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*283 RISKS, SCIENTIFIC UNCERTAINTY AND THE APPROACH OF APPLYING PRECAUTIONARY PRINCIPLE

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Abstract: **The paper intends to clarify the nature and aspects of risks and scientific uncertainty and also to elaborate the approach of application of precautionary principle for the purpose of handling the risk arising from scientific uncertainty**. It explains the relations between risks and the application of precautionary principle at international and domestic levels. In the situations where an international treaty has admitted the precautionary principle and in the situation where there is no international treaty admitting the precautionary principle or enumerating the conditions to take measures, the precautionary principle has a role to play. The paper proposes a decision making tool, containing questions to be asked, to help policymakers to apply the principle. It also proposes a "weighing and balancing" procedure to help them decide the contents of the measure to cope with the potential risk and to avoid excessive measures.

Keywords: Scientific Uncertainty; Risk; Precautionary Principle; Environment; Rio Declaration; SPS; WiMAX

I. INTRODUCTION

The way of handling risk is a complex issue. It involves the limit of science, or the scientific uncertainty, **the status of the precautionary principle in domestic and international legal systems, and the role of the precautionary principle in the policymaking process of domestic decision makers.** This paper aims at clarifying the nature of this complex issue, thus figuring out a possible solution for using the precautionary principle in order to handle the risk arising from *284 scientific uncertainty. The basic idea underscoring the possible solution is assisting domestic decision makers in making their decisions regarding the application of the precautionary principle.

The paper opens by tangling with the explanation for the risk arising from scientific uncertainty. It turns then to clarify the interplay between scientific evidence, scientific uncertainty and the associated risk. The paper examines the status of the precautionary principle, thus inquiring into the question as to whether the widely recognized approach has been accepted as part of customary international law or not. The clarification of the status of the precautionary principle serves as the basis of discussing the

relations between the risks and the precautionary principle. Within the premises of this paper, the author develops an approach for the application of the precautionary principle and to develop a method of applying it.

II. RISKS ARISING FROM SCIENTIFIC UNCERTAINTY: WiMAX AS AN EXAMPLE

Science is "a system of acquiring knowledge" and "the organized body of knowledge people have gained using that system." [FN1] The system uses scientific methods, including "observation" to understand the problem, "hypothesis" to identify possible solution, "prediction" of discovery, "experiment" for the purpose of answering the question, and "conclusion" being the answer of the question. [FN2] **Scientific uncertainty exists in case where a conclusive answer to the question is absent (i.e. no conclusive scientific evidence to support either the positive or negative finding of certain result arising from a product, being put in the market or from the development or application of a technology)**.

Science definitely has its own limit. Experiment could be carried out in an improper way. And because of insufficient scientific knowledge, in relevant fields or underdeveloped situation of the technologies used in carrying out the experiments, different results of various experiments could also come true. All these could lead to the result that conclusive answers are generally unaccepted. It might be that in future, there could be conclusive scientific evidence about certain risks, because of the improvement of our scientific knowledge or the development of technology. Accordingly, it should be clear that when we discuss *285 the risk and the associated scientific uncertainty, it is based on the state of the art.

The relations between scientific evidence, scientific uncertainty and the associated risk are illustrated in Table 1.

Table 1

Sufficient scientific evidence	Conclusive scientific evidence to support the positive finding of certain result arising from the use of a product or the application of a technology.	Risk is definite
	Conclusive scientific evidence to support the negative finding of certain result arising from the use of a product or the application of a technology.	No risk
Insufficient Scientific evidence/Scientific uncertainty	No conclusive scientific evidence to support the positive finding of certain result arising from the use of a product or the application of a technology. No scientific evidence to support the negative finding of certain result arising from the use of a product or the application of a technology	High or low risk, depending upon the nature and other factors of the technology

WiMAX (an acronym for Worldwide Interoperability for Microwave Access) is a typical exemplification of the scientific uncertainty of applying the technology at this stage of technological development. WiMAX, being developed by equipment manufacturers, service providers, and software companies from different countries, is "a communications technology that uses radio spectrum to transmit tens of megabits per second in bandwidth between digital devices such as laptop computers." It is to ensure that equipments made by different manufacturers will interoperate. [FN3] Although it is a valuable technology, the emitted electromagnetic field (EMF) certainly has caused fear.

This kind of fear was distinctly explained by a report: When the Swedish township of Göten had its new WiMAX base-station activated in May 2006, immediately "there were calls to the local hospital emergency service from residents near the base-station, ranging from sharp headaches to difficulty breathing, blurry vision, and even two cases of heart arrhythmia. All symptoms abated once the sufferer relocated away from the base-station." "Sweden was the first country to recognise electromagnetic hypersensitivity as a valid medical condition, and have set up a federal body to assist sufferers of EHS. *286 The Swedish government was asked to close down the nation's WiMAX networks, thus pending further investigation into the claims." [FN4]

Scientifically, there are different assertions about the possible health effects. On the one hand, there are reports suggesting the possible problems arising from the exposure in the electromagnetic field. A WHO report includes the following statements: [FN5]

"As societies industrialize and the technological revolution continues, there has been an unprecedented increase in the number and diversity of electromagnetic field (EMF) sources. These sources include video display units (VDUs) associated with computers, mobile phones and their base stations. While these devices have made our life richer, safer and easier, they have been accompanied by concerns about possible health risks due to their EMF emissions."

