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Methods

Environmental poverty, a decomposed environmental Kuznets curve, and alternatives: Sustainability lessons from China

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ABSTRACT

Amid increasing recognition of the importance of the environmental factor in understanding poverty and development, this article coins the term "environmental poverty" to refer to the lack of the healthy environment needed for society's survival and development as a direct result of human-induced environmental degradation. A decomposed environmental Kuznets curve (EKC) demonstrates that places (such as countries, counties, or cities) following the "grow first, clean up later" approach (or the first half of the EKC) may obtain economic gains accompanied by extreme environmental sacrifice, excessive social injustice, and income and environmental inequalities. The same place may include communities whose curves differ in shape. Some communities may prosper at the expense of other communities, which may fall into environmental poverty and eventually irreversible environmental degradation and economic failure. Places following alternatives or "flat EKCs" may be slow in getting out of economic poverty, but enjoy a healthier environment, equality in income and environmental quality, and social justice. Countries, especially developing countries, should aspire to sustainable alternatives.

1. Introduction

A special feature on poverty and sustainability science in the *Proceedings of the National Academy of Sciences of the United States of America* (PNAS) reports that place matters, cause is complicated, and experimentation is necessary in poverty alleviation, and scientists can contribute to meeting the challenges by describing poverty, understanding causation, and offering and evaluating policies and solutions (Kates and Dasgupta, 2007). Economic growth is often regarded as the key to fighting poverty, for example, in Africa (Collier, 2007; Kates and Dasgupta, 2007); while China's success in poverty alleviation has been well recognized as a result of economic growth (Chen and Ravallion, 2007). But economic growth alone is often insufficient, especially if the growth is achieved at the expense of environmental quality, income equality, and social justice, which are other components of sustainability. Environmental degradation is "slow violence" that particularly affects the poor and occurs gradually and out of sight with delayed destruction dispersed across time and space (Nixon, 2011). Thus, geographical displacement of sources and sinks, traditional ecological knowledge, and environmental justice are central to "the environmentalism of the poor" (Martínez-Alier, 2002).

A critical question is how to achieve sustainable poverty alleviation. On the one hand, many researchers assert that economic growth can lead to both economic and environmental goals while environmental protection may impede economic growth (Weber and Allen, 2010). Beckerman (1992) suggests that the best and probably only way to attain a decent environment in most countries is to become rich in alignment with the environmental Kuznets curve (EKC), which suggests that environmental quality first decreases and then improves along with economic growth. In policy making and practice, the "grow (pollute) first, clean up later" approach continues to dominate the minds of leaders in developing countries such as China (Liu, 2010).

The EKC suggests what seems to have happened; it does not tell what should happen or what a place (such as a country, county, or city) should do. Few articles in the EKC literature actually map the historical movement of a country along an EKC. However, Chinese scholars and officials tend to misinterpret the EKC as a law and misuse it to support the "grow (pollute) first, clean up later" path. They also tend to apply the EKC to the place's overall pollution levels or even the whole environment, though such claims have never been proven. This may be the result of the name and common description of the EKC; it is an "environmental" but not the "SO_2" or "CO_2" Kuznets curve.

Since the 1980s, the Chinese Premier, Wen Jiabao, and Chinese government directives have repeatedly warned that China should stop following the "grow first, clean up later" path taken by more developed countries, which led to an acceleration of environmental pollution and serious health problems (e.g. Wen, 2006). Qu Geping, the well-known Chinese environmental protection minister (1987–1993), frequently called for Chinese officials at all levels to stop following the EKC and the "grow (pollute) first, clean up later" path (e.g. Qu, 2006). The

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repeated warnings have been necessary because local officials tend to believe that rapid economic growth must be achieved at any costs, even if the cost of future cleanup is higher than current economic gains, because impoverished areas have no other path to economic wealth (Su, 2007).

On the other hand, EKC studies do not support the existence of a simple, predictable relationship between pollution and per capita income because multiple factors intervene and identification of these effects is required (Dasgupta et al., 2006; Liu, 2008; Stern, 2004). Harbaugh et al. (2002) conclude that there is little empirical support for an inverted-U-shaped relationship between several important air pollutants and national income. The applicability of the EKC has been long debated (e.g. Levinson, 2002; Liu, 2008; Stern, 2004). This article questions the applicability of the EKC and the "grow first, clean up later" path. It contends that even if the EKC is applicable to the whole environment and it indeed supports the "grow first, clean up later" path, it could still involve different paths and outcomes, some of which are devastating to the poor.

