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A Pandemonium: Sustainability Under Uncertainty from a Perspective of Environmental Economics

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Abstract: ***Despite of its globally recognized importance, as it is accepted more widely, the concept of sustainability has continuously suffered from ambiguity. This ambiguity probably arises because of the wide-ranging meaning of sustainability itself as it encloses a process rather than an event which already occurred or will or expected to be happened in a specific point in time. Not only has its long-run structure led to a struggle with the problem of uncertainty, obscurities on sustainability also comprise its expansive usage on various fields of work including environmental sciences, economics and business operations. Adding to its complexity arise by its very nature, not only studies that has been made on sustainability appreciably range among the different fields but also studies of the same fields are mostly self-contradictory. This paper thus attempts to dissipate clouds even albeit a bit by discussing sustainability as it only focuses on economics as a specific field.***

Keywords: sustainability, uncertainty, environmental economics, sustainable development

(JEL Classification: Q20, D60, D90, Q56)

1. Introduction

In his essay named " The Economics of the Coming Spaceship Earth" , which is seen as the most celebrated paper to provoke the many questions subsequently to be analysed in environmental economics[i], Kenneth E. Boulding describes the economy of the past as an "open economy" while he evaluates the future earth with a closed one . It should be noted that openness and closeness terms here are not used in a way that most economists familiar with even they have some similarities; Boulding's open economy which he said he was tempted to call as the "cowboy economy" is an economy of illimitable plains and he uses the cowboy as a symbol of the ravenous behaviours of the actors in it while the latter is a description of a future earth without unlimited reservoirs of anything either for extraction or for pollution[1] which he named accordingly as a "spaceman economy". The important point here is that, the future which is mentioned above is our present when it is considered that the essay was written in 1966 thus one may fairly question if our earth we live in has already became a spaceship or not.

According to the report of the World Resource Forum which took place in 2012, there was a consensus that natural resources and the environment are subjects of common problems facing all countries in the world with serious challenges for economic development and the participants concluded that scarcity of resources, increasing prices and unsustainable use of resources can hinder economic development, lead to poverty and social unrest which pose risks for global stability.[2] Undoubtedly, these results indicate that we are already confronted with the fact of limited resources matching up with the description of the spaceman economy however our attitude towards consumption, which is defined as the major difference between these two economies by the author, is more violent than ever before.

"..man must find his place in a cyclical ecological system which is capable of continuous reproduction of material form even though it cannot escape having inputs of energy." Boulding suggests while defining "the close" economy of the future.

Probably it would not be inappropriate to say that the idea of the capability of a continuous reproduction in a limited Earth is directly related to the concept of "sustainability" which characterizes any process or condition that can be maintained indefinitely without interruption, weakening, or loss of valued qualities.[3] To achieve sustainability may be a cure to the problem but the solution comes with its complexity by its very nature.

The imperative of sustainability requires sustaining nature's functioning and services for humans over the long run.[4]However long-run is the vital point here by its meaning of the"future" which is as an indicator of the "uncertainty "and the question arises of how to define and operationalize

[1]Boulding, Kenneth E. 1966. *The Economics of the Coming Spaceship Earth.* Environmental Quality in a Growing Economy. Pp.3-14 Batimore, MD: Resources for the Future. Johns Hopkins University Press

[2] 2012. *World Resource Forum Meeting Report. Beijing, China*

[3]Daily, Gretchen C. Ehrlich, Paul R. 1996. *Socioeconomic Equity, Sustainability, and Earth's Carrying Capacity.* Ecological Applications, Vol. 6, No. 4, pp. 991-100

[4,6] Baumgartner, Stefan. Quass, Martin F. 2008. *Ecological-economic viability as a criterion of strong sustainability under uncertainty.*Revised version of Working Paper No.67 (November 2007), University of Lüneburg Working Paper Series in Economics

sustainability under uncertainty.[5]Not only has its long-run structure led to a struggle with the problem of uncertainty, the concept of sustainability has continuously suffered from an ambiguity whose details will be analysed in the following parts. Adding to its complexity arise by its very nature, not only studies that has been made on sustainability appreciably range among the different fields but also studies of the same fields are mostly self-contradictory. This paper thus attempts to dissipate clouds even albeit a bit, by discussing sustainability as it only focuses on economics as a specific field.

