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CLIMATE CHANGE FROM A POST-NORMAL SCIENCE PERSPECTIVE *

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ABSTRACT

This paper is an attempt to discuss the dominant problem formulation of climate change from the perspective of Post-Normal Science. The paper critically examines main characteristics of the dominant problem formulation of climate change based on climate change science and then sketches out the paradigm of Post-Normal Science. The paper demonstrates that the dominant problem formulation of climate change is not in line with the main propositions of Post Normal Science.

Key Words*: Climate Change, Climate Change Science, Climate Politics, Post-Normal Science*

1. Introduction

Anthropogenic climate change is a serious global problem faced by contemporary society since it entertains a great risk for the future of the planet earth and its inhabitants (loss of biodiversity, spread of diseases, famine, drought and loss of small island states etc.) as to the dominant problem formulation developed by the mainstream climate change science presented by the Intergovernmental Panel on Climate Change (IPCC) which was designed as a science-policy interface organization. However, climate change has become a controversial policy issue related to science due to irremediable uncertainties in climate change science and the interplay of economic and political interests in the international arena. This situation has led to a discussion of the relationship between politics and science because they have been traditionally considered to be two separate areas. Traditionally, it is assumed that science represents "objective truth", while politics is viewed as a struggle among different values and interests.

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The purpose of this paper is to approach the interplay of science and politics in the context of climate change issue from the point view of Post-Normal Science.

The literature concerning both climate change and Post-Normal Science is vast. Relying on the literature this paper firstly deals with the main characteristics of dominant problem formulation of climate change based on science and then the controversial points in the formulation. A brief introduction of the insight of Post-Normal Science is followed by a discussion whether the dominant problem formulation of climate change advocated by mainstream climate change science meets the criteria set for the Post-Normal Scientific activities. It is expected that the concepts from Post-Normal Science can help to develop a better understanding of science-politics relationship concerning the climate change issue. It is also assumed that the paradigm of Post-Normal Science has a potential for the legitimating of climate change science/policy by increasing the level of democracy (or participation) in the process of problem formulation.

2. Dominant Problem Formulation of Climate Change Based on Science

Climate scientists as a scientific community introduced global climate change to national and international agenda as a real and important problem relying on the greenhouse theory. To the proponents of global warming, the theory of greenhouse effect is a solidly proven scientific theory (Wolfson and Schneider, 2002: 46). Thus, the IPCC almost confidently declared that the global mean surface temperature of the Earth increased by 0.6 °C over the twentieth century. Moreover, the vast majority of climate scientists believe that further increases in the atmospheric concentrations of greenhouse gases will lead to significant climate change. It is estimated that global mean surface temperatures will raise by 1.5 °C to 5.8 °C, to a great extent, as a result of human activities (Mariarty and Kennedy, 2004: 725). Global warming is dangerous because it will bring about numerous disasters. If the greenhouse gas emissions are not reduced, a variety of serious climate impacts are projected such as increased hunger, water scarcity, droughts, loss of biodiversity, sea level rise, and spread of diseases. As a matter of fact, the first effects of anthropogenic climate change are already being perceived. Losing species, receding glaciers, and changing weather systems are to name a few. Scientific community has been producing alarming predictions about future changes and their impacts concerning climate change. Most of these scenarios are objected by only a tiny group of scientists. Therefore, it is an urgent matter which has to

be responded immediately (Hare, 2005: 88-90). To grapple with such a great risk, it is necessary primarily to implement the Kyoto Protocol which is based on the control of reduction of carbon dioxide emissions. The Protocol hence requires massive cuts in the use of fossil fuels all over the world.

It is generally held that science or scientific community has played a great role in the formulation of climate change policy and legitimating the Kyoto Protocol which reflects this dominant problem formulation (Edwards, 1999: 438). To Gurule (2003), as an epistemic community climate change science community has clear set of beliefs. For instance, the climate change science community is confident that the best means of understanding climate change is General Circulation Models (GCMs). Therefore, computer models are conceivably the single most important tool of global climate change. Furthermore, it is asserted that there is a strong international consensus on the basic science behind global climate change and the future climate predictions produced by the computer models (Wolfson and Schneider, 2002: 42).