This paper attempts to contribute to knowledge on how to achieve sustainable poverty alleviation and development, based on my field work in China using grounded theory and case study as qualitative research methodology. It focuses on three objectives: 1. to define environmental poverty and argue for its inclusion in the evaluation of poverty alleviation and development progress; 2. to apply environmental valuation and environmental poverty to a decomposed EKC to illustrate the varied possible paths and outcomes within an EKC (different from other EKC studies, the paper is based on my findings that a place may have numerous communities with varied environmental and economic levels, from communities falling deep into both economic and environmental poverty to communities making rapid economic growth at the expense of the environment in other communities); 3. to support alternatives to the "grow first, clean up later" path that enable places to achieve a sustainability transition that evades environmental poverty and social injustice, along with economic growth. Horn (2008) suggests that China's economic achievement has been an inspiration to many around the world and leaders from developing countries are turning to China in search of solutions to their own developmental quagmires. Glaeser (2011) indicates that other developing countries should learn from the Chinese model for environment and development. This paper calls for caution.

2. Defining Environmental Poverty

According to the United Nations (1995):

> Absolute poverty is "a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services."
>
> Overall poverty includes "lack of income and productive resources sufficient to ensure sustainable livelihoods; hunger and malnutrition; ill health; limited or lack of access to education and other basic services; increased morbidity and mortality from illness; homelessness and inadequate housing; unsafe environments; and social discrimination and exclusion. It is also characterized by a lack of participation in decision-making and in civil, social and cultural life."

These UN definitions include certain environmental components. However, these broad definitions have not been reflected in various measurements of poverty. For example, the World Bank (2011) defines poverty as "pronounced deprivation in well-being" and measures extreme poverty as living on less than US$1.25 per day and moderate poverty as living on less than $2 a day. It also measures relative poverty, a socially-defined measure of income inequality, using indexes such as the Gini coefficient. Such measures are usually based on per capita annual income and frequently do not take into account other conditions included in the UN definitions of poverty. Meanwhile, environmental issues have become increasingly important for poverty alleviation. As the conventional concept of poverty is not adequate for understanding this situation, there is a need to highlight the environmental components in poverty measurements.

To meet that need and to promote sustainable poverty alleviation, I believe it is necessary to create the term "environmental poverty." The notion of environmental poverty differs from new expressions such as ecological poverty and climate poverty. Climate poverty is poverty related to the impacts of climate change, such as increased occurrence of drought and water scarcity in western China. Ecological poverty is the lack of an ecologically healthy natural resource base needed for society's survival and development. Environmental poverty is the lack of a healthy environment needed for society's survival and development, and this lack is mainly recognized as the consequence of environmental degradation caused by human activities. Environmental quality varies by location and is affected by factors such as population, culture, and technology. There are specific locations that are naturally not suitable for human settlements. The notion of environmental poverty excludes those places and therefore assumes that environmental quality is always adequate for society's survival and development at the early stages of human settlement. Thus environmental poverty is not a "natural" condition but a result of human activities; it is poverty caused by faulty human-environment interactions that reduce environmental wealth to below the needed level.

People in economic poverty may have access to financial support, food, shelter and medical services through governments and international organizations. People in environmental poverty have not been targeted for poverty alleviation. However, someone surviving on one or two dollars a day in an unhealthy environment may well be far worse off than someone else, without any income at all, but living on fertile land (Kanté, 2004). Additionally, environmental poverty is a worthy issue for study and research because it tends to be associated with health problems, diseases, corruption, oppression, social injustice, and political unrest.

