Beyond traditional sustainable development: Stating specific and general sustainability theory and sustainability indices using ideal present-absent qualitative comparative conditions

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Abstract

Sustainability has become a key concept in development theory, yet a clear and well-organized central body of accepted theory supporting it does not exist. Sustainability goals and issues are being addressed with traditional sustainable development tools and strategies which are based on non-systematic theory. The development of sustainability indicators and indices reflect traditional sustainable development principles and concerns, not accepted sustainability theory. Measurements of progress toward sustainability are based on measurements of progress toward traditional sustained development.

All this leads to relevant questions such as the following: Can sustainability goals be achieved based on non-sustainability theories? Can sustainability indicators and indices developed to measure progress toward traditional sustainable development be considered good green lights towards sustainability? It is argued in this paper that the theory-practice consistency principle suggest that sustainability issues should be addressed with policy strategies based on sustainability theory and that sustainability tools are the appropriate means to measure progress toward sustainability. Otherwise, the consistency principle would be broken.

Hence, there is a need to provide theoretical support to sustainability ideas and to the preparation of practical and systematic sustainability indices. The goal of this paper is to introduce a present/absence qualitative comparative framework that can be used a) to identify and state different possible models of desired development; b) to develop general and specific sustainability indices to assess them and monitor them; c) to link the traditional concept of sustainability to the notion of fully desired development; d) to provide a clear way to generalize the concept of sustainability consistently and systematically reflecting its optimal nature.

I. Introduction

Can sustainability goals be achieved based on non-sustainability theories? The answer to this question is more likely no. Hardi and Zdan (1997, P. 11) describe in their assessment principle # 1 that "assessment of progress toward sustainable development should be guided by a clear vision of sustainable development and goals that define that vision". Hence, using non-sustainability theories to address sustainability may be inappropriate, as it would be then more difficult to deal with indicator linkages and aggregation within and between systems. Aggregation and linkages of indicators has been one of the difficulties being faced by the sustainable development indicator framework supporting Agenda 21 (UN 2001) as they are organized in a non-systematic fashion or lacking sustainability theory. However, explicitly or implicitly there seems to be a strong belief in the public and private sector that we can achieve sustainability goals by using traditional sustainable development theory (see Pearce 1993; Trzyna 1995; Singh and Strickland 1996; INCA 1997; Hardi and Zdan 1997) or by simply assuming that the sustainable development framework of Agenda 21 is a sustainability agenda as apparently done by Sandberg and Sorlin (1998) and ECLAC (2002). Traditional sustainable development refers here to the notion of sustained development, specially economic or eco-economic development. The need to adjust eco-economic development plans to reflect social concerns and making them that ways consistent with sustainability principles was highlighted in 2003 (Muñoz 2003).

Can sustainability indicators and indices developed to measure progress toward sustainable development be considered good green lights towards sustainability? Again, the answer to this other question is most likely no. Hardi and Zdan (1997, P.13) indicate in their assessment principle # 2 that "assessment of progress toward sustainability should include a review of the whole system as well as its parts; consider well-being of human, ecological, and economic subsystems, their component parts, and the interaction between parts; consider both positive and negative consequences of human activities, in a way that reflect full costs and benefits for humans and ecological systems, in monetary and non-monetary terms". Therefore, the assumption that indicators and indices designed to measure progress toward sustained development work the same under systematic conditions may be wrong. Notice that any form of sustained development requires the existence of system dominance. It was highlighted in 2002 that under sustainability there is no system dominance (Muñoz 2002); and therefore sustainability is optimal development, not sustained development.

The author believes that we missed the sustainability spill over effect generated by the report released by Bruntland Commission(WCED 1987) because instead of directing efforts toward elaborating a strong and accepted body of sustainability theory to guide optimal development, these efforts were directed toward finding ways to adjust and operationalise traditional sustainable development theories and indicators. For example, priority has been given among European countries to develop a core set of indicators to systematically measure sustainable development in ways that are comparable between countries (OECD 2000) without any mention of the need to direct some efforts into the development of sustainability theories and indices to match the practice/reality.