"For some time a number of individuals have reported a variety of health problems that they relate to exposure to EMF. While some individuals report mild symptoms and react by avoiding the fields as best they can, others are so severely affected that they cease work and change their entire lifestyle. This reputed sensitivity to EMF has been generally termed 'electromagnetic hypersensitivity' or EHS."

"There is a very wide range of estimates of the prevalence of EHS in the general population. A survey of occupational medical centres estimated the prevalence of EHS to be a few individuals per million in the population. However, a survey of self-help groups yielded much higher estimates. Approximately 10% of reported cases of EHS were considered severe."

However, the WHO report contains a further statement, according to which:

*"EHS is characterized by a variety of non-specific symptoms that differ from individual to individual. The symptoms are certainly real and can vary widely in their severity. Whatever its cause, EHS can be a disabling problem for the affected individual. EHS has no clear diagnostic criteria *287 and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem."*

Another report points out that notwithstanding EMF has been linked to a variety of adverse health outcomes, such as childhood leukemia, adult brain tumors, childhood brain tumors, genotoxic effects (DNA damage and micronucleation), neurological effects and neurodegenerative disease, immune system disregulation, allergic and inflammatory responses, breast cancer in men and women,

miscarriage and some cardiovascular effects. These "[e]ffects are not specifically segregated for ELF [extremely low frequency] or RF [radio frequency], since many overlapping exposures occur in daily life; and because this is an artificial division based on frequencies as defined in physics that has little bearing on the biological effects. Both ELF and RF, for example have been shown to cause cells to generate stress proteins, a universal sign of distress in plant, animal and human cells." [FN6]

On the other hand, different reports are made to show a very different perspective. For example, a report has the following description about the safe nature of WiMAX: [FN7]

"INTEL'S MOBILITY guru Sean Maloney said that masts beaming WiMAX signals across the metropolis do not pose any risk to health. But Intel takes the matter seriously, said Maloney, and continues to closely watch research on the effect of radio emissions."

"The successful implementation of WiMAX would require masts to be set up as relay stations, much as cellular masts are pretty much omnipresent, Maloney said yesterday. But the effects of such transmissions were unlikely to have much effect on humanoids within range. He said that since concerns were first raised about cellular transmissions, not one case of them having an effect on human tissue had been proven ..."

*288 **III. RELATIONS BETWEEN THE RISKS AND THE APPLICATION OF THE PRECAUTIONARY PRINCIPLE**

A. The Precautionary Principle Being Widely Recognized

Depending upon whether there is a risk arising from scientific uncertainty, there could be different ways of handling the problems internationally and domestically and there could be different contexts of applying the precautionary principle. Before elaborating on their relations, there is a need to have a brief explanation about the meaning of the precautionary principle.

The precautionary principle is not a new concept. It is argued that the precautionary principle can be traced back to "the hazard-based U.S. environmental and health policies of the 1970s which have, since 1980, become more scientific in risk assessment and factually based and even back to the late 19th and early 20th centuries." [FN8]

The precautionary principle -- which has become gradually widely accepted -- when Rio Declaration on Environment and Development (hereinafter Rio Declaration) [FN9] was signed by 178 nations in 1992. Principle 15 of the Declaration admits manifestly such principle:

"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

It seems that the "precautionary approach" -- as learned from Principle 15 of Rio Declaration -- deals with the situation where "full scientific certainty" is lacking and there are threats of serious or irreversible damage. The cost-effective measures are to be taken by States to prevent damages.

… **VI. CONCLUDING REMARKS**

The paper explains the relations between scientific evidence, scientific uncertainty and the associated risk. It indicates WiMAX to be a typical example showing the scientific uncertainty of applying the technology at this stage of technological development. It then looks into the legal status of the precautionary principle and find that **although there are some international treaties admitting the principle being part of treaty obligation, it is apparent that not all treaties accept the principle. It is also apparent that the precautionary principle is not yet an integral part of customary international law.**

The paper explains the relations between risks and the application of precautionary principle at international and domestic levels. In the situations where an international treaty has admitted the precautionary principle and in the situation where there is no international treaty admitting the precautionary principle or enumerating the conditions to take measures, the precautionary principle has role to play. In these situations, there must be approach to properly decide the application of the precautionary principle.

The paper proposes a decision making tool, containing questions to be asked, to help policymakers to make their decision about applying the precautionary principle. It also proposes a "weighing and balancing" procedure to help them decide the contents of the measure to cope with the potential risk and to avoid excessive measures. It is hoped that the proposed method will help policymakers to have more appropriate decision about the development and application of new technologies or new product, such as the development of relevant WiMAX industries, the issuance of operation licenses, and the rules about setting up masts or towers, by taking into account the interests of different stakeholders.

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…**[FN8]. Lawrence A. Kogan, The Extra-WTO Precautionary Principle: One European "Fashion" Export the United States Can Do without, 17 T*emp. Pol. & Civ. Rts. L. Rev*. 491, at 505-506 (2008).** Some have argued that precautionary principle is thousands of years old. Some other trace it "to a doctor's recommendation in 1854 to remove the handle of a water pump to stop a cholera epidemic" or "to the 1874 amendment of the British Alkali Act that imposed technology-based limits on emissions of noxious gases by certain factories." Robert V. Percival, Who's Afraid of precautionary principle? 23 *Pace Envtl. L. Rev*. 21, at 23 (2005-2006).