industries. Nepal shifted to a different development path when it shifted from relying on forestry to an economy tied to remittances from overseas workers and the service sector.

- Finding #6: Consistency with the SDGs

It was found that, during the research period of 1990-2010, the outcome of the four successful countries was consistent with all of the health, education, income and GHG related SDGs even though SDGs were introduced five years later than the study period except

(i) Bangladesh's GHG related goals,

(ii) Myanmar's health and education related goals, and

(iii) Mongolia's health and education related goals.

Hence, Nepal was the only country to meet all of those goals among those four countries. Therefore, to achieve SDGs it is recommended that Bangladesh should take actions that reduce its GHG emissions; Myanmar should improve both health and education; Mongolia should work to improve human health and education, and Nepal should maintain its current balanced effort during the fifteen-year period of the SDGs.

- Findings by qualitative analysis on questionings to experts

The qualitative analysis brought some valuable insights that helped to explain what the quantitative data analysis could not tell. For example, during the military regime of Myanmar, the quantitative data cannot explain why such foreign investments were possible. But one expert revealed that "international sanctions were taken seriously by only a few donor countries, and the sanction regime was not effective." This statement tells the reality that cannot be revealed by the quantitative data. Another expert also wrote "Bangladesh has been constantly politically unstable, but this has been predictable, and in my experience, this has not really shown up in daily life in Bangladesh. Despite recent events, Bangladesh has been quite peaceful over the period 2002 – 2012." This observation also provides insight which cannot be found in literature reviews.

- Limitations of this study

One limitation of the quantitative data analysis is nobody knows if the data can be reliable or accurate in some countries particularly during periods of military regimes or dictatorships. There are also questions about the reliability of the qualitative analysis based upon interviews with in-country development experts. A number of professionals who are working in internationally recognized organizations opted not to participate and stated that they had no idea why the observed trends were occurring raises questions about how familiar experts as a whole are with the issues of environment and development. Some who responded gave information about what happened outside of the time frame, and some were unfamiliar with aspects of the issue. Therefore, even the best practices done here in this dissertation might not be capable of explaining the findings.

- Additional work that might be needed.

This dissertation was only for a specific 20-year period of 1990-2010 which was a crucial part of the history of international attempts to act on climate change from the first IPCC report to near the end of the implementation of the Kyoto Protocol period. It will be quite interesting to continue this work up to 2015 and into the future to see what happens as we enter the Paris Agreement phase. On the other hand, detailed analysis on each of those unsuccessful countries may provide some additional insights. Moreover, it will be also quite interesting to expand this work to Africa and South America where many more developing counties are located, and then to compare what happened in Asia to other developing countries.

It was also observed that regardless of area and wealth, the majority of countries have Education at the top among the HDI indicators. It will be interesting to find out which is the true reason, (1) during this period, all over the world, Education was the real driver of HDI improvement, or (2) the current HDI emphasizes the impact of Education too much (the current calculation of HDI is too biased toward the Education component.)

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APPENDIX A: FIGURES AND TABLES

Figure 1. Summary of the Motivation of this Dissertation

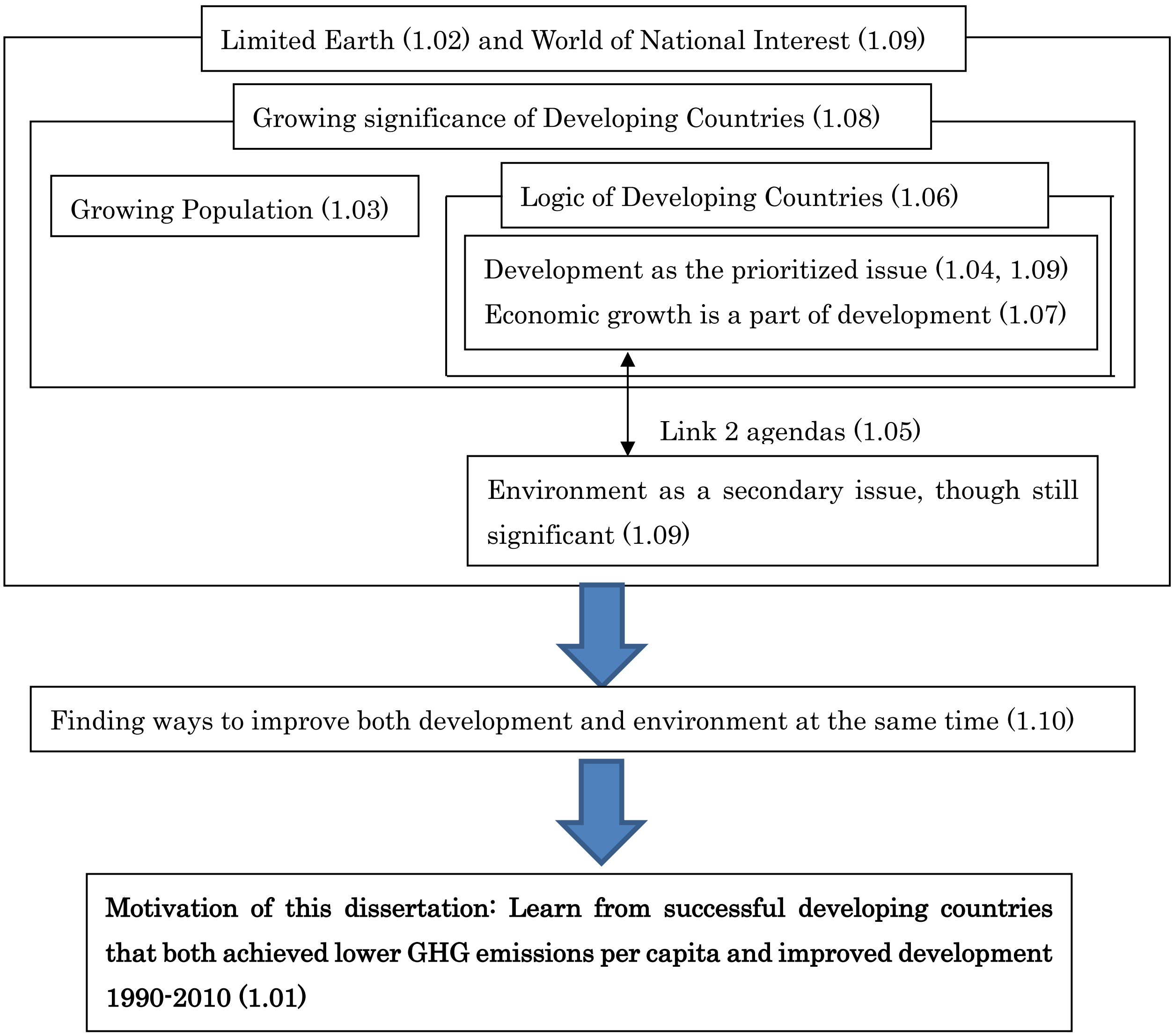
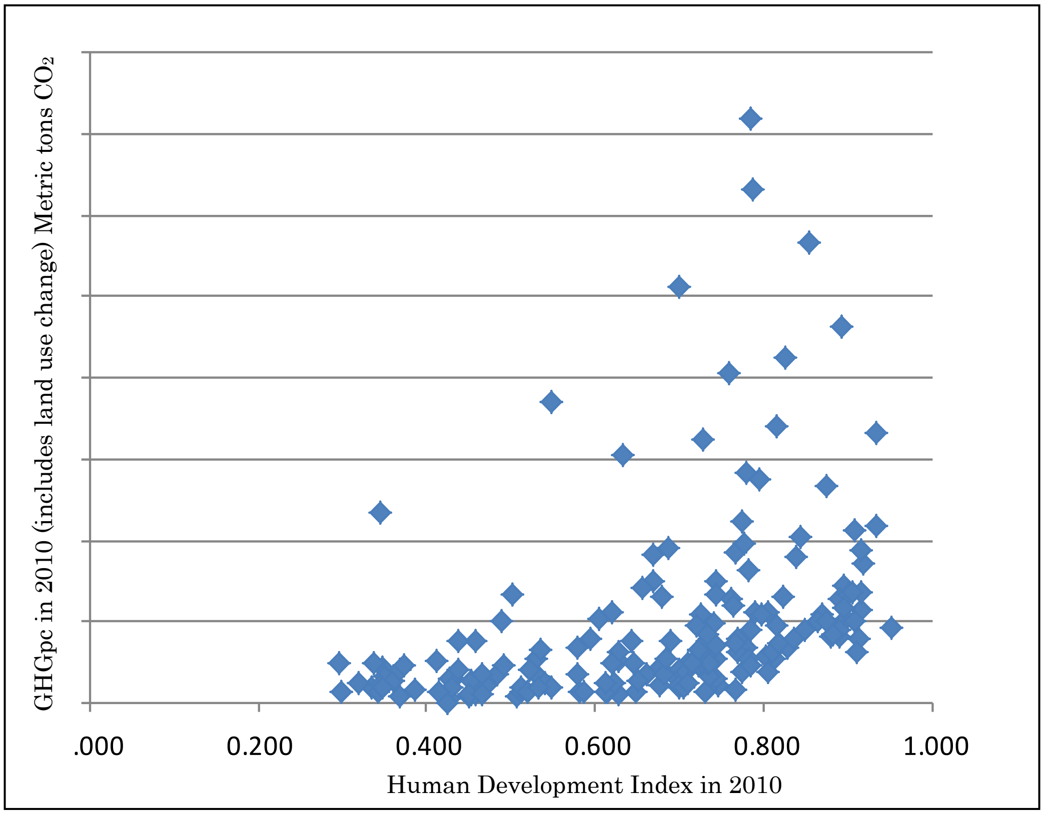
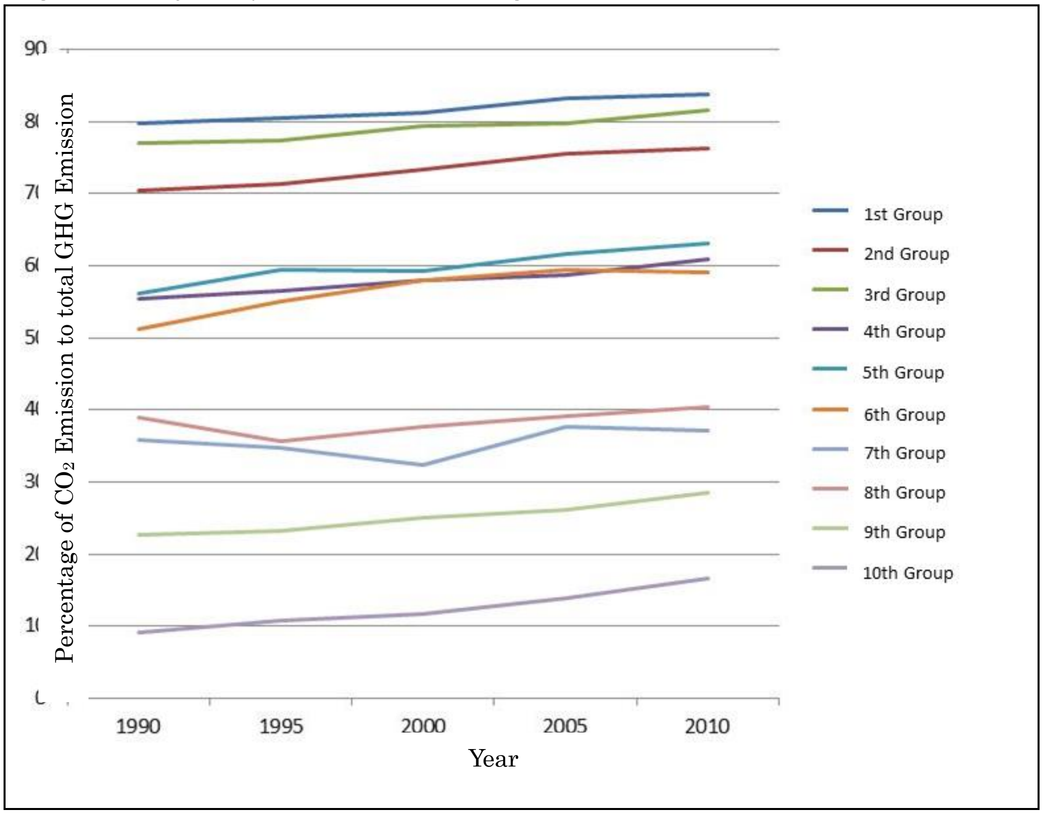


Figure 2. GHG Emissions per capita and HDI of 180 countries in 2010.



SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 3. Trajectory of CO_2 ratio among GHG[1]

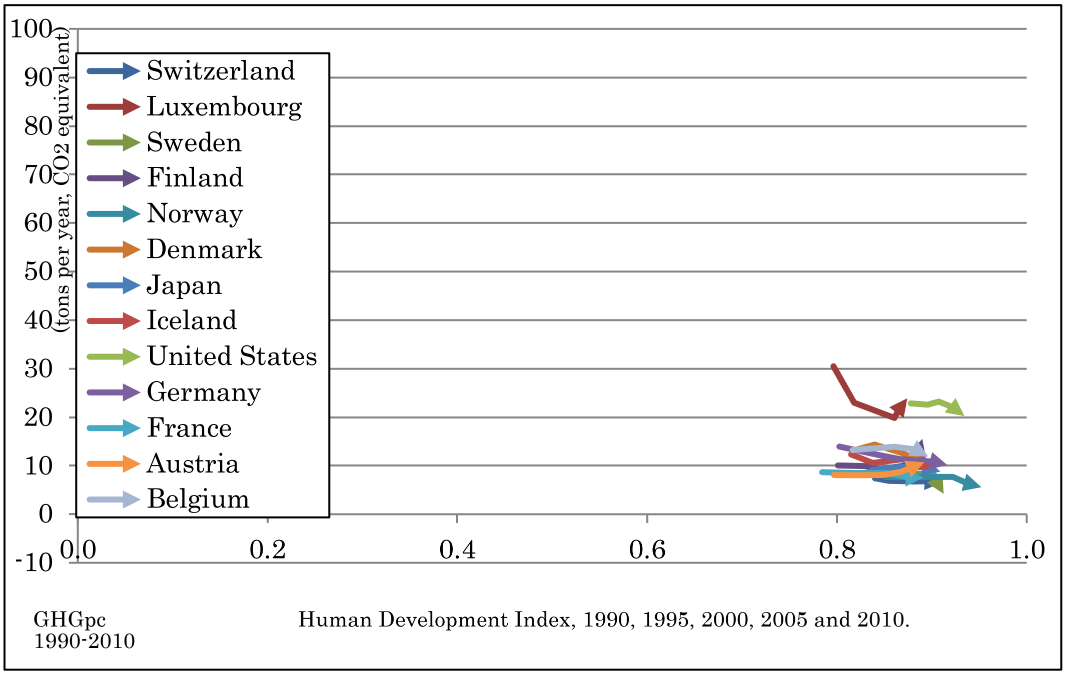


SOURCE: Climate Analysis Indicators Tool (GHG)

[1] The grouping has been done from the richest to the poorest at the year of 2010 where each group has 13 countries.

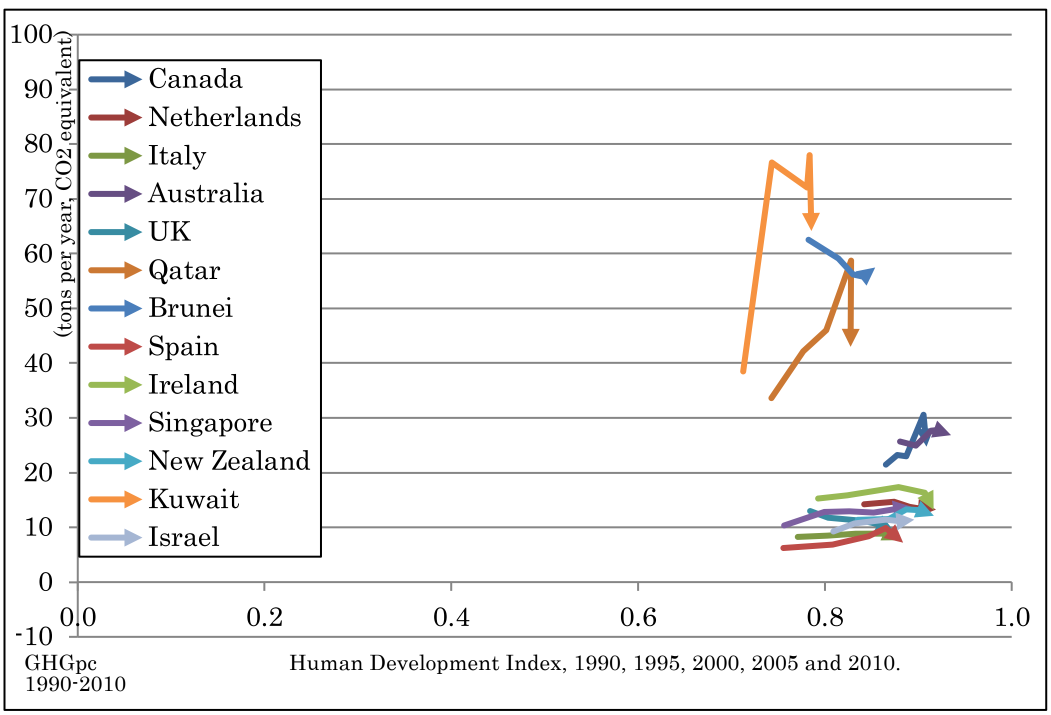
Appendix 1. GHG Emissions Per Capita by HDI for 10 Group Countries, 1990-2010.

Figure 4. GHG Emissions Per Capita by HDI, 1st Group Countries, 1990–2010.



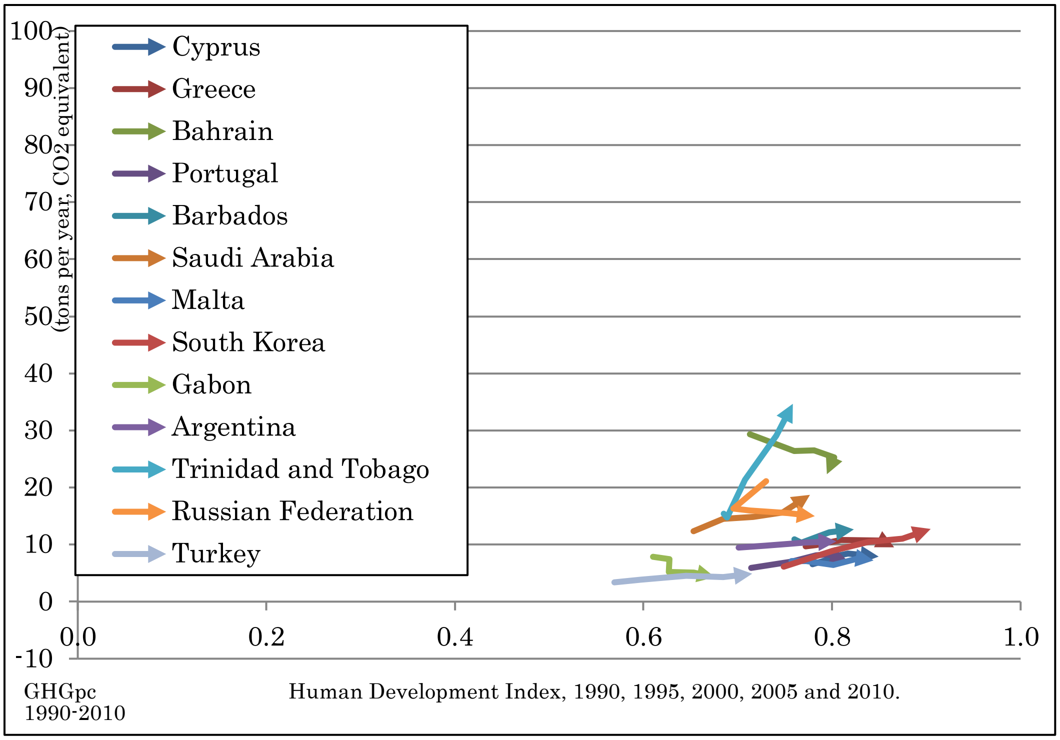
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 5. GHG Emissions Per Capita by HDI, 2nd Group Countries, 1990–2010.



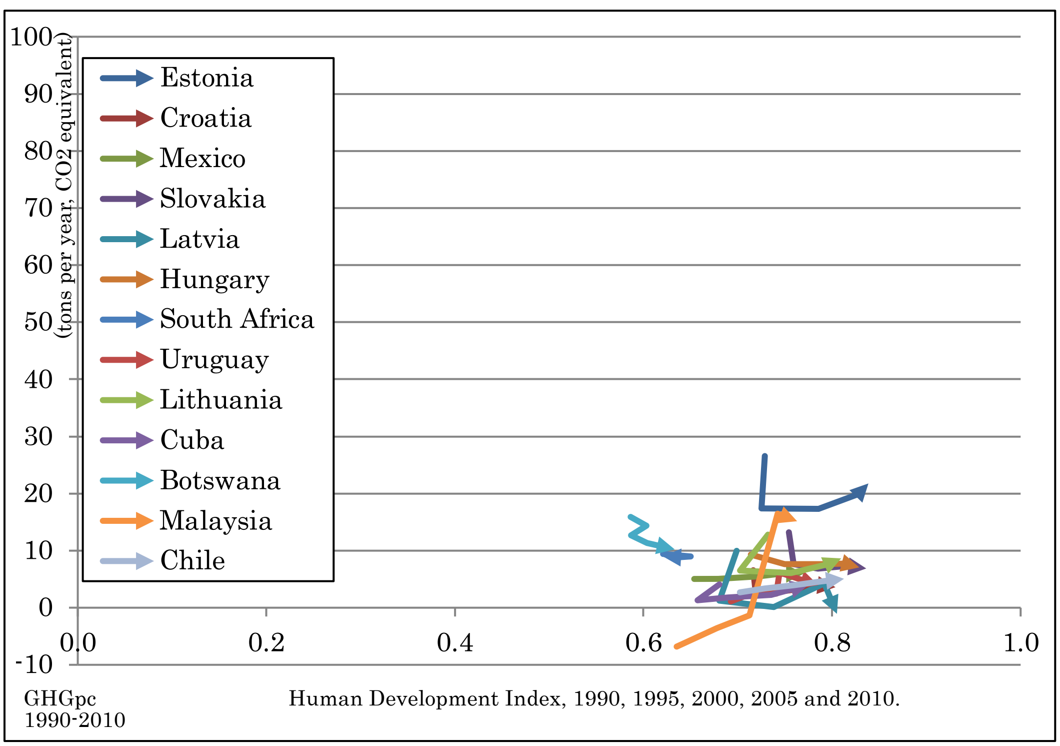
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 6. GHG Emissions Per Capita by HDI, 3rd Group Countries, 1990–2010.



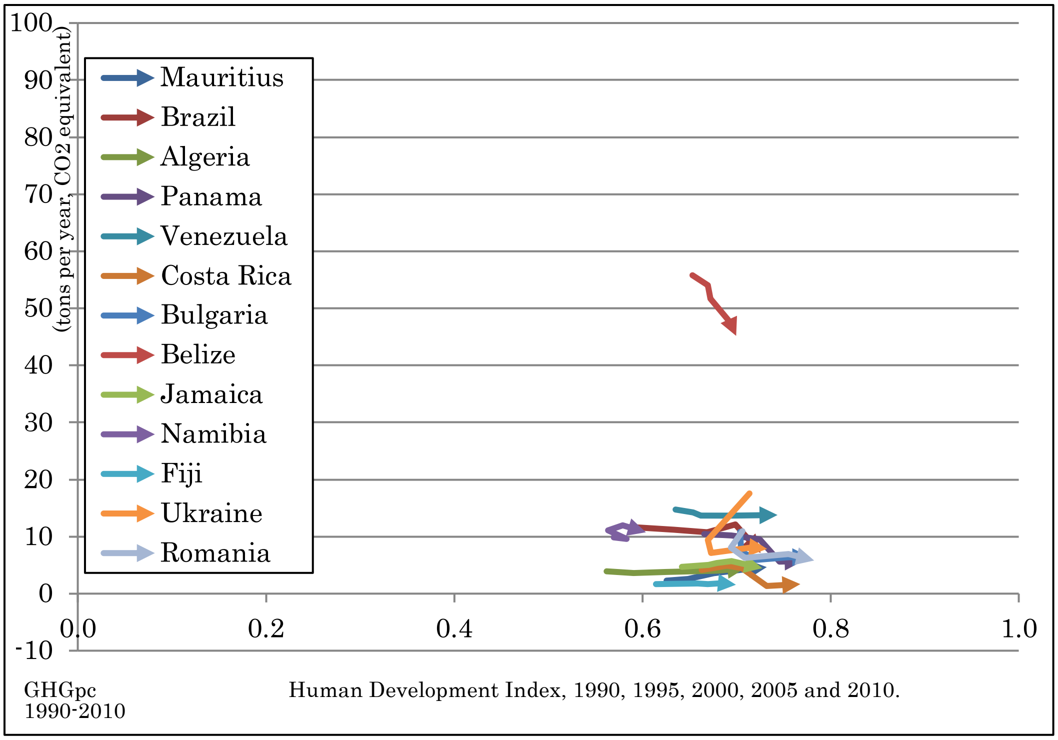
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 7. GHG Emissions Per Capita by HDI, 4th Group Countries, 1990–2010.



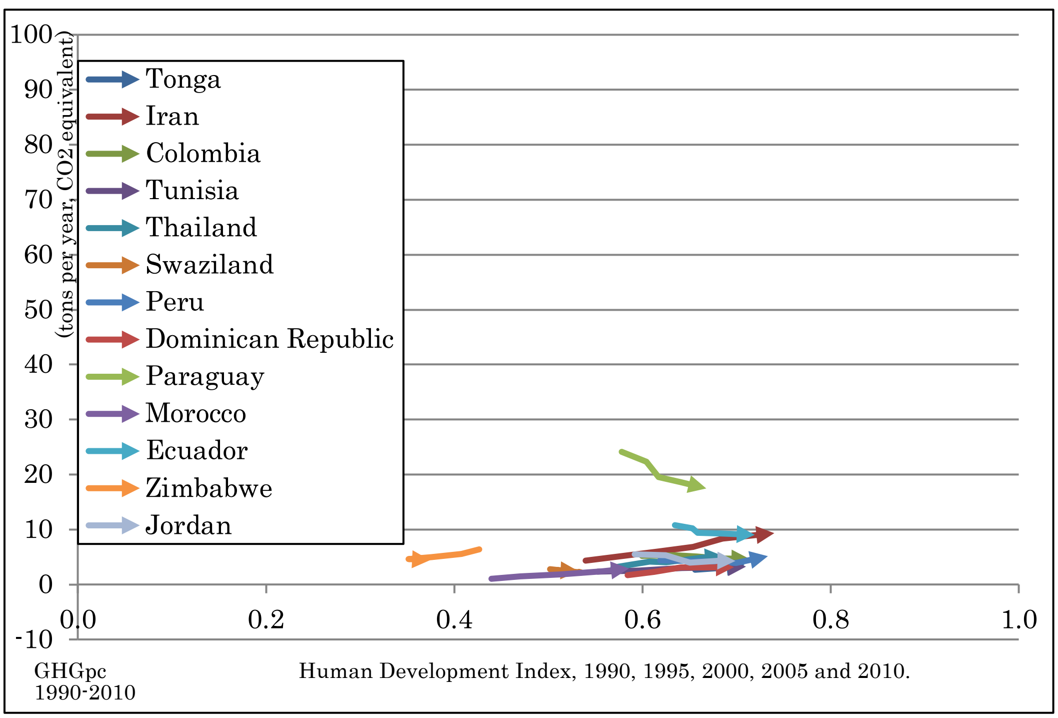
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 8. GHG Emissions Per Capita by HDI, 5th Group Countries, 1990–2010.



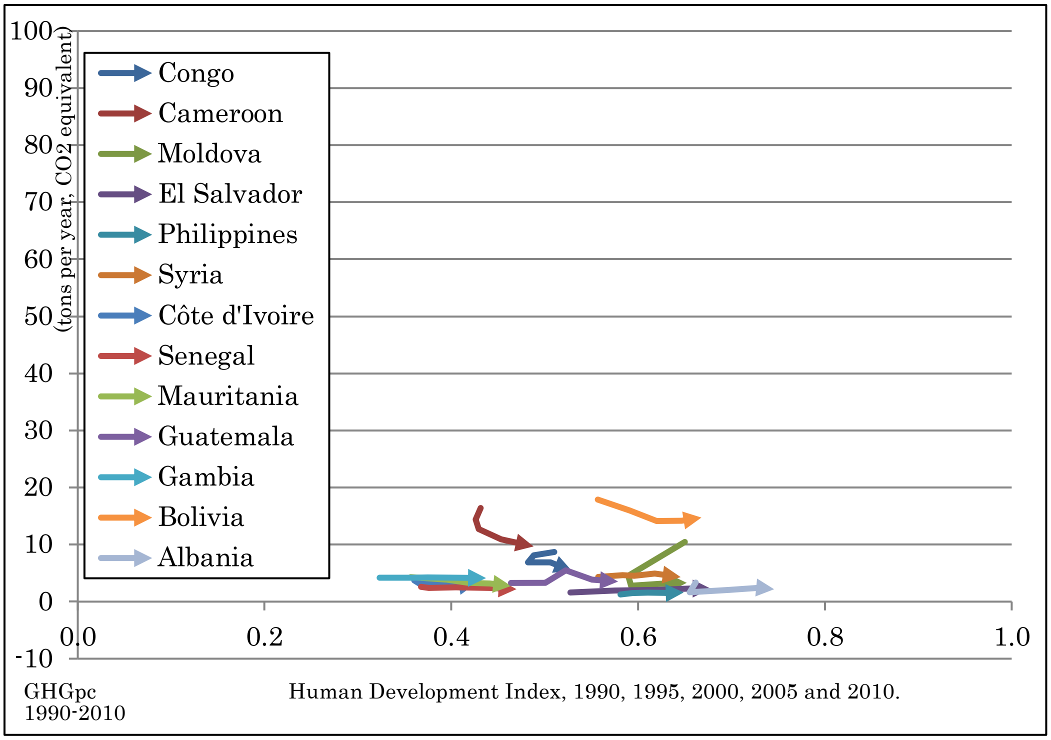
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 9. GHG Emissions Per Capita by HDI, 6th Group Countries, 1990–2010.



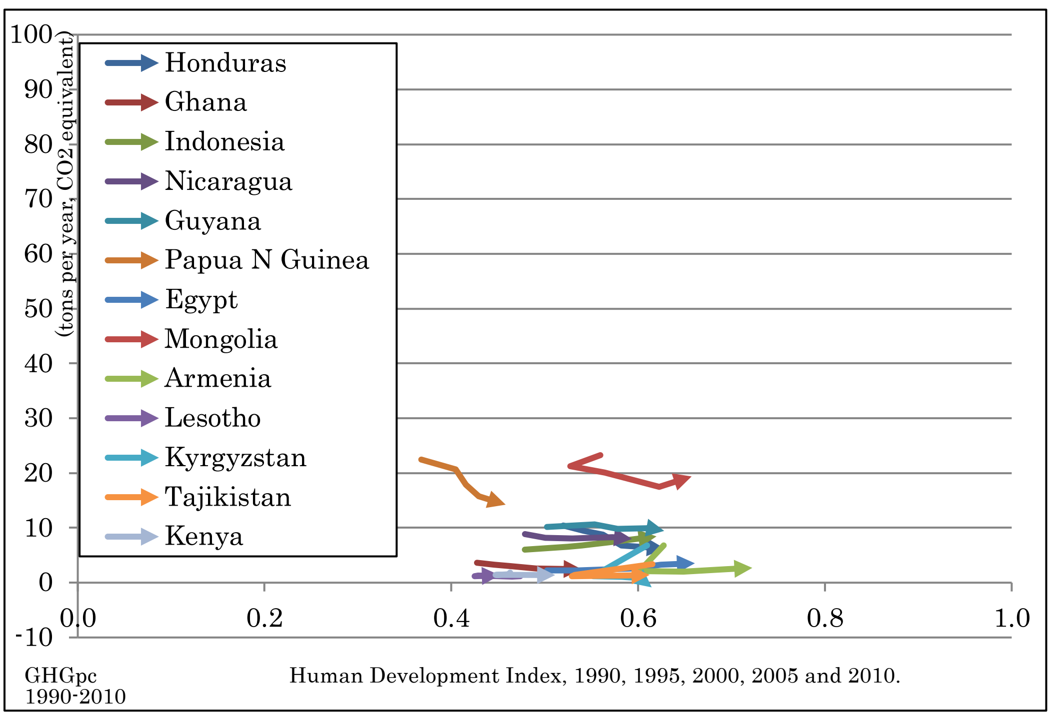
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 10. GHG Emissions Per Capita by HDI, 7th Group Countries, 1990–2010.



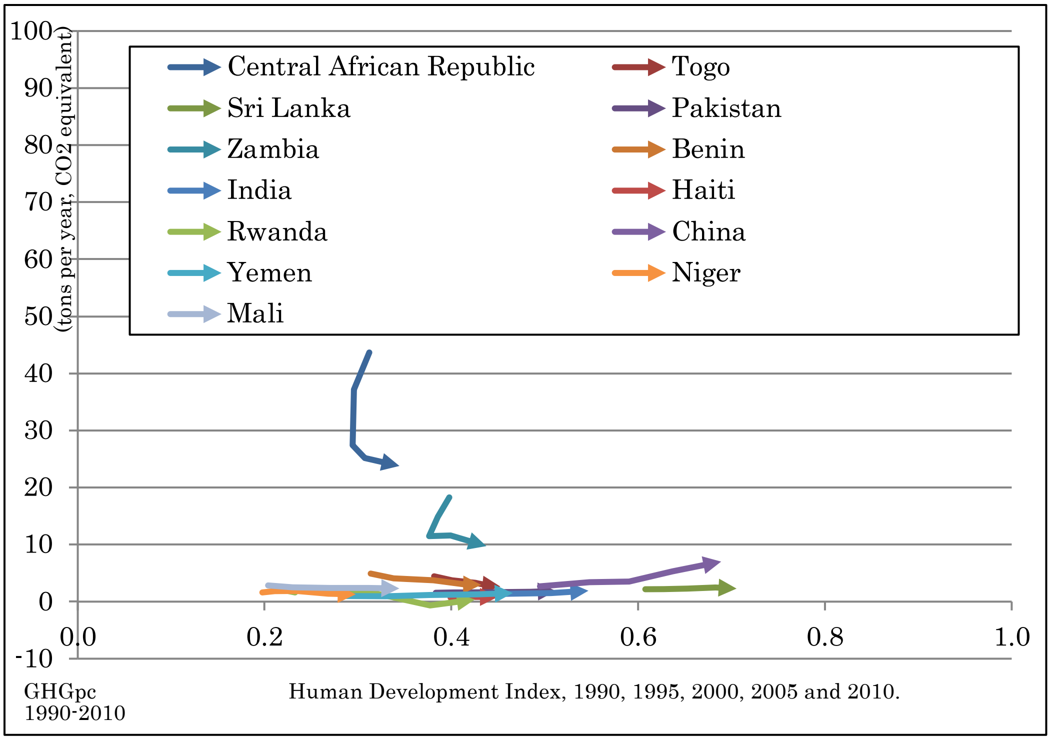
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 11. GHG Emissions Per Capita by HDI, 8th Group Countries, 1990–2010.



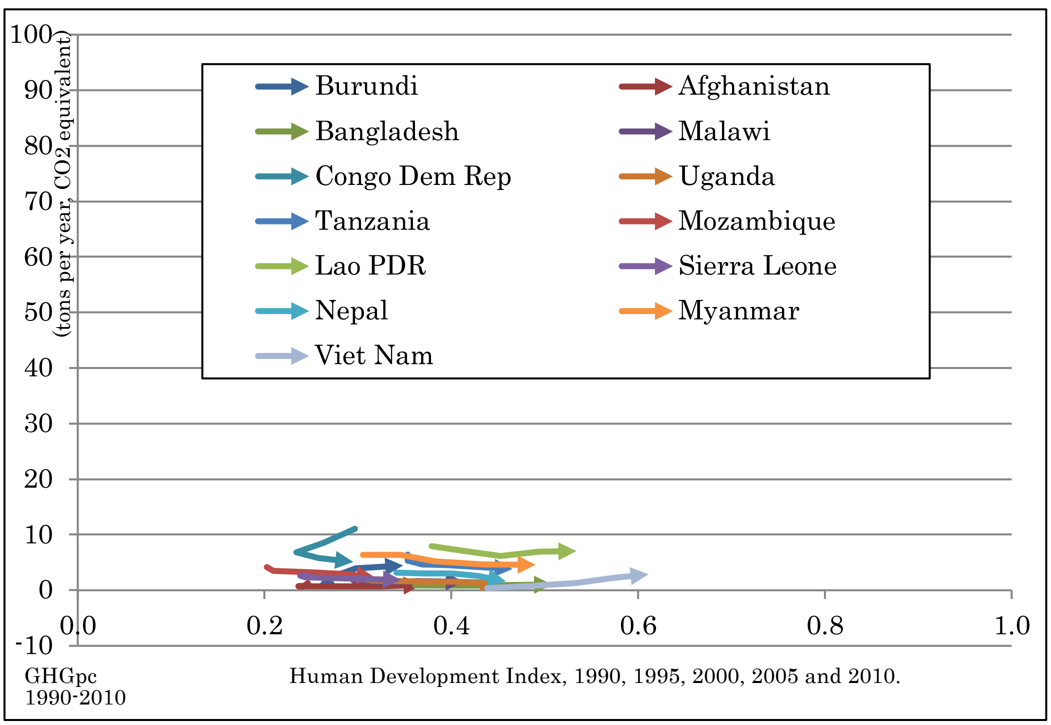
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 12. GHG Emissions Per Capita by HDI, 9th Group Countries, 1990–2010.



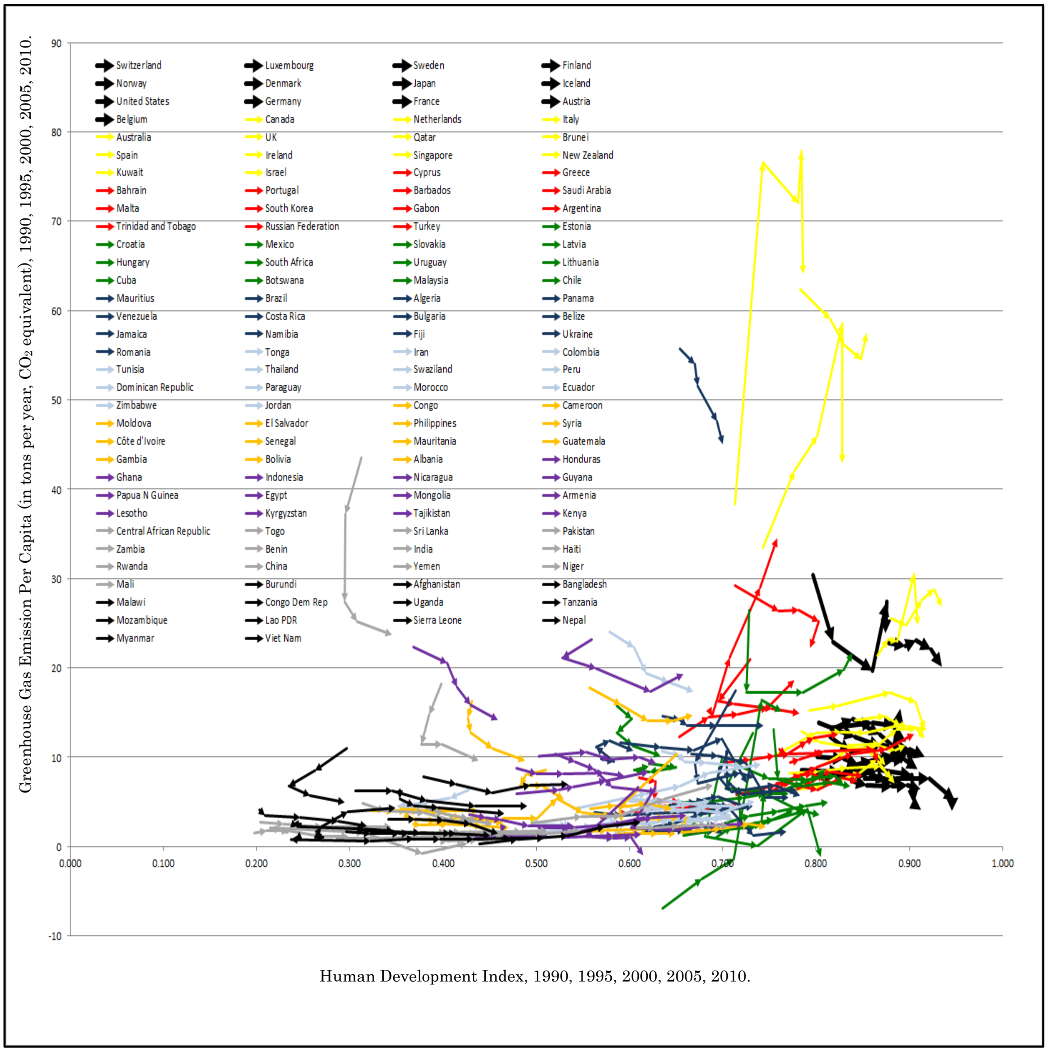
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 13. GHG Emissions Per Capita by HDI, 10th Group Countries, 1990–2010.



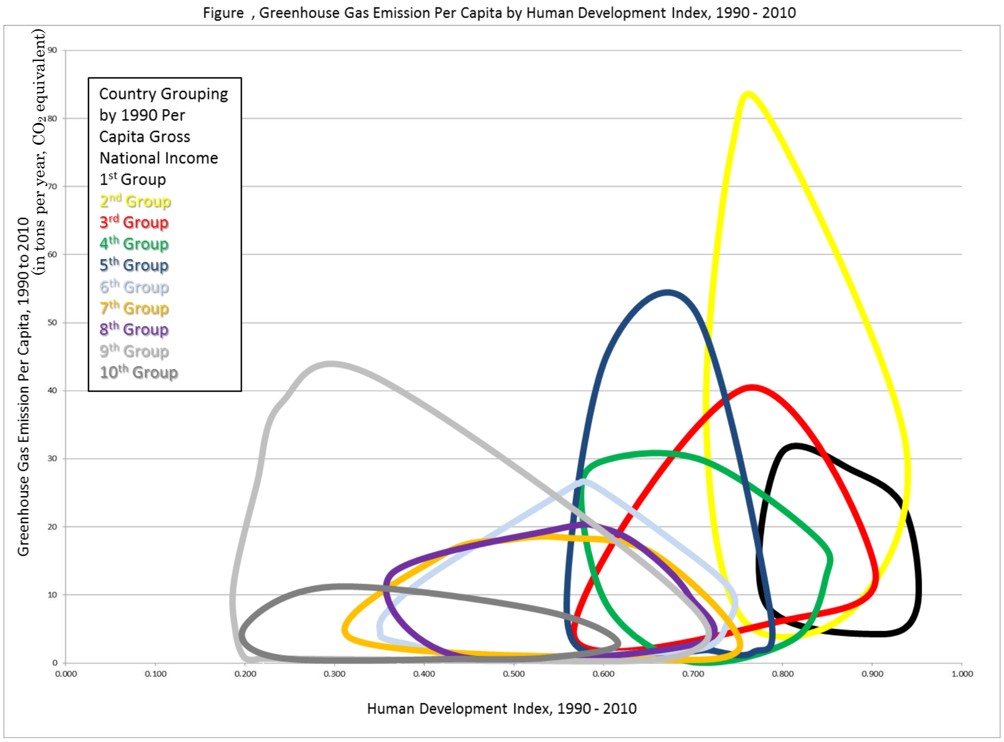
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 14. Greenhouse Gas Emissions Per Capita by Human Development Index, 1990–2010 (by individual countries).



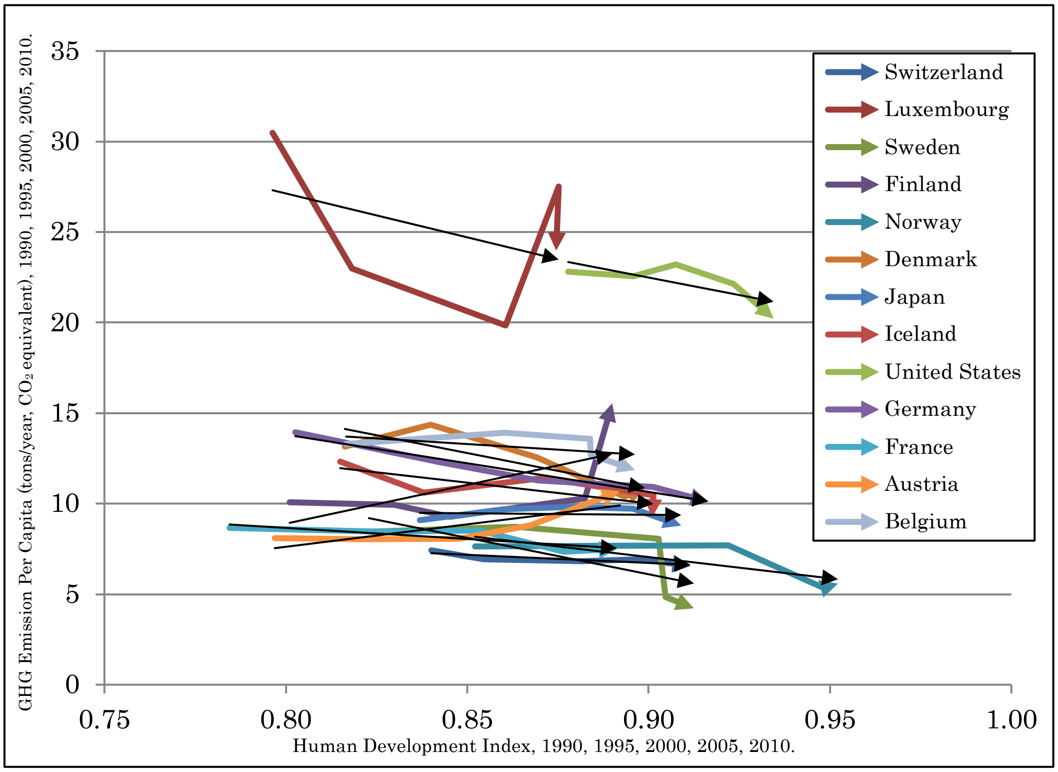
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 15. Greenhouse Gas Emissions Per Capita by Human Development Index (by income groups), 1990–2010.



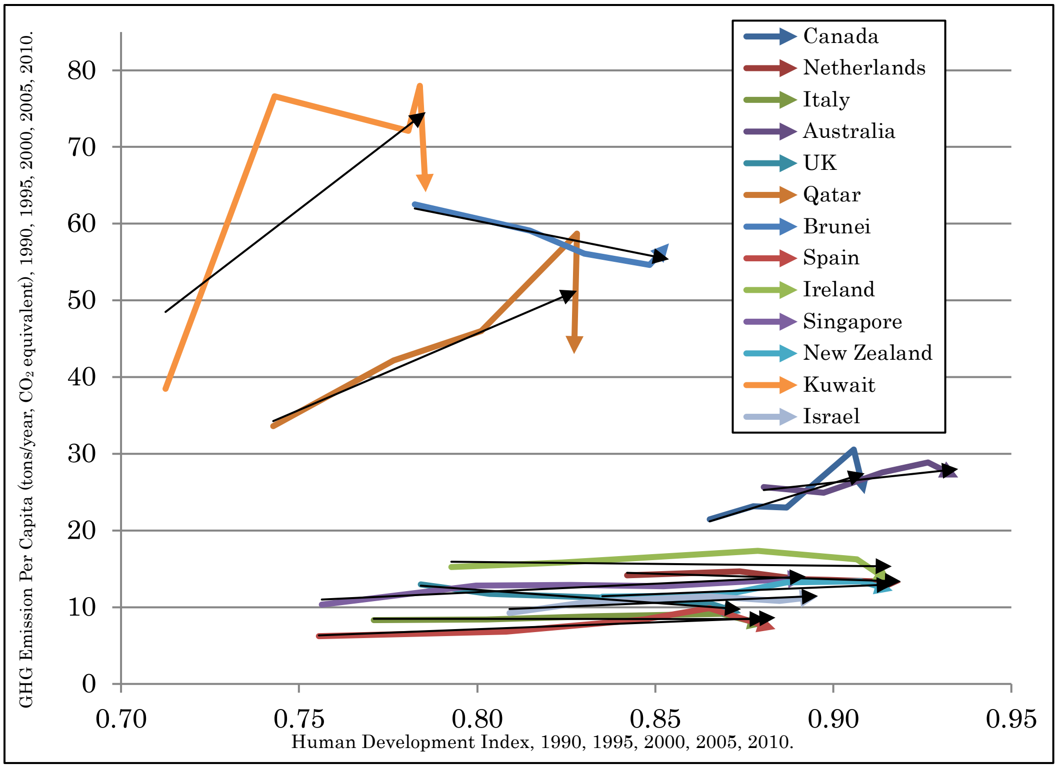
Appendix 2. GHG Emissions Per Capita by HDI for 10 Group Countries, 1990-2010.

Figure 16. GHG Emissions Per Capita by HDI, 1st Group Countries, 1990–2010 (enlarged).



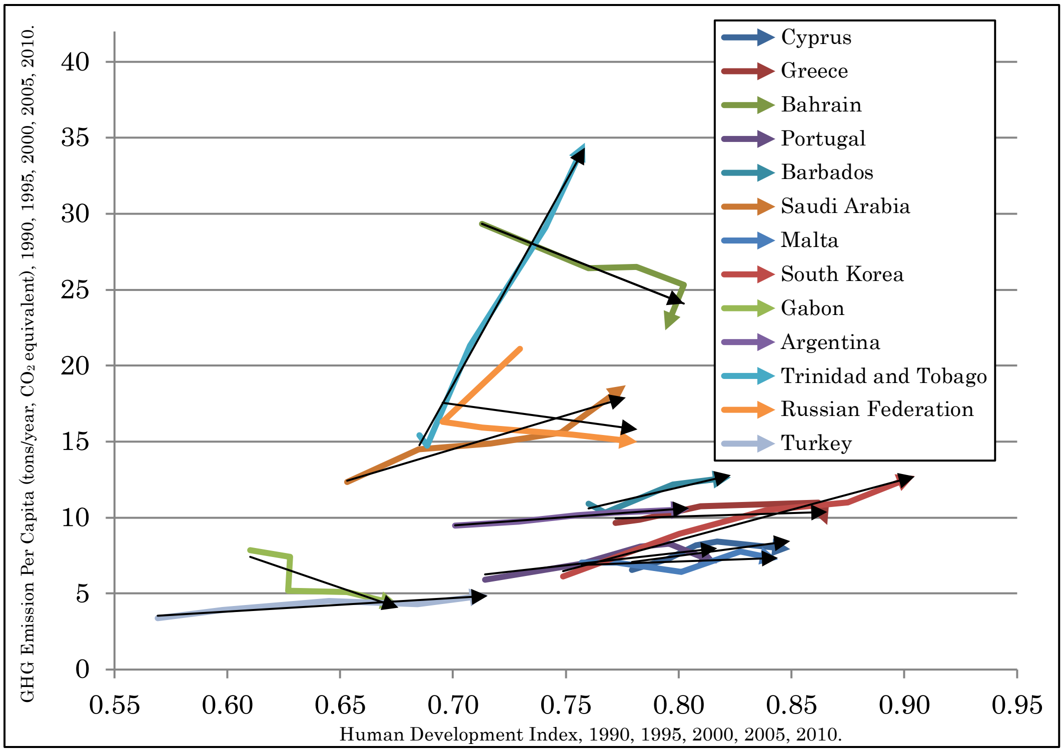
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 17. GHG Emissions Per Capita by HDI, 2nd Group Countries, 1990–2010 (enlarged).



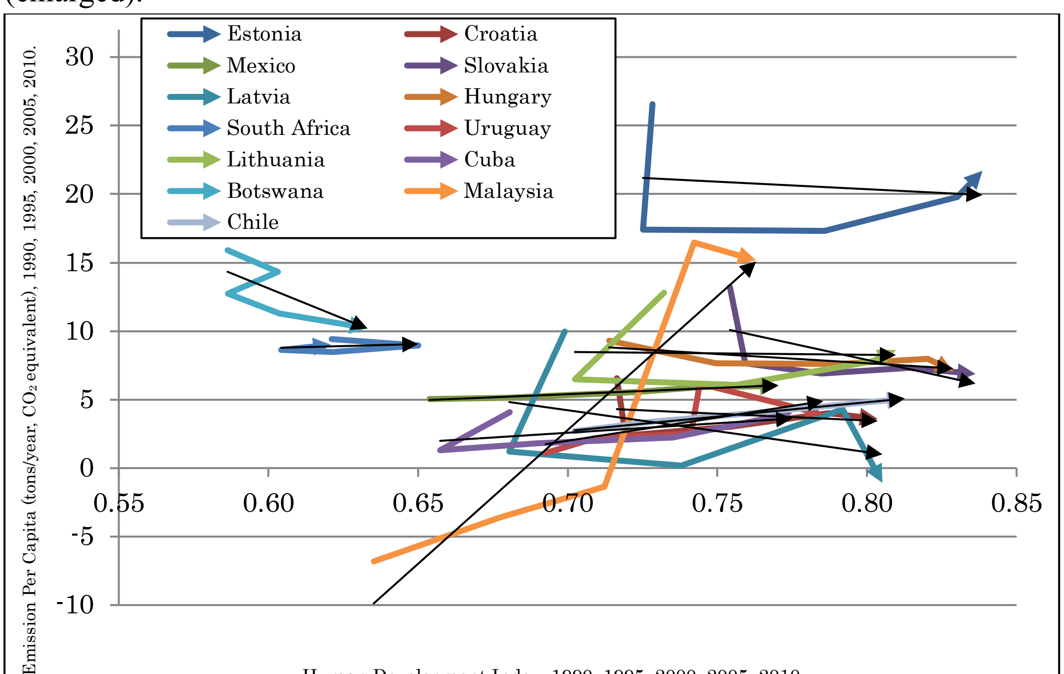
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 18. GHG Emissions Per Capita by HDI, 3rd Group Countries, 1990–2010.



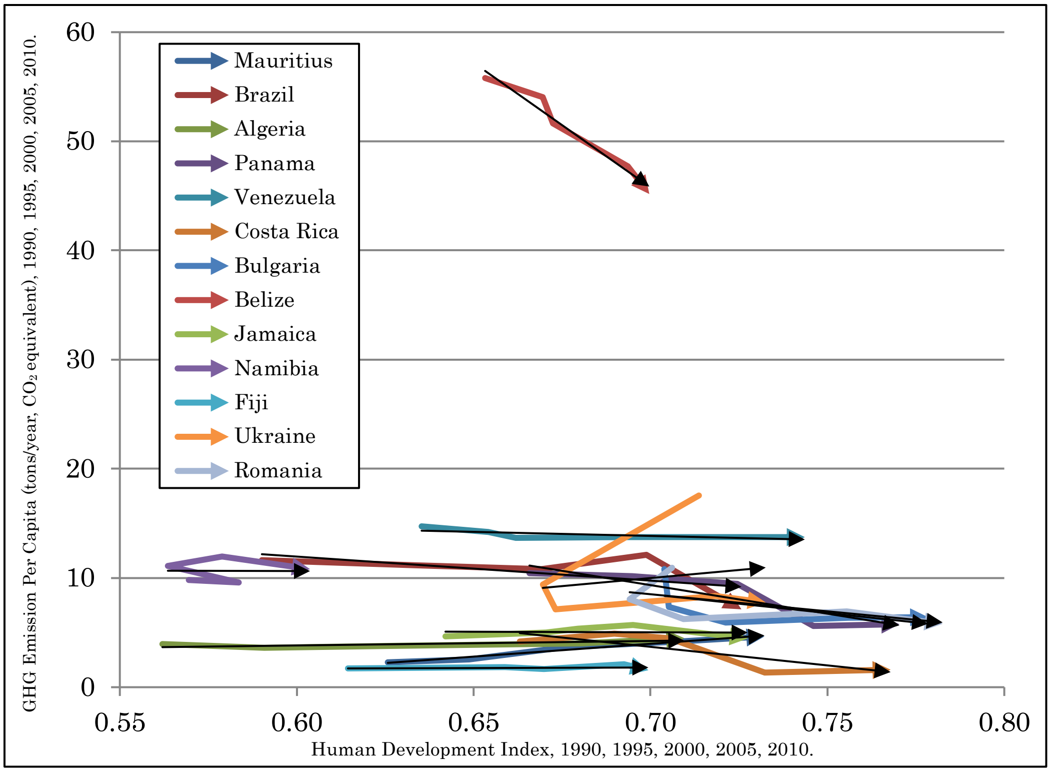
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 19. GHG Emissions Per Capita by HDI, 4th Group Countries, 1990–2010 (enlarged).



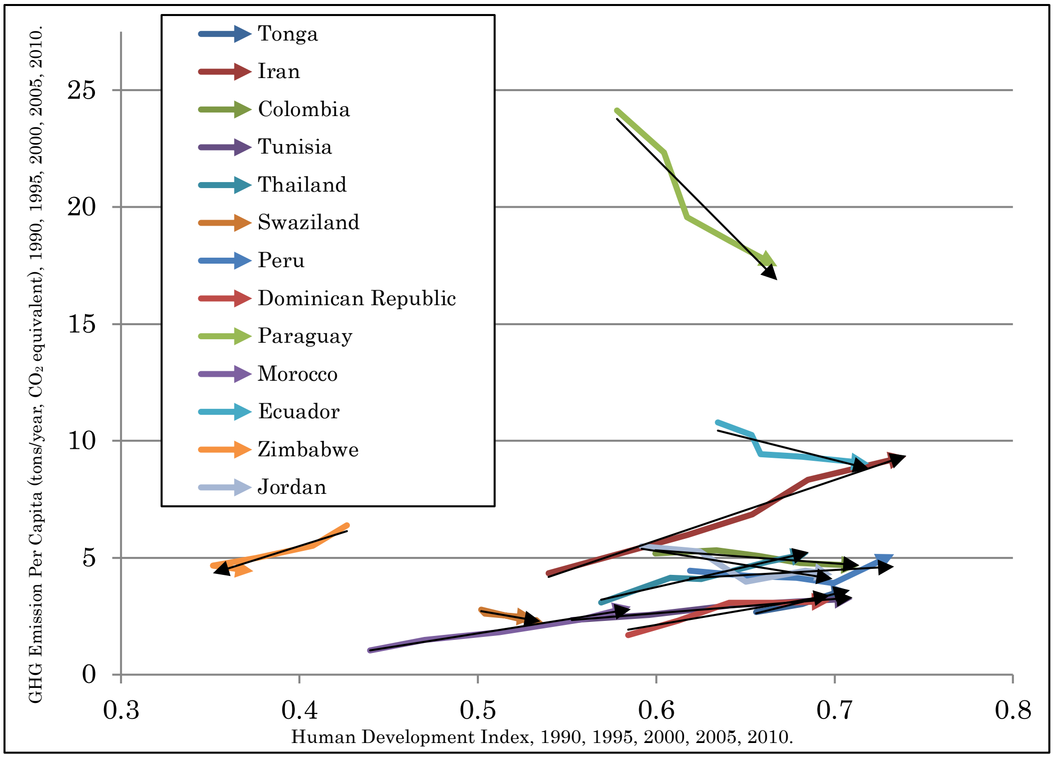
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 20. GHG Emissions Per Capita by HDI, 5th Group Countries, 1990–2010 (enlarged).



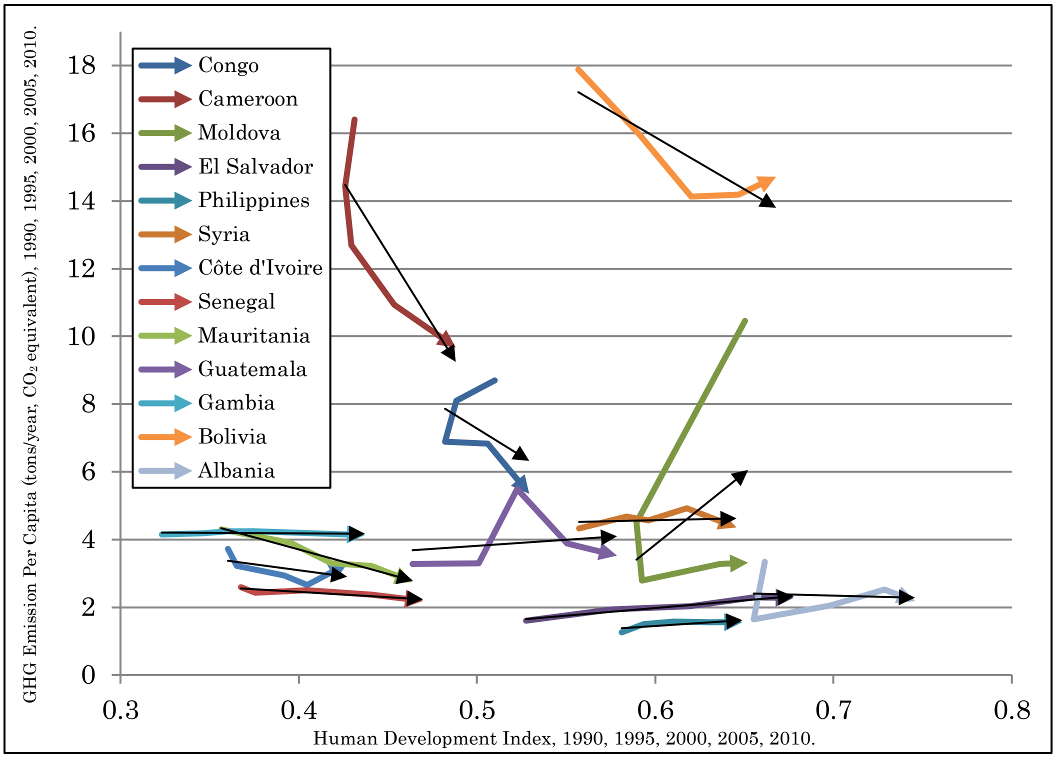
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 21. GHG Emissions Per Capita by HDI, 6th Group Countries, 1990–2010 (enlarged).



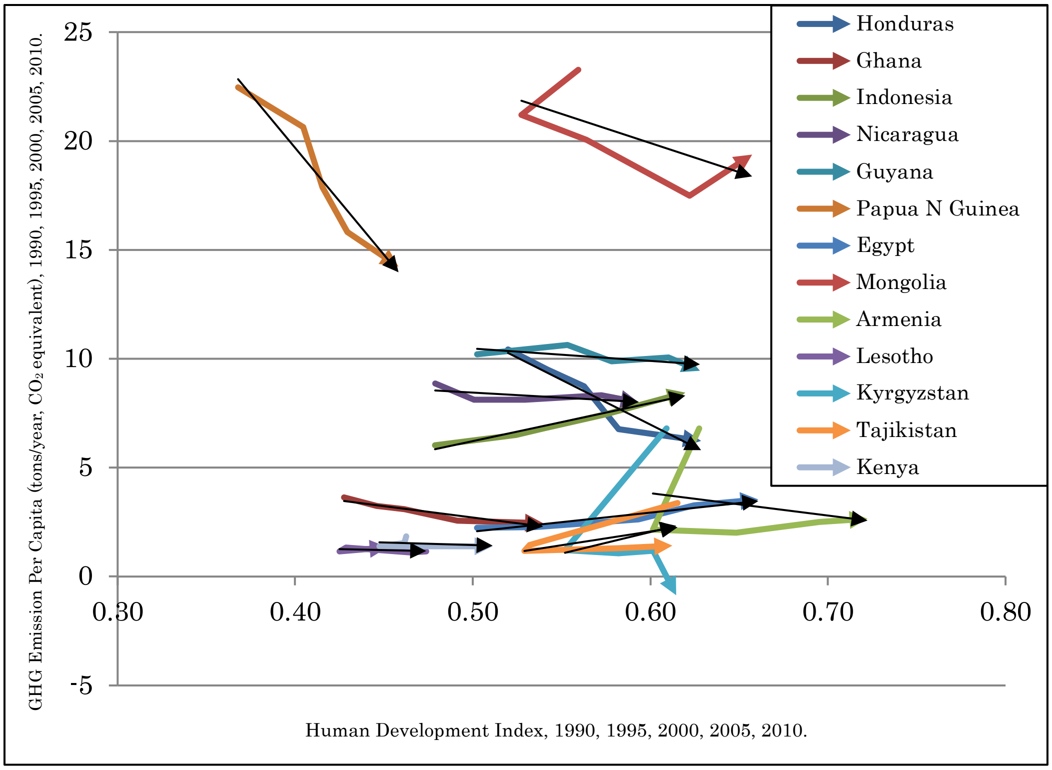
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 22. GHG Emissions Per Capita by HDI, 7th Group Countries, 1990–2010 (enlarged).



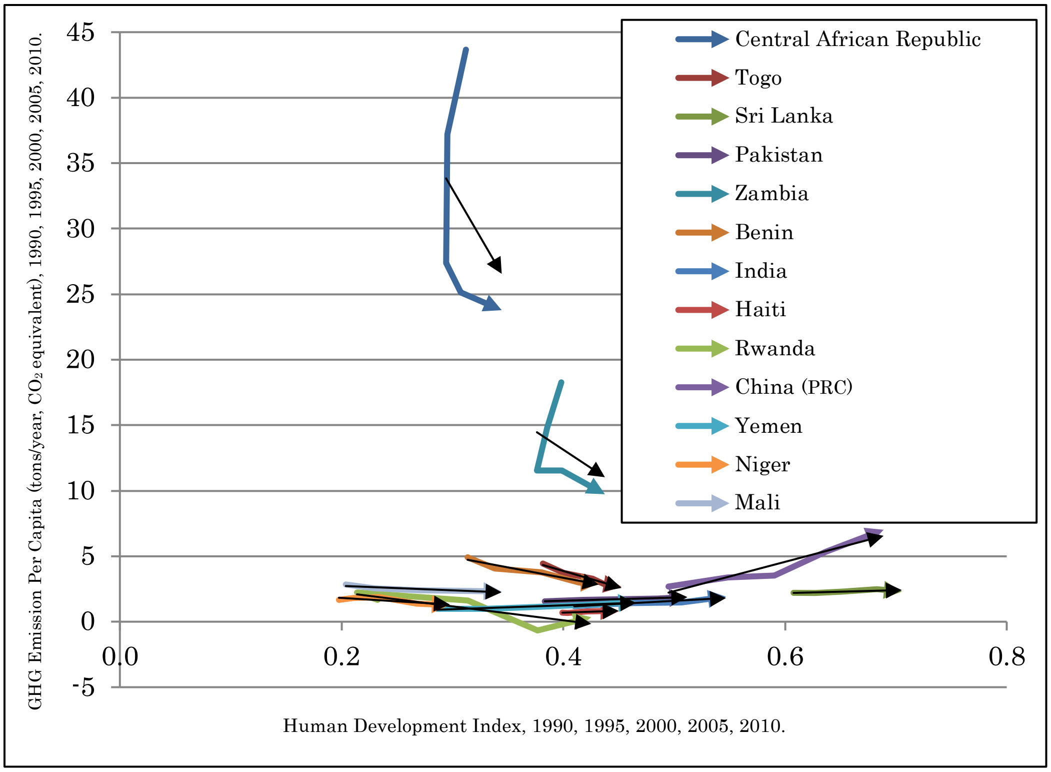
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 23. GHG Emissions Per Capita by HDI, 8th Group Countries, 1990–2010 (enlarged).



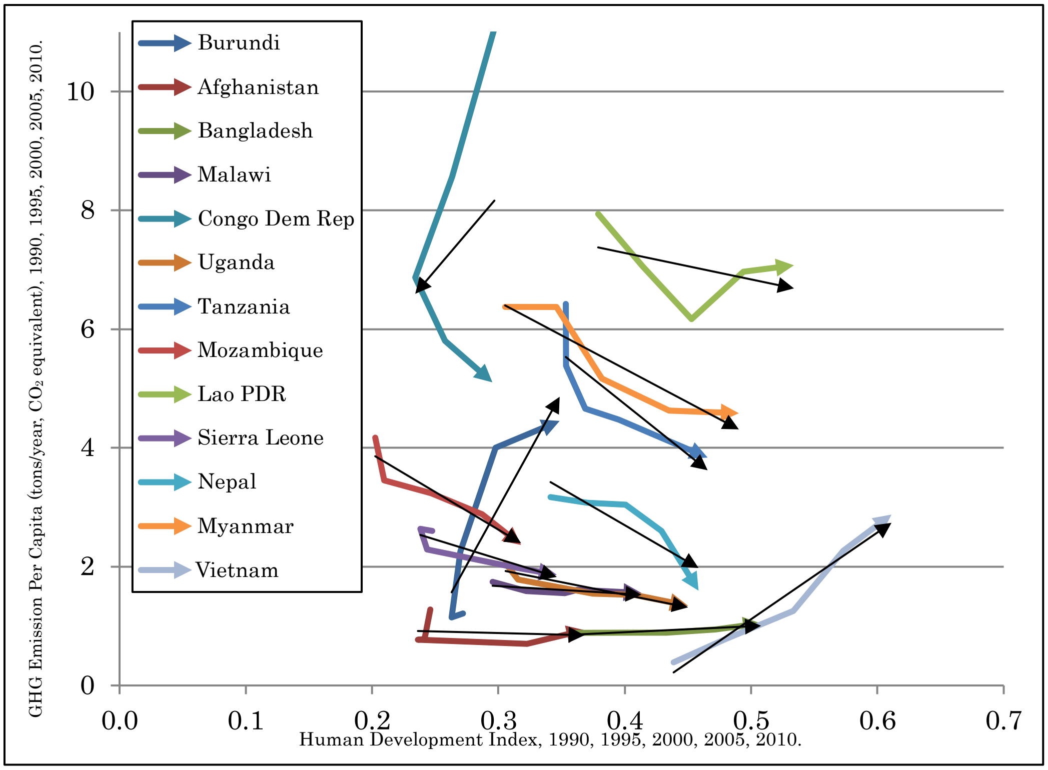
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 24. GHG Emissions Per Capita by HDI, 9th Group Countries, 1990–2010 (enlarged).



SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 25. GHG Emissions Per Capita by HDI, 10th Group Countries, 1990–2010 (enlarged).



SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

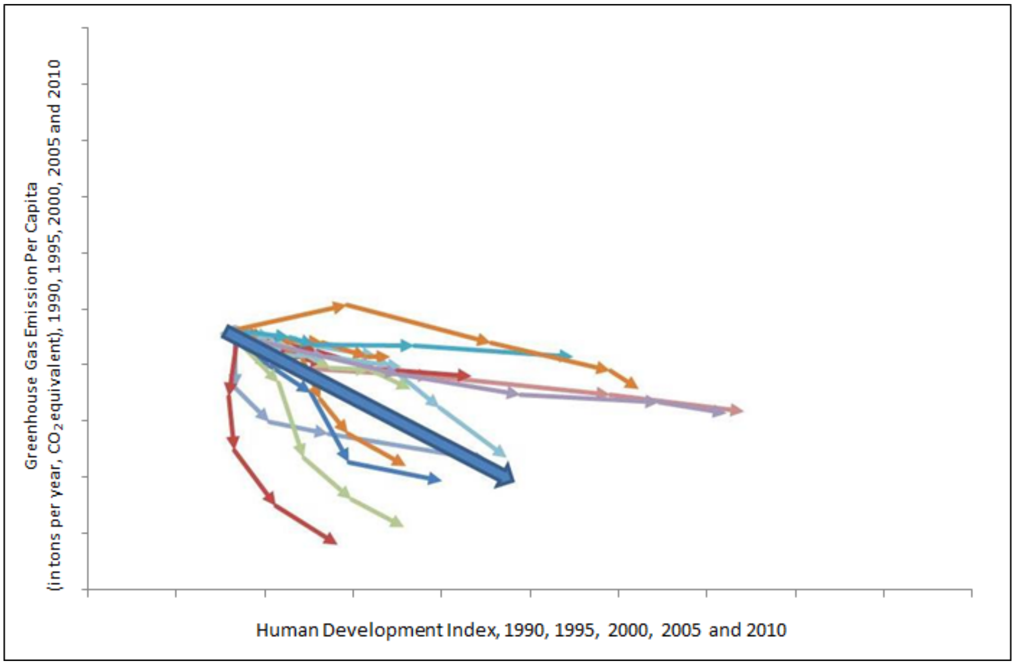
Appendix 3. GHG Emission per capita and HDI of Countries (these figures are to compare their shapes, so no values are indicated on each axis)

Figure 26. Trajectory Group - Downward Slope to the Right: Continuous Improvement of HDI and Slight Decrease of GHGpc

Countries Included: Jamaica, Tunisia, Ireland, United Kingdom, Italy, Mali, Malawi, Uganda, France, Switzerland

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

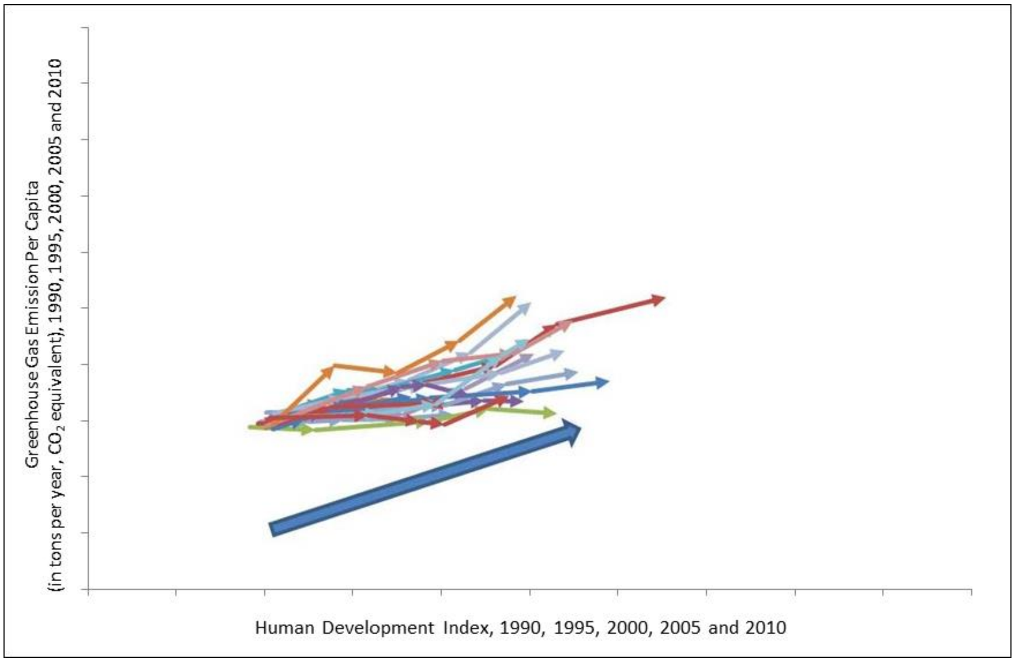
Figure 27. Trajectory Group - Steep Downward Slope to the Right: Continuous Improvement of HDI and Significant Decrease of GHGpc



Countries Included: Venezuela, Papua New Guinea, Honduras, Paraguay, Ghana, Ecuador, Mauritania, Cameroon, Togo, Benin, Mozambique, Nepal, Tanzania, Germany, Denmark

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 28. Trajectory Group - Upward Slope to the Right: Continuous Improvement of HDI and Significant Increase of GHGpc



Countries Included: El Salvador, Syria, Vietnam, India, China (PRC), Egypt, Tonga, Thailand, Iran, Mauritius, Chile, Mexico, Portugal, Cyprus, Greece, South Korea, New Zealand, Saudi Arabia, Netherlands

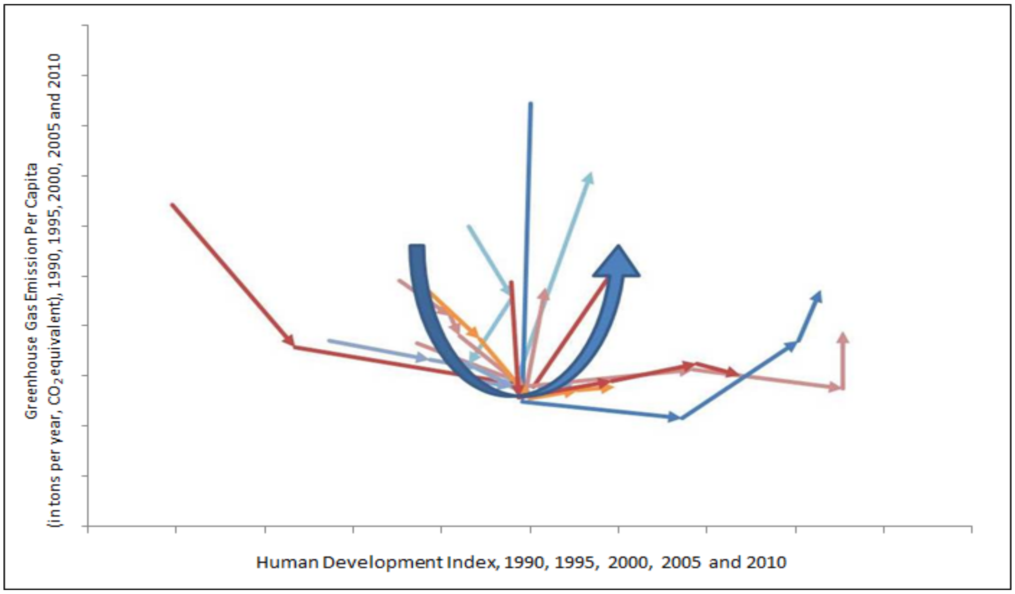
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 29. Trajectory Group - Sloping to the Right: Continuous Improvement of HDI and Slight Increase or No Change in GHGpc

Countries Included: Turkey, Philippines, Morocco, Algeria, Argentina, Fiji, Gambia, Haiti, Pakistan, Sri Lanka, Yemen, Bangladesh

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

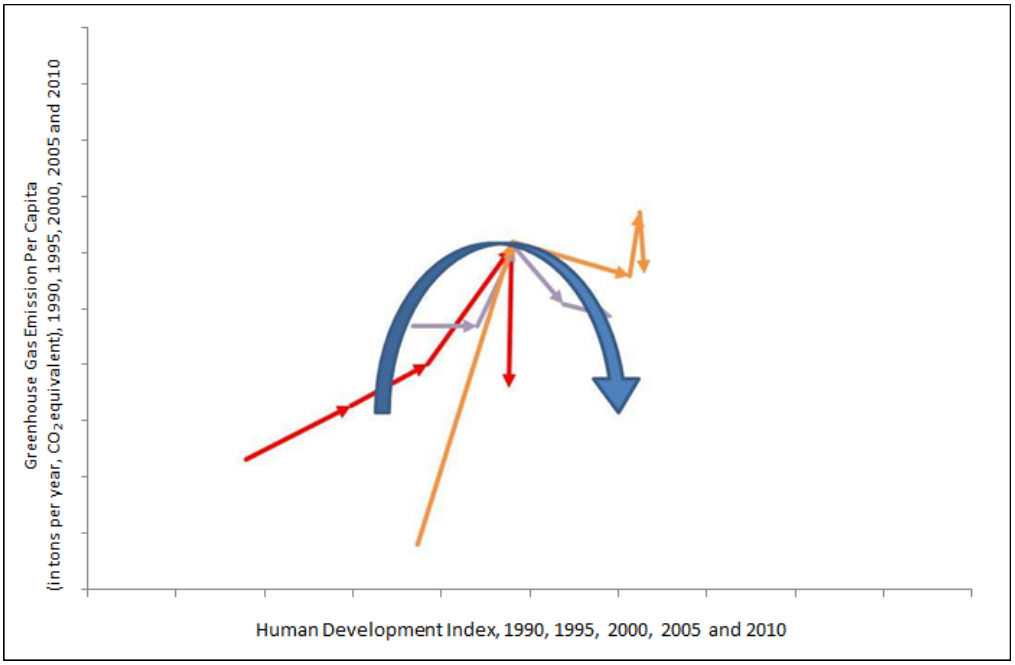
Figure 30. Trajectory Group - U-Shaped: Continuous Improvement in HDI, while GHGpc Initially Decreases then Eventually Increases



Countries Included: Countries Included: Luxembourg, Belize, Bolivia, Ivory Coast, Estonia, Croatia, Botswana, Brunei Darussalam, Iceland

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

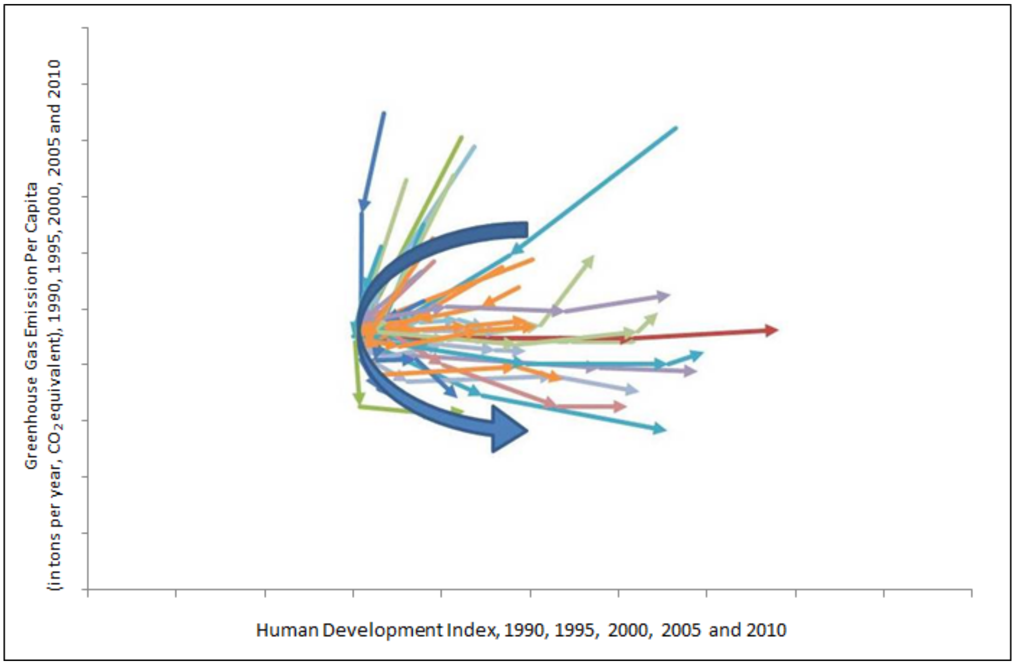
Figure 31. Trajectory Group - Inverted U: Continuous Improvement in HDI, while GHGpc Initially Increases then Eventually Decreases



Countries Included: Qatar, Kuwait, Guatemala

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

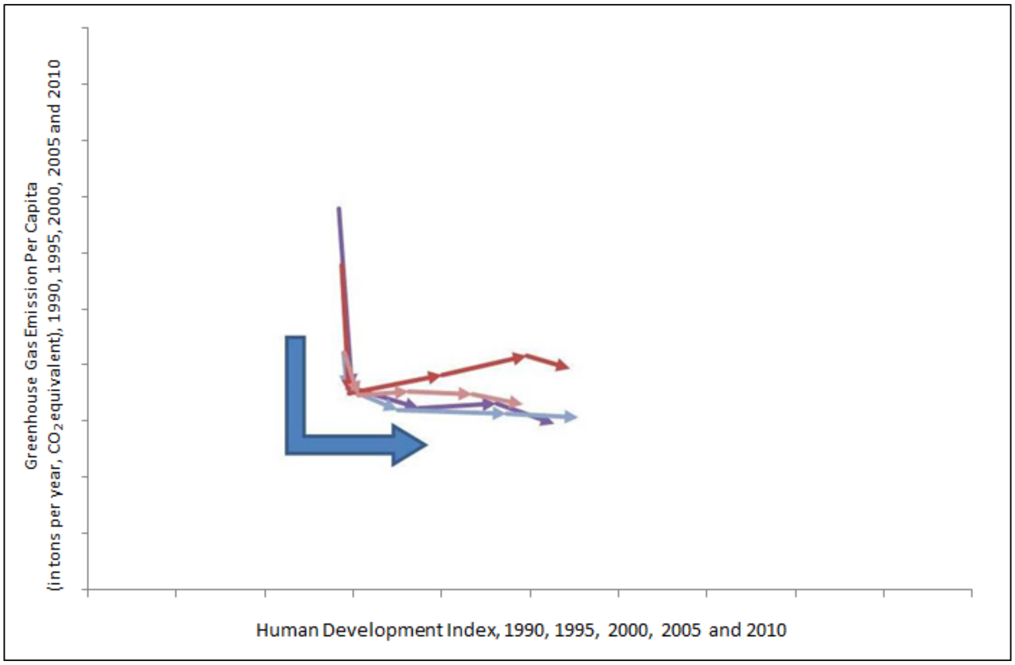
Figure 32. Trajectory Group - U-Shaped Curved to the Right: HDI Declines and GHGpc initially Decreases, then HDI Improves while GHGpc Continuously Decrease



Countries Included: Armenia, Rwanda, Afghanistan, Central African Republic, Sierra Leone, Kenya, Zambia, Congo Democratic Republic, Romania, Moldova, Albania, Kyrgyzstan, Mongolia, Tajikistan, Congo. Zimbabwe, Ukraine, Latvia, Lithuania, Cuba, Russian Federation

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 33. Trajectory Group - Steep Downward Slope then to the Right: HDI is Unchanged while GHGpc Significantly Decreases, then Improvement in HDI while GHGpc is Unchanged



Countries Included: Bulgaria, Senegal, Croatia, Slovakia

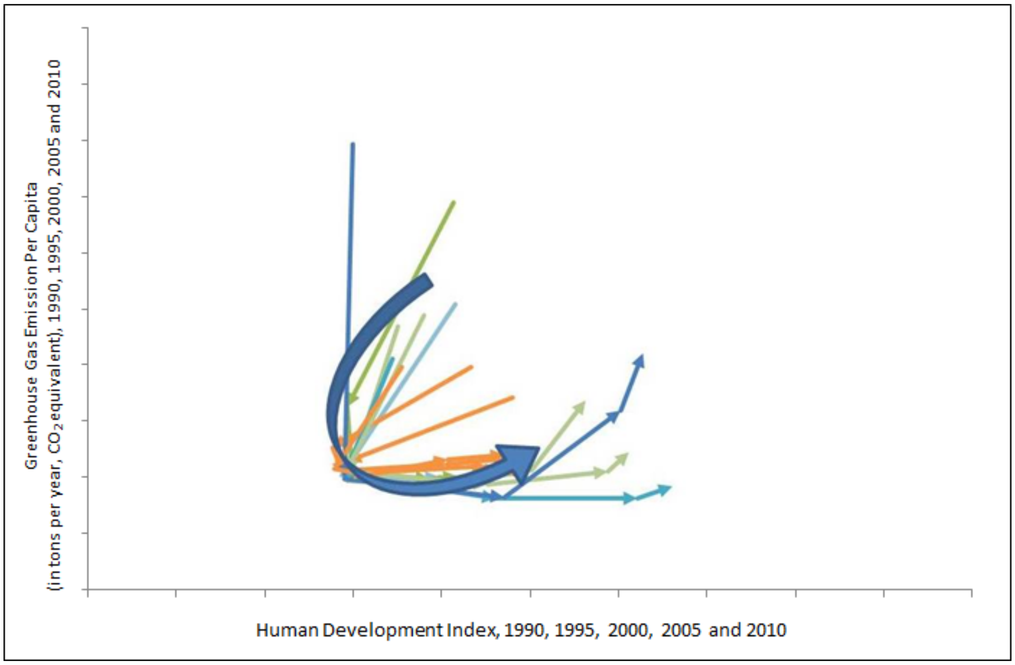
SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 34. Trajectory Group - Sloping to the Right then Steep Upward Slope: Improvement in HDI while GHGpc Unchanged, then Significant Increase in GHGpc with Slight HDI Improvement

Countries Included: Barbados, Trinidad and Tobago, Malta, Singapore, Australia

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 35. Trajectory Group - Former Soviet Union



Countries Included: Armenia, Estonia, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Ukraine

Countries Not Included: Azerbaijan, Belarus, Georgia, Kazakhstan, Turkmenistan, Uzbekistan

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 36. Trajectory Group - G8 Countries

Member Countries: USA, Germany, Japan, France, Canada, UK, Italy, Russia (not included)

SOURCE: Climate Analysis Indicators Tool (GHGpc) and United Nations Development Programme (HDI)

Figure 37. Number of Successful Countries per Country Group, 1990–2010.

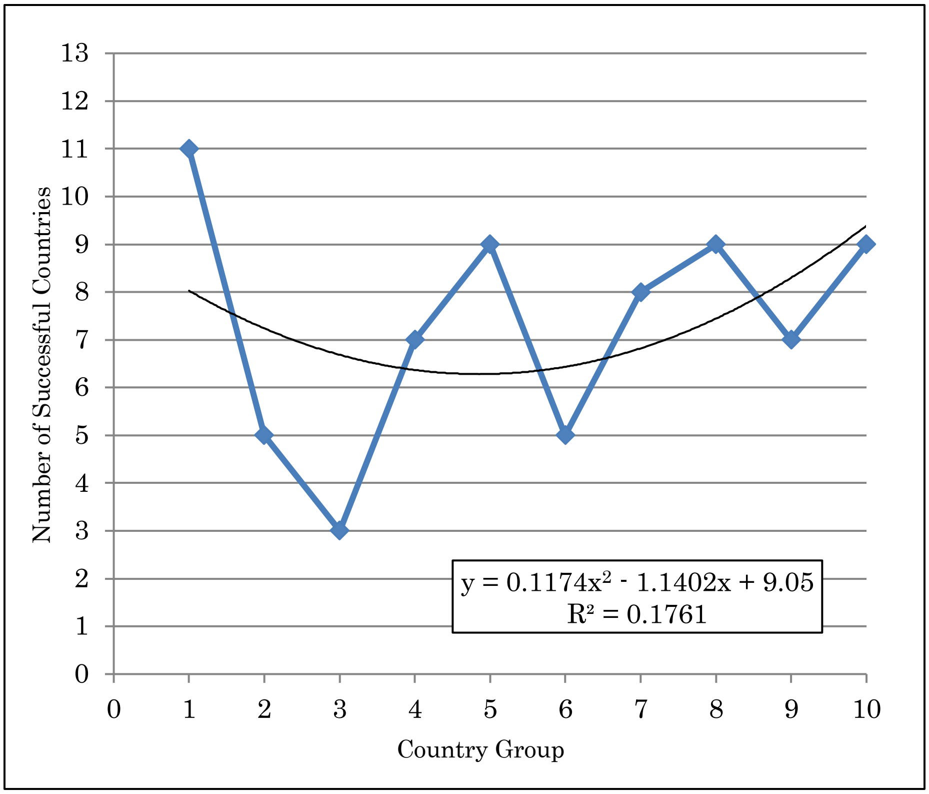


Figure 38. Trajectories of Asian Countries

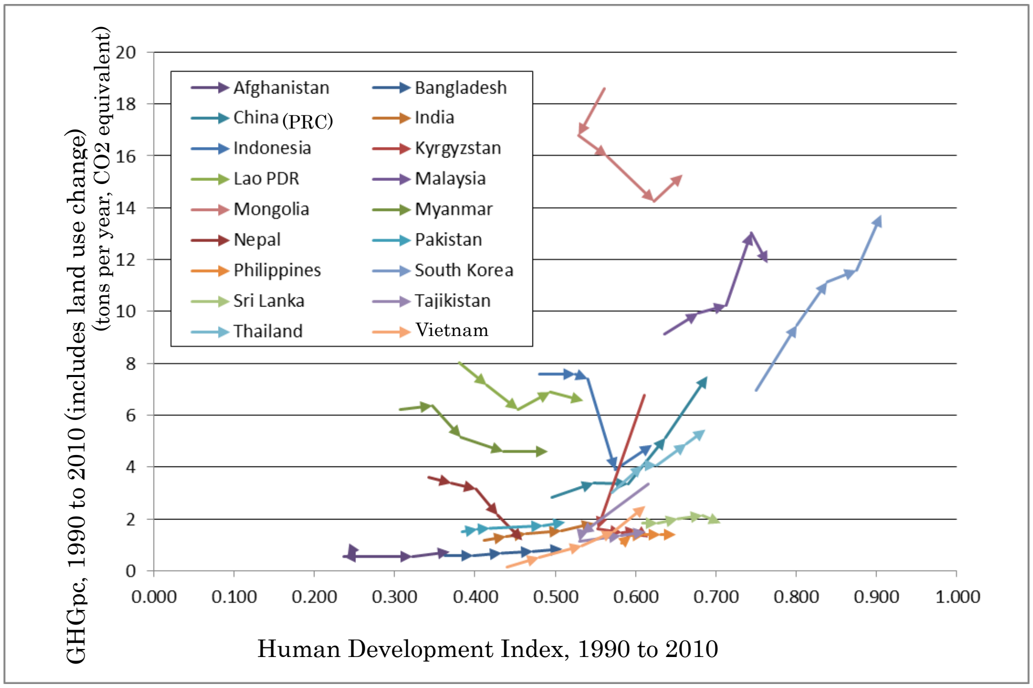
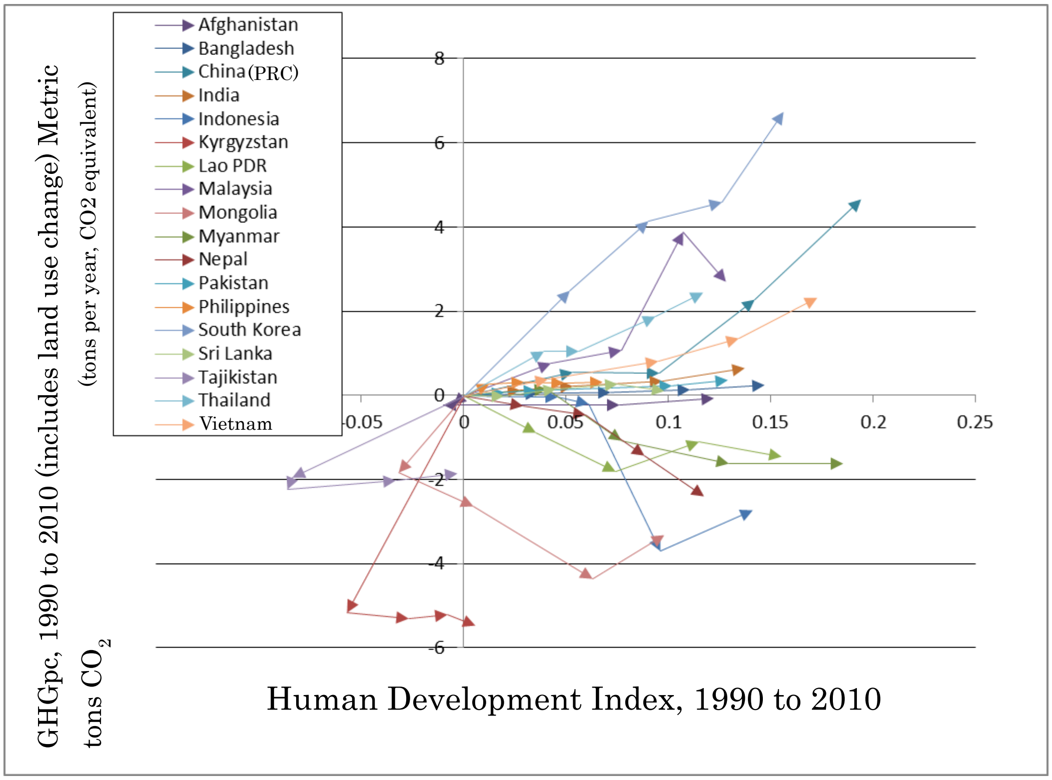


Figure 39. Relative Trajectories of Asian Countries (starting from 1990 as zero)



Appendix 4. Regression Lines of Each Country, Groups 1 to 10.

Table 1. Regression lines of each country in Country Group 1

Country	Regression Line
Switzerland	-8.9497x + 14.781
Luxembourg	-48.472x + 65.911
Sweden	-40.205x + 42.284
Finland	42.848x - 25.384
Norway	-23.452x + 28.156
Denmark	-39.4x + 46.285
Japan	-1.6812x + 10.897
Iceland	-22.839x + 30.573
United States	-38.675x + 57.296
Germany	-31.605x + 39.095
France	-12.219x + 18.435
Austria	24.798x - 12.221
Belgium	-12.389x + 23.823

Table 2. Regression lines of each country in Country Group 2.

Country	Regression Line
Canada	143.85x - 103.28
Netherlands	-14.525x + 26.718
Italy	-0.3548x + 8.7676
Australia	50.171x - 18.893
United Kingdom	-34.103x + 39.552
Qatar	199.19x - 113.67
Brunei Darussalam	-92.87x + 134.66
Spain	18.043x - 7.3037
Ireland	-4.8748x + 19.796
Singapore	22.039x - 5.6669
New Zealand	18.876x - 4.332
Kuwait	356.63x - 205.59
Israel	19.538x - 6.0369

Table 3. Regression lines of each country in Country Group 3.

Country	Regression Line
Cyprus	19.629x - 8.2179
Greece	4.5418x + 6.4392
Bahrain	-58.695x + 71.18
Portugal	16.72x - 5.6783
Barbados	34.722x - 15.786
Saudi Arabia	44.341x - 16.527
Malta	5.2974x + 2.8754
South Korea	39.978x - 23.458
Gabon	-50.922x + 38.489
Argentina	10.895x + 1.8592
Trinidad and Tobago	267.17x - 168.28
Russian Federation	-20.288x + 31.667
Turkey	8.9174x - 1.5321

Table 4. Regression lines of each country in Country Group 4.

Country	Regression Line
Estonia	-10.955x + 29.121
Croatia	-9.9025x + 11.396
Mexico	9.1656x - 1.0206
Slovakia	-47.682x + 46.043
Latvia	-30.591x + 25.636
Hungary	-13.373x + 18.354
South Africa	5.9113x + 5.2107
Uruguay	33.89x - 21.727
Lithuania	-2.0789x + 9.9332
Cuba	13.864x - 7.1257
Botswana	-88.555x + 66.252
Malaysia	195.33x - 133.95
Chile	20.98x - 11.976

Table 5. Regression lines of each country in Country Group 5

Country	Regression Line
Mauritius	23.531x - 12.494
Brazil	-22.027x + 25.181
Algeria	4.0877x + 1.372
Panama	-52.336x + 45.987
Venezuela	-7.4308x + 19.06
Costa Rica	-34.014x + 27.508
Bulgaria	-34.249x + 32.481
Belize	-228.2x + 205.52
Jamaica	-1.0086x + 5.7365
Namibia	-0.755x + 11.094
Fiji	0.986x + 1.1139
Ukraine	29.552x - 10.688
Romania	-31.261x + 30.399

Table 6. Regression lines of each country in Country Group 6

Country	Regression Line
Tonga	18.897x - 9.7748
Iran	25.855x - 9.7729
Colombia	-5.5852x + 8.6688
Tunisia	6.1135x - 1.042
Thailand	17.425x - 6.7126
Swaziland	-13.139x + 9.3107
Peru	4.3093x + 1.4603
Dominican Republic	12.942x - 5.6377
Paraguay	-76.781x + 68.152
Morocco	12.031x - 4.2501
Ecuador	-19.262x + 22.662
Zimbabwe	23.975x - 4.0899
Jordan	-12.012x + 12.495

Table 7. Regression lines of each country in Country Group 7

Country	Regression Line
Congo	-32.615x + 23.585
Cameroon	-84.354x + 50.416
Republic of Moldova	42.301x - 21.529
El Salvador	4.5221x - 0.7371
Philippines	3.5005x - 0.6545
Syrian Arab Republic	1.1774x + 3.8638
Côte d'Ivoire	-7.0389x + 5.9082
Senegal	-3.1442x + 3.711
Mauritania	-14.423x + 9.4752
Guatemala	3.5777x + 2.0242
Gambia	-0.2945x + 4.2998
Bolivia	-30.774x + 34.348
Albania	-1.3589x + 3.2938

Table 8. Regression lines of each country in Country Group 8

Country	Regression Line
Honduras	-41.041x + 31.601
Ghana	-10.461x + 7.9411
Indonesia	17.46x - 2.5109
Nicaragua	-4.6061x + 10.75
Guyana	-5.6756x + 13.308
Papua New Guinea	-98.129x + 58.932
Egypt	8.7461x - 2.3119
Mongolia	-26.754x + 35.958
Armenia	-10.268x + 9.9884
Lesotho	-1.7427x + 1.9996
Kyrgyzstan	19.807x - 9.8407
Tajikistan	12.618x - 5.5006
Kenya	-2.3662x + 2.6303

Table 9. Regression lines of each country in Country Group 9

Country	Regression Line
Central African Republic	-145.22x + 76.573
Togo	-24.679x + 13.744
Sri Lanka	2.2154x + 0.8507
Pakistan	2.4001x + 0.6421
Zambia	-55.965x + 35.515
Benin	-15.935x + 9.724
India	4.6559x - 0.7358
Haiti	2.8643x - 0.4548
Rwanda	-10.641x + 4.3643
China (PRC)	22.346x - 8.8393
Yemen	2.9683x + 0.0625
Niger	-5.1821x + 2.8521
Mali	-3.3894x + 3.4127

Table 10. Regression lines of each country in Country Group 10

Country	Regression Line
Burundi	38.499x - 8.5536
Afghanistan	-0.5333x + 1.0424
Bangladesh	1.0077x + 0.4931
Malawi	-1.2794x + 2.0564
Democratic Republic of the Congo	25.035x + 0.7332
Uganda	-4.2319x + 3.2196
Tanzania: Mainland	-16.985x + 11.531
Mozambique	-12.676x + 6.4249
Lao PDR	-4.4484x + 9.0605
Sierra Leone	-6.5527x + 4.0946
Nepal	-12.343x + 7.6352
Myanmar	-11.279x + 9.8411
Vietnam	14.603x - 6.1862

Table 11. Frequency Count of Successful and Unsuccessful Countries

Country Group	Successful Countries (n)	Unsuccessful Countries (n)	Total for Each Group (n)
1	11	2	13
2	5	8	13
3	3	10	13
4	7	6	13
5	9	4	13
6	5	8	13
7	8	5	13
8	9	4	13
9	7	6	13
10	9	4	13
Total N	73	57	130

Appendix 5. Parameters for evaluating success.

Table 12. Parameters for evaluating successfulness (ordered by the slope of △GHGpc/△HDI)

	COUNTRY	SLOPE of trendline	HDI		GHGpc		Original Group
			absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	
1	Belize	-228.200	0.046	0.071	-10.618	-0.190	5
2	Central African Republic	-145.220	0.032	0.103	-19.884	-0.455	9
3	Papua New Guinea	-98.129	0.090	0.246	-8.230	-0.366	8
4	Brunei Darussalam	-92.870	0.071	0.091	-5.087	-0.081	2
5	Botswana	-88.555	0.047	0.080	-5.688	-0.358	4
6	Cameroon	-84.354	0.057	0.132	-6.730	-0.410	7
7	Paraguay	-76.781	0.090	0.155	-6.665	-0.276	6
8	Bahrain	-58.695	0.081	0.114	-7.001	-0.239	3
9	Zambia	-55.965	0.040	0.099	-8.538	-0.467	9
10	Panama	-52.336	0.105	0.157	-4.695	-0.449	5
11	Gabon	-50.922	0.066	0.108	-3.578	-0.455	3
12	Luxembourg	-48.472	0.078	0.098	-6.516	-0.214	1
13	Slovakia	-47.682	0.082	0.109	-6.335	-0.480	4
14	Honduras	-41.041	0.109	0.209	-4.198	-0.403	8
15	Sweden	-40.205	0.090	0.109	-4.218	-0.500	1
16	Denmark	-39.400	0.083	0.101	-2.299	-0.175	1
17	United States	-38.675	0.057	0.065	-2.600	-0.114	1
18	Bulgaria	-34.249	0.075	0.106	-4.391	-0.406	5
19	United Kingdom of Great Brit	-34.103	0.090	0.115	-3.743	-0.288	2
20	Costa Rica	-34.014	0.105	0.158	-2.559	-0.612	5
21	Congo	-32.615	0.019	0.038	-3.350	-0.385	7
22	Germany	-31.605	0.114	0.142	-3.829	-0.275	1
23	Romania	-31.261	0.077	0.108	-5.136	-0.469	5
24	Bolivia	-30.774	0.111	0.199	-3.176	-0.178	7
25	Latvia	-30.591	0.106	0.152	-11.037	-1.108	4
26	Mongolia	-26.754	0.098	0.175	-3.902	-0.168	8
27	Togo	-24.679	0.071	0.186	-1.790	-0.403	9
28	Norway	-23.452	0.100	0.117	-2.066	-0.271	1
29	Iceland	-22.839	0.086	0.105	-3.070	-0.249	1
30	Brazil	-22.027	0.136	0.230	-4.485	-0.386	5
31	Russian Federation	-20.288	0.052	0.071	-6.123	-0.290	3
32	Ecuador	-19.262	0.085	0.134	-1.753	-0.162	6
33	United Republic of Tanzania:	-16.985	0.112	0.318	-2.586	-0.403	10
34	Benin	-15.935	0.118	0.377	-1.977	-0.402	9
35	Netherlands	-14.525	0.077	0.091	-0.921	-0.065	2
36	Mauritania	-14.423	0.108	0.302	-1.552	-0.361	7
37	Hungary	-13.373	0.115	0.161	-2.241	-0.241	4
38	Swaziland	-13.139	-0.001	-0.001	0.084	0.036	6
39	Mozambique	-12.676	0.115	0.570	-1.806	-0.433	10
40	Belgium	-12.389	0.080	0.098	-1.429	-0.108	1
41	Nepal	-12.343	0.117	0.343	-1.574	-0.497	10
42	France	-12.219	0.107	0.136	-1.151	-0.133	1
43	Jordan	-12.012	0.107	0.181	-1.218	-0.222	6
44	Myanmar	-11.279	0.185	0.606	-1.785	-0.280	10
45	Estonia	-10.955	0.110	0.151	-4.846	-0.182	4
46	Rwanda	-10.641	0.193	0.828	-1.282	-0.778	9
47	Ghana	-10.461	0.112	0.262	-1.184	-0.326	8
48	Armenia	-10.268	0.095	0.151	-4.151	-0.610	8
49	Croatia	-9.903	0.087	0.122	-2.983	-0.455	4
50	Switzerland	-8.950	0.071	0.085	-0.866	-0.117	1

51	Venezuela (Bolivarian Repub	-7.431	0.108	0.170	-0.996	-0.068	5
52	Côte d'Ivoire	-7.039	0.067	0.186	-0.447	-0.120	7
53	Sierra Leone	-6.553	0.099	0.399	-0.736	-0.283	10
54	Guyana	-5.676	0.125	0.250	-0.756	-0.074	8
55	Colombia	-5.585	0.114	0.191	-0.522	-0.101	6
56	Niger	-5.182	0.100	0.506	-0.374	-0.227	9
57	Ireland	-4.875	0.124	0.156	-2.045	-0.134	2
58	Nicaragua	-4.606	0.115	0.239	-0.870	-0.098	8
59	Lao People's Democratic Rep	-4.448	0.155	0.409	-0.870	-0.110	10
60	Uganda	-4.232	0.144	0.473	-0.712	-0.347	10
61	Mali	-3.389	0.141	0.689	-0.533	-0.188	9
62	Senegal	-3.144	0.102	0.278	-0.405	-0.156	7
63	Kenya	-2.366	0.048	0.105	-0.456	-0.247	8
64	Lithuania	-2.079	0.077	0.106	-4.176	-0.326	4
65	Lesotho	-1.743	-0.022	-0.046	0.180	0.155	8
66	Japan	-1.681	0.072	0.086	-0.302	-0.033	1
67	Albania	-1.359	0.084	0.127	-1.152	-0.345	7
68	Malawi	-1.279	0.118	0.399	-0.188	-0.108	10
69	Jamaica	-1.009	0.085	0.133	-0.215	-0.046	5
70	Namibia	-0.755	0.034	0.060	0.990	0.101	5
71	Afghanistan	-0.533	0.122	0.495	-0.344	-0.269	10
72	Italy	-0.355	0.110	0.143	-0.632	-0.076	2
73	Gambia	-0.295	0.114	0.353	-0.017	-0.004	7
74	Fiji	0.986	0.085	0.138	-0.144	-0.085	5
75	Bangladesh	1.008	0.147	0.406	0.159	0.180	10
76	Syrian Arab Republic	1.177	0.088	0.158	0.032	0.007	7
77	Sri Lanka	2.215	0.098	0.161	0.126	0.057	9
78	Pakistan	2.400	0.129	0.335	0.333	0.214	9
79	Haiti	2.864	0.051	0.127	0.105	0.151	9
80	Yemen	2.968	0.180	0.629	0.517	0.526	9
81	Philippines	3.501	0.068	0.116	0.302	0.240	7
82	Guatemala	3.578	0.115	0.247	0.249	0.076	7
83	Algeria	4.088	0.148	0.262	0.565	0.144	5
84	Peru	4.309	0.114	0.185	0.713	0.161	6
85	El Salvador	4.522	0.150	0.285	0.671	0.419	7
86	Greece	4.542	0.094	0.122	-0.116	-0.012	3
87	India	4.656	0.137	0.334	0.719	0.604	9
88	Malta	5.297	0.087	0.115	0.212	0.030	3
89	South Africa	5.911	0.000	0.000	-0.403	-0.043	4
90	Tunisia	6.114	0.157	0.285	0.911	0.390	6
91	Egypt	8.746	0.158	0.315	1.302	0.582	8
92	Turkey	8.917	0.146	0.257	1.516	0.448	3
93	Mexico	9.166	0.117	0.178	0.950	0.189	4
94	Argentina	10.895	0.104	0.148	1.077	0.114	3
95	Morocco	12.031	0.146	0.332	1.871	1.805	6
96	Tajikistan	12.618	-0.003	-0.005	-1.957	-0.580	8
97	Dominican Republic	12.942	0.113	0.193	1.447	0.856	6
98	Cuba	13.864	0.094	0.139	-0.069	-0.017	4
99	Vietnam	14.603	0.172	0.393	2.487	6.390	10
100	Portugal	16.720	0.103	0.144	1.096	0.185	3
101	Thailand	17.425	0.116	0.205	2.103	0.682	6
102	Indonesia	17.460	0.141	0.294	2.419	0.401	8
103	Spain	18.043	0.128	0.170	0.950	0.153	2
104	New Zealand	18.876	0.082	0.098	0.771	0.068	2
105	Tonga	18.897	0.052	0.080	0.929	0.347	6
106	Israel	19.538	0.087	0.107	2.151	0.233	2
107	Cyprus	19.629	0.070	0.090	1.377	0.210	3
108	Kyrgyzstan	19.807	0.005	0.009	-7.661	-1.126	8
109	Chile	20.980	0.110	0.157	2.371	0.881	4
110	Singapore	22.039	0.136	0.180	3.455	0.334	2

111	China, People's Republic of	22.346	0.194	0.392	4.333	1.614	9
112	Mauritius	23.531	0.106	0.170	2.369	1.039	5
113	Zimbabwe	23.975	-0.052	-0.123	-1.963	-0.307	6
114	Austria	24.798	0.095	0.119	2.600	0.321	1
115	Democratic Republic of the C	25.035	-0.001	-0.005	-5.958	-0.539	10
116	Iran, Islamic Republic of	25.855	0.201	0.372	4.999	1.152	6
117	Ukraine	29.552	0.019	0.026	-9.777	-0.557	5
118	Uruguay	33.890	0.093	0.134	2.802	2.542	4
119	Barbados	34.722	0.063	0.083	1.734	0.159	3
120	Burundi	38.499	0.077	0.282	3.237	2.662	10
121	Republic of Korea (South)	39.978	0.156	0.208	6.614	1.079	3
122	Republic of Moldova	42.301	0.002	0.003	-7.139	-0.683	7
123	Finland	42.848	0.089	0.111	5.475	0.544	1
124	Saudi Arabia	44.341	0.123	0.189	6.370	0.516	3
125	Australia	50.171	0.055	0.062	1.249	0.049	2
126	Canada	143.850	0.043	0.050	3.287	0.153	2
127	Malaysia	195.330	0.128	0.201	21.982	-3.226	4
128	Qatar	199.190	0.084	0.114	9.410	0.280	2
129	Trinidad and Tobago	267.170	0.073	0.107	19.256	1.249	3
130	Kuwait	356.630	0.073	0.103	25.656	0.667	2

Table 13. Parameters for evaluating successfulness (ordering by the slope of △ HDI absolute value)

	COUNTRY	SLOPE of trendline	HDI		GHGpc		Original Group
			absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	
1	Iran, Islamic Republic of	25.855	0.201	0.372	4.999	1.152	6
2	China, People's Republic of	22.346	0.194	0.392	4.333	1.614	9
3	Rwanda	-10.641	0.193	0.828	-1.282	-0.778	9
4	Myanmar	-11.279	0.185	0.606	-1.785	-0.280	10
5	Yemen	2.968	0.180	0.629	0.517	0.526	9
6	Vietnam	14.603	0.172	0.393	2.487	6.390	10
7	Egypt	8.746	0.158	0.315	1.302	0.582	8
8	Tunisia	6.114	0.157	0.285	0.911	0.390	6
9	Republic of Korea (South)	39.978	0.156	0.208	6.614	1.079	3
10	Lao People's Democratic Rep	-4.448	0.155	0.409	-0.870	-0.110	10
11	El Salvador	4.522	0.150	0.285	0.671	0.419	7
12	Algeria	4.088	0.148	0.262	0.565	0.144	5
13	Bangladesh	1.008	0.147	0.406	0.159	0.180	10
14	Turkey	8.917	0.146	0.257	1.516	0.448	3
15	Morocco	12.031	0.146	0.332	1.871	1.805	6
16	Uganda	-4.232	0.144	0.473	-0.712	-0.347	10
17	Indonesia	17.460	0.141	0.294	2.419	0.401	8
18	Mali	-3.389	0.141	0.689	-0.533	-0.188	9
19	India	4.656	0.137	0.334	0.719	0.604	9
20	Singapore	22.039	0.136	0.180	3.455	0.334	2
21	Brazil	-22.027	0.136	0.230	-4.485	-0.386	5
22	Pakistan	2.400	0.129	0.335	0.333	0.214	9
23	Spain	18.043	0.128	0.170	0.950	0.153	2
24	Malaysia	195.330	0.128	0.201	21.982	-3.226	4
25	Guyana	-5.676	0.125	0.250	-0.756	-0.074	8
26	Ireland	-4.875	0.124	0.156	-2.045	-0.134	2
27	Saudi Arabia	44.341	0.123	0.189	6.370	0.516	3
28	Afghanistan	-0.533	0.122	0.495	-0.344	-0.269	10
29	Benin	-15.935	0.118	0.377	-1.977	-0.402	9
30	Malawi	-1.279	0.118	0.399	-0.188	-0.108	10
31	Nepal	-12.343	0.117	0.343	-1.574	-0.497	10
32	Mexico	9.166	0.117	0.178	0.950	0.189	4
33	Thailand	17.425	0.116	0.205	2.103	0.682	6
34	Mozambique	-12.676	0.115	0.570	-1.806	-0.433	10
35	Hungary	-13.373	0.115	0.161	-2.241	-0.241	4
36	Guatemala	3.578	0.115	0.247	0.249	0.076	7
37	Nicaragua	-4.606	0.115	0.239	-0.870	-0.098	8
38	Peru	4.309	0.114	0.185	0.713	0.161	6
39	Colombia	-5.585	0.114	0.191	-0.522	-0.101	6
40	Gambia	-0.295	0.114	0.353	-0.017	-0.004	7
41	Germany	-31.605	0.114	0.142	-3.829	-0.275	1
42	Dominican Republic	12.942	0.113	0.193	1.447	0.856	6
43	United Republic of Tanzania:	-16.985	0.112	0.318	-2.586	-0.403	10
44	Ghana	-10.461	0.112	0.262	-1.184	-0.326	8
45	Bolivia	-30.774	0.111	0.199	-3.176	-0.178	7
46	Chile	20.980	0.110	0.157	2.371	0.881	4
47	Estonia	-10.955	0.110	0.151	-4.846	-0.182	4
48	Italy	-0.355	0.110	0.143	-0.632	-0.076	2
49	Honduras	-41.041	0.109	0.209	-4.198	-0.403	8
50	Venezuela (Bolivarian Repub	-7.431	0.108	0.170	-0.996	-0.068	5

51	Mauritania	-14.423	0.108	0.302	-1.552	-0.361	7
52	Jordan	-12.012	0.107	0.181	-1.218	-0.222	6
53	France	-12.219	0.107	0.136	-1.151	-0.133	1
54	Mauritius	23.531	0.106	0.170	2.369	1.039	5
55	Latvia	-30.591	0.106	0.152	-11.037	-1.108	4
56	Costa Rica	-34.014	0.105	0.158	-2.559	-0.612	5
57	Panama	-52.336	0.105	0.157	-4.695	-0.449	5
58	Argentina	10.895	0.104	0.148	1.077	0.114	3
59	Portugal	16.720	0.103	0.144	1.096	0.185	3
60	Senegal	-3.144	0.102	0.278	-0.405	-0.156	7
61	Norway	-23.452	0.100	0.117	-2.066	-0.271	1
62	Niger	-5.182	0.100	0.506	-0.374	-0.227	9
63	Sierra Leone	-6.553	0.099	0.399	-0.736	-0.283	10
64	Mongolia	-26.754	0.098	0.175	-3.902	-0.168	8
65	Sri Lanka	2.215	0.098	0.161	0.126	0.057	9
66	Austria	24.798	0.095	0.119	2.600	0.321	1
67	Armenia	-10.268	0.095	0.151	-4.151	-0.610	8
68	Cuba	13.864	0.094	0.139	-0.069	-0.017	4
69	Greece	4.542	0.094	0.122	-0.116	-0.012	3
70	Uruguay	33.890	0.093	0.134	2.802	2.542	4
71	Papua New Guinea	-98.129	0.090	0.246	-8.230	-0.366	8
72	United Kingdom of Great Brit	-34.103	0.090	0.115	-3.743	-0.288	2
73	Paraguay	-76.781	0.090	0.155	-6.665	-0.276	6
74	Sweden	-40.205	0.090	0.109	-4.218	-0.500	1
75	Finland	42.848	0.089	0.111	5.475	0.544	1
76	Syrian Arab Republic	1.177	0.088	0.158	0.032	0.007	7
77	Croatia	-9.903	0.087	0.122	-2.983	-0.455	4
78	Malta	5.297	0.087	0.115	0.212	0.030	3
79	Israel	19.538	0.087	0.107	2.151	0.233	2
80	Iceland	-22.839	0.086	0.105	-3.070	-0.249	1
81	Jamaica	-1.009	0.085	0.133	-0.215	-0.046	5
82	Fiji	0.986	0.085	0.138	-0.144	-0.085	5
83	Ecuador	-19.262	0.085	0.134	-1.753	-0.162	6
84	Qatar	199.190	0.084	0.114	9.410	0.280	2
85	Albania	-1.359	0.084	0.127	-1.152	-0.345	7
86	Denmark	-39.400	0.083	0.101	-2.299	-0.175	1
87	Slovakia	-47.682	0.082	0.109	-6.335	-0.480	4
88	New Zealand	18.876	0.082	0.098	0.771	0.068	2
89	Bahrain	-58.695	0.081	0.114	-7.001	-0.239	3
90	Belgium	-12.389	0.080	0.098	-1.429	-0.108	1
91	Luxembourg	-48.472	0.078	0.098	-6.516	-0.214	1
92	Lithuania	-2.079	0.077	0.106	-4.176	-0.326	4
93	Netherlands	-14.525	0.077	0.091	-0.921	-0.065	2
94	Burundi	38.499	0.077	0.282	3.237	2.662	10
95	Romania	-31.261	0.077	0.108	-5.136	-0.469	5
96	Bulgaria	-34.249	0.075	0.106	-4.391	-0.406	5
97	Trinidad and Tobago	267.170	0.073	0.107	19.256	1.249	3
98	Kuwait	356.630	0.073	0.103	25.656	0.667	2
99	Japan	-1.681	0.072	0.086	-0.302	-0.033	1
100	Switzerland	-8.950	0.071	0.085	-0.866	-0.117	1
101	Brunei Darussalam	-92.870	0.071	0.091	-5.087	-0.081	2
102	Togo	-24.679	0.071	0.186	-1.790	-0.403	9
103	Cyprus	19.629	0.070	0.090	1.377	0.210	3
104	Philippines	3.501	0.068	0.116	0.302	0.240	7
105	Côte d'Ivoire	-7.039	0.067	0.186	-0.447	-0.120	7
106	Gabon	-50.922	0.066	0.108	-3.578	-0.455	3
107	Barbados	34.722	0.063	0.083	1.734	0.159	3
108	Cameroon	-84.354	0.057	0.132	-6.730	-0.410	7
109	United States	-38.675	0.057	0.065	-2.600	-0.114	1
110	Australia	50.171	0.055	0.062	1.249	0.049	2

111	Tonga	18.897	0.052	0.080	0.929	0.347	6
112	Russian Federation	-20.288	0.052	0.071	-6.123	-0.290	3
113	Haiti	2.864	0.051	0.127	0.105	0.151	9
114	Kenya	-2.366	0.048	0.105	-0.456	-0.247	8
115	Botswana	-88.555	0.047	0.080	-5.688	-0.358	4
116	Belize	-228.200	0.046	0.071	-10.618	-0.190	5
117	Canada	143.850	0.043	0.050	3.287	0.153	2
118	Zambia	-55.965	0.040	0.099	-8.538	-0.467	9
119	Namibia	-0.755	0.034	0.060	0.990	0.101	5
120	Central African Republic	-145.220	0.032	0.103	-19.884	-0.455	9
121	Congo	-32.615	0.019	0.038	-3.350	-0.385	7
122	Ukraine	29.552	0.019	0.026	-9.777	-0.557	5
123	Kyrgyzstan	19.807	0.005	0.009	-7.661	-1.126	8
124	Republic of Moldova	42.301	0.002	0.003	-7.139	-0.683	7
125	South Africa	5.911	0.000	0.000	-0.403	-0.043	4
126	Swaziland	-13.139	-0.001	-0.001	0.084	0.036	6
127	Democratic Republic of the C	25.035	-0.001	-0.005	-5.958	-0.539	10
128	Tajikistan	12.618	-0.003	-0.005	-1.957	-0.580	8
129	Lesotho	-1.743	-0.022	-0.046	0.180	0.155	8
130	Zimbabwe	23.975	-0.052	-0.123	-1.963	-0.307	6

Table 14. Parameters for evaluating successfulness (ordering by the △HDI ratio)

	COUNTRY	SLOPE of trendline	HDI		GHGpc		Original Group
			absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	
1	Rwanda	-10.641	0.193	0.828	-1.282	-0.778	9
2	Mali	-3.389	0.141	0.689	-0.533	-0.188	9
3	Yemen	2.968	0.180	0.629	0.517	0.526	9
4	Myanmar	-11.279	0.185	0.606	-1.785	-0.280	10
5	Mozambique	-12.676	0.115	0.570	-1.806	-0.433	10
6	Niger	-5.182	0.100	0.506	-0.374	-0.227	9
7	Afghanistan	-0.533	0.122	0.495	-0.344	-0.269	10
8	Uganda	-4.232	0.144	0.473	-0.712	-0.347	10
9	Lao People's Democratic Rep	-4.448	0.155	0.409	-0.870	-0.110	10
10	Bangladesh	1.008	0.147	0.406	0.159	0.180	10
11	Malawi	-1.279	0.118	0.399	-0.188	-0.108	10
12	Sierra Leone	-6.553	0.099	0.399	-0.736	-0.283	10
13	Vietnam	14.603	0.172	0.393	2.487	6.390	10
14	China, People's Republic of	22.346	0.194	0.392	4.333	1.614	9
15	Benin	-15.935	0.118	0.377	-1.977	-0.402	9
16	Iran, Islamic Republic of	25.855	0.201	0.372	4.999	1.152	6
17	Gambia	-0.295	0.114	0.353	-0.017	-0.004	7
18	Nepal	-12.343	0.117	0.343	-1.574	-0.497	10
19	Pakistan	2.400	0.129	0.335	0.333	0.214	9
20	India	4.656	0.137	0.334	0.719	0.604	9
21	Morocco	12.031	0.146	0.332	1.871	1.805	6
22	United Republic of Tanzania:	-16.985	0.112	0.318	-2.586	-0.403	10
23	Egypt	8.746	0.158	0.315	1.302	0.582	8
24	Mauritania	-14.423	0.108	0.302	-1.552	-0.361	7
25	Indonesia	17.460	0.141	0.294	2.419	0.401	8
26	Tunisia	6.114	0.157	0.285	0.911	0.390	6
27	El Salvador	4.522	0.150	0.285	0.671	0.419	7
28	Burundi	38.499	0.077	0.282	3.237	2.662	10
29	Senegal	-3.144	0.102	0.278	-0.405	-0.156	7
30	Algeria	4.088	0.148	0.262	0.565	0.144	5
31	Ghana	-10.461	0.112	0.262	-1.184	-0.326	8
32	Turkey	8.917	0.146	0.257	1.516	0.448	3
33	Guyana	-5.676	0.125	0.250	-0.756	-0.074	8
34	Guatemala	3.578	0.115	0.247	0.249	0.076	7
35	Papua New Guinea	-98.129	0.090	0.246	-8.230	-0.366	8
36	Nicaragua	-4.606	0.115	0.239	-0.870	-0.098	8
37	Brazil	-22.027	0.136	0.230	-4.485	-0.386	5
38	Honduras	-41.041	0.109	0.209	-4.198	-0.403	8
39	Republic of Korea (South)	39.978	0.156	0.208	6.614	1.079	3
40	Thailand	17.425	0.116	0.205	2.103	0.682	6
41	Malaysia	195.330	0.128	0.201	21.982	-3.226	4
42	Bolivia	-30.774	0.111	0.199	-3.176	-0.178	7
43	Dominican Republic	12.942	0.113	0.193	1.447	0.856	6
44	Colombia	-5.585	0.114	0.191	-0.522	-0.101	6
45	Saudi Arabia	44.341	0.123	0.189	6.370	0.516	3
46	Togo	-24.679	0.071	0.186	-1.790	-0.403	9
47	Côte d'Ivoire	-7.039	0.067	0.186	-0.447	-0.120	7
48	Peru	4.309	0.114	0.185	0.713	0.161	6
49	Jordan	-12.012	0.107	0.181	-1.218	-0.222	6
50	Singapore	22.039	0.136	0.180	3.455	0.334	2

51	Mexico	9.166	0.117	0.178	0.950	0.189	4
52	Mongolia	-26.754	0.098	0.175	-3.902	-0.168	8
53	Venezuela (Bolivarian Repub	-7.431	0.108	0.170	-0.996	-0.068	5
54	Mauritius	23.531	0.106	0.170	2.369	1.039	5
55	Spain	18.043	0.128	0.170	0.950	0.153	2
56	Hungary	-13.373	0.115	0.161	-2.241	-0.241	4
57	Sri Lanka	2.215	0.098	0.161	0.126	0.057	9
58	Syrian Arab Republic	1.177	0.088	0.158	0.032	0.007	7
59	Costa Rica	-34.014	0.105	0.158	-2.559	-0.612	5
60	Chile	20.980	0.110	0.157	2.371	0.881	4
61	Panama	-52.336	0.105	0.157	-4.695	-0.449	5
62	Ireland	-4.875	0.124	0.156	-2.045	-0.134	2
63	Paraguay	-76.781	0.090	0.155	-6.665	-0.276	6
64	Latvia	-30.591	0.106	0.152	-11.037	-1.108	4
65	Estonia	-10.955	0.110	0.151	-4.846	-0.182	4
66	Armenia	-10.268	0.095	0.151	-4.151	-0.610	8
67	Argentina	10.895	0.104	0.148	1.077	0.114	3
68	Portugal	16.720	0.103	0.144	1.096	0.185	3
69	Italy	-0.355	0.110	0.143	-0.632	-0.076	2
70	Germany	-31.605	0.114	0.142	-3.829	-0.275	1
71	Cuba	13.864	0.094	0.139	-0.069	-0.017	4
72	Fiji	0.986	0.085	0.138	-0.144	-0.085	5
73	France	-12.219	0.107	0.136	-1.151	-0.133	1
74	Uruguay	33.890	0.093	0.134	2.802	2.542	4
75	Ecuador	-19.262	0.085	0.134	-1.753	-0.162	6
76	Jamaica	-1.009	0.085	0.133	-0.215	-0.046	5
77	Cameroon	-84.354	0.057	0.132	-6.730	-0.410	7
78	Albania	-1.359	0.084	0.127	-1.152	-0.345	7
79	Haiti	2.864	0.051	0.127	0.105	0.151	9
80	Croatia	-9.903	0.087	0.122	-2.983	-0.455	4
81	Greece	4.542	0.094	0.122	-0.116	-0.012	3
82	Austria	24.798	0.095	0.119	2.600	0.321	1
83	Norway	-23.452	0.100	0.117	-2.066	-0.271	1
84	Philippines	3.501	0.068	0.116	0.302	0.240	7
85	Malta	5.297	0.087	0.115	0.212	0.030	3
86	United Kingdom of Great Brit	-34.103	0.090	0.115	-3.743	-0.288	2
87	Bahrain	-58.695	0.081	0.114	-7.001	-0.239	3
88	Qatar	199.190	0.084	0.114	9.410	0.280	2
89	Finland	42.848	0.089	0.111	5.475	0.544	1
90	Sweden	-40.205	0.090	0.109	-4.218	-0.500	1
91	Slovakia	-47.682	0.082	0.109	-6.335	-0.480	4
92	Romania	-31.261	0.077	0.108	-5.136	-0.469	5
93	Gabon	-50.922	0.066	0.108	-3.578	-0.455	3
94	Israel	19.538	0.087	0.107	2.151	0.233	2
95	Trinidad and Tobago	267.170	0.073	0.107	19.256	1.249	3
96	Bulgaria	-34.249	0.075	0.106	-4.391	-0.406	5
97	Lithuania	-2.079	0.077	0.106	-4.176	-0.326	4
98	Iceland	-22.839	0.086	0.105	-3.070	-0.249	1
99	Kenya	-2.366	0.048	0.105	-0.456	-0.247	8
100	Central African Republic	-145.220	0.032	0.103	-19.884	-0.455	9
101	Kuwait	356.630	0.073	0.103	25.656	0.667	2
102	Denmark	-39.400	0.083	0.101	-2.299	-0.175	1
103	Zambia	-55.965	0.040	0.099	-8.538	-0.467	9
104	Luxembourg	-48.472	0.078	0.098	-6.516	-0.214	1
105	New Zealand	18.876	0.082	0.098	0.771	0.068	2
106	Belgium	-12.389	0.080	0.098	-1.429	-0.108	1
107	Netherlands	-14.525	0.077	0.091	-0.921	-0.065	2
108	Brunei Darussalam	-92.870	0.071	0.091	-5.087	-0.081	2
109	Cyprus	19.629	0.070	0.090	1.377	0.210	3
110	Japan	-1.681	0.072	0.086	-0.302	-0.033	1

111	Switzerland	-8.950	0.071	0.085	-0.866	-0.117	1
112	Barbados	34.722	0.063	0.083	1.734	0.159	3
113	Tonga	18.897	0.052	0.080	0.929	0.347	6
114	Botswana	-88.555	0.047	0.080	-5.688	-0.358	4
115	Russian Federation	-20.288	0.052	0.071	-6.123	-0.290	3
116	Belize	-228.200	0.046	0.071	-10.618	-0.190	5
117	United States	-38.675	0.057	0.065	-2.600	-0.114	1
118	Australia	50.171	0.055	0.062	1.249	0.049	2
119	Namibia	-0.755	0.034	0.060	0.990	0.101	5
120	Canada	143.850	0.043	0.050	3.287	0.153	2
121	Congo	-32.615	0.019	0.038	-3.350	-0.385	7
122	Ukraine	29.552	0.019	0.026	-9.777	-0.557	5
123	Kyrgyzstan	19.807	0.005	0.009	-7.661	-1.126	8
124	Republic of Moldova	42.301	0.002	0.003	-7.139	-0.683	7
125	South Africa	5.911	0.000	0.000	-0.403	-0.043	4
126	Swaziland	-13.139	-0.001	-0.001	0.084	0.036	6
127	Tajikistan	12.618	-0.003	-0.005	-1.957	-0.580	8
128	Democratic Republic of the C	25.035	-0.001	-0.005	-5.958	-0.539	10
129	Lesotho	-1.743	-0.022	-0.046	0.180	0.155	8
130	Zimbabwe	23.975	-0.052	-0.123	-1.963	-0.307	6

Table 15. Parameters for evaluating successfulness (ordering by the △GHGpc absolute value)

	COUNTRY	SLOPE of trendline	HDI		GHGpc		Original Group
			absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	
1	Central African Republic	-145.220	0.032	0.103	-19.884	-0.455	9
2	Latvia	-30.591	0.106	0.152	-11.037	-1.108	4
3	Belize	-228.200	0.046	0.071	-10.618	-0.190	5
4	Ukraine	29.552	0.019	0.026	-9.777	-0.557	5
5	Zambia	-55.965	0.040	0.099	-8.538	-0.467	9
6	Papua New Guinea	-98.129	0.090	0.246	-8.230	-0.366	8
7	Kyrgyzstan	19.807	0.005	0.009	-7.661	-1.126	8
8	Republic of Moldova	42.301	0.002	0.003	-7.139	-0.683	7
9	Bahrain	-58.695	0.081	0.114	-7.001	-0.239	3
10	Cameroon	-84.354	0.057	0.132	-6.730	-0.410	7
11	Paraguay	-76.781	0.090	0.155	-6.665	-0.276	6
12	Luxembourg	-48.472	0.078	0.098	-6.516	-0.214	1
13	Slovakia	-47.682	0.082	0.109	-6.335	-0.480	4
14	Russian Federation	-20.288	0.052	0.071	-6.123	-0.290	3
15	Democratic Republic of the C	25.035	-0.001	-0.005	-5.958	-0.539	10
16	Botswana	-88.555	0.047	0.080	-5.688	-0.358	4
17	Romania	-31.261	0.077	0.108	-5.136	-0.469	5
18	Brunei Darussalam	-92.870	0.071	0.091	-5.087	-0.081	2
19	Estonia	-10.955	0.110	0.151	-4.846	-0.182	4
20	Panama	-52.336	0.105	0.157	-4.695	-0.449	5
21	Brazil	-22.027	0.136	0.230	-4.485	-0.386	5
22	Bulgaria	-34.249	0.075	0.106	-4.391	-0.406	5
23	Sweden	-40.205	0.090	0.109	-4.218	-0.500	1
24	Honduras	-41.041	0.109	0.209	-4.198	-0.403	8
25	Lithuania	-2.079	0.077	0.106	-4.176	-0.326	4
26	Armenia	-10.268	0.095	0.151	-4.151	-0.610	8
27	Mongolia	-26.754	0.098	0.175	-3.902	-0.168	8
28	Germany	-31.605	0.114	0.142	-3.829	-0.275	1
29	United Kingdom of Great Brit	-34.103	0.090	0.115	-3.743	-0.288	2
30	Gabon	-50.922	0.066	0.108	-3.578	-0.455	3
31	Congo	-32.615	0.019	0.038	-3.350	-0.385	7
32	Bolivia	-30.774	0.111	0.199	-3.176	-0.178	7
33	Iceland	-22.839	0.086	0.105	-3.070	-0.249	1
34	Croatia	-9.903	0.087	0.122	-2.983	-0.455	4
35	United States	-38.675	0.057	0.065	-2.600	-0.114	1
36	United Republic of Tanzania:	-16.985	0.112	0.318	-2.586	-0.403	10
37	Costa Rica	-34.014	0.105	0.158	-2.559	-0.612	5
38	Denmark	-39.400	0.083	0.101	-2.299	-0.175	1
39	Hungary	-13.373	0.115	0.161	-2.241	-0.241	4
40	Norway	-23.452	0.100	0.117	-2.066	-0.271	1
41	Ireland	-4.875	0.124	0.156	-2.045	-0.134	2
42	Benin	-15.935	0.118	0.377	-1.977	-0.402	9
43	Zimbabwe	23.975	-0.052	-0.123	-1.963	-0.307	6
44	Tajikistan	12.618	-0.003	-0.005	-1.957	-0.580	8
45	Mozambique	-12.676	0.115	0.570	-1.806	-0.433	10
46	Togo	-24.679	0.071	0.186	-1.790	-0.403	9
47	Myanmar	-11.279	0.185	0.606	-1.785	-0.280	10
48	Ecuador	-19.262	0.085	0.134	-1.753	-0.162	6
49	Nepal	-12.343	0.117	0.343	-1.574	-0.497	10
50	Mauritania	-14.423	0.108	0.302	-1.552	-0.361	7

51	Belgium	-12.389	0.080	0.098	-1.429	-0.108	1
52	Rwanda	-10.641	0.193	0.828	-1.282	-0.778	9
53	Jordan	-12.012	0.107	0.181	-1.218	-0.222	6
54	Ghana	-10.461	0.112	0.262	-1.184	-0.326	8
55	Albania	-1.359	0.084	0.127	-1.152	-0.345	7
56	France	-12.219	0.107	0.136	-1.151	-0.133	1
57	Venezuela (Bolivarian Repub	-7.431	0.108	0.170	-0.996	-0.068	5
58	Netherlands	-14.525	0.077	0.091	-0.921	-0.065	2
59	Nicaragua	-4.606	0.115	0.239	-0.870	-0.098	8
60	Lao People's Democratic Rep	-4.448	0.155	0.409	-0.870	-0.110	10
61	Switzerland	-8.950	0.071	0.085	-0.866	-0.117	1
62	Guyana	-5.676	0.125	0.250	-0.756	-0.074	8
63	Sierra Leone	-6.553	0.099	0.399	-0.736	-0.283	10
64	Uganda	-4.232	0.144	0.473	-0.712	-0.347	10
65	Italy	-0.355	0.110	0.143	-0.632	-0.076	2
66	Mali	-3.389	0.141	0.689	-0.533	-0.188	9
67	Colombia	-5.585	0.114	0.191	-0.522	-0.101	6
68	Kenya	-2.366	0.048	0.105	-0.456	-0.247	8
69	Côte d'Ivoire	-7.039	0.067	0.186	-0.447	-0.120	7
70	Senegal	-3.144	0.102	0.278	-0.405	-0.156	7
71	South Africa	5.911	0.000	0.000	-0.403	-0.043	4
72	Niger	-5.182	0.100	0.506	-0.374	-0.227	9
73	Afghanistan	-0.533	0.122	0.495	-0.344	-0.269	10
74	Japan	-1.681	0.072	0.086	-0.302	-0.033	1
75	Jamaica	-1.009	0.085	0.133	-0.215	-0.046	5
76	Malawi	-1.279	0.118	0.399	-0.188	-0.108	10
77	Fiji	0.986	0.085	0.138	-0.144	-0.085	5
78	Greece	4.542	0.094	0.122	-0.116	-0.012	3
79	Cuba	13.864	0.094	0.139	-0.069	-0.017	4
80	Gambia	-0.295	0.114	0.353	-0.017	-0.004	7
81	Syrian Arab Republic	1.177	0.088	0.158	0.032	0.007	7
82	Swaziland	-13.139	-0.001	-0.001	0.084	0.036	6
83	Haiti	2.864	0.051	0.127	0.105	0.151	9
84	Sri Lanka	2.215	0.098	0.161	0.126	0.057	9
85	Bangladesh	1.008	0.147	0.406	0.159	0.180	10
86	Lesotho	-1.743	-0.022	-0.046	0.180	0.155	8
87	Malta	5.297	0.087	0.115	0.212	0.030	3
88	Guatemala	3.578	0.115	0.247	0.249	0.076	7
89	Philippines	3.501	0.068	0.116	0.302	0.240	7
90	Pakistan	2.400	0.129	0.335	0.333	0.214	9
91	Yemen	2.968	0.180	0.629	0.517	0.526	9
92	Algeria	4.088	0.148	0.262	0.565	0.144	5
93	El Salvador	4.522	0.150	0.285	0.671	0.419	7
94	Peru	4.309	0.114	0.185	0.713	0.161	6
95	India	4.656	0.137	0.334	0.719	0.604	9
96	New Zealand	18.876	0.082	0.098	0.771	0.068	2
97	Tunisia	6.114	0.157	0.285	0.911	0.390	6
98	Tonga	18.897	0.052	0.080	0.929	0.347	6
99	Spain	18.043	0.128	0.170	0.950	0.153	2
100	Mexico	9.166	0.117	0.178	0.950	0.189	4
101	Namibia	-0.755	0.034	0.060	0.990	0.101	5
102	Argentina	10.895	0.104	0.148	1.077	0.114	3
103	Portugal	16.720	0.103	0.144	1.096	0.185	3
104	Australia	50.171	0.055	0.062	1.249	0.049	2
105	Egypt	8.746	0.158	0.315	1.302	0.582	8
106	Cyprus	19.629	0.070	0.090	1.377	0.210	3
107	Dominican Republic	12.942	0.113	0.193	1.447	0.856	6
108	Turkey	8.917	0.146	0.257	1.516	0.448	3
109	Barbados	34.722	0.063	0.083	1.734	0.159	3
110	Morocco	12.031	0.146	0.332	1.871	1.805	6