The sustainable development/sustainability debate and confusion cited by all authors (see for example Adams 1993, Pp. 27-29; Trzyna 1995, Pp. 15-23; Lafferty and Meadowcroft 2000, Pp. 9-14; Dale 2001, Pp. 1-8) may quickly dissipate once a widely accepted sustainability theory emerges. There is an agreement among the different development paradigms that sustainability means balancing social, ecological, and environmental concerns. Therefore, there is a need to develop a strong theory supporting that goal and vision, and the tools needed to achieve it. How long more can we go without having a widely accepted central body of sustainability theory?

Details of why the answer to the two questions posed in this introduction is more likely "no" are provided below based on the theory-practice consistency principle of the scientific method, which is summarized by the framework shown in Figure 1.

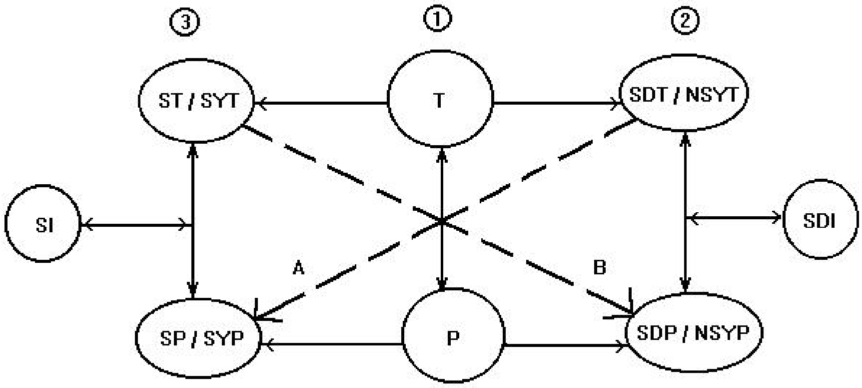

Figure # 1 THE THEORY-PRACTICE CONSISTENCY FRAMEWORK

Column 1 indicates that theory (T) must match the practice (P). Column 2 highlights three aspects: a) that susstainable development theory (SDT) must match sustainable develop ment practice (SDP); b) that non-systematic theory (NSYT) must match non-systematic practice (NSYP); and c) that sustainable development indicators (SDI) are in this case the appropriate tools to assess progress toward sustainable development. On the other hand, Column 3 points out the following: a) sustainability theory (ST) must match sustainability practice (SP); b) system theory (SYT) must match system practice (SYP); and c) that Sustainability indicators (SI) are in this case the appropriate tools to assess progress toward sustainability. Finally, broken arrow A indicates that sustainable development theory (SDT) is not appropriate to deal with sustainability practice (SP) while broken arrow B points out that sustainability theory (ST) is not appropriate to deal with sustainable development practice (SDP).

i. The general consistency principle

All accepted scientific methodologies, be it qualitatively based or quantitatively based have as a common principle the need for theory-practice consistency (T-P principle) to either improve theories or to improve the practice. Without this theory-practice consistency principle (T-P principle), the practical recommendations or the theoretical reformulation reached may be inappropriate. Column 1 in Figure 1 above summarizes this situation by indicating the need for a consistent interaction between theory (T) and practice (P) to achieve practical and theoretical progress in a consistent way (T-P principle), and to design consistent tools to deal with the assessment of relevant issues.

ii. The sustainable development consistency principle

Non-systematic development approaches regardless of the type of paradigm they represent must fulfil this theory-practice consistency principle (T-P principle) to remain scientific. Other wise, they would not fall within the domain of the scientific method.

Column 2 in Figure 1 above summarizes this situation by highlighting that non-systematic theories (NSYT) require non-systematic practice (NSYP) for consistency purposes. In other words, it indicates that traditional sustainable development theories (SDT) must fit sustainable development practices (SDP), and if this is the case, then sustainable development indicators and indices (SDI) are the appropriate tools to assess the importance of gaps between traditional sustainable development theory (SDT) and sustainable development practice (SDP). In other words, to use non-systematic theories (e.g. sustained development) to deal with systematic issues (e.g. sustainability) would be inappropriate as the T-P principle would be violated.

