Integrating Participation in Estimating Soil's Economic Value

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***Abstract*— Although soil's anthropogenic contributions are evident, conservation measures and policies on sustainable use have not always been successful. One main reason is the public's inaccurate depiction and misperception of its relation with human well-being. Economic valuation of soil highlights the need for environmental conservation in the decision making process. Fundamental principles in the science of understanding and estimating economic value for environmental goods and services are becoming well-established, except for particular issues that still remain contentious. One under-appreciated theme is in stakeholder participation and deliberation, which remain in obscurity due to intrinsic factors limiting greater acceptance. There remains an apparent isolation for greater stakeholder participation in most valuation frameworks. This paper focuses on estimating the economic value of soil and discusses how participatory modelling can be integrated in the various valuation frameworks: stock flow and fund service framework, cost-based assessment approach, and total economic value approach. It also examines present constraints and how they can be addressed for future studies.**

***Keywords*— Economic Value, Environmental Economics, Participatory Modelling and Soil**

I. INTRODUCTION

Soil is an important resource with many diverse functions, providing ecological, social, cultural and economic benefits to man [1]. In recent decades, soil resources have been greatly threatened from being critically degraded on the global scale [2]. Although soil lost from erosion may be renewed and regenerated into the system naturally, larger amounts of soil have been lost through accelerated rates of erosion. Attributed mainly to intensified anthropogenic activities and interventions, aggravated levels of soil degradation not only threaten global food security, but also put communities at higher risk from associated disastrous environmental consequences [3]. The problem becomes even more complex for developing countries. Weaker economies, which are usually highly agriculturally dependent, are compelled to produce more and more agricultural products, up to levels of unsustainable exhaustion. Given their incapacity to implement conservation and mitigation measures, these countries are left defenseless to face the disastrous consequences of soil degradation such as long term soil infertility, water pollution and river sedimentation. Thus, the problem confronting soil resources cannot be contextualized exclusively on its environmental dimension, but has to be considered along with its far-reaching economic, political technological and social implications.

Even with the general acceptance of the correlation between soil health and anthropogenic benefits, success in the sustainable use of soil has oftentimes been elusive. A major contributory factor has been traced to the lack of understanding and appreciation of the economic contributions of soil in the various aspects of human wellness. Not knowing the soil's true worth has resulted in lower priority being given to soil in the decision-making table, and poorer stakeholder participation in the conservation measures. The purpose of this paper is to review and discuss the complexities of valuing soil, and lay the foundations in the development of standard frameworks for soil valuation process. We introduce the relation of soil as a natural capital with its economic value, basing on how ecosystem services and environmental goods have been defined in the developing literature. We offer a critical assessment of how these different valuation frameworks can be used in soil value estimation and how they measure up to their intended applications. We then present an integration scheme to enhance the valuation framework for soils using participatory modelling, and discuss possible applications for the approach.

II. THE VALUE OF SOIL

To understand why soil valuation cannot directly be intuited, it is important to recognize its fundamental characteristic as being a public good. Early economic thoughts have since recognized the importance of environmental goods and services to human existence. But because they are part of public goods, their intrinsic qualities of non-subtractability and non-excludability have made them highly susceptible to unregulated use and massive exploitation. Subtractability, sometimes referred to as rivalry, refers to the characteristics of good when used by different users. If the use of the good by

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one consumer diminishes the ability of another to use the same good, then the good is said to be subtractable. Private and common-pool goods, such as farm products, electricity, timber, and coal are considered as subtractable goods, since consumption of a person diminishes the supply and limits the capacity of others to utilize the resources. Excludability refers to the limitations imposed on the population for the permitted use or access of specific products. Farm products are considered excludable, because the owner has the exclusive right to use the goods. Air is a non-excludable resource because no one can be excluded from inhaling air. Most environmental goods are public goods, such that, they are non-subtractable and non-excludable. This has made the valuation of these resources a difficult and complicated task. For soil resources, the reality is perplexed. Because of its high dependency on land, it is oftentimes considered a subset of land, and is therefore assumed that the value of a property covers the soil's utility value. Although in some cases, especially agricultural lands, the cost of land may actually be influenced by soil properties, this does not mean that the economic value of soil has already been captured by the price. Unlike most private goods, soil's associated benefits and costs affect not only individual land owners, but also the community-at-large. And since benefits serve as bases for value, the classical paradigm of valuing soil as a private good devalues its worth significantly and completely fails in capturing its utilitarian value. Soil should therefore be given its utilitarian value, distinct from the land value, and valued as an environmental public good.

