The Threshold of Ecosystem Services Assessment in Urban Forest for Learning Outcomes in Higher Education: Mahidol University (Kanchanaburi Campus)

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Abstract

Science progressive of applying useful intention development the stepping-stones towards dimension context of sustainable development (SD) in higher education institutions (HEIs) among stream pivot of globalization might contrast in both learning and practices process between developed and developing countries. This research will propose generated learning outcomes are cause from approached theorem meet empirical research expect useful participation for improving effectively of SD in HEIs. Highlight essential of these research is demonstrated to possible relatives maintenance of pattern species diversity in ecological under underline distribution impossible (excepted birds) in the urban forest (forest structure classes on good condition LAI = 1.7138, and primary productivity LAIs = 1.67) both mammals [(Pr (>F) = 0.7601] and birds [(Pr (>F) = 1.705e-05]. Which the first step importantly of ecosystem services assessment (ESA) before the next step and integration SD for campus management. Additional synthesis contemplates of used thinking system will be enhancing competencies which might key major mechanism providing encourage problem-solving and forcibly behaviour changing into crossdisciplinary desire refinement ability and mentality. Finally, at currently through tendency the future, HEIs around the world vis-à-vis challenge inevitable facet about question of the roles leadership navigating direction towards SD for equality between exploit utility ecosystem of human and interaction maintain of an ecosystem which basically of needs well-being.

Keyword Ecosystem services, Sustainable development, Biodiversity, Urban forest, Higher education

1. Introduction

Throughout the evolution period of globalization which has human playing roles leadership strong predominantly induction of magnitude changing in ecological. Consequence generated awakening investigate are cause those phenomena occurred are taken to affect both direct and indirect which have an influence existence, for example, the classical epitome of "silent spring" in 1962. In face up to phenomenon cause from change, higher education institutes (HEIs) has an important role of applied learning and practices process in a curriculum with an aim for relevance currently situation and providing envision straight into the future of the stepping-stones expectation sustainable development (SD). In theme involve with SD in HEIs most proposed thinking system enhance competence can reality implement of problematic solving access to utility ecosystem services which usually have conflicts occur in phase of the Triple Bottom Line (TBL). Because of the core of ecosystem services is products of goods and services can allow for launch valuation profitable to a beneficiary on the principle of transfer in economics. Probability facets challenge inevitable in the dimension of SD in HEIs around the world.

Higher education can play a pivotal role in turning society toward sustainability (Corcoran and Wals 2004a). Whereas, education for sustainable development is a contentious concept, at least, a decade ago because of significant symbolize the prominence of the sustainability movement, aid in the communication of major ideas to universities around the world (Velazquez et al. 2005; Wright 2002). Therefore, SD declaration developed accompany pertain to HE are taken the initiated since 1972 the Stockholm declaration, 1977 the Tbilisi declaration, 1990 the Talloires, 1991 the Halifax declaration, etc., through until present the 2030 Agenda Sustainable Development Goals (SDGs). The goal of sustainable development education is to explore the reconciliation of critical ecological, social and economic imperatives, and these imperatives need not be seen as completely ideological but laying the groundwork for this needed “paradigm shift” (Dale and Newman 2005; Clugston and Calder 1999. p. 14). However, some of the same characteristics of university which tend to hinder progress towards sustainability–for example the tradition of decentralization and autonomy–have a dual nature, and can equally act as enablers of change (Clayton 2013. p. 9). The National Committee of Inquiry into Higher Education (NCIHE) report has singularly failed to address co-operation (or connectivity) in the HE sector and is driven by narrow theoretical perspectives which focus principally on economic efficiency (i.e. competition) and instrumentalism (Ison 1999). The challenge that needs to be addressed is how to target, this hard–to–access and powerful cohort of persons to ensure mutual understanding of the various facets of sustainable development and the political constraints within which they have to operate (Filho et al. 2015), even cautious partisans of scientific knowledge aid themselves and the discipline by an occasional and reflective defense of its possibilities (Winterhalder and Smith 2020). However, it is vital to notice that the education system in developing countries might be different from that in developed countries (Wang et al. 2020).

This study is built upon the idea that campus sustainability practices, specifically, greening and education for sustainability (EfS) (Savelyeva and McKenna 2011). This level would require a paradigm change so that education would be built on learning as change and education as sustainability (Sammalisto and Lindhqvis 2008), and no small task but a great opportunity to multiply sustainability’s sweep to the order of magnitude impacts needed to effect change at the campus and, as a result, at societal levels (Krizek et al. 2012). Therefore, I desire will propose context about SD in HEIs by will be divide 2 part included 1) the related of biodiversity and ecosystem services and 2) useful thinking system approach for SD in HEIs from synthesis contemplating literature. Both 2 part with the basic straightforward question as follow i) what’s the key of thinking system use for SD in HEIs?, ii) why must be ecosystem services assessment?, and iii) how many species (focuses mammals and birds) having opportunities appear in the study area and relation with ES?. The set question mentioned is not the desired answer but needs examination thorough plausible radical logic thinking system in SD from HEIs dilemma. And possible problem-solving in facet hindrance emerge of progressive towards SD in HEIs. Though studies will be not encompassed in ecosystem services assessment (ESA) (i.e. specific biodiversity section included mammals, birds, and forest structure). But much more challenges for relatives complexity maintenance in the urban forest community under underline distribution impossible (i.e. mammals). Also, it is the first step important before support to next step and integration with other section of ESA on spatial-temporal scale dynamics. Ultimately, the expectation may be useful approaching ES management in long-term aim for the stepping-stones towards SD in HEIs following declaration announcement.

1.1. Understanding the relation of biodiversity-ecosystem services in urban forest

Urban forest structure is fundamental of the urban landscape as a whole (Wu 2010). Since landscape ecology envisions the landscape as the outcome of the complex relations between humans and nature, it provides a useful framework for sustainability science (Opdam et al. 2018). But account for about issues critical the relationship between biodiversity and ecosystem services how becoming sustainable development is still argument saga. In contrast, a view, because existing field data are from studies that lacked direct experimental control of biodiversity or sufficient replication (Tilman et al. 1996). Under realistic conditions, many other factors potentially interact with biodiversity change to affect service supply (Balvanera et al. 2013). Additionally, spatial mismatches between areas of ecosystem service supply and demand (Bennett et al. 2015). The scale at which studies are conducted may profoundly influence the conclusions (Turner 1989). Necessary to include landscape-scale studies was classified into site (< 1 km2), local (1-10,000 km2), regional (10,000-1,000,000 km2), and national (< 1,000,000 km2) surveys and the temporal scale was classified into days, months, and years (Quijasa et al. 2019). McKinney (2002; see more) got explained conclusively about general patterns of species composition gradients of the urban-rural gradient in terms of characteristics categories are “urban avoiders”, “urban adapters”, and “urban exploiters” for facilitate understand and useful determine research framework, knowledge of the species composition of urban biodiversity can be very useful as an educational tool to better understand the natural world.

