

Reversing Entropy to Sustainability: The Moral Dimension

Sustainability and entropy are concepts more than simply relating to environment and physical systems of energy dissipation, respectively. In the moral, social and co-integrated socio-scientific planes of human experience sustainability is essentially the positive action and response between the episteme of unity of knowledge and its social reconstruction of the unified world-system. Such a praxis of knowledge and experience lies at the core of the moral law of unity. It involves learning and process in the light of the complementary and participatory nature of unity of knowledge as the episteme of action, response and dynamics in relation to the ecological problem under study.

In the Qur'an sustainability as precept is equated with the fundamental objective of creation and life. Since knowledge has ever-increasing potential, so does the possibility of entropy to return back to sustainability, even after a regime ecological decadence. This kind of reversal of entropy is tantamount to mankind's possibility to return to the moral law by self-actualization and redemption. The moral, ethical and worldly issues embedded in such a treatment of ecology¹, sustainability and reversal of entropy are of deep import for epistemological formalism, institutionalism and empirical and policy applications at large.

This paper expounds that worldview by developing a general-system understanding of ecology, sustainability, reversal of entropy and the population interrelationships embedded in the moral domain. The Qur'anic worldview is highlighted on this theme due to its singular centrality on the monotheistic episteme (unity of knowledge) and the unified world-system (i.e. ecology, sustainability and reversal from entropy).

Keywords: entropy, sustainability, Islam and ecology, Bangladesh population-ecology relationship.

Background

Sustainability is usually narrowed down to the study of environmental conservation for the present and future generations. In this sense, the environment is seen as a common capital good. Being so treated as a natural artifact, the environment is indispensably subject to depreciation (Daly et al 1992). Thus, as economic growth and development, globalization and industrialization, privatization and the consumerist transformation of a service economy proceeds on, depreciation of the planet earth and her natural endowments is bound to take place from now into the future. In this sense of the argument surrounding an unsustainable planet earth and her endowments, human consciousness defines the difference between the sensate and the good and responsible consumption and production menus. Such overarching sea change is invoked in the self-reflective socio-cybernetic attitude towards the conscious Gaia (Primavesi, 2000).

But I will go a step further to state that unsustainable conditions inflict our planet earth from now into the future because of a failure in entitlement (ownership) and equitable distribution as well. These problems are combined with the failure in acquiring just and balanced consumption preferences and production menus. The underlying social reconstruction for reversal from the state of un-sustainability to a

¹ Our emphasis in this paper is on ecology and ecological functions. Environment is a subset of the great ecological common.

balanced and inclusive world-system of the environment, self and the other, conveys the meaning of reversal of entropy to sustainability. Ours is thereby a quest for formalism of a general-system methodology to study the socio-cybernetic of ecology, sustainability, and reversal from entropy, all embedded in the moral domain.

Objective

The objective of this paper is thereby to invoke formalism, implication, and then proffer suggestions on how a deep entropy condition concerning ecology can be reversed into a global sustainable order of development that remains embedded in moral consciousness. Our premise for such a social reconstruction is thus an epistemological query. It searches substantively for the meaning and possibility of the moral and ethical reconstruction of the general-system worldview of relational oneness between the menus of consumption, production, ownership and distribution. In inquiring on such a generalized system perspective of change towards sustainability, this paper invokes Islamic values for social reconstruction towards the human ecological generalized outlook of organic oneness and its richly endowed systemic complexity (Bertuglia and Vaio, 2005).

The case of Bangladesh is brought forth in reference to the population-ecology relationship, noting that her poverty-ridden condition and assumedly high population scenario have been blamed as a cause for the unsustainable development state in which Bangladesh is entrapped. Yet this paper argues that the population indicator is not the true cause of Bangladesh failure in sustainability. Rather, the cause of the ecological entropy lies on the human, moral and ethical fronts (Choudhury & Wahid, 1996).

In this paper we examine this kind of social reconstruction by the possibility of moral reversal premised on the Qur'anic ecological model. The Qur'an along with the sayings of the Prophet Muhammad (Sunnah) comprises effectual guidance for individuals, society and the global order on the themes of sustainability and reversal from entropy, certainty and felicity. These are the elements of deep ecology as well, extending the environment constricted definition of ecology (Blauert & Zadek, 1998).

This paper is divided into the following sections: After a definitional section, Part 1 of the paper gives a brief review of the literature in the pertinent thematic area. Part 2 outlines selected Qur'anic injunctions on the theme of sustainability and its moral components. A formal model of ecological socio-cybernetic is derived from the Qur'an and formalized. Part 3 of the paper explains the approach to intertemporal resource valuation as socio-economic valuation with its moral embedding. Part 4 of the paper is a particularization of the general-system formal model to the case of population-ecology interrelationship. The old myth of over-population in development paradigm is critically rejected in reference to the circular causation dynamics of our formal model. Part 5 of the paper is an empirical case study on Bangladesh regarding the relationship between population and economic growth. Our generalized formal model is thus tested by the population-economic growth case study for Bangladesh. Part 6 concludes the paper. The possibility of our formal model of general-system with moral embedding is once again projected for the case of Bangladesh entropy-to-sustainability reversal possibility.

Definitions

Entropy is defined as the state of systemic disorder caused by the failure of any part of a system in maintaining its organic connection with the other parts. Such as, forest depletion is entropy for the environment because of its organic severance from resource supply in maintaining forms of life and livelihood. (Rifkin, 1980, p. 35) writes: “An entropic increase... means a decrease in ‘available’ energy. Every time something occurs in the natural world, some amount of energy ends up being unavailable for future work. That unavailable energy is what pollution is all about. Many people think that pollution is a by-product of production. In fact, pollution is the sum total of all of the available energy in the world that has been transformed into unavailable energy. Waste, then, is dissipated energy.”

Sustainability is the state of continuous reproduction of the dissipated energy that Rifkin equates with entropy. The meaning of sustainability can then be understood as recovery from entropy, or replenishing the decreased energy supply. Sustainability is thereby a dynamic process-oriented idea. The sustainable state of development maintains the resource stock by its continuous recovery. Examples are of recovery of the lost natural endowments and the depreciated investment capital. Most importantly, sustainability marks the state of actualizing and maintaining the moral worth of human actions and responses by consciousness.

Consciousness in turn involves actualization of self-governed balances and responsibility in the relations between self and other, the present and the future generations. In this regard writes Weiss (1995, p. 334): “Sustainability, which implies intergenerational fairness, is possible if we look at the earth and its resources not only as an investment opportunity but as a trust, passed to us by our ancestors, to be enjoyed and passed on to our descendents for their use. Such a ‘planetary trust’ conveys to us both rights and responsibilities.”

In the sense of *organic unity concept of the generalized system* perspective, in which we want to interactively integrate, and co-evolve the linkages between sustainability and reversal of entropy, we consider the possibility of a universe that remains amenable to social reconstruction. The fallen universe of man and nature is not terminally damned. Here comes in the permanence of systemic learning process involving imperfectly constituted entities though, but always subject to improvement by learning. There is nothing in the temporal worldly construct that remains absolutely bad or absolutely good -- always and everywhere. There remains always the possibility for change and reconstruction by learning to rise from lesser to higher levels of moral worth.

PART 1

Review of the literature on general-system sustainability question with moral embedding

Thus if we are to study the problem of environmental decadence, this involves the moral human touch to rise from lesser to higher levels of self-actualization for a better ecological future. Such a future is not limited to the understanding of the environment as a physical entity. Ecology *qua* Environment is rather a complex interrelationship between what we mentioned above as our objective of this study –

the physical environment comprising social construction of consumer preferences, production menus, conscious ownership and equitable distribution of ownership for attaining the wellbeing of the present and future generations. All this is embedded in the moral epistemological theme. Such a wellbeing criterion is of and for all, not simply for the human domain (Inglott, 1990). The moral embedding expands the vista of valuation into a wider field (Myrdal, 1968). On such a Gaia outlook of the human ecological future gained by learning process writes Rifkin (1980, p. 227): “Things don’t just ‘exist’ as some kind of isolated fixed stock. This static view of the world has been replaced by the view that everything in the world is always in the process of becoming.”