A. Environmental Public Good

In classical economics, environmental goods often were categorized in distinct and separate categories because they benefit the general public, and oftentimes at no cost. Its fundamental nature of non-excludability often causes a free-rider syndrome, wherein people consume more than their fair share because of a lack of mechanism to control their appetite. Prices have been used by the market to communicate scarcity to assess utility trade-offs and optimize resource allocation [4]. But because of their abundance in relation to the population demand, most public resources have yet to be assigned value [5]. Most of these public goods have no developed markets, and thus no automatic mechanism to determine the benefits derived by each household [6], [7]. This perception of having zero-value lays the foundation of the seeming disconnect between economics and the environment, and reflective of the people's unwillingness to pay for their portion of costs. The problem is confounded further by the presence of market failures, or the inadequacy of the market to regulate the transaction of goods, which often leads to underproduction or exploitation. In the context of soil, market failure can be due to price externalities (costs and benefits generated as by-products of an economic activity but are not reflected on transacted prices), collective utilization of land, imperfect or weak property rights, absence of perfect competition, or the inadequacy of perfect information among stakeholders.

Accurate assessment and recognition of the economic contributions of soil and other public goods are important in promoting more sustainable use of environmental goods. EPG's significance to human existence has often been overlooked, which have led to their exclusion from the decision-making process [8]. Soil's value has often been entwined with the price of land, which emphasize private benefits to landowners but fails to consider the numerous public benefits and possible social costs of degradation. Without an agreed upon measure of value for evaluating economic, normative, and conservation actions, governments have been passive in correcting these market failures, and people have often been less-accepting of restrained use especially when faced against maximizing profit. This knowledge-gap has resulted in inefficient land-use policies, creating a distorted picture of their economic value, and ultimately to the mismanagement and exploitation of natural resources.

B. Background on Environmental Valuation

Neoclassical economics is the modern economic theory that generally views market regulation as a tool in rationing society's scarce resources from the various agents interacting and promoting their self-interests [9]. But because markets are free to dictate the use of natural resources, people have often exploited environmental goods at unsustainable levels. With the economic thinking of an almost complete decoupling of the environment and the economy, short-term profit-maximization becomes more attractive than long-term sustainable use. One way to resolve this misconception is to express the environment's contributions to human wellness on a monetary scale. In this manner, the environment is brought alongside other economic factors in the decision-making process, and demonstrates a more concrete connection between environmental use and other economic indicators. This valuation of resources, such as soil, makes a more appealing case for decision-makers to decide on

Highlighting the need to include the indirect costs and benefits associated with an economic activity in the decision making process is the main argumentation of environmental valuation. The science of environmental valuation has significantly gained prominence in the last decade as exhibited by the exponential increase in published works on the subject of environmental economics (shown in Figure 1). Several points are still being debated among economists and scholars regarding particular details, but there is a general consensus with regards to the importance of valuing the environment.

III. SOIL VALUATION FRAMEWORK

A. Fundamental Elements

In determining the economic value of soil, numerous approaches have been developed over the years. These frameworks for valuing soil and other environmental goods were designed to reveal the utilitarian component of the resource's value, which is termed as the economic value. Chee [10] enumerated four key economic concepts relevant in the formation of valuation frameworks, namely: [1] market essentialism; [2] substitutability, fungibility and technological optimism; [3] rational actor and consumer choice theory; and [4] utilitarian, anthropogenic and ethical framework. These essential elements ensure that the valuation is realistic and well-founded on the principles of economics.

Table 1: Defining the Essential Elements in Valuation (adapted from Chee, 2004)

Market essentialism	Contextualizing environmental services in the marketplace
Substitutability	Availability of suitable surrogates to associate nature-derived benefits some value using comparable benefits
Fungibility	Adequacy and sufficiency in supply of substitutes
Technological optimism	Belief that foreseeable growth in demand would be answered by advancement in technology
Rational actor	Economic behavior described as wanting to have more rather than less of a certain good
Consumer choice	Consumer preferences and expenditures are driven by motivation to maximize utility, subject to the limitations of budget
Utilitarian and anthropogenic	Man-centric valuation which focuses on estimating value based on the various utilities (or benefits) that satisfy man's needs
Ethical Framework	Environmental goods have intrinsic value outside the conventional utilitarian definition

In developing operational and effective valuation frameworks for soil, these elements are necessary to accentuate the scientific connection alongside the social relevance of results. And although the framework and processes to be used may differ due mainly to objective-centric reasons, these fundamental elements should be observed to ensure unbiased, credible and useable results.