111	Thailand	17.425	0.116	0.205	2.103	0.682	6
112	Israel	19.538	0.087	0.107	2.151	0.233	2
113	Mauritius	23.531	0.106	0.170	2.369	1.039	5
114	Chile	20.980	0.110	0.157	2.371	0.881	4
115	Indonesia	17.460	0.141	0.294	2.419	0.401	8
116	Vietnam	14.603	0.172	0.393	2.487	6.390	10
117	Austria	24.798	0.095	0.119	2.600	0.321	1
118	Uruguay	33.890	0.093	0.134	2.802	2.542	4
119	Burundi	38.499	0.077	0.282	3.237	2.662	10
120	Canada	143.850	0.043	0.050	3.287	0.153	2
121	Singapore	22.039	0.136	0.180	3.455	0.334	2
122	China, People's Republic of	22.346	0.194	0.392	4.333	1.614	9
123	Iran, Islamic Republic of	25.855	0.201	0.372	4.999	1.152	6
124	Finland	42.848	0.089	0.111	5.475	0.544	1
125	Saudi Arabia	44.341	0.123	0.189	6.370	0.516	3
126	Republic of Korea (South)	39.978	0.156	0.208	6.614	1.079	3
127	Qatar	199.190	0.084	0.114	9.410	0.280	2
128	Trinidad and Tobago	267.170	0.073	0.107	19.256	1.249	3
129	Malaysia	195.330	0.128	0.201	21.982	-3.226	4
130	Kuwait	356.630	0.073	0.103	25.656	0.667	2

Table 16. Parameters for evaluating successfulness (ordering by the △GHGpc ratio)

	COUNTRY	SLOPE of trendline	HDI absolute value of increase (decrease)	HDI ratio of increase (decrease)	GHGpc absolute value of increase (decrease)	GHGpc ratio of increase (decrease)	Original Group
1	Malaysia	195.33	0.1277529509	0.2011246915	21.9816575149	(3.2264962346)	4
2	Kyrgyzstan	19.807	0.0052941965	0.0086898563	(7.6611010451)	(1.1259974867)	8
3	Latvia	-30.591	0.1061471941	0.1518554597	(11.0369282692)	(1.1077320971)	4
4	Rwanda	-10.641	0.1925872360	0.8279209182	(1.2815998359)	(0.7777299170)	9
5	Republic of Moldova	42.301	0.0017326748	0.0026642916	(7.1389233747)	(0.6826609676)	7
6	Costa Rica	-34.014	0.1048073658	0.1580661948	(2.5586545958)	(0.6117163165)	5
7	Armenia	-10.268	0.0946968465	0.1508923486	(4.1512706439)	(0.6104233888)	8
8	Tajikistan	12.618	(0.0029070741)	(0.0047247903)	(1.9568533814)	(0.5796702952)	8
9	Ukraine	29.552	0.0189031669	0.0264876248	(9.7765021453)	(0.5567732944)	5
10	Democratic Republic of the C	25.035	(0.0014606047)	(0.0049217936)	(5.9579411562)	(0.5386327554)	10
11	Sweden	-40.205	0.0896128817	0.1088985293	(4.2183341995)	(0.4999650533)	1
12	Nepal	-12.343	0.1171585424	0.3433478398	(1.5743106387)	(0.4965077880)	10
13	Slovakia	-47.682	0.0820635764	0.1088079930	(6.3346017430)	(0.4796703034)	4
14	Romania	-31.261	0.0765585139	0.1084386394	(5.1359166115)	(0.4694135291)	5
15	Zambia	-55.965	0.0395690715	0.0994335630	(8.5380374184)	(0.4673597932)	9
16	Central African Republic	-145.22	0.0320564766	0.1026164257	(19.8843139314)	(0.4554018243)	9
17	Gabon	-50.922	0.0656784670	0.1076449750	(3.5777706141)	(0.4553024752)	3
18	Croatia	-9.9025	0.0871594236	0.1216589068	(2.9831346676)	(0.4548273658)	4
19	Panama	-52.336	0.1045682958	0.1570598035	(4.6954625609)	(0.4494823890)	5
20	Mozambique	-12.676	0.1154320169	0.5701820574	(1.8062642401)	(0.4330060400)	10
21	Cameroon	-84.354	0.0567442269	0.1315605211	(6.7303347757)	(0.4102915205)	7
22	Bulgaria	-34.249	0.0745578547	0.1059202296	(4.3906835821)	(0.4057377659)	5
23	Togo	-24.679	0.0709040364	0.1858174898	(1.7904733065)	(0.4032921975)	9
24	United Republic of Tanzania:	-16.985	0.1122617077	0.3177515485	(2.5863722889)	(0.4026933913)	10
25	Honduras	-41.041	0.1087198582	0.2091442317	(4.1984350097)	(0.4026268450)	8
26	Benin	-15.935	0.1183196998	0.3772122922	(1.9765159962)	(0.4021403403)	9
27	Brazil	-22.027	0.1355414240	0.2296680397	(4.4847016533)	(0.3859880997)	5
28	Congo	-32.615	0.0192323519	0.0377061381	(3.3504348375)	(0.3851234652)	7
29	Papua New Guinea	-98.129	0.0903512333	0.2456360995	(8.2304125007)	(0.3663887285)	8
30	Mauritania	-14.423	0.1075302125	0.3016228884	(1.5517636846)	(0.3610785878)	7
31	Botswana	-88.555	0.0467727183	0.0797682173	(5.6881802975)	(0.3576724298)	4
32	Uganda	-4.2319	0.1444339557	0.4725550825	(0.7122788306)	(0.3465980285)	10
33	Albania	-1.3589	0.0842592033	0.1274016406	(1.1515469485)	(0.3446513714)	7
34	Lithuania	-2.0789	0.0774429146	0.1057662199	(4.1764476757)	(0.3262872247)	4
35	Ghana	-10.461	0.1120956837	0.2622124041	(1.1835974247)	(0.3256824367)	8
36	Zimbabwe	23.975	(0.0524669473)	(0.1229805421)	(1.9630839961)	(0.3073148065)	6
37	Russian Federation	-20.288	0.0519786005	0.0712287464	(6.1232994388)	(0.2900754033)	3
38	United Kingdom of Great Brit	-34.103	0.0899129477	0.1146598851	(3.7433350614)	(0.2884618901)	2
39	Sierra Leone	-6.5527	0.0987301603	0.3990373039	(0.7355269729)	(0.2829612896)	10
40	Myanmar	-11.279	0.1850056868	0.6060133428	(1.7845707844)	(0.2802499813)	10
41	Paraguay	-76.781	0.0898798309	0.1554865394	(6.6650864749)	(0.2762259905)	6
42	Germany	-31.605	0.1138786353	0.1418842599	(3.8292207457)	(0.2746490031)	1
43	Norway	-23.452	0.1000493757	0.1174056079	(2.0659489873)	(0.2705754416)	1
44	Afghanistan	-0.5333	0.1219541423	0.4953675370	(0.3436578395)	(0.2688663470)	10
45	Iceland	-22.839	0.0859563745	0.1054677608	(3.0703401672)	(0.2491886437)	1
46	Kenya	-2.3662	0.0484889435	0.1048020317	(0.4556500951)	(0.2468882296)	8
47	Hungary	-13.373	0.1149938880	0.1610863263	(2.2407759261)	(0.2409703441)	4
48	Bahrain	-58.695	0.0813339538	0.1140959522	(7.0010575229)	(0.2386771844)	3
49	Niger	-5.1821	0.0999977935	0.5059606343	(0.3744131258)	(0.2270456456)	9
50	Jordan	-12.012	0.1069984716	0.1807802694	(1.2178171140)	(0.2218909106)	6

51	Luxembourg	-48.472	0.0781643834	0.0981527490	(6.5160095889)	(0.2137814585)	1
52	Belize	-228.2	0.0464002391	0.0710287819	(10.6181808586)	(0.1903063745)	5
53	Mali	-3.3894	0.1405121256	0.6894226791	(0.5330235137)	(0.1876507136)	9
54	Estonia	-10.955	0.1101884042	0.1512771911	(4.8464243054)	(0.1824815719)	4
55	Bolivia	-30.774	0.1109720732	0.1992961108	(3.1758279892)	(0.1776062111)	7
56	Denmark	-39.4	0.0827246577	0.1013440605	(2.2988202433)	(0.1748334545)	1
57	Mongolia	-26.754	0.0978190071	0.1748388133	(3.9015595948)	(0.1676732983)	8
58	Ecuador	-19.262	0.0847925632	0.1336136264	(1.7526920990)	(0.1624609056)	6
59	Senegal	-3.1442	0.1021746154	0.2779800049	(0.4048867616)	(0.1562526278)	7
60	Ireland	-4.8748	0.1236523176	0.1559781192	(2.0449117418)	(0.1341972591)	2
61	France	-12.219	0.1067902795	0.1361271108	(1.1507676351)	(0.1328598505)	1
62	Côte d'Ivoire	-7.0389	0.0668691711	0.1856038399	(0.4468347639)	(0.1200228642)	7
63	Switzerland	-8.9497	0.0714554161	0.0850542681	(0.8655861125)	(0.1166833272)	1
64	United States	-38.675	0.0566216808	0.0645008468	(2.5999681484)	(0.1139477965)	1
65	Lao People's Democratic Rep	-4.4484	0.1550180880	0.4091154176	(0.8695015592)	(0.1095307513)	10
66	Malawi	-1.2794	0.1178927717	0.3991478972	(0.1879342218)	(0.1077583718)	10
67	Belgium	-12.389	0.0796630381	0.0975526721	(1.4288961334)	(0.1075681768)	1
68	Colombia	-5.5852	0.1142900132	0.1906209811	(0.5217964687)	(0.1007512188)	6
69	Nicaragua	-4.6061	0.1146239390	0.2393775603	(0.8697385348)	(0.0981078914)	8
70	Fiji	0.986	0.0849132766	0.1381872290	(0.1442463019)	(0.0847533134)	5
71	Brunei Darussalam	-92.87	0.0713743460	0.0912148072	(5.0866003601)	(0.0813499539)	2
72	Italy	-0.3548	0.1100341357	0.1427199432	(0.6315365971)	(0.0761853911)	2
73	Guyana	-5.6756	0.1254918023	0.2497737553	(0.7563958722)	(0.0741117491)	8
74	Venezuela (Bolivarian Repub	-7.4308	0.1083058411	0.1704775883	(0.9964637476)	(0.0676234233)	5
75	Netherlands	-14.525	0.0768750131	0.0912892328	(0.9213888732)	(0.0650194945)	2
76	Jamaica	-1.0086	0.0854328052	0.1330639847	(0.2153092092)	(0.0460519424)	5
77	South Africa	5.9113	(0.0001960625)	(0.0003157009)	(0.4025824213)	(0.0427532850)	4
78	Japan	-1.6812	0.0720502584	0.0860867204	(0.3016193254)	(0.0331845418)	1
79	Cuba	13.864	0.0944662860	0.1388054835	(0.0692684956)	(0.0169739742)	4
80	Greece	4.5418	0.0938074035	0.1215074636	(0.1157512664)	(0.0120130532)	3
81	Gambia	-0.2945	0.1139468296	0.3525354504	(0.0165329573)	(0.0039854851)	7
82	Syrian Arab Republic	1.1774	0.0882770005	0.1584124894	0.0318242336	0.0073540947	7
83	Malta	5.2974	0.0869339507	0.1148333135	0.2119241637	0.0300408970	3
84	Swaziland	-13.139	(0.0007235818)	(0.0013581347)	0.0842953909	0.0360591006	6
85	Australia	50.171	0.0545955729	0.0620069085	1.2487271477	0.0486961483	2
86	Sri Lanka	2.2154	0.0976923445	0.1607531132	0.1260010652	0.0572732115	9
87	New Zealand	18.876	0.0815172108	0.0976059871	0.7705709116	0.0677542592	2
88	Guatemala	3.5777	0.1146459141	0.2471482988	0.2492068935	0.0760415459	7
89	Namibia	-0.755	0.0343331284	0.0602954842	0.9896680930	0.1009791192	5
90	Argentina	10.895	0.1036784198	0.1479164193	1.0768826287	0.1136545267	3
91	Algeria	4.0877	0.1475183859	0.2624714089	0.5652678655	0.1437301591	5
92	Haiti	2.8643	0.0507994616	0.1272734284	0.1054166251	0.1507763740	9
93	Spain	18.043	0.1281964172	0.1696717519	0.9499726916	0.1525416924	2
94	Canada	143.85	0.0434901647	0.0502600387	3.2866117413	0.1531332005	2
95	Lesotho	-1.7427	(0.0216261282)	(0.0456476618)	0.1802385015	0.1549215185	8
96	Barbados	34.722	0.0630351825	0.0829322604	1.7336933058	0.1587602709	3
97	Peru	4.3093	0.1144103778	0.1848329911	0.7127022632	0.1606016554	6
98	Bangladesh	1.0077	0.1466953693	0.4061628496	0.1592903480	0.1799244871	10
99	Portugal	16.72	0.1028537244	0.1440081266	1.0959398232	0.1853044738	3
100	Mexico	9.1656	0.1165831137	0.1783086046	0.9503174465	0.1886092630	4
101	Cyprus	19.629	0.0701152468	0.0899712992	1.3770885794	0.2099958730	3
102	Pakistan	2.4001	0.1285001684	0.3352172827	0.3326291984	0.2140544509	9
103	Israel	19.538	0.0866075219	0.1070445488	2.1513683734	0.2325911565	2
104	Philippines	3.5005	0.0676731969	0.1164451521	0.3020753292	0.2401260907	7
105	Qatar	199.19	0.0844984672	0.1137665779	9.4100628507	0.2799664668	2
106	Austria	24.798	0.0951443018	0.1193844328	2.5997677448	0.3211380863	1
107	Singapore	22.039	0.1359133859	0.1796892214	3.4554392294	0.3340564168	2
108	Tonga	18.897	0.0524830007	0.0799976835	0.9286720985	0.3467127511	6
109	Tunisia	6.1135	0.1573879246	0.2847507384	0.9113770945	0.3904882528	6
110	Indonesia	17.46	0.1409357140	0.2944021961	2.4194511257	0.4013845543	8

111	El Salvador	4.5221	0.1501373310	0.2846174440	0.6709826580	0.4187207892	7
112	Turkey	8.9174	0.1461713579	0.2568207631	1.5157846057	0.4481217305	3
113	Saudi Arabia	44.341	0.1234605139	0.1890379520	6.3696777031	0.5159620414	3
114	Yemen	2.9683	0.1798590605	0.6290369665	0.5169133912	0.5256494651	9
115	Finland	42.848	0.0889219151	0.1110048594	5.4749175661	0.5436866064	1
116	Egypt	8.7461	0.1584094386	0.3153200164	1.3018286110	0.5817008933	8
117	India	4.6559	0.1368812915	0.3339408716	0.7194469131	0.6037495087	9
118	Kuwait	356.63	0.0730520450	0.1025304723	25.6557999879	0.6666651919	2
119	Thailand	17.425	0.1164030966	0.2045103989	2.1031456513	0.6815770327	6
120	Dominican Republic	12.942	0.1129954630	0.1933740788	1.4473491901	0.8556205436	6
121	Chile	20.98	0.1104484159	0.1572779864	2.3714816934	0.8810580902	4
122	Mauritius	23.531	0.1064623305	0.1701373525	2.3691100864	1.0385701109	5
123	Republic of Korea (South)	39.978	0.1557980342	0.2080668934	6.6135031794	1.0792100382	3
124	Iran, Islamic Republic of	25.855	0.2005172416	0.3715254857	4.9988868452	1.1521592380	6
125	Trinidad and Tobago	267.17	0.0733014736	0.1069899765	19.2556391420	1.2489605059	3
126	China, People's Republic of	22.346	0.1940137709	0.3920161649	4.3328394649	1.6140752347	9
127	Morocco	12.031	0.1461476780	0.3324289664	1.8714998468	1.8045379968	6
128	Uruguay	33.89	0.0927885841	0.1339638683	2.8024865909	2.5422419132	4
129	Burundi	38.499	0.0766953451	0.2822499896	3.2374206817	2.6624078264	10
130	Vietnam	14.603	0.1724685065	0.3931706053	2.4874842097	6.3895092304	10

Table 17. Parameters for evaluating successfulness (ordering by the slope of △GHGpc/△GNIpc)

	COUNTRY	SLOPE of trendline	GNIpc absolute value of increase (decrease)	GNIpc ratio of increase (decrease)	GHGpc absolute value of increase (decrease)	GHGpc ratio of increase (decrease)	Original Group
1	Burundi	-0.009	-36.937	-0.131	3.237	2.662	10
2	Papua New Guinea	-0.007	653.938	1.025	-8.230	-0.366	8
3	United Republic of Tanzania:	-0.007	316.053	1.519	-2.586	-0.403	10
4	Zambia	-0.006	651.436	1.475	-8.538	-0.467	9
5	Belize	-0.005	2102.048	1.012	-10.618	-0.190	5
6	Mozambique	-0.005	184.779	0.895	-1.806	-0.433	10
7	Nepal	-0.005	353.868	1.815	-1.574	-0.497	10
8	Cameroon	-0.004	226.829	0.238	-6.730	-0.410	7
9	Benin	-0.004	362.690	0.959	-1.977	-0.402	9
10	Honduras	-0.003	1275.428	1.899	-4.198	-0.403	8
11	Rwanda	-0.003	164.756	0.457	-1.282	-0.778	9
12	Sierra Leone	-0.003	230.472	1.118	-0.736	-0.283	10
13	Niger	-0.002	32.906	0.100	-0.374	-0.227	9
14	Paraguay	-0.002	1662.286	1.483	-6.665	-0.276	6
15	Uganda	-0.002	305.915	1.419	-0.712	-0.347	10
16	Bolivia	-0.002	1194.326	1.713	-3.176	-0.178	7
17	Myanmar	-0.002	744.011	5.472	-1.785	-0.280	10
18	Congo	-0.001	1426.491	1.457	-3.350	-0.385	7
19	Mongolia	-0.001	1434.830	2.345	-3.902	-0.168	8
20	Panama	-0.001	4590.121	1.966	-4.695	-0.449	5
21	Ghana	-0.001	634.608	0.958	-1.184	-0.326	8
22	Botswana	-0.001	4702.304	1.795	-5.688	-0.358	4
23	Nicaragua	-0.001	438.349	0.672	-0.870	-0.098	8
24	Mali	-0.001	303.131	1.060	-0.533	-0.188	9
25	Brazil	-0.001	8403.356	3.514	-4.485	-0.386	5
26	Costa Rica	-0.001	5283.029	2.318	-2.559	-0.612	5
27	Mauritania	-0.001	118.748	0.153	-1.552	-0.361	7
28	Kyrgyzstan	-0.001	241.385	0.407	-7.661	-1.126	8
29	Bahrain	-0.001	6988.866	0.821	-7.001	-0.239	3
30	Latvia	-0.001	7811.505	2.518	-11.037	-1.108	4
31	Senegal	-0.001	188.940	0.229	-0.405	-0.156	7
32	Guyana	-0.001	1978.637	3.055	-0.756	-0.074	8
33	Romania	0.000	5814.225	3.327	-5.136	-0.469	5
34	Ecuador	0.000	2820.582	2.540	-1.753	-0.162	6
35	Armenia	0.000	2529.067	4.138	-4.151	-0.610	8
36	Brunei Darussalam	0.000	17197.862	1.232	-5.087	-0.081	2
37	Gabon	0.000	5183.708	0.920	-3.578	-0.455	3
38	Bulgaria	0.000	4029.621	1.822	-4.391	-0.406	5
39	Jordan	0.000	3237.793	3.022	-1.218	-0.222	6
40	Kenya	0.000	280.776	0.551	-0.456	-0.247	8
41	Sweden	0.000	22200.914	0.787	-4.218	-0.500	1
42	Russian Federation	0.000	6243.233	1.634	-6.123	-0.290	3
43	Slovakia	0.000	12608.568	4.048	-6.335	-0.480	4
44	Gambia	0.000	-204.030	-0.284	-0.017	-0.004	7
45	Lao People's Democratic Rep	0.000	833.919	4.044	-0.870	-0.110	10
46	Germany	0.000	19051.665	0.869	-3.829	-0.275	1
47	United Kingdom of Great Brit	0.000	19446.213	1.118	-3.743	-0.288	2
48	Hungary	0.000	9165.358	3.010	-2.241	-0.241	4
49	Colombia	0.000	4322.159	2.657	-0.522	-0.101	6
50	Denmark	0.000	31783.616	1.235	-2.299	-0.175	1

51	United States	0.000	24536.366	1.090	-2.600	-0.114	1
52	Croatia	0.000	9442.953	2.629	-2.983	-0.455	4
53	France	0.000	19051.693	0.893	-1.151	-0.133	1
54	Belgium	0.000	24568.086	1.208	-1.429	-0.108	1
55	Syrian Arab Republic	0.000	2047.869	2.415	0.032	0.007	7
56	Venezuela (Bolivarian Repub	0.000	11106.516	4.798	-0.996	-0.068	5
57	Albania	0.000	3029.731	4.490	-1.152	-0.345	7
58	Norway	0.000	59573.889	2.211	-2.066	-0.271	1
59	Iceland	0.000	8199.092	0.339	-3.070	-0.249	1
60	Netherlands	0.000	26530.455	1.350	-0.921	-0.065	2
61	Ireland	0.000	25931.828	1.999	-2.045	-0.134	2
62	Italy	0.000	14182.751	0.723	-0.632	-0.076	2
63	Togo	0.000	43.896	0.092	-1.790	-0.403	9
64	Switzerland	0.000	38650.262	1.032	-0.866	-0.117	1
65	Luxembourg	0.000	43220.933	1.372	-6.516	-0.214	1
66	South Africa	0.000	4178.640	1.427	-0.403	-0.043	4
67	Greece	0.000	16396.701	1.747	-0.116	-0.012	3
68	Swaziland	0.000	1949.863	1.505	0.084	0.036	6
69	Lithuania	0.000	7981.638	2.847	-4.176	-0.326	4
70	Japan	0.000	18914.403	0.740	-0.302	-0.033	1
71	New Zealand	0.000	18523.990	1.461	0.771	0.068	2
72	Jamaica	0.000	2721.512	1.375	-0.215	-0.046	5
73	Australia	0.000	37172.021	2.039	1.249	0.049	2
74	Malawi	0.000	86.364	0.324	-0.188	-0.108	10
75	Guatemala	0.000	2043.425	2.742	0.249	0.076	7
76	Cyprus	0.000	17774.494	1.815	1.377	0.210	3
77	Malta	0.000	10410.052	1.397	0.212	0.030	3
78	Republic of Moldova	0.000	853.303	0.939	-7.139	-0.683	7
79	Sri Lanka	0.000	1881.437	4.060	0.126	0.057	9
80	Spain	0.000	16490.597	1.242	0.950	0.153	2
81	Portugal	0.000	12936.529	1.664	1.096	0.185	3
82	Estonia	0.000	9747.571	2.696	-4.846	-0.182	4
83	Fiji	0.000	1707.302	0.916	-0.144	-0.085	5
84	Philippines	0.000	1992.080	2.318	0.302	0.240	7
85	Austria	0.000	23762.501	1.114	2.600	0.321	1
86	Singapore	0.000	31182.254	2.447	3.455	0.334	2
87	Israel	0.000	16031.278	1.289	2.151	0.233	2
88	Argentina	0.000	4770.405	1.152	1.077	0.114	3
89	Finland	0.000	17735.306	0.655	5.475	0.544	1
90	Canada	0.000	25275.342	1.246	3.287	0.153	2
91	Qatar	0.000	49034.225	3.064	9.410	0.280	2
92	Turkey	0.000	6258.706	1.655	1.516	0.448	3
93	Mexico	0.000	5678.595	1.717	0.950	0.189	4
94	Uruguay	0.000	8434.569	2.934	2.802	2.542	4
95	Chile	0.000	9291.477	3.733	2.371	0.881	4
96	Peru	0.000	3770.874	2.915	0.713	0.161	6
97	Lesotho	0.000	647.581	1.078	0.180	0.155	8
98	Barbados	0.000	6596.084	0.853	1.734	0.159	3
99	Algeria	0.000	1915.086	0.810	0.565	0.144	5
100	Namibia	0.000	3017.673	1.570	0.990	0.101	5
101	Ukraine	0.000	1205.084	0.675	-9.777	-0.557	5
102	El Salvador	0.000	2494.825	2.847	0.671	0.419	7
103	Côte d'Ivoire	0.000	279.147	0.333	-0.447	-0.120	7
104	Republic of Korea (South)	0.000	14801.403	2.354	6.614	1.079	3
105	Tonga	0.000	1878.560	1.076	0.929	0.347	6
106	Tunisia	0.000	2402.382	1.497	0.911	0.390	6
107	Dominican Republic	0.000	3674.222	2.864	1.447	0.856	6
108	Tajikistan	0.000	503.134	0.941	-1.957	-0.580	8
109	Haiti	0.000	246.052	0.677	0.105	0.151	9
110	Bangladesh	0.000	460.901	1.695	0.159	0.180	10

111	Kuwait	0.001	35795.881	2.865	25.656	0.667	2
112	Saudi Arabia	0.001	9175.864	1.223	6.370	0.516	3
113	Cuba	0.001	2978.324	1.123	-0.069	-0.017	4
114	Mauritius	0.001	5124.374	2.096	2.369	1.039	5
115	Pakistan	0.001	591.401	1.320	0.333	0.214	9
116	Thailand	0.001	3206.226	2.102	2.103	0.682	6
117	Egypt	0.001	2013.201	3.268	1.302	0.582	8
118	India	0.001	987.190	2.674	0.719	0.604	9
119	Yemen	0.001	955.088	2.825	0.517	0.526	9
120	Afghanistan	0.001	172.178	0.620	-0.344	-0.269	10
121	Iran, Islamic Republic of	0.001	4114.292	2.507	4.999	1.152	6
122	Indonesia	0.001	2215.864	3.394	2.419	0.401	8
123	Morocco	0.001	1653.021	1.477	1.871	1.805	6
124	China, People's Republic of	0.001	4170.723	11.988	4.333	1.614	9
125	Trinidad and Tobago	0.002	11503.610	2.997	19.256	1.249	3
126	Vietnam	0.002	1070.873	11.858	2.487	6.390	10
127	Zimbabwe	0.003	-499.750	-0.461	-1.963	-0.307	6
128	Malaysia	0.004	5886.450	2.341	21.982	-3.226	4
129	Democratic Republic of the C	0.019	-49.104	-0.208	-5.958	-0.539	10
130	Central African Republic	0.033	-33.196	-0.069	-19.884	-0.455	9

Table 18. Parameters for evaluating successfulness (ordering by the △GNIpc absolute value)

	COUNTRY	SLOPE of trendline	GNIpc		GHGpc		Original Group
			absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	
1	Norway	0.000	59573.889	2.211	-2.066	-0.271	1
2	Qatar	0.000	49034.225	3.064	9.410	0.280	2
3	Luxembourg	0.000	43220.933	1.372	-6.516	-0.214	1
4	Switzerland	0.000	38650.262	1.032	-0.866	-0.117	1
5	Australia	0.000	37172.021	2.039	1.249	0.049	2
6	Kuwait	0.001	35795.881	2.865	25.656	0.667	2
7	Denmark	0.000	31783.616	1.235	-2.299	-0.175	1
8	Singapore	0.000	31182.254	2.447	3.455	0.334	2
9	Netherlands	0.000	26530.455	1.350	-0.921	-0.065	2
10	Ireland	0.000	25931.828	1.999	-2.045	-0.134	2
11	Canada	0.000	25275.342	1.246	3.287	0.153	2
12	Belgium	0.000	24568.086	1.208	-1.429	-0.108	1
13	United States	0.000	24536.366	1.090	-2.600	-0.114	1
14	Austria	0.000	23762.501	1.114	2.600	0.321	1
15	Sweden	0.000	22200.914	0.787	-4.218	-0.500	1
16	United Kingdom of Great Brit	0.000	19446.213	1.118	-3.743	-0.288	2
17	France	0.000	19051.693	0.893	-1.151	-0.133	1
18	Germany	0.000	19051.665	0.869	-3.829	-0.275	1
19	Japan	0.000	18914.403	0.740	-0.302	-0.033	1
20	New Zealand	0.000	18523.990	1.461	0.771	0.068	2
21	Cyprus	0.000	17774.494	1.815	1.377	0.210	3
22	Finland	0.000	17735.306	0.655	5.475	0.544	1
23	Brunei Darussalam	0.000	17197.862	1.232	-5.087	-0.081	2
24	Spain	0.000	16490.597	1.242	0.950	0.153	2
25	Greece	0.000	16396.701	1.747	-0.116	-0.012	3
26	Israel	0.000	16031.278	1.289	2.151	0.233	2
27	Republic of Korea (South)	0.000	14801.403	2.354	6.614	1.079	3
28	Italy	0.000	14182.751	0.723	-0.632	-0.076	2
29	Portugal	0.000	12936.529	1.664	1.096	0.185	3
30	Slovakia	0.000	12608.568	4.048	-6.335	-0.480	4
31	Trinidad and Tobago	0.002	11503.610	2.997	19.256	1.249	3
32	Venezuela (Bolivarian Repub	0.000	11106.516	4.798	-0.996	-0.068	5
33	Malta	0.000	10410.052	1.397	0.212	0.030	3
34	Estonia	0.000	9747.571	2.696	-4.846	-0.182	4
35	Croatia	0.000	9442.953	2.629	-2.983	-0.455	4
36	Chile	0.000	9291.477	3.733	2.371	0.881	4
37	Saudi Arabia	0.001	9175.864	1.223	6.370	0.516	3
38	Hungary	0.000	9165.358	3.010	-2.241	-0.241	4
39	Uruguay	0.000	8434.569	2.934	2.802	2.542	4
40	Brazil	-0.001	8403.356	3.514	-4.485	-0.386	5
41	Iceland	0.000	8199.092	0.339	-3.070	-0.249	1
42	Lithuania	0.000	7981.638	2.847	-4.176	-0.326	4
43	Latvia	-0.001	7811.505	2.518	-11.037	-1.108	4
44	Bahrain	-0.001	6988.866	0.821	-7.001	-0.239	3
45	Barbados	0.000	6596.084	0.853	1.734	0.159	3
46	Turkey	0.000	6258.706	1.655	1.516	0.448	3
47	Russian Federation	0.000	6243.233	1.634	-6.123	-0.290	3
48	Malaysia	0.004	5886.450	2.341	21.982	-3.226	4
49	Romania	0.000	5814.225	3.327	-5.136	-0.469	5
50	Mexico	0.000	5678.595	1.717	0.950	0.189	4

51	Costa Rica	-0.001	5283.029	2.318	-2.559	-0.612	5
52	Gabon	0.000	5183.708	0.920	-3.578	-0.455	3
53	Mauritius	0.001	5124.374	2.096	2.369	1.039	5
54	Argentina	0.000	4770.405	1.152	1.077	0.114	3
55	Botswana	-0.001	4702.304	1.795	-5.688	-0.358	4
56	Panama	-0.001	4590.121	1.966	-4.695	-0.449	5
57	Colombia	0.000	4322.159	2.657	-0.522	-0.101	6
58	South Africa	0.000	4178.640	1.427	-0.403	-0.043	4
59	China, People's Republic of	0.001	4170.723	11.988	4.333	1.614	9
60	Iran, Islamic Republic of	0.001	4114.292	2.507	4.999	1.152	6
61	Bulgaria	0.000	4029.621	1.822	-4.391	-0.406	5
62	Peru	0.000	3770.874	2.915	0.713	0.161	6
63	Dominican Republic	0.000	3674.222	2.864	1.447	0.856	6
64	Jordan	0.000	3237.793	3.022	-1.218	-0.222	6
65	Thailand	0.001	3206.226	2.102	2.103	0.682	6
66	Albania	0.000	3029.731	4.490	-1.152	-0.345	7
67	Namibia	0.000	3017.673	1.570	0.990	0.101	5
68	Cuba	0.001	2978.324	1.123	-0.069	-0.017	4
69	Ecuador	0.000	2820.582	2.540	-1.753	-0.162	6
70	Jamaica	0.000	2721.512	1.375	-0.215	-0.046	5
71	Armenia	0.000	2529.067	4.138	-4.151	-0.610	8
72	El Salvador	0.000	2494.825	2.847	0.671	0.419	7
73	Tunisia	0.000	2402.382	1.497	0.911	0.390	6
74	Indonesia	0.001	2215.864	3.394	2.419	0.401	8
75	Belize	-0.005	2102.048	1.012	-10.618	-0.190	5
76	Syrian Arab Republic	0.000	2047.869	2.415	0.032	0.007	7
77	Guatemala	0.000	2043.425	2.742	0.249	0.076	7
78	Egypt	0.001	2013.201	3.268	1.302	0.582	8
79	Philippines	0.000	1992.080	2.318	0.302	0.240	7
80	Guyana	-0.001	1978.637	3.055	-0.756	-0.074	8
81	Swaziland	0.000	1949.863	1.505	0.084	0.036	6
82	Algeria	0.000	1915.086	0.810	0.565	0.144	5
83	Sri Lanka	0.000	1881.437	4.060	0.126	0.057	9
84	Tonga	0.000	1878.560	1.076	0.929	0.347	6
85	Fiji	0.000	1707.302	0.916	-0.144	-0.085	5
86	Paraguay	-0.002	1662.286	1.483	-6.665	-0.276	6
87	Morocco	0.001	1653.021	1.477	1.871	1.805	6
88	Mongolia	-0.001	1434.830	2.345	-3.902	-0.168	8
89	Congo	-0.001	1426.491	1.457	-3.350	-0.385	7
90	Honduras	-0.003	1275.428	1.899	-4.198	-0.403	8
91	Ukraine	0.000	1205.084	0.675	-9.777	-0.557	5
92	Bolivia	-0.002	1194.326	1.713	-3.176	-0.178	7
93	Vietnam	0.002	1070.873	11.858	2.487	6.390	10
94	India	0.001	987.190	2.674	0.719	0.604	9
95	Yemen	0.001	955.088	2.825	0.517	0.526	9
96	Republic of Moldova	0.000	853.303	0.939	-7.139	-0.683	7
97	Lao People's Democratic Rep	0.000	833.919	4.044	-0.870	-0.110	10
98	Myanmar	-0.002	744.011	5.472	-1.785	-0.280	10
99	Papua New Guinea	-0.007	653.938	1.025	-8.230	-0.366	8
100	Zambia	-0.006	651.436	1.475	-8.538	-0.467	9
101	Lesotho	0.000	647.581	1.078	0.180	0.155	8
102	Ghana	-0.001	634.608	0.958	-1.184	-0.326	8
103	Pakistan	0.001	591.401	1.320	0.333	0.214	9
104	Tajikistan	0.000	503.134	0.941	-1.957	-0.580	8
105	Bangladesh	0.000	460.901	1.695	0.159	0.180	10
106	Nicaragua	-0.001	438.349	0.672	-0.870	-0.098	8
107	Benin	-0.004	362.690	0.959	-1.977	-0.402	9
108	Nepal	-0.005	353.868	1.815	-1.574	-0.497	10
109	United Republic of Tanzania:	-0.007	316.053	1.519	-2.586	-0.403	10
110	Uganda	-0.002	305.915	1.419	-0.712	-0.347	10

111	Mali	-0.001	303.131	1.060	-0.533	-0.188	9
112	Kenya	0.000	280.776	0.551	-0.456	-0.247	8
113	Côte d'Ivoire	0.000	279.147	0.333	-0.447	-0.120	7
114	Haiti	0.000	246.052	0.677	0.105	0.151	9
115	Kyrgyzstan	-0.001	241.385	0.407	-7.661	-1.126	8
116	Sierra Leone	-0.003	230.472	1.118	-0.736	-0.283	10
117	Cameroon	-0.004	226.829	0.238	-6.730	-0.410	7
118	Senegal	-0.001	188.940	0.229	-0.405	-0.156	7
119	Mozambique	-0.005	184.779	0.895	-1.806	-0.433	10
120	Afghanistan	0.001	172.178	0.620	-0.344	-0.269	10
121	Rwanda	-0.003	164.756	0.457	-1.282	-0.778	9
122	Mauritania	-0.001	118.748	0.153	-1.552	-0.361	7
123	Malawi	0.000	86.364	0.324	-0.188	-0.108	10
124	Togo	0.000	43.896	0.092	-1.790	-0.403	9
125	Niger	-0.002	32.906	0.100	-0.374	-0.227	9
126	Central African Republic	0.033	-33.196	-0.069	-19.884	-0.455	9
127	Burundi	-0.009	-36.937	-0.131	3.237	2.662	10
128	Democratic Republic of the C	0.019	-49.104	-0.208	-5.958	-0.539	10
129	Gambia	0.000	-204.030	-0.284	-0.017	-0.004	7
130	Zimbabwe	0.003	-499.750	-0.461	-1.963	-0.307	6

Table 19. Parameters for evaluating successfulness (ordering by the △GNIpc ratio)

	COUNTRY	SLOPE of trendline	GNIpc		GHGpc		Original Group
			absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	
1	China, People's Republic of	0.001	4170.723	11.988	4.333	1.614	9
2	Vietnam	0.002	1070.873	11.858	2.487	6.390	10
3	Myanmar	-0.002	744.011	5.472	-1.785	-0.280	10
4	Venezuela (Bolivarian Repub	0.000	11106.516	4.798	-0.996	-0.068	5
5	Albania	0.000	3029.731	4.490	-1.152	-0.345	7
6	Armenia	0.000	2529.067	4.138	-4.151	-0.610	8
7	Sri Lanka	0.000	1881.437	4.060	0.126	0.057	9
8	Slovakia	0.000	12608.568	4.048	-6.335	-0.480	4
9	Lao People's Democratic Rep	0.000	833.919	4.044	-0.870	-0.110	10
10	Chile	0.000	9291.477	3.733	2.371	0.881	4
11	Brazil	-0.001	8403.356	3.514	-4.485	-0.386	5
12	Indonesia	0.001	2215.864	3.394	2.419	0.401	8
13	Romania	0.000	5814.225	3.327	-5.136	-0.469	5
14	Egypt	0.001	2013.201	3.268	1.302	0.582	8
15	Qatar	0.000	49034.225	3.064	9.410	0.280	2
16	Guyana	-0.001	1978.637	3.055	-0.756	-0.074	8
17	Jordan	0.000	3237.793	3.022	-1.218	-0.222	6
18	Hungary	0.000	9165.358	3.010	-2.241	-0.241	4
19	Trinidad and Tobago	0.002	11503.610	2.997	19.256	1.249	3
20	Uruguay	0.000	8434.569	2.934	2.802	2.542	4
21	Peru	0.000	3770.874	2.915	0.713	0.161	6
22	Kuwait	0.001	35795.881	2.865	25.656	0.667	2
23	Dominican Republic	0.000	3674.222	2.864	1.447	0.856	6
24	Lithuania	0.000	7981.638	2.847	-4.176	-0.326	4
25	El Salvador	0.000	2494.825	2.847	0.671	0.419	7
26	Yemen	0.001	955.088	2.825	0.517	0.526	9
27	Guatemala	0.000	2043.425	2.742	0.249	0.076	7
28	Estonia	0.000	9747.571	2.696	-4.846	-0.182	4
29	India	0.001	987.190	2.674	0.719	0.604	9
30	Colombia	0.000	4322.159	2.657	-0.522	-0.101	6
31	Croatia	0.000	9442.953	2.629	-2.983	-0.455	4
32	Ecuador	0.000	2820.582	2.540	-1.753	-0.162	6
33	Latvia	-0.001	7811.505	2.518	-11.037	-1.108	4
34	Iran, Islamic Republic of	0.001	4114.292	2.507	4.999	1.152	6
35	Singapore	0.000	31182.254	2.447	3.455	0.334	2
36	Syrian Arab Republic	0.000	2047.869	2.415	0.032	0.007	7
37	Republic of Korea (South)	0.000	14801.403	2.354	6.614	1.079	3
38	Mongolia	-0.001	1434.830	2.345	-3.902	-0.168	8
39	Malaysia	0.004	5886.450	2.341	21.982	-3.226	4
40	Philippines	0.000	1992.080	2.318	0.302	0.240	7
41	Costa Rica	-0.001	5283.029	2.318	-2.559	-0.612	5
42	Norway	0.000	59573.889	2.211	-2.066	-0.271	1
43	Thailand	0.001	3206.226	2.102	2.103	0.682	6
44	Mauritius	0.001	5124.374	2.096	2.369	1.039	5
45	Australia	0.000	37172.021	2.039	1.249	0.049	2
46	Ireland	0.000	25931.828	1.999	-2.045	-0.134	2
47	Panama	-0.001	4590.121	1.966	-4.695	-0.449	5
48	Honduras	-0.003	1275.428	1.899	-4.198	-0.403	8
49	Bulgaria	0.000	4029.621	1.822	-4.391	-0.406	5
50	Cyprus	0.000	17774.494	1.815	1.377	0.210	3

51	Nepal	-0.005	353.868	1.815	-1.574	-0.497	10
52	Botswana	-0.001	4702.304	1.795	-5.688	-0.358	4
53	Greece	0.000	16396.701	1.747	-0.116	-0.012	3
54	Mexico	0.000	5678.595	1.717	0.950	0.189	4
55	Bolivia	-0.002	1194.326	1.713	-3.176	-0.178	7
56	Bangladesh	0.000	460.901	1.695	0.159	0.180	10
57	Portugal	0.000	12936.529	1.664	1.096	0.185	3
58	Turkey	0.000	6258.706	1.655	1.516	0.448	3
59	Russian Federation	0.000	6243.233	1.634	-6.123	-0.290	3
60	Namibia	0.000	3017.673	1.570	0.990	0.101	5
61	United Republic of Tanzania:	-0.007	316.053	1.519	-2.586	-0.403	10
62	Swaziland	0.000	1949.863	1.505	0.084	0.036	6
63	Tunisia	0.000	2402.382	1.497	0.911	0.390	6
64	Paraguay	-0.002	1662.286	1.483	-6.665	-0.276	6
65	Morocco	0.001	1653.021	1.477	1.871	1.805	6
66	Zambia	-0.006	651.436	1.475	-8.538	-0.467	9
67	New Zealand	0.000	18523.990	1.461	0.771	0.068	2
68	Congo	-0.001	1426.491	1.457	-3.350	-0.385	7
69	South Africa	0.000	4178.640	1.427	-0.403	-0.043	4
70	Uganda	-0.002	305.915	1.419	-0.712	-0.347	10
71	Malta	0.000	10410.052	1.397	0.212	0.030	3
72	Jamaica	0.000	2721.512	1.375	-0.215	-0.046	5
73	Luxembourg	0.000	43220.933	1.372	-6.516	-0.214	1
74	Netherlands	0.000	26530.455	1.350	-0.921	-0.065	2
75	Pakistan	0.001	591.401	1.320	0.333	0.214	9
76	Israel	0.000	16031.278	1.289	2.151	0.233	2
77	Canada	0.000	25275.342	1.246	3.287	0.153	2
78	Spain	0.000	16490.597	1.242	0.950	0.153	2
79	Denmark	0.000	31783.616	1.235	-2.299	-0.175	1
80	Brunei Darussalam	0.000	17197.862	1.232	-5.087	-0.081	2
81	Saudi Arabia	0.001	9175.864	1.223	6.370	0.516	3
82	Belgium	0.000	24568.086	1.208	-1.429	-0.108	1
83	Argentina	0.000	4770.405	1.152	1.077	0.114	3
84	Cuba	0.001	2978.324	1.123	-0.069	-0.017	4
85	Sierra Leone	-0.003	230.472	1.118	-0.736	-0.283	10
86	United Kingdom of Great Brit	0.000	19446.213	1.118	-3.743	-0.288	2
87	Austria	0.000	23762.501	1.114	2.600	0.321	1
88	United States	0.000	24536.366	1.090	-2.600	-0.114	1
89	Lesotho	0.000	647.581	1.078	0.180	0.155	8
90	Tonga	0.000	1878.560	1.076	0.929	0.347	6
91	Mali	-0.001	303.131	1.060	-0.533	-0.188	9
92	Switzerland	0.000	38650.262	1.032	-0.866	-0.117	1
93	Papua New Guinea	-0.007	653.938	1.025	-8.230	-0.366	8
94	Belize	-0.005	2102.048	1.012	-10.618	-0.190	5
95	Benin	-0.004	362.690	0.959	-1.977	-0.402	9
96	Ghana	-0.001	634.608	0.958	-1.184	-0.326	8
97	Tajikistan	0.000	503.134	0.941	-1.957	-0.580	8
98	Republic of Moldova	0.000	853.303	0.939	-7.139	-0.683	7
99	Gabon	0.000	5183.708	0.920	-3.578	-0.455	3
100	Fiji	0.000	1707.302	0.916	-0.144	-0.085	5
101	Mozambique	-0.005	184.779	0.895	-1.806	-0.433	10
102	France	0.000	19051.693	0.893	-1.151	-0.133	1
103	Germany	0.000	19051.665	0.869	-3.829	-0.275	1
104	Barbados	0.000	6596.084	0.853	1.734	0.159	3
105	Bahrain	-0.001	6988.866	0.821	-7.001	-0.239	3
106	Algeria	0.000	1915.086	0.810	0.565	0.144	5
107	Sweden	0.000	22200.914	0.787	-4.218	-0.500	1
108	Japan	0.000	18914.403	0.740	-0.302	-0.033	1
109	Italy	0.000	14182.751	0.723	-0.632	-0.076	2
110	Haiti	0.000	246.052	0.677	0.105	0.151	9

111	Ukraine	0.000	1205.084	0.675	-9.777	-0.557	5
112	Nicaragua	-0.001	438.349	0.672	-0.870	-0.098	8
113	Finland	0.000	17735.306	0.655	5.475	0.544	1
114	Afghanistan	0.001	172.178	0.620	-0.344	-0.269	10
115	Kenya	0.000	280.776	0.551	-0.456	-0.247	8
116	Rwanda	-0.003	164.756	0.457	-1.282	-0.778	9
117	Kyrgyzstan	-0.001	241.385	0.407	-7.661	-1.126	8
118	Iceland	0.000	8199.092	0.339	-3.070	-0.249	1
119	Côte d'Ivoire	0.000	279.147	0.333	-0.447	-0.120	7
120	Malawi	0.000	86.364	0.324	-0.188	-0.108	10
121	Cameroon	-0.004	226.829	0.238	-6.730	-0.410	7
122	Senegal	-0.001	188.940	0.229	-0.405	-0.156	7
123	Mauritania	-0.001	118.748	0.153	-1.552	-0.361	7
124	Niger	-0.002	32.906	0.100	-0.374	-0.227	9
125	Togo	0.000	43.896	0.092	-1.790	-0.403	9
126	Central African Republic	0.033	-33.196	-0.069	-19.884	-0.455	9
127	Burundi	-0.009	-36.937	-0.131	3.237	2.662	10
128	Democratic Republic of the C	0.019	-49.104	-0.208	-5.958	-0.539	10
129	Gambia	0.000	-204.030	-0.284	-0.017	-0.004	7
130	Zimbabwe	0.003	-499.750	-0.461	-1.963	-0.307	6

Table 20. Parameter Orders of Developing Countries in Asia

COUNTRY	Original Group	Parameter (i)	Parameter (ii)	Parameter (iii)	Parameter (iv)	Parameter (v)	Parameter (vi)	Parameter (vii)	Parameter (viii)
			HDI		GHGpc			GNIpc	
		HDIvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	GNIpcvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)
Afghanistan	10	71	28	7	73	44	120	120	114
Bangladesh	10	75	13	10	85	98	110	105	56
China, People's Republic of	9	111	2	14	122	126	124	59	1
India	9	87	19	20	95	117	118	94	29
Indonesia	8	102	17	25	115	110	122	74	12
Kyrgyzstan	8	108	123	123	7	2	28	115	117
Lao People's Democratic Republic	10	59	10	9	60	65	45	97	9
Malaysia	4	127	24	41	129	1	128	48	39
Mongolia	8	26	64	52	27	57	19	88	38
Myanmar	10	44	4	4	47	40	17	98	3
Nepal	10	41	31	18	49	12	7	108	51
Pakistan	9	78	22	19	90	102	115	103	75
Philippines	7	81	104	84	89	104	84	79	40
Republic of Korea (South)	3	121	9	39	126	123	104	27	37
Sri Lanka	9	77	65	57	84	86	79	83	7
Tajikistan	8	96	128	127	44	8	108	104	97
Thailand	6	101	33	40	111	119	116	65	43
Vietnam	10	99	6	13	116	130	126	93	2

Table 21(a). Evaluation of Parameter Orders of Developing Countries in Asia

COUNTRY	Original Group	Parameter (i)	Parameter (ii)	Parameter (iii)	Parameter (iv)	Parameter (v)	Parameter (vi)	Parameter (vii)	Parameter (viii)
			HDI		GHGpc			GNIpc	
		HDIvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	GNIpcvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)
Afghanistan	10	△	○	◎	△	△	x	x	x
Bangladesh	10	x	○	◎	x	x	x	x	△
China, People's Republic of	9	x	◎	○	x	x	x	△	◎
India	9	x	○	○	x	x	x	x	○
Indonesia	8	x	○	○	x	x	x	△	○
Kyrgyzstan	8	x	x	x	◎	◎	○	x	x
Lao People's Democratic Republic	10	△	◎	◎	△	△	△	x	◎
Malaysia	4	x	○	△	x	◎	x	△	△
Mongolia	8	○	x	x	○	△	○	△	△
Myanmar	10	△	◎	◎	△	△	○	x	◎
Nepal	10	△	△	○	△	○	◎	x	△
Pakistan	9	x	○	○	x	x	x	x	x
Philippines	7	x	x	x	x	x	x	△	△
Republic of Korea (South)	3	x	◎	△	x	x	x	○	△
Sri Lanka	9	x	x	x	x	x	x	△	◎
Tajikistan	8	x	x	x	△	◎	x	x	x
Thailand	6	x	△	△	x	x	x	△	△
Vietnam	10	x	◎	○	x	x	x	△	◎
	Evaluation Thresholds	1-73 minus slope	1-61 more than 0.1 increase	1-51 more than 15% increase	1-80 decrease	1-78 minus	1-67 minus slope	1-93 more than $1000 increase	1-62 more than 60% increase
		74-130 x	62-130 x	52-130 x	81-130 x	79-130 x	68-130 x	94-130 x	63-130 x
		31-73 △	31-61 △	31-51 △	31-80 △	31-78 △	31-67 △	31-93 △	31-62 △
		11-30 ○	11-30 ○	11-30 ○	11-30 ○	11-30 ○	11-30 ○	11-30 ○	11-30 ○
		1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎	1-10 ◎

Table 21 (b). Revised Evaluation of Parameter Orders of Developing Countries in Asia (adjusting parameters (vii) and (viii).

COUNTRY	Original Group	Parameter (i)	Parameter (ii)	Parameter (iii)	Parameter (iv)	Parameter (v)	Parameter (vi)	Parameter (vii)	Parameter (viii)
			HDI		GHGpc			GNIpc	
		HDIvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)	absolute value of increase (decrease)	ratio of increase (decrease)	GNIpcvsGHGpc SLOPE of trendline	absolute value of increase (decrease)	ratio of increase (decrease)
Afghanistan	10		○	◎			x	x △	x
Bangladesh	10	x	○	◎	x	x	x	x △	x
China, People's Republic of	9	x	◎	○	x	x	x	△	◎
India	9	x	○	○	x	x	x		○
Indonesia	8	x △	○	○	x △	x △	x △	△	○
Kyrgyzstan	8	x	x	x △	◎	◎	○	x △	x △
Lao People's Democratic Republic	10		◎	◎		△		△	◎ △
Malaysia	4	x △	○		x △	◎ △	x	△	
Mongolia	8	○ △	x △	x	○ △		○		
Myanmar	10		◎	◎			○	△	△ ◎
Nepal	10			○		○	◎	x △	△
Pakistan	9	x	○	○ △	x	x	x		x △
Philippines	7	x	x	x	x	x	x	△	
Republic of Korea (South)	3	x	◎		x △	x	x	○	
Sri Lanka	9	x	x △	x △	x	x	x	△	◎ △
Tajikistan	8	x	x	x		◎	x	x △	x
Thailand	6	x			x	x	x		
Vietnam	10	x	◎	○	x	x	x		◎

Table 22. Evaluation of the parameter (i) slope of the HDI vs GHGpc trend line

I	J	K	L	M	N
	original group	HDIvs.GHGpc slope	Evaluation in the world	Evaluation in Asia	
Afghanistan	10	71	△	◎	very successful
Bangladesh	10	75	×	○	successful
China (PRC)	9	111	×	△	marginal
India	9	87	×	○	successful
Indonesia	8	102	×	△	marginal
Kyrgyzstan	8	108	×	NA	
Lao PDR	10	59	△	◎	very successful
Malaysia	4	127	×	×	unsuccessful
Mongolia	8	26	○	◎	very successful
Myanmar	10	44	△	◎	very successful
Nepal	10	41	△	◎	very successful
Pakistan	9	78	×	○	successful
Philippines	7	81	×	○	successful
Republic of Korea	3	121	×	×	unsuccessful
Sri Lanka	9	77	×	○	successful
Tajikistan	8	96	×	NA	
Thailand	6	101	×	△	marginal
Vietnam	10	99	×	△	marginal

Appendix 6. Parameter (i) slope of the HDI vs GHGpc.

Figure 40. Parameter (i) slope of the HDI vs GHGpc trend line

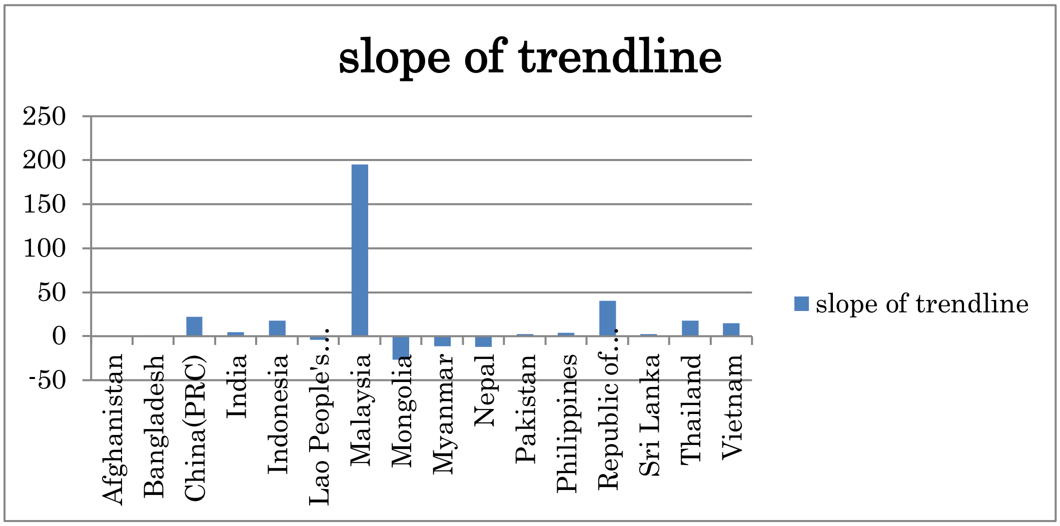


Figure 41. Parameter (i) slope of the HDI vs GHGpc trend line (zoomed up)

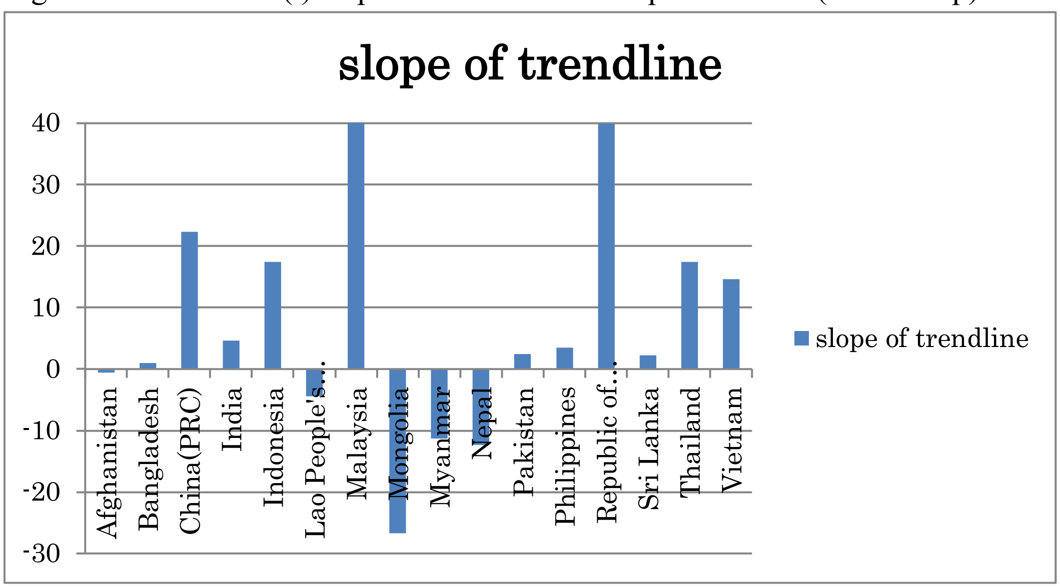


Figure 42. Parameter (i) slope of the HDI vs GHGpc trend line (Grouping)

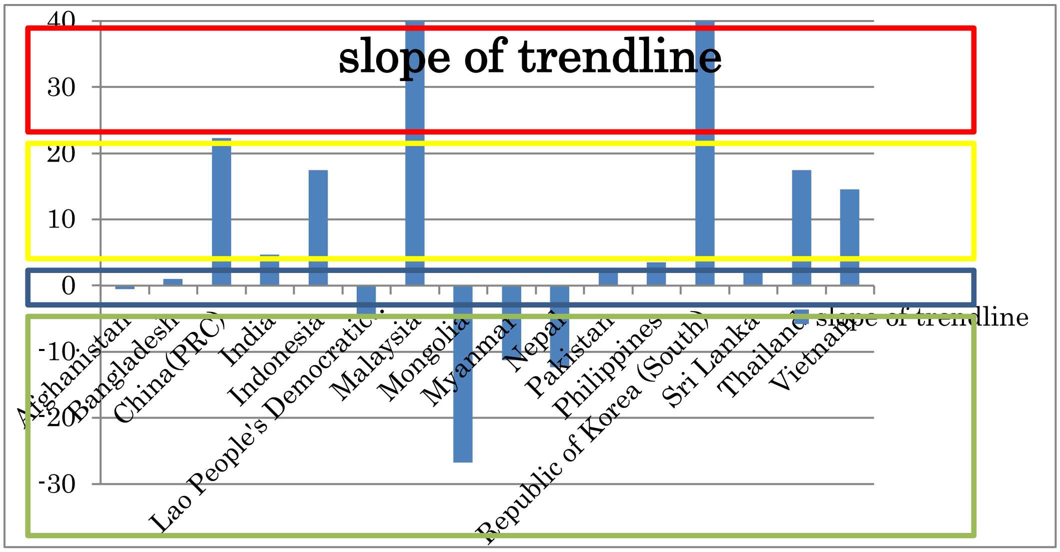


Figure 43. Parameter (ii) absolute value of HDI increase

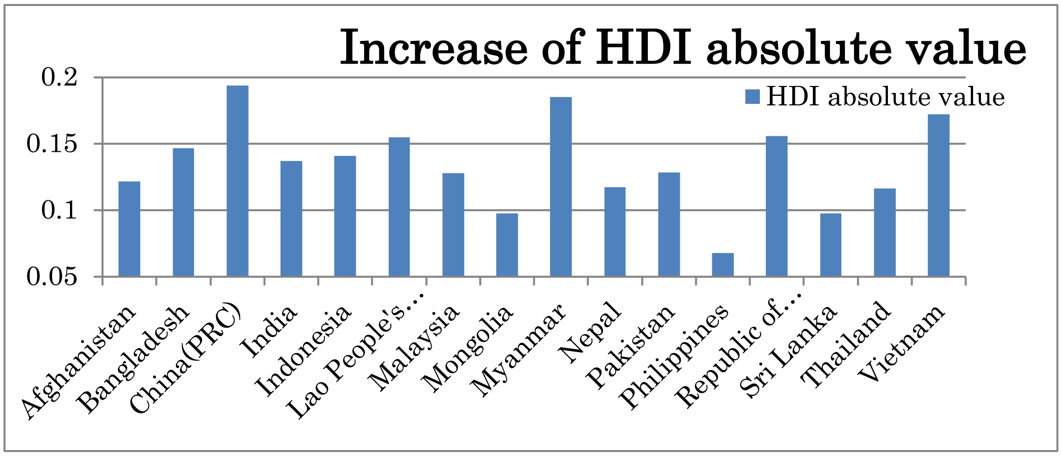


Figure 44. Parameter (ii) absolute value of HDI increase (zoomed up)

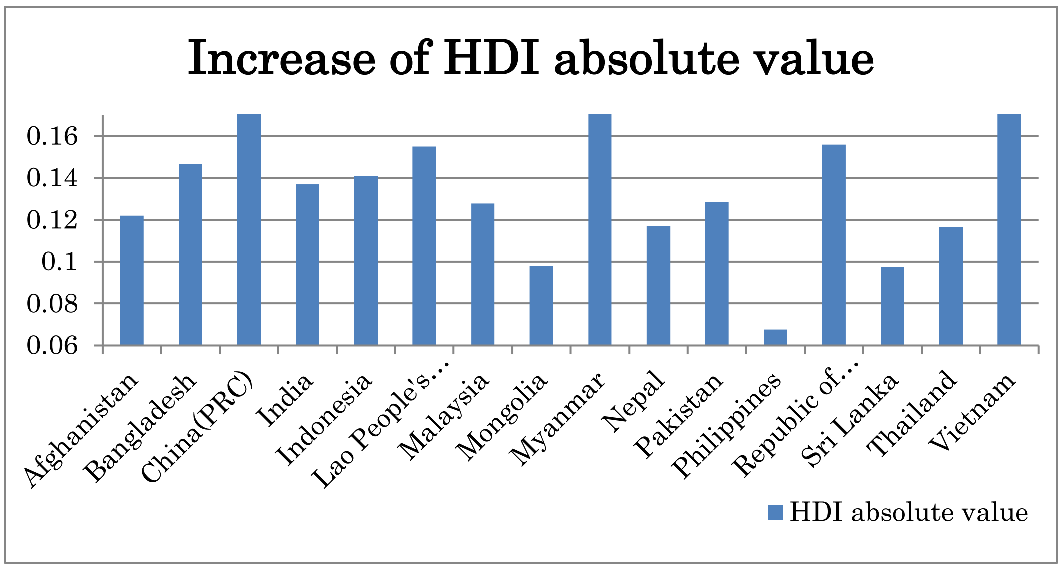


Figure 45. Parameter (ii) absolute value of HDI increase (grouping)

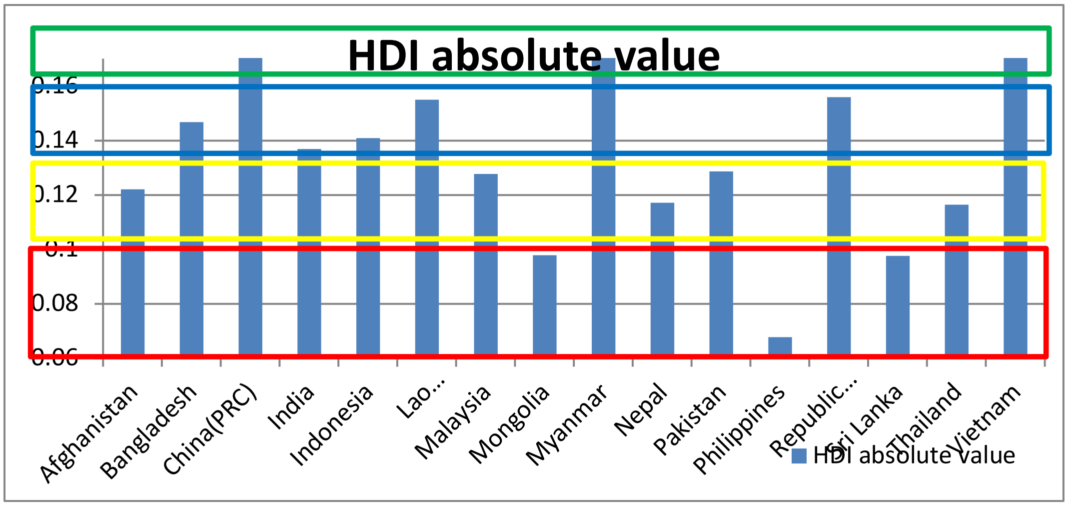


Table 23. Orders of HDI component for each Asian country

		Index Value			
		1990	2000	2005	2010
ASIAN COUNTRIES					
Afghanistan	1	Income	Health	Health	Health
	2	Health	Income	Education	Education
	3	Education	Education	Income	Income
Bangladesh	1	Health	Health	Health	Health
	2	Income	Education	Education	Education
	3	Education	Income	Income	Income
China (PRC)	1	Health	Health	Health	Health
	2	Education	Income	Income	Education
	3	Income	Education	Education	Income
India	1	Health	Health	Health	Health
	2	Income	Income	Education	Education
	3	Education	Education	Income	Income
Indonesia	1	Health	Health	Health	Health
	2	Education	Income	Income	Education
	3	Income	Education	Education	Income
Korea	1	Health	Education	Education	Education
	2	Education	Health	Health	Health
	3	Income	Income	Income	Income
Kyrgyzstan	1	Health	Health	Health	Health
	2	Education	Education	Education	Education
	3	Income	Income	Income	Income
Lao	1	Health	Health	Health	Health
	2	Income	Income	Income	Income
	3	Education	Education	Education	Education
Malaysia	1	Health	Health	Health	Health
	2	Income	Income	Income	Income
	3	Education	Education	Education	Education

Mongolia	1	Health	Health	Education	Education
	2	Education	Income	Health	Health
	3	Income	Education	Income	Income
Myanmar	1	Health	Health	Health	Health
	2	Education	Education	Income	Income
	3	Income	Income	Education	Education
Nepal	1	Health	Health	Health	Health
	2	Education	Education	Education	Education
	3	Income	Income	Income	Income
Pakistan	1	Health	Health	Health	Health
	2	Income	Income	Income	Income
	3	Education	Education	Education	Education
Philippines	1	Health	Health	Health	Health
	2	Education	Education	Education	Education
	3	Income	Income	Income	Income
Sri Lanka	1	Health	Health	Health	Health
	2	Education	Education	Education	Education
	3	Income	Income	Income	Income
Tajikistan	1	Education	Health	Health	Health
	2	Health	Education	Education	Education
	3	Income	Income	Income	Income
Thailand	1	Health	Health	Health	Health
	2	Income	Income	Income	Education
	3	Education	Education	Education	Income
Vietnam	1	Health	Health	Health	Health
	2	Education	Education	Education	Education
	3	Income	Income	Income	Income

Appendix 7. Orders of HDI Component Improvement

Table 24. Orders of HDI component improvement for each Asian country

		Index Value				Improvement
		1990	2000	2005	2010	1990-2010
ASIAN COUNTRIES						
Afghanistan	1	Income	Health	Health	Health	Education
	2	Health	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Bangladesh	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
China (PRC)	1	Health	Health	Health	Health	Income
	2	Education	Income	Income	Education	Education
	3	Income	Education	Education	Income	Health
India	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Income
	3	Education	Education	Income	Income	Health
Indonesia	1	Health	Health	Health	Health	Education
	2	Education	Income	Income	Education	Health
	3	Income	Education	Education	Income	Income
Korea	1	Health	Education	Education	Education	Education
	2	Education	Health	Health	Health	Health
	3	Income	Income	Income	Income	Income
Kyrgyzstan	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Health
	3	Income	Income	Income	Income	Income
Lao	1	Health	Health	Health	Health	Health
	2	Income	Income	Income	Income	Education
	3	Education	Education	Education	Education	Income
Malaysia	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Income
	3	Education	Education	Education	Education	Health

Mongolia	1	Health	Health	Education	Education	Education
	2	Education	Income	Health	Health	Income
	3	Income	Education	Income	Income	Health
Myanmar	1	Health	Health	Health	Health	Income
	2	Education	Education	Income	Income	Education
	3	Income	Income	Education	Education	Health
Nepal	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Health
	3	Income	Income	Income	Income	Income
Pakistan	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Philippines	1	Health	Health	Health	Health	Income
	2	Education	Education	Education	Education	Health
	3	Income	Income	Income	Income	Education
Sri Lanka	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Health
Tajikistan	1	Education	Health	Health	Health	Health
	2	Health	Education	Education	Education	Education
	3	Income	Income	Income	Income	Income
Thailand	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Education	Income
	3	Education	Education	Education	Income	Health
Vietnam	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Health

Table 25. Orders of HDI component improvement for each African country

		Index Value				Improvement
		1990	2000	2005	2010	1990-2010
AFRICAN COUNTRIES						
Algeria	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Education	Health
	3	Education	Education	Education	Income	Income
Benin	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Botswana	1	Income	Income	Income	Income	Education
	2	Health	Education	Education	Health	Income
	3	Education	Health	Health	Education	Health
Burundi	1	Health	Health	Health	Education	Education
	2	Income	Income	Education	Health	Health
	3	Education	Education	Income	Income	Income
Cameroon	1	Health	Health	Health	Education	Education
	2	Income	Income	Income	Health	Health
	3	Education	Education	Education	Income	Income
Central	1	Health	Health	Health	Health	Education
African	2	Income	Income	Education	Education	Health
Republic	3	Education	Education	Income	Income	Income
Congo	1	Income	Income	Income	Income	Health
	2	Education	Health	Health	Education	Education
	3	Health	Education	Education	Health	Income
Congo	1	Health	Health	Education	Education	Education
Democratic	2	Education	Education	Health	Health	Health
Republic	3	Income	Income	Income	Income	Income
Côte d'	1	Health	Income	Income	Education	Education
Ivoire	2	Income	Health	Education	Income	Income
	3	Education	Education	Health	Health	Health
Egypt	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health