It is noteworthy that from the above definitions of entropy and sustainability comes our counter-question: If the total stock of energy in the universe is constant and time only increases entropy by diverting energy from one use to another and so on to alternative uses, then the universal resources remain fixed. However, in such a constricted state of the environment, sustainability of some organisms against other forms would be impossible. The world would then descend into a dismal state of dismay and despondency. According to Heilbroner (1991, p. 20) sharing this particular view of the planet earth in the midst of her environmental decadence, “Thus to anticipate the conclusions of our inquiry, the answer to whether we can conceive of the future other than as a continuation of the darkness, cruelty, and disorder of the past seems to me to be no; and to the question of whether worse impends, yes.”

Prigogine (1980) has taken a similar social becoming view relating time to entropy and systemic change in his theory of ecology. The stability or instability of ecology is seen as the capability or incapability of the population structure of organisms to reproduce themselves against the onslaught of Darwinian kind of invasion by ‘survival of the fittest’. This remains a questionable hypothesis. Even in the experimental experience, the Darwinian hypothesis cannot be established. Consider the single-cell amoeba-type organisms that can reproduce without the help of other organisms, but would still preserve themselves in the environment around. In other words, the amoeba-type organisms singularly protect themselves in the environment on which other organisms and the amoeba feed.

Our contention is along this line of argument in relation to the reversal from entropy to sustainability of ecology and life (Choudhury et al, 1998). It is contrary to the Darwinian argument. Indeed, goodness by moral change enhances the ecological multipliers. On the other hand, the acquisitive society degrades the human and natural habitat by moral decadence. Turning now to such a theory of entropy reversal in social reconstruction towards sustainability, we must take an epistemic approach.

PART 2

The epistemic worldview of social construction of Goodness, Human Ecology and the World-System

The epistemic worldview that we are searching for to formalize and apply to the problem of ecology in general, and within it, to the particular problem of population in Bangladesh in particular, is that which establishes and perpetuates the learning possibility for organic unity of knowledge and its induced entities over knowledge, time and space dimensions (Choudhury, 2009). Our choice of such an episteme is derived from the Qur’an – why?

In answer, we note that in the study of world religious thought, the Qur'an stands out singularly in its episteme of monotheism. This explains the epistemology of unity of knowledge in the framework of an active and responsive law, and its induction of the unified world-system going through the process of social reconstruction. On the issue of ecology, population, entropy to its reversal into sustainability, the episteme of unity of knowledge and its induction of the organically unified world-system in continuity of knowledge, time and space dimensions, the Qur'an crystallizes a definite worldview. This kind of moral and social intellection and its application by cogent sets of instruments relating to practical issues of the world-system, e.g. ecology and its interactive organisms, the Qur'an provides concrete guidance (Carlyle, undated).

Let us now investigate our claim by referring to specific Qur'anic injunctions on the following relations underlying entropy reversal and regained sustainability through a learning process in unity of knowledge and the induced world-system. We place the references to the Qur'anic verses in the footnotes and explicate the morally embedded ecological meaning in the text. Yet we must admit that our Qur'anic coverage of morally embedded ecological theme is nowhere complete. We have selected parts of the verses as exemplar to derive our generalized system socio-cybernetic model of ecology and life embedded in the moral law. For further details on the theme the reader can refer to Choudhury (2006).

Formalizing the Qur'anic learning process model of unity of knowledge (monotheism) and the world-system (ecology)

Our organic learning process model derived from the Qur'an, including its facets linking unity of knowledge to the theme of human ecology as a world-system is built upon the following precepts:

(1) *Oneness of God in the divine law:*² This Qur'anic verse overarches the domains of the heavens and the earth; the seen and the unseen, as is the case in socio-scientific abstraction of the ontological and phenomenological type (Maxwell, 1962).

(2) *The pairing between everything in the universe by the divine law of unity and world-system:*³ Organic pairing in the framework of oneness of the world-system in reference to the divine law of oneness is the most powerful precept establishing universal complementarities, hence the participative nature of the universe. Yet such a pervasive union of being is examined here in the opposing context between Truth⁴ and Falsehood to make the moral sense. Truth and Falsehood exist in mutually exclusion and in perpetual conflict with each other.⁵

(3) *The learning universe of pairs attained by organic interrelationship in the midst of the reflective signs and experience of oneness:*⁶ There are three conjoint parts of the learning processes occurring in the mutual continuity of knowledge, time and space. Firstly, the Qur'anic universe of pairs is richly endowed by diversity of the

² Qur'an (2:255)

³ Qur'an (36:36)

⁴ Qur'an (14:22)

⁵ Qur'an (10:31-33)

⁶ Qur'an (41:53)

good things of life. Contrarily, the universe of Falsehood is weak and meager.⁷ We will refer to this attribute of learning in oneness across diversity as the *Interactive* phase. Herein, the good things of life pair by their attribute of rich diversity. In this regard the Qur'an is richly explicative of the human ecology embedded in the moral law of oneness.⁸ Contrarily, the Qur'an points out that, the ecological disaster is caused by the arrogance of man, not by the order of nature. The explanation of the same phenomenon by entropy theory is one of unavoidable permanent disorder, and thus the earthly descent into inevitable un-sustainability. According to the Qur'anic worldview, there is always hope remaining for man if he returns back to the conscious acceptance and practice of the divine law on earth.⁹

Secondly, the learning process is composed of the consensus stage. We will refer to this as the *Integrative* phase, because of its function in forming the complementary and participative consequences between diversity of organisms that arise in the Interactive phase of the learning process. This overarching phenomenological consequence is exhibited by the pairing of the universe in the good things of life.

Oppositely, Falsehood does not pair, except temporarily, but to subsequently dissipate into methodical independence and individualism. In the population-ecology theme embedded in the moral law, the Qur'an declares regarding the Falsehood show of pervasive individualism¹⁰.

The third stage of the learning process is the evolutionary phase of fresh learning, arising out of the convergence of interactions into integration. Creative evolution of the new phases of interactions leading to integration completes every learning process and continues on the learning processes¹¹ in knowledge, time and space dimensions.¹²

(4) *Derivation of the functional ontology of unity of knowledge in relation to the world-system (e.g. ecology, environment and population):* The Qur'an has laid down its precise method regarding the derivation of knowledge from the epistemic foundation of divine oneness (monotheism) as ordained by the Qur'an and the Sunnah (Guidance of the Prophet Muhammad).

In this regard the Qur'an declares the three stages of knowledge formation.¹³ These are firstly, the Qur'an and the Sunnah taken together as the ontological foundation. Interpretation of the Qur'anic injunctions is done at the level of discourse that follows the three pronged methodical approach to knowledge derivation. These are namely, Interaction, Integration and Creative Evolution (IIE), as explained above.

The principle of enlightened discourse for understanding and applying the exegesis of the Qur'an and the interpretation of the Prophetic Guidance (Sunnah) remains active in the discursive Islamic framework on diverse issues and problems of social and scientific investigation. Hence the Qur'an refers to the emergent cosmic ecological entirety as the multitude of world-systems (A'lameen). In them are the Signs of God's oneness shown not by any pantheistic representation; rather, strictly by the unity of knowledge that arises from the divine law. In its ontological precept the

⁷ Qur'an (14:24-27)

⁸ Qur'an (36:33-42); Chapter 16, 'Bee'

⁹ Qur'an (30:41-43)

¹⁰ Qur'an (3:14)

¹¹ Qur'an (30:11)

¹² Qur'an (42:53)

¹³ Qur'an (4:59,69)

divine law of monotheism applies to ‘everything’ in knowledge, time, and space dimensions, and remains unchangeable.¹⁴

When the law is applied at the interpretive stage to worldly experiences, it is referred to as the Shari'ah (Islamic Law).¹⁵ Overarching all such domains of human experience, actions and responses is systemic interconnectedness. By this organic relationship is established the *sui generis* of participatory or complementary organic unity emulating the law of monotheism (unity of knowledge) (Choudhury & Korvin, 2001).

