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Sustainable development or Environmental Kuznets Curve model: Which route for Africa?

Takawira Gara[1]

Abstract   The Environmental Kuznets Curve (EKC) proposes uncontrolled pollution during initial development stage of a nation and then a gradual shift to environmental protection and remediation as income (GDP) improves, a developmental route that was used by a few countries. This theory, however, is marred with a lot of conceptual and ecological errors. Importantly, there is little evidence of an EKC pathway, mainly because the "statistical analysis on which the EKC is based is not robust" (Stern in International society for ecological economics internet encyclopaedia of ecological economics the Environmental Kuznets Curve, 2003). This study investigates through questionnaire survey, the opinions of young African students studying in China, on the issue of development with environmental pollution and degradation. Results show that 72% of respondents agreed to development with pollution citing EKC, an outcome that indicates the possible developmental route likely to be followed by majority of Africa. The study concluded that environmental protection discussions should not be done at economic level but at ethical level to save human life and conserve biodiversity. The study recommends that all nations, regardless of level of economic development, be encouraged to mainstream the AICHI Biodiversity Targets in their national (local) developmental plans to ensure sustainable development agenda fulfilment. Also, as a precautionary measure, nations should embrace the "polluter-stops-polluting" against the usual "polluter–pays–principle".

Keywords   Africa · Biodiversity · Climate change · Environmental Kuznets Curve (EKC) · Ethics · Pollution · Sustainability

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1 Introduction

The economic prediction by John Maynard Keynes, one of the influential economists in the nineteenth century, that the economy would stabilise in the 2050s after reaching a saturation seems to be a "pie in the sky". This is mainly because the Keynesian economic theory and other neoclassical economic theories ignored the ecological constraints in economic growth. The general belief held by many contemporary economists as a solution to socioeconomic ills like poverty, unemployment and overpopulation was growing the economy and trusting Environmental Kuznets Curve (EKC) to take care of the environmental degradations that naturally come as a result of the economic growth (Daly 2007). In this case, pollution often appears first to worsen and later improve as the country's income grows. This pattern is similar to inequality and income discovered by Simon Kuznets; hence the pattern of pollution and income was christened "Environmental Kuznets Curve". It is, however, now a public fact that economic growth is limited by ecological capacity of the environment to assimilate the resultant pollution, a phenomenon known as the carrying capacity (Czech and Daly 2004), hence the current talk about ecological economics and its sustainable development complement. The world is now faced with an ecological catastrophe as a result of following the neoclassical economics where development is measured by gross domestic product (GDP) which does not account for depreciation of man-made capital goods and depletion of natural resources (Daly 2007). This shortcoming means that development may be done at the expense of environmental degradation, of which some of the effects may not show spontaneously. However, humanity is now in a vicious trap of seeking for more natural resources that are "finite" to quench an insatiable appetite to accumulate more, leading to unprecedented environmental degradation. Mahatma Gandhi seems to add up everything in his famous saying, "There are enough world resources for everyone's need, but not for everyone's greed". The past half century is recorded as the period during which most ecological "crimes" were committed (Huettmann 2012). Subsequently, the natural resource base succumbs to an inescapable unsustainable consumption. Dalai Lama summarised the vicious cycle well when he was responding to a question of what surprised him most. He said, "Man surprised me most about humanity. Because he sacrifices his health in order to make money. Then he sacrifices all his money to recuperate his health. And then he is so anxious about the future that he does not enjoy the present" (Martino 2014). These words fit well in what transpired during the industrialisation age of the developed world and also during the colonisation of Africa when there was unprecedented looting of resources like ivory in some parts of the continent like Democratic Republic of Congo (then Congo Free State) (Hochschild 1998) without considering their sustainable supply. It was "making money, makes sense" without giving attention to the environment that supplied the resources (Grossman and Kreuger 1995). Pollute first and remediate later proved counterproductive as it resulted in environmental degradation as exemplified by many case studies. For example, industrialisation in some parts of South America brought misery to the local inhabitants where people lived a contradictory life of obvious grandeur, but lacking well-being due to environmental neglect during development (Huettmann 2015). On a global scale, many people are now living in constant fear of the impending climate change disaster, that is, if the effects are not already being experienced. This study wishes to explore the underlying pattern of EKC, its ethical and factual inadequacies in environmental protection. The implications of such a developmental model will be closely scrutinised to guide future generations in making developmental decisions accordingly.