In generating critical considerations for conducting case-study research included structure as follows *purpose*, *role*, *tension*, and *challenge* (Corcoran et al. 2004b; see more Table 1). Straková and Cimermanová (2018) who was mentioned refers to Thomas in 2009 discussed how important it is to give learners the opportunity to learn to think, i.e., to learn “how to think” rather than “what to think”. Indeed, there are many challenges and barriers that have been identified in the course of this study regarding the implementation of sustainability declarations (Wright 2002). Sustainability needs to be considered in the context of systems that are changing over time (Turner 2010. p. 120). Therefore, one of the mechanisms for using system thinking in a problem-solving situation is based on the ability to enlarge the systems’ borders and expose hidden dimensions of the system (Assaraf and Orion 2005).
It is a well-accepted method in science to make an initial ‘first-approximation’ to a complex problem and allow the results to determine whether it is worth investing the effort to do more elaborate studies (Costanza et al. 1998). That analysis acknowledges that biodiversity probably plays a significant role in directly providing goods and services as well as regulating and modulating ecosystem properties (this term is used here to include processes and functioning) that underpin the delivery of ecosystem services (Balvanera et al. 2006). These two approaches can be categorised as an ‘ecosystem services perspective’ (biodiversity and ecosystem services are the same thing) and a ‘conservation perspective’ (biodiversity is an ecosystem service) (Mace et al. 2012; see more).

1.2. Approach thinking system and adaptive to sustainable development in HEIs

What is new to the neoliberal university is the scope and extent of these profit-driven, corporate ends, as well as how many students, faculty, administrators, and policy makers explicitly support and embrace these capitalistic goals and priorities (Saunders 2010). The question of the role of higher education in general, and of the university in particular, in contemporary society and culture, is linked to two parallel processes: first, the questioning of the role of the nation-state in the global age, and, second, the gradual decomposition of the welfare state in the majority of OECD countries (Kwiek 2001). Davies and Bansel (2007) gave interested how the market works on students to shape them up as the consuming individuals it desires and has been set questions about the sphere of education because concern such as morality, lives, deep learning, lifelong learning of humanities and well-being included i) how does the work of teachers transform students into less democratic, more neoliberal subjects who are at once more governable and yet believe themselves to be both autonomous and free? ii) how do heightened competition, individualism and individual responsibilisation work along with the reduction in social responsibility to produce the entrepreneurial subjects best fitted for the neoliberal workplace? and iii) how does the calculated invisibility of neoliberalism work against our capacity to make a critique of it?. This case, behind all educational proposals are visions of a just society and a good student, but any understanding the transformations standards education bases the ethics is currently undergoing will navigating what students, teachers, and future teachers should be able to know, say, and do are crucial differences between classical liberalism and neoliberalism albeit the quality of teacher education may not guarantee the effects of such politic policies of education in the real world of real higher education (Apple 2001).

It is well known that monopoly breeds power which acts to insure and extend the monopoly (Hardin 1960). Many environmentalists have adopted elements of neoliberal ideology and discourse, reflecting and reinforcing neoliberal hegemony in ‘‘Free-market’’ of green capitalism, has proliferated since the Reagan-Thatcher year (McCarthy and Prudham 2004). The narrow view of environmentalism reflected in ‘education for sustainability’ (at least its Neoliberal version) may thwart efforts at healing the interlocking dimensions of self, society and environment, as it is adopted in education policies and practices (Le Grange 2011). This requires addressing such critical problems as the depletion of non-renewable resources, the effect of industrialisation on biodiversity and the production of pollution (Bonn and Fisher 2011). It the myth is one of the greatest barriers to the development of a learning organization since it propagates the assumption that universities have attained the highest possible levels of functionality and that whatever is lacking must be accepted as an inevitable limitation of the system (Sharp 2002). That many HEIs should be possible to fall into the entrepreneurial dilemma situation is case transformative from government agencies into an autonomous state adapt according to the green marketplace competition. Although, many ecologists would support the idea that environmental sustainability is mainly a matter of stability, resilience and biotic diversity (Ayres et al. 1998. p. 8). It did not issue surprising for buildup rhetoric discourse argument on the rift of different in their desire scramble superiority privilege hegemony in education franchise legacy by aim for possessing profits to expect in the socio-economics section. And it’s no surprise are also, curricular, teaching, and research have an emphasis in term definition and principle of the green university such as green building, green transportation, green energy, and green campus. Whatever indeed of education for sustainable development doesn’t emerge research about wildlife ecology and welfare or botanical because of these essential components in provision for challenge survivor before well-being. Therefore, the education should therefore give depth in the disciplinary knowledge while also providing opportunities for a great deal of teaching, learning, fieldwork and research in higher education today occurs within the paradigm of academic silos and disciplinary boundaries all affect the university experience (Svanström et al. 2008; Posner and Stuart 2013; Finlay and Massey 2012).

Table 1. Thinking system type use applies for sustainable development programme in HEIs

Thinking system	**Complementary**	**Reference**
Holistic	The integration of different perspectives into education	Svanström et al. 2008; and see more Wals & Jickling 2002; Lozano et al. 2011
Critical	1. An attitude of being or state of mind to thoughtfully consider the problems and subjects that come within a range of one’s experiences; 2. Knowledge of the methods of logical enquiry and reasoning; and, 3. Some skill in applying those methods	Lloyd & Bahr 2010; and see more Richmond 1993; and Flood 2010
Rhizomatic	Base on indigenous knowledge: 1 and 2) Principles of connection and heterogeneity; 3) Principle of multiplicity; 4) Principle of assigning rupture, and 5 and 6) Principles of cartography and decalcomania	Le Grange 2011; see more Berkes 1995; Folke 2002 and 2004

Further, the connotations of both of the phrase’s root words, “sustainable” and “development” are generally quite positive for most people, and their combination imbues this concept with inherent and near–universal agreement that sustainability is a worthwhile value and goal–a powerful feature in diverse and conflicted social contexts (Kates et al. 2005). Applied to sustainability programs, students work on a real-world sustainability challenge, focusing on solution-oriented outcomes or products that can be applied in professional practice (Wiek et al. 2014). Chief among them are: (a) human-induced changes in land cover at the global scale lead to clear losers and winners among species in biotic communities; (b) these changes have large impacts on ecosystem processes and, thus, human well-being; and (c) such consequences will be felt disproportionately by the poor, who are most vulnerable to the loss of ecosystem services (Díaz et al. 2006; see Table 1). The basic premise of sustainable development is that human and natural systems are dynamically interdependent and cannot be considered in isolation in order to resolve critical issues (Dale and Newman 2005). Understanding the complexities surrounding education for sustainability, systems thinking promoting shared vision clarifies how vision radiates through collaborative feedback process and fades through conflictual feedback process (Zeegers and Clark 2014; Flood 2010). Given the complex nature of sustainability issues, it is imperative that education for sustainable development (ESD) pursue an integrative approach in modelling sustainability in the core functions and systems of the university (McMillin and Dyball 2009). As sustainability concept is applied to universities, it should serve as a means of configuring the campus and its various activities so that the university, assessment tools must ask “why” and “how” campuses pursue sustainability in addition to “what” they are currently doing (Alshuwaikhat and Abubakar 2008; Shriberg 2002 and see Table 1).

2. Materials and Methods

2.1. Study area

Mahidol University (Kanchanaburi Campus), Thailand, is located at latitude 14˚07’46.20” N and longitude 99˚09’34.69” E. The area boundaries total 937.5 ha and then have habitat type synonym urban forest and monospecific forest is the mixed deciduous forest. Weather annual average 25-40 celsius and precipitation annual average 1145 mm, and various elevation. In general environmental characteristics, the surrounding composition included community, road, Kwai river, railway, and agricultural area (most cassava plantation).