In the end, the learning process comprises the episteme, the ontological beginning, the derivation of knowledge according to the law of unity by the exercise of the IIE-process, and its continuity in knowledge, space and time dimensions. All these together in seamless continuity apply to all issues and problems of experience. They together invoke the richly complex yet righteous path of continuity of the organic unity of life in respect of the episteme of unity of knowledge and the unified world-system.¹⁶

Such continuity by the learning process in unity of knowledge is the essential meaning of *sustainability*. In it and by it the reversal of entropy to sustainability is made possible by the induction of knowledge.

Application of the Qur'anic law of unity of knowledge to the case of ecological sustainability

The systemic understanding of ecology embedded in the law of monotheism and its impact on consumer preferences, production menu, ownership and distribution are borne out by the verses of the Qur'an together with the implication of reversal from moral entropy to sustainability (e.g. by divine Mercy and Forgiveness; see Choudhury, 2008).¹⁷

We present below the multistage epistemic model of learning process in unity of knowledge and the general-system socio-cybernetic understanding of the ecological system conveyed by the mentioned verses. We point out the stages of the Qur'anic overarching systemic manifestation of the ecological wholeness. We firstly note that the Qur'anic imagery is profuse in the depiction of rewards of truth by the ecological balance and beauty of abundance. This unraveling scenario takes the form of gardens, foliage, trees, and proportion. The same sense of balance and moral reward is conveyed in the mundane experiences of self, science and society by the precept of the unified world-systems that uniquely and universally worship God through the invariance of the divine law of monotheism regulating all.

The parts of the Qur'anic verses (13:1-6) are explicated below in terms of deriving the overarching general-system socio-cybernetic model of moral consciousness and the world-system. The moral embedding of the ecological phenomenon is shown by the contrast between Truth and Falsehood. The possibility for reverse entropy is thus pointed out.

1.ALMR. These are the Signs (or Verses) of the Book (the Qur'an): that which has been revealed unto you from your Lord is the Truth; but most men believe not.

¹⁴ Qur'an (48:23)

¹⁵ Qur'an (42:38)

¹⁶ Qur'an (42:52,53)

¹⁷ Qur'an (13:1-6)

The epistemic foundation of unity of knowledge is laid down in the framework of the persistent, unique and universal Truth of oneness of God and his Law.

We denote the epistemic foundation by the super-cardinal topology (Maddox, 1970),

$$(\Omega, S) \quad (1)$$

Here Ω denotes the unbounded knowledge, time and space dimensions of the Qur'an; S denotes the Sunnah as functional ontology that maps meanings of the Qur'an into human experience.

2. God is He Who raised the heavens without any pillars that you can see; is firmly established on the Throne (of Authority)!

Knowledge emanating from the epistemic foundation of oneness of the monotheistic law is the governing premise of *all* of reality. It is universal, unique and pervasive by the Will of the Creator and Cherisher of the universes.

We denote knowledge-flows by θ , as this is derived from the epistemic roots through human discourse as,

$$\theta \in (\Omega, S) \quad (2)$$

3. He has subjected the sun and the moon (to his Law)! Each one runs (its course) for a term appointed.

The cosmic scale of ecology is embedded in the moral meaning of knowledge, life and experience. Yet the ecology and all its components are depicted here as a temporal positive fact. The diversity of the meaning and consequences embodied in the immanent law of oneness are to be understood and explicated by human knowledge in relation to the socially constructed world-systems (e.g. human ecology).

The variables and entities of 'everything' denoted by the vector (matrix, tensors etc) $\mathbf{x}(\theta)$ are induced by knowledge-flows, θ .

The knowledge-induction of 'everything' is depicted by the following string relationship:

$$\Omega \rightarrow_s : (\Omega, S) \rightarrow (\theta \rightarrow \mathbf{x}(\theta)) \quad (3)$$

4. He does regulate all affairs, explaining the Signs in detail, that you may believe with certainty in the meeting with your Lord.

The law of monotheism is an active worldview in which God is active actor beyond being the Creator. His laws are active by way of establishing its certainty attribute of oneness in the cosmic and ecological scale of comprehension, observation, and application of the law. We now formalize as follows:

$$\begin{array}{l} \Omega \rightarrow_s : (\Omega, S) \rightarrow (\theta \rightarrow \mathbf{x}(\theta)) \\ \downarrow \\ W(\theta, \mathbf{x}(\theta)) \rightarrow \text{recalling } (\Omega, S) \rightarrow \text{continuity} \\ \text{Certainty} \qquad \qquad \qquad \text{by divine} \\ \text{By evaluation} \qquad \qquad \qquad \text{regulation, i.e.} \\ \text{Using wellbeing} \qquad \qquad \qquad \text{reproduction} \\ \text{Function } W(.) \qquad \qquad \qquad \text{of knowledge} \end{array} \quad (4)$$

In terms of unity
Of the law and the
World-system by
The action and responses
Caused by the monotheistic law

5. *And it is He Who spread out the earth, and set thereon mountains standing firm, and (flowing rivers).*

Ecological diversity is laid out in diverse systems of the earth. The abundance of ecology by virtue of the moral law is depicted in the imagery of the earthly landscape.

The World-system, Ecology 1 (mountains, rivers) is denoted by its interior attributes formed by the Interactive, Integrative, Evolutionary (IIE) learning processes of unity of knowledge:

$$\Omega \rightarrow_s : (\Omega, S) \rightarrow (\theta_1 \rightarrow \mathbf{x}_1(\theta_1)) \quad (5)$$

↓

$W_1(\theta_1, \mathbf{x}_1(\theta_1)) \rightarrow$ recalling $(\Omega, S) \rightarrow$ continuity certainty by evaluation using wellbeing function $W_1(\cdot)$ in terms of unity of the law and the world-system by the action and responses caused by the monotheistic law	by divine regulation, i.e. reproduction of knowledge
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6. *And fruit of every kind He made in pairs, two and two.*

The principle of paired universe that establishes the general-system perspective of ecology is explicated here. The emergent ecological complementarities between entities in multifarious diversity, which also conveys the meaning of the participative order of organic unity, learning and evolution, is the surest Sign of Oneness in our living experience.

Ecology 2 (fruits, vegetation)

$$\Omega \rightarrow_s : (\Omega, S) \rightarrow (\theta_2 \rightarrow \mathbf{x}_2(\theta_2)) \quad (6)$$

↓

$W_2(\theta_2, \mathbf{x}_2(\theta_2)) \rightarrow$ recalling $(\Omega, S) \rightarrow$ continuity Certainty By evaluation Using wellbeing Function $W_2(\cdot)$ In terms of unity Of the law and the World-system by The action and responses Caused by the monotheistic law	by divine regulation, i.e. reproduction of knowledge
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$W(\theta, \mathbf{x}(\theta))$ is simulated by means of complementarities and participation between the $(\theta, \mathbf{x}(\theta))$ vector of these variables across diverse systems, all existing in unity of knowledge and organic interrelationships.

7. *He draws the Night as a veil O'er the Day.*

The cosmic representation of monotheism being unraveled in the natural order of human experience is exemplified in the midst of its universal meaning of pairing as organic unity between ecological diversity and complementarities between variables and entities.

The Qur'anic verse marks a further diversity of the grand Ecology comprehending the cosmic scale of the knowledge-induced unified systems.

8. *Behold, verily in these things there are Signs for those who consider!*

The central role of human consciousness of ecological and cosmic holism in the midst of the monotheistic law is established.

The learning processes are shown to persist across knowledge-induced multi-systems and variables and entities to continue across knowledge, time and space dimensions. Time (t) is entered here as a datum to record the events caused by primal knowledge-induction. Time has no other role but to record as datum the knowledge, time, space dimensions of events. We write,

$$t = t(\theta_s, \mathbf{x}_s(\theta_s)) \quad (7)$$

t is time variable shown as datum for recording events $(\theta_s, \mathbf{x}_s(\theta_s), t)$ in a specific system, s, of all systems.

