A REVIEW ON SUSTAINABILITY AS AN OPTIMIZATION PROBLEM

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Abstract

We show that the present policy of sustainability is a solution of an optimization problem. Then we criticize the present concept of optimization by showing that it is not comprehensive enough to cover the spiritual dimension of man needed to handle sustainability and it also inherits values from capitalism and related philosophies which are known to be incompatible with sustainability. Accordingly, the concept of optimization is replaced by a new definition of the best policy based on an Islamic value, which we call *wusta.* We then propose a new concept of sustainability which we hope to formulate its corresponding multiobjective *wustaization* planning model in the near future.

Keywords: Optimization, wustaiziation, sustainability, Islamisation of sustainability, critique of optimization

Introduction

There are many definitions of sustainability since its immergence in 1970s (University of Reading Enviromental Challenge in Farm Management (ECIFM), n.d.; Kates *et al.,* 2005) and hence there are many conflicting sets of sustainability indices or indicators (Bell & Morse, 2008; Hak *et al.,* 2007; Parris & Kates, 2003). Each of these definitions and sets of indices/indicators have achieved some "satisfactory" results but unfortunately has also even more shortcomings. However, it is believed that the most common definition of sustainability on development is by Brundtland Commision (1987) that defines it as "*a development that meets the needs of the present without compromising*

the needs of future generations to meet their own needs" (Sustainability Development, 2010). We show in the next section that this definition is actually an optimization problem. This definition has been criticized by many to even conclude that economics for development is not sustainable. This particular definition was reviewed more recently by Bartelmus (2008) in which he proposes another definition of a sustainability which we will show is just another similar optimization problem. It is even more interesting when Bartelmus suggests that sustainability could be achieved through development (considering ecological economists do not agree as he discusses it at length), but he does not provide an answer for the nature of the optimal growth (such as perhaps an accelerated growth followed by a zero growth) needed for sustainability. In fact, he does not even formulate a multiobjective optimization planning based on his very own definition of sustainable development. This is another issue which we shall discuss in this paper, namely the relationship between Bartelmus' conjecture on sustainable development and the need for an optimal growth based consideration on sustainability.

Further, we criticize the present concept of optimization as naively understood and such concept is available in standard textbooks on optimization or programming. How can one assume such a definition is really fit for the word "optimal", as it was originally intended to carry the burden inherited by the expression "the best"? This third issue to be discussed in this paper will lead to our new concept of doing something in the best possible way to replace the concept of optimality. Finally, we propose a new definition of sustainability based on our new concept of the "the best possible situation" and our new comprehensive nature of economic development or planning in general where the aim is no longer for wealth, prosperity and the like.

A Critique on an Optimal Planning for Sustainability

It looks as though most agree that a sustainable decision is an optimal decision in which when it is implemented, the relevant product is sustainable with respect to the definition of sustainability. It can be noted that, so far only Jaeger (1995) questions this tacit agreement. Indeed, many specific optimization models (with respect to the present definition of optimality and sustainability) have been "successfully formulated" in ecological, agricultural, and business domains as shown by Smorch

(2010), Geunes and Pardalos (2005) and Zhou et al. (2000) in supply chain; Klemes et al. (2010) in industrial processing; and Heinzle et al. (2007) in bioprocesses. Moreover, surprisingly recently, it has been hailed (Kelvin's Conjecture, n.d.) that the architectural design for the National Aquatic Center (for 2008 Olympic) at Beijing as a sustainable architectural design ("effective, perfect, or useful as possible"). In economics, as mentioned earlier, the most interesting issue so far is sustainable development.

