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PULIRAN: A CRITICAL ASSESSMENT OF THE SUSTAINABILITY OF THE LAGUNA DE BAY AND ITS IMPLICATIONS TO THE BIO-REGION

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Abstract

Amidst the global shift towards sustainability, critically assessing the Laguna de Bay's sustainability as a bio-region is imperative. Its role as a large natural ecosystem offers an opportunity to observe the sustainable framework phenomenon. The human-environment interaction is rich, and the ecological degradation of the lake can be linked with nearby lakeshore towns. With a holistic framework composed of the four fundamental elements of sustainability, that is, institution, society, ecology, and economy, the sustainability of the Laguna de Bay can be assessed. In doing this, microcosmic representatives through the barangays of Limbon-Limbon and Ithan have been taken. The data framework is composed of both quantitative and qualitative data triangulated with secondary data to produce a strong data output. Regression analysis, indexing, and plotting in the Cartesian plane are the quantitative data analyses used whilst a transcendental phenomenological approach has been

applied to the qualitative data for understanding the human experience. Findings have shown that the Laguna de Bay has a very weak sustainability index (i.e., 0.0001) and a bias towards an anthropocentric worldview. Additionally, qualitative analysis has shown that the community has a strong regard for cultural capital whilst falling in the rest of the components. Transcendentally, a deep longing for the past with apparent regret and hopeful involvement depicts the sustainability phenomena. Puliran holds deep possibilities for social change as it estimates the phenomenon of sustainability, and quantitatively leads to how a weak sustainable framework can be optimized and balanced for a strong sustainable framework.

Keywords

Laguna de Bay, Sustainability, Puliran, Gaia Theory, ISEE Model, Binangonan, Fisheries

1. Introduction

Since the dawn of the 21st Century, the global trend has been quickly moving towards a search for a more sustainable model of economic development in contrast to the previous domination of welfare capitalism throughout the past century. There have been many studies about climate change and sustainable development ever since humanity was pressured to correct its malpractices. A key to understanding this situation more deeply and comprehensively is to develop a strong awareness of the socio-economic and demographic profile of the bio-region. By magnifying global-scale studies towards a single bio-regional assessment, the amount of understanding that will be developed from this micro-perspective will be substantially beneficial. Knowing the links between the human-environment interactions and sustainability in its simplest occurrence will provide for an efficient and comprehensive way of addressing the global predicament of sustainability in a high-resolution population phenomenon.

The bio-region of Laguna de Bay, or by its old pre-Hispanic name *Puliran*, is a vast span of land comprising three distinct areas, that of Laguna, of Rizal, and of Metro Manila. Considerably the largest freshwater lake in the Philippines, the Laguna de Bay serves both as a source of local livelihood for fishermen and as a source of sustenance for local households, especially those that are impoverished. Most of the lakeshore barangays in the bio-region

depict households that are closely-tied to the natural resource and environment surrounding them.

Though this holds true, the recent expansion of industrialization and rapid urbanization of cities nearby the metropolis of Manila has continued to affect the bio-region. As more cities are being urbanized, more white-collar jobs are brought forth to the available selection, reducing the number of those who actually continue long-held family traditions or livelihood connected with the bountiful harvest of the lake.

There also includes a point of inquiry upon the sustainability of the area. As sustainable development revolves upon a holistic understanding of the whole situation, the Laguna de Bay continues to be affected by global changes in mean temperature, including that of stronger typhoons and more prominent invasions of water lilies that crowd along the banks of the lake depending on the prevailing season. This situation also plays a role in the annual lifestyle and livelihood of the communities as they adapt to changing times amidst global warming and climate change.

1.1. Statement of the Problem

Thus, there is an apparent problem in the sustainability of the Laguna de Bay. Despite the occurring problems that climate change and global warming has imposed upon the community, a clear lack of effort to provide long-term solutions in sustainably developing the bio-region exists. This harms the ecological condition and human-environment interactions of the Laguna de Bay bio-region. Possibly, this may have been caused by mismanagement of local governments, irresponsibility of the local population, or a combination of both. Perhaps a mixed-methods study which investigates the human-environment interaction to the sustainability of the Laguna de Bay by creating a model for examining the implications of the predicament could provide remedy.

1.2. Purpose Statement

The purpose of this mixed-methods study is to critically assess the human-environment interactions in the Laguna de Bay bio-region, and from that assessment, create a model for examining the implications of the human-environment interactions to the sustainability of the bio-region.