Furthermore now,

$$\begin{aligned} \Omega \rightarrow_s : (\Omega, S) &\rightarrow (\theta_s \rightarrow \mathbf{x}_s(\theta_s), t_s) & (8) \\ &\downarrow \\ &W_s(\theta_s, \mathbf{x}_s(\theta_s), t_s) \rightarrow \text{recalling } (\Omega, S) \rightarrow \text{continuity} \\ &\text{Certainty} & \text{by divine} \\ &\text{By evaluation} & \text{regulation,} \\ &\text{Using wellbeing} & \text{i.e. reproduction} \\ &\text{Function } W_s(\cdot) & \text{of knowledge} \\ &\text{In terms of unity} \\ &\text{Of the law and the} \\ &\text{World-system by} \\ &\text{The action and responses} \\ &\text{Caused by the monotheistic law} \end{aligned}$$

$W_s(\theta_s, \mathbf{x}_s(\theta_s), t_s)$ is simulated by means of complementarities and participation between the $(\theta_s, \mathbf{x}_s(\theta_s), t_s)$ vector of variables across diverse systems (s), all existing in unity of knowledge and organic interrelationships.

9. *And in the earth are tracts (diverse though) neighboring, and gardens of vines and fields sown with corn, and palm trees – growing out of single roots or otherwise.*

The continued picture of rich diversity in the earthly ecological system is emphasized in order to bring out the meaning of wellbeing based on consumption preferences, and productivity fecundity conveying production.

10. *Watered with the same water, yet some of them We make more excellent than others to eat.*

The technological induction in the production and consumption of rich ecological diversity is also induced by the moral law. Technology is linked purposively with consumption, production, distribution and ownership of life's artifacts, and therefore by the Will of God. Technology is thereby established by the principle of diversity in oneness and purpose. Technology in this sense is knowledge-induced like other socio-economic variables..

Between verses (9) and (10) we introduce the system-related knowledge-induced consumption preferences denoted by $(P_s(\theta_s))$, production menus denoted by $(Q_s(\theta_s))$, ownership (entitlement) denoted by $(E_s(\theta_s))$, equitable distribution denoted by $(D_s(\theta_s))$, and appropriate technology denoted by $T_s(\theta_s)$.

Let $Z_s(\theta_s) = (P_s(\theta_s), Q_s(\theta_s), E_s(\theta_s), D_s(\theta_s), T_s(\theta_s))$, and take the time-dependent version of this notation. We now reformulate as follows:

$$\Omega \rightarrow_S : (\Omega, S) \rightarrow (\theta_s \rightarrow \mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s) \quad (9)$$

$$\downarrow$$

$$W_s(\theta_s, \mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s) \rightarrow \text{recalling } (\Omega, S) \rightarrow \text{continuity}$$

Certainty	by divine
By evaluation	regulation,
Using wellbeing	i.e. reproduction
Function $W_s(\cdot)$	of

knowledge

In terms of unity
 Of the law and the
 World-system by
 The action and responses
 Caused by the monotheistic law

Wellbeing, $W_s(\theta_s, \mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s)$ is simulated in the presence of pervasive complementarities (or participation) between the $(\theta_s, \mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s)$ vector elements across diverse systems (s). All exist in the framework of unity of knowledge and organic interrelationships.

11. Behold, verily in these things there are Signs for those who understand!

The continuity of the learning process of organic unity of knowledge and the induced world-systems in co-evolutions across ecological complex diversity of systems and entities according to the monotheistic law is forever reminded to humankind (recalled). The monotheistic law marks the invariance principle of history. This is historical consciousness (Lucaks, 1968).

The surest sign of unity of knowledge in social reconstruction using the learning process model on all issues and problems of the world-system (e.g. ecology) is conveyed by degrees of wellbeing attained by simulating it in respect of the vector of variables with participation and complementarities between them. Wellbeing increases from lesser to higher levels along with the increase in consciousness of the monotheistic law of unity of knowledge; that is by higher degrees of complementarities (participation) between variables across systems.

We measure the degrees of such social reconstruction of wellbeing under unity of knowledge by circular causation relations between the variables in reference to diverse systems. We formalize this part as follows:

$$\Omega \rightarrow_S : (\Omega, S) \rightarrow (\theta_s \rightarrow (\mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s)) \quad (10)$$

$$\downarrow$$

$$W_s(\theta_s, \mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s) \rightarrow \text{recalling } (\Omega, S) \rightarrow \text{continuity}$$

Certainty	by divine regulation,
By evaluation	i.e. reproduction
Using wellbeing	of knowledge
Function $W_s(\cdot)$	
In terms of unity	
Of the law and the	
World-system by	
The action and responses	
Caused by the monotheistic law	

$W_s(\theta_s, \mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s)$ is simulated by means of complementarities and participation between the $(\theta_s, \mathbf{x}_s(\theta_s), Z_s(\theta_s), t_s)$ variables across diverse systems (s), all existing in unity of knowledge by organic interrelationships.

The circular causation relations are written as follows:

$$\text{Let } \mathbf{y}_{ijs} = \mathbf{y}_{ijs}(\theta(t), \mathbf{x}(\theta, t), \mathbf{Z}(\theta, t)), \quad (11)$$

$i = 1, 2, \dots, n$ denote number of interaction;

$j = 1, 2, \dots, m$ denote number of variables;

$s = 1, 2, \dots, r$ denote number of overarching systems.

Circular causation relations for testing out and enacting simulation for actualizing possibilities in social reconstruction of greater degrees of complementarities in the good things of life are denoted by the following interrelationships. Since these estimated relations may not necessarily exhibit desired levels of complementarities between the variables, the system is therefore subject to simulation by changes in the coefficients of the estimated relations. The implications of structural and systemic transformation toward affecting socio-economic complementarities are inherent in the changes in coefficients and the resulting simulation of estimated relations.

$$y_{iks} = f(\theta(t), y_{ijs}(\theta, t)), \quad (12)$$

$i = 1, 2, \dots, n$ denote interactions achieved by institutional discourses, as in deriving θ from (Ω, S) in perpetuity of the learning processes.

$k = 1, 2, \dots, m$; but $k \neq j$; denote numbered variables

for given systems denoted by $s = 1, 2, \dots, r$

All of these subscripts are taken over periods of time 't' over which a learning process is completed.

Finally, the wellbeing index is proxied by the knowledge-variable θ , which takes ordinal values as ranks assigned by a combination of institutional discourse and proportionate measures of the socio-economic variables. Such ranks are taken either in the ascending or descending order corresponding to the problem under investigation. In the context of the Qur'an, such a market-polity interaction in assigning θ -ranking is done through the institution called the Shura.¹⁸

The θ -knowledge index of the simulated circular causation relations is given by,

$$\theta = W(y_{ijs}(\theta, t)) \quad (13)$$

This is the monotone of the wellbeing function. Thus it is sufficient to estimate and simulate the θ -relation alone for a proxy of $W(\cdot)$.

Expression (13) is firstly estimated for 'as is results', subject to the system of relations (12). If needed for social reconstruction, according to the episteme of unity of knowledge shown by complementarities between the variables, the estimated coefficients of the relations (12) and (13) are simulated. The simulation

¹⁸ Qur'an (42:38)

involves changes in respect of the generated ordinal values of θ as ranks set by the proportioning of the y_{ijs} -variables, specific to a given system 's' at a given time-period 't'. The time-period marks the learning period in the continuous life of the IIE across knowledge, time and space dimensions. The method of assigning θ -ranks corresponding to the socio-economic variables is shown in the empirical part of this paper.

12. If you do marvel (at their want of faith), strange is their saying: "When we are (actually) dust, shall we indeed then be in a creation renewed?"

The contrary disbelieving view of Falsehood is projected here as denial of the Will of God the One and His monotheistic law. The result is to render utter loss of consciousness and responsibility for the common good, for the preservation of ecological balance.

13. They are those who deny their Lord! They are those round whose necks will be yokes (of servitude):

Denial of the monotheistic law of oneness, as exemplified in the special case of ecological balance, consciousness and responsibility, is the cause of both self-destruction and social destruction *qua* sustainability

14. They will be Companions of the Fire, to dwell therein (for ever)!

Worldly life and the Hereafter are connected by the bridge of divine consciousness. The loss of this consciousness in life means abandonment of ecological balance and justice to all. The punishment for this self-arrogance and deprivation in life is damnation in the Hereafter as the Great Event for meeting out the rewards or punishment of human consciousness in life, as the case will be.