3. Applying Environmental Poverty and Decomposing the EKC

Sustainable development involves the maintenance of wealth, where the required measure of wealth includes not only manufactured and human capital but also natural capital (Dasgupta, 2004). The purpose of estimating environmental accounting prices is to evaluate the benefits and costs associated with changes made to the environment due to human activities (Dasgupta et al., 2000). Recent studies have

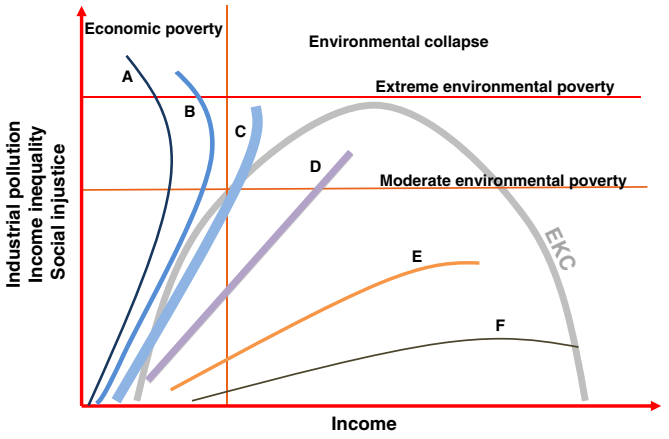

Fig. 1. A hypothetical decomposed first half of the environmental Kuznets curve: Assuming varying income and environmental conditions (line width indicates relative quantity of the population).

attempted to apply environmental and ecological valuations to recognizing ecosystems as ecological wealth and incorporating the value of ecosystem services into national accounts (e.g. (World Bank, 2011)).

To apply a simple valuation to the EKC, we may assume that the environment and economic income have similar values (Fig. 1). The EKC notion implies a trade-off between the environment and income before the tipping point is reached. The literature indicates that it may be helpful to understand the EKC and develop associated policies by decomposing income, the determinant of environmental quality, into technique, scale, and composition effects, using GDP (Gross Domestic Product) per square kilometer, GDP per capita, and share of industry in GDP as proxies (He, 2010; Panayotou, 1997; Rezek and Rogers, 2008; Tsurumi and Managi, 2010).

This paper decomposes the route of the EKC. In this way, different development paths may be examined for their associated total environmental and economic outcomes. In this particular case, the hypothetical EKC refers to the health impact of industrial water and air pollution that includes a number of cancer-causing pollutants, such as cadmium, arsenic, chromium, and lead. Pollution has made cancer China's leading cause of death and ambient air pollution alone is blamed for hundreds of thousands of deaths each year (Chen, 2008; Liu, 2010; World Bank, 2007).

EKC studies tend to presume that a place has a uniform level of income and environmental quality at a certain time. In reality a place, especially a large one, may include different groups of people and communities with a wide range of income levels and environmental quality. For example, many older cities such as London display a massive east/west divide in income levels and environmental conditions (Zambonini, 2010). An EKC for London might be decomposed into different paths for west London and the East End.

In addition to environmental quality, Fig. 1 attempts to illustrate how income affects income equality, as suggested by Kuznets (1955), and social justice (which is closely related to income equality), environmental justice, and corruption (Morse, 2006). As the economy grows, so do the income differences between the groups, as some groups make more progress than others (Fig. 1). Leitão (2010) finds evidence that the higher a country's degree of corruption, the higher the per capita income at the turning point of an EKC, suggesting different income–pollution paths for different countries relative to corruption. When a country has strong institutions that reaffirm the rule of law, ensure government accountability and help control corruption, investment follows and grows (World Bank, 2011). China has widespread corruption, as evidenced by the Minister of Environmental Protection pointing to prominent fraud in project approvals and failure to apply emission control measures for rising pollution (Lague, 2006). The minster told the press that illegal small chemical plants as well as paper and leather mills are still being built, while many outdated technologies continue to be used due to corruption of local officials (Associated Press, 2006). China's National Auditing Office (NAO) reports that over a half-billion dollars, which were meant for tackling water pollution in Chinese rivers and lakes, have been embezzled or misused, seriously undercutting pollution prevention efforts and raising questions about how pervasive corruption is in China's environmental programs (Washington Times, 2009).

Fig. 1 assumes that different groups of people or communities already have different income levels and environmental quality at the starting point of an EKC. As they move along, these differences expand, while the majority people (Groups C and D) may be following an EKC. Group A may be the impoverished and marginalized; their surrounding environment is polluted at disastrous levels, while they receive only a small amount of income benefit. The following tends to happen: polluting factories are built in villages with little compensation to the local population for their loss of land, while few local workers are hired. The factories pollute the air and water and make people sick, crops fail, and fish and livestock die. No one pays a higher price – in time, energy, health, etc. – for environmental damage than the poor as it leads to the loss of their livelihood, as Kanté (2004) states. This group may include most of China's over 400 "cancer villages," communities with greater than expected cancer rates (Liu, 2010). The villagers have to pay for their own cancer treatments, which can easily put the family into substantial debt. The wealthier villagers may endure the expenses for a few years before going bankrupt (IFeng, 2010).