iii. The sustainability consistency principle

As expected, the theory-practice consistency principle (T-P principle) is also binding within the sustainability paradigm since it is also a scientific method of addressing development concerns. Column 3 in Figure 1 above indicates that systematic theory (ST) requires systematic practice (SP); that sustainability theory (ST) must be consistent with sustainability practice (SP); and that sustainability indicators (SI) are the appropriate tools to deal with gaps arising from the interaction of sustainability theory (ST) and sustainability practice (SP). Hence, trying to solve sustainable development problems using sustainability theory would also be inappropriate as again the T-P principle would be broken.

iv. The need for a consistent sustainability theory

The traditional way of scientific thinking is non-systematic and reflects scientific biases, and the traditional concept of sustainable development reflects those biases. For example, Lumley (2002) indicates that different stakeholders see the concept of sustainable development as it best fit their own views on the issues, and therefore, differently. Hence, aims at trying to deal with systematic issues in a piece wise manner appear natural and should be expected. For example, even today the United Nations (UN 2001) is trying to solve sustainability, a system problem, through the use of non-system means, indicators of sustainable development, which is a method that clearly violates the theory-practice consistency principle. Therefore, there is normally a tendency to address sustainability in a compartmentalized manner. There has been clearly a trend to the development and ongoing improvements of issue specific indices and indicators such as in the case of: The Environmental Sustainability Index (YCELP-CIESIN 2005), The Commitment to Development Index (CGD 2006), The Economic Freedom Index (TWSJ-THF 2008), The Human Development Index (UNDP 2008), The Indicators of Sustainable Development (CSD 2004), and The Millennium Development Goals (UN 2007).

If the theory-practice consistency principle (T-P principle) underlying the scientific method is binding, we have no choice, but to find ways to develop systematic theories (SYT) to look at systematic problems (SYP). Figure 1 indicates clearly that this consistency principle (T-P principle) can not be broken if we want to find consistent means and tools to assess, monitor, and to treat the problems efficiently. Specifically, the two broken lines across Figure 1 above have the following meanings: a) broken line B indicates that sustainability theory (ST), practice (SP), and indicators (SI) are not the appropriate means to deal with traditional sustainable development practices/ reality (SDP); and b) broken line A indicates that traditional sustainable development theory (SDT), practice (SDP), and indicators (SDI) are not the appropriate ways to address sustainability issues/ reality (SP). Ways of making the sustainable development framework of Agenda 21 consistent with sustainability theory and indices were suggested in 2003 (Muñoz 2003).

Hence, as highlighted above, there is a need to develop an accepted central body of sustainability theory so that sustainability practice/reality can be addressed by means of consistent sets of sustainability indicators and indices connecting subsystems and overall systems as required by the T-P consistency principle; and this paper aims at advancing ideas on one possible way of doing that using qualitative comparatives tools.

II. Goals of the paper

The goal of this paper is to introduce a present/absence qualitative comparative framework that can be used a) to identify and state different possible models of desired development; b) to develop general and specific sustainability indices to assess them and monitor them; c) to link the traditional concept of sustainability to the notion of fully desired development; d) to provide a clear way to generalize the concept of sustainability consistently and systematically reflecting its optimal nature.

III. Methodology

First, the qualitative comparative present/absent structure of a desired development model is introduced. Second, the different types of models consistent with it are listed and grouped according to over all desirability, according to the absence of some desired characteristics, according to the presence of dominance, and according to full desirability. Third, it is shown in detail how sustainability indices, both specific and general, can be stated consistently and systematically to assess and monitor desired development models using qualitative comparative present/absent conditions as well as it is indicated how they work. Fourth, the concept of sustainability is linked to the fully desired development model and the implications of the special conjunctural structure of the sustainability are highlighted. Fifth, it is described step by step how the notion of present/absence sustainability and indices can be generalized by means of the WIN development model, which includes optimal social, economic, and environmental development at the same time. And finally, some relevant conclusions are listed.

IV. Terminology

The terminology used to present the ideas in this paper is listed below.