2. Sustainability – Conceptual Confusion

Before coming to its structural challenges, a more clear understanding of the term "sustainability" is needed since a conceptual confusion exists. This ambiguity probably arises because of the wide-ranging meaning of sustainability itself as it encloses a process rather than an event which already occurred or will or expected to be happened in a specific point in time. Adding to this complexity of continuity, the concept of sustainability often faces with confusion since it is usually evaluated as a goal desired to be reach in a long period of time. Defining it as a future aim not only struggles with the uncertainty but this inevitable definition also keeps one's place away from sustainability by turning it into such a concept that not needed to be concern now.

Obscurities on sustainability also comprise its expansive usage on various fields of work including environmental sciences, economics and business operations. However, the concept of sustainability in economics is suffering more than the others in terms of the conceptual complexity. Similar to the confusion of economic development and economic growth, being sustainable is often used as an adjective for both but wrongly evaluated as the same. To develop something means to expand or realize its potential, or to bring something to a fuller state. Economic development is therefore is not the same as economic growth, the latter referring to inflation-adjusted increases in the gross domestic product.[6]There is a potential for economic progress based on development rather than growth- an economic progress that is not at the expense of the environment, but on the contrary that tries to fit economic activity and human skills into biogeochemical cycles and adjust the economic system within the framework of the overall finite global life-supporting environment.[7]Hence, sustainability's role of being a long-term goal and its attached ambiguity mentioned before should be more related to the development rather than growth since the possibility of sustaining an endless growth may be disputable. Or to explain it in a one sentence; Worrying about future generations would be unnecessary if unlimited growth were possible.[8]

If one is speaking about the definitions of sustainable development, it is inevitable to mention the definition provided by the World Commission on Environment and Development in other words the Brutland Commission in 1987. The commission defines sustainable development as follows;

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development, which is defined simply as above, was specified as a global objective which should be adopted as the overriding goal with an international cooperation. When one focuses on the fact that this idea,-of course not the idea of sustainability itself but stating it as a global objective- has been asserted 26 years ago, the global performance until present may be questioned. According to the 2012 World Resources forum Resource and Green Economy meeting report, here is one of the factor which was determined as essential;

"A scarcity of resources, increasing prices, and unsustainable use of resources can hinder economic development, lead to poverty and social unrest; these factors pose risks for global stability."

Thus two conclusions can be derived accordingly about on-going global performance; first, as it can be seen obviously, sustainable development has not been accepted as a global goal yet. If it is accepted why do we need any detection about the unsustainable use of resources and their negative effects on economic development? Second, we, "as a future generation" who the Brutland commission stated in 1987, have serious problems about our ability of meeting our own needs; we define scarcity of resources as a factor which pose risks for global stability. Without being so far from the ambiguity mentioned in the earlier part, the reason of failure has been come into being not just because of the global passivity but also because of the abstruse conceptualism of sustainability which is usually understood as an attribute of future development. Under uncertainty, however, future development is foreseeable only to a limited extent.[9]Several attempts have been made by scholars to define sustainability under uncertainty and these studies will be summarized in the following section.

Intergenerational Allocation of Resources

Sustainability, as an inter-temporal concept, is directly related with the allocation of resources between generations by its very nature, regardless of how it is defined. Especially, from the perspective of environmental economics, in order to compass further issues it is important to understand the concept of intergenerational allocation of resources. For this purpose, some of the related discussions will be touched briefly to break the reader in.

[6]Hackett, Steven C. 1960. *Environmentaland Natural Resource Economics*. Theory, PolicyandtheSustainableSociety p.325

[7]Jansson, AnnMari ed.1994. *Investing in Natural Capital: TheEcologicalEconomicsApproachtoSustainability*. Island Pr,

[8]Tietenberg, Tom. *Environmental and Natural Resource Economics.* Fourth Edition.