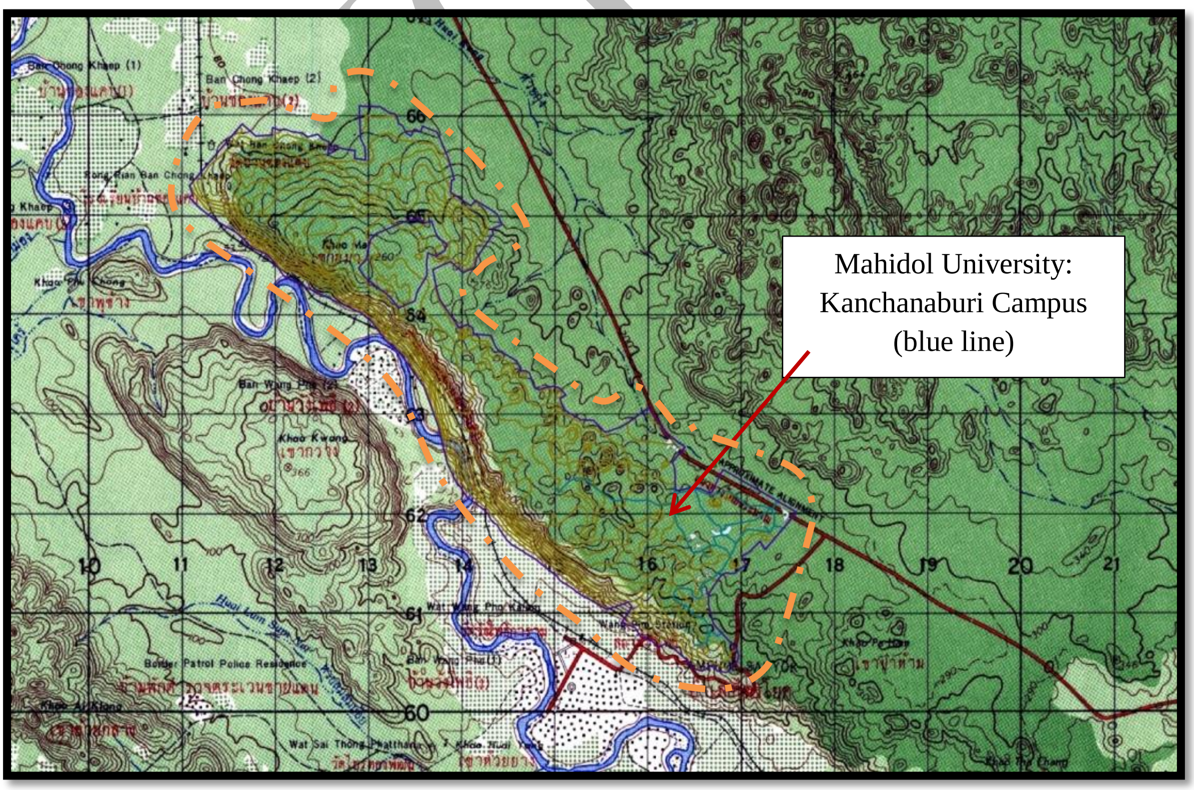


Fig 1. Show Mahidol University (Kanchanaburi Campus) Maps (1:50000)

Finally, Mahidol University Strategic Plan 2020-2023 has a target goal for international green university rankings 1-100 in 2021 and 1-80 in 2023, respectively. The strategic plan has 5 aspects included 1) Land use development 2) Landscape system development 3) In-campus traffic circulation 4) Infrastructure service system development, and 5) Building and construction control.

2.2. The approach empirical research design for fieldwork achievement

Approach this empirical research design thoughtful within reasonable on the principle of SMART framework (Simple, Measurable, Accessible, Relevant, and Timely) for effectively collection data possess adequately both qualitative and quantitative on fieldwork. Methods designed on GIS Maps (1:50000) with grid study size 1 Km^2 provided cover study area by aim for fieldwork achievement, and explore linkages of biodiversity and service provision would be useful given the students' development of system thinking in the learning process (Harrison 2014; Assaraf and Orion 2005). The methods of detail content have as follows.

Systematic camera traps point design for observed and monitoring of appeared-disappeared of mammals species diversity used 12 traps through March-July 2020 periods, each camera traps settled on fieldwork 30 days (30 nights) before translocation other point followed plan regulated (total 60 points) and set function in picture mode, and operated 24 hours. Randomized Latin Square Design for birds species diversity studies used Birds-mist net total 20 points, and spend total 600 hrs. Stratification Random Sampling Design (temporary plot) for forest structure study which monospecific mixed deciduous forest, typical plot size has a square plot size 400 m^2 total of 18 plots. Each typical plot has plot size 40 m^2 for taken the forest inventory measurement recorded included, i) tree height, ii) DBH, iii) plant life form, and then randomly selected tree recorded 15 trees/plot. Trees are assigned to one of seven condition classes: excellent (less than 1 % dieback); good (1 to 10 % dieback); fair (11 to 25 % dieback); poor (26 to 50 % dieback); critical (51 to 75 % dieback); dying (76 to 99 % dieback); dead (100 % dieback) (Nowak et al. 2008a).

2.3. The relative of indices using analytical for learning outcomes

In reviewing these arguments about the relation of biodiversity and ecosystem services which have two aspects of diversity are distinguished: functional-group diversity and functional-response diversity that there is considerable disagreement about what the evidence shows because the problem is such a complex one (Haines-Young and Potschin 2012. p. 8; Folke et al. 2004). Uncertainties about the effects of species richness on services also arise, because different components of biodiversity (e.g., species richness, evenness, composition, functional diversity) have simultaneous effects on services (Balvanera et al. 2013). Therefore, the approach for calculation involves proportional species diversity (*H'*) dependent evenness (*J'*) and species richness (S) (i.e. $H' = J' \text{x} S$) in the community under underline species distribution impossible in the urban forest (except birds) which is the limitation of some underlying the tolerance range are critical in existence for a survivor and reproductive. In dimensional of relatives complexity earlier mentioned recognizing to impossible split decomposition or independent both ecological and theoretical. After thoughtful possibility plausible explanatory in ecological, additional for relevance the patterns of species diversity in the principle of "equal opportunity" on fundamentals of the theory of species diversity of Robert H. MacArthur 1972. I determined to suppose to perfect evenness (for mammals) give each species which case abundance from distribution in their habitat, aim for providing to mathematics constrain give as values each species as doubly are case abundance and not reciprocal, before use $\log_2$-transformation contribute to ɣ. When relative abundance data are available, rather than simply species lists, it should be possible to develop statistically sound approaches to estimating complementarity from sampling data (Colwell and Coddington 1994). This effect was remarkably similar to the size of logS on *H'* in the ecological model in the low, medium, and high species number groups (Stirling and Wilsey 2001). I believe they have diverted attention from the multidimensional nature of the niche and importance of this concept for understanding the fundamental relationship between abundance and distribution (Brown 1984).