Quantitative data will be obtained through a survey questionnaire coupled and supported by secondary data coming from legitimate and official sources. Meanwhile, qualitative data will be obtained through a focus group discussion and through a transcendental phenomenological approach and design in order to fully grasp the essence of the human experience felt. All three sources of data (i.e., primary and secondary quantitative data, and qualitative data) will be triangulated in order to critically assess the situation.

1.3. Research Questions

In assessing the sustainability of the bio-region, the following questions have been set:

- Quantitative: What is the relationship between the socio-economic demands of the lakeshore communities and the ecological degradation of the Laguna de Bay?
- Qualitative: How does the cultural upbringing of the community and level of institutional governance relate to the ecological degradation of the Laguna de Bay?
- Mixed-Methods: What is the optimal point necessary for the community to equitably balance the four elements of institution, society, ecology, and economy? How can it be achieved?

2. Review of Related Literature and Studies

As the literature on sustainable development continues to grow as global pressure and interest increase, it is extremely easy to fall upon a labyrinth that will confuse a reader in the complexities and broad nature of sustainable development. With that, it is necessary to focus solely instead on the fundamentals that constitute sustainability, that is, the four components of institution, society, economy, and ecology.

2.1. The Asian Holistic Approach

Asians understand things from a collective whole rather than separated individual concepts. Such is the case that sustainable development is inherent to an Asian thinking whilst a capitalist mindset has been championed by the West. In modern societies where globalization and migration has allowed for intercultural exchanges, this mindset divide between the East and the West may have possibly waned already. For instance, the Filipino psychology and

philosophy can be taken as inherently having a holistic foundation as the *Kapwa* or *sakop* embodies the collective emotional and filial link shared among brethren (Mercado, 1974).

2.2. Fundamentals of Sustainability

There are several literatures that highlight varying understandings of sustainable development, and many of these have been popular and remarkable studies in the global scene (Gonzales, 2005; Howarth, 2007). Yet there is no given rule stating that only one or two concepts need to be addressed at a time nor is it detrimental to view the situation concurrently in fears of having too broad of an understanding or perspective to make sense. As has been continually expressed, sustainable development is of a coherent and integrated nature that as much as possible, all aspects of the situation need to be accounted for at the same time.

2.2.1. Institution and the Political Capital

Political capital and good governance (institution) have been an art for as early as during the time of the early Romans or with the Ancient Chinese. Though of more recent historical significance, the ruthless and cunning advices of Machiavelli (2011) in handling state affairs still shock individuals in the modern world. Yet beneath these seemingly heartless suggestions dwell an understanding that human nature cannot simply be placed in order without an external force granting it (though of course, it does not necessarily mean that violence is needed as emotions and compassion are equally strong external forces).

It only begins to show that good governance is a result of not only a leader's strong capacity to lead, and of fortitude to choose decisions that are unpopular, but in fact that governance is affected by the perception of the people (Casey, n.d.). As is most relevant with sustainable development, global efforts to improve sustainable practices cannot occur without the support of the general public, and this support will bear fruit only in the charismatic influence of a political leader – the political will and capital to manifest decisions and endeavors.

Political capital by its own is of a non-physical nature. It is rooted in the capacity of the political leader and supported (or diminished) by the perception of the general public. Such is also the case with another capital that shares the same traits, that of a cultural capital.

2.2.2. Society and the Cultural Capital

Cultural capital may possibly begin with understanding the emotions of an individual. The human nature is of much complexity that it is regarded as irrational and strongly influencing the decisions done by both individuals and nations (Kopnina, 2013). In the same breadth, Howarth (2007) provides for five broad factors that can be indicators of a good (culturally rich) life. He mentions having political freedoms, economic facilities, social opportunities, transparency guarantees, and protective security.

For so long, there has been a lengthy discussion of what cultural capital broadly is, but as ecological anthropology gives to show, culture is different in each civilization, and that factor affects how these individuals or nations perceive their world. For the Filipino people, and for Spanish-influenced nations, the Calidad Humana (2015) loosely translated as Human Quality shares this unique tradition. The famous Filipino resiliency and ability to smile despite the hardships faced in any situation is a result of a rich and continuing tradition of Calidad Humana. Several writings pertaining to Calidad Humana illustrates how Filipinos value family and relationships more than simply valuing the economically good life.