B. Key Questions

In building up the methods and techniques to be employed in the framework, it will be helpful to be guided by key questions that will have to be answered preceding the estimation of soil value. These questions form as guide to ensure that the necessary variables are incorporated into the framework.

- What type of soil value would be estimated?
- How is soil being currently used and managed?
- Who are the stakeholders involved in soil utilization and management?
- What are the various soil services that are to be valued?
- What forms of soil degradation and soil-related risks should be considered?
- What possible changes and scenarios are to be proposed (or expected)?
- When and where will these changes occur?
- How will these changes affect the different stakeholders?
- How will the stakeholders respond to these proposed changes?

Stakeholders are key component in coming up with the framework, as highlighted by many of the key questions. This fact however does not usually translate into greater collaboration in the valuation process. In many instances, experts and professionals still hold considerable control in the valuation process. Stakeholders are left with limited influence, oftentimes subjugated to the roles of merely answering questionnaires or providing baseline values to be used in condition assessment. Preconceptions about consumer bias and stakeholder misinformation have limited the inclusion of more engagement. This paper argues that by greater participation amongst stakeholders, the inclusion of more participation by the stakeholder not only creates additional dimension in the analysis but also generates more acceptability with the generated results.

C. Strengthening Stakeholder Participation

Spatial planning has often involved highly complex problems that demand competency from wide-ranging expertise and involve stakeholders from diverging perspective and interests [11]. One of its most fundamental challenges has been supporting learning in these complex systems, characterized by their multifaceted structures and dynamic processes [12]. Traditional techniques in spatial planning have become inadequate in understanding the non-linear causal relationships, that often involve multivariate and integrated approach to monitoring and measurement [13]. These techniques have insufficient feedback mechanism which may allow for any policy or measure to be refined and improved. These limitations in traditional spatial planning methods gave rise to a collaborative attitude in research which is participation/participatory approach.

Participatory approach focuses on a joint-decision making, wherein the primary stakeholders are knowledgeable about the problem and are willing to take part in the analysis. It has become a major principle in development projects, with the support coming from the different relevant stakeholder, such as the government, civil society, and ordinary citizens [14]. Unlike the traditional methods where the whole process of decision-making is left to the discretion of experts, participation considers the stakeholders as collaborators and they are given significant say in the decision-making process. Dialogues between experts, policy makers and primary stakeholders lead into an exchange of knowledge and experience, needed to analyze critical issues and to formalize solutions. There is a feedback mechanism providing both the positive and negative responses by stakeholders, which is essential in evaluating effectives, detecting unintended consequences in the system, and suggesting adaptation mechanisms [12].

Participation can be a tool to empower communities—empowering people to overcome challenges and influencing the community to take control of their lives are inherent to the participation process [14]. It can also lead to the improvement of competencies and capacities of the community, who are directly confronted with the problem. And since the decisions have been made through consensus-building by the primary stakeholders themselves, crafted policies and programs have better chances to be successful and sustainable [11]. Four perceptions or levels of participation in initiating a development project have been identified [14]:

- ***Passive Participation***, weakest of the participatory approaches, requires minimal feedback from primary stakeholders, and assesses participation through methods like head-counting and contribution to the discussion.
- ***Participation by Consultation*** elicits stakeholder responses from questions that have been designed by the researchers, and are given during or outside formal discussions. Decision-making, however, is still left in the hands of professionals, who are in no obligations to incorporate the stakeholders' inputs.
- ***Participation by Collaboration*** forms groups composed of primary stakeholders, and allow them to analyze discuss predetermined objectives set by the project. This method requires an active involvement in the decision-making, and incorporates a component of horizontal communication and capacity building among the stakeholders.
- ***Empowerment Participation*** is where the primary stakeholders become capable and willing to initiate the process, and take part in the analysis as to what and to how things should be achieved. While dialogue between the experts and relevant community bring out critical issues through exchanges of knowledge and experience, ownership and control of the process rest in the hands of the primary stakeholders.