Mathematically, one has to develop a visionary economic planning (not necessary development) model first before obtaining a policy of implementation for achieving sustainability (a sustainable planning policy). The relationship between optimization and sustainability has been studied since 1928 when Ramsay first introduced a development model based on utility optimization. This produced an optimal consumption but proved to be not sustainable. Thus, the model has undergone various changes. Farzin (2010) reviews this type of optimization model for achieving sustainability starting from the Ramsay model to Sollow-Hartwick model in 1970's and others mentioned in his article, and ends with his own model developed in 2006. Of course, Farzin proves that his model produces sustainable economic policy although he has pointed out that the policy is not only impractical but also more suitable for rich countries. Then he suggests a combination of the optimal solution and his rationalization beyond the scope of his optimization. This remains just a theoretical interest. One of the intrinsic weaknesses of these approaches in optimization is due to the well-known weakness in the utility approach of the multiobjective optimization. Hence, we are not interested in this approach in preference to the actual multiobjective optimization which is more appropriate to the definition of the sustainability that we are interested in. Other approaches are found extensively in Islam (2001) and Bartelmus (2008). Of course a formal multiobjective optimization problem in an economic development or planning is yet to be formulated in a sufficiently enough general form so as to represent a standard economic development or planning. These issues in relation to sustainability are comprehensively discussed by Bartelmus (2008). We have therefore decided to concentrate on Bartelmus' (2008) model of a development and sustainability program.

After a review on the state of the art of sustainable development, Bartelmus (2008, p. 52) defines what he terms as operational definition

of sustainable development as "*the set of development programs that meets the targets of human needs satisfaction without violating long-term natural resources capacities and standards of environmental quality and social equity*". This is in fact less general than the Brundtland Commision definition of sustainability stated earlier in our introduction. Bartelmus definition is less general because he makes explicit statements in two aspects: the goals rather than objectives, and the details of "the needs of the future generations" in terms of specific physical resources (natural and environmental) and equity. However, clearly both definitions are development plannings which involve multiobjective and multigoal optimization problems, i.e. a multiobjective optimization problem for Bruntland sustainability development and a multigoal optimization for the Bartelmus sustainability development respectively. The objective functions are the needs of the present and the goals are the targets of "human needs satisfaction". The goals which are interested by many are the eight goals of the UN Millennium Development Goals (MDG) which includes goals for an eradication of poverty and hunger, eradication of diseases (in particular AID and malaria), and still a valid and subjective goal, namely, environmental sustainability (complete lists are in Bartelmus 2008). Those goals are subjected to the Bartelmus constraints: "without violating long-term natural resources capacities and standards of environmental quality and social equity"; whereas those objectives are subjected to the Brundtland Commision constraints, that is, "without compromising…" These constraints are more general than the earlier mentioned ones; and both constraints could be represented by sets of differential equations. It is interesting to note that Bartelmus (2008) does not formulate explicitly his sustainability programme in terms of multigoal or multiobjective optimization.

Later, with our new concept of the best possible way (replacing optimalty concept) and therefore on sustainability, both are extended to religious domain. Hence, we hope to formulate a new model of producing the best possible control model which we argue to be better than the present optimal control model.

A Critique on Optimization: A New Concept of Seeking the Best

In this section we discuss reasons for a new concept of seeking the best in connection with sustainability. We have argued (Shaharir, 2003; 2006) that the present concept of optimization is based on greed and extremism

or moulded in those values from democratic (neo)-liberalism, capitalism, socialism, secularism and elitism. Thus, in the present method of seeking the best decision, it is assumed that such a decision must necessarily be an optimal decision which attains a superlative level of measure of performance: the most, the highest, the biggest, etc.; or the least, the lowest, or the smallest value of a function such as productions, profit, loss, risk, needs etc. This is certainly extremism, a kind of value which is very much in tandem with capitalism and liberalism. Mathematics itself shows that this classical definition is untenable (no decision exists) in the case of a multiobjective optimization planning. In an attempt to rectify this definition, it is thought that in practice no one has really made such a decision because of urgency so much so that a decision is made based on a restricted knowledge. In such a case, the result is that the optimal decision is not as extreme as the original intended optimal decision. However, it is still a kind of extreme with respect to a particular situation. This is Simon (1957) optimal decision based on his "*Models of Man*" in which he characterised man as no longer a rational being but a bounded rational being. The concept is mathematically implemented under the name of "goal optimization" or "goal programming" by Charnes and Cooper (1961). This is the first conceptual shift in the optimization from purely rational capitalistic based to a bounded-rational capitalistic based. Despite its shortcomings (as shown by the introduction of many other definitions of optimum elaborated further later), the Simon optimal-decision is still popular especially in making a decision for a multiobjective planning, criteria, attributes, performances, or other measures known in decision science. In fact, the Bartelmus (2008) definition of sustainability is explicitly suited for an economic development based on a goal programming problem.