Some early industrialised hence "early developed countries" followed the EKC developmental route (Cheng et al. 2012; Grossman and Kreuger 1995). For example, Japan produced tremendous amounts of pollution from its petrochemical, textile, mining and steel production industries during the periods between 1890s and 1960s, before it started to get engaged in pollution control in the 1970s (Cheng et al. 2012) when it felt it had financial capacity to do so. Most of Africa is still in the initial developing stage and is, through support from World Bank subsidies, investing in industries that produce and discharge a lot of pollutants in air, water bodies and soil. Besides, World Bank and its counterpart, the IMF, are also involved in advocating as well as supporting globalisation, a policy that generally breeds negative results when it is implemented under bad governance (Stiglitz 2002). Globalisation and bad governance are a recipe for perpetuating "colonialism" (economic and environmental colonialism) through making the colony a "Pollution Haven". Affluent developed countries can transfer their heavy polluting industries to their "economic colonies" disguised as (or in exchange for) foreign direct investment (FDI) as was the case with Indonesia which was a pollution haven for Japan, Netherlands, USA, UK and a few other developed countries (Apresian 2016). As expected, the developed countries will have their environment improving but continuing to consume high-polluting products from their economic colonies.

Industrialisation, which is one of the indicators of development, requires a lot of energy which predominantly comes from fossil fuels like coal and oil. These produce pollutants such as carbon dioxide, sulphur dioxide, nitrogenous oxides and others which have been proved to contribute to global warming and climate change. Other pollutants released from industries find their way into water resources and soil, thereby degrading them. Once degraded, environmental remediation is a difficult as much as it is an expensive operation, and other negative effects like health problems which lead to suffering and death of people cannot be avoided sometimes. Ethically, for the sake of sanctity of life, human or otherwise, most people expect Africa and other developing regions to embrace sustainable development which respects environmental protection during all stages of development. However, the question that remains is whether African states are ready to sacrifice rapid growth of their GDP, the traditional economic development measure, to protect the environment. The objective of this study is thus to find out the opinions of Africans on this important question. The practicality of sustainable development where any kind of development should be commensurate to the available amount of clean resources, technologies and other requirements is also assessed.

1.1 Pollution and its impacts

There are many definitions of pollution, and since this paper is not critiquing their appropriateness, an appropriate for this particular study is chosen. It says:

> Pollution is any undesirable change in the physical, chemical or biological characteristics of air, water and soil that may harmfully affect the life or present a potential health hazard of any living organism (Bhat 2013).

This definition identifies that the pollutants normally cause problems in air, water and soil, all of which are directly and indirectly linked to the survival of human beings and other organisms. People need fresh air, clean water and clean plant food from the soil. Ecosystem services, such as provision of clean drinking water, clean breathing air, clean plants for food and clean aquatic animals for food, are the natural basis for life because they cannot

be substituted with any human artefacts. This means that preservation of the natural basis of life is a requirement of justice, as it is a necessary condition for order of societies and the global community (Becker et al. 2015).

1.2 Development, EKC and pollution

Pollute first and remediate later is a theory that describes the relationship between development and environmental protection, a model that generally conforms to the EKC (Fig. 1), which is believed to have been followed by some of the early developed countries (Grossman and Kreuger 1995). The theory suggests that during the first stages of development, income is low and environmental degradation abatement is not necessary as much as it is not affordable. This persists until a certain income level is reached when people start to consider trade-offs between development and environmental protection. As income further increases, priorities shift to better environmental quality now being a necessity and affordable through better technologies. This will see the environmental damage not only decreasing, but there is remediation of past effects also (Everette et al. 2010). Beautiful as it may seem on paper, this theory has many limitations and fraught with problems (Carraro and Metcalf 2001; Everette et al. 2010). Firstly, the concept fails credibility test, it being only used as a patina of a "shaky" economic concept (Daly 2007). Economies cannot grow infinitely as suggested by EKC, but they are mainly based on finite natural resources found on the finite planet earth (Daly and Farley 2004), coupled with impossible economic decoupling (Stern 2003; Ward et al. 2016). Some good examples of challenges brought by this model of environmental management centre on unknown consequences of damage from pollutants as is the case with climate change. People did not imagine or fathom what would happen to the gaseous pollutants their industries were continually releasing into the atmosphere. But now we know: climate change. The world is battling with the containment of greenhouse gases that are threatening the world with climate change, whose real effects are still to be clearly understood. Another biggest question for another day is whether climate change is reversible? Another environmental tragedy of the EKC model is that it does not take into account the possibility of damage to certain bio-species into extinction before its turning point (Arrow et al. 1996). If that high possibility occurs, the ethical question is whether the remediation will be able to recreate the extinct species? There is therefore the risk of small changes causing catastrophic damages, meaning that focussing only on economic growth to deliver environmental outcomes could be counterproductive (Arrow et al. 1996).