Although participation by stakeholders is sought, going after the highest levels may not always be necessary, feasible or useful. In integrating participation in the valuation framework, the first concern would be as to which conceptual approach would be most applicable and useful to which valuation framework. There is an issue regarding the differences between how different professionals and experts appreciate environmental information compared to the public. When experts share environmental information, it may be assumed that they share scientific worldview, and that they know how to evaluate the quality of information, and they know how to asses them. When the information is given for public consumption, the view should be replaced with the opposite view, since each user is considered to have a unique conceptual framework, and a varying level of competence [15]. Since stakeholders come from varying background and have different levels of competence, the one-size-fits-all policy cannot be used to elicit public participation.

The enormous challenge on participation is defining how much influence should be given to the stakeholders, and how much should be left with the experts. As much as public participation may offer new insights, public knowledge, experience and perspective may at times be limited or skewed. The community may not always see the bigger picture, and oftentimes represent only the concerns of a portion of society. Unlike outside-experts, they are not disinterested parties and driven by personal motivations. Participants do not have single perspectives but have multiple identities, which have different contexts and mind-sets [15]. Another issue to be addressed is in the extent and depth of knowledge and commitment to participate, of the primary stakeholders. Critics have often slammed participatory approach as treating communities as if the population is heterogeneous; while in reality, stakeholders often have contradictory perspectives and differing opinions. They also say participatory approach may lead to propagating a culture of 'tokenism', allowing hand-picked voices to be included in the discussion to serve as rubber-stamp to highlight participatory credentials. To ensure unbiased results during participative discussion, proper representation of the various groups in the discussion should be ensured.

IV. DIFFERENT FRAMEWORKS FOR SOIL VALUATION

A. Ecosystem Services Approach

One of the most popular and commonly applied valuation frameworks is the ecosystem services approach. Ecosystem services are processes and conditions in nature that directly or indirectly fulfill human needs or satisfaction. The concept includes the production of goods, delivery and transport, regulating and regeneration, protection and maintenance, and other life-supporting services to humans and other living creatures [10]. From the conventional method of damage assessment which concentrated on the resources themselves, this method estimates the value by looking at the various benefits derived from the ecosystem. The Millennium Ecosystem Assessment (2003) paved the way not only in an international collaboration in assessing environmental benefits, but also the commodification of the valuation process using the ecosystem services approach [16]. Although the science of environmental economics has been around for centuries, it was the MEA (2003) which provided a deeper understanding of ecosystem services and extended it to a heuristic classification system [17]. One of the most commonly used topology for ecosystem services has been introduced in MEA (2003), which categorized the benefits into (1) provisioning, (2) regulating, (3) supporting and (4) cultural. Provisioning services are the tangible and most easily perceived services. These are mainly private goods derived from the environment and mostly having markets of their own. Agricultural and timber goods are examples of the provisioning. Regulating services are the regulating processes that serve as maintenance such as climate regulation, water purification, waste treatment and protection from natural disasters. Cultural services are the non-physical benefits which are related to the fulfillment of man's spiritual and cognitive needs. It includes cultural heritage and diversity, aesthetic values and leisure needs. Supporting services are the processes that provide assistance to the other services, are oftentimes impact man indirectly and are measured over longer periods of time. Nutrient and water cycling, soil formation and provisioning of habitat are considered as supporting services of soil.