[9]Baumgartner, Stefan. Quass, Martin F. 2008. *Ecological-economic Viability as a criterion of strong sustainability under uncertainty* .Revised version of Working Paper No.67 (November 2007), University of Lüneburg Working Paper Series in Economics

According to the conventional economic analysis, the flows that took place in the future are considered as less important. This application of discounting neglects the impacts that occur in future and thus has strong implications of the distribution of well-being between generations by devaluing the benefits of future generations. Padilla(2002) suggests that, discounting and environmental degradation are not related directly. According to Padilla, if negative effects that different investments cause on the environment were avoided or properly accounted and compensated, higher investment that resulted from the impacts of applied discount rate on global investment, should not entail environmental degradation. Conversely, Pearce and Turner (1990) suggest that an increase in global investment level resulted from the discount rate would lead to greater use of natural resources and thus degradation even it also led to higher capital endowment inherited to future generations.

Woodward (2000) uses an interpretation of sustainability which is based on the idea that a generation behaves sustainably if it does not expect to be envied by future generations. By including risk into their analysis, they conclude that numerical methods can be used to find optimal-sustainable policies. Woodward, attempts to clarify the meaning of sustainability by using Foley's economic definition of fairness which they assume as a generational obligation hold by policy makers. Their constructed constrained optimization model marks an obligation to treat future generations fairly and also concludes that planning for sustainability requires sustainable growth under uncertainty of future, risk. Moreover, the results of their study have revealed that policy makers can pursue the goal of sustainability without conflicting with the goal of efficiency since they found that the Pareto inefficient outcomes of sustainability constraint are avoided in productive economies.

3. Defining Sustainability under Uncertainty – Attempts and Major Concepts

a) Capital Approach

Before going into details of dividing sustainability into two parts as weak sustainability and oppositely strong sustainability, capital approach to sustainability should be figured out since these two components are directly related to substitutability of capitals. According to some[10], capital aligns very well with the temporal aspect of sustainable development as concept since it is what we pass on today so that the economy may continue tomorrow.

Viederman (1996) defines sustainability as;
Sustainability is a community's control and prudent use of all forms of capital- nature's capital, human capital, human-created capital, social capital and cultural capital- to ensure, to the degree possible, that present and future generations can attain a high degree of economic security and achieve democracy while maintaining the integrity of the ecological systems upon which all life and production depends.

This definition of sustainability which is relatively more comprehensive would be a plausible starting point to understand the approach since it relates the five capitals of sustainable development. Natural capital which plays a vital role in the concept of weak sustainability has been often underestimated by the economists. In an elementary form, economics is defined as the efficient allocation of scarce resources where this scarcity is in terms of capital and labour- which is not true. The scarce one should be natural resources which are not negligible as it has been done by the mainstream economics. Natural capital generates the flow of natural resources. From a perspective of ecological economics, it is not possible to have perfect and unlimited substitution between natural and human-made capital. Ecological economists argue that natural capital and human-made capital are largely complements rather than substitutes and that natural capital is increasingly becoming the limiting factor for further development. Therefore, in order to sustain a stream of income, the natural capital stock must be maintained. [11]

The term which refers to the deployment of knowledge and skills to create an economic value, on the other hand, is human capital. Becker(1993) defines investment in human capital as the activities that influence future monetary and psychic income by increasing the resources or through the human resources. Education, for instance, is such kind of investment. By increasing the stock of human capital through education, a larger and more valuable flow of labor and volunteer services is obtained. The technologies and productive facilities are considered as the human-created capital which economists traditionally think as "capital stock". [12] Coleman (1998), on the other hand, uses the concept of social capital, which he thinks that it comes about through changes in the relations among persons that facilitate action. Hackett(2006) states that, communities with large with large stocks of social capital, enjoy a flow of economic benefits in the form of lower transaction costs, lower-cost dispute resolution and more timely adaptive and cooperative responses to adverse shocks of various kinds.[13] The last form of capital mentioned in Viederman's definition on sustainability was cultural capital which can be defined as the interface between natural and human-made capital determines how society uses natural capital to create human-made capital. Bourdieu (1986) defines cultural capital in three forms; in the embodied state, in the objectified state and in the institutionalized state where the former is related to the long-lasting dispositions of the mind and body, the middle is about cultural goods like books and pictures.