Table 1

*	*
A = Desired social characteristics present.	a = Desired social characteristics absent
*	*
B = Desired economic characteristics present.	b = Desired economic characteristics absent
*	*
C = Desired environmental characteristics present	c = Desired environmental characteristics absent
D = Desired Development Model	d = Undesired development

SSI = System sustainability index

GSSI = General sustainability index

A = Desired social development

B = Desired economic development

C = Desired environmental development

S = Sustainability

The desired development model (D)

A desired development (D) model based on a system approach containing the three desired sources of development, social (A*), economic(B*), and environmental(C*) can be stated as follows:

$$D = \overset{*}{A} + \overset{*}{B} + \overset{*}{C} \qquad d = \overset{***}{abc}$$

The model above indicates that there is desired development (D) when the desired characteristics of the society (A*) or of the economy (B*) or of the environment (C*) or of any combination of them are present. Undesired development (d) takes place when all desired characteristics are not present at the same time.

Since there are three sources of desired development, there are also three types of stakeholder influencing the incentives and regulations affecting the working of this desired development models, namely social agents, economic agents, and environmental agents. Each of these agents is trying to maximize their self-interest in the different markets in which they operate. Moreover, each of these agents is plotting to have their self interest dominate or at least get some benefits from the interactions with other agents within the different possible development paradigms that can be formed as it will be shown below.

1) Identifying the different types of desired development models

Based on the presence or absence of desired characteristics belonging to each of the three components within the desired development system shown above, development can be classified in eight different types as shown in Table 2 below:

Table 2

$D_1 = \overset{***}{abc}$ = all desired social(a), economic(b), and environmental(c)characteristics are absent

$D_2 = \overset{***}{Abc}$ = only all the desired characteristics of the social system(A) are present

$D_3 = \overset{***}{aBc}$ = only all the desired characteristics of the economic system(B) are present

$D_4 = \overset{***}{abC}$ = only all the desired characteristics of the environmental system are present

***

D_5 = ABc = only all the desired characteristics of the society and the economy are present

***

D_6 = aBC = only all the desired characteristics of the economy and the environment are present

***

D_7 = AbC = only all the desired characteristics of the society and the environment are present

***

D_8 = ABC = all the desired characteristics of the three subsystems are present.

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ii) Grouping development models in Table 2 based on their desirability

All models of development in Table 2 above can be subdivided in two groups based on their desirability: a) undesired development, where the desired characteristics of all systems are absent at the same time (model D_1); and b) desired development, where the desired characteristics of at least one source of development are present (models D_2 to D_8).

iii) Grouping the desired development models in Table 2 based on the absence of desired characteristics

Desired development models also can be divided into two groups based on the whether or not they have systems with their desired characteristics absent: a) sustained development models, where at least one system has its desired characteristics absent (models D_2 to D_7). Notice that sustained systems allow for system-system dominance since the systems that have their desired characteristics present dominate. Also notice that the traditional concept of sustainable development is used within the context of the sustained system development mentioned above; and b) self-sustainable development models, where there are not desired characteristics absent (model D_8). Notice that under self-sustainable conditions there is no system-system dominance: all systems interact actively. And this notion highlights the fact that self-sustainable development is not sustained development.

iv) Grouping sustained development models in Table 2 based on dominance

Sustained development models can also be classified into two groups based on how many sources of development are dominant: a) one system driven models, where only the desired characteristics of one source of development dominate (models D_2 to D_4). For example, model D_2 would refer to the ideal socio-centric model or deep anthropocentric model; model D_3 would be the ideal market-centric model or neo-classical model; and model D_4 would be the ideal ecology-centric or deep ecology model; and b) two system driven models, where two sources of development are in a dominant position(models D_5 to D_7). For example, model D_5 would represent the ideal socio-economic model; model D_6 would represent the ideal eco-economic model; and model D_7 would represent the ideal socio-ecological model.

v) The fully desired development model

Hence, the only model in Table 2 where all three systems must be active or dominant at the same time is D_8, which is the true sustainable development model or self-sustainable development model. In this model, all desired characteristics of all subsystems, social, economic and environmental, are present at the same time. In other words, in model D_8 there are not dominated systems and optimal conditions prevail.