Thus, herein, a consequence from calculated expect can predictive null hypothesis testing from species appeared in quantity are less in the urban forest community and conducting prove by linear regression analysis with R statistics program. Relatives index use analysis as follow

Species Diversity Index (*H'*) (Peet 1975)

$$H' = -\sum P_i \log P_i$$

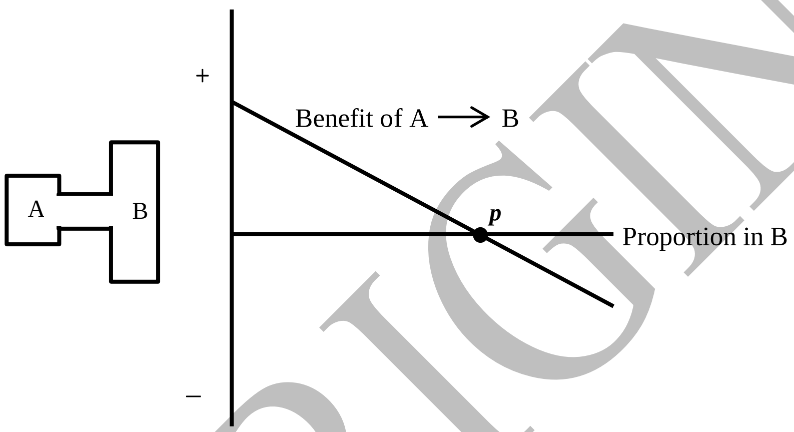
where *Pi* is the percentage of the individuals represented by species percentage of the individuals represented by species *i* and is estimated by *Ni*/*N*.

Eveness Indx (*J'*) (Heip et al. 1998)

$$J' = H'/H_{max}$$

where *H'* is values received from diversity index and H_{max} = Log_2S (S = the total number of species in a sample).

The Principle of Equal Opportunity (MacArthur 1972; p. 175)



A and B are two different habitats of unequal size, joined by a corridor as shown on the left. On the right is portrayed the benefit of A-to-B migration as a function of the proportion of the species in habitat B. When this line drops below zero, B ⟶ A migration is favored. Where the line crosses at proportion p, the habitats have equal opportunity for further colonization.

Leaf Area Index (*LAI*) is a key structural characteristic of forest ecosystems based on the Beer-Lambert Law (Chen et al. 1997; Nowak et al. 2008a)

$$LAI = \mathrm{In}(I/I_o)/\text{-}k$$

where I = light intensity beneath canopy; I_o = light intensity above canopy; and k = light extinction coefficients are 0.65 for hardwoods

Leaf Area Index (LAI_s) is an indicator of vegetation primary productivity (Clayton 2013. p. 87)

$$LAI_s = \sum A(LAI_i) \text{ x } (LAI_i)/A(S)'$$

i= {0, 1, 2, 4, 6} outreach

where LAI_s = average LAI for the given site, $A(LAI_i)$ = area covered by elements of leaf area index *i*, and $A(S)$ = total area of the site

3. Results

3.1. Biodiversity sustain ecosystem services before human well-being

Understanding about species diversity appears in the community of habitat regarding. An understanding of pattern, its causes and consequences of how these processes vary in space and time and how they vary with species number in ecological processes which basic challenge is to elucidate the connections between biodiversity and ecosystem services (Levin 1992; Levin 2010. p. 125; see more; Rosenzweig 1996). Essence important for ecosystem services assessment before human well-being on sustainability.

The results in Table 1 & 2 suggested demonstrate to when I supposed to perfect evenness case abundance from species distribution (i.e. mammals) that predicts can relatives maintenance in the community (i.e. $H' = J'$xS) of diversity (H') will dependent on evenness (J') and richness (S) always in both ecological and theory [mammals (Pr (>F) = 0.7601]. Results mentioned proved S have asymmetrical not effect from supposed to perfect evenness (i.e. mammals) though species diversity appeared in the urban forest have qualitatives are less (i.e. values N = 11 of S equally P_i). Additional did not independent in the relation of community, such as well similarity birds species diversity [(Pr (>F) = 1.705e-05]. This suggests that indirect relationships between S, J', and H' may contribute to direct (univariate) relationships between richness, eveness, and proportional diversity in order to test this hypothesis (Stirling and Wilsey 2001). In that, the presence-absence of the role of species richness is strong implicit suggestions as to the probability of long-term storage of species management efforts at specific sites, because S will regulating how changes in biodiversity may result in or intensify trade-offs among services can then be obtained (Atmar and Patterson 1993; Balvanera et al. 2013).

Table 2 & 3. The empirical relative index of mammals and birds diversity under supposed to perfect evenness are case abundance from distribution in the urban forest for learning outcomes of a sustainable campus.

Mammals

Index	DF	Sum Sq	Mean Sq	F-values	Pr(>F)
Diversity (H')	2	4829.9	2415	3.959	0.02979*
Evenness (J')	2	4547.9	2273.97	3.771	0.0346*
$H' = J'$	2	47.13	23.565	1.2631	0.2974
H' = S	2	4877.1	2438.57	4.0744	0.0272*
$H' = J'$ x S	2	10.54	5.2719	0.2768	0.7601

Total S = 11
Total N = 308
Significant codes = *0.05

Birds

Index	DF	Sum Sq	Mean Sq	F-values	Pr(>F)
Diversity (H')	2	529.20	264.600	33.773	2.116e-10***
Evenness (J')	2	410.82	205.409	24.472	2.127e-08***
$H' = J'$	2	372.19	186.096	23.167	4.331e-08***
H' = S	2	437.82	218.912	27.764	3.816e-09***
$H' = J'$ x S	2	20.297	10.1483	13.394	1.705e-05***

Total S = 20
Total N = 127
Significant code = ***0.001

Each species appeared to have an opportunity compensation for relation maintain in communities from displacement because diversity is not dependent on density are case abundance. But significant implicated in the result, the stands gradually lose some of their species, and those remaining achieve unusual positions of relative abundance at local scales is relatively weak when the competition is equal (Hanski 2011; Thompson et al. 2020). This can be illustrated in two ways (Fig.

2), thus, there should be a linear relationship between species richness locally and that on the large regional scale (Sinclair et al. 2006; p. 379).

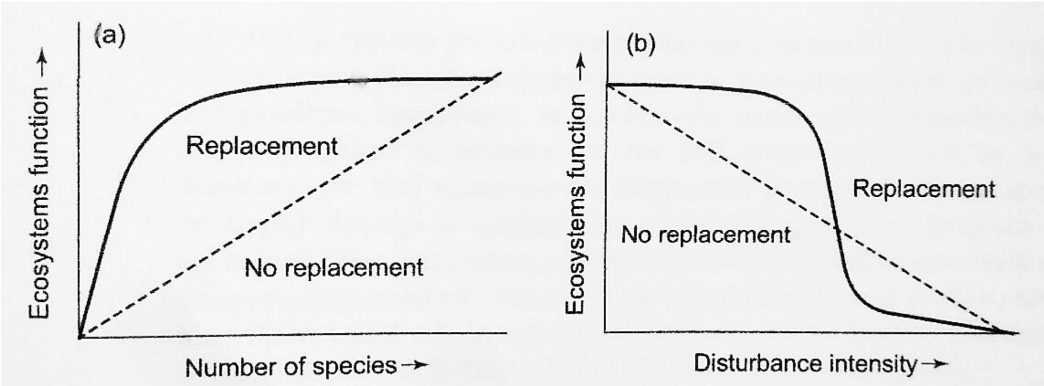


Fig 2. (a) Hypothetical relationship between ecosystem function and species number. If species can replace the function of lost species then system function follows the solid line. If there is no replacement then function follows the broken line. (b) Ecosystem function relative to the degree of disturbance can cause a rapid decline in function when redundancy of species is used up (Sinclair et al. 2006; p. 382).