As an abstract basis for the improvement of sustainable development indicators, the capital approach suggests the

[10]Pezzey, John C.V. Toman, Micheal A. 2002. *The Economics of Sustainability: A Review of Journal Articles.* Resources for the Future.

[11]Jansson, AnnMari ed.1994. *Investing in Natural Capital: TheEcologicalEconomicsApproachtoSustainability*. Island Pr,

[12]S.Becker, Gary ed.1993. *Human Capital, A TheoreticalandEmprical Analysis with Special Reference toEducation*

requirement to measure stocks of each sort of capital and their evolution over time. Within the case of natural capital, it additionally implies the requirement to measure the demand for the environmental services to decide whether or not demand exceeds the capability of ecosystems to fund them. This means an enlargement of the standard production function to involve all types of natural capital (not simply natural resources) and to involve the disadvantages of economic production (e.g., wastes) that may result in deterioration with in the functioning of ecosystems. [14]

After the concept of sustainability was underlined in the Brutland Report with a specific definition as mentioned before, two competing theories of sustainability have begun to be discussed as an economic and ecologic debate; weak and strong sustainability.

b) Weak Sustainability

Weak sustainability, which was developed as a theory from economic models of growth and technological change in the context of limited resources[15], can be defined as the allowance of some natural resources to be run down as long as sufficient compensation is provided by increasing in other resources. Hence this notion has been generalized to conditions of risk, using the concept of non-declining expected welfare. Thus, attempts to analyse sustainability also for conditions of uncertainty have been so far mostly focus on the concept of weak sustainability.

The essential study on economic growth with limited resources that calls for the concept of weak sustainability is Solow's (1974) which is about intergenerational equity and exhaustible resources. Solow defines sustainability as a path that allows every future generation the opportunity to be as well off as its foregoer. The main idea in the concept of the weak sustainability was that limited natural resources and weak substitution between natural and created capital stocks may lead to a problem with an increase in population since per capita consumption may not be sustainable in a world with a growing population.[16]However, according to the conclusions of Das Gupta and Heal's (1979) study, if a possibility of substitution between natural and created capital without limits could be in question, then exhaustible resources would not lead to a needed limit in a population and growth even without technological development. In fact, the concept of weak sustainability is a direct application of the Hartwick-Solow rule from growth theory with exhaustible resources where the literature on weak sustainability translates this rule into sustainability analysis by defining sustainability as non-declining per capita consumption and wealth and by restricting the links between economy and the environment to considering a resource called natural capital in the production process.[17]

Hartwick Rule

The two main intertemporal allocation rules considered in resource economics are the Hoteling rule and the Hartwick rule where the former indicates that along an efficient resource utilization path, the price of an exhaustible resource has to grow with a rate that equals the interest rate[18] and the latter prescribes reinvesting resource rents, thus keeping the value of net investments equal to zero. Under the Hartwick rule, in order to sustain constant levels of per capita consumption, the gains that the society today enjoys from utilizing an exhaustible natural resource must be reinvested in natural or created capital over time.[19]

However, Asheim (2000) suggests that the Hotellingrule is simply applicable in" a cake-eating economy" where consumption is a result of a depletion of a given stock of natural capital even if it seems relevant for all models of non-renewable resource use in principle. According to him, instead, the Hartwick rule was formulated for a production economy where consumption at any point of time, depends not only the extraction of natural capital but also on the stock of created capital available at this point of time. In his another related study, Asheim (2011) concludes that the Hartwick rule essentially constitutes a valuable characterization of an efficient and egalitarian path rather than establishes the basis for a useful prescriptive rule for sustainability.

c) Strong Sustainability

Running down the stocks of natural capital and replacing these stocks with constructed substitutes is not universally seen as being consistent with the requirements of sustainable development however.[20] Under the interpretation of strong sustainability, perfect substitution between different forms of capital is not a valid assumption to make because of the fact that some of the functions and services of ecosystems are essential to human survival; they are life-support services and cannot be replaced. In contrast to the concept of weak sustainability, the concept of strong sustainability, which has developed from ecological science, evaluates sustainability as non-decreasing natural capital. It regards natural capital as providing some functions, which are stressed by defining sustainability as leaving the future generations a stock of natural capital not smaller than the one enjoyed by the present generation, are not substitutable by human-made capital.[21]

[14]Smith, Robert. Simard, Claude. Sharpe, Andrew. 2001. *A Proposed Approach to Environment and Sustainable Development Indicators Based on Capital.* The National Round Table on the Environment and the Economy's Environment and Sustainable Development Indicators Initiative.