Fig. 1 A general illustration of Environmental Kuznets Curve (EKC) (adapted from Jbara'07, 2007)
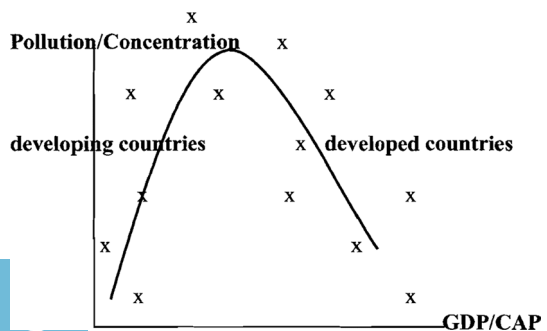
There is therefore need to redefine the concept of development to incorporate the issue of sustainability. Economic growth, which is wrongly assumed to be synonymous with development in many spheres, is generally seen to mean "the increase in production and consumption of goods and services" (Rosales 2008a, b). Many economists seem to suggest that development is different from economic growth in that the former measures qualitative aspects of growth, whereas the latter is quantitative in nature often called GDP (Daly 2007; Daly and Farley 2004). United Nations, however, defines development as high achievements in the areas of health, education and living standards put together to form Human Development Index (HDI). While the HDI has had its fair portion of disapprovals especially its "limited scope" (AHDR 2002), we shall, however, use it here to ensure uniform understanding of the subject in this study. According to HDI, there are three components of human development, namely health, education and living standards. History, research and experience inform that these dimensions of development are usually antagonistic to each other especially health and living standards. Human health is highly dependent on the best environment, while a unit of GDP growth and an improvement in the standards of living depend heavily on increased supply and use of fossil fuels for energy and raw materials (Czech 2015; Giovanni 2003), both of which comes with environmental degradation, thus creating a paradox. It is now widely accepted that there is a conflict between growing the gross domestic product (GDP) and biodiversity conservation (Huettmann 2012). The best scenario as envisaged by the contemporary and ecological economists is to improve the GDP along with development at the constant or reduced throughput (Daly 2007), a scenario that can be termed "sustainable". A choice has to be made between unsustainable development and health, a choice that requires cognitive thinking bearing in mind that the world is close to, or have even exceeded, ecological limits of nature's capacities to absorb human impacts (IPCC 2007b). Scientific findings point that degradation of the ecosystem services is a barrier to the achievement of Millennium Development Goals (now Sustainable Development Goals) as it harms many of the world's poorest people and is sometimes the principal factor for causing poverty. In the developing world, half population of urban dwellers suffer from inadequate water and sanitation-related diseases due to pollution (Reid 2005). Most of the African states fall under this developmental category, and they are undergoing urbanisation, a situation that unfortunately disrespects the needs of nature and sustainability (Huettmann 2015), which continues to cultivate above-mentioned ecological vices.

In some instances, as that which obtained in Congo, the country is richly endowed with natural resources, but the inhabitants are living in abject poverty due to "resource curse". The civil war that erupted between 1996 and 2003 was a result of poor governance of abundant natural resources which was the mainstay of the inhabitants' livelihoods (Eichstaedt 2011). The country has not recovered from this war as disturbances continue to be witnessed across the country resulting in Congo being depicted as the "world's worst humanitarian crisis" by UN agencies, and it was ranked 168th out of 177 countries in the 2007/2008 Human Development Index (Taka 2011).

1.3 Sustainable development

The development trends that were being followed in many economies proved unsustainable, as it left people increasingly poor and vulnerable to a degraded environment (Brundtland 1987). Sustainable development started to gain traction especially during the past two decades as a solution. There are many challenges that may hinder the success of sustainable development, hurdles that are of magnitude and complexity that far surpasses the understanding

of individuals or groups. Chief among them is the unequal distribution of wealth across the world. Unfortunately, the goals of sustainability may continue to be a pipe dream if this challenge is not tackled, and those who should take the initiative to resolve are not interested as they are immensely benefitting in the status quo (Huettmann 2015). For sustainable development to succeed, nations should embrace precautionary principle to deal with possible environmental degradation. This was introduced in 1992 by the United Nations at Rio Summit, with Principle 15 stating:

> In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (United Nations 1992).