There is another optimum measure which is more popular among economists is one introduced by Pareto, an Italian economist-politician during the Nazism and Fascism turmoil in Europe. He believes in laissez-faire economics, liberalism and elitism against Fascism and dictatorship in Italy during Mussolini's popularism. He proposed a new concept in social fairness and optimal distribution of wealth in which his new concept of optimal decision is known by his name, Pareto optimum/ decision/ policy/ instrument/distribution, but also under very strong and assertive terms such as efficient decision, non-inferior decision, and non-dominated decision etc. In this new optimization concept, a set of performance measures or objectives is said to achieve its optimum if one

of the measures or objectives achieves its extremal value and the rest attain no less inferior values than their values by any other decisions. There are, of course, many other concepts in optimizations other than these three types of optima: the classical, Simon and Pareto optima (Ehrgott & Ganibleaux, 2002; Figueira et al., 2004; Marler, 2009; or Sunar & Kahraman, 2001; Freitas, 2004; and Marler & Arora, 2004). However, these three concepts mentioned earlier are most well-known, and most widely used not only by theoreticians but also by practitioners in various fields.

We show that none of these three concepts of optimization can give a right decision for sustainability (as defined earlier in this paper). Perhaps, this could be seen easily by focusing on the nature of a Pareto decision. A Pareto decision is clearly not people-oriented but elitistic, because the decision maker would be happy to even entertain only on the need of one of the many objectives or performance measures (which implies one individual, an elite group or an economic sector) involved. The decision of this nature is obviously not in line with sustainability. Further, since each of these three concepts of optimization involves capitalism (in fact, extremism, liberalism and elitism can only flourish in a capitalistic society) then we can use those arguments which show that capitalism is in contradiction with sustainability. For this we agree with Singer (2010) who argues that capitalism is a barrier to sustainability, and earlier Porrite (2006) who believes that a new form of capitalism (even though he is believed to be a staunchest supporter of capitalism) has to be established for sustainability.

Other consideration is to note that the three concepts of optimization neglect the spiritual dimension of a human being whereas sustainability must necessarily involve spiritual values or to be more precise, religious values, of which the one that we are most interested in is Islamic values. There are plenty of precepts of Islamic teachings (based on *al-Qur'aan*) which are against **extremism** (for examples the terms *musrifiin/*wasters, *Suraht*/Chapter *al-Araf* 7: *ayaht*/verse 31 (later we write *Suraht al-Araf* (7): 31, or simply 7:31);

يَا بَنِي آدَمَ خُذُواْ زِينَتَكُمْ عِندَ كُلِّ مَسْجِدٍ وكُلُواْ وَاشْرَبُواْ وَلاَ تُسْرِفُواْ إِنَّهُ لاَ يُحِبُّ الْمُسْرِفِينَ
[O Children of Adam! Wear your beautiful apparel at every time and place of prayer: eat and drink: But waste not by excess, for Allah loveth not the wasters. Transl. Yusuf Ali, Suraht al-Araf (7): 31]

Mu'tadyyn/transgressors, 2:190;

<div dir="rtl">وَقَاتِلُواْ فِي سَبِيلِ اللّهِ الَّذِينَ يُقَاتِلُونَكُمْ وَلاَ تَعْتَدُواْ إِنَّ اللّهَ لاَ يُحِبِّ الْمُعْتَدِينَ</div>