	3	Education	Income	Income	Income	Income
Gabon	1	Income	Income	Income	Income	Education
	2	Education	Education	Education	Education	Health
	3	Health	Health	Health	Health	Income
Gambia	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Ghana	1	Education	Health	Health	Health	Income
	2	Health	Income	Income	Education	Health
	3	Income	Education	Education	Income	Education
Kenya	1	Health	Health	Education	Education	Education
	2	Education	Education	Health	Health	Income
	3	Income	Income	Income	Income	Health
Lesotho	1	Health	Education	Education	Education	Education
	2	Education	Income	Income	Income	Income
	3	Income	Health	Health	Health	Health
Malawi	1	Health	Education	Education	Education	Education
	2	Education	Health	Health	Health	Health
	3	Income	Income	Income	Income	Income
Mali	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Education	Health
	3	Education	Education	Education	Income	Income
Mauritania	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Mauritius	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Income
	3	Education	Education	Income	Income	Health
Morocco	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Mozambique	1	Health	Health	Education	Education	Education
	2	Income	Education	Health	Health	Income
	3	Education	Income	Income	Income	Health

Namibia	1	Health	Education	Income	Income	Income
	2	Education	Income	Education	Health	Health
	3	Income	Health	Health	Education	Education
Niger	1	Health	Health	Health	Health	Health
	2	Income	Income	Income	Income	Education
	3	Education	Education	Education	Education	Income
Rwanda	1	Income	Health	Health	Health	Health
	2	Education	Education	Education	Education	Education
	3	Health	Income	Income	Income	Income
Senegal	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Sierra	1	Income	Education	Education	Education	Education
Leone	2	Health	Income	Income	Income	Income
	3	Education	Health	Health	Health	Health
South	1	Income	Education	Education	Education	Education
Africa	2	Health	Income	Income	Income	Income
	3	Education	Health	Health	Health	Health
Swaziland	1	Health	Income	Income	Education	Education
	2	Income	Education	Education	Income	Income
	3	Education	Health	Health	Health	Health
Tanzania	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Togo	1	Health	Education	Education	Education	Education
	2	Education	Health	Health	Health	Health
	3	Income	Income	Income	Income	Income
Tunisia	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
Uganda	1	Health	Education	Education	Education	Education
	2	Education	Health	Health	Health	Health
	3	Income	Income	Income	Income	Income
Zambia	1	Income	Education	Education	Education	Education

	2	Education	Income	Income	Health	Health
	3	Health	Health	Health	Income	Income
Zimbabwe	1	Health	Education	Education	Health	Education
	2	Education	Income	Income	Education	Income
	3	Income	Health	Health	Income	Health

Table 26. Orders of HDI component improvement for each OECD country

		Index Value				Improvement
		1990	2000	2005	2010	1990-2010
OECD COUNTRIES						
Australia	1	Education	Education	Education	Education	Health
	2	Health	Health	Health	Health	Income
	3	Income	Income	Income	Income	Education
Austria	1	Income	Health	Health	Health	Education
	2	Health	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Belgium	1	Income	Income	Health	Health	Education
	2	Health	Health	Income	Income	Health
	3	Education	Education	Education	Education	Income
Canada	1	Education	Health	Health	Health	Health
	2	Health	Income	Income	Income	Income
	3	Income	Education	Education	Education	Education
Denmark	1	Income	Education	Education	Education	Education
	2	Health	Income	Income	Income	Health
	3	Education	Health	Health	Health	Income
Finland	1	Health	Education	Education	Education	Education
	2	Income	Health	Health	Health	Health
	3	Education	Income	Income	Income	Income
France	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Germany	1	Income	Health	Health	Health	Education
	2	Health	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Greece	1	Health	Health	Education	Health	Education
	2	Income	Income	Health	Education	Health
	3	Education	Education	Income	Income	Income
Hungary	1	Income	Health	Education	Education	Education
	2	Health	Education	Health	Health	Health
	3	Education	Income	Income	Income	Income

Iceland	1	Health	Education	Education	Education	Education
	2	Income	Health	Health	Health	Health
	3	Education	Income	Income	Income	Income
Ireland	1	Health	Education	Education	Education	Education
	2	Income	Income	Income	Health	Income
	3	Education	Health	Health	Income	Health
Israel	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
Italy	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Japan	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Luxembourg	1	Income	Income	Income	Income	Education
	2	Health	Health	Health	Health	Health
	3	Education	Education	Education	Education	Income
Netherlands	1	Health	Education	Health	Education	Education
	2	Income	Income	Education	Health	Health
	3	Education	Health	Income	Income	Income
New	1	Health	Education	Education	Education	Education
Zealand	2	Income	Health	Health	Health	Health
	3	Education	Income	Income	Income	Income
Norway	1	Income	Education	Income	Income	Education
	2	Health	Income	Education	Education	Health
	3	Education	Health	Health	Health	Income
Portugal	1	Health	Education	Health	Health	Education
	2	Income	Health	Education	Education	Health
	3	Education	Income	Income	Income	Income
Russia	1	Income	Income	Income	Income	Education
	2	Health	Health	Education	Education	Income
	3	Education	Education	Health	Health	Health
Slovakia	1	Health	Health	Health	Health	Education

	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Spain	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
Sweden	1	Health	Education	Health	Health	Education
	2	Income	Health	Income	Income	Health
	3	Education	Income	Education	Education	Income
Switzerland	1	Income	Income	Income	Health	Education
	2	Health	Health	Health	Income	Health
	3	Education	Education	Education	Education	Income
Turkey	1	Income	Health	Health	Health	Education
	2	Health	Income	Income	Education	Health
	3	Education	Education	Education	Income	Income
United	1	Health	Education	Education	Education	Education
Kingdom	2	Income	Health	Health	Health	Health
	3	Education	Income	Income	Income	Income
United	1	Income	Income	Income	Income	Education
States	2	Health	Health	Health	Education	Health
	3	Education	Education	Education	Health	Income

Table 27. Orders of HDI component improvement for each Latin American country

		Index Value				Improvement
		1990	2000	2005	2010	1990-2010
Argentina	1	Health	Health	Education	Education	Education
	2	Education	Education	Health	Health	Income
	3	Income	Income	Income	Income	Health
Barbados	1	Health	Health	Health	Education	Education
	2	Education	Education	Education	Health	Health
	3	Income	Income	Income	Income	Income
Belize	1	Health	Health	Health	Health	Education
	2	Education	Income	Education	Education	Income
	3	Income	Education	Income	Income	Health
Bolivia	1	Education	Education	Education	Education	Health
	2	Health	Health	Health	Health	Education
	3	Income	Income	Income	Income	Income
Brazil	1	Health	Education	Health	Education	Education
	2	Income	Health	Education	Health	Health
	3	Education	Income	Income	Income	Income
Chile	1	Health	Health	Health	Health	Education
	2	Education	Income	Education	Education	Income
	3	Income	Education	Income	Income	Health
Colombia	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Costa Rica	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Education	Income
	3	Education	Education	Education	Income	Health
Cuba	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Dominican	1	Health	Health	Health	Health	Income
Republic	2	Education	Education	Education	Education	Health
	3	Income	Income	Income	Income	Education
Ecuador	1	Health	Health	Health	Health	Health

	2	Education	Income	Education	Education	Income
	3	Income	Education	Income	Income	Education
El Salvador	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Guatemala	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Guyana	1	Health	Health	Health	Health	Income
	2	Education	Education	Education	Income	Health
	3	Income	Income	Income	Education	Education
Haiti	1	Health	Health	Health	Health	Health
	2	Income	Income	Income	Education	Education
	3	Education	Education	Education	Income	Income
Honduras	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
Jamaica	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
Mexico	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Nicaragua	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
Panama	1	Health	Health	Health	Health	Income
	2	Income	Education	Education	Income	Education
	3	Education	Income	Income	Education	Health
Paraguay	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Health
	3	Education	Income	Income	Income	Income
Peru	1	Health	Health	Health	Health	Health

	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Education
Trinidad	1	Health	Health	Income	Income	Income
& Tobago	2	Income	Income	Health	Health	Education
	3	Education	Education	Education	Education	Health
Uruguay	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Health
Venezuela	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Education	Health
	3	Education	Education	Education	Income	Income

Table 28. Orders of HDI component improvement for other countries

		Index Value				Improvement
		1990	2000	2005	2010	1990-2010
FORMER USSR						
Armenia	1	Health	Health	Health	Health	Health
	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Education
Estonia	1	Health	Education	Education	Education	Education
	2	Income	Health	Health	Health	Health
	3	Education	Income	Income	Income	Income
Latvia	1	Income	Education	Education	Education	Education
	2	Health	Health	Health	Income	Health
	3	Education	Income	Income	Health	Income
Lithuania	1	Health	Education	Education	Education	Education
	2	Income	Health	Health	Income	Income
	3	Education	Income	Income	Health	Health
Moldova	1	Health	Health	Health	Health	Health
	2	Education	Education	Education	Education	Education
	3	Income	Income	Income	Income	Income
Ukraine	1	Health	Health	Education	Education	Education
	2	Income	Education	Health	Health	Health
	3	Education	Income	Income	Income	Income
OTHER EUROPE (NON-OECD)						
Albania	1	Health	Health	Health	Health	Income
	2	Education	Income	Income	Income	Health
	3	Income	Education	Education	Education	Education
Bulgaria	1	Health	Health	Health	Health	Education
	2	Income	Education	Education	Education	Income
	3	Education	Income	Income	Income	Health
Croatia	1	Income	Health	Health	Health	Education
	2	Health	Income	Income	Education	Health
	3	Education	Education	Education	Income	Income
Cyprus	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Income

	3	Education	Education	Education	Education	Health
Malta	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Romania	1	Health	Health	Health	Health	Education
	2	Income	Income	Education	Education	Health
	3	Education	Education	Income	Income	Income
ARAB STATES						
Bahrain	1	Income	Income	Income	Income	Health
	2	Health	Health	Health	Health	Education
	3	Education	Education	Education	Education	Income
Iran	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Income	Health
	3	Education	Education	Education	Education	Income
Jordan	1	Health	Health	Health	Health	Education
	2	Education	Education	Education	Education	Income
	3	Income	Income	Income	Income	Health
Kuwait	1	Income	Income	Income	Income	Education
	2	Health	Education	Health	Health	Health
	3	Education	Health	Education	Education	Income
Qatar	1	Income	Income	Income	Income	Education
	2	Health	Health	Health	Health	Health
	3	Education	Education	Education	Education	Income
Saudi Arabia	1	Income	Income	Income	Income	Education
	2	Health	Health	Health	Health	Health
	3	Education	Education	Education	Education	Income
Syria	1	Health	Health	Health	Health	Education
	2	Education	Income	Education	Education	Health
	3	Income	Education	Income	Income	Income
Yemen	1	Health	Health	Health	Health	Health
	2	Income	Income	Income	Income	Education
	3	Education	Education	Education	Education	Income
PACIFIC						
Fiji	1	Health	Health	Education	Education	Education

	2	Education	Education	Health	Health	Health
	3	Income	Income	Income	Income	Income
Papua	1	Health	Health	Health	Health	Education
	2	Income	Income	Income	Education	Health
	3	Education	Education	Education	Income	Income
Tonga	1	Health	Health	Education	Education	Income
	2	Education	Education	Health	Health	Education
	3	Income	Income	Income	Income	Health
NON-AGRICULTURAL SOUTHEAST ASIA						
Brunei	1	Income	Income	Income	Income	Education
	2	Health	Health	Health	Health	Health
	3	Education	Education	Education	Education	Income
Singapore	1	Income	Income	Income	Income	Education
	2	Health	Health	Health	Health	Income
	3	Education	Education	Education	Education	Health

Table 29. Summary of HDI component improvement (from Tables 24-28)

Asian	education	13
	health	2
	income	3

Latin	education	17
	health	5
	income	3

Arab	education	6
	health	2
	income	0

African	education	29
	health	3
	income	2

Ex USSR	education	4
	health	2
	income	0

pacific	education	2
	health	0
	income	1

OECD	education	26
	health	2
	income	0

OTHER EUROPE (NON-OECD)	education	5
	health	1
	income	0

non agri south asia	education	2
	health	0
	income	0

Appendix 8. Revised Orders of HDI Components by Standard Deviation Scores

Table 30. Revised orders of HDI components by standard deviation scores (Asian Countries)

	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
ASIAN COUNTRIES					
Afghanistan	Education	0.356	0.203	73.44837	Education
Afghanistan	Health	0.169	0.100	65.33259	Health
Afghanistan	Income	-0.060	-0.112	30.73269	Income
Bangladesh	Education	0.217	0.064	57.41612	Health
Bangladesh	Health	0.145	0.076	61.658	Income
Bangladesh	Income	0.114	0.062	60.74002	Education
China (PRC)	Income	0.275	0.223	88.50543	Income
China (PRC)	Education	0.206	0.053	56.13354	Education
China (PRC)	Health	0.083	0.014	52.16531	Health
India	Education	0.193	0.040	54.6372	Income
India	Income	0.142	0.090	65.56879	Health
India	Health	0.109	0.040	56.14611	Education
Indonesia	Education	0.128	-0.025	47.15549	Income
Indonesia	Health	0.103	0.034	55.22747	Health
Indonesia	Income	0.097	0.045	57.80827	Education
Republic of Korea	Education	0.178	0.025	52.92709	Income
Republic of Korea	Health	0.139	0.070	60.73935	Health
Republic of Korea	Income	0.130	0.078	63.49932	Education
Kyrgyzstan	Education	0.028	-0.125	35.61227	Health
Kyrgyzstan	Health	0.011	-0.058	41.14154	Education
Kyrgyzstan	Income	-0.032	-0.084	35.56146	Income
Lao PDR	Health	0.196	0.127	69.4665	Health
Lao PDR	Education	0.167	0.014	51.64451	Income
Lao PDR	Income	0.137	0.085	64.70651	Education

Malaysia	Education	0.167	0.014	51.64451	Income
Malaysia	Income	0.106	0.054	59.36038	Education
Malaysia	Health	0.057	-0.012	48.1845	Health
Mongolia	Education	0.244	0.092	60.62257	Education
Mongolia	Income	0.109	0.057	59.87774	Income
Mongolia	Health	0.100	0.031	54.76814	Health
Myanmar	Income	0.245	0.193	83.33175	Income
Myanmar	Education	0.150	-0.002	49.72064	Health
Myanmar	Health	0.091	0.022	53.39017	Education
Nepal	Education	0.239	0.086	59.98128	Health
Nepal	Health	0.186	0.117	67.93542	Education
Nepal	Income	0.072	0.020	53.49688	Income
Pakistan	Education	0.167	0.014	51.64451	edu
Pakistan	Health	0.076	0.007	51.09355	Health
Pakistan	Income	0.053	0.001	50.22021	Income
Philippines	Income	0.054	0.002	50.39267	Income
Philippines	Health	0.046	-0.023	46.50032	Health
Philippines	Education	0.028	-0.125	35.61227	Education
Sri Lanka	Education	0.128	-0.025	47.15549	Income
Sri Lanka	Income	0.123	0.071	62.29213	Health
Sri Lanka	Health	0.066	-0.003	49.56247	Education
Tajikistan	Health	0.060	-0.009	48.64383	Health
Tajikistan	Education	-0.044	-0.197	27.2755	Education
Tajikistan	Income	-0.084	-0.136	26.59375	Income
Thailand	Education	0.261	0.109	62.54644	edu
Thailand	Income	0.102	0.050	58.67055	Income
Thailand	Health	0.052	-0.017	47.41896	Health
Vietnam	Education	0.220	0.068	57.8009	Income
Vietnam	Income	0.169	0.117	70.2251	Education
Vietnam	Health	0.075	0.006	50.94044	Health

Table 31. Revised orders of HDI components by standard deviation scores (African Countries)

AFRICAN COUNTRIES	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Algeria	Education	0.228	0.075	58.6987	Education
Algeria	Health	0.059	-0.010	48.49072	Health
Algeria	Income	0.029	-0.023	46.08127	Income
Benin	Education	0.297	0.144	66.66138	Education
Benin	Health	0.081	0.012	51.85909	Health
Benin	Income	0.036	-0.016	47.28846	Income
Botswana	Education	0.096	-0.057	43.46807	Income
Botswana	Income	0.073	0.021	53.66933	Education
Botswana	Health	0.011	-0.058	41.14154	Health
Burundi	Education	0.317	0.164	68.95934	Education
Burundi	Health	0.081	0.012	51.85909	Health
Burundi	Income	-0.046	-0.098	33.14708	Income
Cameroon	Education	0.122	-0.030	46.5142	Education
Cameroon	Health	0.002	-0.067	39.76357	Income
Cameroon	Income	-0.007	-0.059	39.87286	Health
Central African Republic	Education	0.097	-0.055	43.62839	Health
Central African Republic	Health	0.032	-0.037	44.3568	Education
Central African Republic	Income	-0.018	-0.070	37.97584	Income
Congo	Health	0.031	-0.038	44.2037	Health
Congo	Education	-0.030	-0.183	28.91435	Income
Congo	Income	-0.051	-0.103	32.2848	Education
Congo Democratic	Education	0.131	-0.021	47.52194	Education

Republic					
Congo Democratic Republic	Health	0.023	-0.046	42.97883	Health
Congo Democratic Republic	Income	-0.099	-0.151	24.00691	Income
Côte d' Ivoire	Education	0.157	0.005	50.52226	Education
Cote d' Ivoire	Income	0.008	-0.044	42.4597	Income
Cote d'ivoire	Health	-0.044	-0.113	32.7206	Health
Egypt	Education	0.183	0.031	53.56838	Income
Egypt	Health	0.091	0.022	53.39017	Education
Egypt	Income	0.086	0.034	55.91126	Health
Gabon	Education	0.020	-0.132	34.71446	Health
Gabon	Health	0.015	-0.054	41.75397	Income
Gabon	Income	-0.029	-0.081	36.07883	Education
Gambia	Education	0.206	0.053	56.13354	Education
Gambia	Health	0.091	0.022	53.39017	Health
Gambia	Income	0.023	-0.029	45.04654	Income
Ghana	Income	0.070	0.018	53.15196	Income
Ghana	Health	0.060	-0.009	48.64383	Health
Ghana	Education	-0.053	-0.205	26.31357	Education
Kenya	Education	0.107	-0.045	44.75065	Education
Kenya	Income	0.011	-0.041	42.97706	Income
Kenya	Health	0.007	-0.062	40.52911	Health
Lesotho	Education	0.076	-0.076	41.17011	Income
Lesotho	Income	0.019	-0.033	44.35671	Education
Lesotho	Health	-0.183	-0.252	11.4386	Health
Malawi	Education	0.294	0.142	66.39418	Education
Malawi	Health	0.098	0.029	54.46193	Health
Malawi	Income	0.061	0.009	51.59986	Income
Mali	Education	0.333	0.181	70.88321	Education
Mali	Health	0.113	0.044	56.75854	Health
Mali	Income	0.049	-0.003	49.53039	Income
Mauritania	Education	0.217	0.064	57.41612	Education

Mauritania	Health	0.041	-0.028	45.73478	Income
Mauritania	Income	0.035	-0.017	47.11601	Health
Mauritius	Education	0.228	0.075	58.6987	Income
Mauritius	Income	0.109	0.057	59.87774	Education
Mauritius	Health	0.058	-0.011	48.33761	Health
Morocco	Education	0.256	0.103	61.90515	Education
Morocco	Health	0.084	0.015	52.31842	Income
Morocco	Income	0.072	0.020	53.49688	Health
Mozambique	Education	0.328	0.175	70.24192	Education
Mozambique	Income	0.116	0.064	61.08494	Income
Mozambique	Health	0.085	0.016	52.47152	Health
Namibia	Income	0.055	0.003	50.56512	Income
Namibia	Health	0.020	-0.049	42.51951	Health
Namibia	Education	0.011	-0.141	33.6884	Education
Niger	Health	0.200	0.131	70.07893	Health
Niger	Education	0.150	-0.002	49.72064	Education
Niger	Income	-0.014	-0.066	38.66567	Income
Rwanda	Health	0.456	0.387	109.2746	Health
Rwanda	Education	0.211	0.059	56.77483	Education
Rwanda	Income	0.060	0.008	51.4274	Income
Senegal	Education	0.179	0.027	53.08742	Education
Senegal	Health	0.089	0.020	53.08396	Health
Senegal	Income	0.028	-0.024	45.90882	Income
Sierra Leone	Education	0.144	-0.008	49.07935	Income
Sierra Leone	Income	0.115	0.063	60.91248	Education
Sierra Leone	Health	0.016	-0.053	41.90708	Health
South Africa	Education	0.095	-0.058	43.33481	Income
South Africa	Health	-0.117	-0.186	21.54373	Education
South Africa	Income	0.027	-0.025	45.73636	Health
Swaziland	Education	0.088	-0.064	42.55652	Income
Swaziland	Income	0.011	-0.041	42.97706	Education
Swaziland	Health	-0.170	-0.239	13.42901	Health
Tanzania	Education	0.160	0.008	50.91161	Health
Tanzania	Health	0.134	0.065	59.97381	Income

Tanzania	Income	0.066	0.014	52.46214	Education
Togo	Education	0.228	0.075	58.6987	Education
Togo	Health	-0.006	-0.075	38.5387	Income
Togo	Income	-0.026	-0.078	36.5962	Health
Tunisia	Education	0.228	0.075	58.6987	Education
Tunisia	Health	0.098	0.029	54.46193	Income
Tunisia	Income	0.094	0.042	57.29091	Health
Uganda	Education	0.283	0.131	65.1116	Education
Uganda	Health	0.151	0.082	62.57665	Health
Uganda	Income	0.104	0.052	59.01546	Income
Zambia	Education	0.283	0.130	65.05324	Education
Zambia	Health	0.165	0.096	64.72016	Health
Zambia	Income	-0.004	-0.056	40.39023	Income
Zimbabwe	Education	-0.028	-0.180	29.19937	Education
Zimbabwe	Income	-0.083	-0.135	26.76621	Income
Zimbabwe	Health	-0.084	-0.153	26.59629	Health

Table 32. Revised orders of HDI components by standard deviation scores (OECD Countries)

OECD COUNTRIES	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Australia	Health	0.081	0.012	51.85909	Health
Australia	Income	0.056	0.004	50.73758	Income
Australia	Education	0.033	-0.119	36.25356	Education
Austria	Education	0.094	-0.058	43.30775	Health
Austria	Health	0.079	0.010	51.55288	Income
Austria	Income	0.051	-0.001	49.8753	Education
Belgium	Education	0.106	-0.047	44.59033	Health
Belgium	Health	0.065	-0.004	49.40937	Income
Belgium	Income	0.044	-0.008	48.6681	Education
Canada	Health	0.057	-0.012	48.1845	Income
Canada	Income	0.043	-0.009	48.49565	Health
Canada	Education	-0.044	-0.197	27.2755	Education

Denmark	Education	0.156	0.003	50.36193	Education
Denmark	Health	0.062	-0.007	48.95004	Health
Denmark	Income	0.043	-0.009	48.49565	Income
Finland	Education	0.106	-0.047	44.59033	Health
Finland	Health	0.075	0.006	50.94044	Income
Finland	Income	0.053	0.001	50.22021	Education
France	Education	0.094	-0.058	43.30775	Health
France	Health	0.073	0.004	50.63423	Income
France	Income	0.033	-0.019	46.77109	Education
Germany	Education	0.142	-0.011	48.75871	Health
Germany	Health	0.074	0.005	50.78734	Education
Germany	Income	0.040	-0.012	47.97829	Income
Greece	Education	0.250	0.098	61.26386	Education
Greece	Health	0.056	-0.013	48.03139	Income
Greece	Income	0.042	-0.010	48.3232	Health
Hungary	Education	0.244	0.092	60.62257	Education
Hungary	Health	0.075	0.006	50.94044	Health
Hungary	Income	0.048	-0.004	49.35793	Income
Iceland	Education	0.211	0.059	56.77483	Education
Iceland	Health	0.056	-0.013	48.03139	Health
Iceland	Income	0.013	-0.039	43.32198	Income
Ireland	Education	0.300	0.148	67.03547	Education
Ireland	Income	0.093	0.041	57.11845	Income
Ireland	Health	0.083	0.014	52.16531	Health
Israel	Education	0.167	0.014	51.64451	Income
Israel	Health	0.075	0.006	50.94044	Education
Israel	Income	0.073	0.021	53.66933	Health
Italy	Education	0.189	0.036	54.20967	Education
Italy	Health	0.078	0.009	51.39977	Health
Italy	Income	0.022	-0.030	44.87408	Income
Japan	Education	0.100	-0.052	43.94904	Health
Japan	Health	0.063	-0.006	49.10315	Income
Japan	Income	0.027	-0.025	45.73636	Education
Luxembourg	Education	0.161	0.009	51.00322	Education

Luxembourg	Health	0.074	0.005	50.78734	Health
Luxembourg	Income	0.015	-0.037	43.66689	Income
Netherlands	Education	0.133	-0.019	47.79678	Income
Netherlands	Health	0.056	-0.013	48.03139	Health
Netherlands	Income	0.050	-0.002	49.70285	Education
New Zealand	Education	0.194	0.042	54.85096	Education
New Zealand	Health	0.083	0.014	52.16531	Health
New Zealand	Income	0.039	-0.013	47.80583	Income
Norway	Education	0.194	0.042	54.85096	Education
Norway	Health	0.071	0.002	50.32801	Income
Norway	Income	0.062	0.010	51.77232	Health
Portugal	Education	0.250	0.098	61.26386	Education
Portugal	Health	0.077	0.008	51.24666	Health
Portugal	Income	0.041	-0.011	48.15074	Income
Russia	Education	0.072	-0.080	40.74259	Income
Russia	Income	0.012	-0.040	43.14952	Education
Russia	Health	-0.006	-0.075	38.5387	Health
Slovakia	Education	0.183	0.031	53.56838	Education
Slovakia	Health	0.058	-0.011	48.33761	Income
Slovakia	Income	0.049	-0.003	49.53039	Health
Spain	Education	0.144	-0.008	49.07935	Health
Spain	Health	0.072	0.003	50.48112	Education
Spain	Income	0.045	-0.007	48.84057	Income
Sweden	Education	0.167	0.014	51.64451	Education
Sweden	Health	0.060	-0.009	48.64383	Income
Sweden	Income	0.056	0.004	50.73758	Health
Switzerland	Education	0.122	-0.030	46.5142	Health
Switzerland	Health	0.071	0.002	50.32801	Education
Switzerland	Income	0.025	-0.027	45.39145	Income
Turkey	Education	0.278	0.125	64.47031	Education
Turkey	Health	0.154	0.085	63.03597	Health
Turkey	Income	0.068	0.016	52.80705	Income
United Kingdom	Education	0.178	0.025	52.92709	Education

United Kingdom	Health	0.069	0.000	50.0218	Income
United Kingdom	Income	0.060	0.008	51.4274	Health
United States	Education	0.067	-0.086	40.1013	Income
United States	Health	0.050	-0.019	47.11275	Health
United States	Income	0.046	-0.006	49.01302	Education

Table 33. Revised orders of HDI components by standard deviation scores (Latin American Countries)

LATIN AMERICAN COUNTRIES	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Argentina	Education	0.181	0.028	53.24774	Income
Argentina	Income	0.086	0.034	55.91126	Education
Argentina	Health	0.065	-0.004	49.40937	Health
Barbados	Education	0.144	-0.008	49.07935	Education
Barbados	Health	0.058	-0.011	48.33761	Health
Barbados	Income	0.040	-0.012	47.97829	Income
Belize	Education	0.141	-0.011	48.70792	Income
Belize	Income	0.068	0.016	52.80705	Education
Belize	Health	0.032	-0.037	44.3568	Health
Bolivia	Health	0.116	0.047	57.21787	Health
Bolivia	Education	0.105	-0.048	44.50699	Income
Bolivia	Income	0.053	0.001	50.22021	Education
Brazil	Education	0.170	0.018	52.06858	Health
Brazil	Health	0.102	0.033	55.07436	Education
Brazil	Income	0.052	0.000	50.04776	Income
Chile	Education	0.115	-0.038	45.65914	Income
Chile	Income	0.108	0.056	59.70529	Health
Chile	Health	0.084	0.015	52.31842	Education
Colombia	Education	0.236	0.084	59.66064	Education
Colombia	Health	0.079	0.010	51.55288	Health
Colombia	Income	0.051	-0.001	49.8753	Income
Costa Rica	Education	0.191	0.038	54.42344	Income

Costa Rica	Income	0.080	0.028	54.87652	Education
Costa Rica	Health	0.055	-0.014	47.87829	Health
Cuba	Education	0.217	0.064	57.41612	Education
Cuba	Health	0.063	-0.006	49.10315	Income
Cuba	Income	0.047	-0.005	49.18548	Health
Dominican Republic	Health	0.075	0.006	50.94044	Income
Dominican Republic	Education	0.053	-0.100	38.48281	Health
Dominican Republic	Income	0.120	0.068	61.77476	Education
Ecuador	Health	0.105	0.036	55.53368	Health
Ecuador	Income	0.041	-0.011	48.15074	Income
Ecuador	Education	0.015	-0.137	34.17674	Education
El Salvador	Education	0.175	0.023	52.60645	Income
El Salvador	Health	0.092	0.023	53.54328	Health
El Salvador	Income	0.073	0.021	53.66933	Education
Guatemala	Education	0.221	0.069	57.9658	Health
Guatemala	Health	0.137	0.068	60.43313	Education
Guatemala	Income	0.037	-0.015	47.46092	Income
Guyana	Income	0.216	0.164	78.33053	Income
Guyana	Education	0.009	-0.144	33.42434	Health
Guyana	Health	0.057	-0.012	48.1845	Education
Haiti	Health	0.115	0.046	57.06476	Health
Haiti	Education	0.034	-0.118	36.33702	Education
Haiti	Income	-0.060	-0.112	30.73269	Income
Honduras	Education	0.166	0.013	51.53763	Health
Honduras	Health	0.095	0.026	54.0026	Education
Honduras	Income	0.050	-0.002	49.70285	Income
Jamaica	Education	0.069	-0.083	40.42194	Income
Jamaica	Health	0.034	-0.035	44.66302	Health
Jamaica	Income	0.031	-0.021	46.42618	Education
Mexico	Education	0.117	-0.036	45.87291	Health
Mexico	Health	0.092	0.023	53.54328	Income

Mexico	Income	0.036	-0.016	47.28846	Education
Nicaragua	Education	0.161	0.009	51.00322	Health
Nicaragua	Health	0.149	0.080	62.27043	Education
Nicaragua	Income	0.043	-0.009	48.49565	Income
Panama	Income	0.122	0.070	62.11967	Income
Panama	Education	0.111	-0.041	45.23162	Health
Panama	Health	0.061	-0.008	48.79693	Education
Paraguay	Education	0.189	0.036	54.20967	Education
Paraguay	Health	0.061	-0.008	48.79693	Health
Paraguay	Income	0.015	-0.037	43.66689	Income
Peru	Health	0.128	0.059	59.05516	Health
Peru	Income	0.090	0.038	56.60108	Income
Peru	Education	0.061	-0.091	39.46001	Education
Trinidad & Tobago	Income	0.143	0.091	65.74125	Income
Trinidad & Tobago	Education	0.064	-0.089	39.78065	Health
Trinidad & Tobago	Health	0.023	-0.046	42.97883	Education
Uruguay	Education	0.144	-0.008	49.07935	Income
Uruguay	Income	0.082	0.030	55.22143	Health
Uruguay	Health	0.065	-0.004	49.40937	Education
Venezuela	Education	0.206	0.053	56.13354	Education
Venezuela	Health	0.047	-0.022	46.65342	Health
Venezuela	Income	0.019	-0.033	44.35671	Income

Table 34. Revised orders of HDI components by standard deviation scores (Other areas)

FORMER USSR	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Armenia	Health	0.098	0.029	54.46193	Income
Armenia	Income	0.095	0.043	57.46336	Health
Armenia	Education	0.089	-0.064	42.66646	Education
Estonia	Education	0.189	0.036	54.20967	Education
Estonia	Health	0.072	0.003	50.48112	Health
Estonia	Income	0.040	-0.012	47.97829	Income
Latvia	Education	0.178	0.025	52.92709	Education
Latvia	Health	0.042	-0.027	45.88788	Health
Latvia	Income	0.019	-0.033	44.35671	Income
Lithuania	Education	0.228	0.075	58.6987	Education
Lithuania	Income	0.037	-0.015	47.46092	Income
Moldova	Health	0.014	-0.055	41.60086	Health
Moldova	Health	0.014	-0.055	41.60086	Health
Moldova	Education	-0.011	-0.164	31.12324	Income
Moldova	Income	-0.044	-0.096	33.49199	Education
Ukraine	Education	0.133	-0.019	47.79678	Education
Ukraine	Health	-0.026	-0.095	35.47655	Health
Ukraine	Income	-0.051	-0.103	32.2848	Income
OTHER EUROPE (NON-OECD)	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Albania	Health	0.076	0.007	51.09355	Income
Albania	Income	0.149	0.097	66.77598	Health
Albania	Education	0.017	-0.136	34.32969	Education
Bulgaria	Education	0.117	-0.036	45.87291	Income
Bulgaria	Income	0.076	0.024	54.1867	Education
Bulgaria	Health	0.030	-0.039	44.05059	Health
Croatia	Education	0.206	0.053	56.13354	Education
Croatia	Health	0.065	-0.004	49.40937	Health

Croatia	Income	-0.024	-0.076	36.94111	Income
Cyprus	Education	0.267	0.114	63.18773	Education
Cyprus	Income	0.066	0.014	52.46214	Income
Malta	Health	0.043	-0.026	46.04099	Health
Malta	Education	0.139	-0.014	48.43807	Income
Malta	Health	0.060	-0.009	48.64383	Health
Malta	Income	0.058	0.006	51.08249	Education
Romania	Education	0.117	-0.036	45.87291	Income
Romania	Health	0.061	-0.008	48.79693	Health
Romania	Income	0.056	0.004	50.73758	Education
ARAB STATES	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Bahrain	Health	0.059	-0.010	48.49072	Health
Bahrain	Education	0.054	-0.099	38.60496	Income
Bahrain	Income	0.028	-0.024	45.90882	Education
Iran	Education	0.215	0.062	57.17064	Health
Iran	Health	0.150	0.081	62.42354	Education
Iran	Income	0.088	0.036	56.25617	Income
Jordan	Education	0.094	-0.058	43.30775	Income
Jordan	Income	0.079	0.027	54.70407	Health
Jordan	Health	0.054	-0.015	47.72518	Education
Kuwait	Education	0.233	0.081	59.33999	Education
Kuwait	Health	0.030	-0.039	44.05059	Health
Kuwait	Income	0.000	-0.052	41.08005	Income
Qatar	Education	0.111	-0.041	45.23162	Health
Qatar	Health	0.043	-0.026	46.04099	Education
Qatar	Income	0.000	-0.052	41.08005	Income
Saudi Arabia	Education	0.327	0.175	70.19425	Education
Saudi Arabia	Health	0.091	0.022	53.39017	Health
Saudi Arabia	Income	0.028	-0.024	45.90882	Income
Syria	Education	0.083	-0.069	42.02517	Income
Syria	Health	0.068	-0.001	49.86869	Health
Syria	Income	0.064	0.012	52.11723	Education

Yemen	Health	0.070	0.002	50.25035	Income
Yemen	Education	0.071	-0.081	40.6015	Health
Yemen	Income	0.062	0.010	51.77232	Education
PACIFIC	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Fiji	Education	0.183	0.031	53.58671	Education
Fiji	Health	0.058	-0.011	48.33761	Income
Fiji	Income	0.044	-0.008	48.66811	Health
Papua	Education	0.218	0.066	57.62331	Education
Papua	Health	0.099	0.030	54.61503	Health
Papua	Income	0.041	-0.011	48.15074	Income
Tonga	Income	0.085	0.033	55.7388	Income
Tonga	Education	0.059	-0.093	39.23098	Health
Tonga	Health	0.040	-0.029	45.58167	Education
NON-AGRICULTURAL SOUTHEAST ASIA	1990-2010 Order of components	Values	Value-Average	Standard deviation scores	Revised order of components
Brunei	Education	0.102	-0.051	44.1628	Health
Brunei	Health	0.068	-0.001	49.86869	Education
Brunei	Income	-0.007	-0.059	39.87286	Income
Singapore	Education	0.139	-0.014	48.43807	Income
Singapore	Income	0.111	0.059	60.22266	Health
Singapore	Health	0.089	0.020	53.08396	Education

Table 35. Summary of revised largest HDI component improvement (from Table 30-34)

		original	standard deviation scores
Asian	education	13	4
	health	2	5
	income	3	9

		original	standard deviation score
Latin	education	17	5
	health	5	9
	income	3	11

		original	standard deviation score
ARAB STATES	education	6	2
	health	2	3
	income	0	3

		original	standard deviation score
African	education	29	19
	health	3	6
	income	2	9

		original	standard deviation score
Ex USSR	education	4	4
	health	2	1
	income	0	1

		original	standard deviation score
PACIFIC	education	2	2
	health	0	0
	income	1	1

		original	standard deviation score
OECD	education	26	14
	health	2	9
	income	0	5

		original	standard deviation score
OTHER EUROPE (NON-OECD)	education	5	2
	health	1	0
	income	0	4

		original	standard deviation score
NON-AGRICULTURAL SOUTHEAST ASIA	education	2	0
	health	0	1
	income	0	1

Table 36. Revised order of the HDI components and the sum of the 3 components

	1990-2010 Order of components	Values	Value-Average	Standard Scores	Revised order of components	Sum of 3 components
ASIAN COUNTRIES						
Afghanistan	Education	0.356	0.203	73.44837	Education	169.51
Afghanistan	Health	0.169	0.100	65.33259	health	
Afghanistan	Income	-0.060	-0.112	30.73269	income	
Bangladesh	Education	0.217	0.064	57.41612	Health	179.81
Bangladesh	Health	0.145	0.076	61.658	Income	
Bangladesh	Income	0.114	0.062	60.74002	Education	
China (PRC)	Income	0.275	0.223	88.50543	income	196.80
China (PRC)	Education	0.206	0.053	56.13354	education	
China (PRC)	Health	0.083	0.014	52.16531	health	
India	Education	0.193	0.040	54.6372	Income	176.35
India	Income	0.142	0.090	65.56879	Health	
India	Health	0.109	0.040	56.14611	Education	
Indonesia	Education	0.128	-0.025	47.15549	Income	160.19
Indonesia	Health	0.103	0.034	55.22747	Health	
Indonesia	Income	0.097	0.045	57.80827	Education	
Republic of Korea	Education	0.178	0.025	52.92709	Income	177.17
Republic of Korea	Health	0.139	0.070	60.73935	Health	
Republic of Korea	Income	0.130	0.078	63.49932	Education	
Kyrgyzstan	Education	0.028	-0.125	35.61227	health	112.32
Kyrgyzstan	Health	0.011	-0.058	41.14154	education	
Kyrgyzstan	Income	-0.032	-0.084	35.56146	income	
Lao PDR	Health	0.196	0.127	69.4665	Health	185.82
Lao PDR	Education	0.167	0.014	51.64451	Income	
Lao PDR	Income	0.137	0.085	64.70651	Education	
Malaysia	Education	0.167	0.014	51.64451	income	159.19

Malaysia	Income	0.106	0.054	59.36038	education	
Malaysia	Health	0.057	-0.012	48.1845	health	
Mongolia	Education	0.244	0.092	60.62257	Education	175.27
Mongolia	Income	0.109	0.057	59.87774	income	
Mongolia	Health	0.100	0.031	54.76814	health	
Myanmar	Income	0.245	0.193	83.33175	Income	186.44
Myanmar	Education	0.150	-0.002	49.72064	Health	
Myanmar	Health	0.091	0.022	53.39017	Education	
Nepal	Education	0.239	0.086	59.98128	health	181.41
Nepal	Health	0.186	0.117	67.93542	education	
Nepal	Income	0.072	0.020	53.49688	income	
Pakistan	Education	0.167	0.014	51.64451	Education	152.96
Pakistan	Health	0.076	0.007	51.09355	health	
Pakistan	Income	0.053	0.001	50.22021	income	
Philippines	Income	0.054	0.002	50.39267	Income	132.51
Philippines	Health	0.046	-0.023	46.50032	Health	
Philippines	Education	0.028	-0.125	35.61227	Education	
Sri Lanka	Education	0.128	-0.025	47.15549	Income	159.01
Sri Lanka	Income	0.123	0.071	62.29213	Health	
Sri Lanka	Health	0.066	-0.003	49.56247	Education	
Tajikistan	Health	0.060	-0.009	48.64383	health	102.51
Tajikistan	Education	-0.044	-0.197	27.2755	education	
Tajikistan	Income	-0.084	-0.136	26.59375	income	
Thailand	Education	0.261	0.109	62.54644	Education	168.64
Thailand	Income	0.102	0.050	58.67055	income	
Thailand	Health	0.052	-0.017	47.41896	health	
Vietnam	Education	0.220	0.068	57.8009	income	178.97
Vietnam	Income	0.169	0.117	70.2251	education	
Vietnam	Health	0.075	0.006	50.94044	health	

Appendix 9. Sum of 3 Standard Deviation Scores

Figure 46. Sum of the 3 standard deviation scores for Asian countries

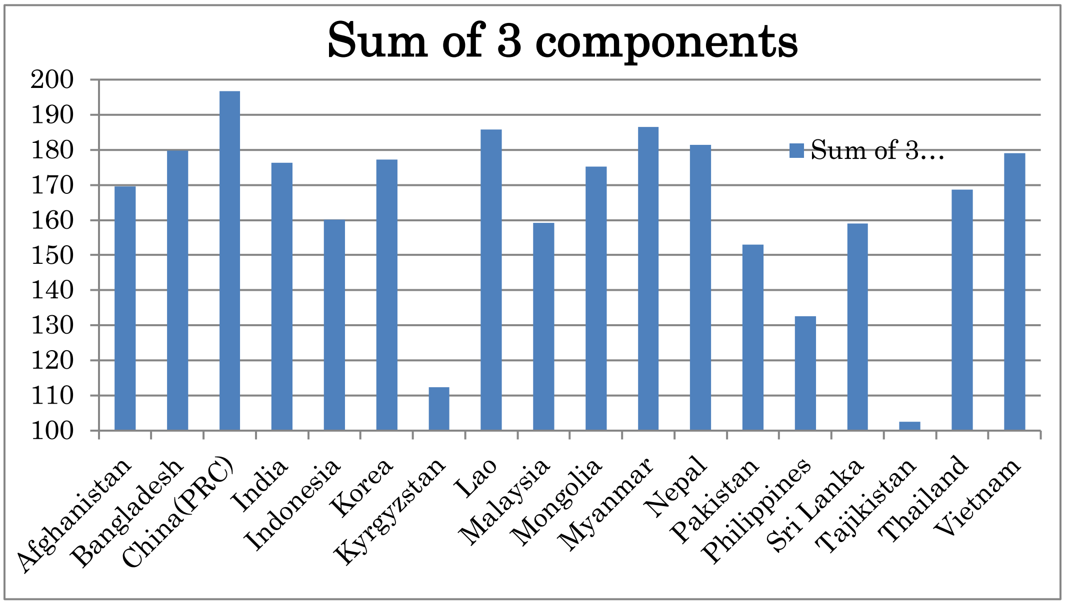


Figure 47. Sum of the 3 standard deviation scores for Asian countries (enlarged)

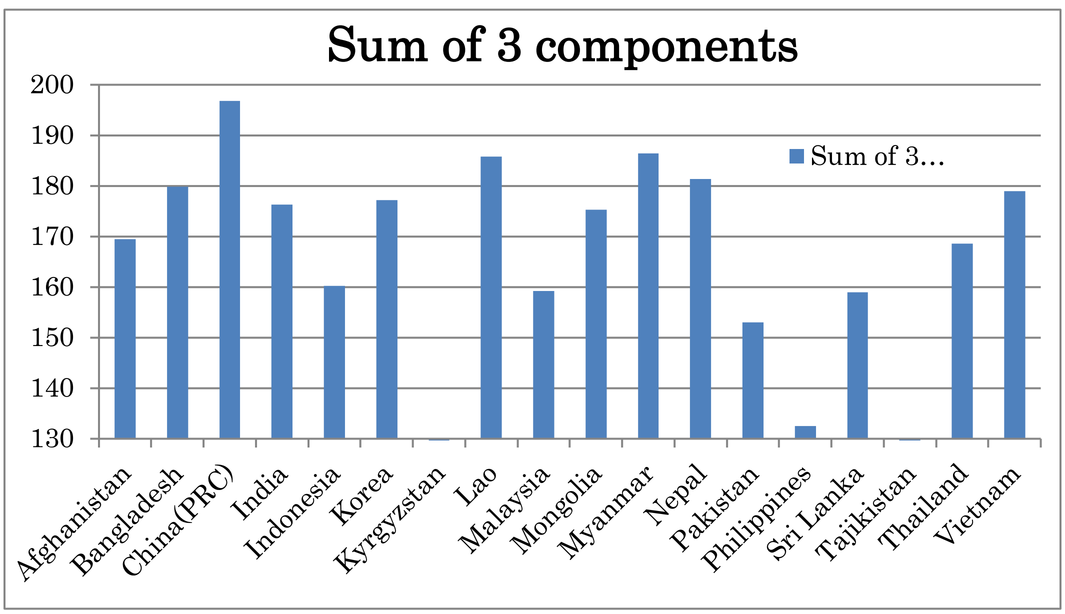


Figure 48. Sum of the 3 standard deviation scores for Asian countries (grouping)

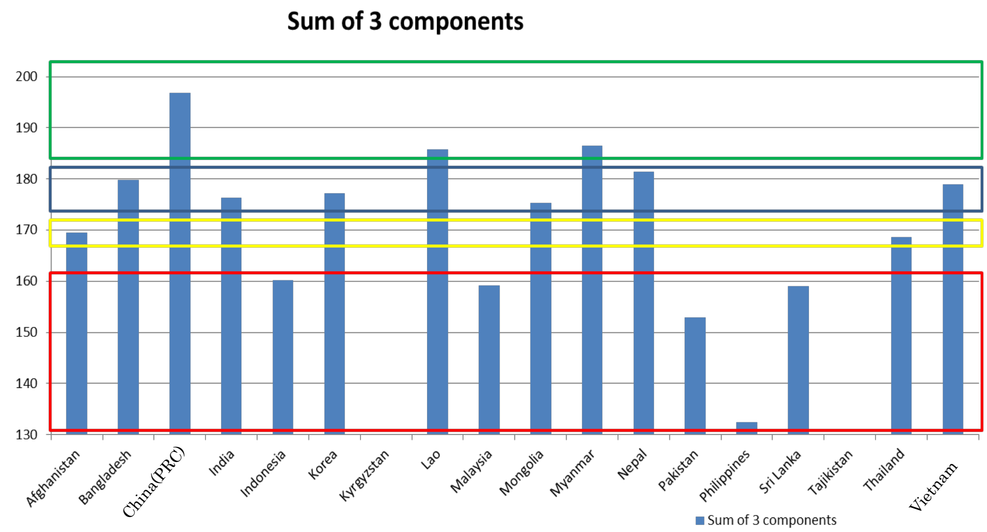


Table 37. Scoring on HDI parameters

	O	P	Q	R	S	T	U	V	W	
	HDI absolute value	World	Asia	HDI standard deviation	HDI ratio of increase	World	Asia	HDI evaluation by absolute value and ratio of increase	HDI evaluation considering HDI standard deviation and ratio of increase	
Afghanistan	28	○	△1	△1	7	◎	◎3	successful4	4	successful
Bangladesh	13	○	○2	○2	10	◎	○2	successful4	4	successful
China(PRC)	2	◎	◎3	◎3	14	○	○2	very successful5	5	very successful
India	19	○	○2	○2	20	○	△1	successful3	3	successful
Indonesia	17	○	○2	×0	25	○	△1	successful3	1	insufficient
Kyrgyzstan	123	×	NA	NA	123	×	NA			
Lao	10	◎	○2	◎3	9	◎	○2	very successful5	5	very successful
Malaysia	24	○	△1	×0	41	△	×0	marginal1	0	unsuccessful
Mongolia	64	×	×0	○2	52	×	×0	unsuccessful0	2	marginal
Myanmar	4	◎	◎3	◎3	4	◎	◎3	very successful6	6	very successful
Nepal	31	△	△1	○2	18	○	△1	marginal2	3	successful
Pakistan	22	○	△1	×0	19	○	△1	marginal2	1	marginal
Philippines	104	×	×0	×0	84	×	×0	unsuccessful0	0	unsuccessful
Korea	9	◎	○2	○2	39	△	×0	marginal2	2	marginal
Sri Lanka	65	×	×0	×0	57	×	×0	unsuccessful0	0	unsuccessful
Tajikistan	128	×	NA	NA	127	×	NA			

Thailand	33	△	△1	△1	40	△	×0	marginal1	1	marginal
Vietnam	6	◎	◎3	○2	13	○	○2	very successful5	4	successful

Appendix 10. GHGpc Absolute Value Increase and Ratio of GHGpc Increase

Figure 49. GHGpc absolute value increased

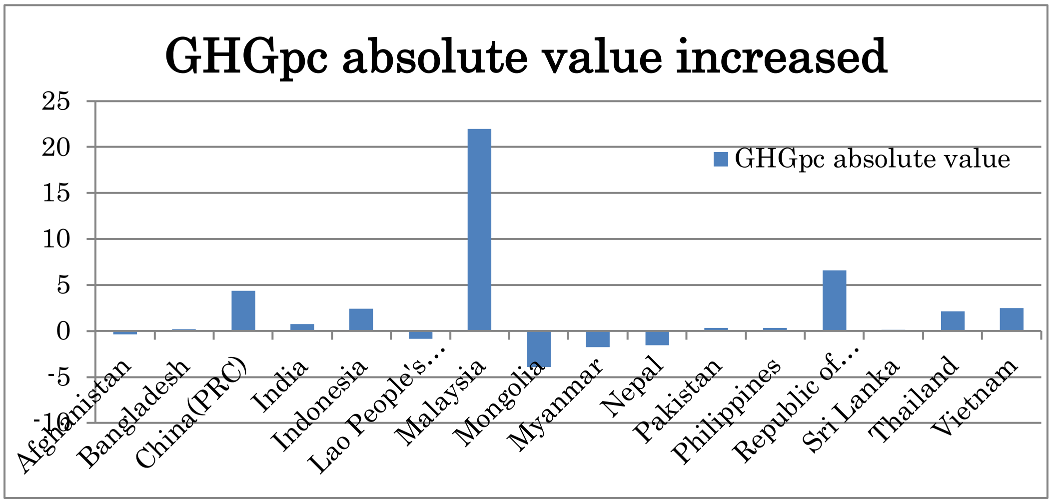


Figure 50. GHGpc absolute value increased (enlarged)

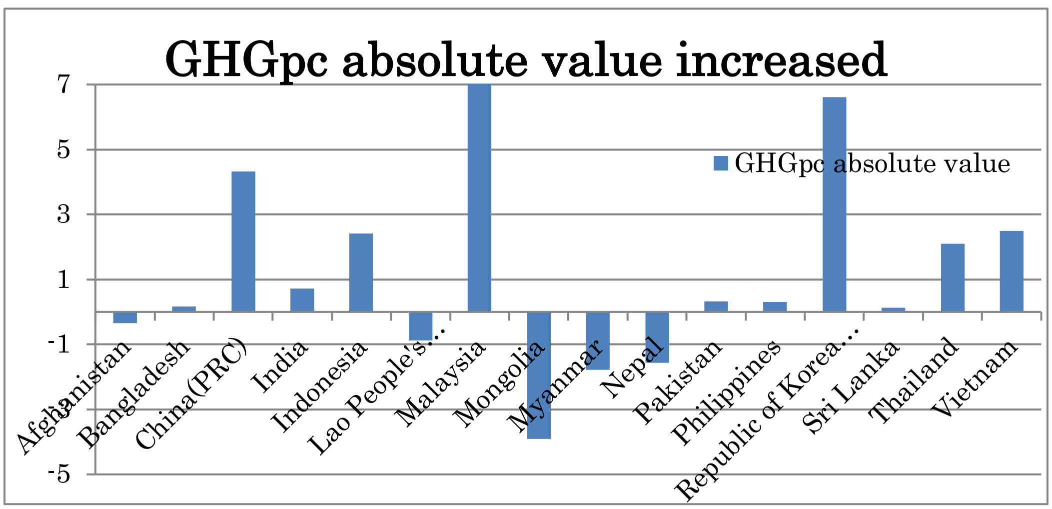


Figure 51. GHGpc absolute value increased (grouping)

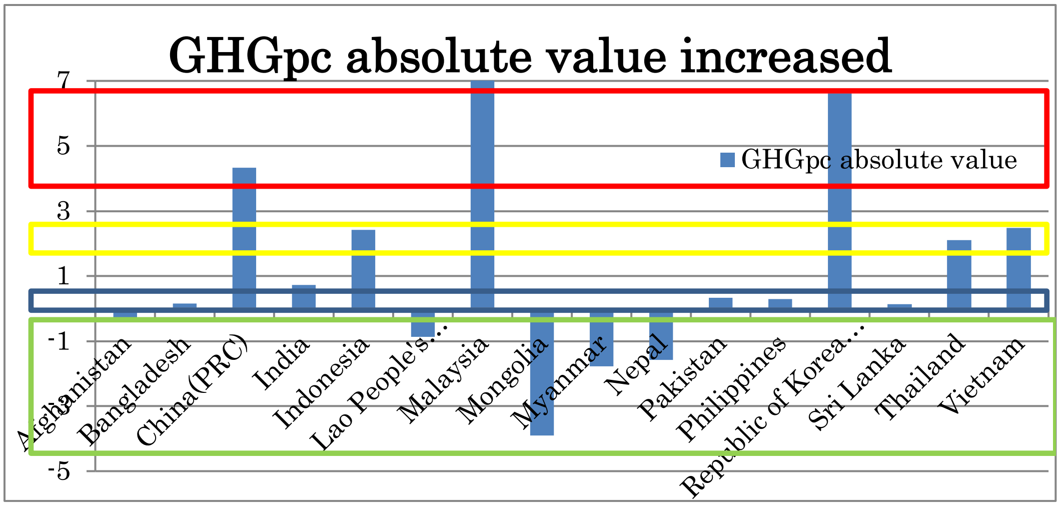


Figure 52. Ratio of GHGpc increase

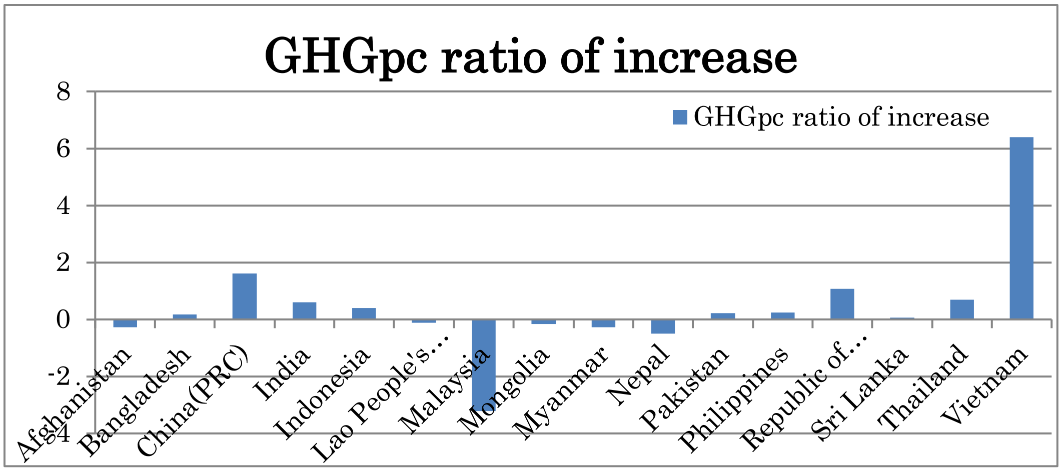


Figure 53. Ratio of GHGpc increase (enlarged)

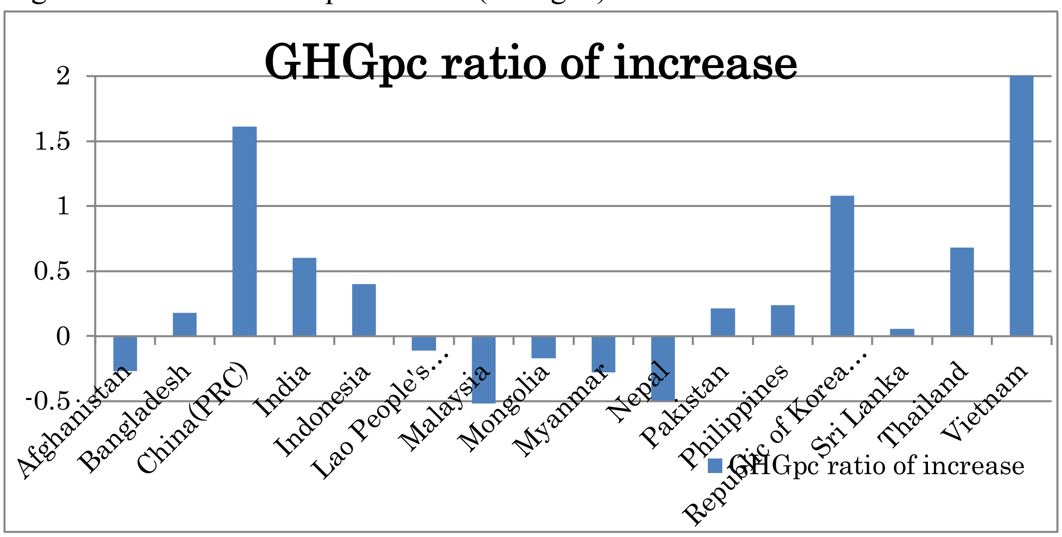


Figure 54. Ratio of GHGpc increase (grouping)

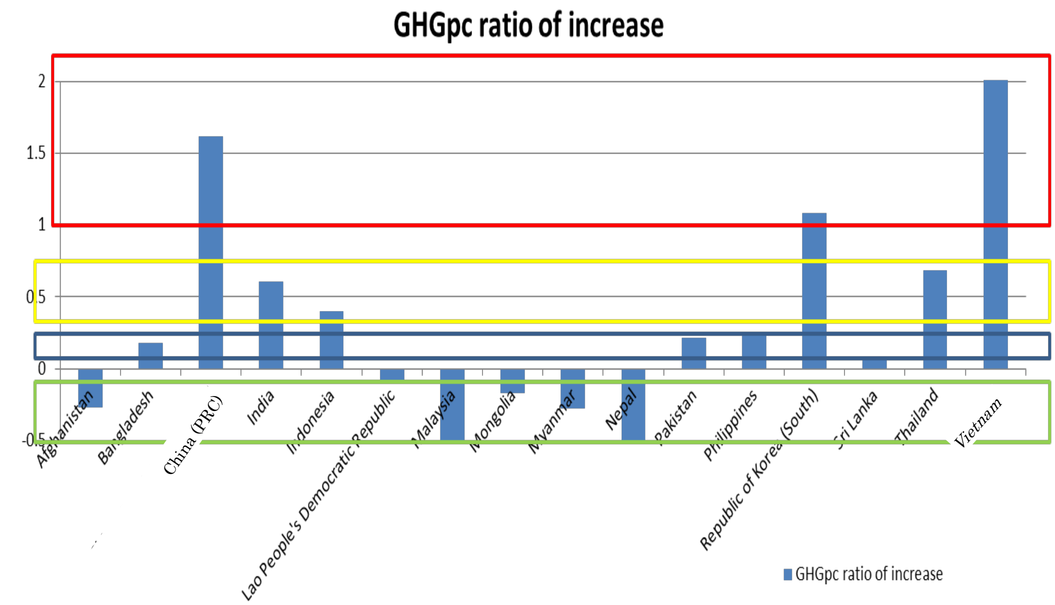


Table 38. Total evaluation of GHGpc parameters

I	X	Y	Z	AA	AB	AC	AD
	GHGpc absolute value increase	World	Asia	GHG ratio of increase	World	Asia	Total evaluation of GHGpc parameters
Afghanistan	73	△	◎	44	△	◎	very successful 6
Bangladesh	85	×	○	98	×	○	successful 4
China (PRC)	122	×	×	126	×	×	unsuccessful 0
India	95	×	○	117	×	△	marginal 3
Indonesia	115	×	△	110	×	△	marginal 2
Kyrgyzstan	7	◎	NA	2	◎	NA	
Lao PDR	60	△	◎	65	△	◎	very successful 6
Malaysia	129	×	×	1	◎	×	unsuccessful 0
Mongolia	27	○	◎	57	△	◎	very successful 6
Myanmar	47	△	◎	40	△	◎	very successful 6
Nepal	49	△	◎	12	○	◎	very successful 6
Pakistan	90	×	○	102	×	○	successful 4
Philippines	89	×	○	104	×	○	successful 4
Republic of Korea	126	×	×	123	×	×	unsuccessful 0
Sri Lanka	84	×	○	86	×	○	successful 4
Tajikistan	44	△	NA	8	◎	NA	
Thailand	111	×	△	119	×	△	marginal 2
Vietnam	116	×	△	130	×	×	marginal 1

Table 39. Final total scores to identify successful countries.

Countries	HDI score	GHG score	Total
Bangladesh	4	4	8
China (PRC)	5	0	5
India	3	3	6
Indonesia	1	2	3
Malaysia	0	0	0
Mongolia	2	6	8
Myanmar	6	6	12
Nepal	3	6	9
Pakistan	1	4	5
Philippines	0	4	4
Republic of Korea	2	0	2
Sri Lanka	0	4	4
Thailand	1	2	3
Vietnam	4	1	5

Table 40. Identifying successful countries

Countries	HDI score	HDI evaluation	GHG score	GHG evaluation	Total	Remarks (Regarding DLHE groups, please refer Section 5.1)
Bangladesh	4	successful	4	successful 4	8	Successful because of both of successful HDI and GHG (DLHE (new CO_2); CO_2 newly rising recently)
China (PRC)	5	very successful	0	unsuccessful 0	5	Unsuccessful because of unsuccessful GHG (DLHE (dom CO_2); dominated by CO_2)
India	3	successful	3	marginal 3	6	Unsuccessful because of marginal GHG (DLHE (dom CO_2); dominated by CO_2)
Indonesia	1	marginal	2	marginal 2	3	Unsuccessful because of marginal HDI and GHG (DLHE (LUCF); dominated by LUCF)
Malaysia	0	unsuccessful	0	unsuccessful 0	0	Unsuccessful because of unsuccessful HDI and GHG (DLHE (LUCF-+); LUCF drastic increased)
Mongolia	2	marginal	6	very successful 6	8	Successful because of very successful GHG even though HDI was marginal (Non DLHE (LUCF); dominated by LUCF)
Myanmar	6	very successful	6	very successful 6	12	Very Successful because of very

Countries	HDI score	HDI evaluation	GHG score	GHG evaluation	Total	Remarks (Regarding DLHE groups, please refer Section 5.1)
						successful HDI and GHG (Non DLHE (reform); emissions dropped because of the military era)
Nepal	3	successful	6	very successful 6	9	Very Successful because of very successful GHG (Non DLHE (Agri&LUCF); dominated by agriculture and LUCF
Pakistan	1	marginal	4	successful 4	5	Unsuccessful because of marginal HDI (DLHE (dom CO_2); dominated by CO_2)
Philippines	0	unsuccessful	4	successful 4	4	Unsuccessful because of unsuccessful HDI (DLHE (dom CO_2); dominated by CO_2)
Republic of Korea	2	marginal	0	unsuccessful 0	2	Unsuccessful because of both marginal HDI and unsuccessful GHG (DLHE (dom CO_2); dominated by CO_2)
Sri Lanka	0	unsuccessful	4	successful 4	4	Unsuccessful because of unsuccessful HDI (DLHE (yet CO_2); CO_2 increased but not much)
Thailand	1	marginal	2	marginal 2	3	Unsuccessful because of both marginal HDI and EKC (DLHE (dom

Countries	HDI score	HDI evaluation	GHG score	GHG evaluation	Total	Remarks (Regarding DLHE groups, please refer Section 5.1)
						CO_2); dominated by CO_2)
Vietnam	4	successful	1	marginal 1	5	Unsuccessful because of marginal GHG (DLHE (new CO_2); CO_2 rising recently)

Figure 55. Trajectories of Very Successful and Successful Asian Countries

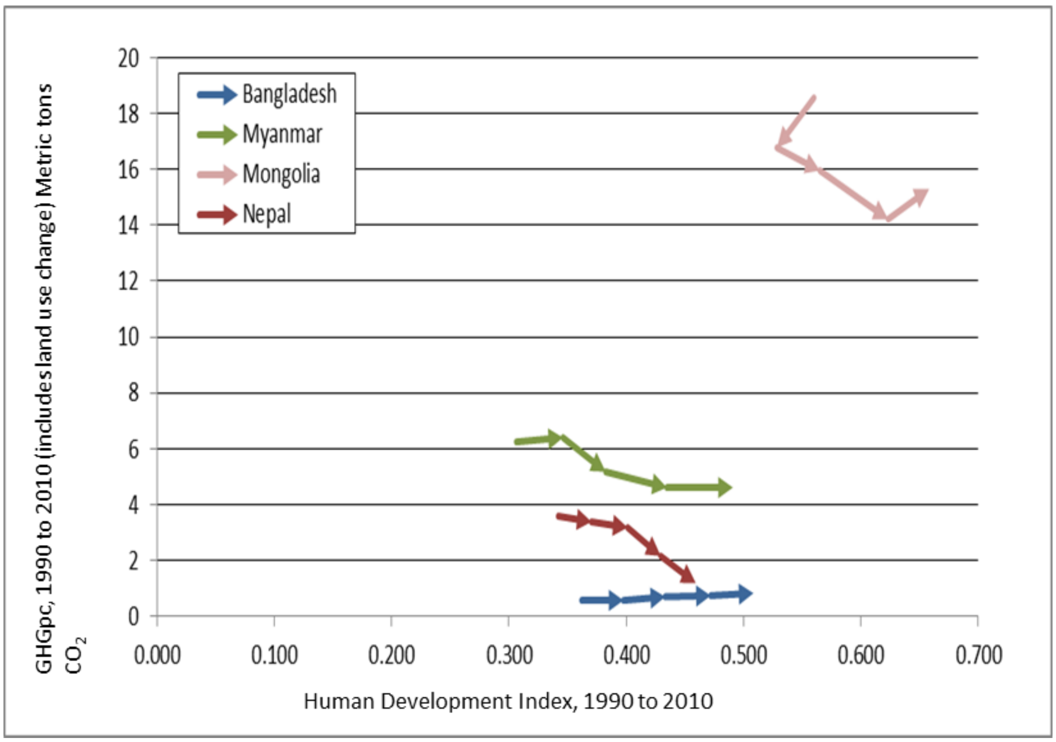


Figure 56. Trajectories of Very Successful and Successful Asian Countries (starting from 0).

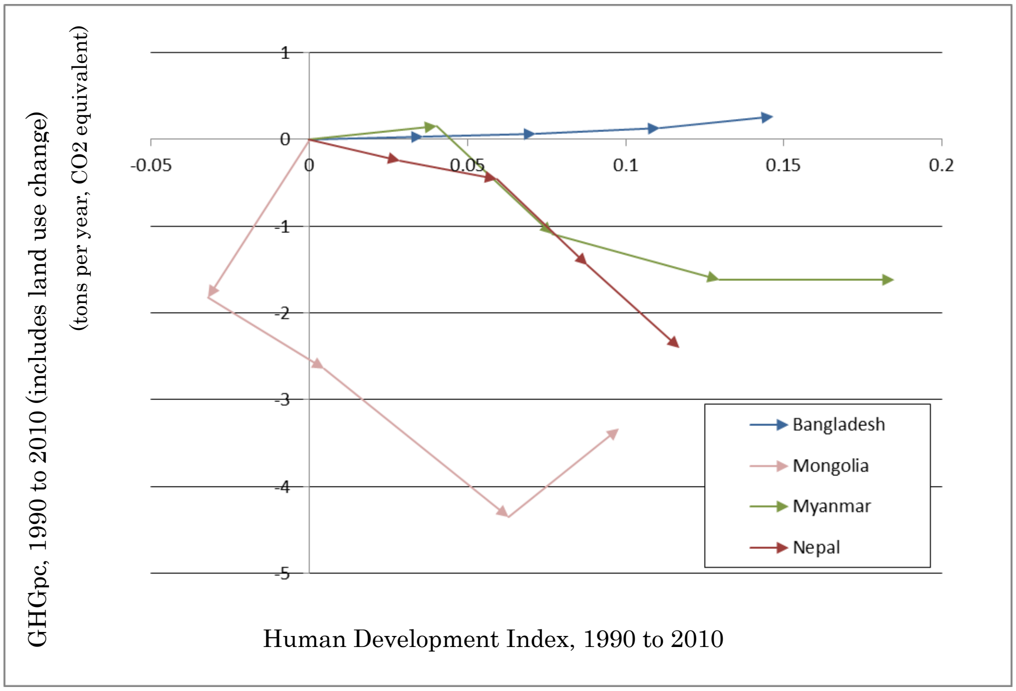


Table 41. Summary of Authors' EKC Arguments

Author	Claims Against EKC	Indicators
Stern (2006) and Dasgupta (2007)	• EKC can be applied to only some environmental problems.	
Chandler (2000)	• Development is not a necessary or sufficient justification for CO_2 emission-increases.	CO_2
Moomaw and Unruh (1997)	• EKC cannot and should not be generalized. • Historical events may be the driving force for the change, but not income. • EKC does not fit with CO_2 emissions. • Economic growth does not necessarily cause an increase in CO_2; rather, economic growth can eventually reduce emissions.	CO_2
IEA (2007)	• Some pollutants and emissions show an N-	Emissions

Author	Claims Against EKC	Indicators
	shaped curve.	
Barquin (2006)	• A "scale effect" should be considered. • If it is possible to prove the existence of EKC models, then their utility as instruments of economic policy is debatable.	Impacts by Motor Vehicles
America's Energy Future (2009)	• Generalizations like the EKC model should not be relied upon. • It is important to track the history of each country because development policies in developing countries are strongly influenced or "trapped" by the EKC theory.	
Orban (2008)	• Even if a case in which economic growth is related to an emission improvement is found, there is no reason to believe that such improvement occurs automatically. • If it can happen automatically, then it may be a case wherein dirty technology is replaced by clean technology.	Dirty Technology
Kidd (2009)	• Although having high standards of living with a clean environment is possible, the opposite is also true. • The environment may further degrade, despite economic development, until the earth's carrying capacity is reached.	Environmental Degradation
Ferrini (2012)	• Institutional change and technology are the most important items.	
Shaffer (2009)	• Pollution reduction will not happen automatically even if growth happens. • Cases in the future will not necessarily be the same as cases in the past. • Whether a case can fit with EKC or not depends on the specifics of the case.	