Principle 25 is also interesting as it emphasises the need to have development and environmental protection concurrently. It says:

> Peace, development and environmental protection are interdependent and indivisible (United Nations 1992).

The adoption of the precautionary approach should not be delayed any day longer, with nations, communities and individuals being seized with "prevention is better than cure" mantra. Other policies crafted by the United Nations to regulate environmental degradation by member states are Sustainable Development Goals and AICHI strategic goals. The Sustainable Development Goals (SDGs) like SDG 14 call for sustainable use of ocean resources and the United Nations' Decade of Biodiversity 2011–2020 as espoused in the multilateral treaty developed in Japan, Aichi, by the Convention of Biological Diversity (CBD) that later was known as the AICHI strategic plans to protect the global biodiversity (United Nations 2010), both are closely linked to the sustainable consumption and conservation of resources.

Sustainable development and natural resource management are well embedded in the African traditions. The indicators of development in the African traditions include physical (environment), human and social harmony. When there are any conflicts among these three, then that development is rendered meaningless to them (Awuah-nyamekye 2012). The involved issues in this respect of sustainability include taboos in resource harvesting like certain forest areas are preserved through disallowing their harvesting, people are not allowed to fish on certain days, certain people are not allowed to eat (hence cannot hunt) certain animals as they believed they were their "totems". As can be clearly seen, these traditions are underpinned in sustainable development. With the introduction of Western and other foreign religions especially Christianity and Muslim, the local African religion (tradition) has continually been under threat of desecration, hence lost "respect" as the newly introduced religions started to dominate (Sarfo-Mensah and William 2010). This has had a bearing on the sustainable development and natural resource management which may also be influencing the way Africans perceive the indicators of development and choice of developmental models.

2 Methodology

This study followed Rousseau's public opinion theory, *volonté de tous,* which collects individual opinions to determine consensus among a diverse population (Zetterberg 2003). The study was conducted through an electronically delivered email questionnaire survey (Bowling 2005) for self-administering, targeting African students studying at Tongji University

in China. The questionnaires combined quantitative measurable variables (structured) and qualitative variables (unstructured) (Mayoux 2006) relevant to the study objective. This methodology was particularly chosen as it involves little or no bias as well as its ability to allow high willingness to disclose sensitive information. Besides, the interview pace is generally low "giving respondents more time to think and reflect, thus yielding more accurate responses" (Bowling 2005). Extra care was taken during crafting of the questionnaire and selection of the respondents, the two major determinants of the quality of data and results of an opinion poll (Zetterberg 2003). The students come from across Africa and at different levels of their study programmes, these factors working in favour of random selection (sampling) of the respondents so that the findings could be easily generalised for the whole African population. To avoid biased responding to environmental questions, those who were in the Institute of Environment for Sustainable Development (IESD), bulky of whom were doing Environmental Management and Sustainable Development programmes, were left out deliberately. However, part of the questionnaire was formulated by adapting points made during a debate of students in Institute of Environment for Sustainable Development (IESD) titled, "Pollution, a necessary evil for development and human well-being". The students who participated in this debate were drawn from all corners of the globe (Table 1).

The questionnaire was both short and self-administering with a brief introduction in form of a short description of the purpose of the survey and explanation of the involved terminology so that informed responses could be drawn. A total of 86 out of a possible 94 distributed questionnaires were administered, returned and analysed. Due to nature of the data collected, Microsoft Excel 2010 was used to analyse the data and come up with descriptive statistics. The discussion was biased towards climate change since greenhouse gases released in one locality have a bearing on the changes in climate in another locality, hence the need for global co-operation to fight the scourge. Other clear pollution problems at local levels were only summarily discussed.

3 Results

A total of 86 questionnaires were filled and returned from respondents drawn from 24 different African countries. The demography showed that 72 were males translating to 84% of total respondents and their age ranged between 19 and 39 years with the majority aged between 22 and 27 years. The educational background showed that most respondents were doing their undergraduate studies, totalling 54 compared to 32 doing postgraduate studies. The major question of this survey which required the opinions of individuals on polluting or not polluting indicated that 72% of total respondents chose development with pollution and the paltry 28% were of the opinion that development that cause pollution should not be accepted. The reasons that motivated such choices were various as summarised in Table 2.