The dominant problem formulation of climate change as depicted here is also backed by the IPCC which was formed in 1988 to make assessment relevant to climate change. The IPCC is hybrid scientific/political organization. The IPCC published several assessment reports about climate change in 1990, 1995, 2001, and 2007. The much quoted sentence "*the balance of evidence suggests that there is a discernible human influence on global climate"* in the IPCC (1995: 22) SAR (the Second Assessment Report) was interpreted by the proponents of global warming as "historic scientific consensus" on climate change (Rashidi and Harper, 2000: 7). The IPCC (2001: 5) TAR (the Third Assessment Report) further reinforced the idea stating that *"There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities"*. AR4 (the Fourth Assessment Report) is more confident than ever that global warming was caused by human beings (90% probability of occurance): **"***Most of the observed increase in globally averaged temperatures since the mid-20th century is* ***very likely*** *due to the observed increase in anthropogenic greenhouse gas concentrations"* (IPCC, 2007: 8). It can be said that the most influential conclusion drawn from the IPCC reports is that human beings are responsible for global warming. To put simply, human beings have altered climate by using fossil fuels (Bogen, 2004).

In brief, the dominant problem formulation of climate change developed by the climate change science community suggests that human induced climate change is real and very serious problem since it will lead to a global catastrophe. Hence, it is necessary primarily to reduce the use of fossil fuels (or to implement the Kyoto Protocol) as a first step to save the world

because there is no scientific dispute over the basic science of greenhouse warming which suggests that an increase in the concentration of greenhouse gases will raise the average surface temperatures (Moriarty and Kennedy, 2004: 724).

3. Controversial Issues in the Dominant Problem Formulation of Climate Change

Despite the consensus build around the IPCC, global climate change constitutes a controversial science based policy area (Edwards, 1999: 438). There are many points in the dominant problem formulation of climate change that give rise to objection such as exaggerations in the problem formation, absence of clear boundaries between climate science and policy, lack of adequate proof for human induced global warming etc. Broadly speaking, the climate controversy can be considered as a result of irreducible uncertainties in climate change science and conflicting interests in the climate change policy.

There are many ways possible to formulate the climate change problem. First of all, climate change is not a single simple problem which can be solved by merely decarbonization. On the contrary, climate change is a "wicked" problem which has no clear definition and thereby a clear-cut solution, because climate is a complex non-linear system (Kellow, 2005: 50). It is generally held that climate is an inherently chaotic system. Therefore, it is not correct to expect that climate science could provide precise answers as the dominant problem formulation implies. Accordingly, it should be admitted that the complete understanding of the entire climate system is difficult to achieve (Luccarini, 2002: 414).

Regarding the complexity of climate system, the scientific base of the dominant problem formulation is arguable because in such systems there cannot be singular and deterministic answers but many probabilistic ones. At the moment we are not able to understand completely the operation of the entire climate system which is composed of many interacting subcomponents. For example, separation of anthropogenic "signal" of climate change from the noise of natural fluctuations is not easy (Wolfson and Schneider, 2002: 14). So, there is no persuasive evidence to claim confidently that human activity is causing climate change, while climate changes naturally. For example, Khilyuk and Chilingar (2003: 370) claim that the sun is responsible for global warming, not mankind. Furthermore, the computer models (GCMs) used for prediction of climate effects not immune from many structural and parametric uncertainties. Thus, it should be accepted that climate change projections are not absolute truth claims but heuristically valuable simulations. They only show the

probabilities of various scenarios. Unfortunately, there is not a laboratory to test the results produced by the computer models. Thus, it is impossible to apply traditional positivist scientific validation criteria to the results of climate change science. Moreover, all uncertainties related to climate change cannot be or will not be solved (Wolfson and Schneider, 2002: 17).