Author	Claims Against EKC	Indicators
Ostrom (1990)	• Growth makes environmental costs increase faster than the speed of the growth itself. • Growth may not improve environmental conditions but may even worsen it.	Worsening of Environmental Conditions
Brock and Taylor (2010)	• Pollution data, like GHG per capita, are unreliable measures. • Models of threshold effects do not consider the timing of the pollution policies imposed. • Emissions are produced in proportion to economic output; when aggressive regulation is imposed, emissions-to-output-ratio drastically decline.	Greenhouse Gas
Raymond (2004)	• While higher income is significantly associated with improvements in welfare, evidence of an actual EKC trend in country data is lacking. • Per capita income shows a negative relationship with indicators of international environmental impacts such as GHG emissions.	Greenhouse Gas

Figure 57. Trajectories of GHGs (China (PRC))

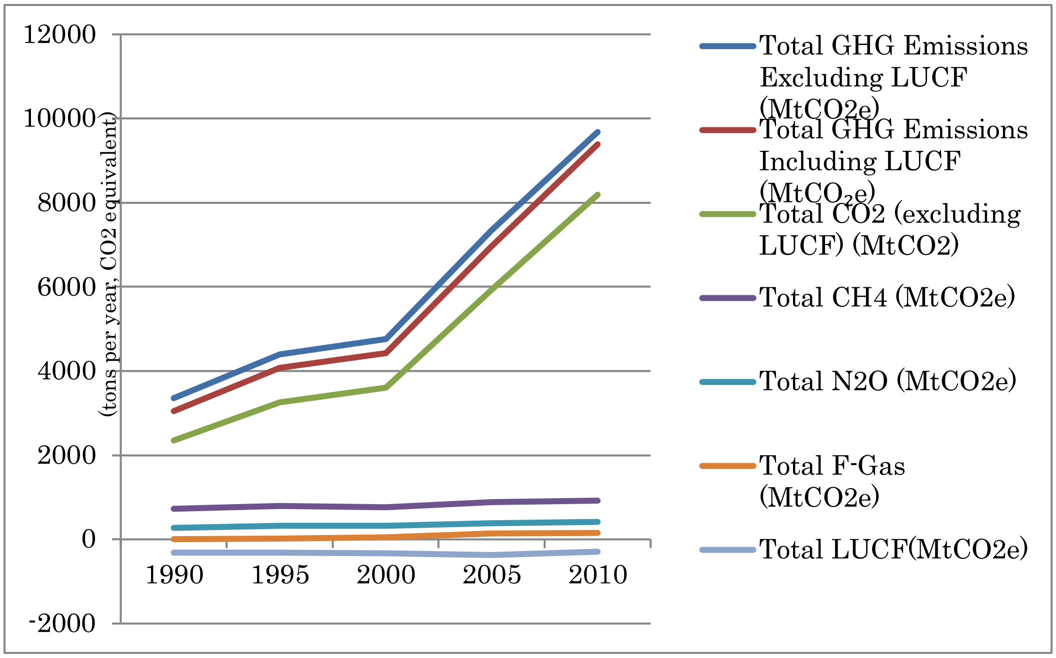


Figure 58. Trajectories of GHGs (India)

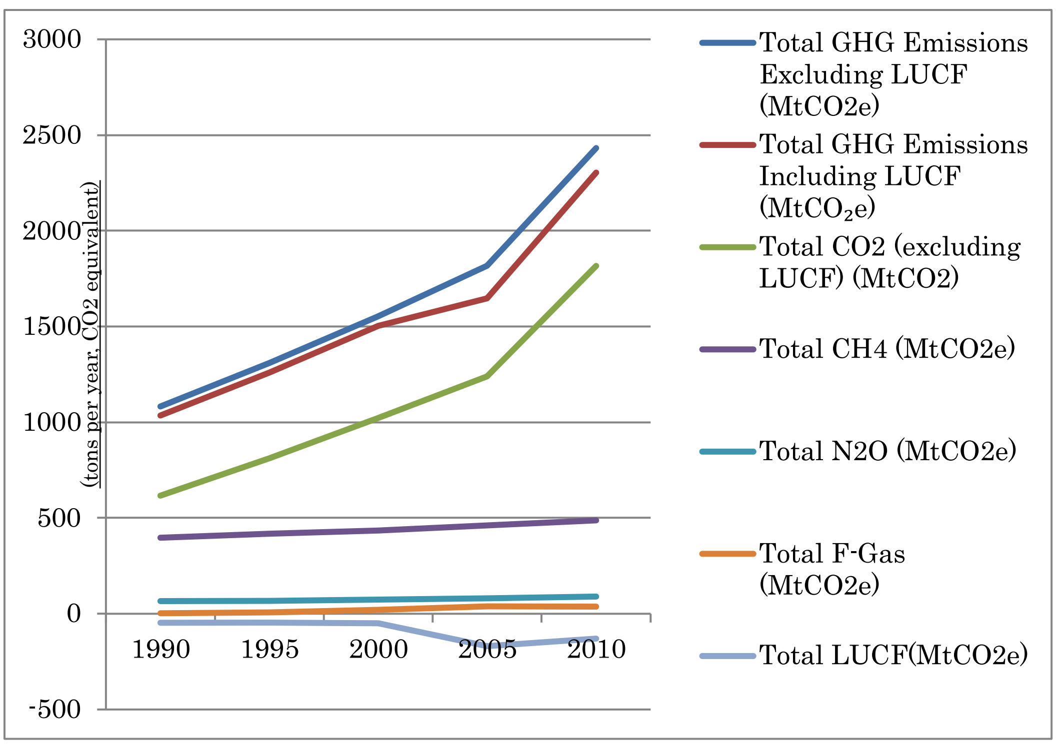


Figure 59. Trajectories of GHGs (Republic of Korea)

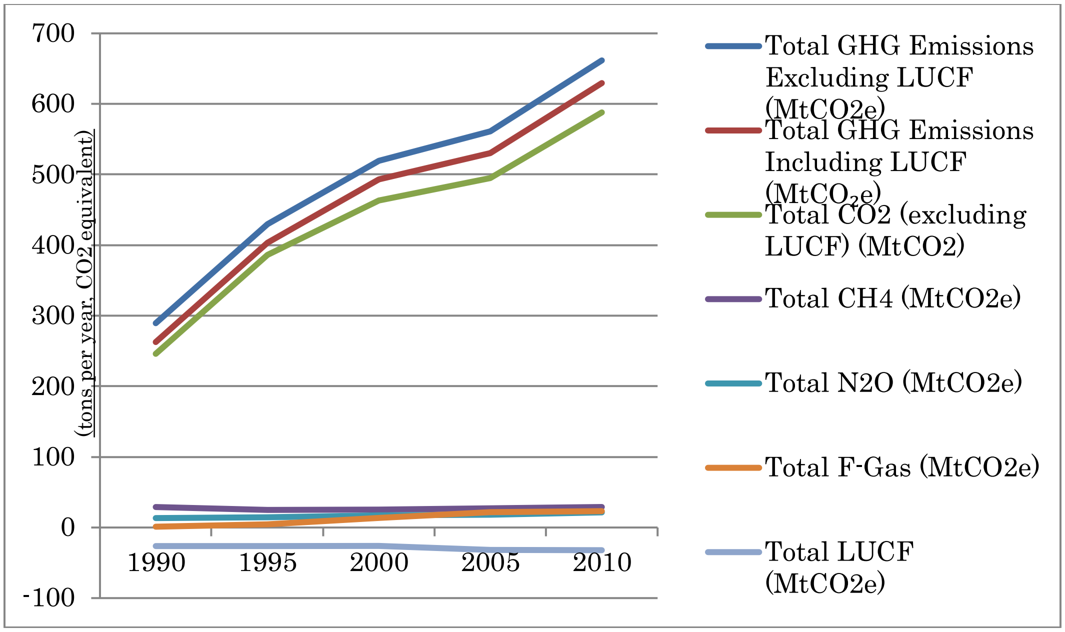


Figure 60. Trajectories of GHGs (Pakistan)

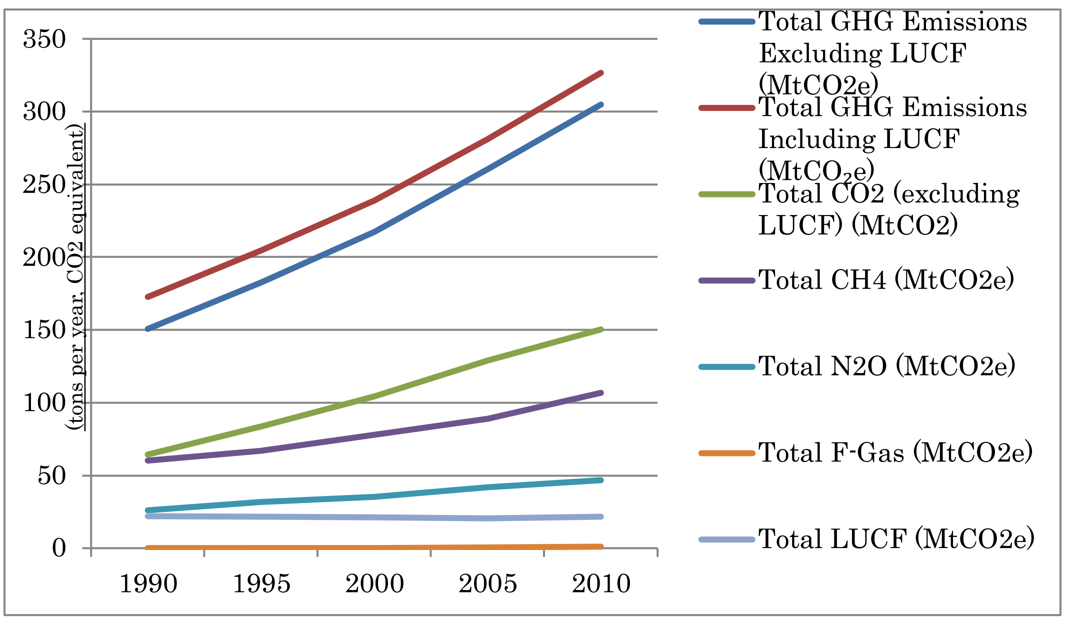


Figure 61. Trajectories of GHGs (Philippines)

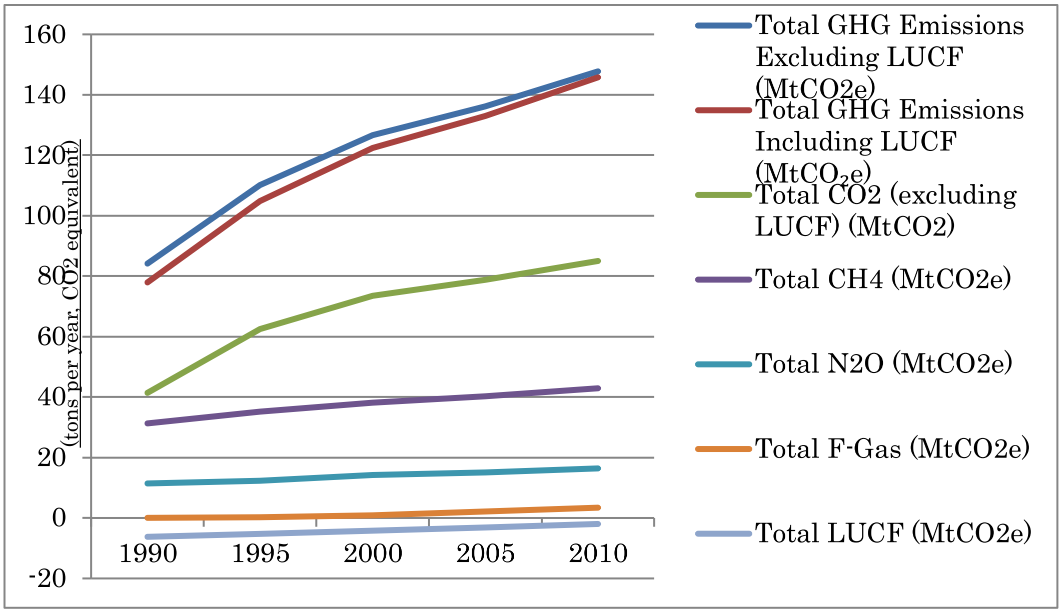


Figure 62. Trajectories of GHGs (Thailand)

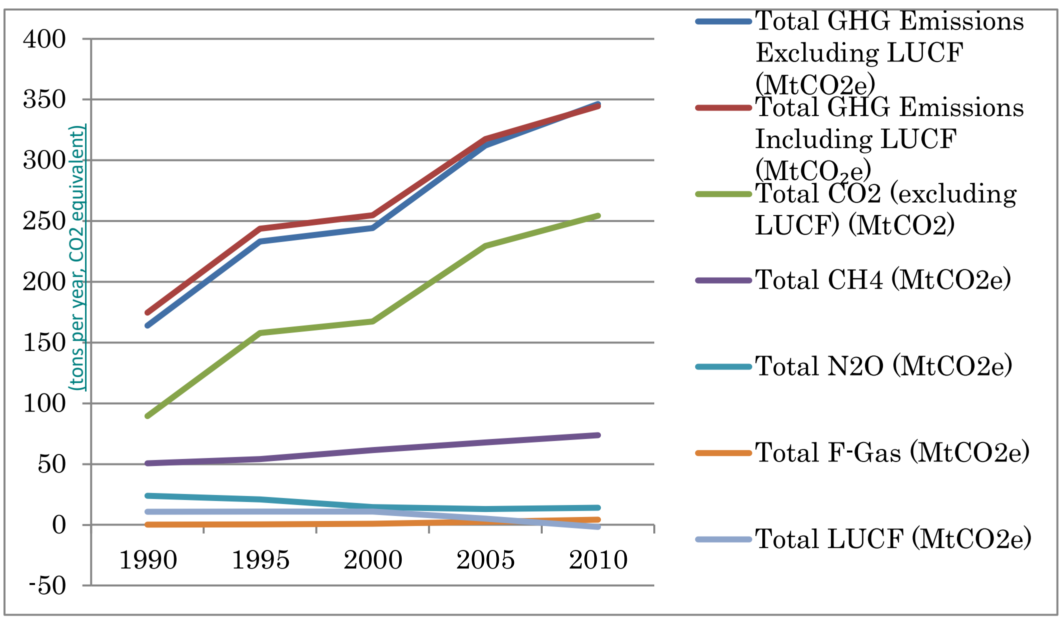


Figure 63. Trajectories of GHGs (Malaysia)

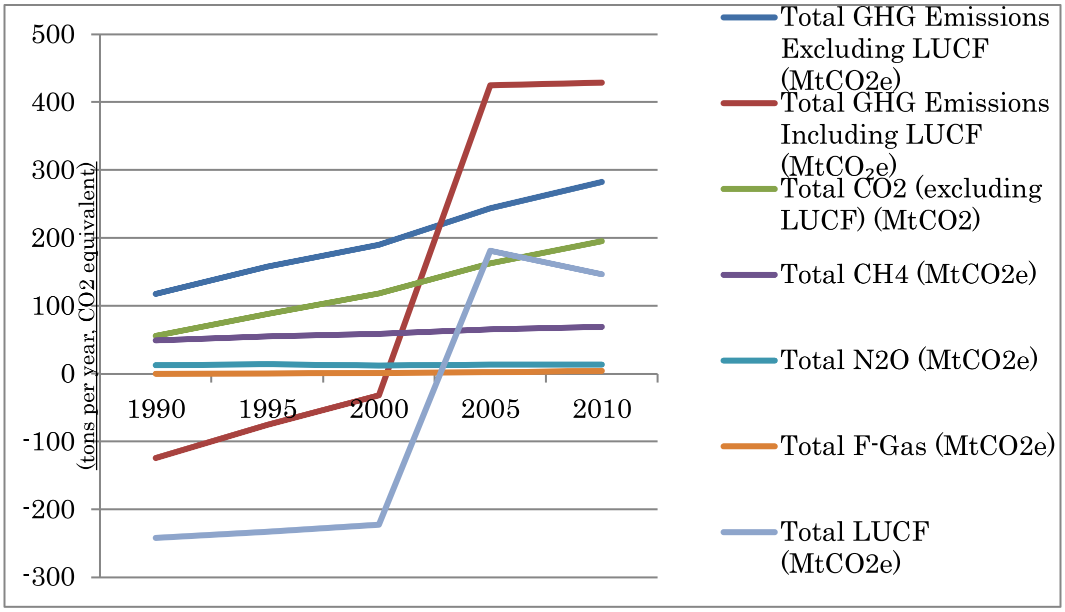


Figure 64. Trajectories of GHGs (Indonesia)

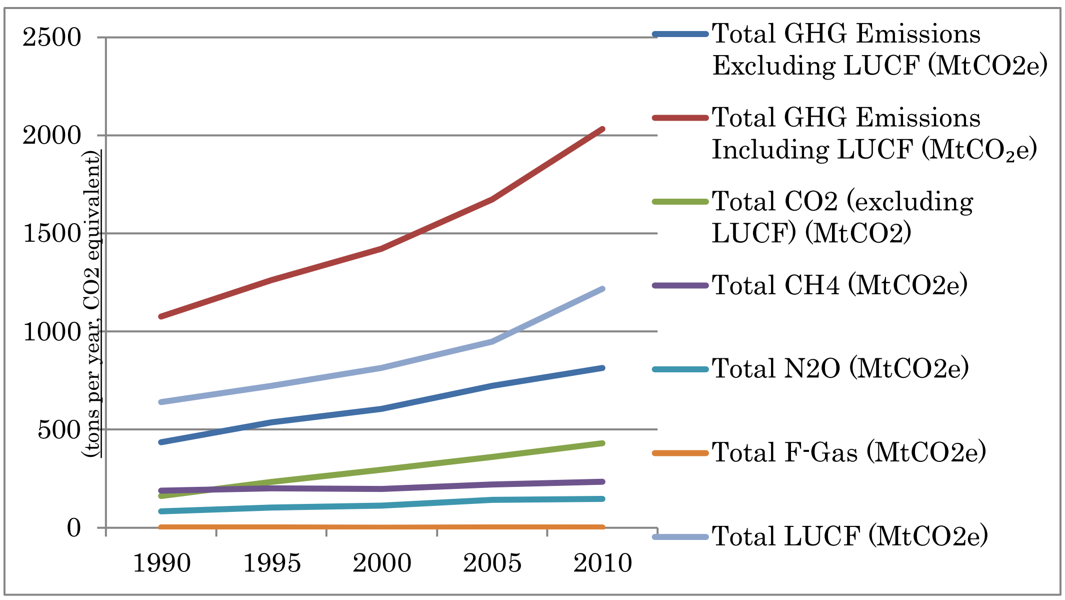


Figure 65. Trajectories of GHGs (Sri Lanka)

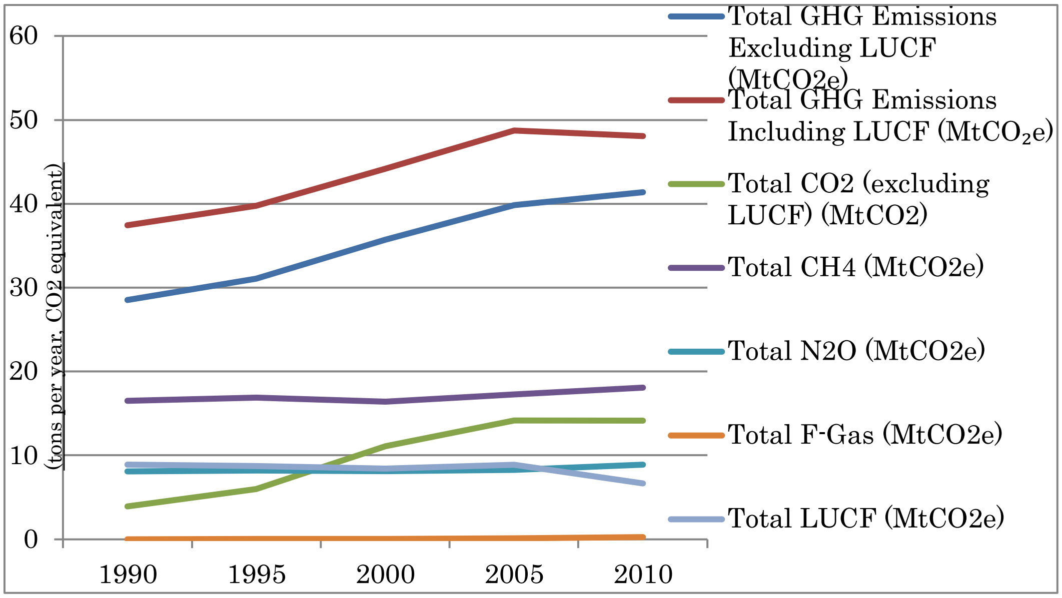


Figure 66. Trajectories of GHGs (Bangladesh)

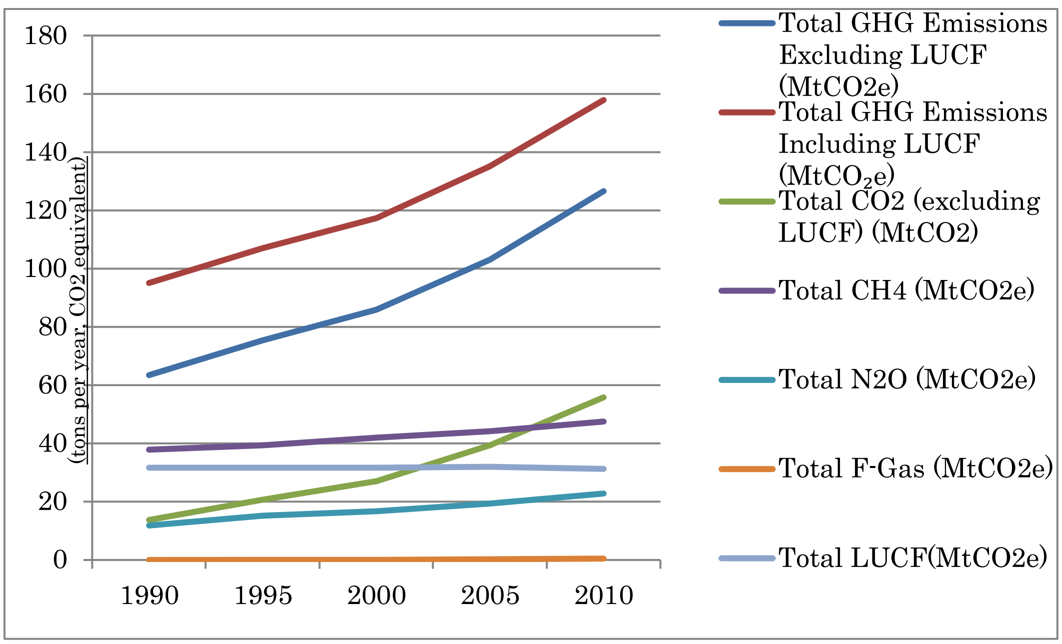


Figure 67. Trajectories of GHGs (Vietnam)

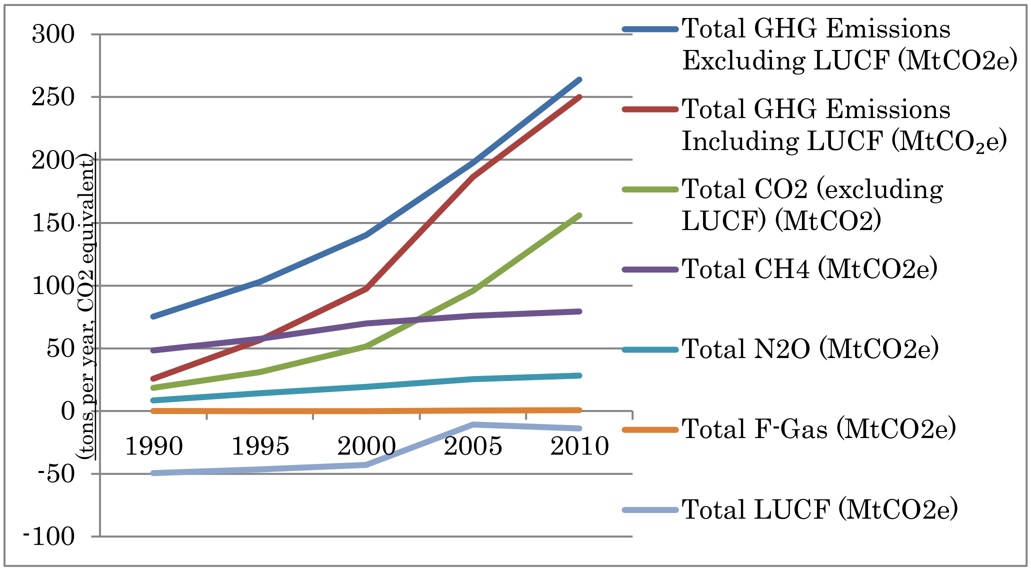


Table 42. Summary of Identifying DLHE Countries

DLHE countries	DLHE groups	Analysis summary
Bangladesh	DLHE(newCO2)	1. The main source became CO2 from energy sector including electricity/ heat, manufacturing/ construction, transportation and other fuel combustion even though once CH4 from agriculture and LUCF were the main sources in 1990. 2. Main emitter of CO2 from energy sector has become electricity/ heat.
China (PRC)	DLHE(domCO2)	CO2 increased to dominate 87% of GHG and 80% of the CO2 in 2010 (since most of them are from energy sector) is dominated by electricity/ heat and manufacturing/ construction.
India	DLHE(domCO2)	1. CO2 increased to dominate 79% of GHG and 74% of the CO2 (since most of them are from energy sector) in 2010 is dominated by electricity/ heat and manufacturing/

		construction. 2. This is exactly the same trajectory with China while China started the speed up of the domination from 2000 while India started from 2005
Indonesia	DLHE(LUCF)	1. Total GHG emission became almost double during the period because of increases of all GHG gasses. 2. The all-time main source had been LUCF which dominated more than half of the contribution while CO2 from energy sector and CH4 from agriculture also increased. 3. Once CH4 from agriculture and LUCF were the main sources in 1990.2. Main emitter of CO2 from energy sector has become electricity/ heat.
Malaysia	DLHE(LUCF-+)	Other than the drastic change of LUCF, the emission showed the typical CO2-energy lead trajectory.
Mongolia	Successful as NonDLHE (LUCF)	LUFC had been the dominating gas through 1990-2005. All other GHG emissions had been stable or even decreased from 1990 till 2000, then they (CO2, CH4, and N2O) started increase from 2005 because of agriculture sector and electricity/ heat, manufacturing/ construction, and other fuel combustion.
Myanmar	Very successful as NonDLHE (reform)	1. CO2 was not significant through the period (less than 5% all through the period). 2. LUCF, CH4, and N2O, and agriculture sector were significant

		contributors, but emission increases were not remarkable after drastic drop through 1995-2000. This period was in its military rule heading to the democratic reforms happened from 2011.
Nepal	Very successful as NonDLHE (Agri&LUCF)	1. CO_2 was not significant through the period (less than 10% all through the period). 2. LUCF, CH_4, and agriculture sector were significant contributors.
Pakistan	DLHE(domCO_2)	1. Through the period, CO_2 increased to occupy 46% of GHG and 77% of the CO_2 (since most of them are from energy sector) in 2010 is dominated by electricity/ heat, manufacturing/ construction, and transport. 2. This is a very similar trajectory with China, India, and Korea.3. Pakistan still has CH_4 from agriculture as a significant source.
Philippines	DLHE(domCO_2)	1. Through the period, CO_2 increased to occupy round 50-60% of GHG and 86% of the CO_2 (since most of them are from energy sector) in 2010 is occupied by electricity/ heat (42%), manufacturing/ construction (29%), and transport (16%). 2. This is a very similar trajectory with China, India, Korea, and Pakistan. 3. Philippines still has CH_4 from agriculture as a significant source. 4. CO_2 emission from transport is higher than manufacturing/

		construction in Philippines. It maybe result from geological reason when Philippines are made by many small islands where cannot be suitable for trains.
Korea	DLHE(domCO2)	1. Through the period, CO2 increased to keep its domination above 93% of GHG and 87% of the CO2 (since most of them are from energy sector) in 2010 is dominated by electricity/ heat (55%), manufacturing/ construction (17%), and transport (15%). 2. This is a very similar trajectory with China and India while China started the speed up of the domination from 2000 while India started from 2005, but Korea started already before 1990. 3. While China and India had agriculture sector as the 2nd contributor, in Korea, agriculture sector was very insignificant.
Sri Lanka	DLHE(not yetCO2)	1. CH4 had been the biggest contributor through the period while it was also stable through the period. N2O and LUCF hand been also other significant gases ranked 2-4 through the period, however they were also stable. 2. While other gasses were more or less stable, Only CO2 showed remarkable increase which bring it up from 4th position to 2nd position because of increases by CO2 emissions from transportation,

		electricity/ heat, and other fuel combustion (other than CO_2).
Thailand	DLHE(domCO_2)	1. Through the period, CO_2 increased to keep its domination above 50% of GHG and 87% of the CO_2 in 2010 is dominated by electricity/ heat (39%), manufacturing/ construction (26%), and transport (22%). 2. This is a very similar trajectory with China, India, Korea, Pakistan, and Philippines. 3. Thailand still has CH_4 from agriculture as a significant source
Vietnam	DLHE(newCO_2)	1. The main source became CO_2 from energy sector including manufacturing/ construction, electricity/ heat, transportation and other fuel combustion even though once CH_4 from agriculture was the main source until 2000. 2. Main emitter of CO_2 from energy sector has become manufacturing/ construction and electricity/ heat. 3. LUCF had been an absorber through the period but the amount of absorption drastically decreased in 2005 (from 40s to 10s $MtCO_2e$).

Table 43. Major Arguments about Technology Transfer /Adaptation

Author	Claims about Technology Transfer/Adoption
Orr (2003)	• People will adopt an innovation if it will enhance their utility. • People will accept a new technology if they believe that it is far better than the previous one.
Grubler (2003)	• Diffusion happens taking over a longer period where the technology originated, and more quickly in areas where diffusion was introduced later.
Halila (2007)	• To address the less successful environmental innovations, three factors must be considered: 1) realism while evaluating one's own innovation, 2) access to capital, and 3) utilization of networks.
Ugaglia (2010)	• Innovation processes can be a complex phenomenon wherein recipients need to search for new resources that they do not normally have. • Situations can be different for countries adopting new technologies for the first time, which is often the case in developing countries.
Hascic (2010)	• An important determinant of innovation is a country's general innovative capacity.
Johnson (2010)	• Since environmental issues tend to be local in nature, local knowledge and solutions are required. • It is essential to consider the skills required for the continued use and repair of new technologies at the very onset of adoption.
Ockwell (2010)	• The majority of existing policy mechanisms do not recognize the importance of developing indigenous eco-innovation capabilities among developing countries. • Policy improvement is needed to respond to context-specific technological and cultural requirements.
Iida and Takeuchi	• Although free trade lowers environmental regulation, it

Author	Claims about Technology Transfer/Adoption
(2010)	is still preferable when the evaluation of the environmental damage is high. • When a country cares less about the environmental damage caused by technology transfer, free trade is Pareto improving. • If the developing country's concern is high enough to conduct environmental protection, free trade is not preferred.
Johnstone (2010)	• Market-based instruments can induce innovation and by encouraging potential innovators to allocate resources to identify the best way of achieving a given environmental objective, and policy flexibility can provide incentives for innovation.
Gallagher (2013)	• Technology transfer also occurs in the north-to-south-to-north, south-to-south, and south-to-north directions, and the ensuing innovation is no longer a local process, but rather happens on a global scale.

Table 44. Results of the modified KAYA components

	EC/P/HDI		GHG/EC
	Inc LUCF		IncLUCF
Bangladesh	1.220342554	Bangladesh	0.687602
China (PRC)	1.76216565	China (PRC)	1.065681
India	1.234507137	India	0.973882
Indonesia	1.228497755	Indonesia	0.88128
Korea	1.9285229	Korea	0.892447
Malaysia	1.807640544	Malaysia	-1.02547
Mongolia	0.694556378	Mongolia	1.020018
Myanmar	0.661971424	Myanmar	0.677007
Nepal	0.886428895	Nepal	0.422825
Pakistan	0.945294841	Pakistan	0.961876
Philippines	0.840646913	Philippines	1.321341
Sri Lanka	1.266671455	Sri Lanka	0.71909
Thailand	1.980593465	Thailand	0.704873
Vietnam	1.797389532	Vietnam	2.950999

Grouping of Each Asian Country

Figure 68. Grouping EC/P/HDI of each Asian country

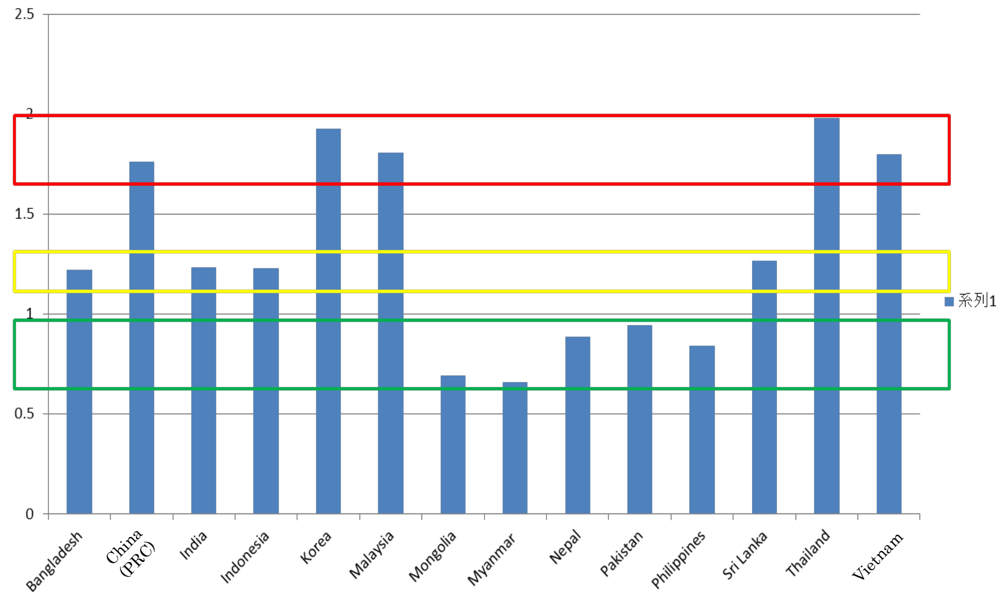


Figure 69. Grouping GHG/EC of each Asian country

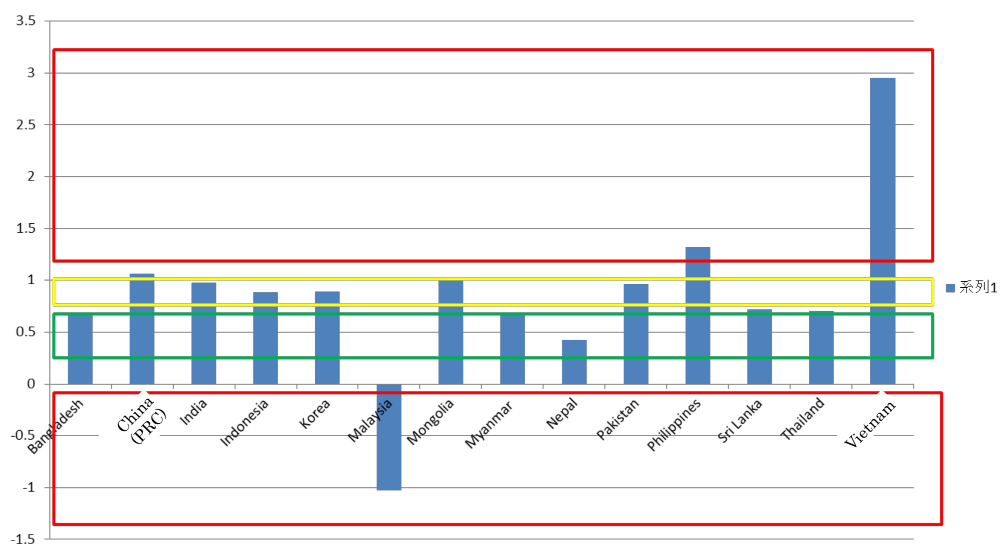


Table 45. Summary of the groups and their orders

<table>
<tr><th colspan="3">EC/P/HDI</th><th colspan="3">GHG/EC</th></tr>
<tr><td rowspan="5">EFFECTIVE</td><td>2</td><td>Mongolia</td><td rowspan="5">EFFECTIVE</td><td>3</td><td>Bangladesh</td></tr>
<tr><td>1</td><td>Myanmar</td><td>2</td><td>Myanmar</td></tr>
<tr><td>4</td><td>Nepal</td><td>1</td><td>Nepal</td></tr>
<tr><td>5</td><td>Pakistan</td><td>5</td><td>Sri Lanka</td></tr>
<tr><td>3</td><td>Philippines</td><td>4</td><td>Thailand</td></tr>
<tr><td rowspan="4">MEDIOCRE</td><td>6</td><td>Bangladesh</td><td rowspan="6">MEDIOCRE</td><td>11</td><td>China (PRC)</td></tr>
<tr><td>8</td><td>India</td><td>9</td><td>India</td></tr>
<tr><td>7</td><td>Indonesia</td><td>6</td><td>Indonesia</td></tr>
<tr><td>9</td><td>Sri Lanka</td><td>7</td><td>Korea</td></tr>
<tr><td rowspan="5">INEFFECTIVE</td><td>10</td><td>China (PRC)</td><td>10</td><td>Mongolia</td></tr>
<tr><td>13</td><td>Korea</td><td>8</td><td>Pakistan</td></tr>
<tr><td>12</td><td>Malaysia</td><td rowspan="3">INEFFECTIVE</td><td>14</td><td>Malaysia</td></tr>
<tr><td>14</td><td>Thailand</td><td>12</td><td>Philippines</td></tr>
<tr><td>11</td><td>Vietnam</td><td>13</td><td>Vietnam</td></tr>
</table>

Table 46. Each country's result of modified KAYA components

	EC/P/HDI		GHG/EC	
Nepal	EFFECTIVE	4	EFFECTIVE	1
Myanmar	EFFECTIVE	1	EFFECTIVE	2
Bangladesh	MEDIOCRE	6	EFFECTIVE	3
Mongolia	EFFECTIVE	2	MEDIOCRE	10
Vietnam	INEFFECTIVE	11	INEFFECTIVE	13
China (PRC)	INEFFECTIVE	10	MEDIOCRE	11
India	MEDIOCRE	8	MEDIOCRE	9
Korea	INEFFECTIVE	13	MEDIOCRE	7
Malaysia	INEFFECTIVE	12	INEFFECTIVE	14
Thailand	INEFFECTIVE	14	EFFECTIVE	4
Indonesia	MEDIOCRE	7	MEDIOCRE	6
Pakistan	EFFECTIVE	5	MEDIOCRE	8
Philippines	EFFECTIVE	3	INEFFECTIVE	12
Sri Lanka	MEDIOCRE	9	EFFECTIVE	5

Figure 70. Final Results of Evaluation of Each Asian Country

		HDI (education, health, income)											
		very successful			successful			marginal			unsuccessful		
		Education	Health	Income	Education	Health	Income	Education	Health	Income	Education	Health	Income
GHG	very successful			Myanmar (50,53,83/186, EC/P/HDI effective(#1), GHG/EC effective(#2)), NonDLHE(reform)		Nepal (60,68,53/181, EC/P/HDI effective(#4), GHG/EC effective(#1)), NonDLHE(Agri&LUCF)		Mongolia (61,55,60/175, EC/P/HDI effective(#2), GHG/EC mediocre(#10)), NonDLHE(LUCF)					
	successful					Bangladesh (57,62,61/180, EC/P/HDI mediocre(#6), GHG/EC effective(#3)), DLHE(newCO2)		Pakistan (52,51,50/153, EC/P/HDI effective(#5), GHG/EC mediocre(#8)), DLHE(domCO2)					Philippines (36,47,50/133, EC/P/HDI effective(#3), GHG/EC ineffective(#12)),DLHE(domCO2) Sri Lanka (47,50,62/159,EC/P/HDI mediocre(#9), GHG/EC effective(#5)),
	marginal						Vietnam(58,51,70/179, EC/P/HDI ineffective(#11), GHG/EC ineffective(#13)), DLHE(newCO2) India (55,56,66/176, EC/P/HDI mediocre(#8), GHG/EC mediocre(#9)), DLHE(domCO2)	Thailand (63,47,59/169, EC/P/HDI ineffective(#14), GHG/EC effective(#4)), DLHE(domCO2)		Indonesia (47,55,58/160, EC/P/HDI mediocre(#7), GHG/EC mediocre(#6)), DLHE(LUCF)			
	unsuccessful			China(PRC)(56,52,89/197, EC/P/HDI ineffective(#10), GHG/EC mediocre(#11)), DLHE(domCO2)						Korea(53,61,63/177, EC/P/HDI ineffective(#13), GHG/EC mediocre(#7)), DLHE(domCO2)			Malaysia (52,48,59/159, EC/P/HDI ineffective(#12), GHG/BC ineffective(#14)), DLHE(LUCF-+)

Appendix 11. Trajectory of HDI, KAYA Components and GHG (Myanmar)

Figure 71. Trajectory of HDI components (Myanmar)

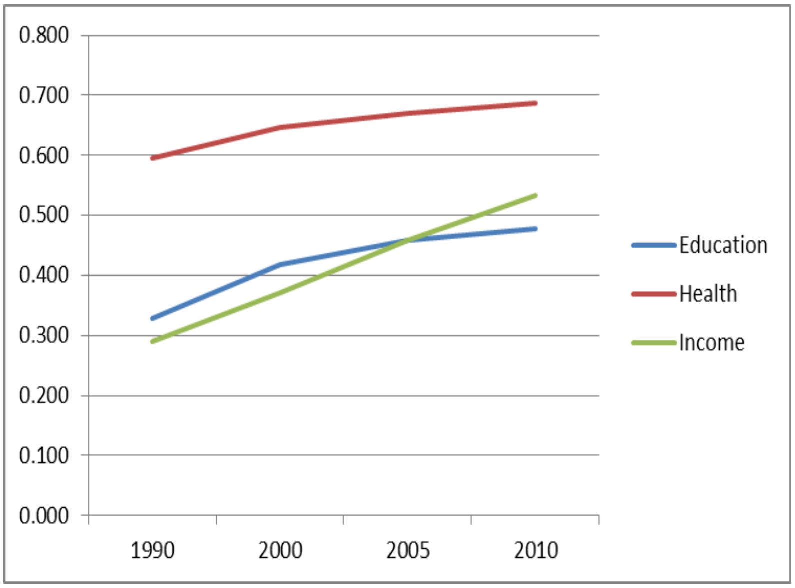


Figure 72. Trajectory of Increased ratio of HDI components (Myanmar)

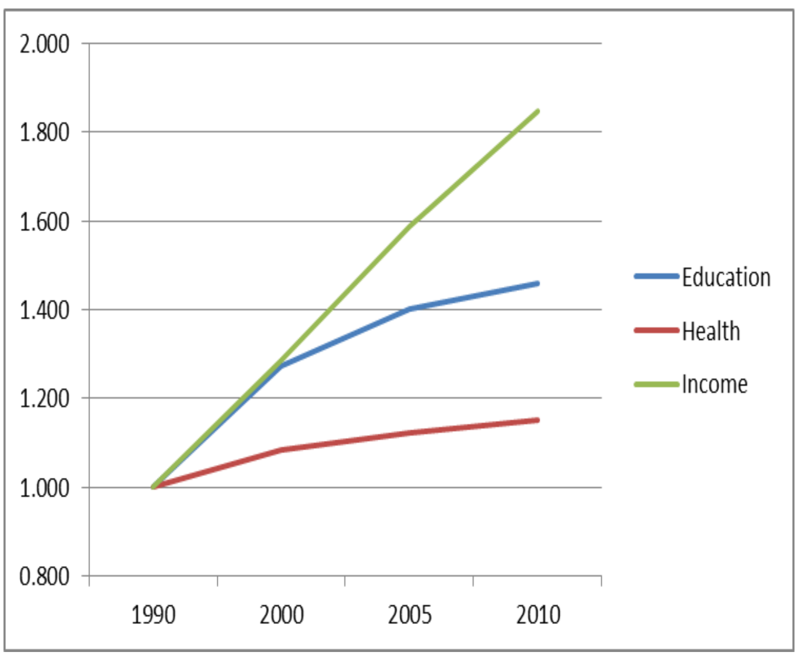


Figure 73. Trajectory of Modified KAYA components for Myanmar

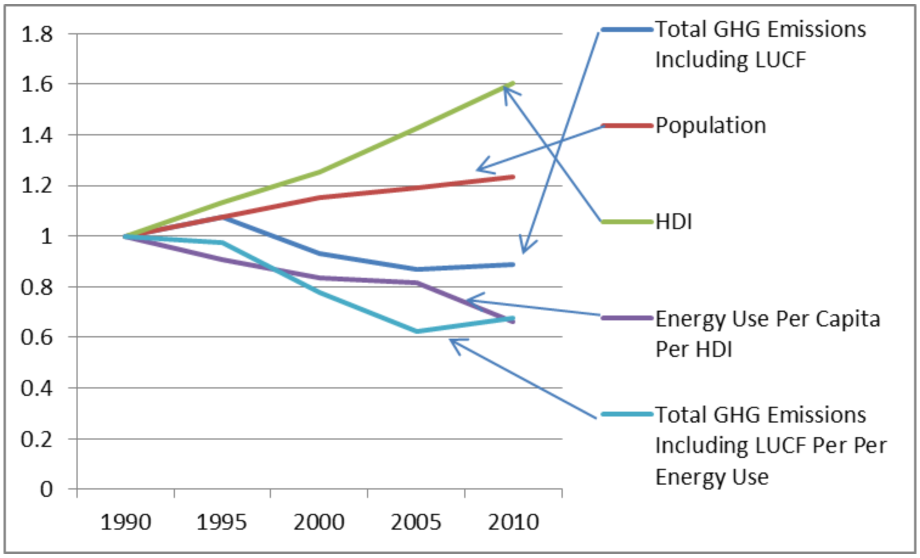


Figure 74. Trajectory of Modified KAYA components per capita (equation #7) for Myanmar

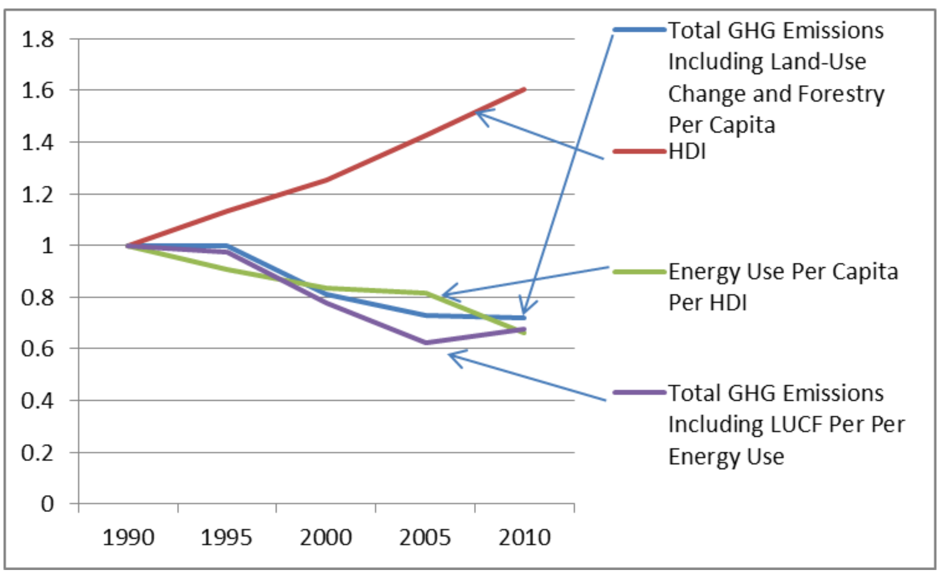


Figure 75. Trajectory of GHGs (Myanmar)

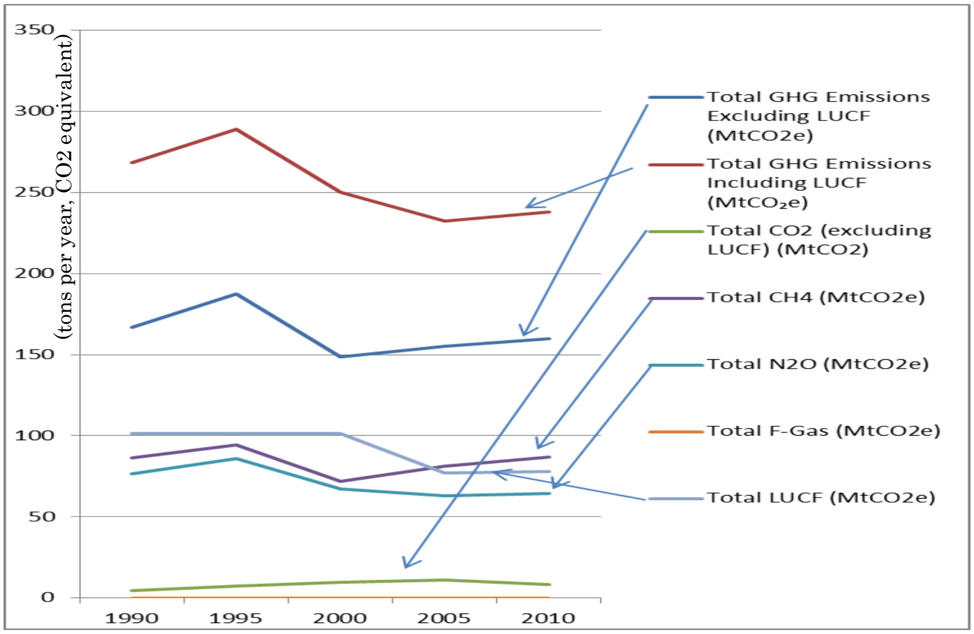


Figure 76. Trajectory of each GHG ratio (Myanmar)

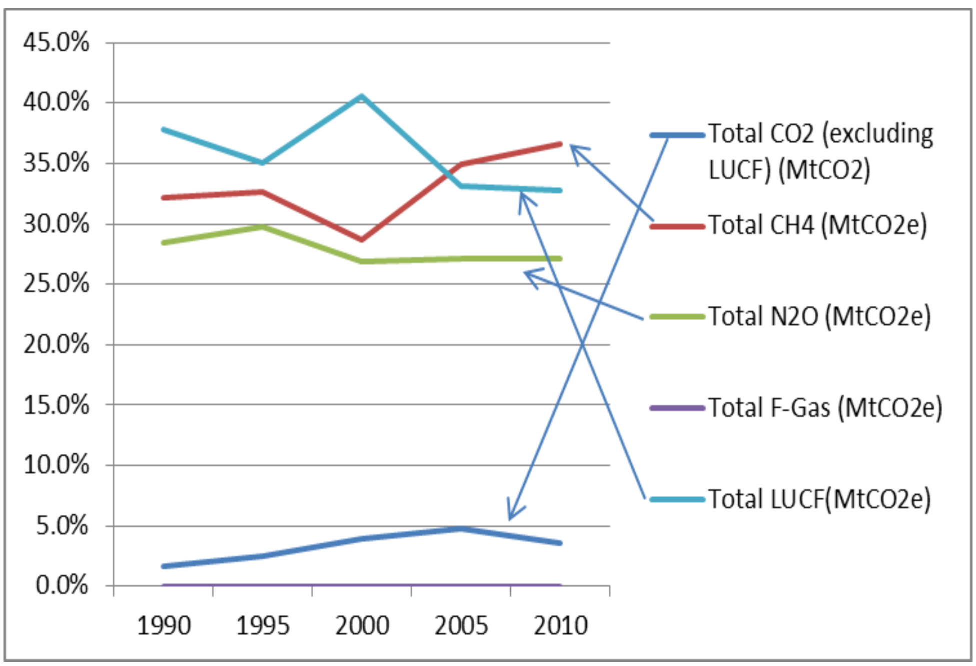


Figure 77. Trajectory of GHG emissions by sources (Myanmar)

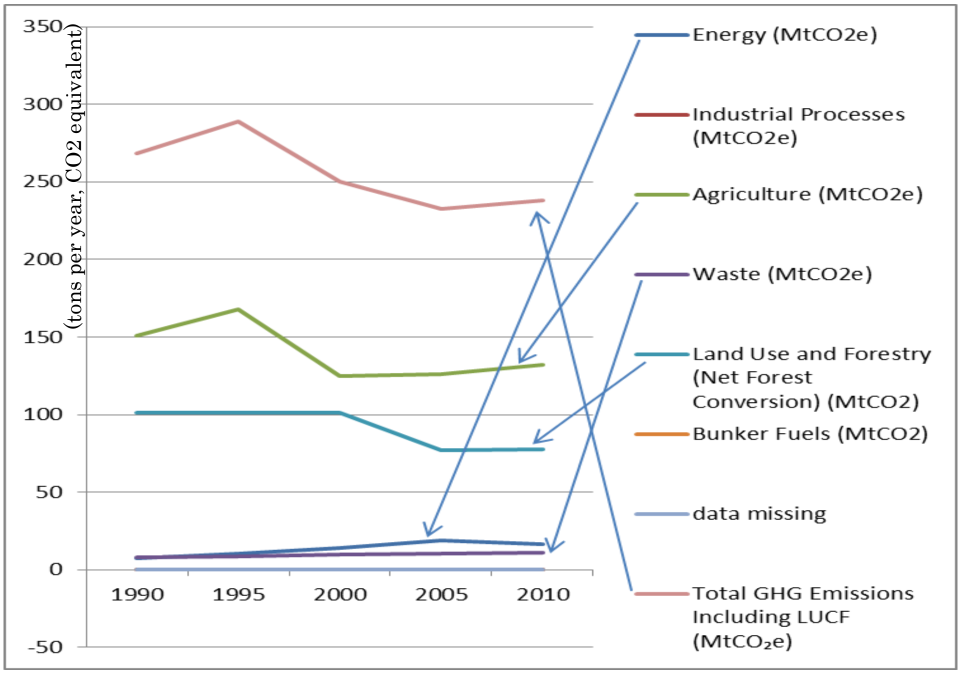
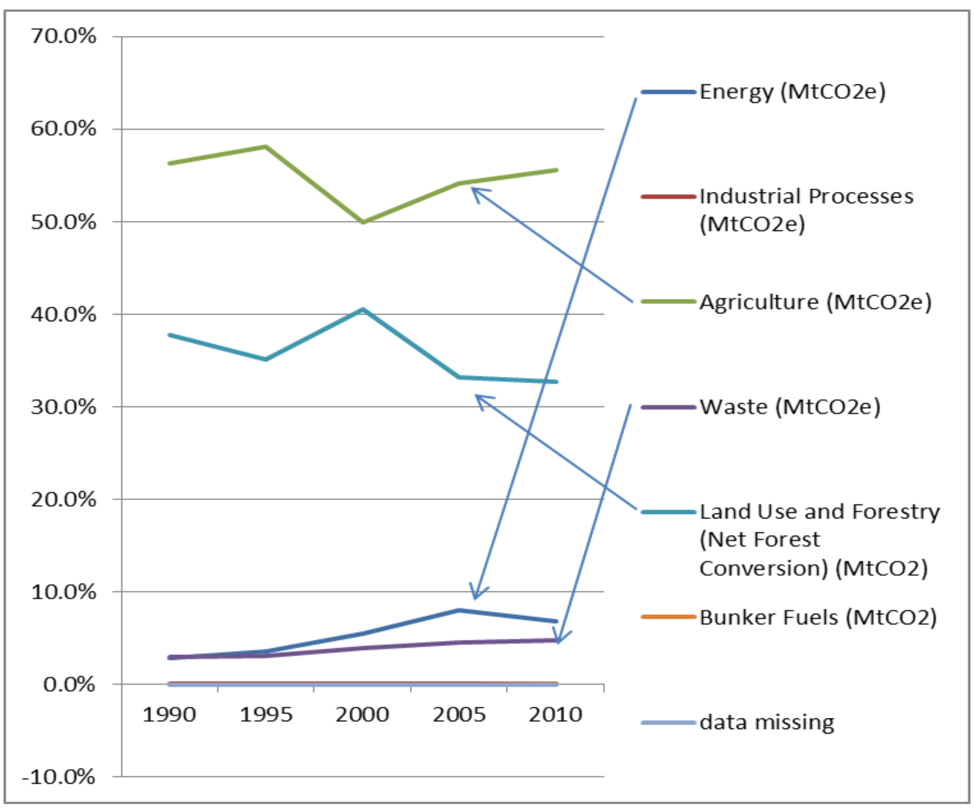


Figure 78. Trajectory of Ratio of GHG emissions by sources (Myanmar)



Appendix 12. Trajectory of HDI, KAYA Components and GHG (Nepal)

Figure 79. Trajectory of HDI components (Nepal)

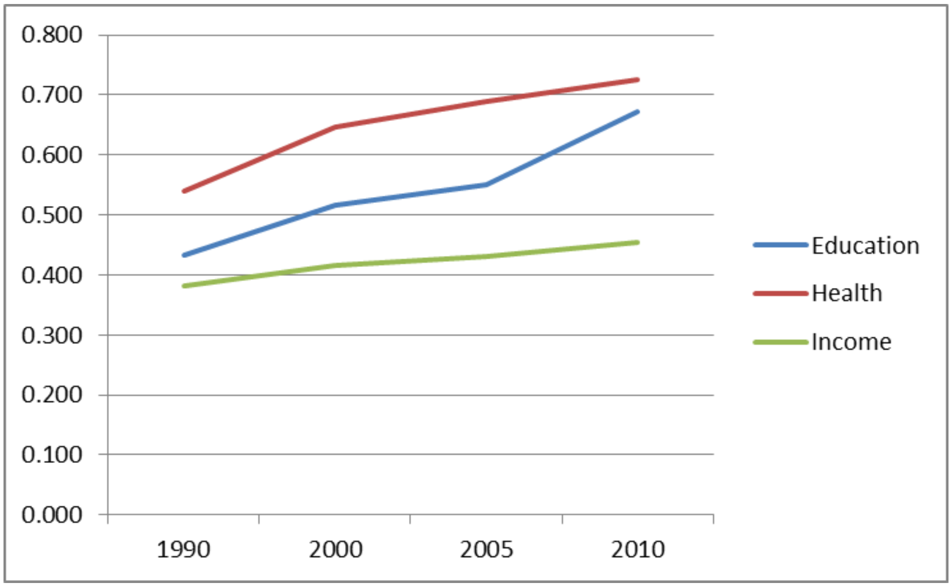


Figure 80. Trajectory of Increased ratio of HDI components (Nepal)

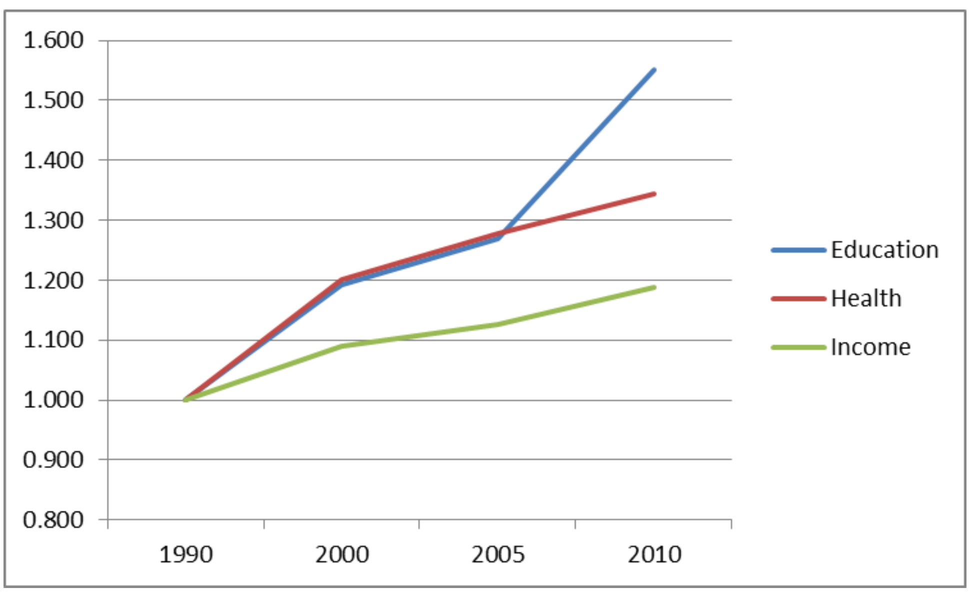


Figure 81. Trajectory of Modified KAYA components for Nepal

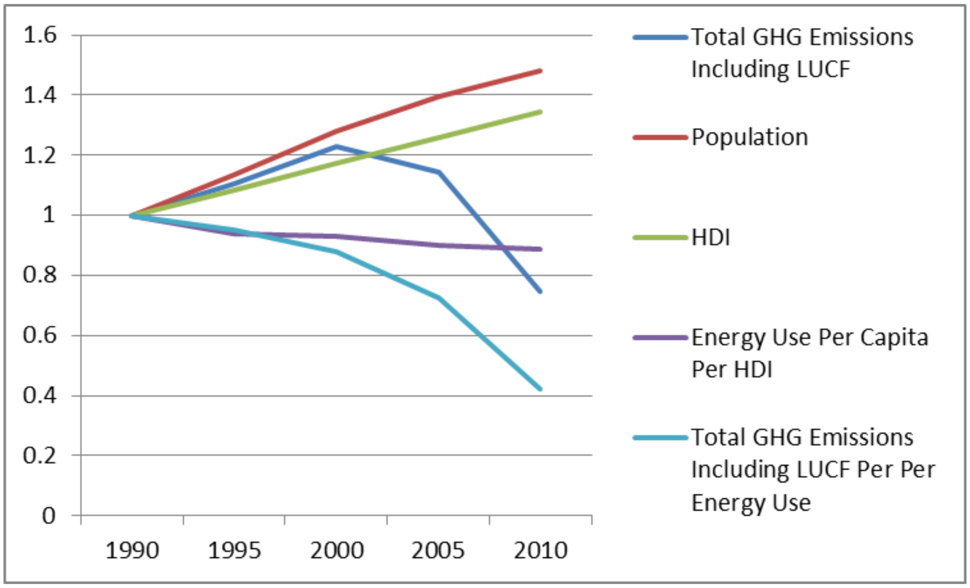


Figure 82. Trajectory of Modified KAYA components per capita (equation #7) for Nepal

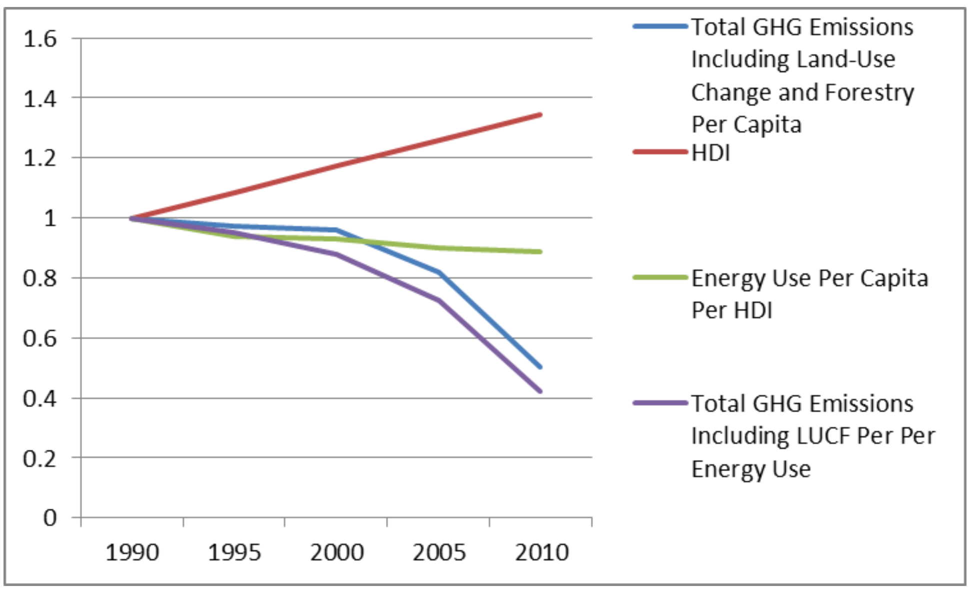


Figure 83. Trajectory of Modified KAYA components for Nepal (excluding LUCF)

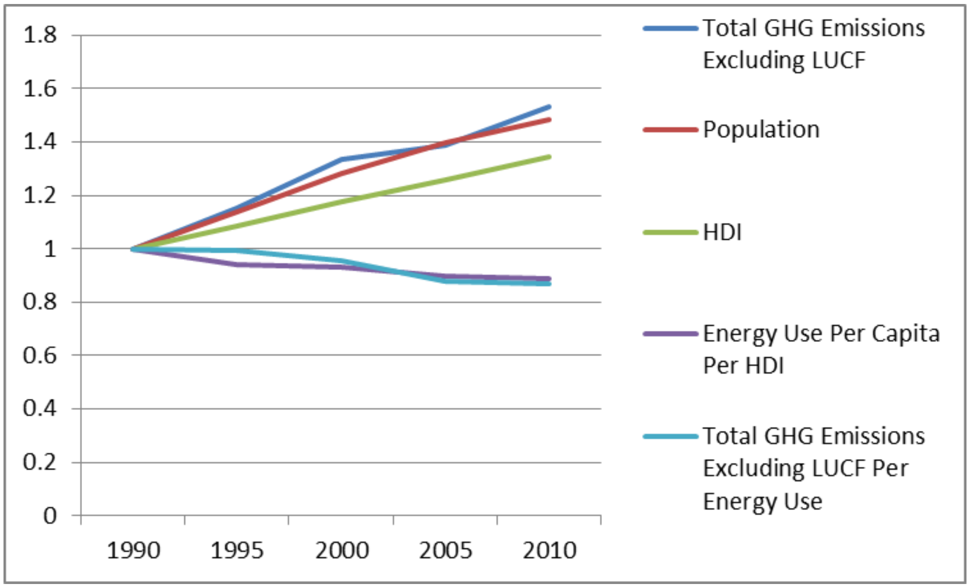


Figure 84. Trajectory of Modified KAYA components per capita (equation #7) for Nepal (excluding LUCF)

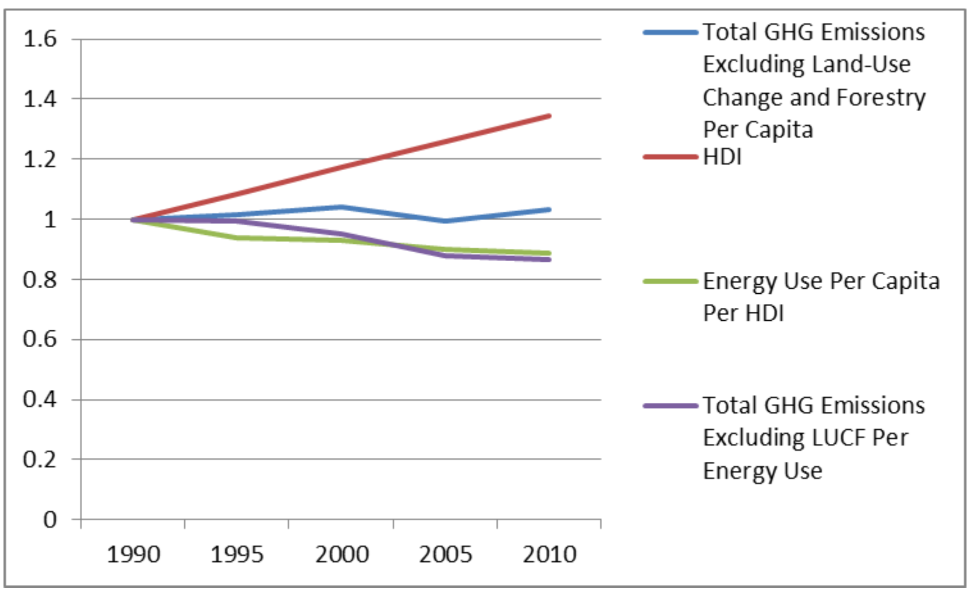


Figure 85. Trajectory of GHGs (Nepal)