Indeed, a family requires having enough financing measures to be able to lead a comfortable life and to provide for the basic needs of one's household, yet impoverishment does not forsake the Filipino nation from being happy – a rich cultural capital found similarly in Spanish-influenced countries such as Chile. To illustrate further, the Philippines has been hit by one of the strongest typhoons in late 2013, locally called as Typhoon Yolanda (or Haiyan, as it is known internationally). Despite the devastation that resulted from the catastrophe, and despite the slow pace of rehabilitation efforts (proving a probable decrease in political capital as a result of reduced trust from the general public), the Filipino families there continue to live on and have been able to find the capacity to once again smile. That is Calidad Humana. That is where the unique tradition of Filipino culture begins to play, yet the Philippines is not simply just a Spanish-influenced nation, it is also Asian.

2.2.3. Ecology and the Natural Capital

Ecological sustainability sits at the limelight of global debate in the 21st century as increasing global carbon emissions prove to be detrimental to the world. Rapid industrialization as a precursor to the predicament at present, only gives to show how erratic

nature can be. But despite this seemingly dismal take is the hope found in allowing the Earth to correct the errors by its own, and to simply reduce human-induced pressures on the environment (Maslin, 2004). Pollution, as it is generally understood, touches only the surface of what it truly is. The true meaning of pollution comes from understanding that the reduction or perversion of a stock or of a flow is also a form of polluting the environment (Dasgupta, 1982).

Natural capital can, however, take many forms. Often, the public regard simply land-based resources such as trees and forests as the natural resources available, yet fail to understand the importance of fisheries and aquatic resources. An unsustainable rate of catchment does not only accelerate the production of high entropy, but will also deteriorate the condition of the aquatic resource. In light of the difficulty of providing property rights to aquatic resources as it flows, general public understanding takes these as a common-property resource (Gordon, 1954), that when subjected to such, and with the self-interested behavior of humanity (Smith, 2010), will ultimately lead to overexploitation and possible stock exhaustion or extinction (Clark, 1973).

With that in mind, the Laguna de Bay becomes a fragile bio-region that is greatly affected both by human-induced pressures and by global warming and greenhouse effects (Maslin, 2004). It has been empirically shown that a decrease in the population of the fish stock in the Laguna de Bay continues to be aggravated as conditions in the lake continue to deteriorate from its once pristine conditions in the 1970s (UST Social Research Center, 2001; Gonzales, n.d.). This prevalence gives to show how detrimental it becomes for the community when the natural resources present are exploited to levels of non-sustainability. It can be deduced as well that the human-environment interaction here is at a distraught (de Sherbinin et al., 2007) even though the lakeshore fishing communities are inherently tied to the bountiful resources coming from the Lake as an ecology-based economy.

2.2.4. Economy and the Economic Capital

Within the context of sustainable development, an adherence towards scientific advancement and the production of goods in a growing economy is a sign of a Techno centric inclination (Davies, 2013). However, it should be noted that this is a weak sustainable framework as it focuses on a single factor, and not on a balanced whole.

The speedy production of high entropy goods are a direct result of rapid industrialization, most observable from those coming from emerging or developing countries. By far, the inclination of individuals towards economic goods has been a diversion and desensitization from emotions. As expressed by Gonzales (2005), the prevalence of a non-sustainable paradigm in the existence of a strong and demanding economic capital reduces the stock of both cultural and ecological capital. This occurrence can lead to possibly severe imbalances not only in the environment, but also to the traditions long practiced by a community, especially one that is closely linked to nature. These communities that are ecology-based and integrated to the local bio-region are the most vulnerable.

This is apparent with the condition of the Laguna de Bay wherein the fishing households by the lakeshore can no longer sustain families the same way that has been during the time when the lake is still clean (UST Social Research Center, 2001). This recurring theme of an ecology-based economy that defines the Philippine economy integrates the economic capital with the human-environment interactions prevalent with it (Low, Costanza, Ostrom, Wilson, & Simon, 1999; de Sherbinin et al., 2007). The fragile link that ties the two asserts the importance of observing sustainable practices as a means to sustain the quality of life experienced by a community, and to prolong it whenever able.