[Fight in the cause of Allah those who fight you, but do not transgress limits; for Allah loveth not transgressors. Transl. Yusuf Ali, Suraht al-Baqaraht (2): 190]

and *mubazziryyn/*spendthrifts, 17:27;

<div dir="rtl">إِنَّ الْمُبَذِّرِينَ كَانُواْ إِخْوَانَ الشَّيَاطِينِ وَكَانَ الشَّيْطَانُ لِرَبِّهِ كَفُورًا</div>

[Verily spendthrifts are brothers of the Evil Ones; and the Evil One is to his Lord (himself) ungrateful. Transl. Yusuf Ali, Suraht al-Isra' (17): 27]

Each of them practices a form of extremism and the God abhors each of them. Islam is also against **materialism,** examples in the expressions *yuriydu thawab al-duniya*/desires a reward in this life, 4: 134;

<div dir="rtl">مَّن كَانَ يُرِيدُ ثَوَابَ الدُّنْيَا فَعِندَ اللّهِ ثَوَابُ الدُّنْيَا وَالآخِرَةِ وَكَانَ اللّهُ سَمِيعًا بَصِيرًا</div>

[If any one desires a reward in this life, in Allah's (gift) is the reward (both) of this life and of the hereafter: for Allah is He that heareth and seeth (all things). Transl. Yusuf Ali, Suraht al-Nisa' (4): 134]

and *radhuwa bil hayat al-duniya*/pleased and satisfied with the life of the present, 10:7-8);

<div dir="rtl">إِنَّ الَّذِينَ لاَ يَرْجُونَ لِقَاءنَا وَرَضُواْ بِالْحَياةِ الدُّنْيَا وَاطْمَأَنُّواْ بِهَا وَالَّذِينَ هُمْ عَنْ آيَاتِنَا غَافِلُونَ أُوْلَئِكَ مَأْوَاهُمُ النُّارُ بِمَا كَانُواْ يَكْسِبُونَ.</div>

[Those who rest not their hope on their meeting with Us, but are pleased and satisfied with the life of the present, and those who heed not Our Signs. Their abode is the Fire, because of the (evil) they earned. Transl. Yusuf ali, Suraht/Chapter Yunus/Jonah (10): 7-8];

greed (for examples in the expressions *laya'kuluwna amwal al-nas… yaknizuwna al-zahdaba*/who in Falsehood devour the substance of men… those who bury gold and silver 9: 34;

<div dir="rtl">يَا أَيُّهَا الَّذِينَ آمَنُواْ إِنَّ كَثِيرًا مِّنَ الأَحْبَارِ وَالرُّهْبَانِ لَيَأْكُلُونَ أَمْوَالَ النَّاسِ بِالْبَاطِلِ وَيَصُدُّونَ عَن سَبِيلِ اللّهِ وَالَّذِينَ يَكْنِزُونَ الذَّهَبَ وَالْفِضَّةَ وَلاَ يُنفِقُونَهَا فِي سَبِيلِ اللّهِ فَبَشِّرْهُم بِعَذَابٍ أَلِيمٍ</div>

[O ye who believe! there are indeed many among the priests and anchorites, who in Falsehood devour the substance of men and hinder (them) from the way of Allah. And there are those who bury gold and silver and spend it not in the way of Allah, announce unto them a most grievous penalty. Transl. Yusuf Ali, Suraht al-Tawba (9): 9];

and *jama'a maa laww 'addadah/* who pileth up wealth and layeth it by, 104: 1-4),

وَيْلٌ لِّكُلِّ هُمَزَةٍ لُّمَزَةٍ الَّذِي جَمَعَ مَالًا وَعَدَّدَهُ يَحْسَبُ أَنَّ مَالَهُ أَخْلَدَهُ كَلَّا لَيُنبَذَنَّ فِي الْحُطَمَةِ

[Woe to every (kind of) scandal-monger and-backbiter, Who pileth up wealth and layeth it by, Thinking that his wealth would make him last for ever! By no means! He will be sure to be thrown into That which Breaks to Pieces. Transl. Yusuf Ali, Suraht al-Humazaht (104): 1-4].