The hardship experienced by cancer villagers is well depicted in the 2010 documentary "The Warriors of Qiugang" (Environmental 360, 2011):

"Like many villages in China's industrial heartland, Qiugang — a hamlet of nearly 1900 people in Anhui province — has long suffered from runaway pollution from nearby factories. In Qiugang's case, three major enterprises with little or no pollution controls churned out chemicals, pesticides, and dyes, turning the local river black, killing fish and wildlife, and filling the air with foul fumes that burned residents' eyes and throats and sickened children."

The villagers were able to force the factories to relocate, though only about one kilometer away, but they have not received any compensation for their lost health and livelihood, or for the brownfield cleanups the village cannot afford to do (Geall, 2011).

A similar dire situation was reported by Nan and Su (2006) and Ye (2006) in Xingang Village in Northern Jiangsu Province. The village used to be called "land of peach blossoms" due to its rivers, productive rice fields, and lush vegetation. A chemical factory was built on the village's farmland in 2001, which emitted toxic gas and water. Pig farming came to an end as the animals died of poisoned water and feed. Rice yield dropped from 9750 to 2250 kg per hectare in four years. The rice was unsafe to eat. From 2001 to 2005, 55 villagers developed cancer and 40 of them died. The majority of the farmers in the village suffer from cancer or other serious health problems. In such villages, human and environmental capital is seriously compromised for future economic growth. A hidden assumption of the EKC is that environmental degradation is always within the ecosystem's carrying capacity and thus reversible (Liu, 2008). For the cancer villages, the damage is likely irreversible.

Some other cancer villages may represent Group B, communities that experience remarkable income growth followed by heavy losses, due to irreversible environmental damage. The story tends to unfold like this: factories are built on the village's land; farmers who lose land receive decent compensation; many work and are themselves among the initial investors in the factories, which tend to be among the most polluting; the local economy grows rapidly and industrial pollution continues to increase. While county and township leaders, big investors, and a few locals, such as village leaders, get rich, the majority of the farmers eventually become ill, lose their share of the factories, and fall back into economic poverty.

Group C may include the industrial workers, such as migrant workers and miners, who get out of poverty and make decent income at the expense of their health. Eventually, their poor health leads to loss of working ability and their income stagnates. Tang (2006) reports that occupational diseases affect over 200 million people in China, 90% of whom are migrant workers who are likely to fall into acute poverty due to loss of their ability to work and the expensive care of incurable diseases such as pneumoconiosis. Occupational diseases are also widespread in rural areas producing numerous "pneumoconiosis villages" and "villages with high levels of lead-poisoning" (Wen, 2005). China reported 8361 new pneumoconiosis cases in 2003 and 918 of them were at late stages (Yin, 2005).

China Daily (2011) reports that:

"Heavy metal pollution has caused environmental deterioration and mounting health problems in Hunan Province where several lead-poisoning and "cadmium-rice" cases have been reported. The Xiangjiang River, along which over 40 million people live, is dangerously polluted with heavy metals. In 2010, more than 200 children in Chenzhou City suffered excessive lead levels in their blood due to pollution from

the local mining industry. In a similar case in 2009, more than 1350 children were poisoned by lead pollution from a local smelting plant in Wenping. Lead-poisoning cases happen all around China and a string of such cases have been reported in Shaanxi, Anhui, Guangdong, Sichuan, Fujian, and Yunnan provinces in recent years."

Group D may include the employees of state government or enterprises and multinational corporations who enjoy high income levels and live away from polluting factories. However, their environmental quality is still very low due to air pollution and foods contaminated with heavy metals (Gong, 2011a, 2011b). Group E may include local government leaders and private investors who acquire large amounts of profit and live in cleaner environments further away from sources of industrial pollution. Group F may include central and provincial government leaders who enjoy the fastest income growth with only a small decline in environmental quality.