Under conditions of uncertainty, it is inevitable that a political choice has to be taken one way or another. This point is critical because irremediable uncertainties in science leave ample space for "contrarians" or "skeptics" (a label to call those who do not agree with the dominant problem formulation) to object. Actually, uncertainties in science can be used by different interests in different ways. This situation inevitably leads to politization of science. For example, for the proponents of global warming climate skeptics have close ties with the fossil fuel industry. Moriartry and Kennedy (2004: 727) claim that fossil fuel industries and biggest consumers of fossil fuels such as the USA and Australia are supporting any scientists who are skeptical about global warming. However, they do not forget to add that research grands and fees from energy companies cannot explain the motivations of all the skeptics. On the other hand, climate skeptics attack on climate scientists by alleging that they are working to further their own self-interest such as earning money and reputation, not to save the world. It seems that scientists who are studying in the disciplines related to climate change are luckier than the others to benefit from research funds. Careers of many scientists are now dependent on global warming for being successful in acquiring research funding (Bate, 1997: 103).

With regard to the politization of science, it is extremely important to note how translations are made between scientific and political arena about uncertainties. Nevertheless, the distinction between science and policy in the climate change issue is almost absent. As a result of politisation, climate science is increasingly being drawn into politically supported analytical structures. Therefore, climate change science is not always separately identifiable from the political process that shapes it (Brunner, 2001: 6). It must be recognized that climate science goes beyond delivering factual knowledge by formulating the problem and thereby formation of political choice. In this regard, climate change science is not something to be considered pure or applied science. To differentiate this sort of scientific activities from that of pure or applied science, science and technology scholars have used different concepts such as trans-science, mandated science, fiducial science, and regulatory science (Lövbrand, 2007: 40). Rabinson and Shaw (2004: 144) describe climate change science as "mandatory science" because it is produced for public policy or legitimaton of public policy.

The lack of clear boundaries between climate science and climate politics gives rise to question the role played by the IPCC in the process of making climate change policy. While some consider it as "the voice of reason and dispassionate objectivity" some others see its role "a malevolent conspiracy" (Philander, 2001: 2106). To Haas (2004: 583), the accuracy of the IPCC science and its usefulness is limited. Moreover, Kellow (2005: 54-55) claims that the IPCC intentionally used emission scenarios to produce the figure 5.8 °C, which is needed to make the Kyoto Protocol operational. However, the figure of 5.8 °C is highly unlikely and the most likely figure is 2.5 °C. The most likely figure makes climate change less terrifying and more manageable. To yield popular support to decarbonization policy, the dominant problem formulation of climate change has exaggerated "urgency" and "certainty".

Moreover, the Kyoto Protocol reflects political and energy policy realities rather than scientific justification (Haas, 2004: 583). The redistributional effects of the dominant problem formulation are not fair. It seems that the Protocol favors renewable technologies, shifting from coal to gas and nuclear electricity generation, while the economies based on coal and fuel are loser. Boehmer-Christiansen (1997: 439) proclaims that climate research, bureaucracy and "alternative" fuels are winning coalition in shaping climate change policy.

In short, the dominant problem formulation of climate change is scientifically and politically arguable. Scientifically, behavior of the earth's climate is extremely complex. As a result, it is difficult to predict future climate precisely. Politically, decarbonizaton policy adopted by the Kyoto Protocol affects international interests differently. Scientific uncertainties allow the biggest consumers of fossil fuels to refuse the Protocol claiming that foundation of international climate change regime regulated by the Protocol is poor science, unsound science, junk science or shaky science rather than sound science (Zillman, 2005: 3).

Interaction between science and policy in the climate change controversy also raises difficult questions about the role of science and democracy in the dominant problem formulation. Is the role played by the scientific community in formulating the problem regarding climate policy is justifiable when scientific uncertainties and conflicting interests are taken into account? The conceptual models of interaction between science and policy identified by Liberatore and Funtowicz (2003: 148-149) may help answer the question.