Islam also against **individualism** (for examples in the terms *al-insaanu qatura/*niggard man, 17: 100);

قُل لَّوْ أَنتُمْ تَمْلِكُونَ خَزَآئِنَ رَحْمَةِ رَبِّي إِذًا لَّأَمْسَكْتُمْ خَشْيَةَ الإِنفَاقِ وَكَانَ الإنسَانُ قَتُورًا

[Say: "If ye had control of the Treasures of the Mercy of my Lord, behold, ye would keep them back, for fear of spending them: for man is (every) niggardly!" Trans. Yusuf Ali, Suraht al-Isra' (17): 100];

And *yabkhaluuwn/*those who covetously withhold, 3: 180, and *bakhil/*greedy miser, 92: 8-10 etc.

وَلاَ يَحْسَبَنَّ الَّذِينَ يَبْخَلُونَ بِمَا آتَاهُمُ اللّهُ مِن فَضْلِهِ هُوَ خَيْرًا لَّهُمْ بَلْ هُوَ شَرٌّ لَّهُمْ سَيُطَوَّقُونَ مَا بَخِلُواْ بِهِ يَوْمَ الْقِيَامَةِ وَلِلّهِ مِيرَاثُ السَّمَاوَاتِوَالأَرْضِ وَاللّهُ بِمَا تَعْمَلُونَ خَبِيرٌ

[And let not those who covetously withhold of the gifts which Allah Hath given them of His Grace, think that it is good for them: Nay, it will be the worse for them: soon shall the things which they covetously withheld be tied to their necks Like a twisted collar, on the Day of Judgment. To Allah belongs the heritage of the heavens and the earth; and Allah is well-acquainted with all that ye do. [Trans. Yusuf Ali, Suraht Ali 'Imraan (3): 100];

وَأَمَّا مَن بَخِلَ وَاسْتَغْنَى وَكَذَّبَ بِالْحُسْنَى فَسَنُيَسِّرُهُ لِلْعُسْرَى

[But he who is a greedy miser and thinks himself self-sufficient, And gives the lie to the best, - We will indeed make smooth for him the path to Misery. Transl. Yusuf Ali, Suraht al-Layl (92): 8-10]

Since each of these values is related to the three concepts of optimality described above, then it is only proper, at least, to make some amendments to those three classical or established optimal concepts in order to achieve a better decision making for sustainability. A critical evaluation on the economic liberalism based on Islamic perspectives as presented by Choudhury (2008) naturally motivates us towards a revision on the present concept of optimisation. Even without the Islamic-value consideration, one would arrive at a similar conclusion. Cairns (2002) for example, has already discussed the need for modern man to embrace "sacred values" (which is obviously just another name for a spiritual or religious values) to achieve sustainability; whereas Mabogunje (2004) argues that sustainability needs change of "current human values" (which is clearly to a more spiritual or sacred nature than the present); and to compliment for all these needs it is interesting to note Waytz (2010) who makes an exposition on reasons behind the positive aspect of embracing sacred values something which are not exchangeable with monetary values. Thus, sacred values are very much needed for fighting against materialism which is a barrier for sustainability. This is also in line with the change in the objectives of an economic theory based on materialism (economics for wealth, physical development), secular-liberalism (economics for justice or prosperity with minimal government intervention and indifferent to religion) or socialism (welfare economics, economics for well being with a heavy and wide government in intervention) into the happiness paradigm (very religiously value-laden) which we have shown its development recently (Shaharir, 2008).