3. Methodology

3.1. Theoretical and Conceptual Framework

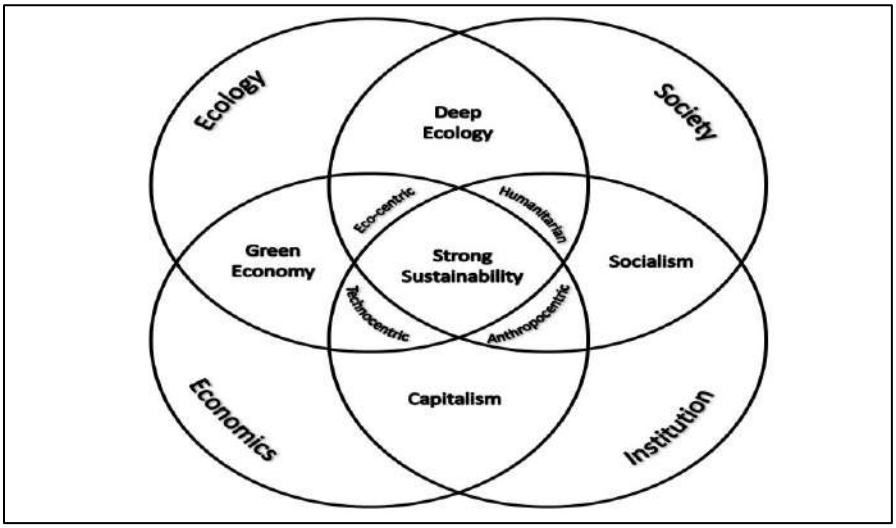

Figure 1: *Theoretical and Conceptual Framework*

The concept of sustainable development is a vast yet fully encompassing field of study. As shown in Figure 1 above, within its realm includes the first level of abstraction which involves the concepts of ecology, society, institution (governance), and economics taken in their entirety in the mundane (worldly). Each of which are important in achieving a truly strong sustainable world. Taking into consideration Figure 1, one will view that all spheres (capital concepts) interact with each other in two or more levels of abstraction – situations and worldviews; all of which increase in complexity towards the central theme of strong sustainability.

In the second level of abstraction (situations), the concepts interact in pairs constructing four distinct situations namely deep ecology, socialism, capitalism, and green economy (Maslin, 2004; Bartelmus, 2013). Deep ecology pertains to the unison of ecology and society where emphasis is placed within the raw nature of humanity as an animal part of the natural order of the world. Socialism, on the other hand, pertains to the interaction between society and institution that depicts the sharing of resources between the people and the institutional government set within the nation's territory.

Meanwhile, Capitalism merges economics and the institution wherein *laissez-faire* reign most supreme to the fulfillment of the market system in allocating scarce resources for satisfying unlimited needs and wants. Finally, Green Economy illustrates the partnership between ecology and economic where the modes of production are not only rooted in renewable energy and resources, but include as well the preservation and conservation of ecological features within the nation. All of these four are scenarios that depict the interactions of each of the four main concepts under sustainable development.

Within the third level of abstraction (world views), three of the a for mentioned concepts combine to depict four distinct yet abstract worldviews of sustainable development. The combination of economics, ecology, and society provide an eco-centric worldview of sustainability. Within this worldview, the world is a fragile ecosystem that is vulnerable to catastrophic events that alter the natural balance of the world. Individuals subscribing to this worldview tend to disregard most human activities towards economic growth and population growth citing that both of which damage or degrade the natural order.

The Humanitarian worldview, on the other hand, is a combination of ecology, society, and institution. A humanitarian thinking depicts the sensational and emotional approach of humanity towards highlighting culture, religion, and virtues as goals for attaining wisdom and an enlightened life within the mundane world; thus, materialism is discouraged as it ties individuals to the material and physical world.

Meanwhile, the anthropocentric worldview which incorporates the ideas of society, institution, and economics all contribute towards elevating the importance of the human race. Within its scope of understanding, humans are rational animals that are destined to rule the Earth as its sole sovereign. It takes into consideration the welfare of humanity above all else – even if it means the degradation of environmental features as this worldview understands nature to be an abundant, self-sustaining, and resilient source of sustenance for human needs and wants.

Finally, the Techno centric worldview is an assemblage of institution, economics, and ecology. It views the goal of humanity towards scientific advancement, and in the improvement of technology. Within its scope, it contributes and devotes its time towards research and development of new products or towards sustained innovation. It should be noted,

however, that all four of these within the third degree of abstraction are all modes of a weak sustainability. The failure roots from the inability to address all four concepts of sustainable development in equal importance.