[13,15,17]Hackett, Steven C. 2006. *Environmental and natural resources economics: theory, policy, and the sustainable society*. ME Sharpe, p.403

[17]Gutes, M. 1996. *Commentary: The Concept of Weak Sustainability*. Ecological Economics 17: 147-56.

[18]Asheim, Geir B. Buchholz, Wolfgang. 2000. *The Hartwick Rule: Myths and Facts.* Department of Economics. University of Oslo.

[19]Hackett, Steven C. 2006. *Environmental and natural resources economics: theory, policy, and the sustainable society*. ME Sharpe.p.403

[20,23]Hackett, Steven C. 2006. *Environmental and natural resources economics: theory, policy, and the sustainable society*. ME Sharpe.p.405, p.403

[21]Gutes, M. 1996. *Commentary: The Concept of Weak Sustainability*. Ecological Economics 17: 147-56.

Even if the need to understand the flow of goods and services from all valuable forms of capital and the practical trade-offs involved with meeting basic human needs makes the concept of the strong sustainability relevant[22],not all scholars have embraced only these two theories of sustainability. According to Baumgartner and Quass, for instance, the requirement of maintaining different natural and capital stocks as separate physical quantities cannot be guaranteed in a world of uncertainty. They therefore use the concept of ecological-economic viability which refers to the different components and functions of a dynamic, stochastic system at any time remain in a domain where the future existence of these components and functions is guaranteed with sufficiently high probability, as a criterion.

Ayres, on the other hand, suggest that both weak and strong criteria are not realistic since they both imply a centralized decision-making process and maker who decides on behalf of society among alternative programs and plans. In contrast, he suggests that in real life economic decisions are mostly decentralized. Additionally, Ayres relates the confusion in the discussion of strong sustainability to distinctive assumptions of weak and strong sustainability. The assumptions that were mentioned in the related study are the assumption of substitutability between natural and manufactured capital and is that, in his terms, economic well-being covers all other concerns. The confusion arises from the acceptance; Ayres suggests that if the latter is accepted then the discussion of sustainability turns out to a kind of an economic debate about elasticities of substitution and technological advance. Moreover, his claim is that if the former is incongruous for a suitable physical environment for the human being, then according to the strong sustainability leads to a need to back out of the conventional market framework in order to establish the conditions for maintaining human happiness.

Consequently, capital approach evaluates sustainable development as the non-declining per capita wealth over time. Defining sustainability as the non-declining capital or utility (wealth) strictly marks the need to assert wealth as the fundamental rule of sustainable development by proposing an apprehension that focuses only on per capita wealth and neglects overall utility of the society (total wealth). Thus, related literature and limits of this kind of evaluation will be discussed in the following section.

d) Defining Sustainability as a Non-Declining Utility Attempts and Limits

Attempts have been made to define sustainability under uncertainty, usually conceptualizing sustainability as non-declining utility or welfare. Hence, this conceptualizing leads to the evaluation of sustainability under the concept of weak sustainability. Asheim and Brekke (2002), for instance, fare forth with the following definition of sustainability; "A generation's management of its stocks of man-made and natural capital is sustainable if it constitutes a first part of a feasible development with non- decreasing utility." According to them, this kind of definition does not guarantee that development will have non-decreasing utility even when generations comprehend sustainability since sustainability does not prevent lower utility for sacrificing of one generation benefits for the future'shigher utility and it also ignores uncertainty. Thus, in their study, Asheim and Brekke(2002), discusses the question of whether the risk of decreasing future utility is acceptable by extending the definition of sustainability into a structure in which capital management does not have deterministic results.