Table 1 List of students who contributed to the drawing of reasons for yes or no

Continent	Number of students
Africa	14
Asia	10
Europe	8
North America	2
Australia	1

Table 2 Summary of responses of personal opinion on developmental route for Africa and reasons for that choice

Response		Reason for no					Reason for yes				
		No 1	No 2	No 3	No 4	No 5	Yes 1	Yes 2	Yes 3	Yes 4	Yes 5
No to pollution	24 (28%)	8 (33%)	6 (25%)	2 (8%)	4 (17%)	4 (17%)					
Yes to pollution	62 (72%)						22 (35%)	8 (13%)	8 (13%)	4 (6%)	20 (32%)

Key:

No 1   Environment important than development

No 2   More pollution will cause more climate change problems

No 3   There are other developmental routes that can be used that are friendly to the environment

No 4   Africa is developed and beautiful as it is

No 5   Health is better than riches

Yes 1   This is the path that has always been used by the developed countries to reach where they are and they are enjoying now (EKC theory reference)

Yes 2   Challenges of environmental degradation can be tackled as they come through adaptation

Yes 3   There is no practical way of developing without having environmental pollution problems and therefore pollution is a necessary "devil"

Yes 4   Africa is poor to have money to employ towards environmental protection as they have a priority to develop first

Yes 5   The developed world has already contributed to the climate change that is affecting everybody and it is only fair that Africa do the same if justice is to be realised

However, the two major reasons cited for the Yes to development with pollution were EKC theory (36%) and secondly that the challenges of environmental degradation can be tackled as they come through adaptations (32% of respondents) (Fig. 2).

The majority of the twelve people who were against development that resulted in uncontrolled pollution highlighted that the environment weighed far greater than development (33% respondents) and 25% thought that more pollution in case of greenhouse gas emissions would exacerbate the situation of climate change which is already affecting the globe, and as such, there was no need to add more pollution to the environment for the sake of development (Fig. 3).

4 Discussion

Sex disaggregation was employed to analyse if this had a bearing on the choice of the developmental route. A total of 79% female respondents were against development that was accompanied by unprecedented pollution which is expected as already discovered in other previous studies. Zelezny et al. (2000) concur with results in this study where women generally had a soft spot for the environment and would rather conserve environment than have development that degrades the environment. However, the general population opinion indicates that most respondents support development at the expense of environment. The age distribution of the population studied can explain this shared opinion given that most of the respondents fell in the 22–27 age category. This age group was also discovered to be less concerned with environmental protection in a study by Kvaløy et al. (2012).

The general results of the opinion survey (72%) portray that Africa might be ready to sacrifice the environment for the sake of development. Most respondents believed that EKC route is the path that was used by the majority of developed countries to reach where they are. While this sounds a fair justification at first thought as some studies are in agreement with this historical fact (Cheng et al. 2012), however, after some deep reflection, it may not be the best decision to follow. Importantly, the amount of knowledge concerning some irreversible effects of pollution that is available today was not known back then. Soon after World War 1, nations embarked on industrialisation at the detriment of irreversible degradation of the environment as they were not clearly aware of their actions on a large scale (Weiss 1992). Consequently, people could afford to indulge in such "ecocide" without experiencing problems. However, some of the results of their actions especially those that are linked to climate change are now affecting the current generations. With respect to intergenerational environmental justice, there is need to divert and take a different economic development approach to the one followed by the early developed nations. There is growing consensus that climate change is irreversible (IPCC 2007a; Schneider 2004), a development that calls the present generation to realign their developmental priorities to arrest the situation from further deterioration through mitigation. While development is a human right that is enshrined in the United Nations Human Rights Charter, that right cannot be absolute as it is limited by intragenerational as well as intergenerational environmental justice. Distributive justice through cap and trade mechanism as enunciated in a study by Rosales (2008a, b) where those countries that contributed more to climate change are expected to have their economic growth given a limit and buy extra economic growth (pollution) from developing lower polluting nations has been proposed. This compensate the historically disadvantaged nations, providing them with some income for their economic growth. It should also be
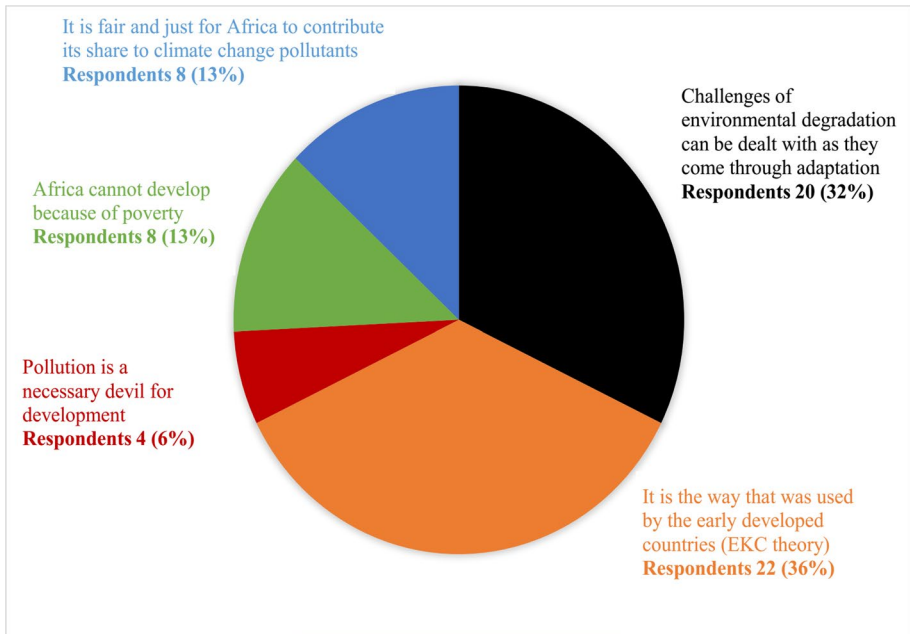
It is fair and just for Africa to contribute its share to climate change pollutants
Respondents 8 (13%)