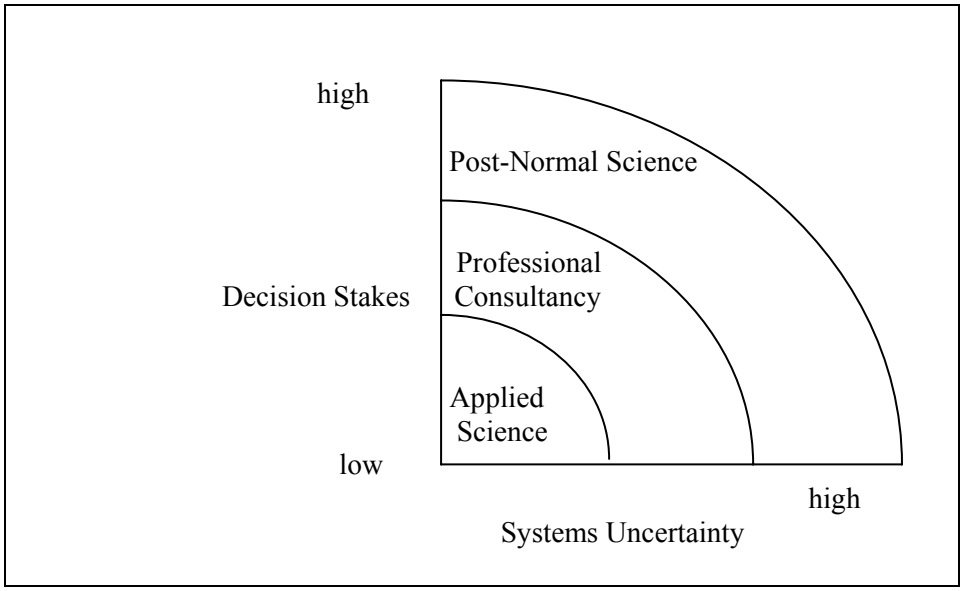
Liberatore and Funtowicz (2003: 148-149) identify several models of interaction between science and policy such as modern model, precautionary model, framing model, demarcation model, and extended participation. The modern model suggests that scientific knowledge can determine the best policy (truth speaks to power). The precautionary model acknowledges uncertainties in scientific knowledge and needs other criteria for policy legitimation. The demarcation model draws clear boundaries between policy and science to protect science from political interference. The framing model suggests that the knowledge produced by science is formed by policy commitments. The extended participation model advocates plurality of perspectives to enhance procedural legitimacy and quality of knowledge.

It seems that modern model envisaging perfect scientific knowledge in policy process is not adequate in explaining the dominant problem formulation of climate change when uncertainties are taken into consideration. The other models point out abuse of science and imperfections in the use of science in policy process. Therefore, the models above apart from the modern model have explanatory power, to a certain extent, and can be deployed to explain the dominant problem formulation of climate change. The dominant problem formulation of climate change will be interpreted from the perspective of Post-Normal Science or the extended participation model below.

4. Post-Normal Science

Post-Normal Science can be seen as a response to the legitimacy crisis of science regarding complex science related policy problems such as climate change by means of the extended participation model. Theory of Post-Normal Science as presented by Funtowicz and Ravetz is based on two background variables, namely knowledge and values. Funtowicz and Ravetz present the insight of Post-Normal Science by means of a diagram with two axes, systems uncertainties and decision stakes or values (see Figure 1). Accordingly, it is possible to identify three types of science or problem-solving strategy; normal science, professional consultancy and Post-Normal Science. The area in which both aspects are low shows where applied science is effective. When the application of routine techniques is not adequate professional consultancy entailing skill, judgment and courage is needed. The area where the competence of professionals is not enough for the solution of science-related policy issues is the realm of post-normal problems. In order to deal with post-normal problems, a new problem solving strategy is required (Ravetz, 1999; Ravetz, 2002; Funtowicz and Ravetz, 2003).