However, Asheim and Brekke also criticizes the interpretation of sustainability as the feasibility of non-decreasing utility by suggesting that this kind of approach would eschew uncertainty and accordingly, give another definition of sustainability which they believe lead to an approach that allows for evaluations of risk and uncertainty where negative catastrophic events with small probabilities are given a higher weight than expected utility allows; "*An allowance-bequest strategy is sustainable if, for any history, the living generation's utility does not exceed the certainty equivalent of the utility of its immediate successors. A generation's management of its stocks of man- made and natural capital is sustainable if it is in accordance with a sustainable consumption-bequest strategy."*

In their article in which they are interested in estimation of accounting prices, evaluation of policy change in an imperfect economy and also sustainability of an intergenerational well-being along a projected economic program, where the latter, according to them, should be related with the growth of an economy's production possibilities set, Arrow, Dasgupta andMäler focus on the fact that sustainability and optimality should be evaluated as different concepts. They analyze future uncertainty in the productivity of capital assets with its effects on the accounting prices and thus call attention to the underestimation of the social worth of those assets in case of ignorance of uncertainty in economic models.

There are also critiques for the capital perspective about the measurement problem. The requirement to measure of all capital stocks by using a common unit, namely money, has often evaluated as problematic because of the difficulty in both determination of the ways in which capital contributes to wealth and translation their value into monetary terms. Moreover, there are ethical debates; certain observers place a question mark after the right of humans to exploit nature in a destructive manner, even if this, at least in the short run, may increase total national wealth. [23] Last but not least, as it is tried to be shown above, another limitation of the capital approach is about the degree of substitutability among capital types. As the theory of strong sustainability asserts, critical capital stocks such as ecosystem as a part of natural capital, cannot easily be replaced by increased income or human capital. Hence, usage of a single monetary unit to measure sustainable development cannot be accepted smoothly since it would not be so plausible to evaluate all forms of capital as aggregately regardless of whether they are critical or not.

4. Measuring Sustainable Development

[23,24]United Nations Economic Comission for Europe. 2009. *Measuring Sustainable Development.*

As it can be seen from the part proceeded until, defining sustainability is a divisive and challenging process. However, measuring it is not less troublesome. Various quantitative criterions such as indicators, indexes and benchmarks have been developed for this purpose and they will be analysed shortly. It should be noted that, even it was mentioned before that this study would only focus on one specific field in terms of sustainability, namely economy, the attempt to achieve this "principle of parsimony" may fail especially under the title of measurement of sustainability since the metrics encloses the sustainability of environmental, social and economic domains all together. On these grounds, the measurement of sustainability and sustainable development will be discussed separately.

Measurement of sustainable development was formally formulated in Agenda 21 which was one of the main reports of the United Nations Conference on Environment and Development took place in 1992 in Rio de Janerio in Brazil. Following UNCED in 1992, the United Nations Commission on Sustainable Development was established, one of its tasks being to monitor countries' efforts in developing and using sustainable development indicators. A set of sustainable development indicators were developed by this commission, however, the studies of Eurostat showed that some of the proposed indicators were not that well oriented to national needs.[24]Some countries have developed their own sustainable development indicator sets and the process of developing these indicators is still valid. Switzerland, for instance, developed the Monet Indicator system. The United Kingdom measures progress in sustainable development through a suite of 68 national sustainable development indicators and also a new set of indicators have been developed by the studies of the Department for Environment, Food and Rural Affairs. Germany also published an indicator report in 2012 including a summary which shows the mathematically calculated status of the indicators in the target year in simplified form[25]. The OECD also has developed conceptual framework and indicators that help governments monitor progress towards green growth.