15. They ask you (Prophet Muhammad) to hasten on the evil in preference to the good

Such is the arrogant and unconscionable character of Falsehood in general. It is exemplified here by the example of disparagement of ecology by Falsehood revolting against Truth in worldly life.

16. Yet have come to pass, before them, (many) exemplary punishments!

The positivistic signs of many a defeat and social ills left behind by the unconscionable deniers of the monotheistic law are the mark of history. It is exemplified by the arrogance of Falsehood in denying the moral ecological balance to fellowmen and the environmental commons in entirety. Yet the entropic model of moral decadence can be reversed towards sustainability with the re-assertion of Truth and consciousness against Falsehood.

Qur'anic Verses invoked in (12)-(16) above provide the building blocks of the 'de-knowledge' model. This is the model premised on Falsehood and is ecologically unfriendly. The contrasting mark of the 'de-knowledge' model that is contrary to all the attributes of unity of knowledge and the unified world-system, upon which sustainability abides, is the methodological individualism and

disassociated nature of the variables and entities. Thereby, complementarities and participation derived from and recursively regenerating unity of knowledge across learning processes, are denied and replaced by the belief on scarcity of resources, conflict, competition and marginalism. Consequently, the ecological world-system is bound to depreciate. Reversal of ecological entropy to sustainability is not possible, except by reverting to the unifying agenda of ecological change (Cayley, 1991).

17. But verily your Lord is full of forgiveness for mankind for their wrong-doing, and verily your Lord is (also) strict in punishment.

The total consequences of the knowledge and 'de-knowledge' systems of life, exemplified by the case of ecology across all systemic stages comprising the cosmic and the earthly and social domains, are presented by these verses to exist in perpetual conflict.

Because the 'de-knowledge' model of ecological decay is premised on scarcity of resources, conflict, competition and marginalism, it cannot explain the nature and transformation into the ecological sustainable universe. Reversal from entropy to sustainability remains unexplained in the 'de-knowledge' model.

Contrarily, the learning process model of unity of knowledge is not premised on scarcity assumption. Knowledge and its induced artifacts are reproducible phenomena. Consequently, the knowledge model of unity explains both the 'de-knowledge' ecological disorder as also the possibility to return to sustainability by reversal to the knowledge-centered worldview, knowledge-induced consumer preferences, production, ownership, distribution, and technological menus.

Reversal or switching points in the trajectories of entropy turned toward sustainability mark out punctuated and evolutionary equilibriums in the history of sustainability. Such phenomena also belong to the conscious nature of self-governed organization of punctuated equilibriums in orderly evolutionary systems with complexity. Krugman (1996) and Thurow (1996) have contributed to this area of research.

Topological contrast between Truth and Falsehood in the moral embedding of sustainability.

The following relations convey the contrasting knowledge and 'de-knowledge' attributes of the respective kinds of ecological world-systems:

1. Knowledge-induced ecological order:

Probability $\lim_{i \cup_i \cap_j} \{\theta_{ijs}\} = \theta_s$, which we denote by θ , specific to a given system 's'. $i = 1, 2, \dots, n$ denote interactions. $j = 1, 2, \dots, m$ denote variables pertaining the interactive systems taken together. (14)

Now existence of θ as derived from the learning process IIE-strings given by relations (1)-(13) implies,

$$\cup_i \cap_j \{y_{ijs}(\theta)\} \neq \phi, \text{ for } i = 1, 2, \dots, n; j = 1, 2, \dots, m; \text{ for given } s. \quad (15)$$

For the overarching systemic ecological holism as of the general-system model, we obtain the convoluted integral:

$$\text{Convoluted } \int_s \{\cap_s \theta_s\} d\theta_1 \dots d\theta_r \quad (16)$$

= Interactively integrated total wellbeing of the entire complex of learning processes over given time-periods across overarching systems.

2. 'De-knowledge' ecological disorder:

Probability $\lim_i \cup_i \cap_j \{\theta'_{ijs}\} = \phi$ (nullity), because of methodological individualism, dissociation and independence between the variables at large for any system s . (17)

Now, θ'_{ijs} of the 'de-knowledge' model implies

$$\cup_i \cap_j \{y_{ijs}(\theta)\} = \phi, \quad (18)$$

for $i = 1, 2, \dots, n$; $j = 1, 2, \dots, m$; for given s , for the same reasons as (17).

A convoluted integral is not well-defined for the 'de-knowledge' ecological domain. Instead, each system ' s ' yields its own separate integral. The sum-total of 'de-knowledge' index of the entire ecological disorder is now given by,

$$\{\cup_s \theta_s\}, \text{ which provides a linear space of aggregation.} \quad (19)$$

Consequently, the assumptions of scarcity that marks the tenor of thinking, actions and responses in the 'de-knowledge' ecological model is contrary to the ever-increasing possibility of knowledge in the knowledge-centered ecological model. For this reason as well, it is possible to revert from entropy to sustainability in the knowledge-centered model; whereas this is not possible in the 'de-knowledge' ecological model.

The 'de-knowledge' ecological model is linear in form. The knowledge-centered ecological model has non-linear forms. See Choudhury (2000) for further details on the non-linear complexity of the knowledge-centered model formalism contrasting the linear representation of 'de-knowledge' paradigm.

The implication regarding the meaning of entropy has thus changed in the knowledge-centered model. The knowledge-induced world-system, as of ecology, is neither a finite and closed nor an infinite intertemporal universe. Consequently, the knowledge-induced projection of energy in such a universe cannot be a constant stock. As a result, it is possible for all good things of life in the knowledge-induced ecological model to gain from the ever-widening and increasing knowledge-flows simultaneously. This is the basis of the principle of pervasive complementarities and participation. The general-system socio-cybernetic model of ecology is thus of the natural form of the learning process. It is richly complex but holds up an orderly ecological worldview along with application (Maurer, 1999).

PART 3

Intertemporal ecological valuation in the moral plane

In the intertemporal case of ecological valuation using the knowledge-centered formalism of the learning process model it is necessary to have information regarding the future cash-flows, the availability of resources, the prices and markets of species, consumer preferences, production menus, ownership and distributional factors at distributed points of time. Such kinds of information can be generated only by agents and states interacting at close points with the contiguous generations. Valuation in such a case requires application of an IIE-process model to overlapping generations (Choudhury, 2011). At every such continuous point of re-evaluation of future prospects there is also the recurrent need for consciousness to appeal to the moral law. In the case of sustaining and reversing an entropy condition of the environment, the ecological model is one of unity of knowledge and the maintenance of the stock and its growth at a rate that will defeat the environmental depreciation effects.

In the opposite case of the linear form of the 'de-knowledge' model of ecological valuation of the future, the prevalent methods of discounting, present-valuation of future cash-flows, and resource availability, cannot capitalize on future information at the present time in the face of incomplete markets, information asymmetry, and failure of forecasting. It is thereby impossible to estimate at the present what amount of resources ought to be saved and what financial contributions present generation ought to make for the intertemporal wellbeing of future generations. Indeed, Phelps (1989) points out that in such an intertemporal incomplete-information case of ecological valuation the savings problem regarding the intergenerational equity question remains unsolved.

The Qur'anic epistemic worldview of unity of knowledge and the consequential knowledge-induced unified ecological world-system resolves the indeterminateness problem of intertemporal valuation caused by the linear 'de-knowledge' ecological model. The Qur'an¹⁹ declares in this regard that man shall learn from stage to stage as he is taken through the knowledge-journey. On this point Yusuf Ali (1946, p. 1711, n. 6047) comments: "Man travels and ascends stage by stage. Man's spiritual life may be compared to an ascent from one heaven to another". While it is the mention of heavens here, this is equivalent to its generalization to the course of time, systems of ecological domains, and the variables and entities embedded in the progress of such systems over knowledge, time and space dimensions.