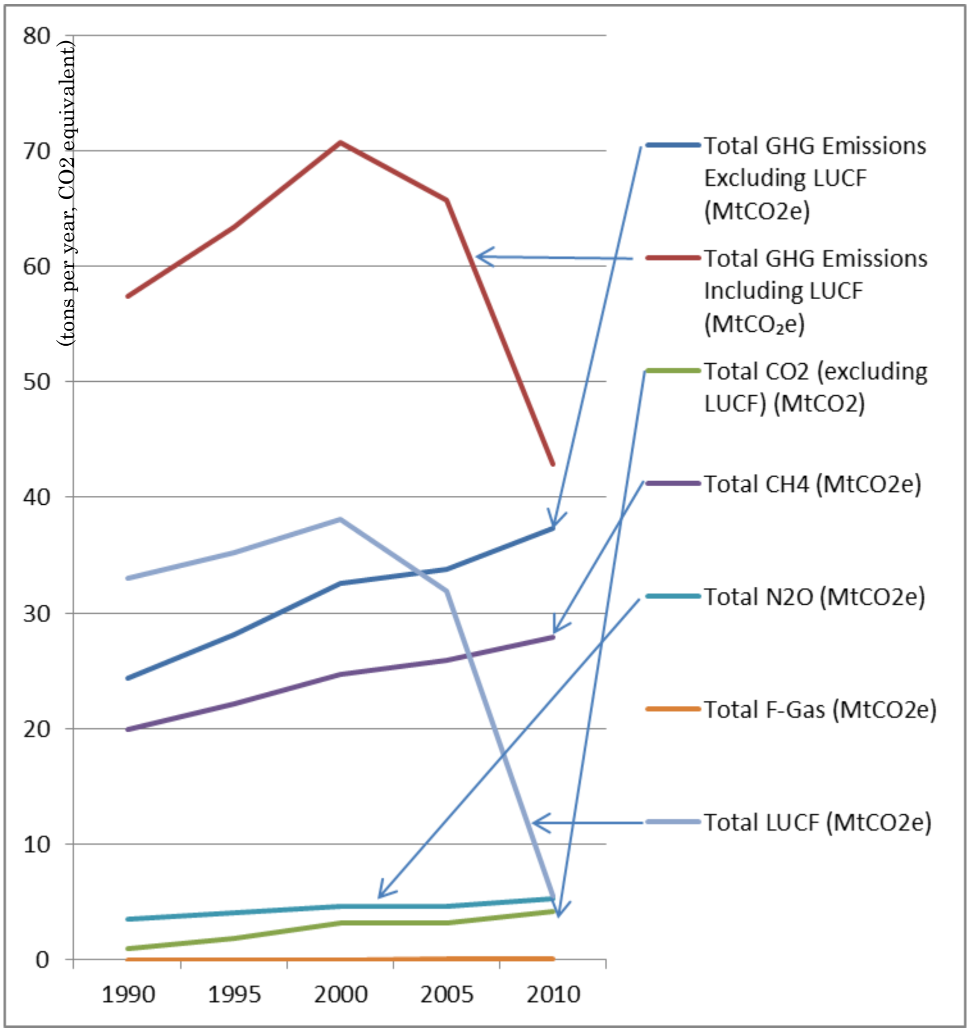


Figure 86. Trajectory of each GHG ratio (Nepal)

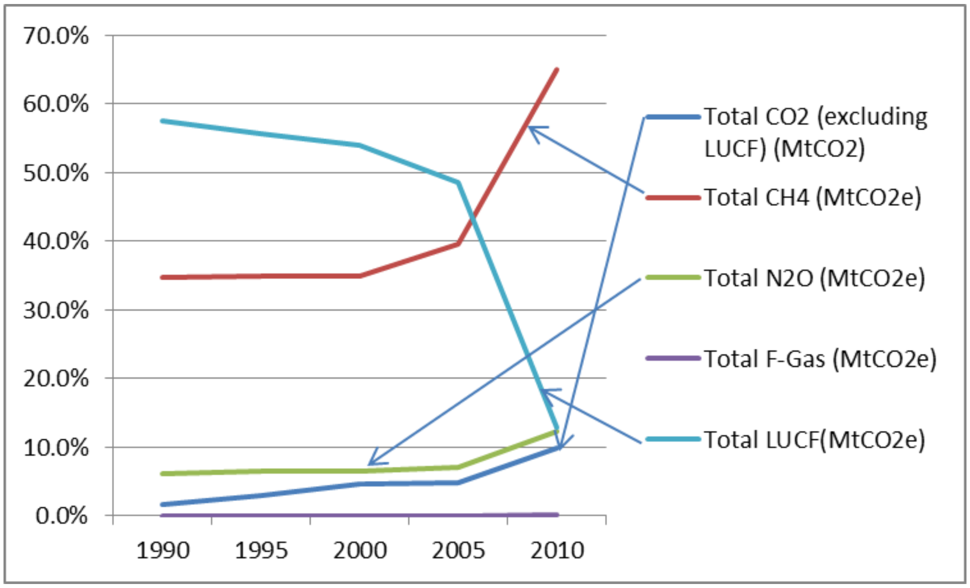


Figure 87. Trajectory of GHG emissions by sources (Nepal)

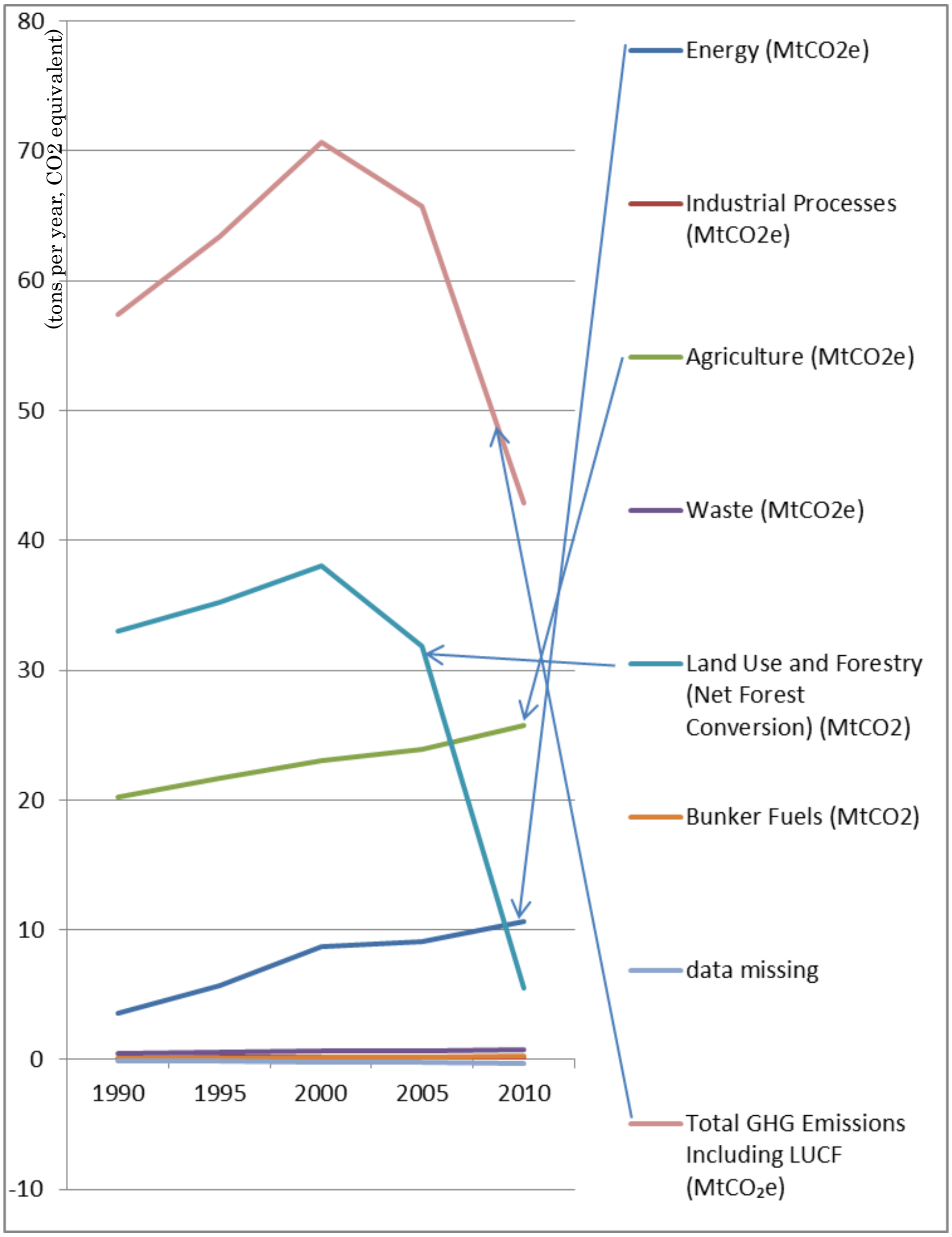


Figure 88. Trajectory of Ratio of GHG emissions by sources (Nepal)

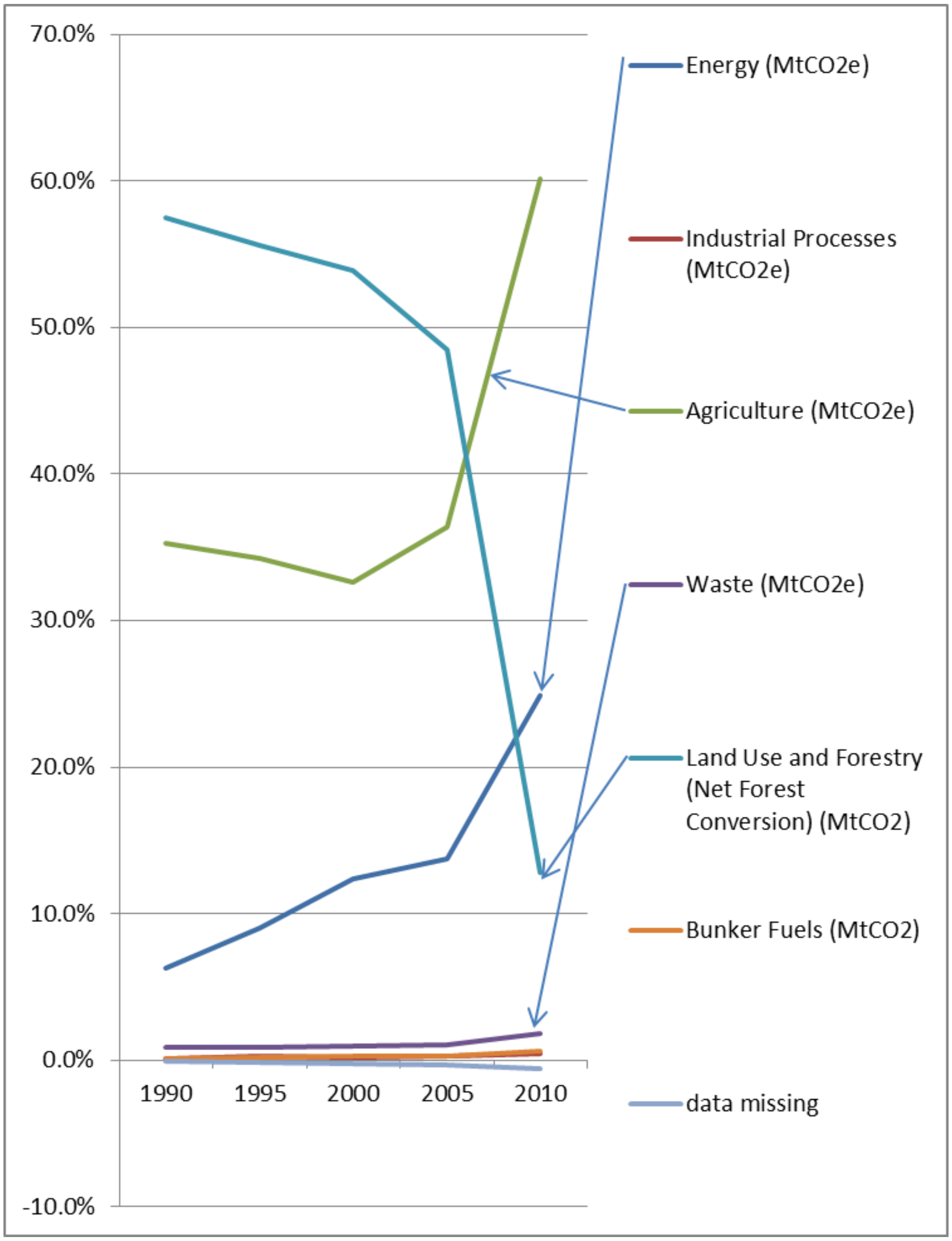
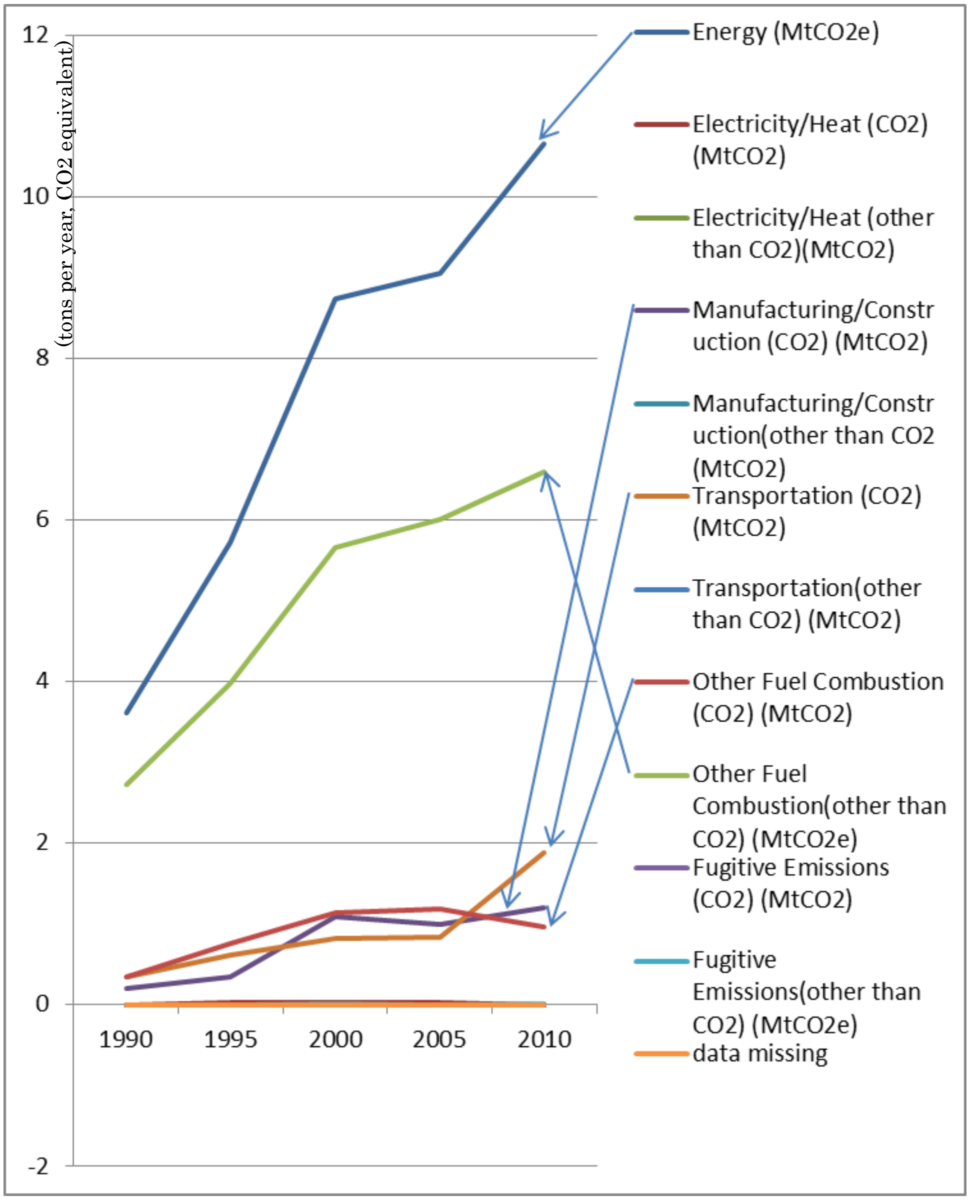


Figure 89. Trajectory of GHG emissions from energy sector by sources (Nepal)



Appendix 13. Trajectory of KAYA Components and GHG (Mongolia)

Figure 90. Trajectory of GHGs (Mongolia)

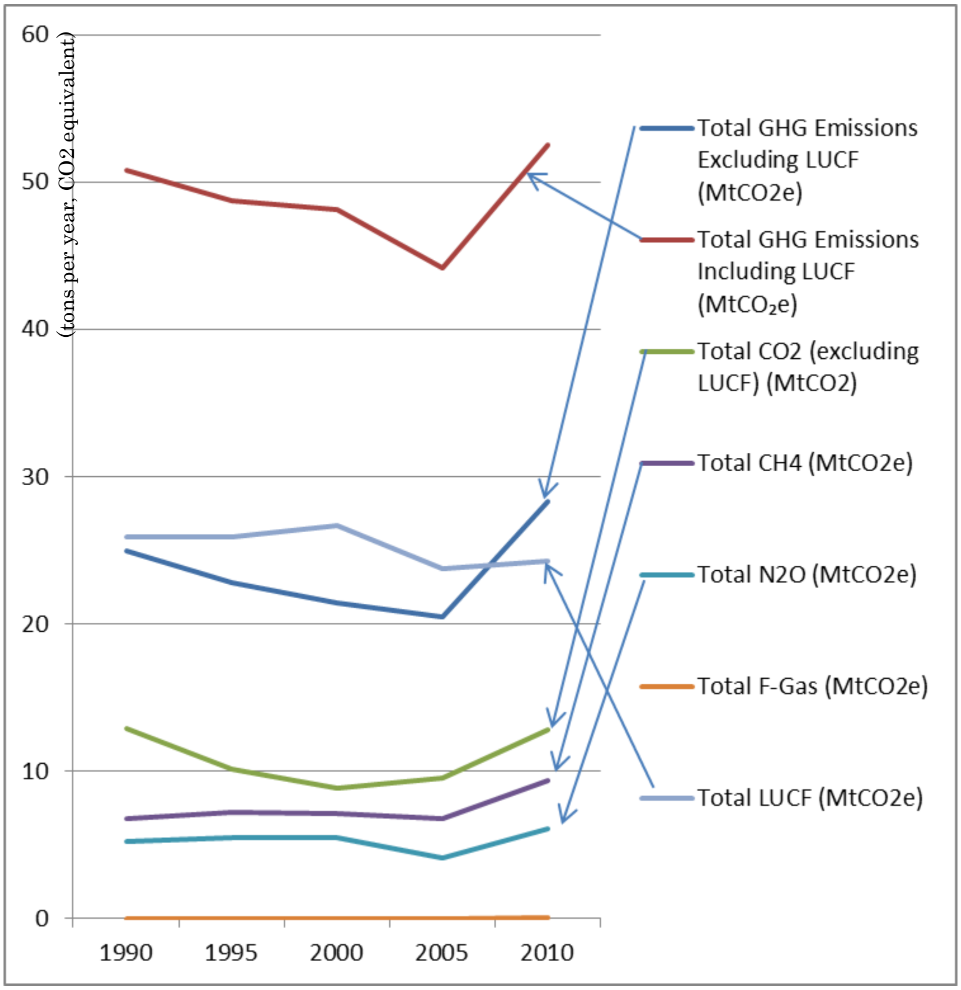


Figure 91. Trajectory of each GHG ratio (Mongolia)

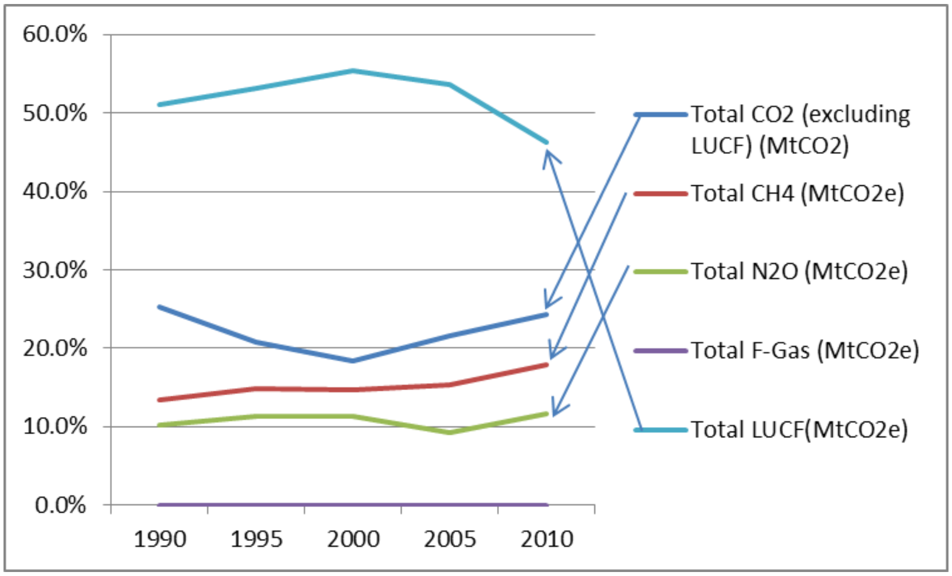


Figure 92. Trajectory of GHG emissions by sources (Mongolia)

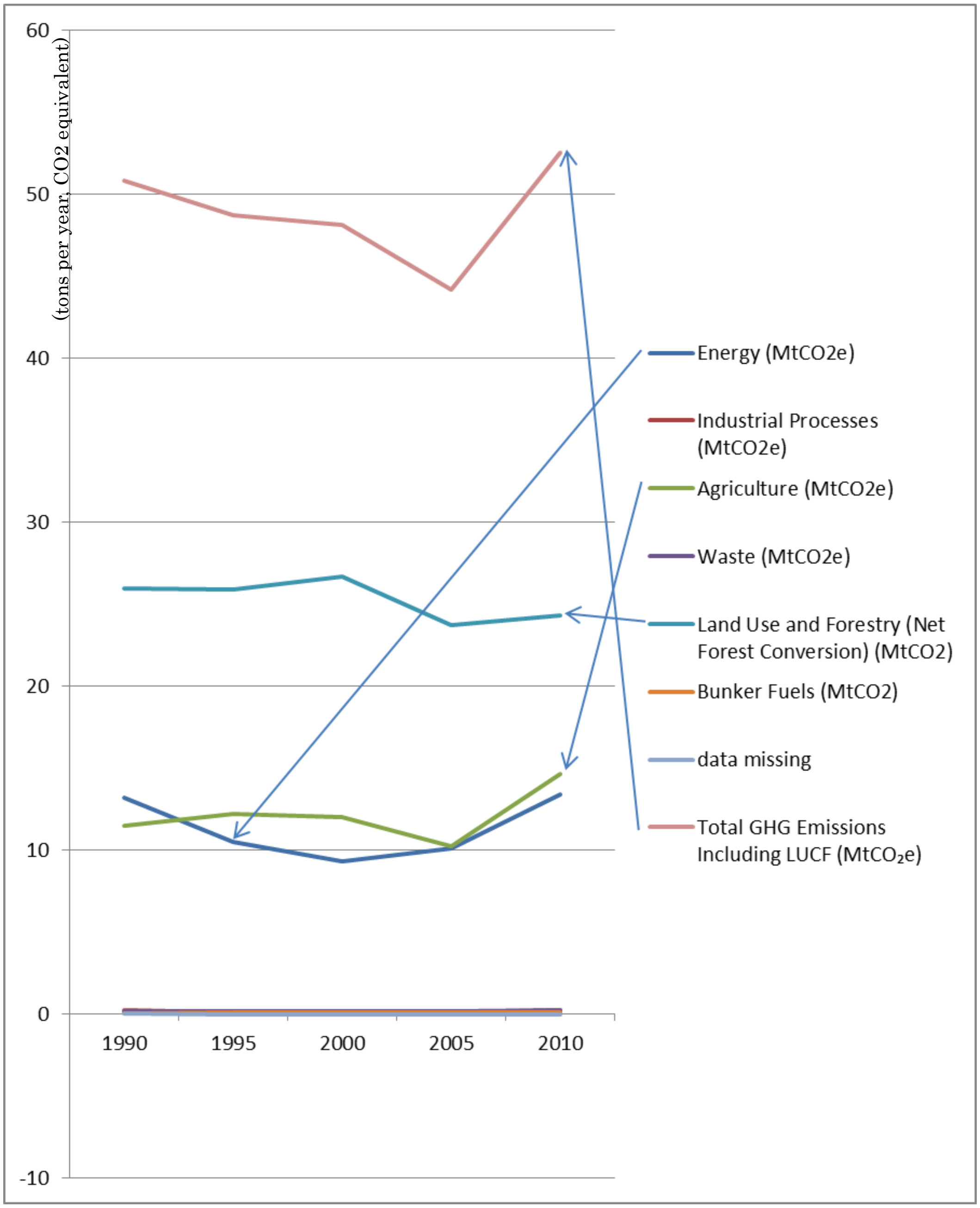


Figure 93. Trajectory of Ratio of GHG emissions by sources (Mongolia)

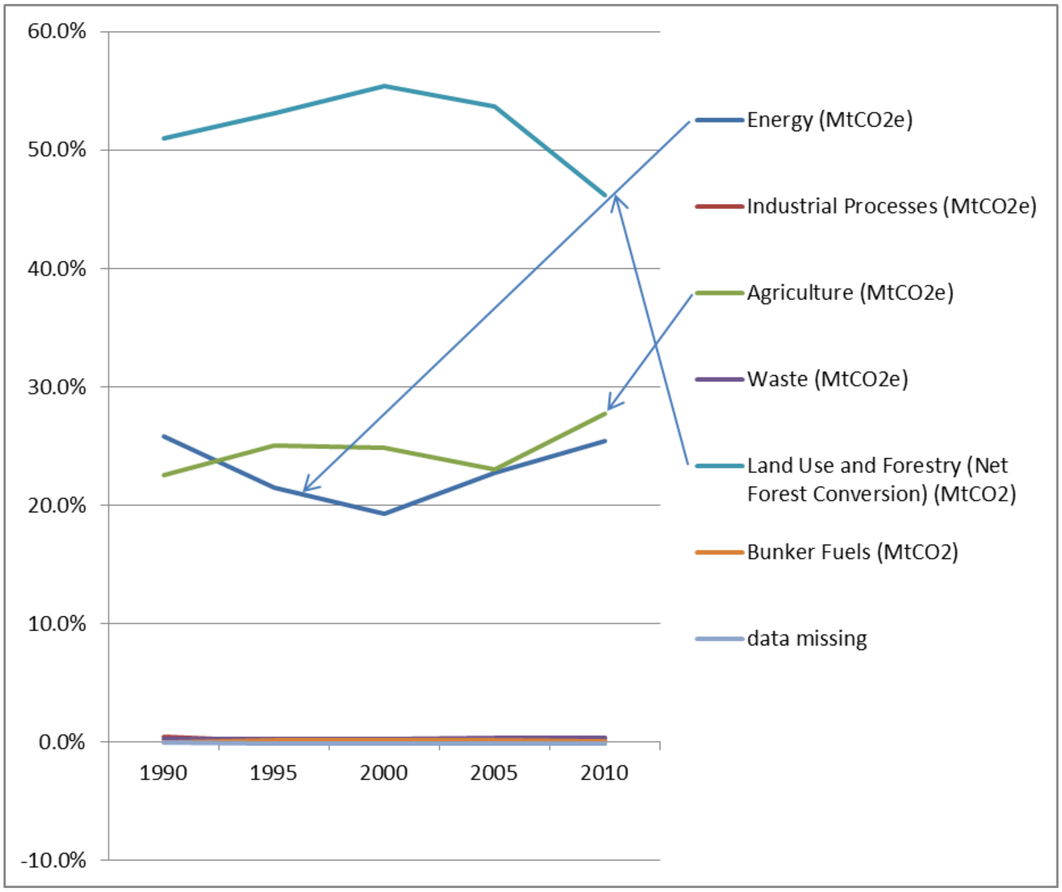


Figure 94. Trajectory of GHG emissions from energy sector by sources (Mongolia)

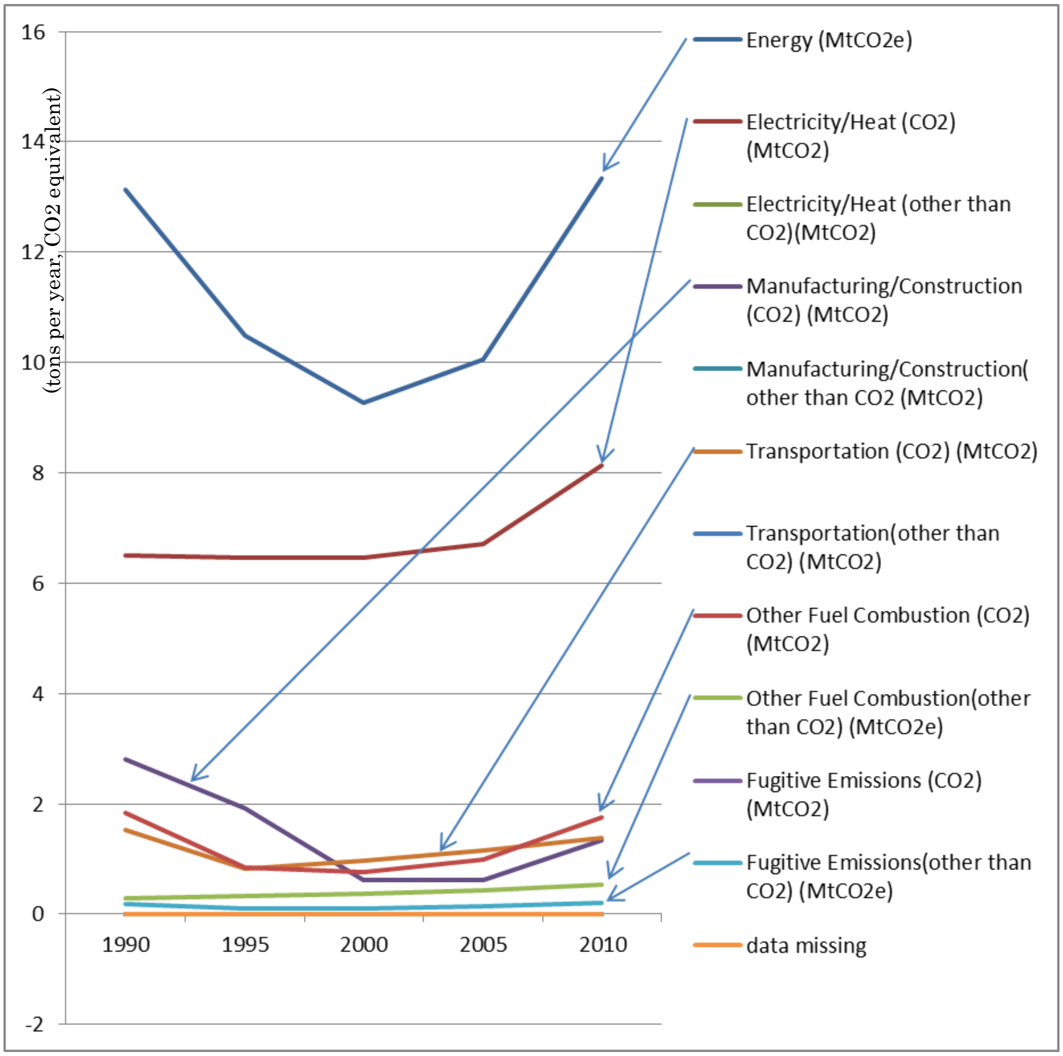


Figure 95. Trajectory of Ratio of GHG emissions from energy sector by sources (Mongolia)

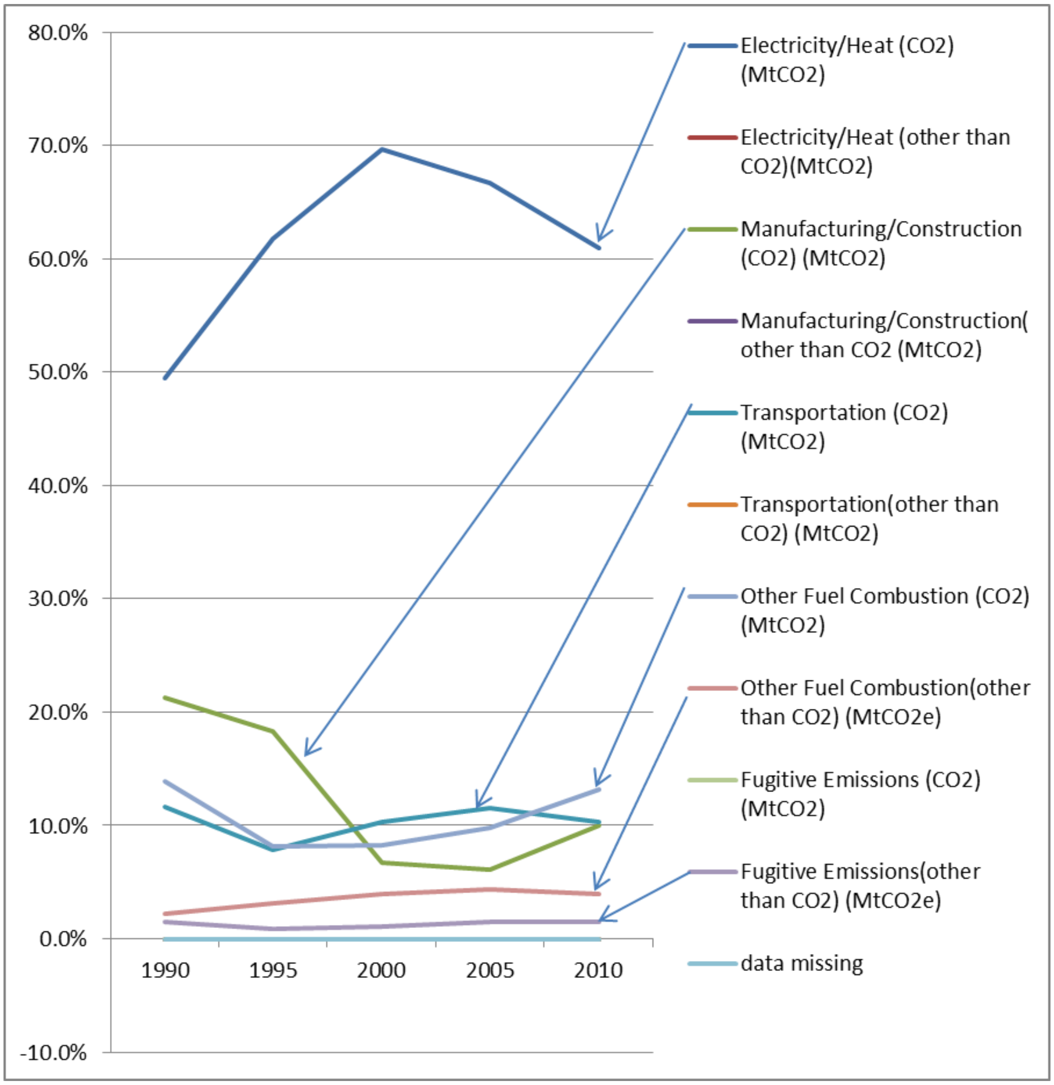


Figure 96. Trajectory of Modified KAYA components for Mongolia

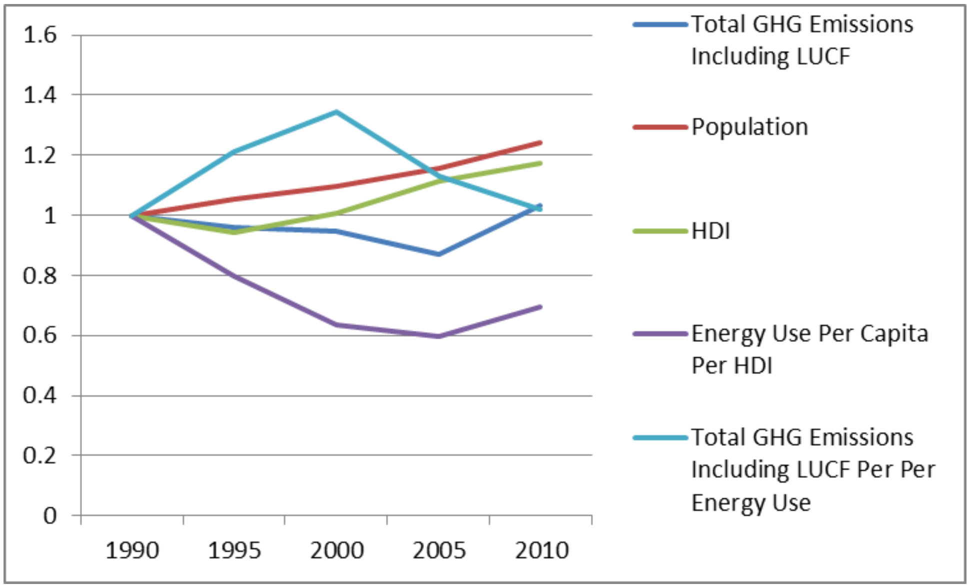
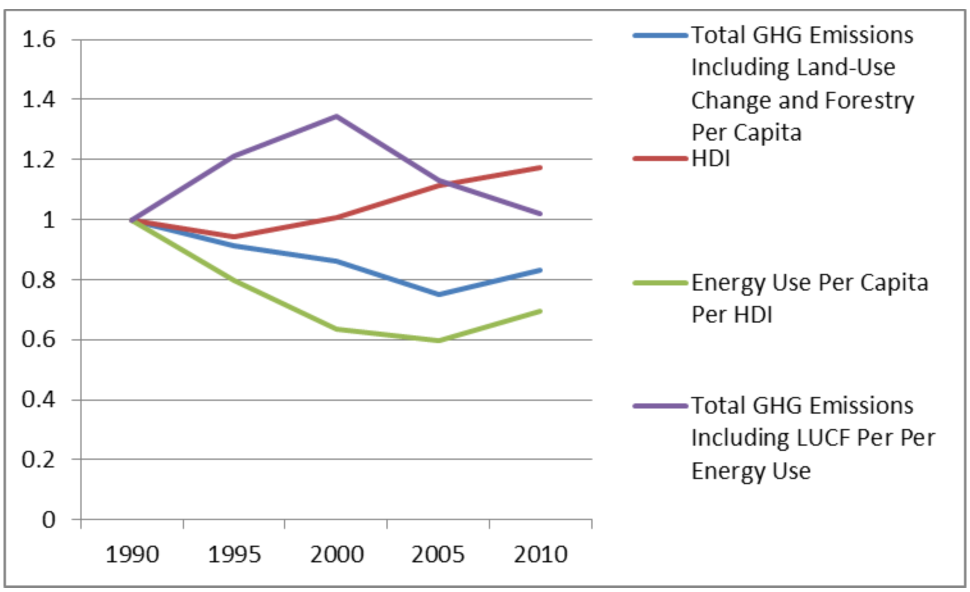


Figure 97. Trajectory of Modified KAYA components per capita (equation #7) for Mongolia



Appendix 14. Trajectory of HDI, KAYA Components and GHG (Bangladesh)

Figure 98. Trajectory of HDI components (Bangladesh)

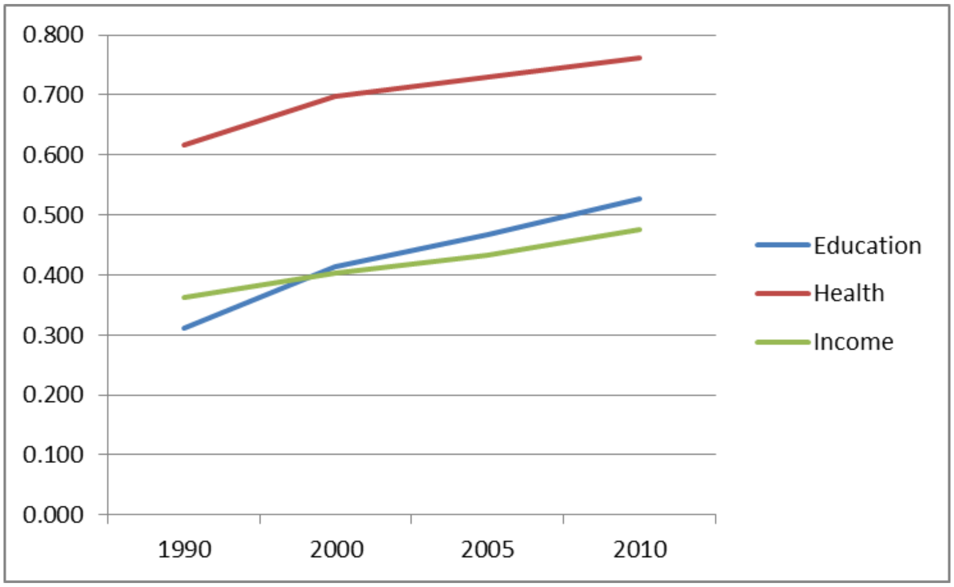


Figure 99. Trajectory of Increased ratio of HDI components (Bangladesh)

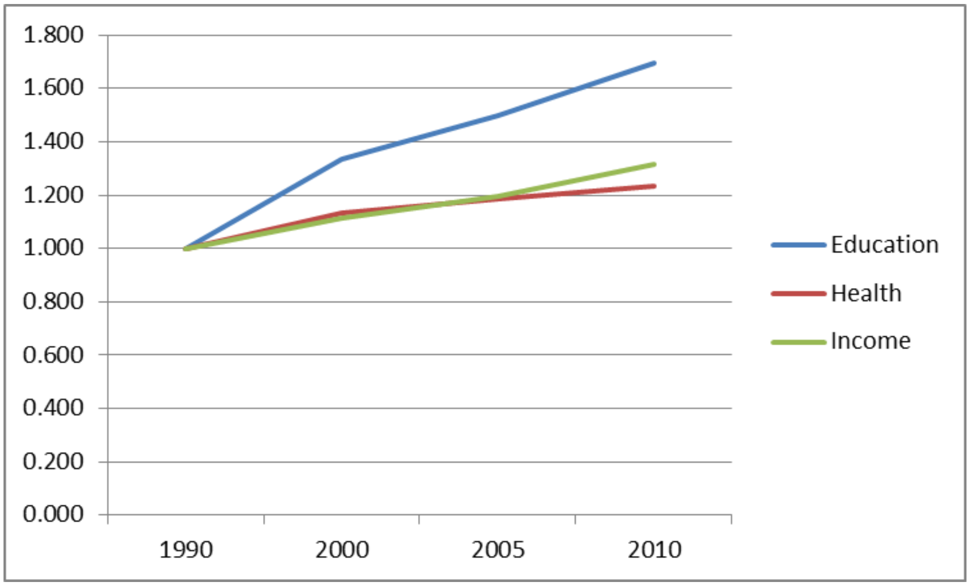


Figure 100. Trajectory of Modified KAYA components for Bangladesh

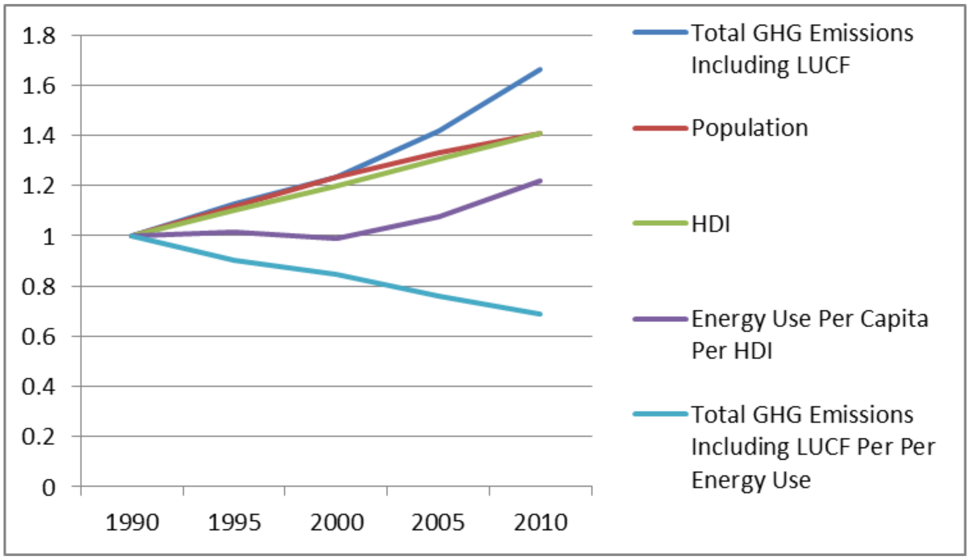


Figure 101. Trajectory of Modified KAYA components per capita (equation #7) for Bangladesh

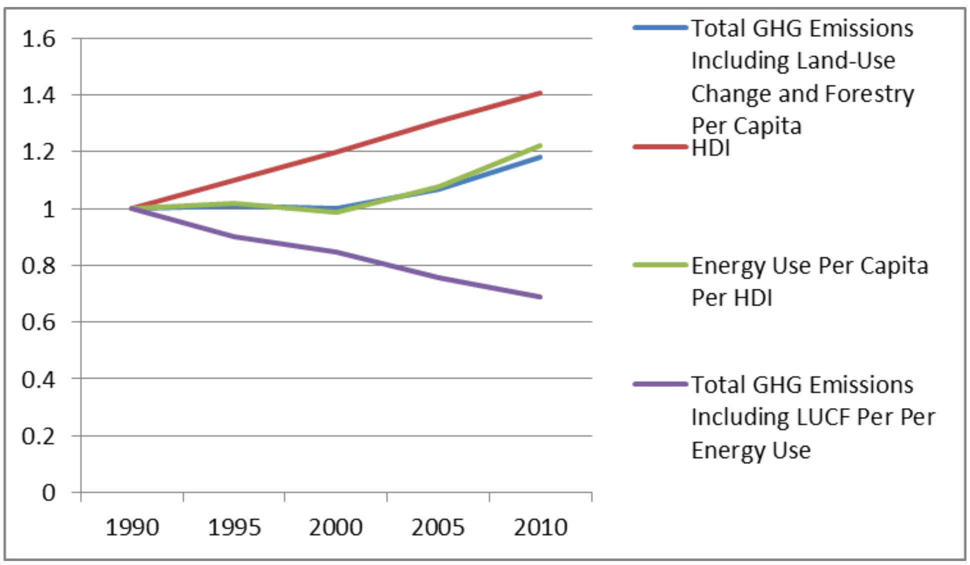


Figure 102. Trajectory of GHGs (Bangladesh)

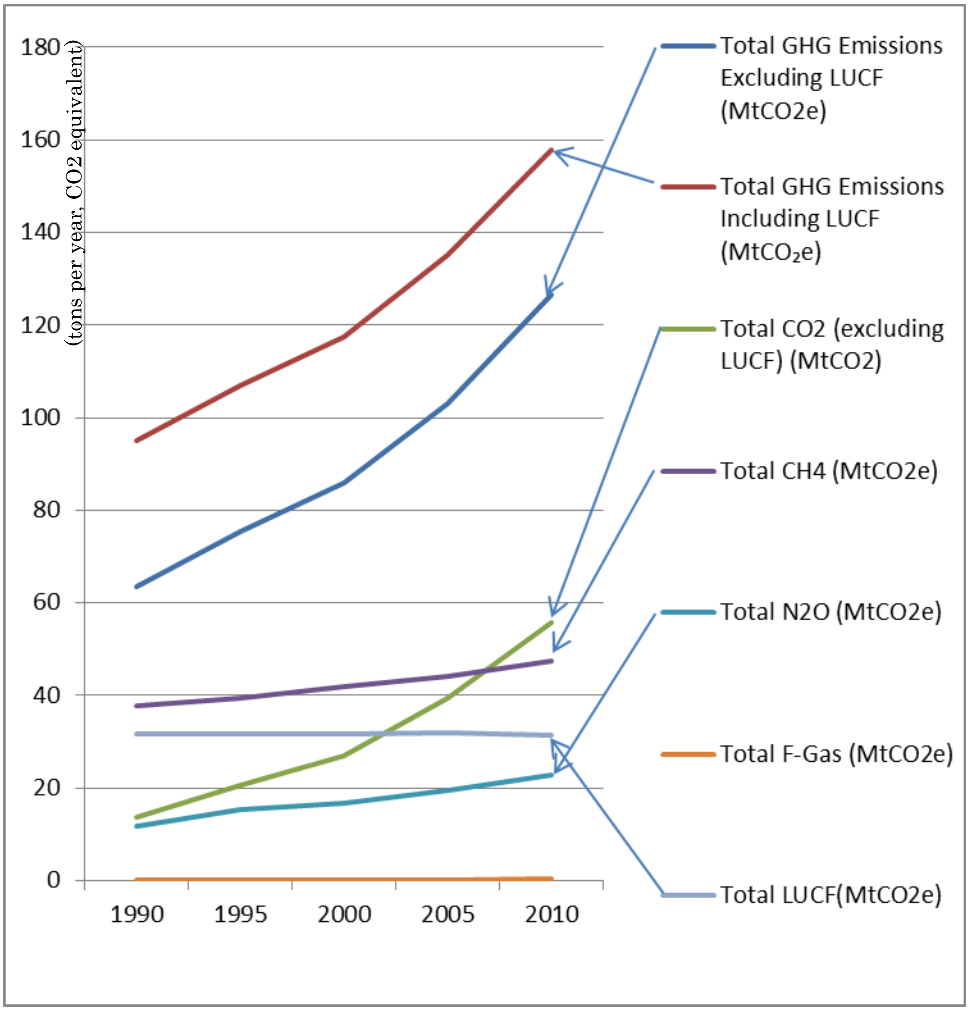


Figure 103. Trajectory of each GHG ratio (Bangladesh)

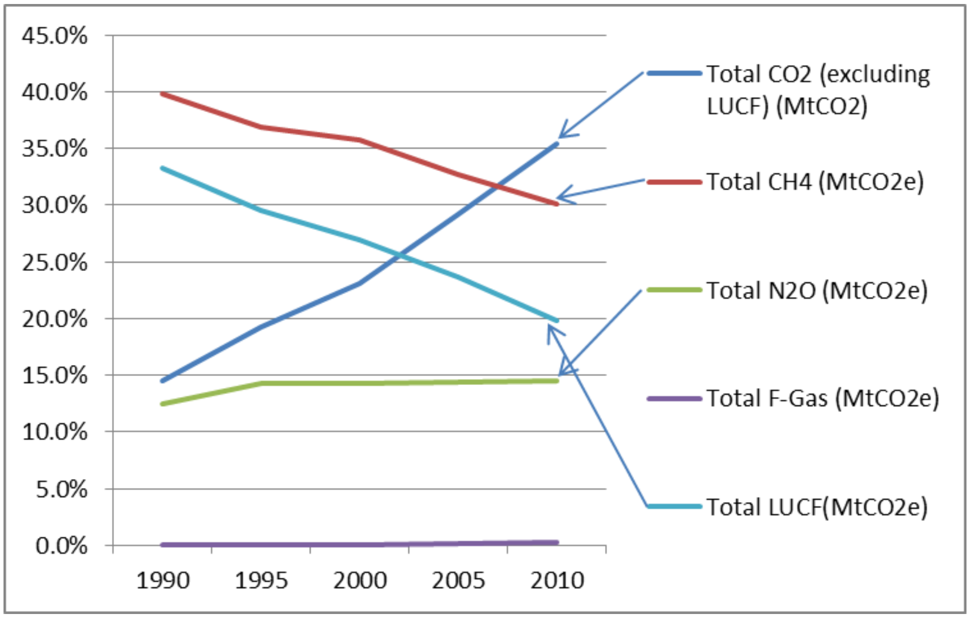


Figure 104. Trajectory of GHG emissions by sources (Bangladesh)

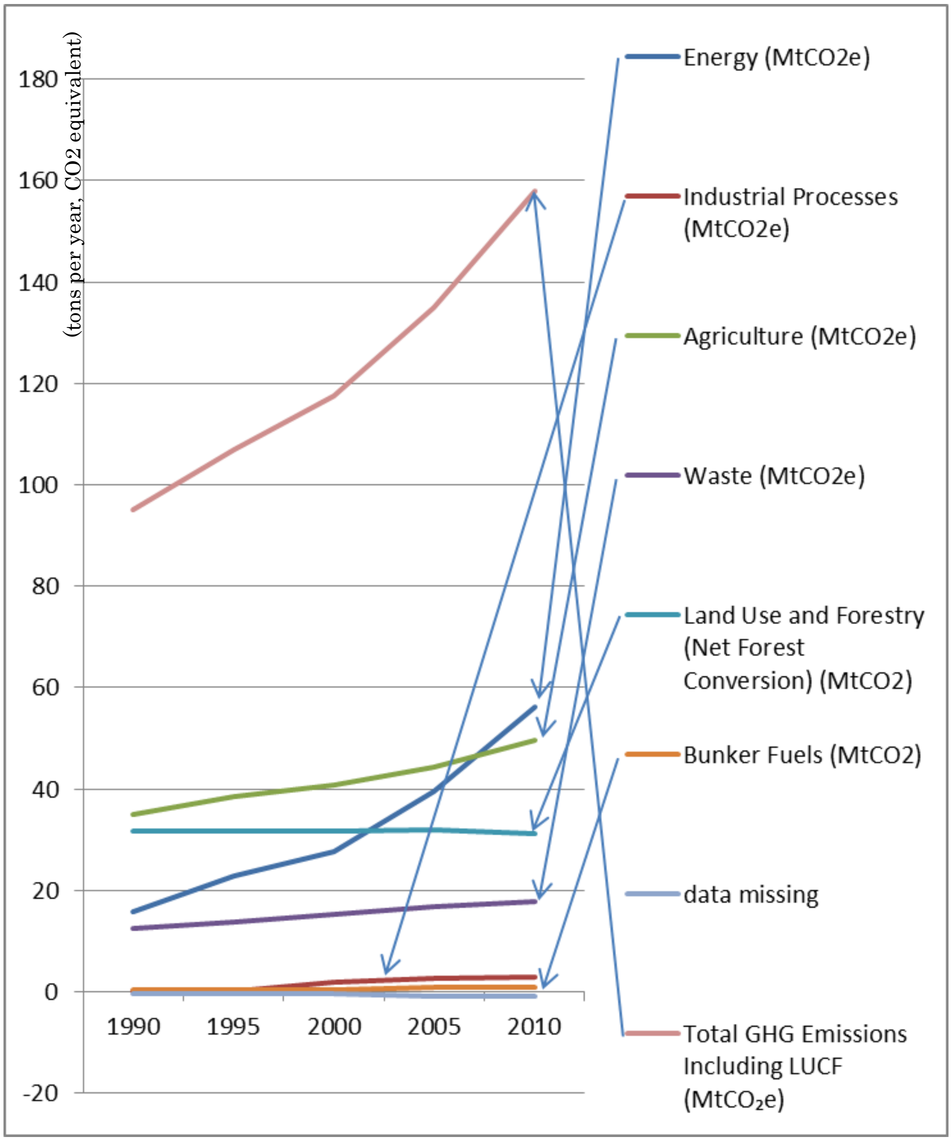
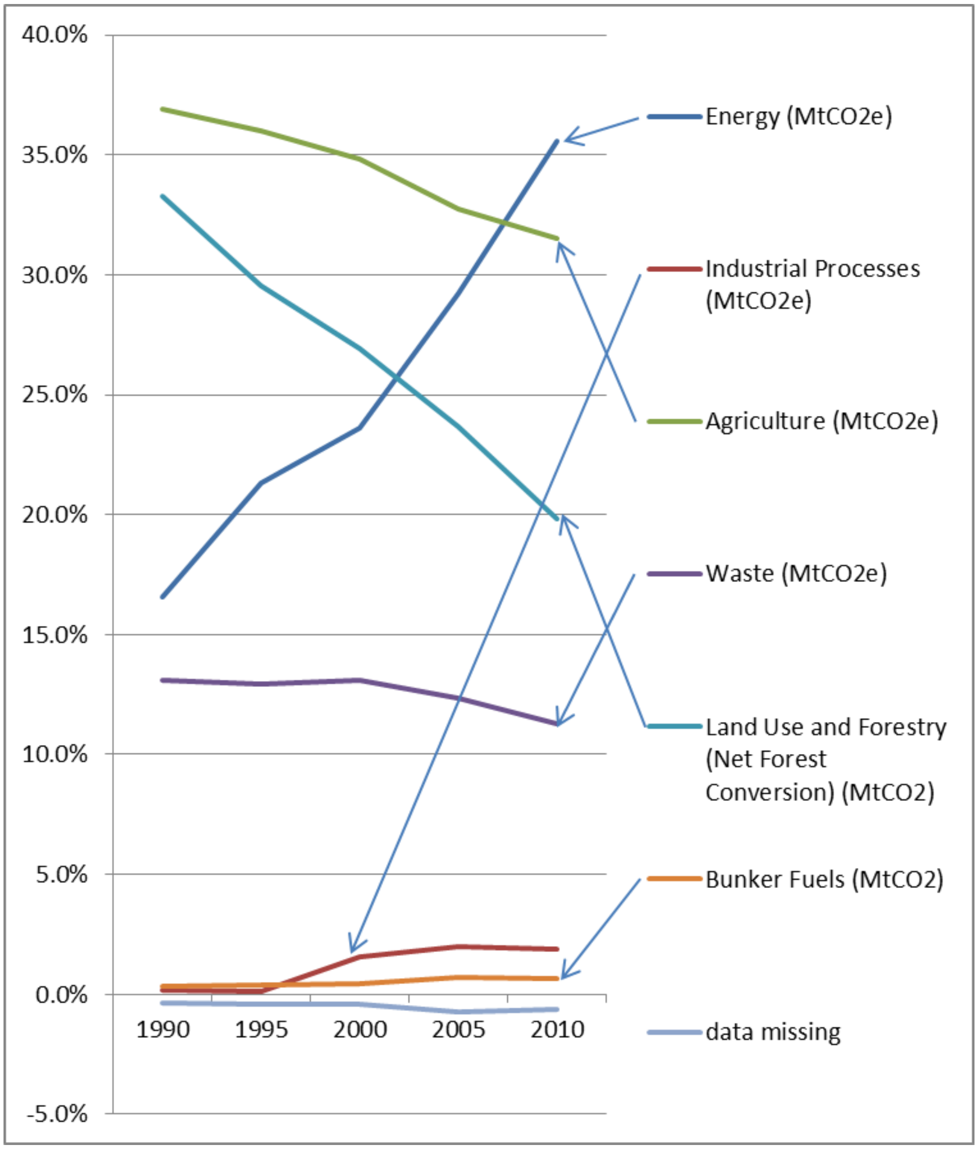


Figure 105. Trajectory of Ratio of GHG emissions from energy sector by sources (Bangladesh)



Appendix 15. Trajectory of KAYA Components and GHG (China (PRC))

Figure 106. Trajectory of Modified KAYA components for China (PRC)

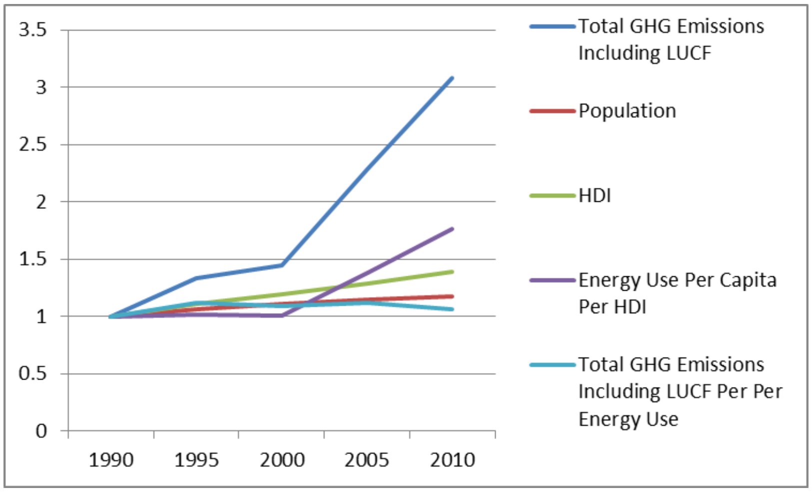


Figure 107. Trajectory of Modified KAYA components per capita (equation #7) for China (PRC)

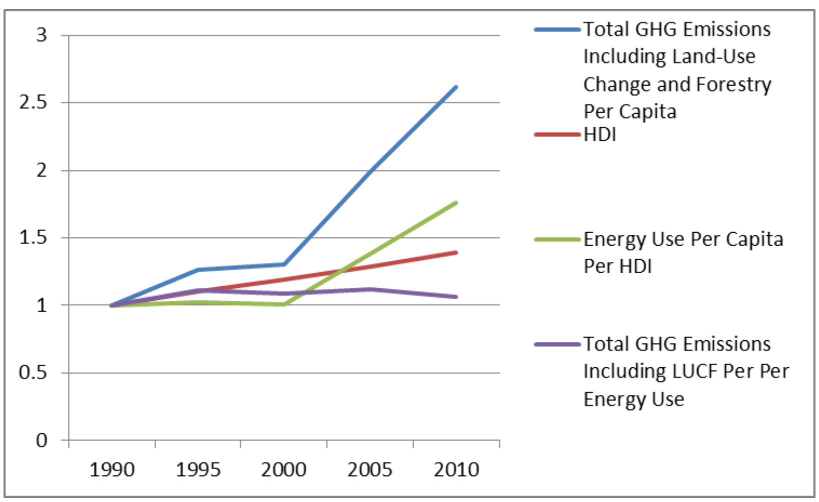


Figure 108. Trajectory of GHGs (China (PRC))

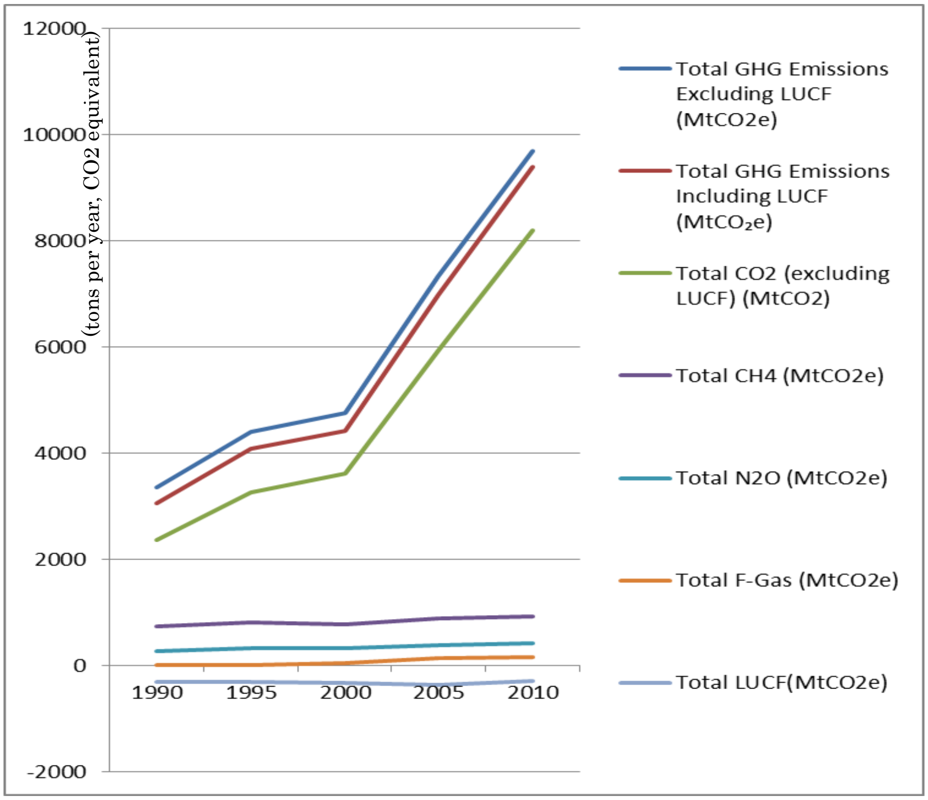


Figure 109. Trajectory of each GHG ratio (China (PRC))

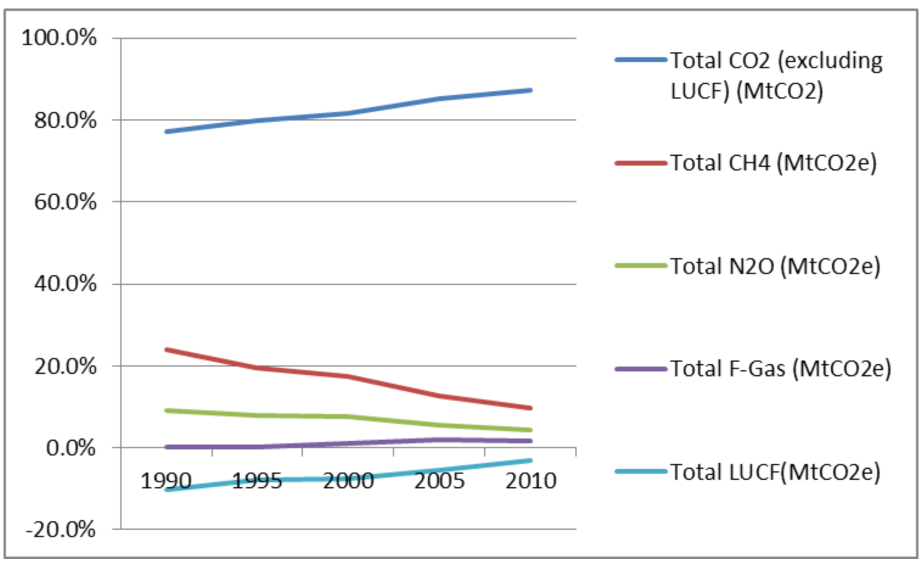


Figure 110. Trajectory of GHG emissions by sources (China (PRC))

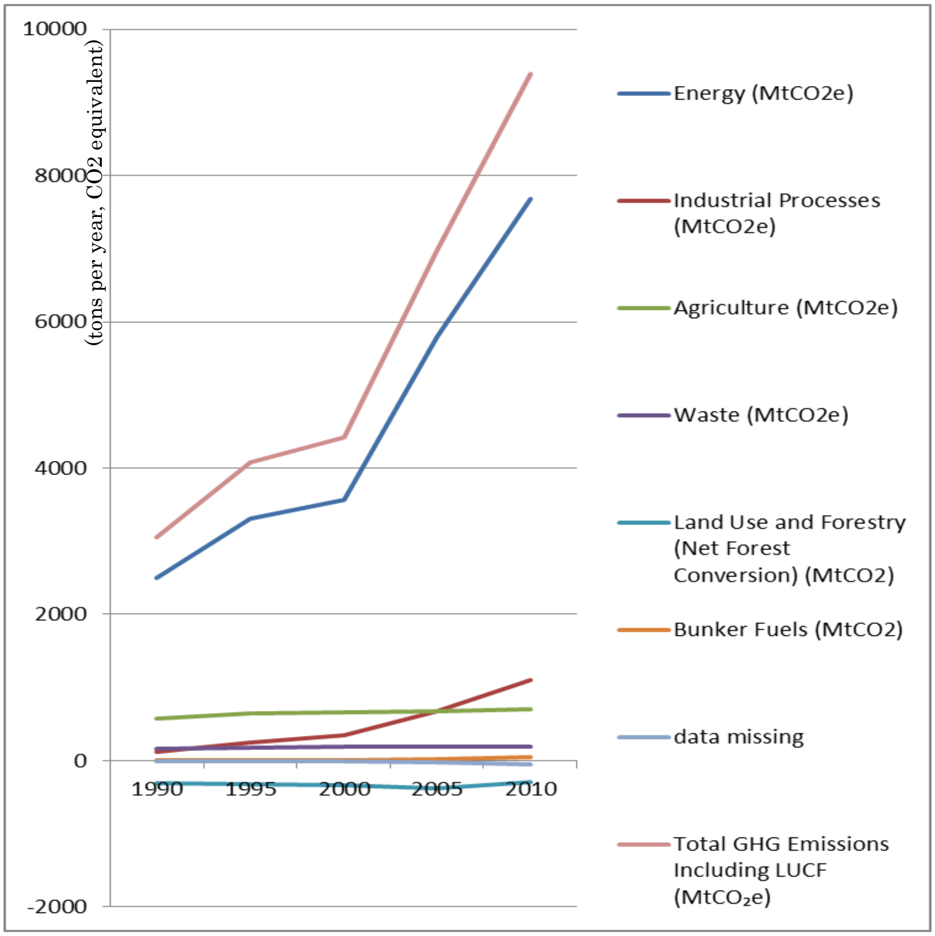


Figure 111. Trajectory of Ratio of GHG emissions by sources (China (PRC))

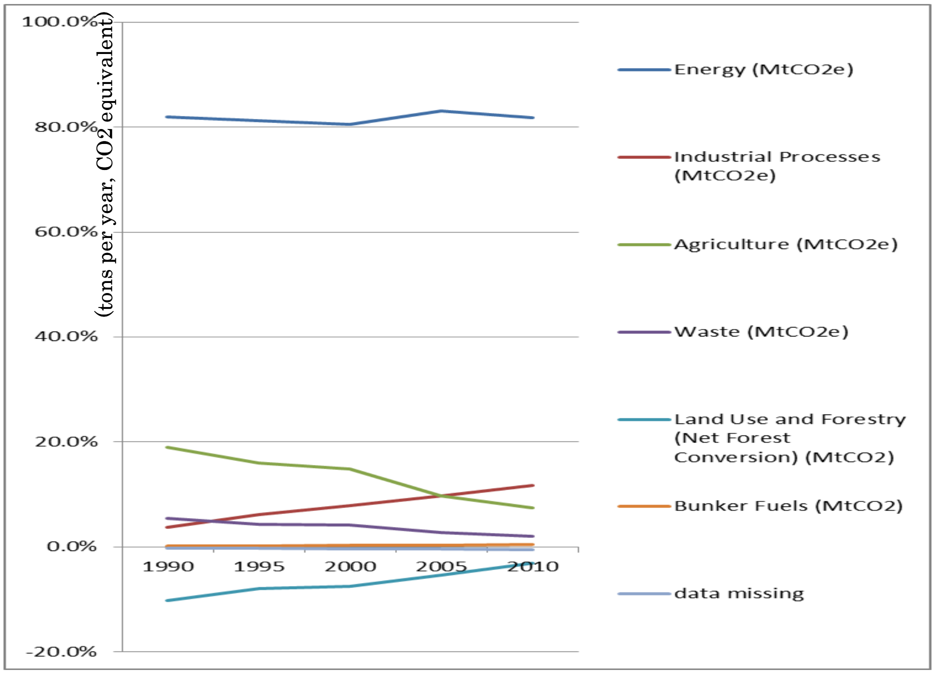


Figure 112. Trajectory of GHG emissions from energy sector by sources (China (PRC))

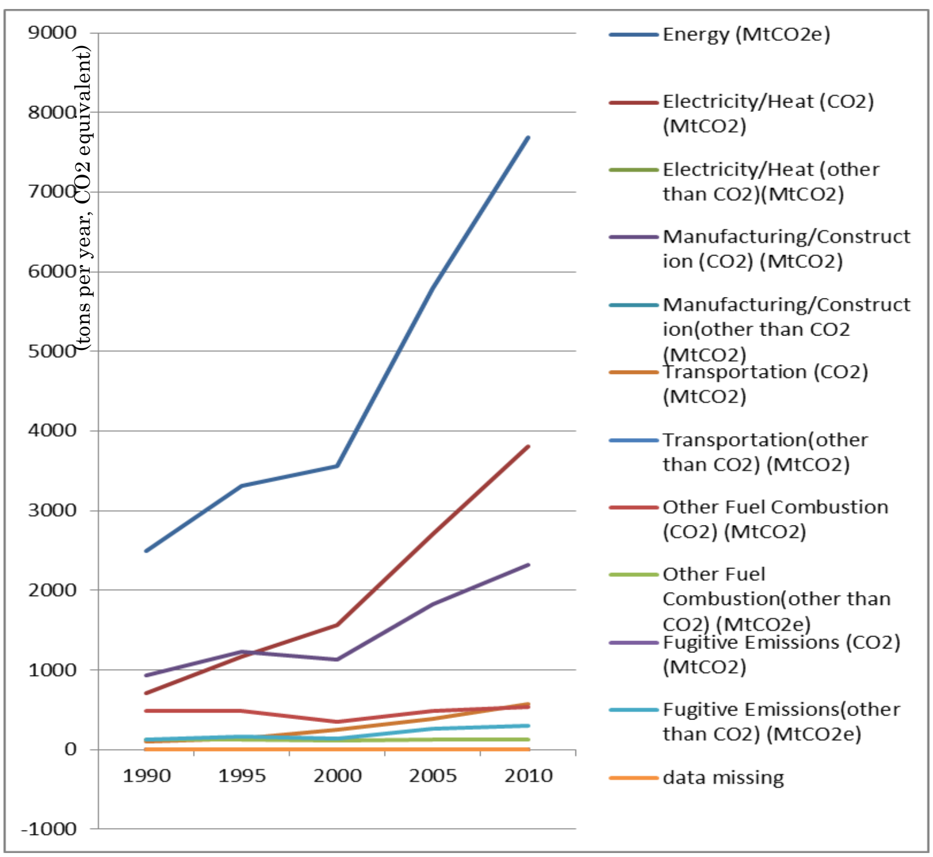


Figure 113. Trajectory of Ratio of GHG emissions from energy sector by sources (China (PRC))

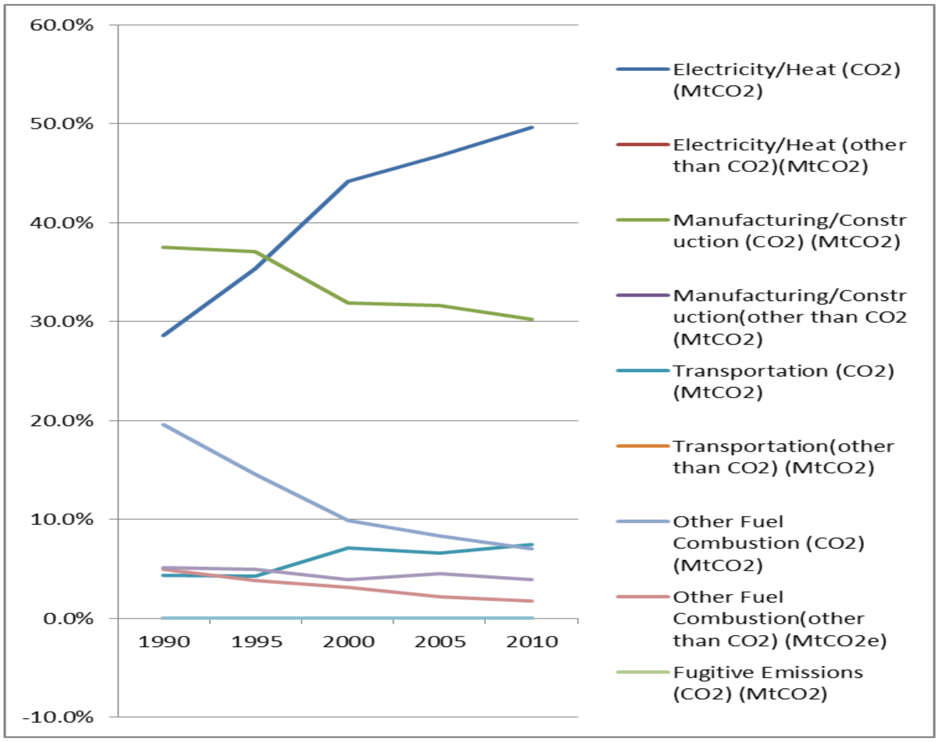


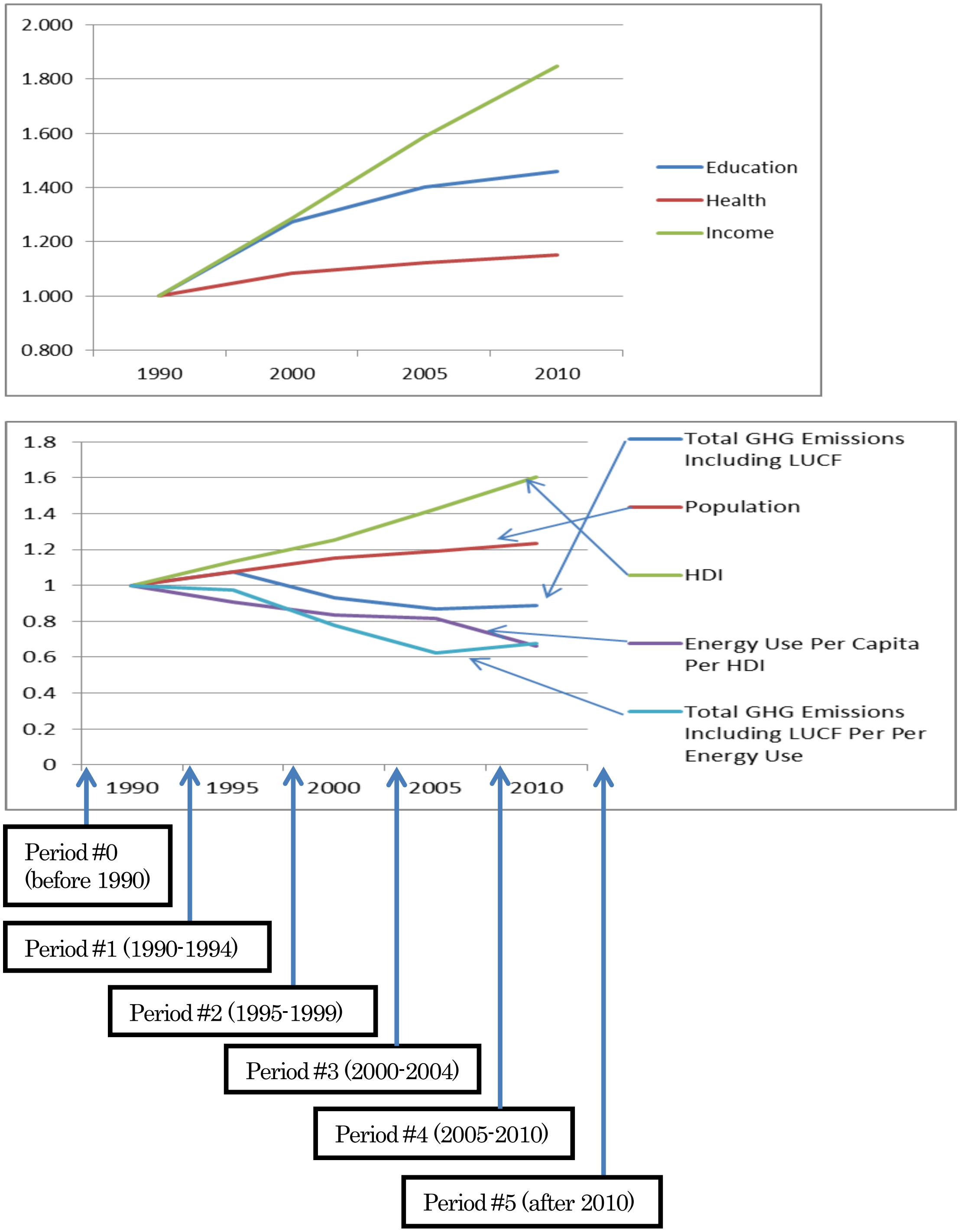
Table 47. Myanmar, Mongolia, Pakistan and Philippines' Successfulness

Countries	Development Indicator	GHGpc	EC/(P*HDI)	GHG/EC	Type
Myanmar (very successful)	50,53,83/186 Very successful	Very successful	Effective	Effective	Reform
Mongolia (successful)	61,55,60/175 Marginal	Very successful	Effective	Mediocre	Non DLHE (LUCF)
Pakistan (unsuccessful by HDI)	52,51,50/153 Marginal	Successful	Effective	Mediocre	DLHE (domCO_2)
Philippines (unsuccessful by HDI)	36,47,50/133 Unsuccessful	Successful	Effective	Ineffective	DLHE(domCO_2)

Table 48. Myanmar, Bangladesh, Sri Lanka and Thailand's Successfulness

	Development Indicator	GHGpc	EC/(P*HDI)	GHG/EC	Type
Myanmar (very successful)	50,53,83/186 Very successful	Very successful	Effective	Effective	Reform
Bangladesh (successful)	57,62,61/180 Successful	Successful	Mediocre	Effective	DLHE (new CO_2)
Sri Lanka (unsuccessful by HDI)	47,50,62/159 Unsuccessful	Successful	Mediocre	Effective	DLHE (yet CO_2)
Thailand (unsuccessful by both)	63,47,59/169 Marginal	Marginal	Ineffective	Effective	DLHE (domCO_2)

Figure 114. Myanmar's trajectory divided into 6 periods[2]



2 20170227 BBC News Myanmar profile – Timeline http://www.bbc.com/news/world-asia-pacific-12992883

Appendix 16. Myanmar Timeline

Period #0 (Country's situation before 1990)

1962 - Military coup, forming a single-party state with the Socialist Programme Party as the sole political party, and banning independent newspapers.