In their 2009 report, which was prepared with the cooperation of Eurostat, United Nations economic commission compares policy-based indicators with capital-based indicators. It should be noted that even if the report was prepared for statistical offices in the UNECE, OECD and EU member states, it is not confined with its members and serves a comprehensive study on the analysis of the measurement of sustainable development since it targets other audiences as well. According to the report, policy-based indicators' main strength is about the close connection between the indicators and the national goals established for sustainable development while they hold the weakness of the risk of instability since these types of indicators may be subject to change whenever policies change. For the capital-based indicators, on the other hand, clear and well-established conceptual basis is considered as their main advantage, however the report also underline the problems in translating the conceptual idea of the capital approach into practical indicators. In addition, measurement problems of the capital perspective in terms of well-being as it is tried to be mentioned in previous section in this paper have also been marked in the report.

With respect to the measurement of sustainability, indicators can be divided into two groups depended on how the concept of sustainability is defined. For the weak sustainability indicators, it is needed to use an approach that focuses on a constant per capita level of stock. A number of measures have been developed that attempt to take indicators of human-made, human, natural and social capital and reduce them to a single aggregated indicator of weak sustainability. The concept of weak sustainability, therefore, calls for a measurement process where the national income and product accounts would be extended beyond the market-mediated flows underlying gross domestic product measurement to include all stocks of capital and both market-mediated and nonmarket flows of valuable goods and services.[26] Green GDP in which the Hartwick rule is used to calculate may be a good example for this method; it is calculated by subtracting Hotelling rent for non-renewables, total expenditures on pollution control and other direct costs due to environmental degradation from GDP. Arrow et al.(2004), for instance, suggested genuine investment, which refers to the sum of the values of investments or disinvestments in each of society's capital assets, as an indicator of weak sustainability. Adding to these indicators, there are also other measures of weak sustainability such as the index of sustainable economic welfare; ISEW and genuine progress indicator; GPI. Strong sustainability indicators, on the other hand, include measures of ecological resilience such as biological diversity and yield variability in agriculture, measures of carrying capacity and ecological impact analysis.[27] Carrying capacity based on net primary product; NNP and ecological footprint; EF, are the two strong sustainability indicators.

Opschoor and Reijnder (1991) suggest that the number of environmental indicators proposed must be small and cover the areas of ; all kinds of resources both including renewable, non-renewable and semi-renewable ones, pollution and the biological diversity or integrity of ecosystems. It should also be noted that according to some* case studies, one would face with an indication of a substantial disparity between the trend in conventional GDP, weak sustainability measures and strong sustainability measures.

5. Conclusion

The general evaluation of economics whose definition can be plainly related to the efficient allocation of scarce resources has underestimated the role of natural capital by mostly focusing on the scarcity of capital and labor. With

[25] Federal Statistical Office, Sustainable Development in Germany, Indicator Report 2012 https://www.destatis.de/EN/Publications/Specialized/EnvironmentalEconomicAccounting/Indicators2012.pdf?__blob=publicationFile

[26,28]Hackett, Steven C. 2006. *Environmental and natural resources economics: theory, policy, and the sustainable society*. ME Sharpe.p.408, p.413

* Seecasestudies in the main source of thispaper; Sub-SaharanAfrica, Latin Americaandthe Caribbean.

the emergence of environmental economics being a sub-discipline whose main philosophy is based on sustainable development and also of ecological economics where environmental problems regarded more seriously, the inevitable reconsideration of sustainability flourished. Recognizing the importance of the concept of sustainability was undoubtedly vital but also only one stroke in the sea.

Despite of its globally recognized importance, as it is accepted more widely, the concept of sustainability has continuously suffered from ambiguity which probably arises because of the wide-ranging and long-term meaning of sustainability itself. Adding to its structural complexity which comes with the uncertainty of future, even defining sustainability itself is a controversial issue as it ranges among the assumptions. This paper thus attempted to take the matter in hand with great modesty by aiming to provide clarification. For this purpose, the conceptual confusion of sustainability was tried to be discussed and major approaches and catch titles of the subject tried to be clarified by providing a semantic integrity. This was tried to be done insofar by focusing on different approaches proposed by various scholars and thus previous attempts. As a matter of fact, it would be impossible to include every each term, concept and discussion in the very limited confines of this paper. However, the desired goal was to underline the importance of the concept of sustainability, which can be evaluated as the only solution that the mankind have for a world with limited natural resources but unlimited ravenous behaviors of the actors in it.

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