The specific case now is that of the knowledge-induced time-valuation of the moral effects of the Qur'anic epistemic worldview. Our formalized model of learning processes in unity of knowledge and the social reconstruction of the ecological world-system formed by such learning agrees with the Qur'anic epistemic worldview. The 'de-knowledge' ecological model cannot explain such intertemporal conscious participation and learning behavior.

There are the touching words of Bruteau (1997) that bring out the active nature of mankind's relationship with the moral dimension, which active ecological valuation involves in our learning model of participation by interaction with the overlapping future points of occurrences of events. Bruteau's words are:

¹⁹ Qur'an (84:19)

"If you can see the God you love present in, even as, this world, then feel that union and rejoice in that. And be active in it, contribute to it, participate in the building, in the artwork, in the healing, in the understanding. This is where Reality is. You yourself are both a member of the Finite and a member of the Infinite...." Presencing of human beings with events and time is essential for intertemporal moral valuation.

In a similar tone and depth writes Gulen regarding the meaning of participation in the moral reconstruction of self-and-other relationship in socio-scientific holism. Ecology shares in this idea of its moral valuation by taking an active role of social reconstruction in every event and at distributed points in time. That is the recalling phenomenon of the monotheistic law that incites creation; and its creative and regulatory process must be actively invoked at all future points of the moral ecological valuation.

Gulen writes on such a moral participatory relationship in our global social reconstruction: Gulen (2006, p. 148-49) writes: "We use 'the horizon of hope' to mean traveling beyond the visible dimension of existence, and considering existence as an interrelated whole in the absence of which things and events cannot be perceived as they really are. Nor can its essence and relation with the Creator as well as the relation between them and humanity be grasped. Scientific disciplines that conduct their own discourse largely in isolation from one another and the prevailing materialistic nature of science that has compartmentalized existence and life cannot discover the reality of things, existence, or life."

PART 4

Population-ecology relationship in entropy-to-sustainability reversal

Since the knowledge-centered worldview of organic unity of knowledge and the unified world-system does not harbor the assumption of scarcity of resources, and thus of competition, conflict and marginalism, therefore, population must be thought of as a knowledge-induced human and ecological resource. The principle of complementarities between the good things of life in the knowledge-centered model of ecology would then show population and ecology to be coexisting entities. The Qur'an²⁰ points to this kind of coexistence complementing population and resources.

The general-system model of ecological coexistence with the knowledge-centered worldview that was formalized earlier can now be particularized to the case of population and ecology relations. The message in such a critical socio-economic development relationship is conveyed by the assumption of abundance contra scarcity. The result of abundance is felicity to human beings and his ecological environment, one supporting the other by plenty, wellbeing, and moral consciousness.

The model of population-ecology then takes the following form: Consider the population-ecological relationship in respect of the following aggregate production function. Double arrows denote the circular causality between the denoted variables.

The following variables are defined:²¹

²⁰ Qur'an (80:21-32)

²¹ Here we take the socio-economic development and market-polity relationships as part of the great ecological order of which the other ones are subsets Choudhury,).

Q denotes real GDP and stands for the measurement of economic growth.

Pop denotes population size.

X_a denotes agricultural output.

X_m denotes manufacturing output.

p_a denotes price level of agricultural goods.

p_m denotes price level of manufacturing goods.

Thus, p_a/p_m is the relative price of agricultural goods to manufactures.

x denotes the age structure of the population.

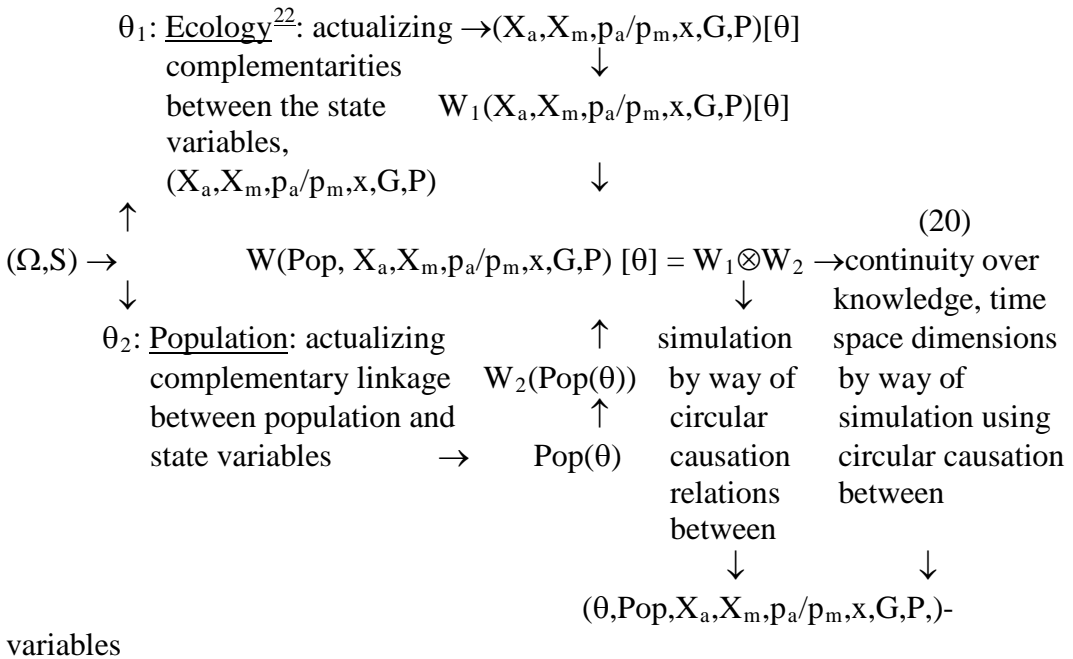
G denotes gender distribution of the population.

H denotes expenditure in human resource development.

P denotes a policy vector or instruments of participatory development financing instruments.

θ is the usual knowledge-flow variable whose ordinal values are assigned by noting the degree of complementarities between the mentioned socio-economic variables. See the empirical section for an actual assignment of θ -values in terms of proportionately distributed socio-economic variables.

The desired complementarities between population and the ecological socio-economic variables are denoted by the two-way arrows in the following circular interrelationships. Our constructed learning process general-system model is now exemplified by the following population-ecology general-system model specification. :



We rewrite one derived circular causation expression from the above string relations of population-ecology interrelationship) in the following form:

$$\text{Pop} = f_1(X_a, X_m, p_a/p_m, x, G, H, P)[\theta] \tag{21}$$

This expression means that a systemic linkage between X_a and X_m with stable relative prices p_a/p_m is expected to yield a stable population structure. How

²² Ecology is of the grand design that overarches markets and socio-economic diversity. Thus the variables although of the economic type are comprised within ecology.

does such a relationship come about? Price stability and real economic yields are expected to promote household choice on fertility. The resulting increase in the labor force would support the required agricultural-manufacturing sectoral linkage to sustain the above-mentioned relationship. The underlying microeconomics of fertility behavior (Nerlove, 1974) would eventually determine the x and G variables. The input of H variable will further influence the above relationship between population-ecology.

The principal force underlying the complementary relationship shown above is the participatory knowledge-flow variable that emerges from the household, community, market and institutional learning processes in IIE-form. The participatory development financing instruments to promote the sectoral linkages and bring about employment would influence the population-ecology complementarities by a combination of institutional and market forces. An automatic adjustment under conditions of discursive learning opening up opportunities takes effect.

Now consider another of the circular causation relation in the population-ecology relationship derived from the above string relation of unity of knowledge and the world-system (i.e. Population-Ecology complementary interrelationship):

$$Q = f_2(\text{Pop}, X_a, X_m, p_a/p_m, x, G, H, P)[\theta] \quad (22)$$

Good agricultural-manufacturing linkage will have a positive relationship to Pop. Consequently, p_a/p_m will also have a positive relation both with X_a & X_m linkage, and thereby, with Pop. x , G , H . These variables would now be endogenous variables, being related recursively to the changing economic structure of agriculture-manufacturing sectoral linkage, and the evolution of the relative prices. x would reflect the structure of young population. G would reflect a greater proportion of male population in the labor force, as women continue to sustain a stable population growth structure. The participatory policies enhance the transformation process positively in the direction of Pop and also between themselves. In all of these, the market-polity interactions generate active role of θ -values.