Developing sustainability indices to assess and monitor desired development models

The presence and absence of desired characteristics in specific systems allows for the preparation of sustainability indices. Sustainability indices can be helpful for the following reasons: a) they can help to simplify complex economic, social, and environmental data; b) they can be an aid to efficiently integrating existing sets of sustainability indicators; c) they can be used to simplify monitoring tasks; d) they can be used to uncover information relevant to specific systems that can be easily compared and convey to policy makers and decision-makers; and e) they can help to integrate quantitative and qualitative information under the same framework and state of mind eliminating the illusion of precision usually associated with quantitative data.

Two types of sustainability indices can be prepared: a) System specific sustainability index (SSI), which indicates the degree of sustainability of a particular system based on the number of desired characteristics present out of the total number of desired characteristics representing that specific system. This leads to the development of social, economic, and environmental sustainability indices, which are fully comparable; and b) general system sustainability index (GSSI), which indicates the over all degree of sustainability of the desired development system or paradigm based on the total number of desired characteristics present over the total of all desired characteristics within that system. This leads to the development of a general index of sustainability, which is directly linked to system-specific indices of sustainability. Developing indices this way ensures that indicators within and between systems can be linked and aggregated in a consistent and systematic manner as required by the systematic nature of sustainability issues and by the T-P consistency principle mentioned in the introduction.

Following, there is a detailed description of how these specific and general sustainability indices can be stated using qualitative comparative tools:

i) System-specific sustainability index

Let's consider the existence of two systems, system "$_j$" and system "$_k$"; then their system specific sustainability index can be found by means of the following expressions:

$SI_j = P_j / N_j$ and $SSI_k = P_k / N_k$

Where:

SSI_j and SSI_k = Sustainability Index for system "$_j$" and for system "$_k$" respectively

P_j and P_k = No. of desired characteristics present in system "$_j$" and system "$_k$" respectively

N_j and N_k = Total No. of desired characteristics within system "$_j$" and system "$_k$" respectively

The above first expression indicates that the sustainability index(SSI_j) for the system "$_j$" results from dividing the numbers of desired characteristics present in this system(P_j) by the total number of desired characteristics attached to it (N_j). The second expression is defined in similar fashion.

The following needs to be highlighted with respect to system specific sustainability indices (SSI):

1) Notice that if $P_j = N_j$ -----> $SSI_j = 1$

$P_k = N_k$ -----> $SSI_k = 1$

This would imply the existence of full sustainability of in these systems.

2) Notice that if $P_j = 0$ ----> $SSI_j = 0$

$P_k = 0$ ----> $SSI_k = 0$

This would imply the full undesirability/ unsustainability of development within these two systems.

3) Therefore, the range of the two system specific sustainability indices(SSI) is from zero to one as indicated below:

0 \< SSI_j /< 1

0 \< SSI_k /< 1

This implies that system specific sustainability moves from full un-sustainability to full sustainability. In other words, as the number of desired characteristics present increases, the sustainability index increases, and the level of system specific sustainability increases.

ii) General system sustainability index

If we assume that the total system is made up by the two systems mentioned above, SS_j and SS_k; then we can used them to show how the General System Sustainability Index($GSSI_{jk}$) works.

The general system sustainability index($GSSI_{jk}$) can be found as follows:

$GSSI_{jk} = P_{jk} / N_{jk}$

Where:

P_{jk} = total number of desired characteristics present in the two systems "$_j$" and "$_k$"

N_{jk} = total number of desired characteristics attached to both systems "$_j$" and "$_k$"

According to the above expression, the general system sustainability index ($GSSI_{jk}$) for the two systems results from dividing the total number of desired characteristics present in the two systems by the total number of desired characteristics attached to those two systems. Again, please notice the following:

1) If $P_{jk} = N_{jk}$ -------> $GSSI_{jk} = 1$

This means full general system sustainability exist.

2) If $P_{jk} = 0$ --------> $GSSI_{jk} = 0$

This means full general system unsustainability exist.

3) Therefore, the range for the general system sustainability index ($GSSI_{jk}$) moves too from zero to one as indicated below:

0 /< $GSSI_{jk}$ \< 1

On the other hand, using the information from the two specific systems $_j$ and $_k$, they can be related to the general system sustainability index ($GSSI_{jk}$):

Since $P_{jk} = P_j + P_k$ and $N_{jk} = N_j + N_k$; then the following is true:

1) If $P_{jk} = N_{jk}$ ----> $P_j + P_k = N_j + N_k$ ----> $GSSI_{jk} = 1$

This means full general system sustainability exist.