If consideration distinguishes each subset on the proportion of diversity in the community of urban forest will observe the values of diversity dependent on evenness [mammals Pr (>F) = 0.2974; birds Pr (>F) = 4.331e-08], which that can demonstrate to dominant species significance in the community [i.e. Golden Jackel (n) = 139, Rufous-fronted Babbler (n) = 16], vice versa the roles important of dominant species can not indicate to control in the trophic niche. Because having opportunity displace through on principle prey-predator system, additional each species will be encountering the stressor factors cases environmental stochasticity stimulating adaptive under tolerance range aim for a survivor and reproductive. The core of this case, demonstrated prove asymmetrical of S when distribution impossible or distribution occurrence and how to sustain diversity contribute to ɣ?. As S [mammals Pr (>F) = 0.0272; birds Pr (>F) = 3.816e-09] still relative maintenance in community although each species exist under tolerance factors of distribution impossible (i.e. mammals) for survivor and reproductive in urban forest which monospecific forest. Synonym birds species diversity which most birds species appeared is resident birds (n = 18) and insectivorous. However, insectivorous birds may also control invertebrate herbivore populations, some territorial species (such as bell-miners) may also displace other insectivorous birds and hence affect the impact of invertebrates on forests (Agra et al. 2016. p. 123). While species richness does not necessarily affect the diversity of ESs performed by social insects (Elizalde et al. 2020).

Nevertheless, the results could be used to guide which biodiversity attributes should be the focus of future research to advance understanding of the functional importance of biodiversity for ecosystem service supply (Harrison et al. 2014).Without this knowledge, even if we understood how social and ecological systems interact to produce ecosystem services, we would not understand how varying the amount of services provided is likely to affect the well-being of various stakeholder groups (Bennett et al. 2015). Resolving, even understanding, the trade-offs between conservation and development and the hard choices they entail is difficult because the relationship (or the views people hold about this relationship) between people and nature is so strongly influenced by where they are raised, how they are educated, their life experiences and the survival conditions and options they have faced (McShane et al. 2011). The biggest challenges are posed by the limited understanding of the ways in which biodiversity regulates ecosystem functioning at local and regional scales and the intrinsic difficulty of predicting unexpected, accelerated, and sometimes irreversible changes triggered by alterations of local and regional biodiversity by human intervention (Stuart Chapin III F et al. 2005. p. 322).

3.2. The potential of ecosystem services capacity in urban forest structure

The capacity of ecosystems to provide goods and services for sustainability use are determined by ecological criteria such as integrity, resilience, and resistance has two major concerns included 1) the tendency for growth to overshoot carrying capacity and 2) the possibility that the optimum carrying capacity is less than the maximum, albeit impossible identify the best solution for "optimal" in terms of system functionality for sustainable (de Groot et al. 2002; see Table 1; Barrett and Odum 2000; Wu 2013). Because ecosystem functions refer variously to the habitat, biological or system properties or processes of ecosystems and still scientific arguments underpin that ecosystem properties depend great on biodiversity in terms of the functional characteristics of the organisms present in the ecosystem (Costanza et al. 1997; see Table 1; Schneiders et al. 2012). Whereas if consideration about detail context those indeed it effort investigate meeting facet delicately in asymmetrical both species richness is drivers biodiversity in ecosystem process and the values inference cause calculated predictive by a human. Occurrence not accidentally when profitably economics involvement in ecosystem services assessment. Such implication usually discipline is trade-offs and synergies by objectives conflicts problem-solving of access utility ecosystem.

Table 4. Average of urban forest structure study total of 18 plots cover study area (937.5 ha)

Plot	Tree heights	DBH	*LAI* In(I/Io)/-k	*LAIs* ∑ A*LAI*i*(*LAI*i)/*A(S)*
1	14.93	54.7	5.11	1.08
2	22.81	47.7	5.48	1.27
3	24.10	76.9	6.14	1.56
4	16.21	70.5	5.49	1.27
5	17.09	64.9	5.89	1.56
6	19.27	100.9	6.23	1.56
7	20.77	94.9	6.26	1.46
8	12.99	55.9	5.39	1.27
9	24.97	84.2	6.76	1.56
10	26.37	67.8	7.07	1.56
11	22.86	65.9	6.59	1.56
12	20.37	61.9	6.40	1.36
13	19.99	63.1	6.06	1.46
14	16.30	61.1	5.67	1.46
15	18.97	58.2	6.37	1.56
16	17.06	51.9	5.82	1.56
17	14.20	61.5	5.60	1.27
18	14.49	60.1	4.82	1.08

- *LAI* = 1.7138 relevance good condition (1-10 % dieback) from ∑*LAI* divide the total area
- LAI_s = Small tree (n = 27) = 0.1152; and Tree (n = 243) = 1.5552

Forest area as a proportion of total land area, which serves as SDG Indicator to highlight potential mitigation measures so that the range of ecosystem functions and services directly supported by biodiversity are maintained (FAO and UNEP 2020. p. 10; Brockerhoff et al. 2017). An accurate quantification of urban forest structure is also needed to assess the various ecosystem services and values provided by the urban forest (Nowak et al. 2008b). Differences in ecosystem productivity will most likely be due to differences in forest structure, so determining these characteristics is a vital first step in providing the type of detailed evaluation needed for effective urban forest management (Kim 2016).

Table 5. Linear regression variable analysis of the relationship between *LAI* and LAI_s of mixed deciduous forest in the urban forest for the threshold of ecosystem services assessment

Plot	**DF**	**Sum Sq**	**Mean Sq**	**F-values**	**Pr(>F)**
1	2	26706	13352.7	28.923	1.265e-08***
2	2	19806	9902.9	30.817	5.789e-09***
3	2	53496	26748	87.981	9.599e-16***
4	2	45213	22606.5	39.979	1.896e-10***
5	2	37517	18758.7	103.42	< 2.2e-16***
6	2	94320	47160	272.63	< 2.2e-16***
7	2	83036	41518	83.314	2.407e-15***
8	2	27777	13888.5	34.543	1.347e-09***
9	2	64335	32168	103.32	< 2.2e-16***
10	2	40468	20233.9	429.52	< 2.2e-16***
11	2	38400	19199.8	68.787	5.611e-14***
12	2	33884	16941.8	55.472	1.633e-12***
13	2	35381	17690.6	71.971	2.7e-14***
14	2	33207	16603.7	125.01	< 2.2e-16***
15	2	29563.9	14781.9	163.02	< 2.2e-16***
16	2	23419	11709.4	101.57	< 2.2e-16***
17	2	33888	16943.9	59.343	5.79e-13***
18	2	32764	16382.0	27.64	2.187e-08***

- Significant code = ***0.001

As the results of the first step of ESA in Table 4 & 5 demonstrated the forest structure on study area boundaries can be assigned to classes good condition (*LAI* = 1.7138) of the proportion of the total area. Such forest structure are not only sustain primary productivity but support importance of S asymmetrical both mammals [Pr (>F) = 0.0272] and birds [Pr (>F) = 3.816e-09] contribution particular to *H*' [mammals Pr (>F) = 0.02979; birds Pr (>F) = 2.116e-10] and *J'* [mammals Pr (>F) = 0.0346; birds Pr (>F) = 2.127e-08] in community. Although the pattern of species diversity will be mechanism cause are different. These differences in species richness can help explain for biodiversity assessments is the ability to build predictive models linking fine-scale changes in vegetation structure (Do Nascimento et al. 2020). Similarity, Valencia-Aguilar et al. (2013) discusses species diversity of amphibians and reptiles of the countries in the Neotropics, the research indicated that amphibians and reptiles provide many ecosystem services, some of which are vital to the functioning of the ecosystems and the provision of other services. Such information could also improve understanding of how the direct and indirect interactions among these organisms and others contribute to ecosystem services (Valencia-Aguilar et al. 2013). In most species, the incidence of occurrence was roughly the same in landscapes with 30, 50, and 100 % forest cover, but the incidence dropped to zero in all but a single species in the landscapes with 10 % (Hanski 2011).