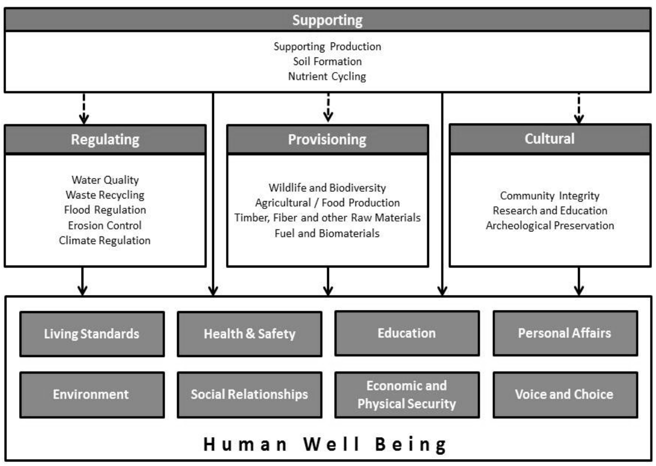

Figure 1: Soil services and their relations to components of human well-being

Although the approach has become one of the most commonly used approach in estimating value, the framework still has a number of limitations when used in valuing soils. The combining of the supporting services (i.e. nutrient cycling and soil formation), with the other services has been questioned as it has been compared with mixing means (or processes) with the results [18]. This has resulted to ambiguity in the valuation process, with some environmental functions having overlaps causing double counting of benefits. Another limitation is the inherent difficulty of isolating contributions by a single environmental good. With a clustered approach, it makes it very difficult to isolate the contributions of specific environmental goods, such as soil. For example, if agricultural products would be used to estimate the value of soil, how can soil value be isolated from other contributory variables such as water supply and local biota? Given these limitations of the approach, the ecosystem approach can be viewed as a springboard to bridge widely accepted norms and techniques in valuing environmental assets towards more specific approaches in exclusively estimating soil's economic value. For these reasons, this paper will focus on the next three frameworks to include participatory modelling in estimating soil value.

B. Using Funds and Flow Approach

Natural capital is defined as "the stock of materials or information contained within an ecosystem" [19]. Capital enables for the production of goods and services, which in turn are converted to wealth and well-being [20]. The environment can be viewed as a stock from which other valuable goods can be obtained or manufactured, or as a fund of ecological services that provide benefits to man. Different goods and services that provide for man's well-being are produced from the natural capital, either as being a transformative fund, or as a source of material flows. This approach is called the stock flow and fund service framework. It focuses on the earth-system management of resources, differentiating between the tangible and intangible goods, and recognizes that the final classification is based on utility [21]. While fund is being used in its entirety at a given time and is not depreciated through usage, stocks are discretely utilized based on the need and are depleted [22].

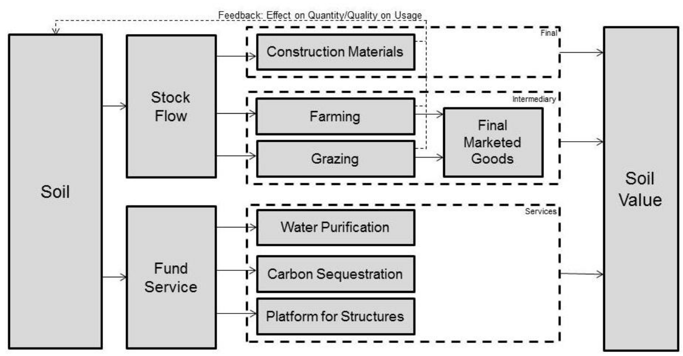

Figure 2: Framework using flow/fund approach for valuing soil

The valuation of the environment would therefore either be as a function of the service-providing fund's value or in terms of the rate if change of the stock [22]. For soils, if we would view it as a stock-source, it would be considered as provider of nutrients and platform from which agricultural products grow. The valuation would then be roughly based on the amount of agricultural yield, and in relation to the change in the nutritional content of soil. If we would look at soil's fund service, for example its water purification capacity, this soil's contribution would be based on the value of the total water purified. Soil and other environmental goods play both roles as a stock source and a fund service, the tasks are distinct and are treated differently [22]. Unlike the MEA Approach which values natural resources as aggregated in whole ecosystems, the funds/flow approach allows for the valuation of specific environmental goods, such as soil. It minimizes the uncertainty resulting from the estimation of soil value from the assessed value of the entire ecosystem. Its principles and fundamentals are deeply rooted in economics, resulting to a more conservative estimation of economic value. This substantive inkling towards conventional economics is where many of its critics base their objections. By providing value estimates on soils for example as natural capital, some have argued that the estimates would be significant underestimation of their real value since other factors of value, specifically the resource's intrinsic value are not considered. Others have raised concerns that by bringing natural capital in the same category as other replaceable assets promotes weak sustainability [23] and is therefore ethically irresponsible [24]. They believe behavior towards environmental use may be skewed in favor of production and more profitable activities, even if consequences would degrade ecological, cultural and other non-utilitarian values. Although this criticism may be valid to a certain extent, there are counter-arguments that advocate the necessity of putting natural capital alongside other economic assets. By using monetized units commonly used economic planning, environmental conservation becomes a major constituent in the decision-making process. This is a step forward from the neoclassical thought that had diminished the role of the environment in economic planning.