Post-Normal Science can be defined as an issue-driven science in which "facts are uncertain, values in dispute, stakes high and decisions urgent". Uncertainties and value-loadings are the essential elements of Post-Normal Science. The traditional dichotomy between "hard" objective scientific facts and "soft" subjective value-judgments is rejected. Post-Normal Science unifies facts and values and replaces truth by quality as evaluative concept. As a result of complex systems theory Post-Normal Science acknowledges plurality of legitimate perspectives. Accordingly, Post-Normal Science emphasizes on dialogue, mutual respect and mutual learning. By means of "extended peer community", Post-Normal Science democratizes policy process. The maintenance of quality is established through dialogue between all stakeholders or those affected (extended peer communities). Post-Normal Science is also open to extended facts. Post-Normal Science integrates technical scientific expertise with local knowledge, legitimate interests, values and desires of the extended peer communities (Funtowicz and Ravetz, 2003).



Source: Ravetz (1999: 650).

Figure 1: Post-Normal Science

The term Post-Normal Science is derived from the concept of normal science defined by Kuhn. The concept of normal science provides a sociological explanation for evolution of science and operation of scientific research. Normal science can be defined as research conducted within a specific

paradigm. Paradigm provides methodologies and values to carry out research. Normal science as a problem solving strategy can be depicted as a puzzle solving activity undertaken by experts within a specific paradigm (Tacconi, 1998: 96). The philosophy of Post-Normal Science rejects the assumption that routine puzzle-solving activities conducted by experts provide adequate knowledge base for policy decisions (Ravetz, 1999: 648). This statement does not mean that normal science is useless at all. On the contrary, there is complementarity between normal science and Post-Normal Science. When the intensity of the uncertainty and the intensity of the decision stakes are low, routine puzzle solving activities are adequate to solve problems. But under post normal conditions (where uncertainties and decision stakes are high) normal science should be reinforced by Post-Normal Science.

Because Post-Normal Science is still developing, the elaboration of this theory thus far does not provide clear criteria to assess certain scientific activities (van de Kerkhof and Leroy, 2000: 905). However, there are many identifiable elements of Post-Normal Science which are easily distinguishable from that of normal science: Objectivity replaced by intersubjectivity, truth replaced by quality, one true explanation replaced by multiplicity of legitimate perspectives, disciplinarity replaced by transdisciplinarity, strategic rationality replaced by communicative rationality, peer community replaced by extended peer community, etc.

Post-Normal Science essentially challenges the authority of science in the policy process. Post-Normal Science rejects the modern model which assumes perfect knowledge (truth speaks to power). Post-Normal Science invites science to the policy process as a stakeholder without having the monopoly of objective truth and ethics since science is conceived as a socially constructed discourse rather than the representation of truth.

5. Post-Normal Science and Climate Change

If the climate change issue is viewed from the point view of Post-Normal Science, it is possible to label climate change as a post normal problem and climate change science around the IPCC, to some extent, as Post-Normal Science (Saloranta, 2001: 395).

Climate change is surely a post normal problem because in its two aspects political stakes (owing to development and energy considerations of states) and scientific uncertainties (due to the complexity of climate system) are intense. Ravetz (2002: 2) points out that "*even global climate change does not have a simple "cause" that can be identified and eliminated. Hence the old*

belief scientific certainty is lost; in place of objective facts, we have an open clash of interests and world views". While majority of climate scientists believe in the greenhose theory and the Kyoto Protocal, the skeptics constantly question the consensus built around the IPCC. For example, skeptical environmentalist Lomborg (2001) argues that even though climate change is real, the solution offered by the Kyoto Protocol (significant cuts in greenhouse gas emissions) will not stop global warming. Therefore, it is better to spend money on more urgent problems such as AIDS, malaria, sanitation, and clean water.

The dominant problem formulation of climate change does not comply with main propositions of the paradigm of Post-Normal Science. First of all, the dominant problem formulation of climate change gives the impression that climate change is a simple problem caused by human activities (largely use of fossil fuel) producing carbon emissions. So, it needs a simple solution which is massive reduction in the use of fossil fuels. If so, climate change should be considered in the area of normal science where routine techniques are adequate to eliminate uncertainties. But, this does not reflect the reality because climate change contains irreducible uncertainties. Post-Normal Science maintains irreducibility of certain risks and uncertainties.