Beijing could possibly be such an example. Central government leaders live and work in the Zhongnanhai Garden at the center of Beijing, to the west of the Forbidden City. They enjoy "te gong" (special supplies) of foods of the highest quality possible, such as were supplied to Chinese emperors in the past, according to numerous Chinese reports (e.g. Financial Knowledge Net, 2011), which the government denies but the public believes. If the practice of "te gong" is true, industrial pollution and contamination have no real impact on Chinese leaders. Though their outdoor air quality is negatively affected by traffic outside the Garden, their "getaway houses" are in the northern suburbs where environmental conditions are the best in the Beijing area. These suburbs have also become homes to people in Group E. Meanwhile, environmental conditions are terrible in many other parts of the capital, in and near which cancer villages have been reported.

Chinese leaders often make development decisions, including decisions about building polluting factories, without the participation and knowledge of the people who will be most negatively affected, people in Groups A, B, and C. Chow (2006) criticizes government officials for considering themselves a class above the majority of the population and having the authority to rule over the farmers with fairly widespread abuse of power, including illegal land seizure. Pan (2006) points out that a flawed understanding of growth and political achievement, held by some Chinese officials, causes economic and environmental inequalities, and the rich consume while the poor suffer the effects of the resulting pollution. Wang et al. (2010) found that land developers and government leaders tended to focus on short-term economic benefits and ignored the ecological damages and environmental degradation resulting from land reclamation. Rural poverty happens partly because farmers' rights have been violated by illegal activities of local government officials, such as the confiscation of land from farmers for urban development while farmers receive a compensation that is arbitrary and well below market price (Chow, 2006).

Fig. 1 includes hypothetical economic and environmental poverty lines. The "moderate environmental poverty line" may denote the basic human needs of environmental quality such as clean air, safe water, safe foods, productive soil, forest, etc., just as the term "poverty line" has often been set to reflect the income needed to obtain basic human needs such as food, shelter, etc. Extreme environmental poverty signifies a line beyond which environmental damage is irreversible and leads to income stagnation or decline, while entire livelihoods may collapse.

Along with the benefit of an income increase, all groups may be able to get out of economic poverty, except for Groups A and B (Fig. 1). Then, all groups may enter into environmental poverty, except for Groups E and F. Environmental degradation may be already under control for Groups E and F, which may suggest the reaching of the tipping point in an EKC. Total economic and environmental wealth declines for Groups A, B, C, and D due to environmental loss. Groups A and B end up in both economic and environmental poverty (double poverty). Income disparity develops among the groups, and the disparity becomes extremely large between Groups A and F. Cui and Zhu (2011) report that "China's top 10% families possessed 45% of total wealth while the bottom 10% had 1.4% in 2004; the difference was 32 times. By 2009 the difference reached 40 times and relative poverty has been increasing rapidly." The Hurun Report says that China has at least 189 billionaires, but that number is more likely to be 400 or 500, which is possibly more than the U.S. has (Frank, 2011). The "powerful and wealthy" enjoy lifestyles matching those of the wealthiest people in the west, while China as a whole experiences escalating environmental degradation, income inequality, social injustice, and corruption (Liu, 2010).

An IFeng (2010) report shows that while investors focus on profit and ignore environmental problems, government officials follow a tacit law that it is better to die of poison than of poverty, ignoring the negative impact of pollution on the health of the local residents and implementing no measures to deal with the resulting occurrence of diseases. The outcome is often that the officials get rich without being poisoned while the poor get poisoned while staying poor, as Fig. 1 implies. Local governments often regard major GDP-generating polluters as "star enterprises" and help them in placating pollution victims. Yuanshi, Hebei, is reported to be such a case, where industrial water pollution is believed to have ruined farmland and caused cancer and other health problems among the farmers (Zhang and Bai, 2011). The pollution victims are helpless when the government and the industries are on the same side. Lawsuits against polluters have been rarely allowed, let alone successful.

Environmental recovery in an EKC should not be expected to happen for Groups A and B (Fig. 1). These people or communities are in an irreversible environmental and economic decline and are sacrificed, as many of them would die of cancer or other pollution induced diseases. The future of Group C is also in doubt. It is only possible for the other people or communities, those in Groups D, E and F, to expect environmental recovery.

4. Sustainability Transition as an Alternative to the EKC

Conventional wisdom tends to believe that the "grow first, clean up later" path is an economic law that must be followed by all countries, even if it has been proven that the cost of cleanup is higher than the economic gains during growth, because only polluting industries are available to societies at early stages of development (Su, 2007). Considering some of the very undesirable outcomes described in Fig. 1, this paper argues that countries should seek alternatives even if an EKC does apply. Weber and Allen (2010) point out that if a massive increase in pollution is to be avoided, a proactive and explicit approach to environmental quality is needed, rather than expecting an EKC.