2) If $P_{jk} = 0$ -----> $P_j + P_k = 0$ ---------> $GSSI_{jk} = 0$

This means full general system unsustainability exist.

Therefore, system specific sustainability indices(SSI_j and SSI_k) can be related directly to the general systems sustainability index($GSSI_{jk}$) as follows:

$GSSI_{jk} = P_{jk} / N_{jk}$

$GSSI_{jk} = P_j + P_k / N_j + N_k$

$GSSI_{jk} = (N_j)(SSI_j) + (N_k)(SSI_k) / N_j + N_k$

Where ( )( ) = Multiplication

Hence, the above expression links the different system specific sustainability indices SSI_j and SSI_k to the general system sustainability index ($GSSI_{jk}$). The following aspects are relevant to the above general sustainability index ($GSSI_{jk}$):

1) Once the desired development characteristics of each system N_j and N_k are set, then changes in the general sustainability index ($GSSI_{jk}$) can only come from changes in system specific sustainability indices SSI_j and SSI_k

2) If $SSI_j = SSI_k = 0$ -------> $GSSI_{jk} = 0$

This indicates that full system specific unsustainability implies full general system unsustainability.

3) If $SSI_j = SSI_k = 1$--------> $GSSI_{jk} = 1$

This implies that full system specific sustainability equals full general system sustainability.

4) Since N_j and N_k are constant, changes in SSI_j and SSI_k can come only from changes in P_j and P_k, respectively.

Please, notice that if we increase the numbers of desired characteristics attached to one system (N_j or N_k) without changing the number of the desired characteristics present in that system (P_j or P_k are constant), then the value of the specific sustainability index (SSI_j or SSI_j) and the value of the general sustainability index ($GSSI_{jk}$) will decrease making them look less sustainable. If we reduced, the size of the set of required characteristics, then the opposite situation will happen.

Finally, please notice that the general system sustainability index ($GSSI_{jk}$) can also be found by finding the average of the system specific sustainability indices SSI_j and SSI_k as shown below:

$$GSSI_{jk} = SSI_j + SSI_k / 2$$

The above equation also indicates that changes in the general system sustainability index ($GSSI_{jk}$) respond only to changes in system specific sustainability indices SSI_j and SSI_k. Again, only when $SSI_j = SSI_k = 1$, we have that $GSSI_{jk} = 1$. This indicates that full general system sustainability requires full system specific sustainability. Notice that the formula of the general system sustainability index could be extended to as many system specific sustainability indices as we desired or have.

iii) How the sustainability index framework works?

To show in simple terms how the sustainability index framework works in practice, the sustainability index (SSI) of each of the different models of development listed in Table 2 is calculated below in Table 3 and the sustainability nature of each of those models is also highlighted.

Table 3

Development Model	Model Structure	Sustainability Index	Sustainability Nature
*** D_1 =	abc	SSI = 0/3 = 0	Fully unsustainable
*** D_2 =	Abc	SSI = 1/3	Sustained
*** D_3 =	aBc	SSI = 1/3	Sustained
*** D_4 =	abC	SSI = 1/3	Sustained
*** D_5 =	ABc	SSI = 2/3	Sustained
*** D_6 =	aBC	SSI = 2/3	Sustained
*** D_7 =	AbC	SSI = 2/3	Sustained
*** D_8 =	ABC	SSI = GSSI = 3/3 = 1	Fully sustainable

Notice in Table 3 above that as the number of active systems that are present increases, the sustainability index increases, with model D_8 having the highest sustainability index possible (fully sustainable) and model D_1 having the lowest possible (fully unsustainable). Moreover, we can see in Table 3 that all models with a one system driven structure (D_2, D_3, D_4) have the same degree of sustainability(1/3) and that all models with a two system driven structure (D_5 , D_6 , D_7) have also the same degree of sustainability(2/3); and therefore, the degree of sustainability of one system driven models is lower than that of two system driven models. The above information support the observation that we should expect the sustainability index of specific systems or of the over all system to decrease as the number of desired characteristics present decreases. We can also see in Table 3 that models D_2 to D_7 are sustained models indicating that there can be one system driven and two system driven sustained development models. Besides, notice that only model D_8 is a fully sustainable model, with all desired characteristic present at the same time (A*B*C*) and with a sustainability index (SSI) and general sustainability index (GSSI) of one; and therefore, with optimal characteristics.