Post-Normal Science also rejects the supremacy of scientific expertise in post normal problems. The dominant problem formulation of climate change reflects the supremacy of science. Demeritt (2001: 307) suggests that translation of scientific knowledge of climate change to international diplomatic consensus in a short period of time clearly demonstrates the authority of science in providing legitimacy for political action.

The interests of all those who affected or affect climate change (stakeholders) are not well represented in the IPCC process (Haas, 2004). For example, the views of fossil fuel industry are all dismissed in the climate change debate. Post-Normal Science requires a broader scope of the involved persons, institutions and movements because of the principles of extended peer communities and plurality of legitimate perspectives. Objections to mainstream climate science (role of clods, unreasonable assumptions of the GCMs etc.) are not welcomed by the IPCC scientists (Schiller and Tanzler, 2004: 187) However, the advocacy for scientific consensus and marginalization of the skeptical views are not compatible with the main message of Post-Normal Science, which is mutual respect and mutual learning. Instead of establishing truth (scientific consensus), Post-Normal Science respects non-equivalent descriptions which cannot be reduced to a common denominator (Haag and Kaupenjohann, 2001: 54).

Moreover, the IPCC cannot be seen as an extended peer community, since it is dominated by the scientists from wealthy northern countries. To meet the criteria of Post-Normal Science the IPCC should be clearer about uncertainties and different interests. The IPCC should also open the values of climate change science community to discussion. For instance, the hegemony of computer models in understanding climate change needs to be interrogated. Post-Normal Science does not approve the faith in technical expertise (powerful computer models) in eliminating irremediable uncertainties concerning complex systems. Post-Normal Science accepts irremediable uncertainties and let the society face them and decide by themselves through extended peer communities.

It should be noted that it is impossible to draw clear boundaries between climate science and climate policy. Therefore, politisation of climate science is inevitable. If climate change is seen as a political conflict requiring decision-making under uncertainty, the scientific community should put their values, interests and aims forward explicitly, instead of disguising themselves as objective value-free expertises. Because it is not true to assume that climate change is an issue which is beyond interests and beyond politics. It is convenient to declare that climate change science means climate change politics and vice versa.

6. Conclusion

This paper has discussed the dominant problem formulation of climate change (anthropogenic climate change requiring massive reduction in the use of fossil fuels) in terms of Post-Normal Science. The paper has shown that climate change is a post normal problem but the dominant problem formulation of climate change is not in line with the main principles of Post-Normal Science. It seems that Post-Normal Science principles (intersubjectivity, multiplicity of legitimate perspectives, dialogue, mutual respect, mutual learning, extended peer community, and extended facts etc.) have a great potential for democratization of interplay of climate science and climate politics, which have become inseparable from each other. From the point view of Post-Normal Science the IPCC cannot be seen as a boundary organization because science and policy have been integrated through the IPCC processes. The radical message proclaimed by Post-Normal Science is that nobody has the monopoly of objective truth in post normal problems. It also means that nobody can prescribe climate policy from a position of value neutrality. Therefore, the IPCC should be open to knowledge claims from key stakeholder communities

(including fossil fuel industry) and debate instead of building an international consensus on the climate change policy because it is impossible to separate problem definition and scientific solution from the interests of different stakeholders.

ÖZET

POST NORMAL BILIM PERSPEKTIFINDEN İKLIM DEĞIŞIKLIĞI

Bu çalışmada iklim değişikliğinin hakim sorun formülasyonu, post normal bilim perspektifinden tartışılmaktadır. Çalışmada önce eleştirel olarak iklim bilimine dayalı iklim değişikilğinin hakim sorun formülasyonunun temel özellikleri, daha sonra, post normal bilim paradigması incelenmiştir. Çalışmada iklim değişikliğinin hakim sorun formülasyonunun post normal bilimin temel önermeleri ile uyuşmadığı görülmüştür.

Anahtar Sözcükler*: İklim Değişikliği, İklim Değişikliği Bilim, İklim Politikası, Post Normal Bilim.*

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