Moving forward with this framework is the integration of participatory modelling. By moving past expert-centric to more stakeholder based process of soil valuation, the process is opened up to more inputs by the stakeholders themselves. Instead of a scroll-down list of flow and fund services, stakeholders are engaged for more discussion on their soil use practices. The decision as to the degree of participation is based on needs of the research and on specific circumstances surrounding the study.

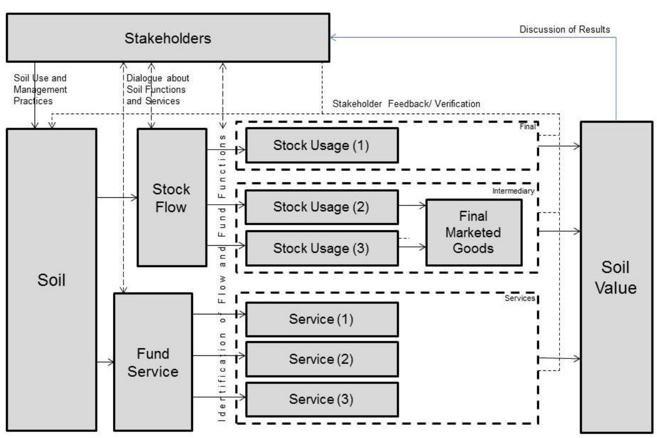

Figure 3: Fund/Flow Framework with Participatory Approach

C. Using Cost-Based Assessment Approach

Another approach concentrates on the capacity of healthy environment in preventing disasters and minimizing the disruption of services. With environmental services being regarded as granted, free, and always available, public perception about its economic worth may be skewed towards being greatly undervalued. A pragmatic way of overcoming perception bias is by estimating value based on the services that would be lost by the use of the resource. This approach looks into the passive and active effects of soil degradation. Passive effects are the loss, degradation or decrease of services, such as decrease in agricultural productivity due to nutrient deficiency. Active consequences are mainly the natural hazards that can potentially pose risks to human safety or security, such as flooding or pollution of waterways. Similar to the idea of evaluating risks in financial transactions, soil resources can be valued based on the different costs: cost of damage-avoided or replacement cost. Replacement cost and damage-cost avoided methods are valuation techniques related with each other, given that both estimate value based on either the cost of replacing goods or services from loss or degraded quality of a certain good, or the cost of avoiding damages due to loss of service or good. These techniques assume that instead of directly soliciting people's willingness to pay for certain goods, value can be estimated on the current cost of replacement or prevention associated with the environmental good.

The Damage-Cost Avoided calculates value from the cost in preventing the loss or reduction of supply or quality of environmental goods. These preventive costs are considered to be the minimum estimates of the benefits from a certain intervention measure, since it is assumed that individuals would choose the most economical way to secure the use or consumption of certain commodities or environmental functions. For example, the loss of topsoil from exacerbated erosion can be prevented by investing on conservation technologies such as reforestation of upland areas, or implementation of farming practices that reduce erosion. Another method is the replacement cost method (RCM) which estimates the value of environmental damage according to the price that would be needed to restore the environment from its previous undamaged state. In soil valuation, replacement cost method may be used to estimate to value based from the degradation rates occurring from its current use. The erosion and degradation of farmlands affects not only agricultural production upstream, but may also degrade reservoirs, contaminate water supplies, cause sedimentation in dams, or disrupt ecosystems downstream. The costs of rehabilitating the upstream farmlands, restoring downstream ecosystem, dredging sediment-filled reservoirs and decontaminating polluted water supplies would be tallied, which would then be used in estimating the replacement cost. Modified RCM is using shadow projects which provide an equal alternative to the environmental good or service that would be lost due to degradation. The different costs of the shadow project would then be calculated and then used as the estimate for the value of the environmental good. Replacement cost method has often been criticized by environmentalists regarding whether the estimated value is reflective of the true cost of damage. Some even argue that once the environment has been damaged, it would be unlikely that any amount would be able to restore it from its pristine state. Others fear that by using the replacement cost method, the assessment would only be reflective of the short- and medium-term consequences of environmental degradation, while sacrificing the long-term impacts.

The cost based assessment framework can considerably be benefitted by participatory modelling. Since the framework considers the impact resulting from some type of soil degradation, stakeholders will be able to provide alternative perspectives, and the argumentations in support of or against a specific proposal. In proposing for conservation technologies to combat soil erosion for example, farmers would be more suited to discuss the practicability and sustainability of conservation measures in the user-level and not simply on the administration side. Consequently, given the empowering nature of participatory modelling, farmers may become more welcoming to the proposed changes since they themselves were given the opportunity to decide on the conservation measure.