1987 - Currency devaluation wipes out many people's savings and triggers anti-government riots.

1988 - Thousands of people are killed in anti-government riots.

1989 - Slorc declares martial law, arrests thousands of people. NLD leader Aung San Suu Kyi, the daughter of Aung San, is put under house arrest.

Period #1

1990 - Opposition National League for Democracy (NLD) wins landslide victory in general election.

1991 - Aung San Suu Kyi awarded Nobel Peace Prize for her commitment to peaceful change

Period #2

1995 - Aung San Suu Kyi is released from house arrest after six years.

1997 - Admitted to Association of South East Asian Nations (ASEAN).

1998 - 300 NLD members released from prison

Period #3

2000 - Ruling council lifts restrictions on movements of Aung San Suu Kyi and senior NLD members.

2002 - Pro-democracy leader Aung San Suu Kyi released after nearly 20 months of house arrest. Aung San Suu Kyi taken into "protective custody" after clashes between her supporters and those of government.

2003 - Five senior NLD leaders released from house arrest after visit of UN human rights envoy.

2004 - Government and Karen National Union - most significant ethnic group fighting government - agree to end hostilities. Constitutional convention begins, despite boycott by National League for Democracy (NLD) whose leader Aung San Suu Kyi remains under house arrest.

Period #4

2007 - Aung San Suu Kyi's house arrest is extended for another year. The International Committee of the Red Cross accuses the government of abusing the Myanmar people's rights. UN envoy Ibrahim Gambari meets opposition leader Aung San Suu Kyi. UN Security Council deplores military crackdown on peaceful protesters.

2008 - A series of bomb blasts hits the country. Cyclone Nargis hits the low-lying Irrawaddy delta. Some estimates put the death toll as high as 134,000. Government insists it can cope with cyclone aftermath without foreign help.

2009 - UN envoy Ibrahim Gambari meets opposition leader Aung San Suu Kyi. The EU extends the 2006 sanctions for another year but adds that they can be reviewed in the event of moves towards democracy. UN and aid agencies say hundreds of thousands in the Irrawaddy Delta still need assistance a year after Cyclone Nargis. The UN says Myanmar now allows it to bring in all the staff it needs. Aung San Suu Kyi is convicted of breaching conditions of her house arrest, following visit by an uninvited US national. The initial sentence of three years' imprisonment is commuted to 18 months' house arrest. US Secretary of State Hillary Clinton announces plans for engagement with military rulers. Aung San Suu Kyi begins talks with Myanmar's military leaders and she was allowed to meet Western diplomats. Main military-backed party, the Union Solidarity and Development Party (USDP), claims resounding victory in first election for 20 years. Opposition groups allege widespread fraud and the election is widely condemned as a sham. The junta says the election marks the transition from military rule to a civilian democracy. A week after the election, Aung San Suu Kyi - who had been prevented from taking part - is released from house arrest.

Period #5

2011 - Government authorizes internet connection for Aung San Suu Kyi. Thein Sein is sworn in as president of a new, nominally civilian government. President Thein Sein meets Pro-democracy leader Aung San Suu Kyi. She says she will stand for election to parliament. US Secretary of State Hillary Clinton visits, meets Aung San Suu Kyi and holds talks with President Thein Sein. US offers to improve relations if democratic reforms continue. President Thein Sein signs law allowing peaceful demonstrations for the first time; NLD re-registers as a political party in advance of by-elections for parliament due to be held early in 2012. Burmese authorities agree truce deal with rebels of Shan ethnic group and orders military to stop operations against ethnic Kachin rebels.

2012 - NLD candidates sweep the board in parliamentary by-elections, with Aung San Suu Kyi elected. The European Union suspends all non-military sanctions against Burma for a year. Manmohan Singh pays first official visit by an Indian prime minister since 1987. Myanmar abolishes pre-publication media censorship. In a major cabinet reshuffle, President Thein Sein replaces hard-liner Information Minister Kyaw Hsan with moderate Aung Kyi, the military's negotiator with opposition leader Aung San Suu Kyi. President Thein Sein tells the BBC he would accept opposition leader Aung San Suu Kyi as president if she were elected. Visiting European Commission chief Jose Manuel Barroso offers Myanmar more than $100m in development aid. US President Barack Obama visits to offer "the hand of friendship" in return for more reforms. He urges reconciliation with the Rohingya minority.

2013 - Four private daily newspapers appear for the first time in almost 50 years as the state monopoly ends. President Thein Sein visits Washington. President Obama praises Myanmar's political and economic progress but criticizes violence against Rohingya Muslims.

2014 - US extends some sanctions for another year, saying that despite the recent reforms, rights abuses and army influence on politics and the economy persist.

2015 - A draft ceasefire agreement is signed between the government and 16 rebel groups. Floods affect much of low-lying parts of country, killing 100 people and displacing a million others. Opposition National League for Democracy - led by Aung San Suu Kyi - wins enough seats in parliamentary elections to form a government. Htin Kyaw sworn in as president, ushering in a new era as Aung San Suu Kyi's democracy movement takes power after 50 years of military domination.

Table 49. Myanmar Timeline

	Period #0	Period #1	Period #2	Period #3	Period #4	Period #5
Political Stability	No	Indication	Indication	Transition	Transition	Beginning
Peace	No	No	No	No	No	Indication
Foreign Aid	1	0.43	0.19	0.34	0.82	-
Kyoto protocol Ratification/ Acceptance				13 August 2003		
Forestry Policy[3]		The Forest Law 1992	Myanmar Forest Policy, Forest Rules, Communit y Forestry Instructio n 1995			

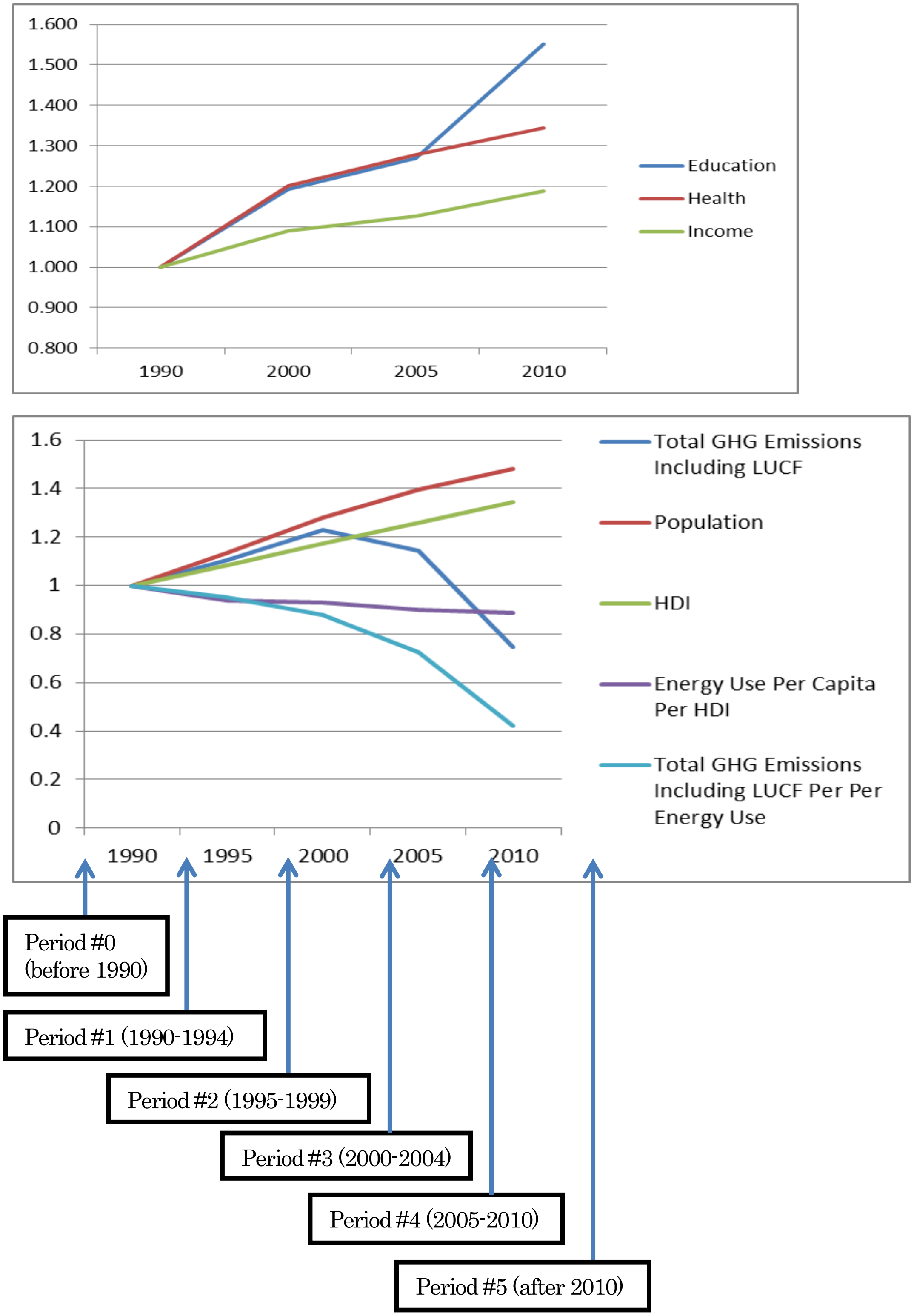
[3] "*REDD Country Report*". REDD Research and Development Center. April 4, 2016. https://www.ffpri.affrc.go.jp/reddrdc/ja/redd/_trends_2014/04_country_report_myanmar.pdf#search=%27%E3%83%9F%E3%83%A3%E3%83%B3%E3%83%9E%E3%83%BC+%E6%A3%AE%E6%9E%97%E6%94%BF%E7%AD%96%27.

Table 50. Net ODA received per capita (current US$) during each period being compared with the total received during the period of 1986-90[4]

	86 90	91 95	96 00	01 05	06 10
Afghanistan	1	2.77768	1.263779	10.38338	27.17271
Bangladesh	1	0.831339	0.533822	0.511628	0.590508
China (PRC)	1	1.625289	1.178342	0.801531	0.589637
Indonesia	1	1.114622	0.824528	0.803282	0.612493
India	1	1.098329	0.7513	0.594359	0.815797
Lao PDR	1	1.895174	2.516942	2.142071	2.93457
Sri Lanka	1	1.051383	0.526288	0.866264	0.934764
Myanmar	1	0.427589	0.19404	0.342068	0.821948
Mongolia	1	19.20264	28.56587	28.65286	31.76899
Malaysia	1	0.53839	-0.20818	0.303312	0.3746
Nepal	1	0.952394	0.765151	0.734322	1.169099
Pakistan	1	0.924026	0.608814	1.005512	1.314235
Korea, Rep.	1	-0.3672	-3.63837	0	0
Philippines	1	1.210989	0.603218	0.451566	0.296581
Thailand	1	1.109517	1.184659	-0.13863	-0.34957
Vietnam	1	3.171311	6.578152	8.186502	12.744

[4] "World Bank Indicator – Net ODA received per capita (current US$)." World Bank. January 11, 2015. https://data.worldbank.org/indicator/DT.ODA.ODAT.PC.ZS?view=chart.

Figure 115. Nepal’s trajectory divided into 6 periods



Appendix 17. Nepal Timeline

Period #0

1955 - Nepal joins the United Nations.

1955 - King Tribhuwan dies, King Mahendra ascends throne.

1959 - Multi-party constitution adopted.

1960 - King Mahendra seizes control and suspends parliament, constitution and party politics after Nepali Congress Party (NCP) wins elections with B. P. Koirala as premier.

1962 - New constitution provides for non-party system of councils known as "panchayat" under which king exercises sole power. First elections to Rastrya Panchayat held in 1963.

1972 - King Mahendra dies, succeeded by Birendra.

1980 - Constitutional referendum follows agitation for reform. Small majority favors keeping existing panchayat system. King agrees to allow direct elections to national assembly - but on a non-party basis.

1985 - NCP begins civil disobedience campaign for restoration of multi-party system.

1986 - New elections boycotted by NCP.

Period #1

1990 - Pro-democracy agitation coordinated by NCP and leftist groups. Street protests suppressed by security forces resulting in deaths and mass arrests. King Birendra eventually bows to pressure and agrees to new democratic constitution.

1991 - Nepali Congress Party wins first democratic elections. Girija Prasad Koirala becomes prime minister.

1994 - Koirala's government defeated in no-confidence motion. New elections lead to formation of Communist government.

Period #2

1995 - Communist government dissolved. Start of Maoist revolt which drags on for more than a decade and kills thousands. The rebels want the monarchy to be abolished.

1997 - Prime Minister Sher Bahadur Deuba loses no-confidence vote, ushering in period of increased political instability, with frequent changes of prime minister.

Period #3

2001 – On June 1st, Crown Prince Dipendra kills King Birendra, Queen Aishwarya and several members of the royal family, before shooting himself. The king's brother, Gyanendra is crowned king. In July, Maoist rebels step up campaign of violence. Prime Minister GP Koirala quits over the violence; succeeded by Sher Bahadur Deuba. In November, Maoists end four-month old truce with government, declare peace talks with government failed. Launch coordinated attacks on army and police posts. In November, state of emergency declared after more than 100 people are killed in four days of violence. King Gyanendra orders army to crush the Maoist rebels. Many hundreds are killed in rebel and government operations in the following months.

2002 - Parliament dissolved, fresh elections called amid political confrontation over extending the state of emergency. Sher Bahadur Deuba heads interim government, renews emergency.

2003 – In January, rebels, government declare ceasefire. In August, rebels pull out of peace talks with government and end seven-month truce. The following months see resurgence of violence and frequent clashes between students/activists and police.

2004 - Nepal joins the World Trade Organisation (WTO). Street protests by opposition groups demanding a return to democracy. Royalist Prime Minister Surya Bahadur Thapa quits.

<u>Period #4</u>

2005 – In February, King Gyanendra dismisses the government, restores an absolute monarchy and declares a state of emergency, citing the need to defeat Maoist rebels. But in April, King Gyanendra bows to international pressure, lifts the state of emergency and reinstates parliament. In November, Maoist rebels and main opposition parties agree on a programme intended to restore democracy.

2006 – In April, King Gyanendra agrees to reinstate parliament following weeks of violent strikes and protests against direct royal rule. Maoist rebels call a three-month ceasefire. Then in May, Parliament votes unanimously to curb the king's political powers. The government holds peace talks with the Maoist rebels. In November, the government signs a peace deal with the Maoists - the Comprehensive Peace Agreement (CPA) - formally ending the decade-long insurgency.

2007 – In January, Maoist leaders enter parliament under the terms of a temporary constitution. In April, Maoists join an interim government, a move which brings them into the political mainstream. In September, Maoists quit the interim government, demanding the abolition of the monarchy. November's constituent assembly elections are postponed. In December, Parliament approves the abolition of monarchy as part of peace deal with Maoists, who agree to rejoin government.

2008 –In April, former Maoist rebels win the largest bloc of seats in elections to the new Constituent Assembly (CA) but fail to achieve an outright majority. In May, Nepal becomes a republic. In July, Ram Baran Yadav becomes Nepal's first president. In August, Maoist leader Pushpa Kamal Dahal aka Prachanda forms coalition government, with Nepali Congress going into opposition.

2009 - Prime Minister Prachanda resigns following a row with President Yadav over the integration of former rebel fighters into the military.

Period #5

2011 - UN ends its peace monitoring mission.

2012 - The Constituent Assembly (CA) is dissolved after failing to produce a draft constitution.

2013 - The left-wing Nepali Congress wins the second Constituent Assembly elections, pushing the former ruling Maoists into third place and leaving no party with a majority.

2014 - Nepal and India sign a deal to build a $1bn hydropower plant on Nepal's Arun river to counter crippling energy shortages.

2015 - A 7.8-magnitude earthquake strikes Kathmandu and its surrounding areas killing more than 8,000 people, causing mass devastation and leaving millions homeless. Parliament passes a landmark constitution, which defines Nepal as a secular country, despite calls to delay voting after more than 40 people are killed in protests.

2016 - Government lifts fuel rationing after the ethnic minority Madhesi communities, partially backed by India, end a six-month border blockade in protest over the new constitution which they say is discriminatory. Maoist party pulls out of the governing coalition. Prime Minister K.P. Oli resigns ahead of a no-confidence vote in parliament. Parliament elects former communist rebel leader and Maoist party leader Pushpa Kamal Dahal aka Prachanda as prime minister for the second time.

Table 51. Nepal Timeline

	Period #0		Period #1	Period #2	Period #3	Period #4	Period #5
Political Stability	No		No	No	No	No	No
Peace/Stable	No		No	No	No	No	No
Foreign Aid	1		0.95	0.77	0.73	1.17	-
Kyoto protocol Ratification/ Acceptance						16 September 2005	
Forestry Policy[5]	National Forestry Plan, 1976, National Conservation Strategy 1988, The Master Plan for the Forestry Sector (MPFS, 1989)		Forest Act 1993, Community Forestry Directives 1994	Forest rules 1995,	Revised Forestry sector Policy 2000, Leasehold Forest Policy 2002, Five- year Periodic Plans 2002-07, Operational Guidelines (revised) 2002, National Biodiversity Strategy		

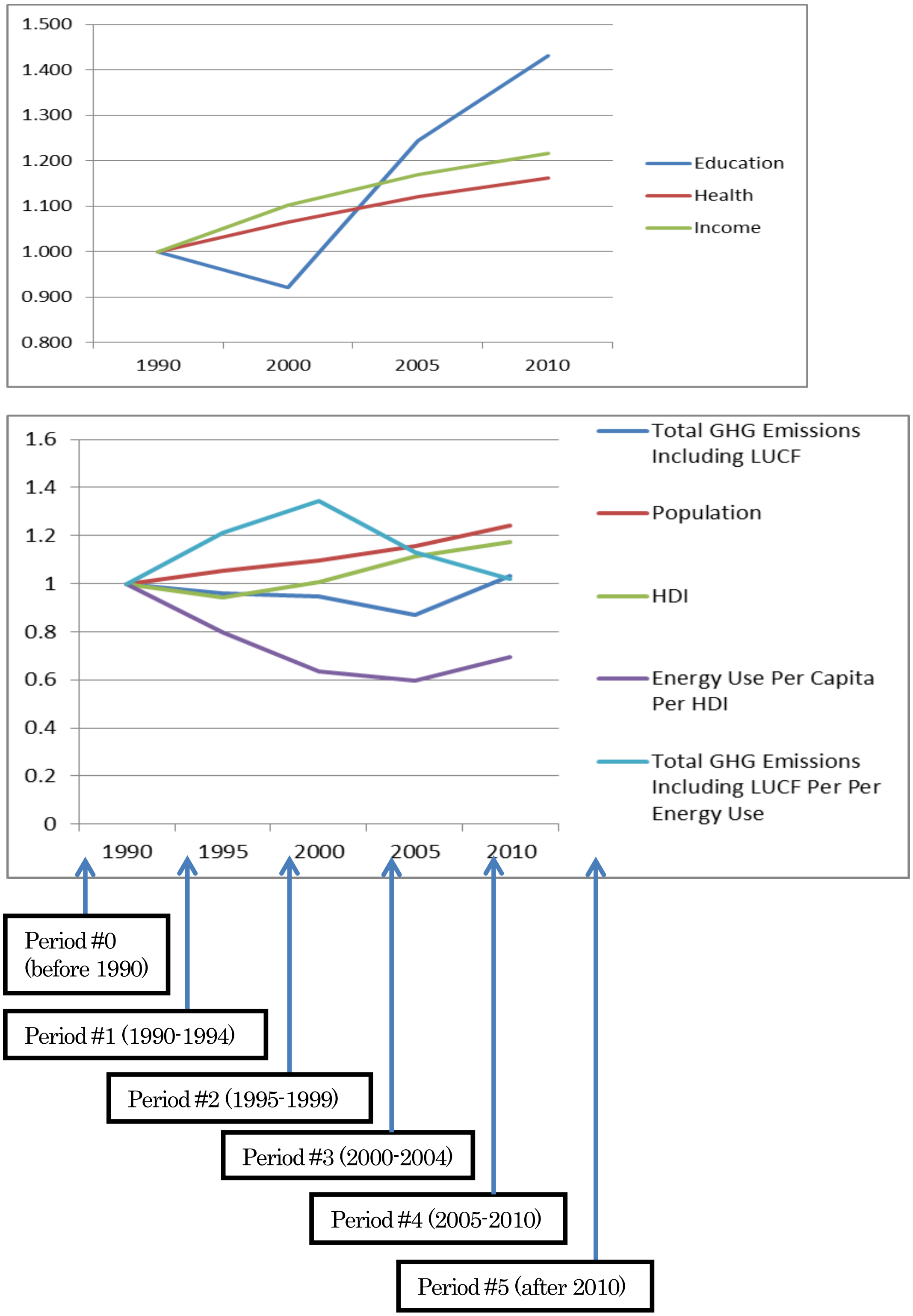
[5]"*Forestry Sector Policy 2000".* Ministry of Forests and Soil Conservation. April 16, 2017. http://theredddesk.org/sites/default/files/forestry_sector_policy_2000_0.pdf#search=%27nepal+forest+policy%27

"Policy, Act, Rules, Regulations and Guidelines related to the DoF". Ministry of Forests and Environment. April 16, 2017. http://dof.gov.np/about_us/policy.

Keshav Raj Kanel, Ph.D. "*Current Status of Community Forestry in Nepal*". Community Forestry Division Department of Forest Kathmandu, Nepal. Submitted to Regional Community Forestry Training Center for Asia and the Pacific Bangkok, Thailand. January 2005.

	Period #0		Period #1	Period #2	Period #3	Period #4	Period #5
					2002, Monitoring and Evaluation concept and strategies 2002, Collaborative Forest Management Guideline 2003, Forest Products Auctioning Procedure 2003, Non-Governmental Service Providers Guideline 2003		

Figure 116. Mongolia's trajectory divided into 6 periods



Appendix 18. Mongolia Timeline

Period #0

1924 - The People's Party chooses Lenin's "road to socialism bypassing capitalism" and renames itself the Mongolian People's Revolutionary Party (MPRP). The Mongolian People's Republic is proclaimed.

1961-63 - UN Security Council approves Mongolia's UN membership. Diplomatic relations established with the UK.

1966 - Soviet Communist Party General-Secretary Brezhnev signs a friendship treaty in Ulan Bator allowing secret stationing of Soviet troops in Mongolia.

1973-81 - Mongolia accuses China (PRC) of planning annexation, protests against Chinese leaders' call for withdrawal of Soviet troops, accuses China (PRC) of "aggressive intentions" and expels some Chinese residents.

1984 - "Mongolia's Brezhnev", party General-Secretary Tsedenbal, head of state since 1974, is forced out of office by the MPRP Politburo.

1986 - Gorbachev's Vladivostok speech opens the way to detente with China (PRC) and the withdrawal of Soviet troops from Mongolia.

Period #1

1990 - Street demonstrations force resignation of the MPRP Politburo. Political parties are legalized. Elections to the Great Hural (parliament) are won by the MPRP, but 19 of the 50 seats in a new standing legislature go to non-communists.

1992 - Mongolia's new constitution gives first place to human rights and freedoms. In the first democratic elections the MPRP wins 71 of the 76 seats in the new single-chamber Great Hural.

1993 - The first direct presidential elections are won by Ochirbat, nominated by the National and Social Democrats.

Period #2

1996 - The National and Social Democrats win 50 seats in the Great Hural elections, but the MPRP can deny a quorum, hindering passage of legislation.

1997 - MPRP candidate Bagabandi wins presidential election.

2000 - After the democrats form three new governments in two years the MPRP wins 72 seats in the Great Hural elections. The National and Social Democrats and three other parties form a new Democratic Party.

Period #3

2001 - UN launches appeal for $8.7m (£6m) to support herders suffering in worst winter conditions in more than 50 years. IMF approves nearly $40 million in low-interest loans over next three years to help tackle poverty and boost economic growth.

2004 - Russia writes off all but $300 million of Mongolia's debts.

2004 June-August - Parliamentary elections, in which the opposition performs strongly, result in political deadlock over contested results. Tsakhiagiin Elbegdorj is eventually appointed as prime minister following power-sharing deal.

Period #4

2005 - Protesters in the capital demand the government's resignation and an end to poverty and official corruption. MPRP candidate Nambaryn Enkhbayar wins presidential election.

2006 - Coalition government headed by Tsakhiagiin Elbegdorj falls after the MPRP pulls out, blaming the leadership for slow economic growth. Parliament chooses MPRP's Miyeegombo Enkhbold as the new prime minister.

2007 - Prime Minister Miyeegombo Enkhbold resigns. He is replaced by MPRP leader Sanjagiin Bayar.

2008 - President Enkhbayar declares a state of emergency to quell riots in the capital which left five dead and hundreds injured. Violence erupted after the opposition accused the governing party of rigging elections.

2009 - Former Prime Minister and candidate of the opposition Democratic Party, Tsakhiagiin Elbegdorj, wins presidential election, defeating incumbent Nambaryn Enkhbayar by a narrow margin. Governing MPRP says it accepts the result. In October Prime Minister Sanjagiin Bayar of the MPRP resigns for health reasons. Foreign Minister Sukhbaataryn Batbold succeeds him.

2010 - Extreme cold kills so much livestock that the United Nations launches a programme to pay herders to clean and collect carcasses. This will help maintain living standards while disposing of possible sources of disease. PM Sukhbaataryn Batbold takes over as head of governing MPRP from former PM Sanjagiin Bayar. In November, controversy as Mongolian People's Revolutionary Party reverts to Communist-era name of Mongolian People's Party. Ex-President Nambaryn Enkhbayar sets up small breakaway Mongolian People's Revolutionary Party.

Period #5

2011 - Mongolia selects the US Peabody Energy, China (PRC)'s Shenhua and a Russian-Mongolian consortium as partners to develop the highly sought-after Tavan Tolgoi coal deposit in the Gobi desert. (2012 April - Mongolia puts Tavan Tolgoi coal mine deal on hold while it decides whether to go it alone on developing the project.) Mongolia and Rio Tinto-owned Ivanhoe Mines reach agreement on stockholding in the massive Oyu Tolgoi copper mine. Mongolia settles for a 34%

share, as previously agreed, dropping demands for parity. (2013 August - Mining giant Rio Tinto says it will lay off up to 1,700 workers at the massive Oyu Tolgoi mine in Mongolia following a dispute with the government.)

2012 - Parliamentary elections. Democratic Party wins most seats and goes on to form a coalition with the Mongolian People's Revolutionary Party, but in December, Mongolian People's Revolutionary Party threatens to leave governing coalition in protest at its former leader Enkhbayar's jail sentence.

2013 - Tsakhiagiin Elbegdorj, from the Democratic Party, wins a second term as president.

2014 - Prime Minister Norov Altankhuyag is dismissed by a vote of parliament. He had been under fire for alleged corruption and economic underperformance. Parliament elects Chimed Saikhanbileg as prime minister in a vote boycotted by the opposition Mongolian People's Party.

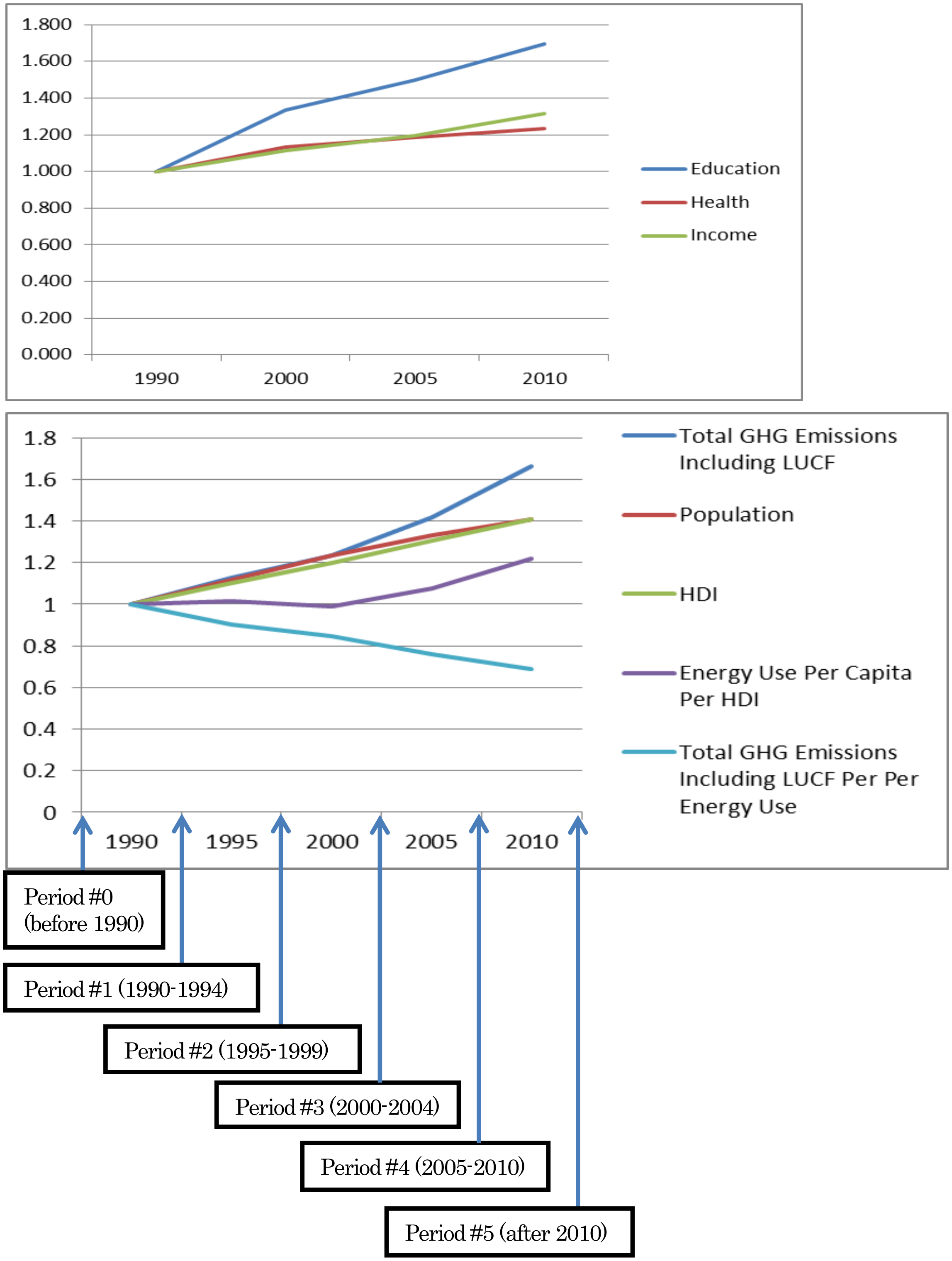
2015 - The opposition Mongolian People's Party agrees to form a coalition government with the Democratic Party and the Justice Coalition. Prime Minister Chimed Saikhanbileg removes the Mongolian People's Party from the coalition government by dismissing six of its ministers.

2016 - Opposition Mongolian People's Party scores a landslide victory in the parliamentary election winning 65 out of 76 seats. Prime Minister Chimed Saikhanbileg is among the Democratic Party incumbents who fail to win re-election.

Table 52. Mongolia Timeline

	Period #0	Period #1	Period #2	Period #3	Period #4	Period #5
Political Stability	No	Indication	Indication	Indication	Indication	Transition
Peace	Yes	Yes	Yes	Yes	No	Yes
Foreign Aid	1	19.20264	28.56587	28.65286	31.76899	-
Kyoto protocol Ratification/ Acceptance			15 December 1999			

Figure 117. Bangladesh's trajectory divided into 6 periods



Appendix 19. Bangladesh Timeline

<u>Period #0</u>

1971 - Sheikh Mujib arrested and taken to West Pakistan. In exile, Awami League leaders proclaim the independence of the province of East Pakistan on 26th March. The new country is called Bangladesh.

1972 - Sheikh Mujib returns, becomes prime minister. He begins a programme of nationalising key industries in an attempt to improve living standards, but with little success.

1975 - Sheikh Mujib becomes president of Bangladesh. The political situation worsens. He is assassinated in a military coup in August. Martial law is imposed.

1976 - The military ban trade unions.

1977 - General Ziaur Rahman assumes the presidency. Islam is adopted in the constitution.

1979 - Martial law is lifted following elections, which Zia's Bangladesh National Party (BNP) wins.

1981 - Zia is assassinated during abortive military coup. He is succeeded by Abdus Sattar.

1982 - General Ershad assumes power in army coup. He suspends the constitution and political parties.

1983 - Limited political activity is permitted. Ershad becomes president.

1986 - Parliamentary and presidential elections. Ershad elected to a five-year term. He lifts martial law and reinstates the constitution.

1987 - State of emergency declared after opposition demonstrations and strikes.

1988 - Islam becomes state religion. Floods cover up to three-quarters of the country. Tens of millions are made homeless.

Period #1

1990 - Ershad steps down following mass protests.

1991 - Ershad convicted and jailed for corruption and illegal possession of weapons. Begum Khaleda Zia, widow of President Zia Rahman, becomes prime minister. Constitution is changed to render the position of president ceremonial. The prime minister now has primary executive power. Cyclonic tidal wave kills up to 138,000.

Period #2

1996 - Two sets of elections eventually see the Awami League win power, with Sheikh Hasina Wajed, the daughter of Sheikh Mujibur Rahman, becoming prime minister.

1997 - Ershad is released from prison. The opposition BNP begins campaign of strikes against the government.

1998 - Two-thirds of the country devastated by the worst floods ever. Fifteen former army officers sentenced to death for involvement in assassination of President Mujib in 1975.

Period #3

2000 - Sheikh Hasina criticises military regimes in a UN speech, prompting Pakistani leader General Musharraf to cancel talks with her. Relations strained further by row over leaked Pakistani report on 1971 war of independence. Bangladesh expels Pakistani diplomat for comments on the 1971 war. The diplomat had put the number of dead at 26,000, whereas Bangladesh says nearly three million were killed.

2001 - Seven killed in bomb blast at a Bengali New Year concert in Dhaka. Sixteen Indian and three Bangladeshi soldiers killed in their worst border clashes. Bomb kills 10 at Sunday mass at a Roman Catholic church in Baniarchar town. Bomb at Awami league office near Dhaka kills 22. Hasina steps down, hands power to caretaker authority, becoming the first prime minister in the country's history to complete a five-year term. At least eight people are killed and hundreds injured as two bombs explode at an election rally in south-western Bangladesh. Hasina loses at polls to Khaleda Zia's Nationalist Party and its three coalition partners.

2002 - Pakistani President Musharraf visits; expresses regret over excesses carried out by Pakistan during 1971 war of independence. In September, Iajuddin Ahmed sworn in as president. December, simultaneous bomb blasts in cinemas in a town north of Dhaka kill 17 and injure hundreds.

2004 Opposition calls 21 general strikes over the course of the year as part of a campaign to oust the government. Worst flooding in six years leaves nearly 800 people dead, millions homeless or stranded, and an estimated 20m in need of food aid. September's floods in Dhaka are said to be the worst in decades. In August, Grenade attack on opposition Awami League rally in Dhaka kills 22 people.

Period #4

2005 - Prominent Awami League politician Shah AMS Kibria is killed in a grenade attack at a political rally. The party calls a general strike in protest. Around 350 small bombs go off in towns and cities nationwide. Two people are killed and more than 100 are injured.

2006 – In February, opposition Awami League ends year-long parliamentary boycott. Violent protests over government's choice of a caretaker administration to take over when Premier Zia completes her term at the end of the month. President

Ahmed steps in and assumes caretaker role for period leading to elections due in January 2007. In November, a 14-party opposition alliance led by the Awami League campaigns for controversial election officials to be removed. Chief election commissioner MA Aziz steps aside. In December, election date set at 22 January. Awami alliance says it will boycott the polls. Awami leader Sheikh Hasina accuses President Ahmed of favouring her rival. Blockade aimed at derailing parliamentary elections paralyses much of the country.

2007 - In January, a state of emergency is declared amid violence in the election run-up. President Ahmed postpones the poll. Fakhruddin Ahmed heads a caretaker administration. In April, Sheikh Hasina is charged with murder. Begum Khaleda Zia is under virtual house arrest. Several other politicians are held in an anti-corruption drive. In August, government imposes a curfew on Dhaka and five other cities amid violent clashes between police and students demanding an end to emergency rule. In November, cyclone Sidr kills thousands.

2008 – In August, local elections take place, seen as a big step towards restoring democracy. Candidates backed by the Awami League perform strongly. In December, general elections: Awami League captures more than 250 of 300 seats in parliament. 2009 - Sheikh Hasina is sworn in as prime minister in January.

Around 74 people, mainly army officers, are killed in a mutiny in Dhaka by border guards unhappy with pay and conditions. Police arrest some 700 guards. A further 1,000 guards are detained in May. The government bans the local branch of the global Islamist organisation Hizb-ut Tahrir, saying it poses a threat to peace.

2010 - Five former army officers are executed for the 1975 murder of founding PM Sheikh Mujibur Rahman.

Period #5

2012 - Key figures from the main Islamist party Jamaat-e-Islami, including leader Motiur Rahman Nizami, are charged with war crimes by a government tribunal investigating alleged collaboration with Pakistan during the 1971 independence struggle. In October, Muslim rioters attack Buddhist villages and shrines in south-east Bangladesh after an image said to show a burnt Koran was posted on Facebook. The government denounces the attacks as "premeditated and deliberate acts of communal violence against a minority."

2013 - War crimes tribunal sentences prominent Muslim cleric Abul Kalam Azad to death for crimes against humanity during the 1971 independence war. Prime Minister Sheikh Hasina vetoes Islamist bill to outlaw criticism of Islam. European retailers promise to sign an accord to improve safety conditions in factories after a garment factory building collapsed in April, killing more than 1,100 people. Worker protests close hundreds of factories and extract a government pledge to raise the minimum wage and make it easier to form unions. At least two people are killed as police clash with thousands of protesters after the conviction of Ghulam Azam, leader of the Jamaat-e-Islami party, for war crimes committed during the 1971 war of independence. Ghulam Azam dies in October 2014.

2014 - Opposition BNP boycotts parliamentary elections, Prime Minister Sheikh Hasina returns for third term in office. Jamaat-e-Islami Leader Motiur Rahman Nizami and another leading figure, Mir Quasem Ali, found guilty of war crimes during independence war in 1971.

2015 - Court sentences another senior Jamaat-e-Islami figure, Abdus Subhan, to death for war crimes committed during independence war in 1971. Bangladesh bans Islamist militant group Ansarullah Bangla Team, which claims responsibility for killing and assaulting several pro-secular public figures.

2016 - Two students are sentenced to death for the 2013 killing of atheist blogger Ahmed Rajib Haider. The Islamic State group claims an attack on a cafe in Dhaka's diplomatic quarter in which 20 hostages, including 18 foreigners, are killed but the government rejects the claim saying the militant group Jamaat-ul-Mujahideen was responsible. Business tycoon and senior leader of Bangladesh's largest Islamist party Jamaat-e-Islami, Mir Quasem Ali, is executed for war crimes committed during the 1971 war of independence.

Table 53. Bangladesh Timeline

	Period #0	Period #1	Period #2	Period #3	Period #4	Period #5
Political Stability	No	No	No	No	No	No
Peace	No	No	No	No	No	No
Foreign Aid	1	0.831339	0.533822	0.511628	0.590508	-
Kyoto protocol Ratification/Acceptance				22 October 2001		

Table 54. Experts' responses for the question related to Myanmar

Answers	Representative Comments
Data was untrustworthy (5)	• "I think Myanmar is a case where indicators based on statistical data will be misleading. Data is untrustworthy because until recently the regime was secretive and what data was produced was to verify performance goals (where they existed) or to divert attention from areas of exploitation. Their purpose was rarely to give a true picture of the development parameter being reported on." • "we know that there are huge gaps between the official stats and what happened in the field" • "Myanmar is late comer to accurate reporting on global indices. I personally wouldn't judge any improvements in indices as an improvement on the ground per se." • "The result is actually interesting since, I had an impression that Myanmar's growth was slow during the period of

Answers	Representative Comments
	international economic sanctions. If there was high income growth notwithstanding low FDI and ODA, this may be partially explained by the convergence theory, i.e. Myanmar's growth was higher just because its starting income level was very low. Growth theories (generally speaking) predict low income economies to grow faster than middle/high income countries."
Secondary and tertiary industries (11)	• "the income level of Myanmar people has been increased due to the economy boost originated from recent rapid growth mainly in real estate business and related tourism by the visitors, which have been created by positive expectation for Myanmar's economy and industry by overseas investors." • "A new law on investments in October 2016 has improved business climate. Tourism and tourism related infrastructure construction will contribute to growth….. Income component of Myanmar increased due to shift from low productivity agriculture to higher productivity industries supported by emphasis on economic/industrial zones, SMEs and garments. The limited increase in CO_2 is explained by SME emphasis as opposed to polluting large industries." • "the sector shifting caused due to labor transaction (sic) from the agricultural and forestry sector to labor-intensive light industrial sector and tourism, which increased the average income." • "increase in trade, manufacturing and services is correct." • "…shift from primary industry (agriculture and forestry) to secondary and tertiary industries certainly contributed to the economic growth as primary industry is usually low in productivity than the other industries." • "It is developing its energy and industrial sectors." • "might have promoted the private sector to invest on local service sectors, including the limited middle scale industries." • "The improving political landscape allowed more international tourists to visit, boosting incomes and employment."

Answers	Representative Comments
	• "I believe it was more towards light industries whose GHG emission would be modest."
Foreign investment (6)	• "there were sizable flows of investment from countries like China (PRC), that could have presumably supported the industrial growth of the country." • "The increase in income of Myanmar is possibly partly because during this period, the country has opened its economy to private sector participation." • "GDP seems to be driven by increased industry and services probably driven by FDI with country opening." • "Arguably, Myanmar did enjoy some political stability in the period 1990-2010 in the form of an authoritarian military regime, which likely contributed to inflow of some foreign direct investment which was outside the international sanctions regime (capital coming mainly from the PRC and other Asian countries). One might also argue that "international" sanctions were taken seriously by only a few donor countries (e.g., the US), and the sanction regime was not effective at stopping capital inflow…. It should be noted that political stability is not the same as predictability of decision-making, so although Myanmar was run by an authoritarian military regime (and to some extent still is today) the investment environment may have been predictable enough to allow risk quantification; those investors willing to ignore a weak sanctions regime could understand the risks and make reasonable well-informed investment decisions." • "Myanmar started to develop its oil and gas reserves, inviting foreign investors etc. Myanmar has also developed many hydropower plants with investors mainly from the PRC. Much of the oil and gas, as well as the electricity generated from hydropower, was exported during that period. This resulted in a much higher GDP." • "personally think that Myanmar's recent transition from a military-rule government to democratic government has

Answers	Representative Comments
	provided a favorable economic and political environment for strong foreign direct investments into the country, ranging from labor-intensive sectors, telecom sectors, to real estate, etc. though starting from a very low base.”
Agriculture production increased (2)	• “Increased income was due to increased agricultural production. Agriculture has been contributing to GDP and had a large share of employment (e.g., 40% of the GDP in 2010 and 70% for employment).... As population expanded during 1990-2010, agricultural areas have expanded, resulting in increased agricultural production and increased income..” • “Over the medium term Myanmar‘s growth will remain strong with FDI flow into the agri-business sector rising because of opening up of the economy.”
Military regime (5)	• “the military industry supported the country’s economy in 1990-2010” • “the military government worked well compared to the previous communist regime” • “the military government allowed income development in businesses and livelihoods that did not produce GHGs such as the cottage craft industries, and freer and more marketable agriculture cropping (not livestock rearing) for national and international markets” • “While a military government was in control, it did maintain peace and order – civil society advocating political change did so peacefully – therefore conditions for economic growth were stable”, and “government was taking good steps on life and education (previous army party USDP did some good work).”
Trading (export of natural resources increased) (13)	• “The export of natural resources increased (natural gas, mineral, and oil)” for “trading with neighboring countries, such as China (PRC) and Thailand.”

Answers	Representative Comments
Special Economic Zones (SEZs) (2)	• "Income component of Myanmar increased due to shift from low productivity agriculture to higher productivity industries supported by emphasis on economic/industrial zones" • "the recent development of SEZs (which may be with good technology compared with conventional ones) in Myanmar, I suppose the average wage and also total amount of income for the people of Myanmar went up."
ODA (3)	• the increase in ODA has contributed meaningfully to introduction of energy efficiency, better technology for energy and industrial sectors, • there were still significant (if small value) foreign aid interventions throughout Myanmar over the time period which improved practices on the margin and overall HDIs, with minimal investment, and • Improved rural infrastructure, and skills development together with ODA advice and support and improvement in political stability contributes to better HDI.
Better education system (3)	• "better education system to make and feel responsive citizens is the important one" • "Myanmar was able to increase its HDI by investing more on the health and education sector…. By increasing the score of indicators on life expectancy, education, and income will surely improve the HDI value."
To implement laws and rules in forestry sector (3)	• "there has been marked improvement in forest management" • "authorities might successfully set strict conditions in environmental assessments which are required for FDIs." • "Myanmar was able to implement laws and rules in forestry sector which played the vital to regulate the behaviors of the local people regarding to use of forest product which might have the milestone for decreasing GHGpsc. Moreover, the people of Myanmar might have highly depended on forest and agriculture for livelihood before implementation of new laws and rules on forestry sector, but the new laws and rules might have forced the local people to shift their economy

Answers	Representative Comments
	from traditional way of living embedded with forest and agriculture to non-agro-forestry sector.”
Remittances from overseas workers (1)	• “Many people from Myanmar work outside the country. For example, after Filipinos, they are the next biggest group of foreign healthcare workers in Singapore.”
Technology increases productivity (2)	• “The limited increase in CO2 in this transition may be at least partly due to (i) adoption of energy-efficient technologies from other countries; (ii) donor-funded projects to provide or introduce such technologies.” • “Myanmar may have realized that the increase in technology increases productivity e.g. more lumber with forest replacements in parallel, as replacement. With increased production there was no need for more labor. The additional labor force did other economic activities. Also increased technology reduced wastage and therefore carbon emission.”
Hydro based with low GHG emissions (3)	• “Myanmar has developed many hydropower plants with investors.” • “Myanmar’s energy generation is concentrated to hydropower which accounts for almost 70% of the installed capacity.” • “Maybe new FDI industry and increased services were supplied from grid, which is hydro based with low GHG emissions.”
Others (4)	• “further distancing from strict socialism and increasing opening up of the economy during the nineties” • “twin deficits” and “government prioritization of public investment and social spending.” • “In the given scenarios as mentioned, I think Decentralization of powers, fair and equitable share of benefits among central, regional and local level all governmental as well as non-governmental institutions should be main cause” •

The numbers in parentheses in the table refers to the numbers of experts who mentioned the factor in their responses.

Table 55. Experts' responses for the question related to Nepal

Answers	Representative Comments
Remittances from Nepalese working abroad (36)	• "One of the key factors is the remittance and in fact Nepal is amongst the top 5 countries to receive highest per capita remittance in terms of GDP." • "… and foreign remittances have resulted in steady reduction in poverty thus improving the health and income component which reflects in the steady incline in the HDI." • "One key contributor to the improved performance in health and income is likely to be the increasing income from employment abroad. A large section of the younger generation particularly in the rural areas seek employment abroad. This increases income of poor households increasing access to better health and also increases awareness in many areas including health related awareness. This phenomenon also may have taken more people out of agriculture and forestry- based activities which would have eventually contributed GHG reduction in LUCF." • "these workers' allowance to their relatives/families reaches around 20% of Nepal's GDP." • "One possibility is that income growth has been driven by remittance from migrant workers, such as in Middle East. I remember that the remittance accounts for more than 10% of the total income of Nepal. If this remittance flow is used for domestic households to consume imported goods, Nepal can achieve income growth without increased domestic production vis-a-vis additional emission of CO2." • "Nepal has been benefiting by remittance. A very big number youths are working in countries like middle east (sic), South Korea, Japan and Malaysia. Also, there are some in Europe and America. They left home with elders. Farming occupation is almost abandoned from much of villages in Nepal. They can buy good food and visit hospital if they fall sick."

Answers	Representative Comments
	• "Nepal's improvement in HDI –income, health and education -- are largely credited to the emergence of democracy and political transition. This historic transition has shifted the economic activities -- largely the agro- and forestry based into remittance based. Country's economy show (sic) a lot of cash flow from remittance—that gave higher income and hence better health and education condition." • "Regarding the improvement of HDI, I think, the government direct and indirect policy also promote the youth for migration to Arabian Countries for labour work. Today, the remittance of the youth is became (sic) main source GDP of the country as well as household income which have been using for health, education, food and so on." • "The economic component is also found improved even in the political instability because of remittance particularly the labor force supply to the overseas countries. It is estimated that about 50 hundred thousand Nepalese youth now in overseas for employment. Instability create an environment to the youth to go to foreign employment. So the major portion of country's administration expenses is bearing by the remittance."
Increased migration (2)	• "The heavy migration of labor man power specially productive age force is either went abroad for job huntings (sic) or gathered around big cities of Nepal. This situation in other way caused no chance of clearing forest or income from forest by damaging it. So despite political instability since 2006 and even before, the attraction towards natural resources is lessened. Now the situation is forests and wilderness increased and agricultural encroachment reduced." • "shifting agriculture to urban labors has been observed, though they are still poor while economic indicators are not necessary getting worse, and quite a few have worked as an

Answers	Representative Comments
	overseas Nepalese worker, which would significant economic indicators.”
Service sector (particularly tourism) (11)	• The massive increase in adventure tourism over the last 2-3 decades which has added significantly to Nepal’s GDP” • “I suspect the significant change in tourism arrivals, from 2003, is a big factor, since it is the main source of revenue in the country, and foreign exchange earner.”
Increasing health facilities (12)	• “The big push of the government in terms of increasing health facilities with support from various development partners is also improving the health components” • “the government focused on the health sector’s development.” • “technological innovation in health care service.” • “Increment in primary health care and establishment of community health centre” • “In health sector, health post has established in every area of country and mobile health camp was done in remote area of country for diagnosis of disease of cure has been done” • “In health sector health services centers are increasing day by day” • “Number of health workers and doctors employment is increasing in hospitals including Government and private” • “Numbers of health-related institutions are increasing in both government and private sectors.”
Increased or continuous government and donors funding for maternal health, and female community health volunteer	• “Improved HDI could be due to a number of factors including increased or continuous government and donors funding for maternal health” • “Increased health facility in rural areas under the Ministry of Health. According to the data of DoHS, besides Doctors, Nurse/ANM and HA, around 3190 village health workers, 3985 MCHW and 63326 female community health volunteers including trained traditional birth attendants have been mobilized.”

Answers	Representative Comments
(6)	
Increased access to health services due to improved rural roads (3)	• "Improved HDI could be due to a number of factors including increased access to health services due to improved rural roads." • "Comparatively health facilities are increasing throughout the country due to transportation and communication services and people have access on it."
Support from various development partners (11)	• "ODA may have stalled during the civil war years, but the MDBs and other development partners have maintained a significant presence and have been trying to expand financial assistance since 2006." • "the ODAs support remained continuous in peace building and health sector even during the period of insurgency which helped to improve HDI in the health sector." • "It is experienced that ODAs support was significant even when the state of political stability and peace was fragile in Nepal. During the insurgency, development partners consulted with the GoN and agreed to prepare the Basic Operating guidelines (BOGs) to pour their development assistance in different sectors like, health, education and improved governance."
Government investment and efforts (9 including one negative view)	• "In addition to the support from donors, the Government of Nepal is also increasing its investment from its national budget in the health sector." • "the government has invested substantially in health and education sectors which have helped the country to achieve better human development outcomes." • "The health component is able to improve HDI because Government of Nepal has been started the health insurance policy from which people are concerned about health." • "Improvement in Nepal's HDI in health component might be due to Effectiveness of GoN plans and policies in health sector and prioritization of health services in national annual budget."

Answers	Representative Comments
	• "During this period, Nepal HDI particularly child mortality and income poverty have been significantly improved within several unfavorable situations. Here are some reasons: Nepal has been investing huge resources in community based small but effective programme since long time like safer motherhood programme, community forestry programme, adult literacy programme and free primary education for all. These types of programme have positive impacts in other development sectors including health education and income. Adult literacy programme has not only contributed in literacy rate but also improve their knowledge and participation in health and education as well." (2 experts particularly focused on the government efforts for achieving an inclusive growth.) • "Nepal makes its best efforts on inclusive growth, improving access to clean energy, education, clean water, etc., in rural communities" • "Improvement in both health and income indicators of Nepal can be attributed to a political consensus to pursue inclusive development with focus on HDI within the overall framework of aid supported reconstruction and rehabilitation efforts." (negative view on the government investment) • "the support from the government at policy and program level was not extending at the required level at the grass root."
Awareness-raising campaigns/activities (11)	• "Similarly, the Government of Nepal has concentrated comparatively more on sensitization and awareness-raising campaigns/activities (hand wash campaign, immunization campaign, and maternal health services) on health issues in rural areas which supported to improve the health of rural people."

Answers	Representative Comments
	• "Improving the access of information about health - Healthcare Foundation Nepal (HECAF- Nepal) uses healthcare magazines for disseminating information about healthcare services, events, news and other issues concerning health which has improved the life of people." • "Improvement in Nepal's HDI in health component might be due to …. Conduction of awareness program focused on child and maternity health to reduce infant mortality rate and deaths during pregnancy" • "Nepal's HDI, particularly its health and income component able to improve may be because of …. Launch of awareness raising programmes like the welcome to School Initiative, health campaigns, primary health services ensure the access towards the services." • "Nepal's HDI particularly its health component is improved because of the development and mobilization of Village health workers (VHWs) across the country particularly focusing in the rural and remote locations. These VHWs has provide their extra effort to increase the awareness level of women in the family. Organised mass awarness campaign in the community, local school aiming to increase the awareness on sanitation health and hygiene. The Government of Nepal has provided continuity to this programme from the beginning due to its successful outcomes. So this achievement made so far even in the difficult circumstance, while the country possesses through an insurgency or serious political conflict and instability." • "Growing awareness on climate change and also putting effort on mitigation and adaptation" as one of the main reasons for reduction of GHG.
The laws and rules related to forests in legal sense (13)	• "Forest conservation has been supported mainly from the fact that the country has suffered from flooding, land-sliding, and earthquakes, and that the poor are the most affected people."

Answers	Representative Comments
	• "the application of laws and regulations that related to forestry helped to decrease the adverse impact to the establishment of forestry, which contribute to the GHG emission reduction." • "better management of forest sectors has contributed to Co2 emission reduction through sequestration." • "Certainly, there is change the forest policy in the past which create an enabling environment and increased people participation for the conservation and management of forest resource." • "The younger population with better education are not inclined to be in the forestry business. Further the rules and regulations make it difficult for those who wish to enter into the industry to do any business." • "the main reason for reduction of GHG" was "Enforcement of forest act and rules and several guidelines related to forestry through the period of 1976-2015."
Community forestry (12)	• "a core policy of Nepalese Government" • "the forestry laws and rules also promoted to make the community forestry more inclusion." • "The community forest management model in Nepal substantially contributed to forest conservation in Nepal." • "Community forestry is resource-based organization which has played key role in promoting education, health (through emergency fund they have established), and invested in income generation activities for poorer members of the community." • "The community forestry programs from the early 80s were responsible for the greening of the Middle Mountains and High Mountains of Nepal including parts of the frontal foot hills (Siwaliks or Churias) bringing noticeable LUCF in Nepal." • "has been progressively updated to take into account the needs of local communities and the experiences of stakeholders involved in community forestry projects. Local

Answers	Representative Comments
	people are involved in managing forest areas in order to fulfill their needs for forest products and, indirectly, to enhance the conservation of soil and water, whilst contributing to improving the environment” • “While development agencies/donor supported in forestry sector there was less priority in forest management that’s why forestry programmes are not very much affected with donor support. But for acceleration of active forest management there is need of external fund and will have good return.”
Alternative energy options (10)	• “Fuel wood consumption is decreasing due to other options.” • “In rural community of hill region of Nepal, the domestic smoke pollution is the major cause of respiratory infection in women and children. Death of young children due to acute respiratory infection was mainly due to indoor smoke. However, this disease is decreasing with changing the trend of consumption of fossil fuels and the introduction of alternative energy options such as improved cooking stoves, solar home system and micro-hydro from last few years.” • “People’s dependency on forest for their livelihoods reduced. Because, people planted forests in private farmlands, availability of Liquid Petroleum Gas as cooking energy and reduction of population dependent on agriculture. In addition to this, people are-encouraged to use alternative energy – improved cook stoves, bio-gas, solar power, micro-hydro.” • “Uses of Alternative Renewable Energies like ICS, Biogas, Micro-hydro, Solar, Improved water mills have also helps in reduction of GHGs emission.” • “Nepal’s low GHGpc per capita should be low simply based on it source of energy. For example, power is largely dependent on hydropower. As a result, the country’s emission factor for the power generation is almost a zero value. Therefore.”
Education (6)	• education was one of keys to improve HDI of Nepal.

Answers	Representative Comments
	• "government has set up health services to the rural areas. Peoples' awareness on modern medicine has increased sharply. Education and media has also positive role in raising awareness in public" • "Adult literacy programme has not only contributed in literacy rate but also improve their knowledge and participation in health and education as well." "The younger population with better education are not inclined to be in the forestry business."
Pervasive NGO involvement (3)	• "Nepal is the darling of the NGO community. Huge increase in local community development activities across all villages and towns." • "Healthcare and hospitals partnering with NGOs/INGOs operating different social work spreading awareness programs like health education, organizing specialty health camps to treat villagers at a reduced cost or free of charge as well as providing regular immunization and family planning advice and devices." • "Instead of political stability, peace and increasing ODAs, sector activities shifted out of forestry due to the promotion of renewable technology by different INGOs/NGOs has reduced the GHGs emission per capita."
Change in Agriculture (3)	• "The likely contributors to increase in HDI in Nepal over 1990-2010 are increase in income from growth of the agriculture sector and…" • "modest reductions in fertilizer use and other agricultural efficiency improvements could account for a lot of CH4 and N2O reduction which shows up in the LULUCF accounting."
Military conflict ended (2)	• "Nepal officially began a new era of peace in 2005-06 when – after 10 years of civil war - the Maoist rebels agreed to lay down their arms. The military conflict ended, which may account for most of the health and income improvements, but the political conflict did not."
Composition of exported goods	• "the Nepal's composition of exported goods has varied over the course of the period. As its major trading partners, such

Answers	Representative Comments
(3)	as India, change their industrial structure, their needs for imported goods from Nepal may be changing. India may no longer need wood from Nepal, rather they want other goods, such as small agri-based products." • "Nepal accepted direct investment from India in textile sector and increased export of carpets and textiles to India."
Small scale entrepreneursh ip/income generating activities at local level (3)	• "Small scale entrepreneurship/income generating activities at local level…. has played significant role to enhance individual livelihood contributing towards national economy" • "the local resources base enterprises were established and proper functioning of micro-finance at local level, whereas easily access and control of local people on financial movement, resulting increase the income of local people."
Restraining livestock activities (2)	• "Improved productivity of animals through better nutrition, health, management and breeding acts as a mitigation strategy reducing GHGs emission from the livestock sector. Similarly, increased productivity of livestock reduces GHGs emission per unit animal products (milk, meat etc.) and thus helps to reduce total GHGs emission either by reducing the number of animals or by reducing rate of increase in livestock population."
Empowering the most marginalized in the society (2)	• "Poverty reduction from promoting the empowerment of marginalized groups emphasizing equal opportunities for all. Access of empowerment to women in various rather than their capabilities, such as political participation and decision-making, economic participation and decision-making, and power over economic resources" • "Nepal's HDI, particularly its health and income component able to improve may be because …. the greater attention has been given to empower the most marginalized in the society,"
Others (communities level efforts	• "Nepal is under the developing country, however, there was successfully achieved the visible improvement in the different HDI indicators particularly, health and income

Answers	Representative Comments
and commitments, ownership development)	component because of …. increase communities level efforts and commitments, ownership development….”

The numbers in parentheses in the table refers to the numbers of experts who mentioned the factor in their responses.

Table 56. Experts responses for the question #1 related to Mongolia

Answers	Representative Comments
Socialist regime (2)	• “Mongolia is experiencing a rapid population migration to Ulaanbaatar since early 2000s. During the socialism period, population migration must have been restricted, but people are migrating more with a freer movement policy and repeated Zuds (cold winter). Probably, the “green development” in 1990s was the benefit of the socialism regime.” (negative view) • “Two different periods can be identified. 1990-1995, the GHG emission decreased significantly. 1995-2000. GHG emission started to increase slowly. One explanation could be the withdrawal of the soviet support to the country leading to a slow down the economy and industrial sector, and therefore a fall on the related emission. Meanwhile, as the move to market economy was taking up the economic indicator and the income level went up….. the decrease or good performances in GHG emission appear to be mainly due the industrial and economic slowdown in the early 90th caused the change of political changes.”
Growth of the service sector and private & public-sector trading	• “Probably it is because of the growth of the service sector and private & public-sector trading.” • “the share of manufacturing and construction were diminishing, while mining and some service sectors were

Answers	Representative Comments
(2)	expanding. This may explain the decreased GHG emissions…. Increased revenues from the mining sector may have contributed, to some extent, to increase in those social welfare payments and also investments in education and health.”
Efficiency and technology	• “The decrease in GHG emissions could be accounted for by efficiency improvements, e.g. via modernization of combined heat and power (CHP) plants, as well as exports of coal for which GHG emissions are reported in the country of final use” • “I guess that GHG emission from the energy sector decreased, maybe because more efficient power development was achieved thanks to the increased ODA along with its relevant higher technical standards.” • “I think there was a huge influx of returning citizens from Europe and north America seeking to invest in the new economy and speculate. They significantly changed the attitude to traditional soviet era environmental management and construction and energy industries – and as you mentioned introduced more efficient and more profitable approaches with new technology.” • “I think Mongolia’s energy generation as well as manufacturing was (and to some extent still is) relying on highly inefficient and polluting technologies from the Soviet era. I’m sure there was a huge room for improving GHG emission per unit energy generation or per production.” • “Perhaps it moved towards renewable energy.”
Opening up the economy (2)	• “The reason is possibly due to opening up the economy to private sector participation in the manufacturing and construction sectors” • “the move to market economy was taking up the economic indicator and the income level went up…. income increase might be related to the transition to the market economy.”