The central theme of Figure 1 converges towards a strong sustainability framework that incorporates all four concepts of ecology, society, institution, and economics. Within this scope, sustainable development is most desired to be.

3.2. Sampling Framework

As microcosmic representations of the Laguna de Bay bio-region, the selected barangays of Limbon-Limbon and Ithan are taken as these are lakeshore communities with a natural bay. Additionally, each barangay is situated fronting each other thus giving a remarkable opportunity to observe these two fishing communities with respect to seasonal variations.

With only a total population of 4,364 (NSO, 2010), these barangays remark as simple towns not densely populated and are distributed linearly along the banks of the lake. Geographically, the location is prime for fishing (and even small-scale agriculture) as local nutrients from the nearby mountains flow downwards to the lake. However, sea-level rise has recently submerged nearby land areas, disabling previously done small-scale agriculture.

With that, the sampling framework uses a purposive sampling that is specifically directed towards fishing households. In light of the unavailability of data regarding the actively fishing households in the barangays of Ithan and Limbon-Limbon, the required sample size has been estimated at 87 households (with an estimated fishing household population of 112, an alpha-level of 0.05, and a margin of error of 0.05).

4. Results

As a simple demographic and socio-economic profile, there have been more male respondents than female ones by about 28 percent while the average age is 43.66, estimating a considerable number of adults that are generally male. An average daily household income of PhP 404.28 and an average daily household expenditure of PhP 340.70 gives to show a difference of PhP 63.58 that can be used for other means or for future savings. Additionally, the average household size is at 5.46 persons. Initial respondent input provides that local

households do not generally purchase their daily food from markets, but instead harvest them from the nearby lake or from household gardens; thus, eliminating expenses from such. Observations of the area depict a tranquil rural landscape nearby the Laguna de Bay lakeshore, an indication of a peaceful community that implies a high likelihood of having a high cultural and political capital present. Large masses of water lilies flood the area as well.

4.1. Quantitative Data Results

A total of five regression models have been endeavored. Each of the four sustainability factors has been given a distinct econometric model, and have all been enumerated below:

4.1.1. Economic Capital

$$Ek = 0.12468(Ek_1 * Ek_2) - 0.04882(Ek_3 * Ek_4) \quad (1)$$

In considering the economic capital, two interaction terms are involved. The first is between the average daily household income and the number of qualified workers in the household while the second is between the average daily household expenditure and the total number of family members in the household. This gives to show that as families grow larger, the smaller will their economic capital become, leading to increased poverty.

4.1.2. Natural Capital

$$\frac{Nk}{(Nk_1 * Nk_2)} = -0.008 + 0.0042\left(\frac{Nk_1 * Nk_3}{Nk_1 * Nk_2}\right) + 0.0089\left(\frac{\ln(Nk_1)}{Nk_1 * Nk_2}\right) \quad (2)$$

Natural capital, on the other hand, is primarily affected by the average daily fish catch of the household (Nk_1). It interacts both with the willingness to pay for nature conservation (Nk_2) and for water pollution abatement (Nk_3). Simply put, the willingness to support any environmental program serves only as a reactive solution that minimally mitigates some of the negative effects of an unsustainable fish catch.

4.1.3. Cultural Capital

$$Logit(Ck) = 0.736998(Ck_1 * Ck_2) + 0.390602(Ck_3 * Ck_4) \quad (3)$$

As a non-physical element, the cultural capital is expressed in terms of a logit wherein a positive value indicates as strong while negative ones as weak. It involves two interactions. The first is between the self-rated evaluation of family life and religiousness (predominantly

Catholic), or simply the general outlook of one's family life. Meanwhile, the second interaction is between one's feeling of belongingness and his/her involvement in social issues, or the human capital advantage described by Dr. Abigail de Leon in her study of culture (as cited in Calidad Humana, 2015). It models the households' tendency to address internal concerns first before his/her external community; an emphasis on the Filipino's priority for familial responsibility.