Challenges of environmental degradation can be dealt with as they come through adaptation
Respondents 20 (32%)

Africa cannot develop because of poverty
Respondents 8 (13%)

Pollution is a necessary devil for development
Respondents 4 (6%)

It is the way that was used by the early developed countries (EKC theory)
Respondents 22 (36%)

Fig. 2 Pie chart showing the reasons for a YES to developing with pollution

More pollution will cause more climate change
Respondents 6 (25%)

Environment important than development
Respondents 8 (33%)

Other means of development that dot pollute can be used
Respondents 2 (8%)

Africa is beautiful and developed as it is.
Respondents 4 (17%)

Health is better than material health
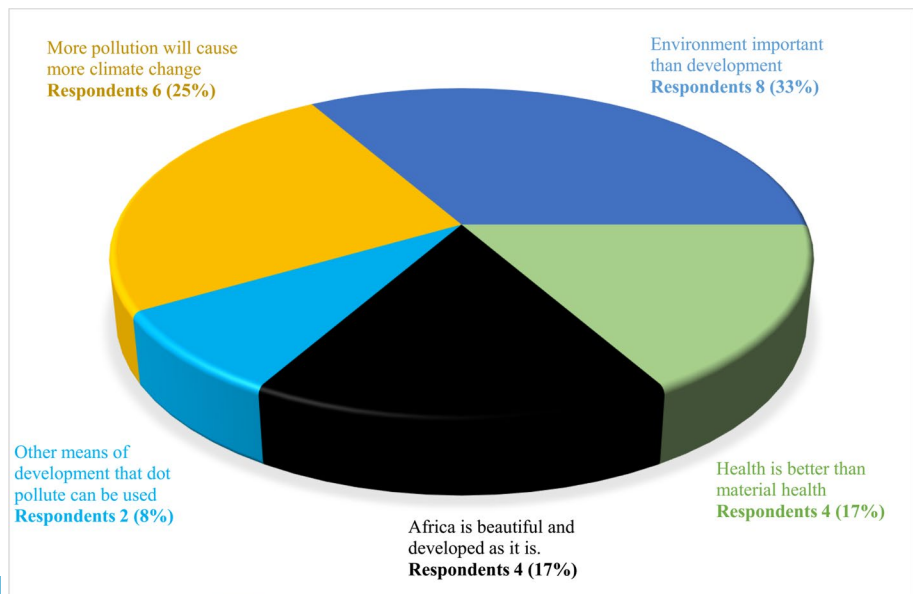**Respondents 4 (17%)**

Fig. 3 Segmented doughnut showing the reasons for the NO reason to pollution

noted that the effects of climate change are far-reaching, its effects infringing on other people's rights such as on the basic right to health and food. These effects are heavily felt by poor developing countries due to their low adaptive capacity, and it would then be expected that most Africans would be against more pollution. However, this is opposite of the findings of this study, and such results are in perfect agreement with previous studies by Kvaløy et al. (2012).