Answers	Representative Comments
Non GHG emitting productions (5)	• "it seems that in the mid-90s the economy picked up but Mongolian economy during that time is mainly related to livestock and production of other "rural agriculture products" (for the lack of better term) such as production of cashmere/wool, dairy, etc." • "GHGpc declined with the education in livestock rearing." • "The improvement in income with decreased GHG emissions suggests that there were more investments on non-GHG generating sectors like health and education." • "Mongolia's reliance on low emission agriculture…. explains income growth with decreased GHG emissions."
Sparsely populated country so did not fit with large scale manufacturing and energy industry (1)	• "any economic improvement has minimal effect in GHG emission." • "Manufacturing and energy sector is not well-developed at this time or not at scale that could drastically change GHG emissions…. I think it is important to contextualize population increase and economic growth of the Mongolia. Mongolia still remains a sparsely populated country compared to other developing countries in Asia. Economic activities are concentrated in few selected areas in the vast country. Only one or two big mining operation and several enterprises makes up the economy. The energy sector is not that developed in 1990-2000. Most people are not connected to central heating or electricity services and major power plants and heating boilers at that time may not be operating at its full capacity as they are in need of repairs or upgrades (most are built during the time when the country had strong economic ties with Russia."
Democratic system that has emerged (2)	• "Although Mongolia has experienced numerous changes of political leadership over the years since the fall of the former USSR, the democratic system that has emerged has been predictable (if a bit messy) with 2 major parties taking turns running the country" • "Mongolia chose a parliamentary system. The parliamentary system is a very volatile system in a short

Answers	Representative Comments
	run, which is characterized by frequent change of governments, change of political heavyweights in the parliament. At the same time, this kind of system provides more stable political development in the medium and long run.”
Majority of industrial enterprises went bankrupt (4)	• “we should note that right from the moment of the Soviet Union collapse in 1991, With the collapse of the and sharp decrease of economic support from the Soviet Union, majority of industrial enterprises went bankrupt, shut down and ceased to exist. Sharp decrease in a number of the industrial energy users has resulted in a sharp decrease of energy consumption, hence reduction in GHG.” • “trading with Russia drastically decreased after 1990. Many sectors in Mongolia severely damaged for a while.” • “You are right that there was decreased GHG emissions from manufacturing/construction, as many state enterprises of these sectors have been bankrupted and dismantled” • “Mongolia’s per capita GDP was around \$1000-\$1500 in late 1980s, while it sharply decreased to around \$500 in early 1990s. From 1990s up to around 2005/2010 (until the mining boom arrived), the Mongolian economy seriously stagnated, and that is why GHG emission decreased (or no major increased).”
International bilateral and multilateral donor organization (6)	• “During 1990-2000, which we name as an economic transition period from centrally planned to market economy, income was maintained at steady improvement because solely of the ODA.” • “international bilateral and multilateral donor organization helped the country sustain the HDI level inherited from the former socialist system, which used to invest substantial financial resources in education, healthcare, infrastructure and other aspects of HDI,” • “I guess that GHG emission from the energy sector decreased, maybe because more efficient power

Answers	Representative Comments
	development was achieved thanks to the increased ODA along with its relevant higher technical standards," • "Mongolia could not continue relying on single support from Soviet Union as from 1990's. Mongolia started acceptance from other developed countries from 90's," • "Introduction of leapfrogging technology was a result of combined educated workforce and higher levels of ODA. Donors are always interested in environmental consequences of aid supported projects," • "ODA assistance improved the energy efficiency of the manufacturing and construction sectors, which helped income increase without increasing the GHG emissions."
Exports of coal (and minerals) for which GHG emissions are reported in the country of final use. (4)	• "exports of coal for which GHG emissions are reported in the country of final use." • "If it is mining sector that contributed to income increase, it may happen without causing significant increase of GHG emission (because large GHG generation will happen where the fossil fuel is consumed)." • "the coal price without huge fluctuation throughout the period 1990-2000 is the key to maintain its income steady improvement," • "From the early 2000s, the country enjoyed a kind of resource export boom (copper, gold etc.)."
Severe weather and climate (1)	• "Construction increased but is still restricted to non-winter months."
Overseas remittance (1)	• "Perhaps, household income was supplemented by overseas remittance"
Others (5)	• "Majority of people could have involved in production sector, through promotion of private sector and smallholders." • "Willingness and responsibility of each citizen to combat global, regional and sectoral challenges are main thing."

Answers	Representative Comments
	• "Introduction of leapfrogging technology was a result of combined educated workforce and higher levels of ODA" • "The implementation of Leapfrogging technology and investment in education sector might have play important role to maintain steady improvement of the Mongolia's HDI."

The numbers in parentheses in the table refers to the numbers of experts who mentioned the factor in their responses.

Table 57. Experts' responses for the question #2 related to Mongolia

Answers	Representative Comments
Yes, it happened by the large increase of ODA (17)	• "the development happened to Mongolia since 1990 is closely related with ODA." • "Given Mongolia's PPP scheme has been shaky to date, I believe ODA has played an important role. It is doubtful if the state-of-the-art technologies could have been introduced by the private sector alone." • "ODA specially from European countries require the adoption of Best Available Technologies (BAT) in supported projects." • "the state-of-the-art technologies generally cost a lot." • "large increase of ODA since 1990 may have contributed to the introduction of leapfrogging technology. Leapfrogging technology requires substantial funds to ensure it will work effectively and achieve the desired efficiency." • "especially the introduction of more advanced technology in the mining sector, and combined heat and power production." • "the ODA is assisting in development of establishing a better urban infrastructure including energy efficiency of buildings, sewage, drainage, healthcare. The government, in consultation with international organizations and the United Nations, aims to utilize resources from Mining to reduce the nation's carbon and ecological footprints, reduce the high air pollution at Ulaanbaatar that houses at least one-half of the national population due to power plants, burning and vehicular pollution."
No, it was not happened by the increase of ODA (3)	• "I don't think there are a lot of leapfrogging technology introduced at this time. ODA increase at that time is mostly to support the country while it is in transition in the early 90s, setting up basic infrastructure such as roads, water supply, healthcare facilities, toilets, etc.; and assistance during natural disasters such as dzuds. But at that time a large part of ODA efforts are related to bringing

Answers	Representative Comments
	in electricity/heating and connecting the country through transportation and communication networks. ODA, of course, brings in technology from outside Mongolia to solve issues in cost-efficient and timely manner.” • “Mongolia faced serious economic difficulties after the disintegration of Soviet Union. If you see the economic trend with longer span, Mongolia’s per capita GDP was around \$1000-\$1500 in late 1980s, while it sharply decreased to around \$500 in early 1990s. From 1990s up to around 2005/2010 (until the mining boom arrived), the Mongolian economy seriously stagnated, and that is why GHG emission decreased (or no major increased). And that economic crisis was the major reason why ODA significantly increased in that period.” • “The large increase of ODA is, I believe, due to the transition to the market economy and the withdrawal of the Soviet Union support. I am not sure about the leapfrogging technology you are referring to. It is more likely that the end of soviet system had negative impact on the overall society initially. Then a modernization process took place after mid-90th both due to private sector investment (especially mining industry) and ODA support.”
It was brought by private sector investors (3)	• “In my opinion, ODA was not the main reason for introduction of leapfrogging technology in Mongolia. Main technological innovations, such as coal-to-gas in the energy sector, exploration and extraction technologies in the mining sector, new materials and technologies in the urban infrastructure sector mainly were brought by the private sector investors. At the same time, ODA brought so much needed investments in the public infrastructure, including public roads; energy sector, including combined heat-and-power stations; aviation sector, including air-navigation equipment, and support to the government financing of education, health and social protection sectors. These ODA support allowed the government to

Answers	Representative Comments
	smoothen the transition period of early 1990-s, as well as passage through the financial crisis periods (Mongolia used IMF bailout 3 times since early 1990-s)." • "a modernization process took place after mid-90th both due to private sector investment (especially mining industry) and ODA support."
Mongolians place a high value on obtaining the latest technologies (1)	• "During informal discussions with Mongolian business people and government staff, it has been expressed to me several times that Mongolians place a high value on obtaining the latest technologies and wish to be up to date with global trends. In one example, a business man explained that the country needed certain medical technology, and even though there was no one qualified to operate it, the priority was to obtain it first."

The numbers in parentheses in the table refers to the numbers of experts who mentioned the factor in their responses.

Table 58. Experts' responses for the question #3 related to Mongolia

Answers	Representative Comments
The education improvement (9)	• "Education and health had been priority for major donors in Mongolia, including ADB, JICA, and to a lesser degree, the World Bank. There were also other bilateral donors (China (PRC), Republic of Korea, etc.) which supported education." • "ODA at that time includes education improvement, including trainings and capacity building to operate new facilities and to help the government in developing long term plans. Around 1990-2000 GHG emissions are not among the more urgent concerns, hence not the primary focus of ODA at that time. But sustainable development is among the focus then so ODA were seemed to be geared towards efficient resource use." • "(ODA) was vital support Mongolia during this period and it is true that donors placed high priority on improving education system and supporting energy sector through provision of technical supports." • "access to education to so called "Manhole children" had gotten some attention from donors. As Mongolia was socialist country, I believe that access to education and standard of education were high in general."
The decreased GHG emissions from the energy sector (4)	• "Japan's support on Mongolia in 90's was in energy, transport, and telecommunication sector, and then, it was extended to education, health, and agricultural sector." • "At least, ADB has always put a priority in minimizing environmental impacts from the energy sector."

	• "ODA was only one of a multitudes factors for economic development of Mongolia…. One exemption is ADB's financial assistance for upgrading combined heat and power stations in Ulaanbaatar. These projects helped the city improve efficiency of the city's energy sector." • "The decreased GHG emissions from the energy sector could suggest that sources of GHG emissions may have used cleaner production technologies, improved their energy efficiency, or use renewable energy in their operations."
The decreased GHG emissions from manufacturing/construction innovations (3)	• "(ii) and (iii) have always been the priorities of the donors in my understanding."
All 3 of these key areas (4)	• "I am confident that the donors placed high importance on those factors during the design of the ODA projects",
Others (2)	• "Presumably, the international standards applied for the Oyu Tolgoi mine make some contribution, to minimize environmental impacts and GHG emissions" • "maybe just education for the energy sector because the companies need energy related workforce."

The numbers in parentheses in the table refers to the numbers of experts who mentioned the factor in their responses.

Table 59. Experts' responses for the question #1 related to Bangladesh

Answers	Representative Comments
planned/intended/controlled (13) but majority of them (9 experts) talked about the development of Bangladesh as a whole, rather than specifically talking about the "balanced development."	• "The successful outcomes in Bangladesh are because a lot of the government programs (even for local infrastructure development) are designed as bottom up and community driven. Government programs have also managed good convergence with independent bottom up initiatives (such as Grameen Bank)." • "Bangladesh has been constantly politically unstable, but this has been predictable, and in my experience, this has not really shown up in daily life in Bangladesh. Despite recent events, Bangladesh has been quite peaceful over the period 2002 – 2012. My understanding is that all Governments over that period, despite massive corruption, were planning to develop the industrial and transport sectors, and garments for foreign exchange, and these things actually happened, whether one party or the other." "The development that happened in Bangladesh is largely due to planning, rather than good fortune. The public in general and private sector in particular have responded positively to such planning providing the required synergy." • "Bangladesh has had great successes with family planning, with average HH size having just over 2 children, so some gains are well planned," • "I think in summary external countries would have pushed Bangladesh first. Then the Gov started planning as they realized they needed sustained growth because they started learning from the neighbors." • "Bangladesh has a working development planning system in the government that may

Answers	Representative Comments
	have been instrumental in their balanced development" • "Balanced development is well planned. Focus has been on health, education, skills development and reduction in greenhouse gas emissions, connectivity, electronic communication, and energy sector development. Bangladesh is also benefitting from its roles in regional cooperation." • "Since the Government does follow development plans I think that up to a certain extent the balanced development would have been planned and intended." • "The balance development that happened in Bangladesh was happed by planned/intended/controlled because the rapidly growing population has higher demand of consumption that happen to pressure on energy use. The higher pressure ultimately leads to increase the rate of GHG which is essential to control."
Combination of good planning and fortune (3)	• "It is probably a combination of both. Bangladesh has a planned economy, but implementation of plans may not be great. We might say that Bangladesh got lucky but was ready to capitalize on that luck." • "BAN has a strong civil service and it may have worked with international players and guidance to achieve more with limited resources."
Fortune (4)	• "I doubt whether it was planned or controlled. It was probably fortunate event. I think access to forests probably decreased due to poor infrastructure, and thus resulted in lower forestry practice."

Answers	Representative Comments
	• “No, not planned I think it’s a fortune of without plan/intention. Bangladesh stood one of most corrupted country. Improvement of this development indicators sounds promising. Who knows citizens, society and environment themselves are also resilience as well.” • “This has probably been without planning. GHG emissions are probably a result of increased use of natural gas versus heavy fuel oil during the early-2000s. But, this is probably changing now since Bangladesh is running out of gas and the share of heavy fuel oil in the power generation mix is increasing again.” • “Reason is not clear but it is definitely not due to planned/intended/controlled efforts of the government. Small NGOs, women and overall hardworking populations efforts and innovation led to its good performance. This is something even the economic discipline yet to explain.”
Natural direction (1)	• “Bangladesh has been able to maintain sustained economic growth over the years and as a result the ability of the state to expand its assistance in health and education has increased significantly. This may not have been planned that way but it is a natural direction in state sponsored programs when moving forward in a country with high poverty levels.”
Learned from the past (1)	• “While I suspect that it may come from the large volume of population as well as rapid increase in population, the balanced development that happened in Bangladesh is not necessarily planned/intended/controlled. Energy and industrial sectors are relatively good due to significant foreign investment mainly garment sector, which has already facing an invisible

Answers	Representative Comments
	wall due to hiking labor cost. On the other hand, Bangladesh development may not be necessarily sacrificing environment. Flooding and poor quality of water environment has already caused the detriment of environment. Government of Bangladesh recognized the issue, and their priority has been given to the shifting water source from groundwater to surface water, and the urgent need of solid waste management."

The numbers in parentheses in the table refers to the numbers of experts who mentioned the factor in their responses.

Table 60. Experts' responses for the question #2 related to Bangladesh

Answers	Representative Comments
Yes (Sacrifice environment) (8)	• "Post 2019, there will be larger increase given introduction of large base-load coal power plants. In the power sector, Bangladesh is likely to balance increase in domestic coal with increasing power imports as these would be economically efficient compared to imported gas (there are expected gas shortages post2020)" • "There is possibility of sacrificing the environment. For example, the current government plans consider potential construction of coal-fired plants that would increase air pollution and CO2 emissions." • "its gas resources are almost consumed. So it will have to shift to Coal and other dirty sources. As of now chances are high that environment will be sacrificed for the development." • "Bangladesh is arguably following the "scorched earth" development path of India and the PRC, but mainly because population density continues to increase and there is tremendous pressure for economic development including improvements in agricultural productivity through more intensive use of fertilizers and other agricultural chemicals." • "there has been a total abdication of environmental management, so the environment has been sacrificed for industrial development. There is no Government will for enforcement of environmental regulations (there is a lot of corruption that accounts for this…)."
No (will not sacrifice environment) (8)	• "The focus has been on increasing the health facilities, access to education and social protection which essentially need not be achieved at the cost of environment." • "No- because the government plans did not include such mega scale infrastructure- the priority was getting the key connectivity infrastructure implemented (roads, railways, transmission lines) and balancing with local development priorities. Their aim was to lift people out of poverty,

Answers	Representative Comments
	through infrastructure and community development that is more suited to their local context. The country is also quite exposed to climate change and has limited financial capacity for investing in mega infrastructure. The investment climate also did not attract large private sector players (who could "Bangladesh is highly sensitive to environmentally sustainable development." • "Considering the vulnerability of the country, it is a risky take if development is prioritized at the cost of environment." • "Even though there is no specific emphasis in reducing environmental impacts in the development programs, the awareness among the stakeholders of the need to be conscious of the adverse environmental impacts has driven the development programs to be more environmentally acceptable. Also, many of the development programs are largely funded by external development partners and hence environmental protection is embedded in the programs. Therefore, it is unlikely that Bangladesh will go through the same path as that of China (PRC) and India." • "The economic growth of Bangladesh has been driven mainly by external sector: (i) growth in remittance and (ii) growth in export of garments. They are not much affected by the state of politics, peace and ODA as domestic sector. In terms of HDI growth, large non-profit organizations, such as BRAC or Grameen, may have played a significant role in improving availability of quality education or healthcare services especially in rural areas." • "I do not agree that it be should happed as India and China (PRC) are doing. Because we should understand and analyze the political economy of the countries. Bangladesh do not have the same power that of China (PRC) and India in the world. Therefore, Bangladesh should be back to its strategies by the pressure of developed countries even India and China (PRC)."

Answers	Representative Comments
	• "Bangladesh is somewhat lucky vis a vis India and China (PRC) as the country possesses natural gas resources, a source of clean energy and which as of present is the basis for more than half of the country's energy needs, to supplement increasing energy demand. The country has so far planned its energy resources well. If it were not for that planning, the situation would have been different, but not to the extent that of China (PRC) or India."

Table 61. Experts' responses for the question #3 related to Bangladesh

Answers	Representative Comments
Local development and rural electrification (4)	• "The present government has made goals on 100% electricity access and per-capita power consumption by 2021 and is working towards these targets." • "Local development through micro-credit, gramin development bank, Mohammad Yunus, Noble Laurette on Economics from Bangladesh." • "connectivity and clean energy." • "Despite political confusion, Bangladesh has maintained a reasonable level of planning and execution in all sectors, starting from proper planning in. energy…. ."
Foreign investments (2)	• "One of the policy measure taken is the FMA (Multi-Fiber Agreement). With FMA, the Government successfully invited foreign investments on the textile and garment subsector that did not produce much GHG and could absorb increased population by engaging them as cheap labor forces." • "Bangladesh policy makers have helped improve the climate for foreign investors and liberalizing the capital markets by making it a better investment for foreign firms for oil and gas exploration and construction of natural gas pipelines and power stations."
Improve the living standard and poverty	• "The policy goal was set to improve the minimum living standard"

reduction (4)	• "Possibly, it is during this period that a Poverty Reduction Strategy Paper (PRSP), which is a development strategy document, allowed market mechanism as the driving force of development in Bangladesh." • "the policy goals and priorities set forth were in the areas of health care, quality of education, social security and improvement in the standard of living. The specific outcomes that were achieved were increase in health facilities, access to education and social protection." • "Bangladesh has a history of supporting strong social safety programs targeting the poor which may explain the small gap between top and bottom tiers."
Job generation and low labor cost (3)	• "Manufacturing sector developed quickly lately, which contribute to job opportunities and economy development, for instance, Bangladesh has become the world second largest textile exporter, after China (PRC). I think the development should be driven by job generation to the People, in this case, even without political stability (such as the central government changes frequently), the economy generally still can be improved in a certain level." • "the country benefits from low wages and increases in textiles jobs (garments sector) resulting from wage increases in other countries like China (PRC) and Vietnam." • "Over the medium term, Bangladesh's strength lies in competitive clothing sector thanks to relatively cheap labor."
Supporting export-oriented industry and private sector (3)	• "the policies of supporting export-oriented manufacturing and private sector focusing at such industries as the textile industry through using the competitive advantage of low manufacturing cost (low labor cost)." • "clothing sector" and "private sector."
Supports from development partners	• "Over the medium term, Bangladesh's strength lies in …. international aid helping to cover financing needs"

(5)	• "With improved political stability, and policy focus on capacity development, skills training, health, education, connectivity and clean energy together with regional cooperation and ODA support." • "do not have internal capacity to develop large scale infrastructure (both human resources and money). A lot of the money has come from the concerted efforts of development partners who also did not want to invest in mega infrastructure. I believe these development partners have significantly shaped the policy goals." • "whether one party or the other, there was a development plan, and development proceeded more or less as intended (although slow and subject to corruption). …while politics in Bangladesh were volatile, the predictability of "normal instability" allowed normal things to happen – life in the streets and construction of projects carried on… I have a sense that hundreds of millions of dollars poured into Bangladesh over the period you are interested in." • "The financial sector reforms in the country, which ADB supported, is regarded as one of the best in the region and supported proper capital allocation. Private sector has responded positively these changes." • "if total inflows did not increase noticeably from 2005; disbursement efficiency may have improved."
Health and education (2)	• "Despite political confusion, Bangladesh has maintained a reasonable level of planning and execution in all sectors, starting from proper planning in education /health, energy, transport sectors etc."
Others (1)	• "capacity development and skills training" • "the laws and rules either formal or informal (community-based institution and indigenous knowledge and practices)" • "proper planning"

The numbers in parentheses in the table refers to the numbers of experts who mentioned the factor in their responses.

Table 62. Issues Raised as the Factors That Became Reasons of Their Success.

	Myanmar		Nepal		Mongolia		Bangladesh	
	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc
ODA	Minor	Minor	Major	None	Major	Major	Major	None
Remittances	Minor	None	Major	None	Minor	None		
Trading	Major	None			Minor	Minor	Major	None
Secondary/tertiary/service industries	Minor	None	Major	None				
Better education	None	None	Minor	None				
To implement laws and rules	Major	Major	None	Major				
Technology/productivity	Minor	Minor			Major	Major		
Foreign investment	Major	None					Major	None
Empowering the most marginalized, Improve the living standard			Major	None			Major	None
SEZs	None	None						
Agriculture production	None	None						
Military regime	None	None						
Hydro based with low GHG	None	Minor						
Increased migration			Minor	None				
Increasing health facilities			Minor	None				

	Myanmar		Nepal		Mongolia		Bangladesh	
Government and donors funding for health			Minor	None				
Access to health services by improved rural roads			Minor	None				
Government investment			Major	None				
Awareness-raising campaigns			Major	Minor				
Community forestry			Minor	Major				
Alternative energy options			Major	Major				
Pervasive NGO involvement			Major	None				
Change in Agriculture			None	Minor				
Military conflict ended			None	None				
Composition of exported goods			None	None				
income generating activities at local level			None	None				
Restraining livestock activities			None	Minor				

	Myanmar		Nepal		Mongolia		Bangladesh	
Socialist regime					None	Minor		
Opening up the economy					Major	None		
Non GHG emitting productions					None	Minor		
Sparsely populated country					None	Minor		
Democratic system emerged					Major	None		
Enterprises went bankrupt					None	Major		
Exports of coal (and minerals)					Major	Minor		
Severe climate					None	Minor		
Local development and rural electrification							Major	None
Job generation							Major	None
Health and education							Major	None

Table 63. Evaluation of expert responses for Myanmar

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Secondary and tertiary industries	◖	This view does not precisely fit the data because (i) GHG emissions did not increase in CO2 from the energy and industrial sectors during the research period, and (ii) until the research period ended in 2010, there does not appear to have been sufficient political stability and peace to bolster the tourism industry. Moreover, some of the experts seemed to be confused about the research period (1990-2010) and discussed times outside the research period.
(ii) Foreign direct investment	●	Foreign direct investment in the private sector increased during the research period. This can also conceivably explain why some of the tertiary industries, including the service industries, became the receivers of labor that shifted out of primary industry and became income generators that replaced primary industry, since such investment supported labor-intensive sectors, the telecom sector, real estate, etc.
(iii) Agriculture production increased	○	one of these experts did not discuss the research period, and the view of the other expert does not fit the data analysis for this period
(iv) Military regime	◖	Controlling by military regime can explain why Myanmar's development was stable not much to be disturbed during the period, but this cannot provide a clear answer to the question itself.
(v) Trading (exports of natural resources increased)	●	The experts wrote that "The export of natural resources increased (natural gas, mineral, and oil)" for "trading with neighboring countries, such as China (PRC) and Thailand." This fact answered the question because the CO2 produced by the combustion of oil and gas was not counted as emissions from Myanmar.

Items Raised by Experts	Fit	Evaluation of expert responses
		It should be noted that this income increase was not a very environmentally friendly improvement, as it produced emissions outside Myanmar.
(vi) Special Economic Zones (SEZs)	○	The first SEZ in Myanmar was built in 2012-15 and so was outside the research period. Therefore, this cannot be the answer to the question.
(vii) ODA	◖	While the data analysis did not observe much quantitative increase in total ODA during the period, these experts indicated the possibility of qualitative improvement caused by the ODA even though the amount was not significant. The researcher cannot find any reasons to exclude this possibility. At the same time, this explanation seems too weak to have produced Myanmar's success, which was the most significant success in Asia during this period.
(viii) Better education system	○	The question specifically asks about the improvement of the income component among the three HDI indicators. In addition, the benefits achieved by education improvement (which produces responsive citizens) cannot provide a tangible answer to the question itself.
(ix) Implementation of laws and rules in the forestry sector	●	The implementation of laws and rules in the forestry sector, which can create conditions that are more favorable for receiving FDI, improved the efficiency of forestry and agriculture, which may have reduced emissions from these sectors or caused inefficient activities to be phased out of these sectors.
(x) Remittances from overseas	◖	While several experts pointed out this explanation for Nepal, only one response from a Myanmar expert raised the issue of remittances from overseas workers. While remittances could have been one of the reasons the income component improved

Items Raised by Experts	Fit	Evaluation of expert responses
		without increasing GHGs, their significance in Myanmar was not as great as in Nepal (More people gave this answer for Nepal).
(xi) Technology increases productivity		Two experts highly evaluated the benefits provided by technology improvements. These two experts indicate two different possibilities. One indicated that ODA and FDI expedited technology improvements in efficiency, while another indicated that the implementation of laws and rules in the forestry sector increased the efficiency of the forestry industry and, as a result, freed up additional labor that shifted to other industries.
(xii) Hydro-based energy with low GHG emissions		the additional energy needs produced by the shift out of the agriculture and forest industries were met by non-GHG-emitting sources, namely hydropower. But this cannot provide a clear answer to the question itself.

Figure 118. Summary of factors influencing successful development for Myanmar.

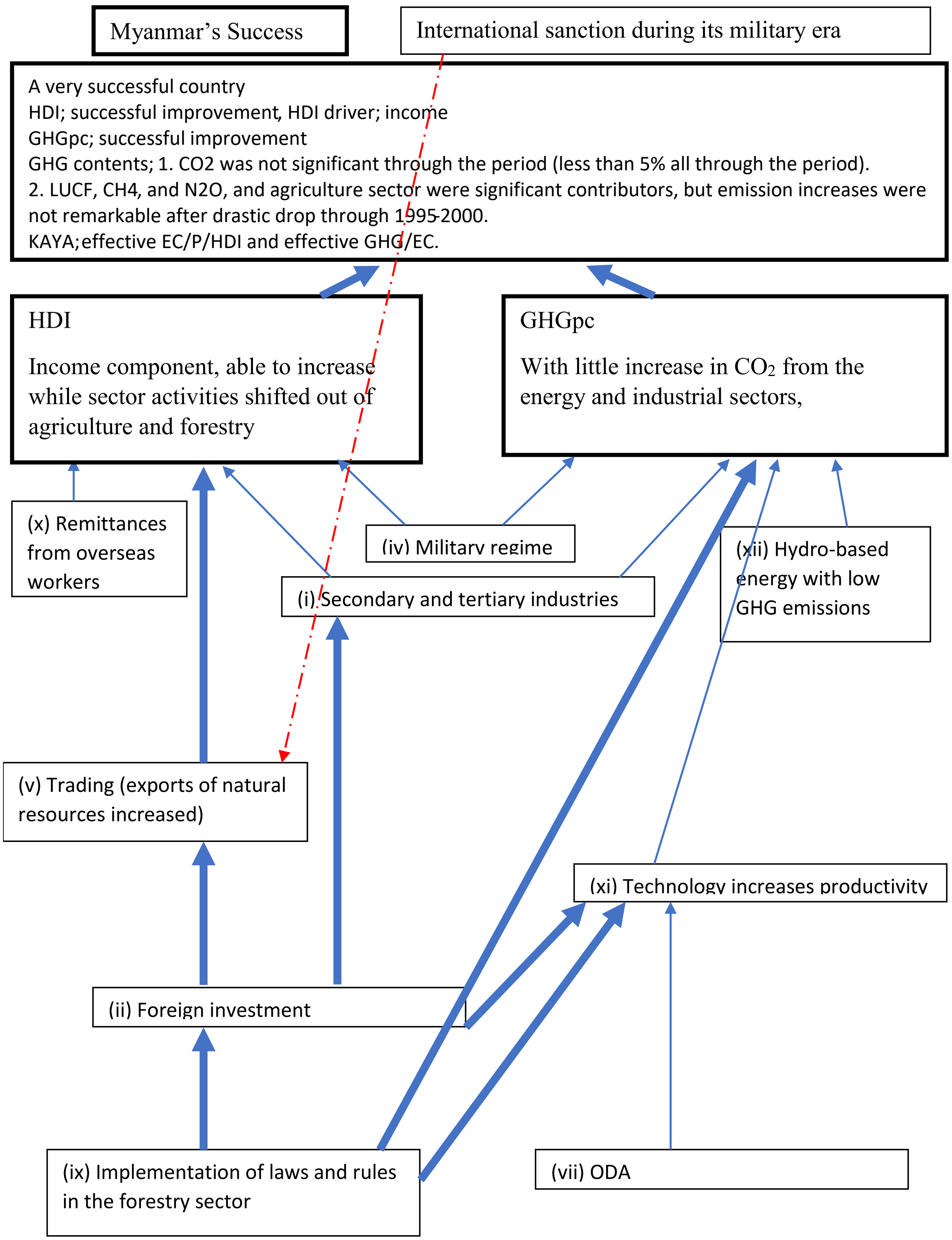


Table 64. Evaluation of expert responses for Nepal

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Remittances from Nepalese working abroad	●	36 of them raised this possibility, including 17 Nepalese experts. While popular answers are not necessarily correct, among all the questions for the four successful countries, this answer was given by the greatest number of experts.
(ii) Increased migration	◖	While (i) refers to Nepalese working abroad, this reason refers to migration within the country from rural to urban areas that simultaneously happened along the significant labor flaw moved abroad. Therefore, this reason is counted in addition to (i).
(iii) Service sector	●	According to eleven experts “Adventure tourism over the last 2-3 decades” “is the main source of revenue in the country, and foreign exchange.”
(iv) Increasing health facilities/ Increased or continuous government and donor funding for maternal health and female community health volunteers	●	Eighteen experts mentioned That donor and government funding and ODA, with technological innovations, improved/ increased health facilities including primary care and community health centers, government and private hospitals and doctors, and female community health volunteers.
(v) Increased access to health services due to improved transportation and communication services	◖	Three experts mentioned improved rural roads, transportation and communication services as a reason for the improved health parameter.

Items Raised by Experts	Fit	Evaluation of expert responses
(vi) Support from various development partners	◖	While the data analysis showed that ODA did not increase during the research period, 11 experts highly evaluated the positive impacts provided by support from donors, regardless of the amount. “It is experienced that ODAs support was significant even when the state of political stability and peace was fragile in Nepal.”
(vii) Government investment and efforts	●	In addition to support from various development partners, nine experts (including one negative view) mentioned government investment as the reason for the success. Two experts focused particularly on the government’s efforts to achieve an inclusive growth. Government efforts were beneficial for clean energy improvement, education through programs such as literacy improvement, for improving heath by better insurance policy, child mortality and clean water, and income poverty reduction. Education indirectly helped to improve health.
(viii) Awareness-raising campaigns/ activities	●	This can be treated as one of the government efforts mentioned above, designated by 11 experts as a remarkable issue. Those campaigns and activities became beneficial for improving health of rural people. In addition, one expert mentioned growing awareness of climate as one of the main reasons for the reduction of GHG.
(ix) Laws and rules related to forests in the legal sense	●	Their views supported the validity of the finding in the data analysis, clarifying one of the reasons activities shifted out of Nepal’s forestry business. Concern for flooding, landslides and earthquakes enhanced forest conservation and land regulation, then those helped GHG emission reductions and management of forest resources.

Items Raised by Experts	Fit	Evaluation of expert responses
(x) Community forestry	●	As in (x), one of the findings from the data analysis was supported by 12 experts: "The sudden decrease in emissions from LUFC may have been a result of the establishment of laws and rules related to forestry throughout the period 1976-2003." Ten experts focused particularly on the benefits derived from the establishment of community forestry as the core policy which contributed to forest conservation and income generation activities.
(xi) Alternative energy options	●	Ten experts mentioned the promotion of alternative energy options in Nepal. These experts, rather than answering the question directly, cited it as the reason for Nepal's good performance in GHGpc because it carried the possibility of contributing to a reduction in wood consumption (which means shifting out of forestry). Some of them particularly mentioned the in-house usage of fuel that induces smoke pollution.
(xii) Education	◖	Education and media including adult literacy and awareness programme contributed health improvements, and also better education contributed young people to get rid of forestry business.
(xiii) Pervasive NGO involvement	●	Nepal has been "the darling of the NGO community" and significant contributions were done by healthcare and hospitals partnering with NGOs/INGOs and by shifting out of forestry due to the promotion of renewable technology by different INGOs/NGOs.
(xiv) Change in agriculture	◖	3 experts raised (i) growth of the agriculture sector, and (ii) reductions in fertilizer use and other agricultural efficiency improvements

Items Raised by Experts	Fit	Evaluation of expert responses
		contributed CH4 and N2O reduction which shows up in the LULUCF accounting but it did not show a perfect fit with the trajectories.
(xv) Military conflict ended	○	Starting of a new era of peace in 2005-06 may account for most of the health and income improvements, but the trajectories did not show much differences before and after 2005.
(xvi) Composition of exported goods	◖	India where is a Nepal's major trading partner changed their needs for imported goods from Nepal. They need less woods and more textiles including carpets.
(xvii) Small-scale entrepreneurship/ income-generating activities at the local level	◖	Small scale entrepreneurships/ local resources base enterprises resulted increase the income
(xviii) Limiting livestock activities	◖	Improved productivity of animals reduced GHGs emission per unit animal products
(xix) Empowering the most marginalized in society	●	In Nepal, the greater attention has been given to promote empowerment of the most marginalized group for poverty reduction.

Figure 119. Summary of factors influencing successful development for Nepal

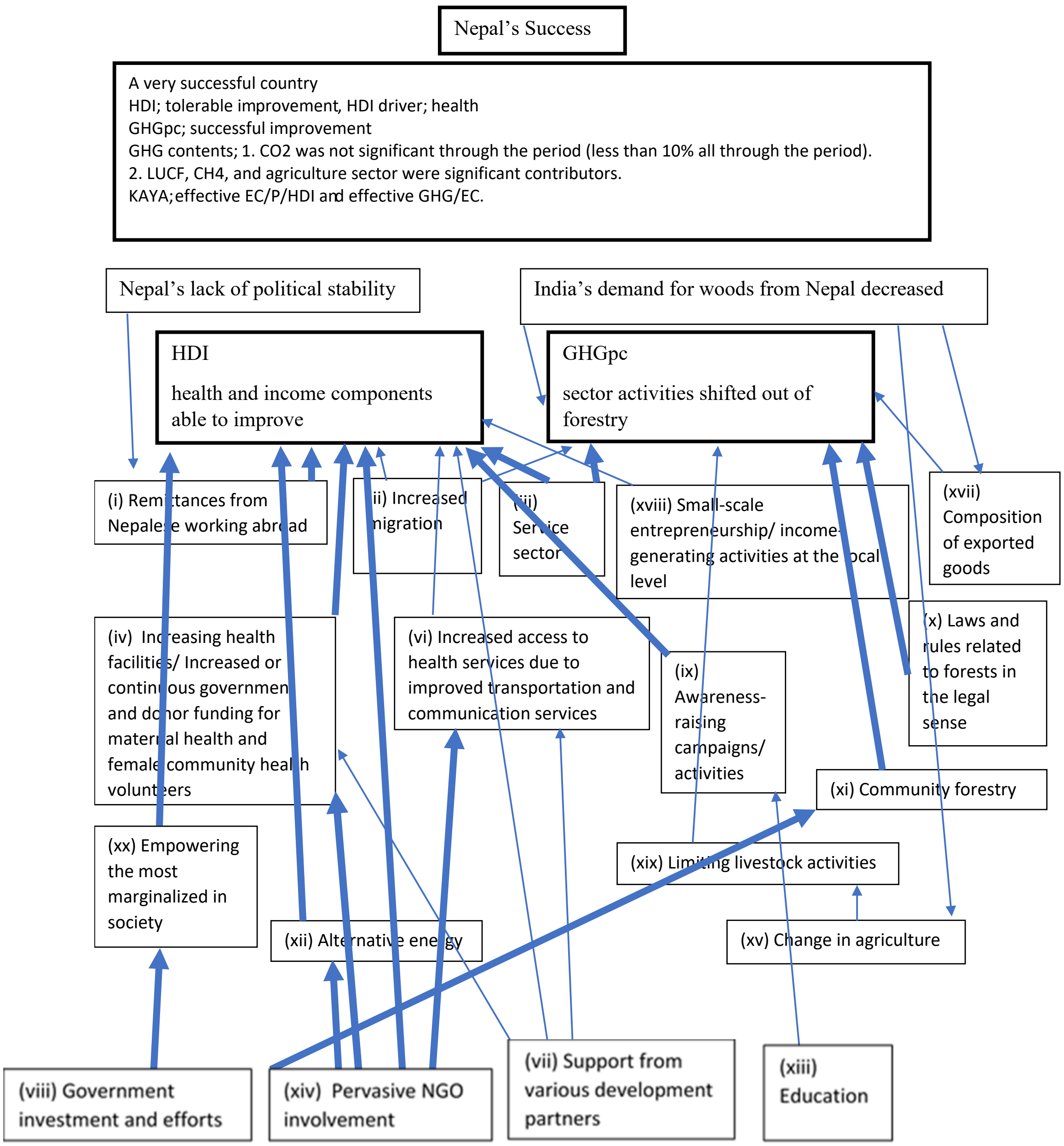


Table 65. Evaluation of expert responses for Mongolia

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Socialist regime	◖	Two experts cited the socialist regime as the answer to the question, looking at it from different angles. One expert treated it from a positive angle, explaining that the restrictions imposed by the socialist regime produced "green development," while the other treated it from a negative angle, saying that the withdrawal of Soviet support for the country had led to a slowdown in the economy and the industrial sector, and therefore a fall in related emissions. Considering that the withdrawal of Soviet support happened just before the research period began in 1990, the view that a slowdown in the economy and the industrial sector caused a fall in related emissions makes sense. However, this is not enough to explain why the HDI income component was able to maintain steady improvement with decreased GHG emissions.
(ii) Growth of the service sector and private- and public-sector trading	●	These responses by the experts are consistent with the findings: HDI's income component was able to maintain steady improvement with decreased GHG emissions because mining and some service sectors were expanding with little increase in GHGs while revenue increased. However, the reason this transition happened is not clear.
(iii) Efficiency and technology	●	These views indicate that before the research period, the technology used in the energy and manufacturing sectors introduced to Mongolia by the USSR was less efficient, and it was improved by modernization. ODA seem to have been helpful in this modernization.
(iv) Opening up the economy	●	After the withdrawal of the socialist regime, the opening up of the economy to private sector participation can explain why HDI's income

Items Raised by Experts	Fit	Evaluation of expert responses
		component maintained steady improvement. It is necessary, however, to learn the details of what happened.
(v) Non-GHG-emitting production	◖	Such production may have been happening at that time, but the question was about decreased GHG emissions from the energy sector but not from production, so this answer does not perfectly fit as the answer to the question.
(vi) Sparsely populated country so did not fit with large-scale manufacturing and the energy industry	◖	It can modestly justify the finding of "decreased GHG emissions from the energy sector throughout the period 1990-2000," since the centralization in Ulaanbaatar of the population along with the population increase is assumed to have started in this period.
(vii) Emergence of a democratic system	◖	It is reasonable to think that the emergence of a democratic system created favorable conditions for investment in Mongolia that explain why HDI's income component maintained steady improvement, but it does not show a clear justification for the decreased GHG emissions from the energy sector in 1990-2000.
(viii) Majority of industrial enterprises went bankrupt	◖	This explanation points to the negative view of the socialist regime. While it explains the decreased GHG emissions as in (i), it cannot adequately explain why the HDI income component was able to maintain steady improvement.
(ix) International bilateral and multilateral	●	Observing the data that show that ODA amounts for Mongolia increased during the period, this high evaluation of ODA fits with the finding that the income component maintained steady improvement

Items Raised by Experts	Fit	Evaluation of expert responses
donor organization		with decreased GHG emissions from the energy sector in 1990-2000.
(x) Exports of coal (and minerals) for which GHG emissions are reported in the country of final use	●	This can reasonably explain why Mongolia's HDI, particularly its income component, was able to maintain steady improvement with decreased GHG emissions from the energy sector throughout the period 1990-2000, since the exports did not increase GHG emissions from Mongolia.
(xi) Severe weather and climate	◖	This may explain the lack of increase in GHG emissions (although during the winter, coal incineration could have increased for heating purposes), but it does not explain why Mongolia's HDI, particularly its income component, was able to maintain steady improvement.
(xii) Overseas remittances	◖	This can be part of the reason for the increase in income while GHG emissions decreased; it was also applicable to Myanmar and Nepal. However, remittances cannot be a major or obvious reason for the trajectory found by the data analysis. Actually, remittances in Mongolia in 2009 was only 4.9% of GNI, while remittances in Nepal was 23.3% of GNI.[6]

[6] Dilip Ratha; Sanket Mohapatra; and Ani Silwal. "*The Migration and Remittances Factbook 2011*." Migration and Remittances Unit, World Bank/June 10, 2018. http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/Mongolia.pdf. Accessed June 10, 2018.

Dilip Ratha; Sanket Mohapatra; and Ani Silwal. "*The Migration and Remittances Factbook 2011*." Migration and Remittances Unit, World Bank/June 10, 2018. http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1199807908806/Nepal.pdf. Accessed June 10, 2018.

Figure 120. Summary of factors influencing successful development for Mongolia

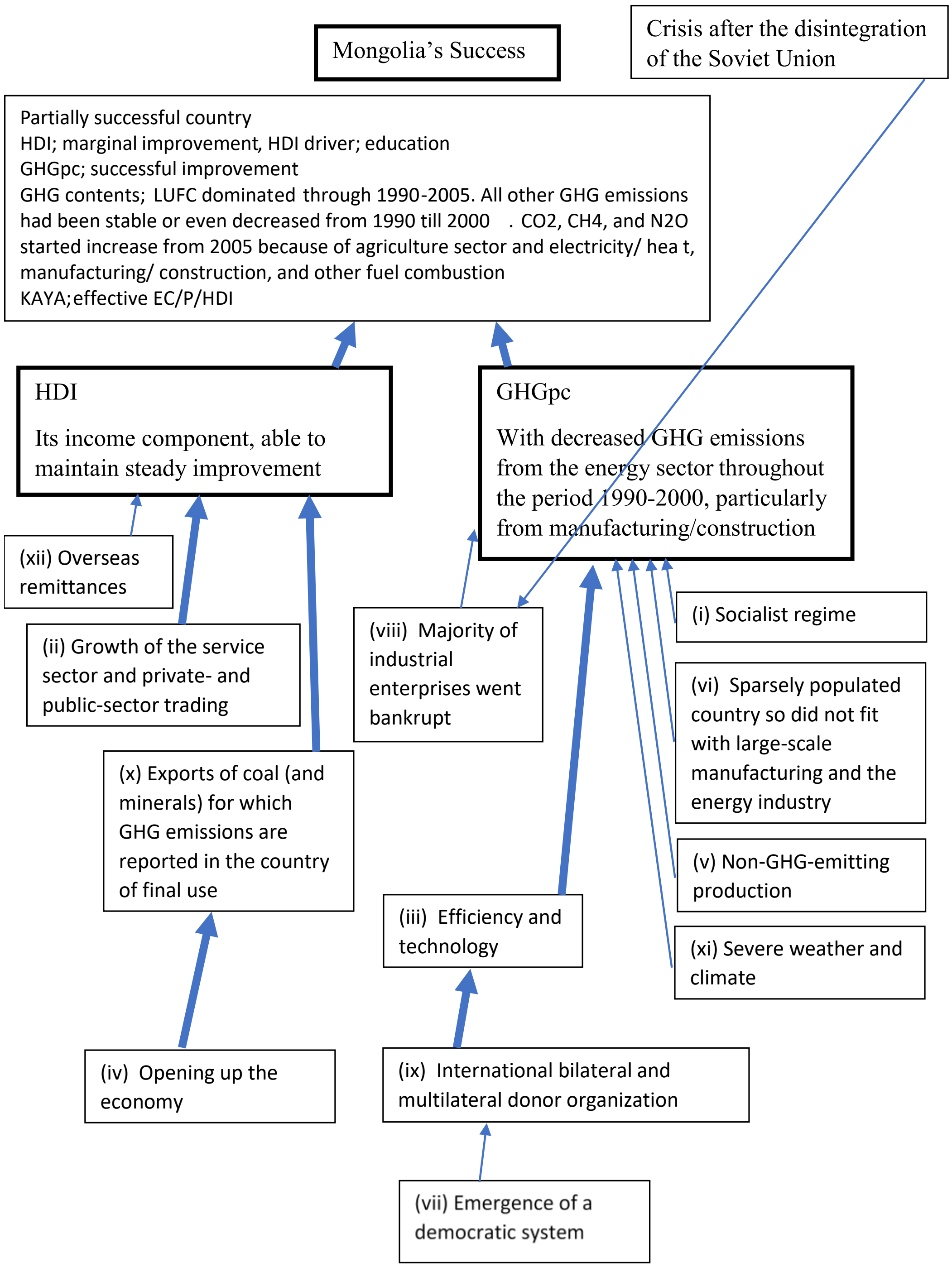


Table 66. Evaluation of expert responses for Bangladesh

Items Raised by Experts	Fit	Evaluation of expert responses
(i) Local development	●	Local development was enhanced "through micro-credit, gramin development bank (sic), Mohammad Yunus, and Noble Laurette on Economics (sic)."
(ii) Foreign investments	●	Government successfully provided better condition for foreign firms and investments on the textile and garment subsector as well as oil and gas exploration, construction of natural gas pipelines and power stations that did not produce much GHG to accommodate needs by increased population.
(iii) Improvement in the standard of living and poverty reduction	●	It was during this period that a Poverty Reduction Strategy Paper (PRSP), which is a development strategy document, allowed market mechanism as a driving force of development in Bangladesh. Government prioritized to improve the minimum living standard from the areas of health care, quality of education, social security, and strong social safety programs targeting the poor.
(iv) Job generation and low labor costs/ Supporting export-oriented industry and the private sector	●	The policies of supporting export-oriented manufacturing and private sector such as textiles jobs (garments sector) that came along with job generation by low wages. Even without political stability, the economy generally still can be improved in a certain level.
(v) Support from development partners	●	The financial sector reform supported by development partners was one of the best in the region and supported proper capital allocation to which private sector has responded positively then promoted foreign investments.

Items Raised by Experts	Fit	Evaluation of expert responses
(vi) Planning and execution	●	“Despite political confusion, Bangladesh has maintained a reasonable level of planning and execution in all sectors, starting from proper planning in education/health, energy, transport sectors.”
(vii) Other		One expert mentioned each of the following: capacity development and skills training, formal or informal laws and rules (community-based institutions and indigenous knowledge and practices), and proper planning.

Figure 121. Summary of factors influencing successful development for Bangladesh

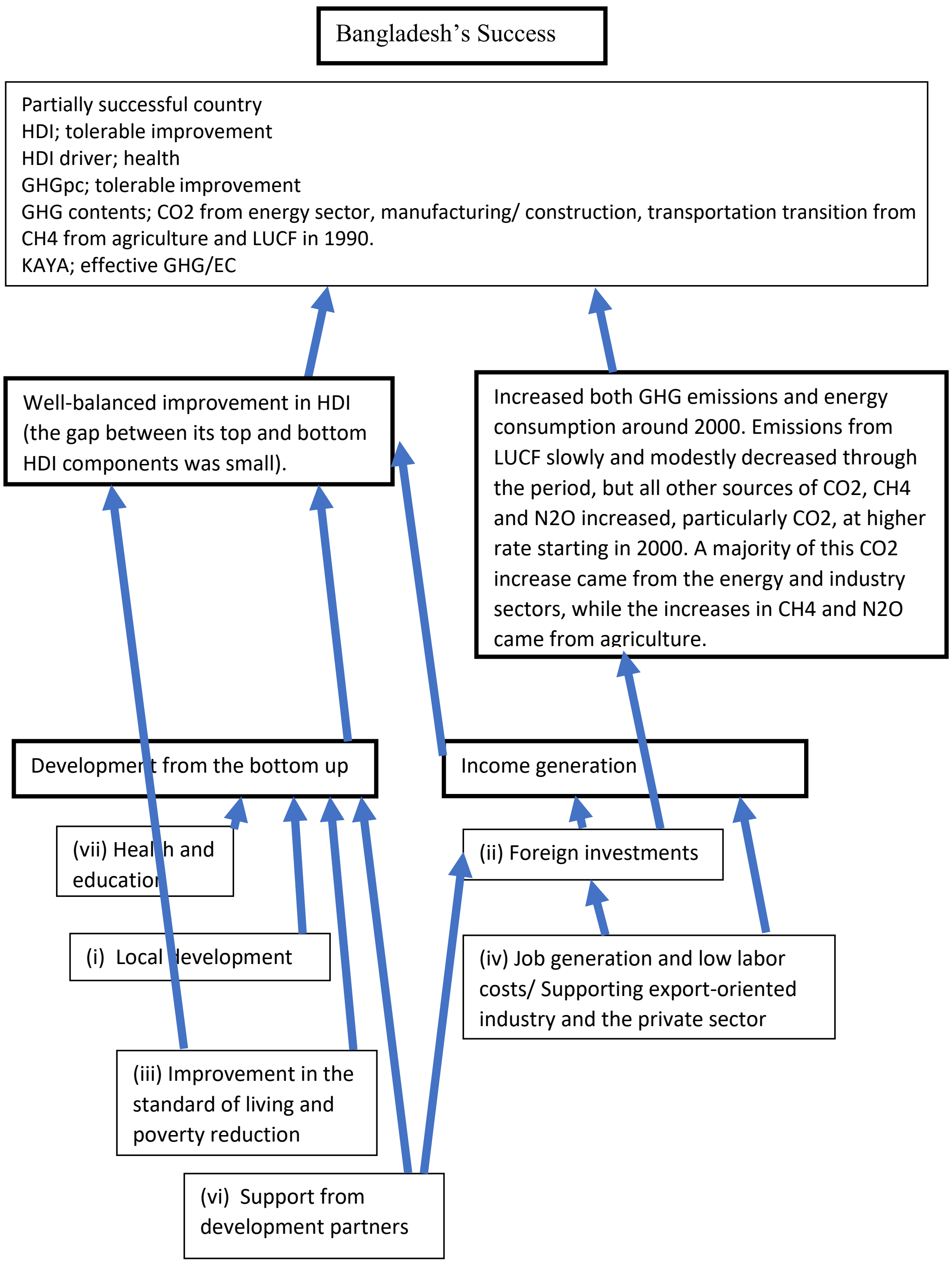


Table 67. Evaluations of expert responses by degree of fit with HDI and GHGpc goals by the four successful countries

Items Raised by Experts	Myanmar		Nepal		Mongolia		Bangladesh	
	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc
ODA	◖	◖	●	○	●	●	●	○
Remittances/ migration	◖	○	●	○		○		
Trading	●	○	○	◖	●	●	●	○
Secondary/tertiary/service/ local level industries	◖	○	●	○				
Better education	○	○	◖	○			●	○
Laws and rules	●	●	○	●				
Renewable energies/ Non-GHG-emitting productions	○	◖	●	●	○	◖		
Technology/productivity	◖	◖			●	●		
Foreign investment	●	○					●	○
Empowerment of the most marginalized/ improvement in the standard of living/ Local development			●	○			●	○
Agriculture production/ Change in agriculture/	○	○	○	◖				

Items Raised by Experts	Myanmar		Nepal		Mongolia		Bangladesh	
	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc	HDI	GHGpc
Limiting livestock activities								
Military regime	◐	○						
Improving access to health services			●	○				
Government investment			●	○				
Awareness-raising campaigns			●	◐				
Community forestry			◐	●				
Pervasive NGO involvement			●	○				
End to military conflict/ Opening up the economy			○	○	●	○		
Socialist regime/ Enterprises went bankrupt/ Emergence of democracy					◐	◐		
Geological reasons					○	◐		
Job generation							●	○

Table 68. Relations between the Items raised by Experts and SDG Goals

Items Raised by Experts	SDG Goals	Related Countries
ODA	NA	Myanmar Nepal Mongolia Bangladesh
Remittances/ migration	GOAL 8: Decent Work and Economic Growth	Myanmar Nepal Mongolia
Trading	GOAL 8: Decent Work and Economic Growth	Myanmar Nepal Mongolia Bangladesh
Secondary/tertiary/service/ local level industries	GOAL 8: Decent Work and Economic Growth	Myanmar Nepal
Better education	GOAL 4: Quality Education	Nepal Bangladesh
Laws and rules	NA	Myanmar Nepal
Renewable energies/ Non-GHG-emitting productions	GOAL 7: Affordable and Clean Energy	Myanmar Nepal Mongolia
Technology/productivity	GOAL 7: Affordable and Clean Energy GOAL 13: Climate Action	Myanmar Mongolia
Foreign investment	GOAL 8: Decent Work and Economic Growth	Myanmar Bangladesh
Empowerment of the most marginalized/ improvement in the standard of living/ Local development	GOAL 1: No Poverty GOAL 2: Zero Hunger	Nepal Bangladesh
Agriculture production/ Change in agriculture/ Limiting livestock activities	GOAL 13: Climate Action	Nepal
Military regime	GOAL 1: No Poverty	Myanmar

Items Raised by Experts	SDG Goals	Related Countries
Improving access to health services	GOAL 3: Good Health and Well-being	Nepal
Government investment	NA	Nepal
Awareness-raising campaigns	GOAL 4: Quality Education	Nepal
Community forestry	GOAL 13: Climate Action	Nepal
Pervasive NGO involvement	NA	Nepal
End to military conflict/ Opening up the economy	GOAL 8: Decent Work and Economic Growth	Mongolia
Socialist regime/ Enterprises went bankrupt/ Emergence of democracy	NA	Mongolia
Geological reasons	NA	Mongolia
Job generation	GOAL 8: Decent Work and Economic Growth	Bangladesh

Table 69. Relations between the Successes and SDG Goals

SDGs	Bangladesh (HDI; tolerable improvement driven by health GHGpc; tolerable improvement)	Myanmar (HDI; successful improvement driven by income GHGpc; successful improvement)	Mongolia (HDI; marginal improvement driven by education GHGpc; successful improvement)	Nepal (HDI; tolerable improvement driven by health GHGpc; successful improvement)
Goals related to Health				
GOAL 2: Zero Hunger	●	○	○	●
GOAL 3: Good Health and Well-being	○	○	○	●
GOAL 6: Clean Water and Sanitation	NA	NA	NA	NA
Goal related to Education				
GOAL 4: Quality Education	●	○	○	●
Goals related to Income				
GOAL 1: No	●	◐	○	●

Poverty				
GOAL 8: Decent Work and Economic Growth	●	●	●	●
Goals related to GHGpc				
GOAL 7: Affordable and Clean Energy	○	◐	●	●
GOAL 13: Climate Action	○	◐	●	●

Table 70. Validity of the Original Four Hypotheses for the Successful Four Countries

Groups	Countries	Hypotheses 1	Hypotheses 2	Hypotheses 3	Hypotheses 4
Very successful	Myanmar	● (GHGpc)	○	◐	● (From agriculture and forestry to experts in natural resources and tertiary industries)
	Nepal	● (HDI health	● (India's	◐	● (From forestry

		and income and GHGpc)	demand)		to remittances from overseas workers and the service sector)
Successful	Mongolia	○	○	● (GHGpc)	○
	Bangladesh	● (Improve HDI)	○	◐	○

APPENDIX B: QUESTIONNAIRE

Questionnaires for the experts sent by emails.

A. Introduction

Your expert assessment will be helpful for my research on "successful development" through 1990-2010. This research is being conducted as part of my academic activity, and not related with my position at ADB, and my request to participate into my survey is only a personal request as a friend.

I tried to design this questionnaire for you to be able to complete within one hour of your valuable time. It may take 20 minutes to read the 5 questions (I would be very grateful if you could please provide answers to any questions on which you have insight: feel free to skip the others if you feel you do not want or you feel you cannot). It should take less than 40 minutes to provide your views.

Moreover, your preference on anonymity will be fully implemented if you request it under Question H.

After reading those questionnaires, you can decide if you can kindly agree to participate into this survey, then only if you will to participate into this survey, please send me your agreement/consent at first. With your agreement/consent, it will be very helpful if you can kindly introduce other experts to whom I should also try to ask his/her participations in addition to yours. I will appreciate when you can kindly send me back your responses within one week from today. If you forget to send me your agreement/consent but send me your responses, then I automatically suppose that you agreed to participate into the survey. Please use for your valuable reply my email address (shotaro_expert_survey2017@yahoo.co.jp) which is in the CC list of this email.

B. Summary of my research

My research is related to "successful development" through 1990-2010, which I defined as development that achieved successful performance in two important measures, HDI[7] which has 3 components of income, health, and education, and Greenhouse Gas per capita (GHGpc)[8] since this can be a showcase of development without sacrificing environmental improvement. I analyzed the available data of 130 countries in the world, then did further detailed analysis on

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[7] The Human Development Index (HDI) is a composite statistic of life expectancy, education, and income indices to rank countries into four tiers of human development. It is a tool developed by the United Nations to measure and rank countries' levels of social and economic development based on four criteria: Life expectancy at birth, mean years of schooling, expected years of schooling and gross national income per capita. The HDI makes it possible to track changes in development levels over time and to compare development levels in different countries. (SOURCE: UNDP)

[8] Climate Analysis Indicators Tool (CAIT) 2.0. ©2014. Washington, DC: World Resources Institute. Available online at: http://cait2.wri.org. Please Note: CAIT data are derived from several sources. Full citations are available at http://cait2.wri.org/faq.html#q07. Any use of LULUCF (net forest conversion) data should be cited as FAO 2014, FAOSTAT Emissions database, http://faostat3.fao.org/faostat-gateway/go/to/browse/G2/*/E.

14 Asian developing countries that are Myanmar, Nepal, Mongolia, Bangladesh, Pakistan, Philippines, Sri Lanka, Vietnam, India, Thailand, Indonesia, China (PRC), Republic of Korea, and Malaysia. My findings were that among those 14 countries, Myanmar and Nepal showed very successful development during the research period since Myanmar's performances in HDI and in GHGpc were both categorized as a very successful country, and Nepal's performance in HDI was categorized as a successful country and in GHGpc was categorized as a very successful country. Bangladesh and Mongolia also showed successful development during the research period since Bangladesh's performance in HDI was categorized as a successful country and in GHGpc was categorized also as a successful country, and Mongolia's performance in HDI was categorized as an marginal country but in GHGpc was categorized as a very successful country.

Below is a summary of findings on each of these 4 countries and related questions for which I am requesting your valuable insights.

C. Myanmar

1. Findings from my data analysis

Myanmar's remarkable improvement of HDI was achieved mainly by income increase. In the meantime, The GHGpc decrease in Myanmar was basically caused by the reduction of GHG that followed the reductions of emissions from Land Use Change and Forests (LUCF), and the gases from agriculture methane (CH4) and nitrous oxide (N2O) even while population increased. The decreased emission from LUFC may be a result of laws and rules related to forestry through 1992-95[9]. These data showed that sector activities in Myanmar shifted out of agriculture and forestry without damaging its economy. Moreover, Myanmar's successful development has been achieved without (i) political stability, (ii) democracy, and (iii) increasing ODAs.

2. Questions

Why is Myanmar's HDI, particularly its income component, able to increase while sector activities shifted out of agriculture and forestry without much increase in CO_2 from energy and industrial sectors, and without political stability, peace and increasing ODA?

D. Nepal

1. Findings from my data analysis

Nepal's remarkable improvement of HDI was achieved mainly by health

[9] The Forest Law (1992), Myanmar Forest Policy, Forest Rules, Community Forestry Instruction (1995)

improvement from 2005, and modest income component improvement. In the meantime, Nepal's very successful performance on GHGpc was caused by GHG reduction from the reduction of GHG from LUCF started from 2000 while the population increased. The sudden decrease of the emission from LUFC may be a result of those establishments of laws and rules related to forestry through the period of 1976-2003[10]. These data showed that sector activities in Nepal shifted out of forestry around 2000 without damaging its economy.

Moreover, Nepal's successful development has been achieved without (i) political stability, (ii) peace, or (iii) increasing ODAs.

2. Questions

Why was Nepal's HDI, particularly its health and income component able to improve while sector activities shifted out of forestry without political stability, peace or increasing ODAs?

E. Mongolia

1. Findings from my data analysis

[10] National Forestry Plan (1976), National Conservation Strategy (1988), The Master Plan for the Forestry Sector (MPFS, 1989), Forest Act (1993), Community Forestry Directives (1994), Forest rules (1995), Revised Forestry sector Policy (2000), Leasehold Forest Policy (2002), Five- year Periodic Plans (2002- 07), Operational Guidelines (revised) (2002), National Biodiversity Strategy (2002), Monitoring and Evaluation concept and strategies (2002), Collaborative Forest Management Guideline (2003), Forest Products Auctioning Procedure (2003), Non Governmental Service Providers Guideline (2003)

Mongolia's success was caused by stable emission (went down from 1990 to 2005 and recovered from 2005 to 2010) while HDI slightly increased. During the stagnation of the country during 1990-2005, HDI, particularly income component did not improve significantly, but remained stable. In the meantime, the total GHG emissions in 2010 were almost identical with the emissions in 1990.

Moreover, Mongolia's development was achieved without political stability. One remarkable issue observed was that the ODA increased significantly during the Period 1990-1995 maintaining this high level until 2010 which was not linked with the extreme cold winter weathers in 2001 and 2010. During the period, there were improvements observed that were (i) the improved education through the Period 2000-2010, and also (ii) the decreased GHG emissions from energy sector through Period 1990-2000 particularly from manufacturing/construction by introducing state-of-the-art technologies from developed countries through ODA. Those improvements may be a result of leapfrogs caused by drastic increase of the ODA.

2. Questions

Question 1. Why was Mongolia's HDI, particularly its income component able to maintain steady improvement with decreased GHG emissions from the energy sector throughout the period 1990-2000 particularly from manufacturing/construction while population increased as well as there was no political stability?

Question 2. Did introduction of leapfrogging technology happen because of large increase of ODA since 1990?

Question 3. If manufacturing/construction through ODA was a salient factor, did the donor place high priority on (i) the education improvement, (ii) the decreased GHG emissions from the energy sector, and/or (iii) the decreased GHG emissions from manufacturing/construction innovations?

F. Bangladesh

1. Findings from my data analysis

Bangladesh's improvement of HDI was achieved by a very well-balanced improvement in HDI (the gap between its top and bottom HDI components was small). In the meantime, Bangladesh had similar continuous increases in GHG and population until 2000, but from 2000, the rate of increase in GHG became faster than the population, therefore GHGpc got worse. This means some change happened that increased GHG emissions as well as energy consumption round 2000.

Around 2000, emission from LUCF slowly and modestly decreased through the period, but all other sources of CO_2, CH_4 and N_2O increased, particularly CO_2 with the higher rate from 2000. A majority of this CO_2 increase was from the energy and industry sectors, while CH_4 and N_2O were from agriculture. The abrupt increase from the CO_2/energy industry in 2000 was linked with growth in the electricity/heat, sector, but there were no changes during this time in HDI.

It was also observed that (i) energy consumption increase did not improve HDI, but (ii) Bangladesh became efficient to emit GHG per energy usage.

Moreover, Bangladesh's successful development had been achieved without (i) political stability, (ii) peace, or (iii) increasing ODA.

2. Questions

Question 1. Was the balanced development that happened in Bangladesh planned/intended/controlled, or simply good fortune without plan/intention/control?

Question 2. If it was not planned/intended/controlled, was the development that happened in Bangladesh beginning in 2005 likely to track the similar pattern of China (PRC) and India where prioritized development sacrificing environment?

Question 3. If the development was planned/intended/controlled, what policy goals were established and what policy measures were taken to achieve this outcome while there was no political stability, peace, and increased ODA?

G. General Question

From my data analysis, for those countries that showed very successful performances in HDI and GHGpc, it seems that the reasons of the successful development were (i) transformation to other industries while abandoning industries that rely on deforestation, (ii) adoption of leapfrog low carbon imported technologies supported by ODA, and (iii) balanced improvements on health, education, and income. Please tell me if you observed similarities or differences in your experiences (experience in any country is appreciated; please specify country or countries).

H. Do you prefer to remain anonymous?

At the end of your responses, please let me know if I may quote you with attribution or do you prefer not to be identified by name? Please choose one of the 5 options below, otherwise feel free to write down here how you want to be quoted. If I quote you by name, I will send you a copy of what I plan to say to obtain your approval. Your preference will be fully respected.

1. Can disclose information including your name, position, organization, and country (such as “Mr. Sasaki who is a Japanese senior environment specialist from Asian Development Bank said…”)

2. Can disclose your position, organization, and country (such as “a Japanese senior environment specialist from Asian Development Bank said….”)

3. Can disclose organization, and country (such as “a Japanese officer from Asian Development Bank said….”)

4. Can disclose only country (such as “a Japanese officer in a multilateral development support agency said….”)

5. Can disclose minimum information (such as “an officer in a multilateral development support agency said….”)

APPENDIX C: EXPERTS LIST

	Experts List
1	Japanese Transport Specialist from Asian Development Bank (ADB)
2	Japanese Principal Energy Specialist from ADB
3	Officer in a multilateral development support agency
4	Japanese Senior Water Resources Specialist from ADB
5	Nepali specialist working in ADB
6	Officer in a multilateral development support agency
7	Japanese Principal Financial Sector Specialist from ADB
8	Officer in a multilateral development support agency
9	Officer in a multilateral development support agency
10	Japanese staff from a multilateral development institution
11	Officer in a multilateral development support agency
12	Principal Portfolio Management Specialist from ADB
13	Officer in a multilateral development support agency
14	Officer in a multilateral development support agency
15	Officer in a multilateral development support agency
16	Officer in a multilateral development support agency
17	Officer in a multilateral development support agency
18	Officer in a multilateral development support agency
19	Sri Lankan Director from ADB
20	Japanese Transport Specialist from ADB
21	American consultant for ADB
22	Officer in a multilateral development support agency
23	Officer in a multilateral development support agency
24	Former Japanese officer of ADB currently working for a Japanese energy company
25	Former officer in a multilateral development support agency
26	Officer in a multilateral development support agency
27	Mongolian consultant for ADB
28	Officer in a multilateral development support agency
29	Former Japanese officer of ADB currently working for a Japanese energy company
30	Japanese Natural Resources Specialist from ADB

31	Former Japanese officer in a multilateral development support agency
32	Consultant for ADB
33	Consultant for ADB
34	Japanese officer from ADB
35	International Environment Consultant (Independent Consultant), India
36	Canadian environment consultant for ADB
37	Consultant for a multilateral development support agency
38	Officer in a multilateral development support agency
39	Officer in a multilateral development support agency
40	Canadian consultant for ADB
41	Officer in a multilateral development support agency
42	Officer in a multilateral development support agency
43	Officer in a multilateral development support agency
44	Unit Head, Project Administration from ADB
45	Associate Professor Nepal Tribhuvan University
46	Education Specialist from ADB
47	Nepali Energy Specialist from ADB
48	Principal Natural Resources and Agriculture Economist, ADB
49	Consultant for ADB
50	President of Nepal Biodiversity Research Society, Tribhuvan University Nepal
51	Senior climate change expert, Nepal Climate Change Support Program (NCCSP)
52	Regional coordinator (RC), Nepal Climate Change Support Program (NCCSP)
53	Regional coordinator (RC), Nepal Climate Change Support Program (NCCSP)
54	District climate change officer, Nepal Climate Change Support Program (NCCSP)
55	Regional coordinator (RC), Nepal Climate Change Support Program (NCCSP)
56	District Coordinator (DC), Nepal Climate Change Support Program (NCCSP)
57	Livelihoods and Governance Expert, SAAR Paramarsa Sewa, Nepal
58	Japanese Senior Investment Specialist from ADB

59	Lecturer, Tribhuvan University, Nepal
60	Visiting faculty, Kathmandu Forestry College, Nepal
61	Independent consultant, Nepal
62	Researcher in Development Studies, Kathmandu University, Nepal
63	President, Nepal Forum for Environmental Journalist (NEFEJ)
64	Managing Director, Nepal Environmental and Scientific Services (NESS) P Ltd
65	Technical director, Nepal Environmental & Scientific Services
66	Consultant for ADB
67	Officer in a multilateral development support agency
68	Japanese Principal Energy Specialist from ADB
69	Nepalese freelance consultant
70	Officer in a multilateral development support agency
71	Sri Lankan officer in a multilateral development support agency
72	Officer in a multilateral development support agency
73	Japanese officer from ADB
74	Japanese officer from ADB
75	Officer in a multilateral development support agency
76	Officer in a multilateral development support agency
77	Sri Lankan Senior Environment Specialist from ADB
78	Officer from the ADB
79	Korean Investment Specialist from ADB
80	French Senior Urban Specialist from ADB
81	Consultant for a multilateral development support agency
82	Bhutanese Senior Environment Specialist from ADB
83	Officer in a multilateral development support agency