Linking sustainability (S) and the fully desired development model (D_8)

As documented in the introduction, it is widely accepted that sustainability (S) is defined as development that balances social, economic, and environmental concerns. Hence, sustainability is self-sustained development. In other words, sustainability is not traditional sustainable development as sustainability is not sustained development.

The only model in Table 2 and in Table 3 above that is self-sustained is model D_8 and therefore, this is the only model that is consistent with the definition of sustainability. Based on the above, the following is true:

$$D_8 = A^*B^*C^* = S = \text{self-sustained} = \text{optimal development} = \text{sustainability}$$

Rearranging terms, we have:

$$S = A^*B^*C^*; \text{ where } S = \text{Sustainability}$$

Therefore, sustainability(S) equals self-sustained development; sustainability equals development that balances social, economic, and environmental concerns, and hence, sustainability equals optimal desired development.

The implications of the special structure of the sustainability model (S)

The systematic and interactive structure of the sustainability model (S) presented above makes it easier to see that sustainability is consistent in theory with concepts and statements related to equity, cooperation, coordination, responsibility, accountability, participation, perfect markets, ideal world, harmony, fair trade, respect, holistic view, flexibility, interdependency, integration, resilience, endurance, dynamic system, the socio-eco-economic rational man, conjunctural interactions, system development, democracy, and other related concepts. In conclusion, sustainability (S) is the type of socio-eco-economic development capable of enduring socio-eco-economic discourse, now and in the future. And this sustainability model (S) is generalized below.

Generalizing the sustainability model (S) through the WIN development model

In order to arrive to any generalization of the above sustainability model (S), we have to find out the structure of the ideal social (A*), economic (B*), and environmental (C*) systems. Below there is a detailed theoretical description of how this can be done:

i) Modelling social development to express it in ideal terms

A model of desired social development (A) can be stated as below:

$A = X_1 + X_2 + X_3 + ... + X_n$

Where: A = desired social development

X = desired social characteristic

The above model indicates that there is desired social development when the desired social characteristics X_1 or X_2 or X_3 or +...+ X_n or any combination of them are present. In the case, when all the desired social characteristics are present at the same time, then we have ideal social development, which can be stated as:

$$A^{*} = X_1X_2X_3....X_n ;$$

where, A^{*} = ideal social system

Therefore, an ideal social system exists when all desired characteristics are present at the same time.
The social sustainability index for the ideal social system can be found as follows:

$$SSIA^{*} = P_X / N_X = n / n = 1 \text{ since } P_X = N_X = n$$

The above holds because the total number all the desired characteristics attached to the social system (N_X) equals the total number of desired characteristics that are present (P_X) when there is ideal social development.

ii) Modelling the economic development to express it in ideal terms

A model of desired economic development (B) can be stated as below:

$B = Y_1 + Y_2 + Y_3 + ... + Y_n$

Where, B = desired economic development

Y = desired economic characteristic

The above model indicates that desired economic development exist when the desired economic characteristics Y_1 or Y_2 or Y_3 or +...+ Y_n or any combination of them are present. However, there is ideal economic development when all the desired characteristics are present at the same time, as indicated below:

$$B^{*} = Y_1Y_2Y_3....Y_n ;$$

where B^{*} = ideal economic system

Therefore, an ideal economic system exists when all desired characteristics are present at the same time. The economic sustainability index for the ideal economic system can be found as follows:

$$SSIB^* = P_Y / N_Y = n / n = 1 \text{ since } P_Y = N_Y = n$$

The above holds because the number of desired characteristics attached to the economic system(N_Y) equals the number of desired characteristics present(P_Y) when there is ideal economic development.