4.1.4. Political Capital

$$Logit(Pk) = 1.174388(Pk_1 * Pk_2) + 0.622414(Pk_3 * Pk_4) \quad (4)$$

Similarly with cultural capital, political capital takes a logit as well. The first interaction is between policy and legislation and government effectiveness, or simply a community's perception of the local government while the second interaction is between voice and influence and corruption, or public voice. Here exists that as perceived good governance increases, the need to voice one's opinion or dissent lessens whereas a decrease in perceived good governance will lead to dissatisfaction and greater pressure for government transparency.

4.1.5. Sustainability Capital

$$\frac{Logit(Sk)}{Sk_2} = -36450.7 + 0.084959(\frac{Log(Sk_1)}{Sk_2}) \quad (5)$$

The culmination of all four capitals will lead to the sustainability capital. It is composed of both free goods (Sk_1 = Ck + Nk) and of physical goods (Sk_2 = Nk + Ek). Political capital here is inherent as an institutional framework integrated in the whole. Basically, the model shows that an increase in the amount of free goods is insufficient, especially as the effects of large amounts of physical goods dampen any positivity from an increase in free goods. This implies, therefore, that corrections in physical imbalances are paramount over focusing in human capital.

4.1.6. Sustainable Cartesian Plot

Within the second level of analysis, an index valuing from 0.00 to 0.50 has been used. Indexing all the capitals, the sustainability capital registers as very weak (0.0001) together with the ecological capital (0.0026) and the economic capital (0.0995) whereas both the political

and the cultural capital registers as very strong (0.4351). Furthermore, the Laguna de Bay sustainability plots as an anthropocentric worldview (0.77, -0.10) as shown in Figure 2 below.

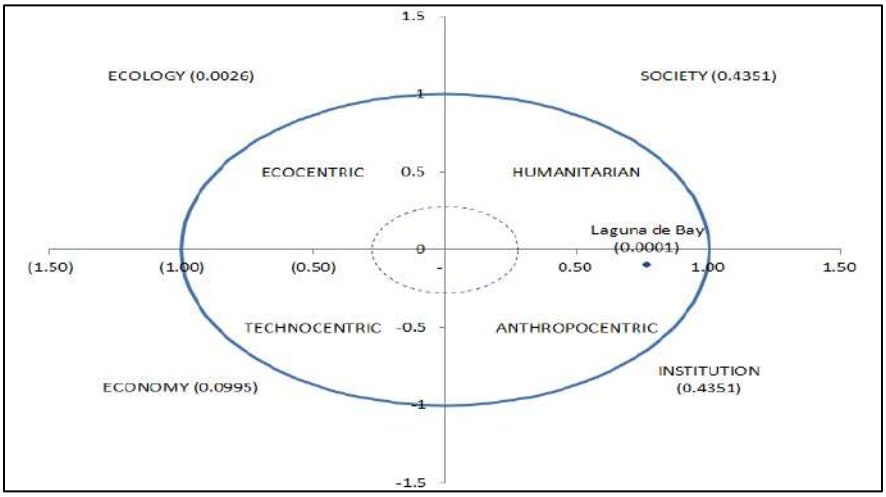

Figure 2: *Sustainable Cartesian Plot*

4.1.7. Correlation of the Economic and the Natural Capital Components

In further understanding the relationship between the socio-economic demands of the bio-region and of the ecological degradation of the Laguna de Bay, a correlation test has been done. The corresponding correlation of the regression shows a value of 0.46; thus, there exists to be a positive correlation between the two with a computed strength of 46 percent.

4.2. Qualitative Data Results

4.2.1. Qualitative Transcendental Consciousness

With the textual description (what), the primary question is what did the participants experience in their cultural upbringing and in their experience of the local governance in relation to the ecological degradation of the bio-region?

> Within the inputs provided by the participants, a longing for the past (of the pre-1970s condition) of the Laguna de Bay bio-region exists. The lake is culturally tied to the community as their livelihood is attached to the ecology-based fishing lifestyle that they have come to grow up with. This longing, however, is coupled by dismay as the past can hardly be returned to, and that the pre-1970s conditions of the lake would be difficult to achieve again. Additionally, local governance from the municipal level is

essentially non-existent. Only through the barangay does a concrete action emanate from. Although activities that range from bayanihans (loosely translated as community heroism) to involvements in meetings prevail. There has been a significant difference between the pre-1970s period where aquaculture flourished and of the present day conditions in the Laguna de Bay.