Nonetheless, the result of all both Table 4 & 5 I acceptable are not completely might be reasons because of (i) not cover seasonal a year, (ii) wildfire periods measurement, (iii) forest logging and habitat degradation for agricultural are trespass campus boundary, and (iv) edge density both internal and external of the study area. Because of is a significant gradient in LAI through the successional stages and a significant difference in LAI between the stages (Kalacská et al. 2004). This result suggests that the use of the Beer-Lambert law to accurately estimate LAI will require consideration of light conditions and the seasonal pattern of k, these data clearly indicate the difficulty in obtaining a stand average of LAI and the importance of the location of measurements (Saitoh et al. 2012; Chen et al. 1997). However, the result data received can be further elucidate analysis continues from these studies involve the function interact in the ecological niche and divergence?. It is the question important for investigating complex possible evidence leading to an alternative relationship in the community of urban forest before consideration area management, and how the potential of biodiversity multilayer can contribute ecosystem services categories due to many facets occurred when values in economic participation involvement. For maintenance of future ecosystem services, it is important to understand which species or communities contribute the most and which of those are likely to be threatened by future disease and anthropogenic change (Hocking and Babbitt 2014). Following this framework, valuation of ecosystem services consists of four steps: (i) specification of the boundaries of the ecosystem to be valued; (ii) assessment of the ecosystem services supplied by the system; (iii) valuation of the ecosystem services; and (iv) aggregation or comparison of the values of the services (Hein et al. 2006; see more). A major challenge for future research remains the inclusion of dynamic processes into the model, including possible regime shifts of ecosystems (de Groot et al. 2010).

4. Discussion

4.1. Transformative learning of ecosystem service studies in campus sustainable

Probably because, is effort investigating intersect of supply and demand in the phase prominent overlap related between ecosystem, environment, and economics (3E) which have a human interplay from enterprise characteristics and predominant regulated direction top-bottom. It difficult like attempt an uphill task because phase relation have asymmetrical (i.e. S in biodiversity and values in market cause inference by a human), and that conduct to human will should be action-reaction response adaptive complexity. The economics of biodiversity and ecosystem services is largely about the failure of markets to signal the true cost of biodiversity change in terms of ecosystem services, the failure of governance systems to regulate access to the biodiversity embedded in 'common pool' environmental assets, and the failure of communities to invest in biodiversity conservation as an ecological 'public good' (Perrings et al. 2009. p. 231). These are two interlinked yet distinct issues of "identification with nature" and the idea of "ecological identity" (Kumar and Kumar 2007; see detail section 3).

Therefore, universities are also positioned to answer the call of the profession-to help students develop the knowledge and problem-solving skills to become effective practitioners (Steinemann 2003). Although, not all real-world learning opportunities are appropriate for academic learning in sustainability programs: while some opportunities are more appropriate for extracurricular activities others are less suitable for sustainability, either because their relation to key features of sustainability has not been considered or because there is no relation at all (Brundiers et al. 2010). One of the major objectives of the reforms in higher education is represented as an input–output system for structural shift to transform role, if transformations in knowledge production entails a rethinking of economic fundamentals, the shift to a knowledge economy also requires a profound rethinking of education as emerging forms of knowledge capitalism, involving knowledge creation, acquisition, transmission and organization (Olssen and Peters 2005). Thereby, university management should make campus sustainability the foundation for campus operations, research, and teaching and strive to conserve natural resources and support their sustainable use through conducting affairs in a manner that safeguards the environmental health and safety of the university community (Alshuwaikhat and Abubakar 2008). A campus would practice what it preaches and make sustainability an integral part of operations, planning, facility design, purchasing, and investments and tie these efforts to the formal curriculum (Cortese 2003). They are also important in campus operation both to support the integration of certain activities in existing management structures and to justify the relevance of such activities (Barth 2013).

I would like to suggest that the brain also contains a ''who'' system for social cognition and that this system operates by processing information about others and the self as actors in social dramas (Brown 2020). The systems thinking paradigm, when combined with the learner-directed learning process, will breed students who are hungry to understand how things really work and who will continually be looking for how these workings might (Richmond 1993). Systems thinking goes back and forth constantly between structure (diagrams of stocks, flows, and feedback) and behavior (time graphs) (Meadows 2009; p. 89). Finally, students felt motivated because they were working toward concrete and relevant objectives (Wiek et al. 2014). According to Sugarman (2015) discussed summary conceivable account for Martin and McLellan in the Education of Selves: How Psychology Transformed Students in 2013, has three key features as follows First, students act and experience in ways that are expressive of their presumed uniquely individual psychological interiors, Second, they are strategically enterprising in pursuit of self-defined goals and Third, these features of self-expression and self enterprise are entitlements; that is, basic rights students can presume and demand from teachers, school administrators, and peers. This system-based thinking, analysis, and integration it to demonstrate that behaviours developed cross-sectional study by students albeit the case studies was not to identify the "best" learning program but become elucidate mentality enhance competency give progressively advanced investigate participatory processes in university sustainability initiatives from learning outcomes related practices in HEI (Sikdar 2003 Shephard 2008; Sipos et al. 2008; Disterheft et a. 2015). Example, Barth et al. (2007) in Germany, Sustainable development necessitates societal modernisation and may only be realised via the active participation of competent citizens; therefore the concept of Gestaltungskompetenz is characterised in particular by key competencies that are required for forward-looking and autonomous participation in shaping sustainable development. Thus, individuals who are motivated to change their behaviors toward sustainability will need to develop personal plans to enable this (Arbuthnott 2008). Possible explain summary which should key mechanism competency adaptive complexity aid crossdisciplinary and problem-solving in SD included 5 majorities as follows;

1). Goal: activity emerges surrounding themselves at the current situation able to recall linked involve with life-experience and emotional intelligence.

2). Expectation: hindsight predictive profitably obtainable explicit may be either one or synchronize both abstract and concrete depend upon time-intensive.

3). Opportunity: exploratory access data for open-window knowledge receptive aim to improve understanding encompass transcendental and instill thinking systems permeate.

4). Control: the power regulation of trustee regime in the proportion management of range assertion imperative entail possessive legitimately.

5) Commitment: achievement privilege eligible legislation of possessing legacies both abstract and concrete which will generate case consensus the key stakeholder involvement.

Approach thinking system aims for transformation learning process will enhancing competencies of student participate problem-solving in SD from learning outcomes in HE which supportable reality implementation of sustainability. The use, valuation and assessment of biodiversity as a key component in the provision of ecosystem services because biodiversity is a single word that is used for a complex set of measures and concepts, and because it does genuinely play multiple roles in ecosystem processes and services (Mertz et al. 2007; Mace et al. 2012). The linkages among ecosystem services that create synergies and trade-offs are not fixed, but can shift through time due to change in ecosystem processes or policies that address ecosystem services (Bennett et al. 2009, see Table 1). The ultimate effects of biodiversity on the configuration of a portfolio of final services will be given by the combination of the biodiversity effects on those key functions. (Balvanera et al. 2013). It also calls for new paradigms that allow humans to reconnect to the biosphere and become active stewards of the earth system as a whole (Colding and Barthel 2017).