Climate change has been implicated in biodiversity loss, resulting in extinction of many flora and fauna as reported in many studies. A report by IPCC (2014) associated the extinction of many animals a couple of centuries ago to natural climate change. The situation obtaining today is worrisome due to anthropogenic contributions to climate change, which multiplies the risk of biodiversity loss by more or less the same factor. The effects of climate change do not follow an explainable linear path. A small change in the climate propagates huge and drastic change to the environment. The partial reduction in CO_2 emission in one region has limited benefits in the fight against climate change due to the cumulative nature of global warming (King et al. 2015), hence the need for all nations including those from African continent to work together to fight this scourge. If global temperatures go beyond 1.5–2.5 °C, such an increase has a potential of sweeping 30% of studied flora and fauna into extinction (IPCC 2007b). Besides climate change, there are also other host of human practices that are a danger to biodiversity. Already, there are unverified reports of hundreds of species being lost per day due to deforestation (Stork 2009). Even the Peregrine Falcon, the most adaptable and widespread known animal, is at risk of extinction due to human pursuit and use of organochloride pesticides (Sriram and Huettmann 2017). Researchers are therefore advocating for a proactive rather than reactive approach when dealing biodiversity losses and species extinction, as these damages are irreversible. Moreover, there are also many other ecosystem damages that will not fully recover when remediation is instituted at a later stage of economic development (Easterling et al. 2004).

The major point of reference to accept development with pollution in this study was EKC. Regrettably, this has major weaknesses, most of which are intertwined in the biodiversity losses already discussed. Once a species has gone extinct, there is no replacement even when there is enough finance to remediate the degraded environment later. Based on this reason alone, it is paramount to approach the subject with precaution (precautionary approach) as the real damage may be unimaginable. Besides, a host of studies suggest that EKC model might not be as practical as it seems on paper. A study of EKC using the relationship between several air pollutants showed that this model did not have empirical support (Egli and Steger 2007; Harbaugh et al. 2002) to stand the robust test of multifactor pollutants that dominate economies (Ezzati et al. 2001) and cannot, therefore, form the basis for making such decisions. After all, the emergence of sustainable development in recent years has given the world a new perspective to development without unwarranted environmental degradation. The model of sustainable development is premised within the interdisciplinary symbiotic ecology where economic growth, social welfare and environmental protection are considered inseparable (Cheng et al. 2012). In instances where social welfare is given much credence, environmental crisis may be inevitable as the situation that prevailed in the 1960s due to exclusive anthropocentrism. A lot of developing countries that have been embracing sustainable developmental models at very low economies had their economies performing better than their counterparts who did otherwise (Sterm 2004). This means that sustainable development is possible in practice, against the popular belief by respondents who thought that Africa cannot develop without polluting because of poverty. In certain instances, rich countries are continuing to fare poorly in environmental management when compared with poor nations. For example, Yemen, a poor crisis-ridden

war-torn nation scores a better ranking as opposed to the developed USA in "climate action" activities (Lomborg 2017) meant to mitigate against global climate change.

Another major reason that was cited when choosing development with pollution was that the respondents were of the opinion that challenges of environmental degradation can be tackled as they come through adaptation. This "wait and see" attitude is very much related to the "business as usual" approach already discussed and seen to result in some irreversible loss of biodiversity. The precautionary principle which guards against much of the unpredictable outcomes can also be point of reference to guide nations in making eco-environmental decisions.

A few individuals (8%) chose the route of pollution much for the need of environmental justice. They argued that, for instance, people that are hit hardest by climate change are those that contributed least to its occurrence. This historical imbalance needs the developing regions to be afforded the global environmental space to develop if justice is to be mete out. However, there are efforts already put in place in order to correct the historical imbalance through a legally binding climate change agreement, part of which reads:

> Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities (UNFCC, Article 3.1, Principles) (UNFCC 1992).