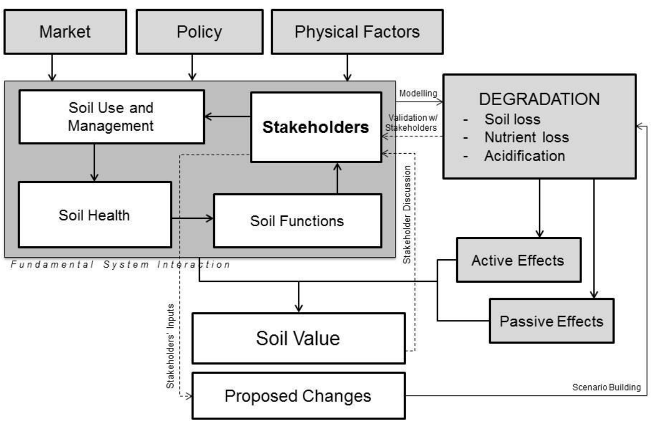

Figure 4: Cost Based Valuation with Participatory Modelling

The use of participatory modelling in the cost-based valuation may be unable to fully eliminate the salient weaknesses of the framework, and in some areas may even compound the challenges. Potential long-term costs may inadvertently be concealed, or a social crisis may ensue which can be magnified by postponement [25]. Given the propensity of stakeholders to focus on the immediate rather than long-term consequences, it is pertinent that these be reflected in the models and that they would be well-represented in the discussions. It usually takes years and decades for the long term gains of conservation and sustainable use to be realized, while the short-term profits from exhaustive use is almost immediate. Soil loss resulting from several storm events may seem inconsequential, but stretched over several years or decades, the effects could be devastating. It is important though difficult to set mechanisms that would consider both short-term and long-term benefits and costs in estimating value. Another important challenge is considering the highly complex effect of time in the valuation, which may be oblivious to the stakeholders' mindset. Comparing long-term benefits of conservation versus the short-term economic gains is difficult and multi-faceted.

D. Using Total Economic Value Approach

The concept of total economic value (TEV) focuses on analyzing the utilitarian value of goods and services from the resource's direct and indirect use [26]. It is divided into the use (or active) values and the non-use (or passive) values. Use value is the value that individuals derive from usage, and can be further sub-categorized into direct and indirect. Direct use values pertain to the direct utilization of environmental goods and services often linked with commercial analysis. The direct use-value may either be consumptive (depletes the quantity of goods) or non-consumptive (does not affect quantity). Soil fertility which contributes to agricultural production is an example of direct use value. For most private goods, their total value is almost equal with the aggregated direct use values. But for soil and other environmental goods, they oftentimes perform other roles that do not necessarily produce marketable outputs but provide vital service towards the common good. The value arising from these benefits is called indirect use-value. Indirect use-values pertain to goods and services that are used as intermediary inputs for production, and are associated with the ecological aspect of analysis. Some of soil's indirect benefits include climate regulation, water quality regulation and water storage. Non-use value, or value-not-in-use, refers to the value that the general public places on the existence of resources regardless whether they directly use or experience the resources now or in the future [24]. It is not dependent on the resource's existing usage, but relies on the quality and quantity of goods that are not-consumed. Because of its connection to the collective good, it is usually connected with social dimension of analysis. Non-use values are divided into option value and intrinsic value. Option value arises from keeping alternative usage of the environmental good in other capacities in the future. Soil used in agricultural production may be used in other capacities, such as for timber production, for grazing or for supporting structures. Soil's option value becomes particularly important to recognize, when soil's nutrients are degraded from over exhaustion, and alternative uses are considered. Intrinsic value pertains to value that exists even though individuals have no plan of using the resource for themselves. It may be disaggregated into altruistic value, bequest value and existence value. Altruistic value refers to the worth that individuals allocate for certain resources so that others may be able to enjoy them, while bequest value arises when the concern is towards the enjoyment or use of future generations. Lastly, existence value is what people place on the conservation of an environmental resource, which they intend to guard from being directly used or consumed. In total the total economic value of an environmental good is calculated by: Total Economic Value: $TEV = DU + IU + OV + EV$; where DU = Direct Utilization; IU = Indirect Utilization; OV = Option Value; and EV = Existence Value.