In the f_1 and f_2 relations with the positive relation of the various variables to Q and Pop, it is illogical that the causality between Q and Pop can be negative. We therefore conclude that structural changes caused by market-polity IIE-learning process are primarily necessary to determine the nature of causality between Q and Pop.

PART 5

A simplified model of population-growth circular causation relationship in the moral space with resource complementarities: the case of Bangladesh

Our derivation and formalization of the knowledge-induced model of pervasive complementarities as the surest sign of the episteme of unity of knowledge embedded in population-ecology interrelationship points to the ever-expanding positive relationship in this coexistence. Both population and ecology are resources that bring about wellbeing. They must therefore be sustained simultaneously. We test this hypothesis for the case of population-ecology circular causality interrelationship for Bangladesh.

Table 1: Data for Bangladesh

Year	% of RGDP X_1	% Change in Population X_2	Theta-1 θ_1	Theta -2 Population θ_2	Average Theta θ
2003	4.4				
2004	5.3	4.24	8.7	7.87	8.29
2005	4.9	0.00	9.5	1.00	5.25
2006	6.4	2.11	9.8	10.0	9.9
2007	6.6	2.09	10.0	9.8	9.9
2008	6.3	2.06	9.3	9.5	9.4
2009	4.9	1.63	8.7	9.52	9.1
2010	5.7	0.00	9.1	1.00	5.05

Source: CIA World Factbook, February 19, 2010.

θ -values are generated.

Summary Results for Bangladesh Data

Equation 1:

(23)

$$y(X_1) = 3.86 - 0.16X_2 + 0.26\theta$$

(3.08) (-0.60) (1.44)

where, $y(X_1)$ = % of RGDP, X_2 = % change of population, θ = average value of θ_1 and θ_2 .

$$R^2 = 36.66\%, \text{ SE} = 0.70,$$

X_2 has been found to be statistically insignificant at more than 10% level.

θ has been found to be statistically significant at 10% level.

Equation 2:

(24)

$$y(X_2) = 0.12 - 0.51X_1 + 0.56\theta$$

(0.03) (-0.59) (1.90)

where, $y(X_2)$ = % change of population, X_1 = % of RGDP, θ = average value of θ_1 and θ_2 .

$$R^2 = 49.60\%, \text{ SE} = 1.26$$

X_1 has been found to be statistically insignificant at more than 10% level.

θ has been found to be statistically significant at 7% level.

Equation 3:

(25)

$$y(\theta) = -0.75 + 1.29X_1 + 0.85X_2$$

(-0.15) (1.44) (1.90)

where, $y(\theta)$ = average value of θ_1 and X_1 = % of RGDP, X_2 = % change of population.

$$R^2 = 63.82\%, \text{ SE} = 1.55$$

X_1 has been found to be statistically significant at 10% level.

X_2 has been found to be statistically significant at 7% level.

The statistical results of the Circular Causation Equations 1 and 2 show that the negative relationship between percentage change in population change and percentage change in RGDP are insignificant at the 10 per cent level.

The Circular Causation Equation 3 points out that the knowledge-variable, which signifies complementarities between per cent rates of changes in population and RGDP is significantly related in the positive sense of the signs of the coefficients of the explanatory variables.

These results establish two fundamental facts of importance in the population-ecology (percentage change in RGDP) relationship for Bangladesh. Firstly, the neoclassical immiserization theory of economic growth (Bhagwati, 1968) that argues for a negative relationship between population change and the rate of economic growth is untenable, except in the weak sense, even so in the case of Bangladesh with its large population size and low level of development. Secondly, there exists the possibility of resource augmentation in the face of population growth to generate complementarities between these good things of life as the moral law would pronounce.

The Qur'an declares that the law of abundance exists permanently in the case of the knowledge-centered model of development that rejects scarcity for the choice of abundance based on the divine possibility to provide; and the learning model of pervasive complementarities (unity of knowledge and the unified world-system, namely ecology) to yield abundance²³. Such is the circular causation result of the interrelationships in the moral plane. In this regard the Qur'an further points to the blessings that ensue from intertemporal resource augmentation and ecological sustainability in the face of moral consciousness and intertemporal socio-economic valuation. In this way, entropy is reversed into sustainability.

The grand ecological wellbeing now contrasts Truth against Falsehood and continues this conflict along the learning path from the worldly experience to the Hereafter.²⁴ The saying of the Prophet Muhammad also testifies to the reverse entropy to sustainability ecological possibility: For every step man takes towards God, God comes ten steps towards the good and repenting man.

PART 6

Conclusion

A socio-cybernetic systemic approach to the study of ecology with moral embedding is new in the literature. It started with a glimmer of hope at the Rio Earth Summit (Parikh, 1992). But much remains to be accomplished in this direction for a greater understanding of the intertemporal epistemic socio-cybernetic theory of ecology with moral embedding. The traditional formalism in this area brought in by the neoclassical school of economic thought, and the Darwinian idea of constrained interaction, scarcity of resources, conflict, competition, systemic independence and individualism, do not enable the understanding and analysis of complex non-linear models that the moral and social embedding of ecology and sustainability brings about. Consequently, the wider field of valuation of human ecology cannot be done by such models. It is necessary to look elsewhere for the social reconstruction of the human ecological future.

We have ventured in this demanding area of non-linear learning process-dynamics centered in the moral dimensions. The core of this epistemic approach is found in unity of knowledge and its induction of the unified world-system. These ideas were explained and formalized substantively. The impelling inevitability for invoking the episteme of the monotheistic law in respect of studying ecology as socio-cybernetic (Birrner, 1999) in a learning process model of world-system turned us to inquire into the Qur'anic dimension of knowledge, time and space centered in the monotheistic worldview.

²³ Qur'an (17:51)

²⁴ Qur'an (25:70-77)

This resulting inquiry has been a revealing exercise in analytical formalism and empirical analysis. The consequential elements of the moral dimension of ecology-sustainability interrelationship are used to interpret the nature of unity by complementarities in the formalism and the empirical estimation that followed.

The general-system socio-cybernetic construct of ecology and population is shown in both the general case and the particular case of Bangladesh in Figure 1.