iii) Modelling the environmental development to express it in ideal terms

A model of desired environmental development(C) can be stated as below:

$$C = Z_1 + Z_2 + Z_3 +....+ Z_n$$

Where, C = desired environmental development

Z = desired environmental characteristic

The above model indicates that a desired environmental system exist when the desired environmental characteristics Z_1 or Z_2 or Z_3 or +...+ Z_n or any combination of them are present. On the other hand, there is ideal environmental development when all the desired characteristics attached to this system are present at the same time, as indicated below:

$$C^* = Z_1Z_2Z_3....Z_n \text{ ;}$$

where C^* = ideal environmental development

Therefore, an ideal environmental system exists when all desired characteristics are present at the same time. The environmental sustainability index for the ideal environmental system can be found as follows:

$$SSIC^* = P_Z / N_Z = n / n = 1 \text{ since } P_Z = N_Z = n$$

Again, the above holds because the number of desired characteristics attached to the environmental system (N_Z) equals the number of desired characteristics present(P_Z) when there is ideal environmental development.

iv) Expressing the sustainability model(S) as the general WIN development model

As indicated above, there is sustainability when the social(A*), economic(B*), and environmental(C*) systems are present in ideal form at the same time.

$$S = A^*B^*C^*$$

Substituting for A^*, B^*, and C^*, we have:

$$S = (X_1X_2X_3...X_n)(Y_1Y_2Y_3...Y_n)(Z_1Z_2Z_3...Z_n)$$

Rearranging terms, we have the following:

$S = (X_1Y_1Z_1)(X_2Y_2Z_2)(X_3Y_3Z_3)...(X_nY_nZ_n)$

The above ordering assumes that the desired characteristics of the social, economic, and environmental system can be rearranged in compatible ways (e.g. win-win-win options). Then, we can represent each trichotomy choice as follows:

$W = X_1Y_1Z_1$ = first three elements

$I = X_2Y_2Z_2$ = second three elements

$N = X_3Y_3Z_3$ = third three elements

$! = X_nY_nZ_n$ = last three elements

Then, after substituting this new terminology in the sustainability equation, we have:

S = WIN...!

The above model indicates that the sustainability (S) model can be generalized by a WIN...! development model that balances social, economic, and environmental concerns as it contain all the desired social, economic, and environmental characteristics of development at the same time.

Finally, the general sustainability index for sustainability or optimal development can be found as follows:

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$GSSIABC = P_{XYZ} / N_{XYZ} = n + n + n / n+ n + n = 1$

The above holds because all the desired characteristics of the social, economic, and environmental system are present when there is optimal development. Notice that all desired characteristics present (P_{XYZ}) equals all the desired characteristics attached to all systems (N_{XYZ}).

Specific conclusions

Some specific conclusions are the following: First, it was stressed that traditional sustained development is not sustainability. Therefore, dealing with sustainability problems require sustainability theory and sustainability tools to fulfil the theory-practice consistency principle of scientific methodologies; and therefore, it requires developing approaches that go beyond traditional sustainable development thinking.

Second, it was shown that a desired development model based on a qualitative comparative present/absent structure can be used to identify different possible models of development and group them in different ways to appreciate their unique and common characteristics.

Third, it was described in detail how sustainability indices, both specific and general, which are needed to assess and monitor desired development consistently and systematically can be stated using the same qualitative comparative present/absent structure. Fourth, it was indicated how a link can be established between the accepted concept of sustainability and the notion of fully desired development in order to be able list the general implications of the conjunctural structure of sustainability.

And finally, it was pointed out step by step how we can generalize the notion of present/absence sustainability theory and indices through the WIN development model, to reflect optimal social, economic, and environmental conditions at the same time.

General conclusions

A few general conclusions are the following: It was documented that sustainability is a systematic issue and that traditional sustainable development is not. Therefore, dealing with sustainability issues require the development and use of consistent and systematic approaches in order to respect the T-P consistency principle. In other words, in order to develop approaches that are appropriate to deal with sustainability issues we need to go beyond traditional sustainable development thinking and come out with ideas on how to reflect the true nature of sustainability in our models both in theory and in practice.

The presence/absence qualitative comparative approach to address sustainability issues proposed in this paper provides clear theoretical basis for developing a systematic central body of sustainability theory to support the gathering of sustainability indicators and the preparation of consistent sustainability indices to assess and monitor progress toward the stated desired vision and goals of sustainability.

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