This section of the paper focuses on some possible alternatives to the "grow first, clean up later" path and the EKC. Let us assume that a place is at O, the starting point of development (Fig. 2). The place may follow an EKC in favor of the "grow first, clean up later" path on Route A from O

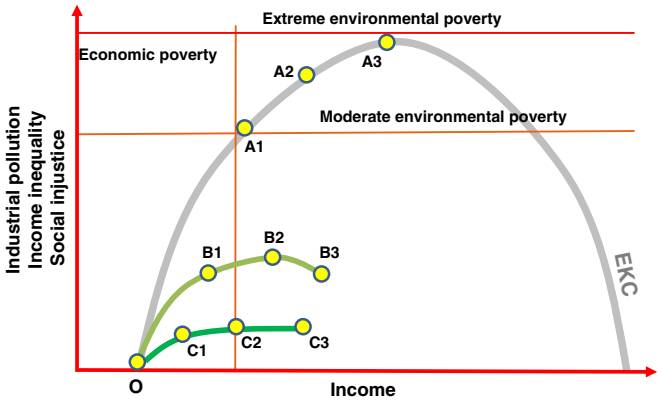

Fig. 2. The environmental Kuznets curve and alternative paths.

to A3. It may also take sustainable alternatives such as Route B from O to B3 or Route C from O to C3. If an EKC is followed, the place will get out of economic poverty quickly but enters into environmental poverty at A1. The place has less total wealth when environmental poverty is included in the calculation. It is possible to use Route A to represent the case for many places in China and for the country as a whole. Some researchers have suggested that China may have reached the tipping point as environmental degradation in some places is under control while others insist conditions continue to get worse for the country.

On Route B, the place first trades environmental quality for income gains and then switches to sustainable development. Income growth is slow but the total wealth is higher than that with Route A, due to higher environmental quality. This seems to have been the route some Chinese communities have been following, different from the rest of the country. One example is Miyun County and Huairou District in Beijing. When the Miyun Reservoir became the only source of clean water for Beijing in 1997, the Beijing Government ordered Miyun and Huairou to reduce pollution to ensure safe water supply (Chen, 2007), resulting in loss of potential income growth for the two poorest district/county in Beijing. After a decade of slow economic growth, however, they have "surprisingly" experienced faster growth, in the past few years, than many of the other fourteen districts/counties in Beijing. Their superior environmental conditions eventually attracted major outside investments in organic and green foods, green industries and services, business headquarters, convention centers, and a variety of industries including health and wellness, outdoor sports, recreation, training and education, and resort construction (Xiang et al., 2009).

Another example is Ninghai, Zhejiang Province, which used to be a poor agricultural county, unattractive to industries due to its remote location and lack of land, energy, mineral resources, and transportation. Even by 2000, nearly 90% of the population was rural and dependent on agriculture (Ninghai Government, 2010). After shutting down its many small scale paper-mills and coal and mineral mines, Ninghai has attracted many "green industries" and is now one of China's wealthy counties (Tao, 2009).

Though only hypothetical, Route C is even better for environmental sustainability as a place on this route will always enjoy better environmental quality, even if income does not grow. The place gains total wealth with its income improvement, which is slow in earlier stages. Later on, the economy may experience faster growth due to the quality of environmental conditions and money saved from cleanups during later stages of development. Though lacking real world examples, it can be the best option for places which have not yet experienced environmental degradation. It may take a longer time for places on Routes B and C to get out of poverty than places on the EKC. However, Routes B and C may actually provide better livelihoods by avoiding environmental poverty, income disparity, severe social injustice, or the possibility of collapse that places taking Route A may have to endure.

Routes B and C may also be decomposed into different paths for different groups, with the same method used to decompose the EKC (Fig. 1). However, in the above cases, the internal differences may be so small that even the poorest group would not fall into environmental poverty. Some scholars may regard Routes B and C as "flat EKCs." However, they are different from EKCs because they not only look flat, but also do not depend on income as EKCs do. Realizing they are better paths, some places may choose to adopt sustainable approaches at early stages of development (Liu, 2008).