As far as the Islamic-values are concerned, in so far as the values which are related to the optimal decision making, we have proposed a new concept of the best situation based on the Islamic concept of moderation, just and balance, namely, *wusṭa* (the term is in the *quranic* expression, *ummatan wasaṭdan/*the people who practice *wusta,* 2: 143) where,

وَكَذَٰلِكَ جَعَلْنَاكُمْ أُمَّةً وَسَطًا لِّتَكُونُواْ شُهَدَاء عَلَى النَّاسِ وَيَكُونَ الرَّسُولُ عَلَيْكُمْ شَهِيدًا

[Thus, have We made of you an **Ummat justly balanced** , that ye might be witnesses over the nations, and the Messenger a witness over yourselves;… Transl. Yusuf Ali, *Surah al-Baqaraht* (2): part of *ayaht* 143; the bold is mine to emphasise his translation of the أُمَّةً وَسَطًا *ummatan wasatdan,* but a better translation would be the people who practice *wustdo*]

This concept of *wasatdan* (translated by Yusuf Ali above as "justly balanced") which we prefer to retain in its root word, *wustdo* (or *wusţa,* with a dot below t) where we anglicise it as *wusta* can be used in improving the Simon-optimal decision making but more meaningful is in the innovation of the Pareto optimal decision making. This involves a new definition of a *wusta* decision as follows:

- A *wusţa* policy is such that at least half of the performance measures achieve their classical optimal values and the rest attain no less values than by any other policies.
- A *wusţa* goal policy is such that each ordered performance measures achieve its classical optimal value one after the other according to the given priority.

We have shown (Shaharir, 2006) that these new optimal policy in general are different from the classical optimal solution, the Pareto optimal solution, and in some way improves the Simon optimal solution. We believe that these policies are better than those classical policies obtained from the present optimization concept and hence potentially produce more sustainable economic results.

A New Definition of Sustainability

The conceptual change in the optimization (which is religiously value laden) simultaneously creates a need for a change in the definition of a sustainability so that it includes not just the non-spiritual or non-sacral nature of biological, chemical, physical sustainabilities and the sustainabilities of the interactions of the secular man and nature but also include among all creations (in religious sense, particularly Islam) and the Creator (the God, particularly Allah) so that the spiritual dimension of the sustainability is indispensable. We call this a generalised definition of the sustainability and we define it as follows:

> *Keterlestarian ialah keadaan teracapainya keperluan jasmani, sosial, politik, ekonomi, **ilmu-pengetahuan,** dan **rohani-agama** sekarang pada aras **wustdo** tanpa pengorbanan sumber berkenaan dan **sarwa makhluk** supaya generasi kelak boleh menikmati kebahagian hidup dunia dan akhirat sekurang-kurang sebaik generasi kini*. (In Malay)

> [Trans: Sustainability is a state of being achieving a *wusṭa* (moderate, balanced and just) level of the physical, social, political, economic, **science-knowledge** and **religio-spiritual** need of the present man without sacrificing the all **relevant resources** and **all beings created by Allah** so that future generation will be able to enjoy at least the same level of happiness in this world and hereafter as the present generation]

The salient new features in this definition are the replacement of optimal level by a *wusṭa* level of consumptions (human needs), an explicit additional human need, "the spiritual need", emphasising the human need satisfaction as the "happiness", and long term or future generation is replaced by "this world and here-after". Thus, sustainability is no longer an optimization problem but rather a *wustaisation* problem where we no longer have to optimize but rather to *wustaise* objectives or goals in life.

Conclusion

Based on spiritual dimension of man (Islamic values) we have shown that the present optimization concept is unacceptable and accordingly we introduce a new kind of best policy which we would term it as *wusta* policy. Hence, a new definition of sustainability based on this new policy is Islamically value laden. This, we believe, is a better instrument for sustainability.

We hope to be able to mathematically formalise our new definition of sustainability given in section 3 above in our forthcoming paper, as a multiobjective wustaization problem and hence obtain at least a qualitative nature of the sustainable policies based on our new way of seeking the best, the *wustaization* method. We also hope that a generalised set of sustainability indices could be produced based on our new sustainability concept. Of course, the implications of these new findings would be studied as well as compared with the present theories and applications.

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