4.2. How adaptive to the stepping-stones for developing towards sustainable in HEIs

The result is an emergent research landscapes with potential for alternative academic frameworks and new sustainability pathways in the areas such as sustainable consumption; wildlife and water conservation; reducing poverty; community development; transition towns; sustainable business development; ecological resilience; sustainable food and change management for sustainability (Tilbury 2012. p. 6). Understanding how altering the mix of ecological and social contributions to services affects long-term sustainability, is a key step in improving management of ecosystems and their services (Bennett et al. 2015; see more about challenges step). Therefore, it is crucial to consider the scales of ecosystem services when valuation of services is applied to support the formulation or implementation of ecosystem management plans (Hein et al. 2006). The deep, underlying reason for this, I believe, is a matter of theory and knowledge of human thinking (Glaser 1983. p. 11).

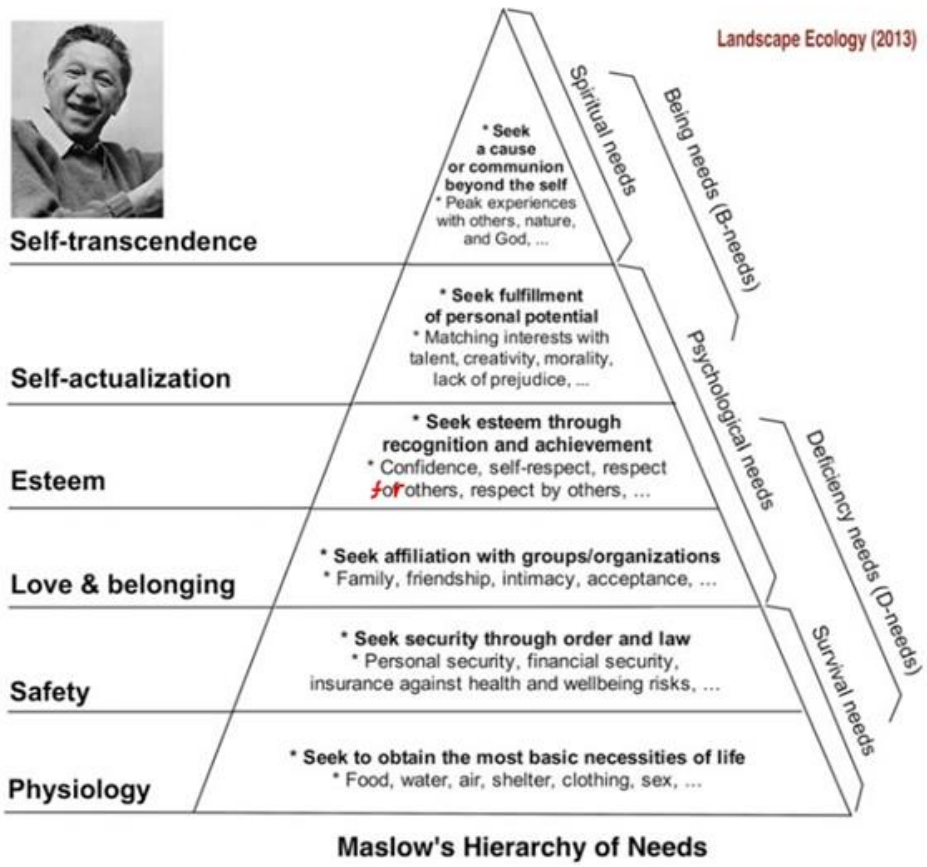


Fig 3. Maslow’s hierarchy of human needs (based on descriptions in Maslow 1954 and Koltko-Rivera 2006) (Wu 2013)

Landscape ecology concepts and approaches, together with the necessary spatially explicit data sets, thus have a strong potential for both contributing to and learning from the further development of theories about resilience and sustainability (Cumming 2011). As in Figure 3. involve with Maslow’s hierarchy of human needs is the theory structure was useful account for identified basic needs on top-bottom pyramids. By fundamental, these aim for build-up opportunity accessible utility manifold are causing motivate. Motivation mentioned suggested probably pursuiting stimulus from a bio-physic symbol. And that taken pressure human interplay action-reaction to adaptive complex among phase prominent overlap (i.e. 3 E.) on TBL consequent themselves. From the case, Maslow’s theory structure raised become set question earlier about “what”, “why”, and “how”, and elucidate summary possible involve adaptive the stepping-stone of sustainable development in HEIs among stream pivot globalization, and progressive developing knowledge by essence thinking system to the fore providing crossdisciplinary competency aim to making-decision for problematic solving. Before enlarging into the local community, regional, and national.