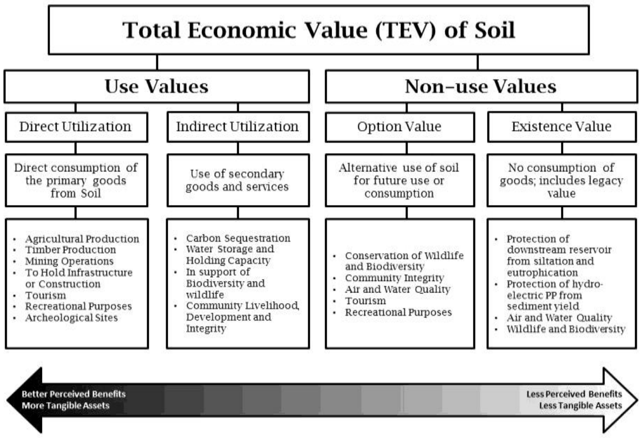

Figure 5: Components of total economic value for soils

A primary advantage of the TEV framework is that it distinguishes the tangible and more obvious benefits with the less perceptible uses. It features the patrimonial significance and irreversibility concerns of environmental goods by bringing together non-use values alongside the traditional use-value [27]. This reinforces the ecological argumentation of nature's intrinsic value but still using an anthropogenic argumentation in establishing value. One main problem in using the TEV framework is estimating value for intangible and non-market based benefits such as option value and bequest value. Because of their nature of being highly subjective and volatile, extra care is required when eliciting bequest or option value, especially when using stated preference techniques. Moreover, for soil and other environmental goods, the direct use component of the economic value tends to dominate, questioning the commensurability of non-use values with the use values. Some researchers argue that there exists only weak comparability in the valuation of environmental goods, and there should be caution in using a single measuring system (i.e. monetary value) in evaluating environmental utility [28]. For example, soil's contribution to agricultural production is hard to compare with its supportive function for infrastructure, since one has available alternatives while the other has none.

The inclusion of participation in the TEV framework is compulsory given that option and existence values would ultimately require some type of stakeholder engagement. The integration of participatory modelling for the use value can be patterned to the fund/flow framework (in Figure 3), except that the benefits are categorized as being direct or indirect benefits. Though the level of perception can be minimized to passive participation rather than collaboration or empowerment, it runs the risk in suppressing the range of analysis and discussion that can be induced by more engagement.

V. CONCLUSION

The steep rise of human population in the past century has greatly strained the amount and quality of environmental resources. Soil in particular, has been under threat from degradation due to poor resource management and the lack of understanding of its contribution to human well-being. Soil and other environmental goods are not generally transacted, that they have no developed markets on their own. The absence of a market, together with a pricing mechanism that communicates resource utility and scarcity, has led to gross mismanagement and exploitation of soil and other natural resources. Policy and decision makers have often neglected the need for comprehensive soil management and conservation programs because the social cost is viewed on an incomparable system, which most decisions are based into.

Economic valuation of soil provides an explicit connection between the principles of welfare economics and the need for environmental protection and sustainable resource management. The valuation of the environment and the ecosystem services approach have changed the conversation on nature conservation and resource management, and on various areas of public policy [29]. But coming to an estimated value entailed long standing debates on concepts, valuation coverage, suitability of methods and the usability of results. It wasn't a question whether frameworks and methods of non-market based valuation can be developed, but whether the values and outcome will bring about conservation and sustainable use of soil. For change to occur, the methods should not only be scientifically grounded for replicability, but also be logically justified for acceptability.

One avenue for greater acceptance especially with stakeholders is using participatory modelling in the valuation process. By incorporating more participation in valuation, not only will it give added perspective in the analysis but also engage the stakeholders to become more invested. Trade-offs from alternative usage or proposed changes will be better understood from the perspective of management as well as soil users such as farmers and land-owners. The levels of participation that may be utilized in the different valuation frameworks may be adjusted in accordance with the specific objectives and circumstances of the research.

Participatory modelling still may not be able to answer all the challenges that persist in the valuation of soil and related environmental good. But it is a step forward showing great potentials for the field. Some of the criticisms may have been answered but others still hold true, which make part of the current limitations in this field.

VI. BIBLIOGRAPHY

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