5. Implications to Sustainability Concept and Policy

Developing countries should avoid using unsustainable approaches to poverty alleviation and realize that alternative sustainable approaches are available. Dasgupta et al. (2000) argue that environmental problems in the modern world reflect a combination of ignorance and institutional failure. Global environmental problems often affect the resource base of the world's poorest people most severely (Dasgupta, 2004). The interaction of poverty and environmental degradation is often invoked in the form of a vicious circle known as the "poverty trap," in which poverty leads to environmental degradation and environmental degradation deepens poverty (Yang and Pan, 2001). The concept of environmental poverty helps understand another dimension of the "poverty trap" — environmental degradation leads to environmental poverty even if it does not initially deepen economic poverty. A decomposed EKC reveals the deadly consequences of the "grow first, clean up later" path: the same place may include communities whose curves differ in shape. Some communities may prosper at the expense of other communities. China's ecological crisis, mounting social disparities and endemic corruption are critical counterpoints to its economic success and have worsened in tandem with economic reform, causing widespread discontent and threatening to jeopardize future growth (Horn, 2008).

Highlighting environmental justice and environmentalism of the poor, this paper challenges the conventional wisdom that economic growth leads to environmental recovery. Despite being a wealthy nation, Japan has made progress in environmental protection and disaster relief measures only through continuous, and often difficult, struggles by the people against the Japanese government (Chen, 2011). Trying to prevent what has happened in Japan from happening in other countries, Ui (1992) argues that the most important factor for the prevention of pollution problems is the development in the general population of an appreciation for basic human rights and the need to always remain free from oppression. Political rights and civil liberties are found to be strongly associated with reduced environmental burdens, particularly at low-income levels (Torras and Boyce, 1998). These arguments are important for China and other developing countries, which may have poorer human right records than Japan did when its industrial pollution was at its worst. It is much harder for Chinese victims of pollution to put pressure on their government. Cleanups tend to be delayed, resulting in more serious and sometimes irreversible damages. Government environmental cleanups happen usually because of other reasons such as making the cities more attractive to investors and tourists or protecting water supply to the population centers. The cleanups usually transfer pollution to other places and produce additional victims. To promote green growth, developing countries such as China need to consider environmental poverty along with increasing public access to environmental information and participation in environmental management. The Chinese lessons also highlight the need for political reforms and recognizing public health as a new dimension of sustainability science (Bloom, 2007). All countries, especially the poorer ones, should aspire to alternatives or "flat EKCs" for all citizens in order to prevent environmental poverty and improve environmental quality, income equality, and social justice.

6. Conclusions

This paper first coins the term environmental poverty as the lack of the healthy environment needed for society's survival and development as a direct result of environmental degradation caused by human activities. Through valuation, a hypothetical decomposed EKC reveals the varied possible paths and outcomes for six groups of people or communities within the same place, in term of impacts of industrial pollution on health. On the one hand, the powerless and poor may fall deep into economic and environmental poverty, while on the other hand, the powerful and wealthy may achieve rapid economic growth with little environmental sacrifice. This would result in extreme injustice through polarization of income and environmental quality. Environmental recovery is possible for the powerful and rich but not the powerless and poor communities. To avoid these risks, places should seek alternatives that would be more likely to enable them to achieve a transition to sustainability that evades environmental poverty and extreme injustice, while achieving economic growth. Developing areas need to realize that sustainable alternatives are not only available but also

must be adopted in order to protect the environment, achieve economic growth, and ensure social justice.

It must be stressed that reliable quantitative data were unavailable to test the EKC with overall industrial pollution's impact on health. New methods of measurement need to be developed to gather such data. Thus what Figs. 1 and 2 show is qualitative and hypothetical only. Its credibility is to be tested by future research when quantitative data become available. Besides, the notion of environmental poverty and a decomposed EKC are based on only limited empirical information from China with much speculation. The assumptions behind them also invite criticism, debates, quantitative testing, and further investigation. For example, some researchers may assign the environment less value than income, and vice versa. Additionally, China is definitely very unique geographically, historically, economically, and politically. As place matters, cause is complicated, and experimentation is necessary (Kates and Dasgupta, 2007), there are certainly other possibilities under other assumptions that are also worth exploring. Further research should also attempt to use the same method to decompose the second half of the EKC, which will especially require additional empirical experience from the more developed nations.

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