Simply put, this means rich countries have to pay more taxes to fund climate change adaptation and mitigation programmes as a way to fairly distribute the global burdens (and benefits) brought about by climate change (Caney 2005). Indeed, negotiations are taking place and agreements being reached as evidenced by the recent Paris Cop21 Climate Change Conference where rich countries were to provide in excess of USD80 billion for climate change adaptation and mitigation programmes. The AICHI Biodiversity Targets, drawn from the Strategic Plan for Biodiversity 2011–2020, are United Nations initiated guiding principles to be used by all nations in promoting the preservation of environmental integrity and biodiversity. These targets are required to be mainstreamed in the national and local development strategy of each nation for successful biodiversity conservation. Therefore, co-operation is highly recommended seeing that the fight against global warming and climate change effects is never local but global.

Human health, one of the indicators of development, is at risk of serious compromise if there is environmental degradation during development. Pollution breeds fatal diseases resulting in unprecedented human suffering, fulfilling the prophetic words of the Dalai Lama where he indicated that people create problems which will hound them in their lifetime and they will live in constant fear. The environmental pollution has always been linked and blamed for public health problems like the Minamata disease due to mercury poisoning in the drinking water. A total of 60 medical doctors conducted a study to see whether there were safe limits for air pollution to lung cancer risk. Their findings indicated that exposure to particulate matter 2.5 ($PM_{2.5}$) and particulate matter (PM_{10}), even at levels below the currently recommended limits, may increase the risk of lung cancer (Ole et al. 2013; Pope and Dockery 2013). The developed countries are not spared the brunt of pollution as reported in The Lancet, a medical journal which reported death and sicknesses to many inhabitants of those areas (Markandya and Wilkinson 2007) (Table 3).

A total of 20% children die before the age of five, of which two-thirds is a result of world environmental pollution. A good recent case study of the uneconomic effects in the long run of developing with pollution is China. The comparison of losses due to natural disasters attributed to climate change has been averaged at RMB 160 billion per year since

Table 3 Air pollution-related effects of coal and lignite in Europe (deaths/cases per TWh) adapted from Markandya and Wilkinson (2007)

	Deaths	Serious illness	Minor illnesses
Lignite	32.6	298	17.676
Coal	24.5	225	13.288

2000 and is now at RMB 323,64 billion, an increase of 13% per annum against a GDP increase of 10% (Xu 2014). This indicates that environmental degradation that resulted in climate change is now eating into the development that was once realised (Taguchi 2001). This can also happen in Africa if no action is put to stop pollution.

5 Conclusions and recommendations

When it comes to environmental pollution and degradation, human life and that of other living things are at stake. The EKC and such other theories like "polluter pays principle" should not dominate environmental protection discussions to minimise loss of human life or otherwise. Life is too precious to be valued in monetary terms and therefore cannot be equitably compensated as it is not renewable. How much is enough to pay and bring back the extinct animals? Can money afford to bring back the lost life? Some animals are extinct and more others are under threat of going extinct due to pressures exerted on them by environmental pollution leading to biodiversity loss. We are now fully aware that climate change is real and not reversible, animal extinction is real and nobody is able to create them, diseases due to pollution are real and people do suffer as a result, and clean drinking water is now a scarce commodity due to pollutant contamination, to mention only a few. Therefore, pollute first and remediate later is both irresponsible and unsustainable as it causes environment to be degraded, leaving nothing but a depleted and unsafe world for future generations. Pollution, by its nature, has a fundamental generation gap where the current generation suffers from pollution contributed by their preceding generation. People should leave a legacy of a clean environment for the future generation by change of mind set and consumption pattern.

There is an urgent need therefore to embrace the precautionary approach when dealing with environmental management issues now and as we go forward, seeing that we have learnt from previous experiences that some environmental deprivations are irreversible. As Einstein once said "we can't solve problems by using the same kind of thinking we used when we created them", the present generation cannot enjoy the privileges enjoyed by the early developed nations of developing with little attention on environmental protection. All nations, regardless of level of economic development, are encouraged to mainstream the AICHI Biodiversity Targets in their developmental plans as an important right step in sustainable development agenda fulfilment. People have a responsibility as moral agents to be stewards of the environment by co-operation and conservation (win–win situation) rather than domination (win–lose situation). As a moral rule, the issue of environmental protection should be discussed at ethical rather than economic level for it to be successful. The protection of the biosphere for the future generations is an ethical matter, not an economic matter for no one can bring back the life lost due to any form of pollution. Finally, this phrase summarises the importance of sustainable development discussed throughout this

study, "When the last tree has been cut down, the last fish caught, the last river poisoned, only then will we realize that one cannot eat money" (Obomsawin 1972).

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