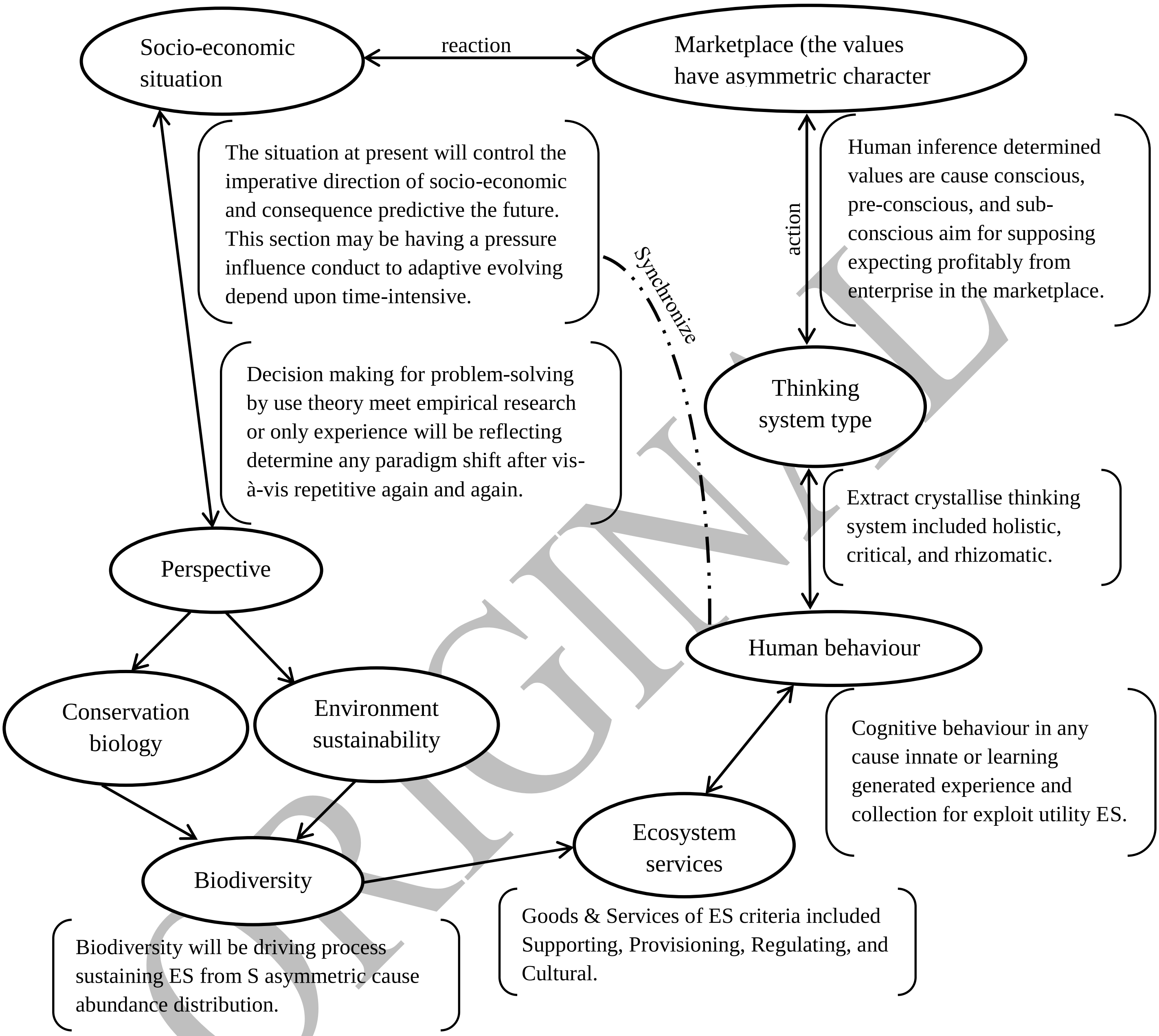


Diagram 1. Show forth-back loop (+/–) from a raised question about “what”, “why”, and “how” pertain to Maslow’s hierarchy of human needs.

Deep and remove envelop multilayer of human needs (diagram 1) one plausible probability through flowing loops is inference determining values which have asymmetrical in the marketplace for chain-interlock linked interplay action-reaction adaptive, this view might be point important to related maintain of non-linear of human behaviour in the phase prominent overlap on TBL. Moreoveer, plausible assumption possibly about radical of thinking system of SD and Maslow’s hierarchy of human needs any generated cause from 2 theoretical included 1) Modernization Theory and 2) Dependency Theory. Both these theory are cause unpleasant management of trustee regime for access utility natural resource “inequality” albeit strive of human enterprise expect profits from exploiting for will receiving rewards response willingness themselves are the difference. Additional probably initiative marketplace competition smuggle superior privilege hegemony in the monopoly game. These theories contributed to imperative human has been selection 3 choice for well-being included weak, balance, and strong on landscape sustainability. It endeavor problem-solving investigating meeting point of trade-offs and synergies in the phase of asymmetrical parallel on TBL cause human enterprise. Which highlight essential involve ecosystem process maintenance provides sustaining critical survivor if a human is still expectation profitable from goods and services indeed should be recognized production cost of an ecosystem is not reciprocal. To assess the potential overlap of each biodiversity priority template with ecosystem services have the evidence is limited to date of social-ecological systems are constantly changing, these studies suggest that humans face the same survival challenges repeatedly and learning for expecting a result in positive benefits to human well-being (Turner et al. 2007; Folke et al. 2002; Wheeler et al. 2012; Sandifer et al. 2015). Substantial empirical research is needed on learning in global settings, in particular when dealing with complexity in the context of a world society, focusing competencies both as means and outcome (Anderberg et al. 2009). It requires a shift of mindsets so that the paradigm that underlies both research and educational programmes is that SD is promoted in the best possible way and precautions are taken that research and education is not leading in the wrong direction (Holmberg et al. 2012). They challenge the dominant role of the researcher as an expert and encourage participatory inquiry techniques so that research is undertaken with ‘with people’ rather than ‘on people’ (Tilbury 2012. p. 7). One evidence demonstrated linked together in a web of relationships significant of people are motivated create manage habitat heterogeneity on the landscape scale from sustainable resource use practices have been emerging from new scientific approaches of nature in modern ecology, thereby enhancing the diversity of biological resources available in the longer term (Berkes et al. 1995. p. 291). In term ‘Ecosystem people”, Ecosystem people are motivated not only to utilise natural resources prudently, but also to conserve them in the longer term. Such The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) McElwee et al. (2020; see details) mention summary manifestation use Indigenous and local knowledge (ILK) particularly important for questions in applied ecology include: (a) enriching understandings of nature and its contributions to people, including ecosystem services; (b) assisting in assessing and monitoring ecosystem change; (c) contributing to international targets and scenario development to achieve global goals like the Aichi Biodiversity Targets and the Sustainable Development Goals and (d) generating inclusive and policy-relevant options for people and nature. It is adaptive because it acknowledges that the natural resources being managed will always change, so humans must respond by adjusting and conforming as situations change (Gunderson 2000).

From the results analyzed and descriptive of all it is, analysing the key elements and principles of the initiatives higher education strategies for advancing sustainability would be a logical creativity researching (curricula, research, operations, outreach, and assessment and reporting) collaboration with other universities because making SD an integral part of the campus system and culturally appropriate of community, these strategies that encourage ‘Educate-the-Educators’ programmes of performance measures in both academic and administrative processes, and to be more reflective and organized in their planning and organization (Douglas et al. 2015; Brinkhurst et al. 2011; Fien 2002; Lozano et al. 2011; Ghanizadeh 2017). The analysis of complexities and imbalances result in thin rather than thick morality in field of power of the politics educational of “what is” has led to a neglect of “what might be” in the very categories themselves—markets, choice, national curricula, national testing, and standards which emphasize distinctions between the developed and developing (Apple 2004; Boas and Gans-Morse 2009). If universities have been recognized as key institutions in contributing to global sustainability, it is imperative that university stakeholders share a common understanding of the term and come to some consensus on role that universities can play in creating a sustainable future (Wright et al. 2013). Such Hans van Weenen (2000; see p. 28) is who discoursed summary highlight essence of sustainable development is about life interest on quality education in higher education are difference between developed and developing but have a same big challenge is survivor before well-being. He suggested showed how university/campus could be adaptive and/or reaction under antropogenic era have the roles more predominantly concern alteration ecosystem if expectation the stepping-stones towards sustainable development of the higher education' 21, sustainable development is about life: about "L" for Limits, "I" for interdependence, "F" for fundamentals and "E" for equity. This set of issues reflects the importance of dealing with material concerns, acknowledging the relationship between humanity and nature, being committed to addressing fundamental causes, and considering ethical values (van Weenen 2000).

Finally, to advance anticipatory and innovative research for sustainability requires advances in our ability to standardize, assemble, document, and share data (Palmer et al. 2005).

Acknowledgements

Special thank you of mind for respectful to Asst. Prof. Thatchavee Leelawat Vice President for Information Technology and Kanchanaburi Campus of Mahidol University and Assoc. Prof. Philip D. Round Academic Staff at the Faculty of Science of Mahidol University gave mercy and merit of "GURU" on morality principle the Four Sublime States of Buddha. And thank you Mr Suphat Prasopsin Mahidol Education Staff supported to Bird-mist Net equipment for fieldwork. All provide support to this research project achievement simple and demonstrated to awakening upon determination statement "Wisdom of the Land" of Mahidol University, additional awareness worthy and vision of sustainable development of the campus. Finally, this journal intention the open access aim to standing for "equality" on curious in learning and practices process of the basic assertions right of student and anti-racism of humanity base on SDGs declaration both Thailand and around the world.

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