On the other hand, the structural description (in what context), the primary question now becomes *in what context do these participants experience the relationship of their cultural upbringing and of their experience of the local governance towards the ecological degradation of the bio-region?*

Some of the participants spoke of how their parents have been traditional fishermen that could afford to provide the family with their basic needs, and with a good life and education solely from the bounties of the lake. Yet they also speak of how they have gradually observed the decline of fish catch in the area wherein each year continues to be harder than the last. In the participants' perspective, their cultural upbringing is in the traditional Filipino context of community Kapwa attitude, and wherein filial values are inherent. Additionally, avoidance towards opining about political matters is strongly observable. They explain that they could not express their sentiments as they do not know the Mayor (i.e., Boyet Ynares) personally, and that it is better to avoid open speech with any dissatisfaction from government assistance experienced in the past.

Following the results of the reductions, a conclusion can now possibly be done for the qualitative data analysis to extract the essence of the transcendental phenomenological consciousness being sought for understanding the totality of the sustainability phenomena in light of cultural upbringing and local governance. In considering all of the above reductions, the qualitative data analysis synthesizes that:

The sustainability phenomena experienced by fishermen is integrally linked with the ecological conditions of the lake. The cultural upbringing of the people is tied to the

ecology-based fishing lifestyle that dictates how fishermen experience the sustainability phenomena. There exists a sentimental valuation of a pristine environment, and of a desire to return to it. The transcendental consciousness, in its essence of the sustainability phenomenon, is of a deep longing for the past both with apparent regret and hopeful involvement.

5. Discussion

As has been discussed and shown throughout the whole study, sustainability is a holistic framework that necessitates a full address to each of the fundamental components. Focusing only on a single component will simply lead to a transfer of worldview instead of a balancing effect. To truly practice and aim for a strong sustainability framework, the community of the bio-region of Laguna de Bay should improve on the lake quality.

The ecology-based economy demands that to improve local economy, the natural resource should be returned to sustainably positive values. At present, the local community falls far behind the ideal value of natural capital, and therefore requires a reversal of daily fish catch into daily fish growth (one that allows a defined time where fish may repopulate). Theoretically, this is suggested, yet practicality implies that by following such, the local fishing communities will die of hunger in that proposed timeframe; therefore, another solution is required.

6. Conclusion

In answering the research questions provided in the introduction, the relationship between the socio-economic demands of the lakeshore communities and the ecological degradation of the Laguna de Bay is of a positive correlation. The inherent human-environment interaction causes the two fundamentals to improve or to degrade concurrently at relatively equal paces. It can be reliably concluded that increased lake degradation results to poorer conditions for communities highly reliant on fishing, as is the case with many of the lakeshore towns and barangays in Rizal and in Laguna far from urbanized centers.

On the other hand, the cultural upbringing of the community is traditionally Filipino where filial responsibility and concern becomes paramount before community involvement is

even considered. The inherence of Calidad Humana in the interpretation of this phenomenon depicts the rich cultural capital of the bio-region. Coupled with a high institutional index, albeit being inconclusive denotes that policy framework can indeed have an effect if applied. Strict rules and implementation that are free from corruption and transparent to the general public will allow for engaging the community towards ecological aspirations and local efforts for conservation. Furthermore, the strong emotional attachment experienced by the lakeshore communities holds immense possibilities to translate that emotional attachment towards a strong sustainable framework.

Finally, optimality in the sustainable development framework can be achieved when the ecology and the economy indices are strengthened to above moderate levels; however, to achieve this, the bio-region must resolve the ecological degradation of the Laguna de Bay as it is integrally tied to the local economy. Failure to do so will only result to loss of resources, effort, and public morale in being able to resolve the predicament. Furthermore, in light of the unpredictable yet largely intensified devastation brought forth by climate change effects, it is safe to invest in the community's apparent resiliency and strong emotional attachment to the Laguna de Bay so that future disturbances will not completely devastate the bio-region.

7. Recommendations

With regards to doing the study at a different context, limnology will show that river systems are far more dynamic than lakes, and that changes in the results from a static-state Laguna de Bay to a dynamic river system will possibly highlight new possibilities. Furthermore, though possibly Herculean in scope, it is highly lucrative to conduct this study and apply the same quantitative analysis of plotting the sustainability point of any bio-region, and to culminate multiple bio-regions in order to observe a possible pattern or curious observation that can visualize how sustainable development interacts with these four capital components in actuality.

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