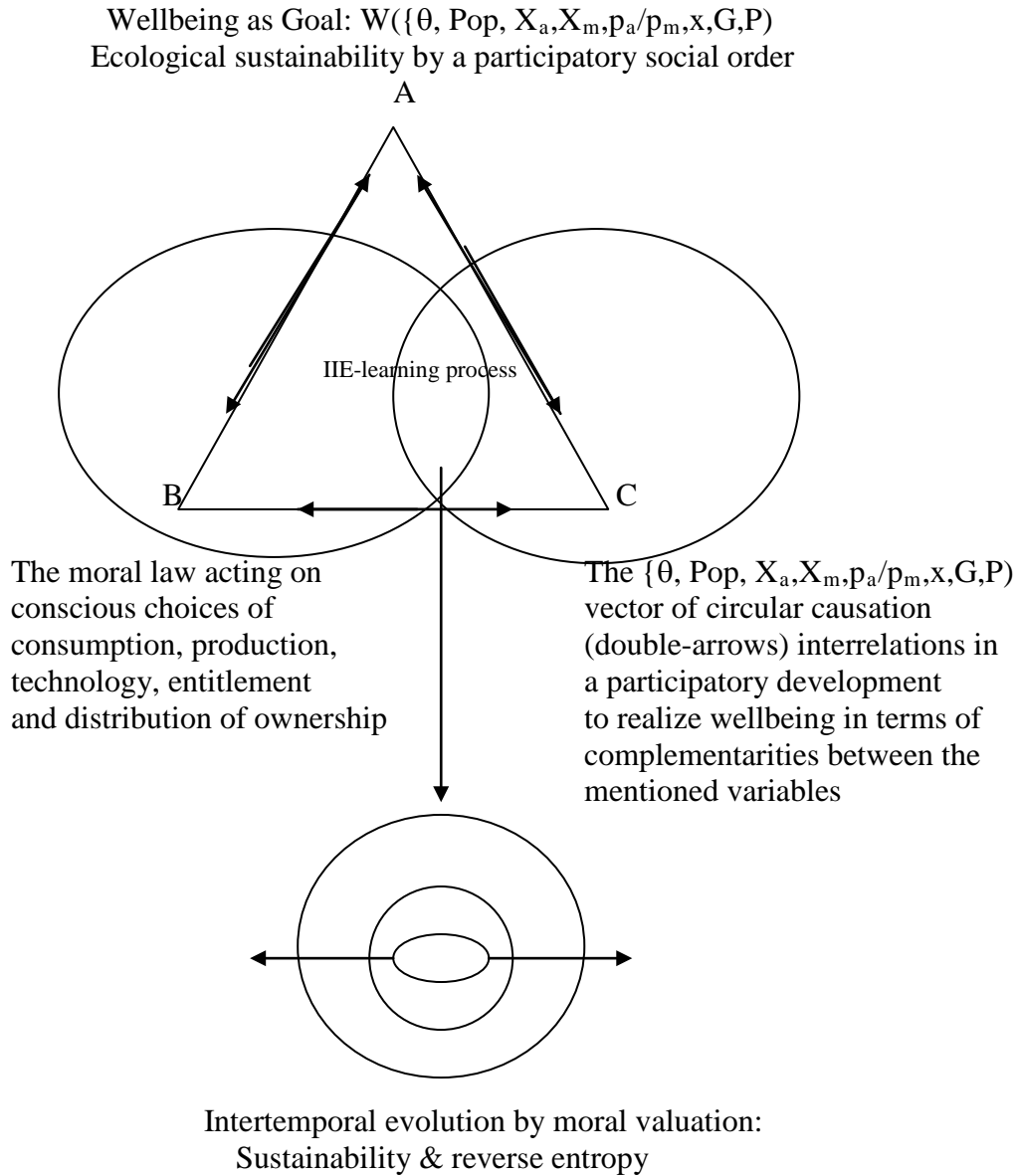


Figure 1: Illustrating the general-system socio-cybernetic construct of ecology and population

References

- Ali, A. Y. (1946). *The Holy Qur'an, Text, Translation and Commentary*, p. 1711, n. 6047), New York, NY: McGreggor & Co.
- Bertuglia, C.S. & Vaio, F. (2005). "Dynamical systems and the phase space", in *Nonlinearity, Chaos & Complexity, the Dynamics of Natural and Social Systems*, Oxford, UK: Oxford University Press, pp. 49-70.
- Bhagwati, J. (1958). "Immiserizing growth: a geometrical note", *Review of Economic Studies* reprinted in American Economic Association, *Readings in International Economics*, Homewood ILL: Irwin, 1968, Chap. 17.
- Birrer, F.A.J. (1999). "Sustainability. Democracy, and sociocybernetics", *Kybernetes: The International Journal of Systems and Cybernetics*, Vol. 26, No. 6, pp. 810-21.
- Blauert, J. & Zadek, S. (1998). "The art of mediation: growing policy from the grassroots", in Blauert, J. & Zadek, S. eds. *Mediating Sustainability, Growing Policy from the Grassroots*, West Hartford, CONN: Kumarian Press, pp. 1-18, esp. p. 7.
- Bruteau, B. (1997). *God's Ecstasy*, p. 179, New York, N.Y: The Crossroad Publishing Co.
- Carlyle, T. (undated). "The hero as prophet, Mahomet: Islam", in his *On Heroes, Hero-Worship, the Heroic in History*, New York, NY: Thomas Y. Crowell.
- Cayley, D. (1991). "A managed planet", in his *The Age of Ecology*, Toronto, Ont: James Lorimer & Co. Publishers, Chap. 7.
- Choudhury, M.A. (2000). *The Islamic Worldview, Socio-Scientific Perspectives*, Kegan Paul International, London, Eng.
- Choudhury, M.A. (2006). *Science and Epistemology in the Qur'an* (five vols. with generic titles), Lewiston, New York: The Edwin Mellen Press.
- Choudhury, M.A. (2008). "Global ethics in the light of Islamic political economy", *International Journal of Arab Culture, Management and Sustainable Development*, 1:1, pp. 65-81.
- Choudhury, M.A. (2009). "Which of the two? – knowledge or time", *Philosophical Papers and Review*, May.
- Choudhury, M.A. (2011). *Islamic Economics and Finance: An Epistemological Inquiry*, in the series *Contributions to Economic Analysis*, Vol. 291, West Yorkshire, UK: Emerald Publishers.
- Choudhury, M.A. & Wahid, A.N.M. (1996). "Social frictions, social dynamics, and economic development: some experiences of Bangladesh", in Wahid, A.N.M. & Weis, C.E. eds. *The Economy of Bangladesh*, Westport, CONN: Praeger, pp. 17-32.
- Choudhury, M.A. Shahadat Hossain & Mohammad Mohiuddin, (1998). "Violent Effects of Deforestation and Watershed Management on Wave and Ocean Current Cybernetical Relationships: An Empirical Study with Respect to Bangladesh Ecology", *Kybernetes: International Journal of Systems and Cybernetics*, Vol. 27, No.5, 1998..

Choudhury, M.A. & Korvin, G. (2001). "Knowledge-induced socio-scientific systems", is appearing in the *International Journal of Sustainability in Higher Education*, Vol. 3, No.1.

Daly, H.E. (1992). "From empty-world to full-world economics: recognizing an historical turning point in economic development", in R. Goodland, H.E. Daly, S. el-Serafy & B. von Droste Eds. *Environmentally Sustainable Economic Development: Building on Brundtland*, pp. 29-40, Paris, France: UNESCO.

Gulen, M.F. (2006). *Toward Global Civilization of Love & Tolerance*, Somerset, New Jersey: The Light, Inc.

Heilbroner, R.L. (1991). *An Inquiry into the Human Prospect*, New York, NY: W.W. Norton.

Inglott, P.S. (1990). "The rights of future generations: some socio-philosophical considerations", in S. Busuttill, E. Agius, P.S. Inglott & T. Macelli Eds. *Our Responsibilities Towards Future Generations*, pp. 17-27, Malta: Foundation for International Studies & UNESCO.

Krugman, P. (1996). *The Self-Organizing Economy*, Cambridge, MA; Basil Blackwell.

Lucaks, J. (1968). *Historical Consciousness*. New York, NY: Harper & Row Publishers.

Maddox, I.J. 1970. *Elements of Functional Analysis*, Cambridge, Eng: Cambridge University Press.

Maurer, B.A. (1999). "From micro to macro and back again". In his *Untangling Ecological Complexity, the macroscopic perspective*, pp. 21-47, Chicago ILL: The University of Chicago Press

Maxwell, G. (1962). "The ontological status of theoretical entities", in H. Feigl & G. Maxwell, Eds. *Minnesota Studies in the Philosophy of Science, Vol. II: Scientific Explanation, Space and Time*, pp. 3-27, Minneapolis, Minnesota: University of Minnesota Press.

Myrdal, G. (1968). "The wider field of valuations", in *Asian Drama, an Inquiry into the Poverty of Nations, Vol. 1*, pp. 49-127, New York: Pentheon, 1968.

Nerlove, M. (1974). "Household economy: towards a new theory of population and economic growth", *Journal of Political Economy*, April.

Parikh, J.K. Oct. (1992). "Restructuring consumption patterns for sustainability", *Network*, No. 20.

Phelps, E.S. (1989). "Distributive justice", in Eatwell, J. Milgate, M. & Newman, P. eds. *The New Palgrave Social Economics*, New York, NY: W.W. Norton, pp. 31-34.

Primavesi, A. (2000). *Sacred Gaia*, London, Eng: Routledge.

Thurow, L. (1996). "A period of punctuated equilibrium", in his *The Future of Capitalism*, London, Eng: Nicholas Brealey Publishers, Chap. 14.