When an Anthropologist Meets Hydrologists: A Reflection on the Epistemology and Sociology of Knowledge of Mekong Hydrology[1]

Jakkrit Sangkhamanee[2]

Abstract

The article discusses how hydrological science came to be benchmark knowledge in regional management of the Mekong River. It examines 'hydrology' through sociological studies of science classrooms and laboratories and offers a philosophical analysis of scientific practices. The author, as an anthropologist, argues that scientific knowledge of water, and the science community that produces it, are cultural constructs. Since scientific hydrology is always shaped by social factors, there is no absolute legitimacy in claiming scientific practice, bias-free methodology, and universality of knowledge implementation. The article calls for a non-monolithic standard in justifying knowledge employed in river management.

Keywords: Sociology of Knowledge, Mekong, Hydrology, Water Management

บทคัดย่อ

บทความนี้อภิปรายแนวคิดของการหยิบยกเอาองค์ความรู้อุทกวิทยาแบบวิทยาศาสตร์มาใช้เป็นบรรทัดฐานในการจัดการน้ำ โดยเฉพาะในลุ่มแม่น้ำโขง ผู้เขียนวิเคราะห์ความรู้อุทกวิทยา ไม่เพียงแต่ในแง่ที่เป็นความรู้แบบวิทยาศาสตร์อย่างที่มักยอมรับและยกย่องกันมา หากแต่ทำความเข้าใจความรู้ดังกล่าวในแง่ของการเป็นปรากฏการณ์และกระบวนการทางสังคมแบบหนึ่ง นอกจากนี้ งานชิ้นนี้ยังวิจารณ์กระบวนการแสวงหาและสร้างความรู้ของอุทกวิทยาในลุ่มแม่น้ำโขง ที่ไม่ได้มีความเข้มงวดแบบ "วิทยาศาสตร์" ตามที่คนภายนอกมักเข้าใจและยอมรับกัน ในฐานะที่ผู้เขียนเป็นนักมานุษยวิทยา การเข้าไปศึกษาอย่างมีส่วนร่วมในห้องเรียนและห้องทดลองอุทกวิทยานั้น ทำให้พบว่าความรู้อุทกวิทยาที่อ้างว่าเป็นวิทยาศาสตร์นั้น ในความเป็นจริงแล้ว คือความรู้ที่เป็นแบบแผนทางวัฒนธรรมแบบหนึ่ง และชุมชนวิทยาศาสตร์เอง ก็เหมือนกับชุมชนทางวัฒนธรรมอื่นๆ ทั่วไป ดังนั้น จึงไม่ควรจะได้รับสิทธิ์ขาด ในการนิยามว่าความรู้ใดคือความรู้ที่เป็นมาตรฐานหนึ่งเดียวในการจัดการน้ำอย่างมีประสิทธิภาพ บทความนี้เสนอว่า เราควรข้ามพ้นความเชื่อที่มองว่า อุทกวิทยาแบบวิทยาศาสตร์คือหนทางหนึ่งเดียวของความรู้เรื่องน้ำและการจัดการน้ำ หากแต่ควรเปิดโอกาสให้ความรู้หลากหลายมิติเข้ามามีส่วนในการสร้างองค์ความรู้อย่างเท่าเทียม

คำสำคัญ: สังคมวิทยาความรู้ แม่น้ำโขง อุทกวิทยา การจัดการน้ำ

'Give me a laboratory and I will raise the world' sarcastically proclaimed a renowned science philosopher Bruno Latour (1983). The statement represents one among many examples reflecting the mentality of scientists once equipped with scientific provision and thus their self-perception of holding power in managing the world. Hitherto, such assertion has been recounted by the fellows of science and has gained support from many science communities at large. The underlying belief is that science, scientific methodology, and scientific community are legitimate authorities in producing neutral, absolute knowledge and sound practices, thus earning legitimacy to control the external natural world. Such idea, however, is not only in itself problematic. But eventually renders some challenging debates of its roles toward the wider society beyond that of the scientific community during several past decades. The case in point is that the assumption in which scientific knowledge, once produced and gained acceptance from science communities, is epistemologically and methodologically neutral and universal, that it can be used by science experts in different settings, is in fact an insufficient treatment of science in societal reality.

Looking from a philosophical aspect, 'science' itself has been questioned as regards its epistemological disconnectivity and non-universal methodologies (Feyerabend 1975, 1989 and Kuhn 1996). The sociology of science, additionally, raises up the debates of how science has been distorted when putting into rather more complex social conditions (Merton 1937). Some arguments even go further by pointing out that science is often influenced by social factors not only when it is externally applied into practice. In fact, however, the production of science within an exclusive science community itself is already an initial matter of social condition that the science community and its knowledge are situated into (Knorr-Cetina 1981 and 1999, Latour and Woolgar 1979). In this regard, not only we can analyze scientific knowledge and the practice of science as being shaped by external cultural factors from wider society. But also science and the science community can be considered as being a cultural entity in itself. In other words, we can go beyond accepting the dichotomy between science and culture. Culture, as this article argues, is in fact an intrinsic matter of science community and practice. One anthropologist once rightly proposes ***'give anthropologists a culture, and we will show how utterly science and its laboratory are entangled in it.'*** (Martin 1998: 41). This article is an attempt to illustrate the very point that science, and in this case scientific hydrology in particular, is a production of culture as well as a cultural product. In that case, we can see the sociology of scientific knowledge since it is being produced within a restricted environment of laboratory and classroom, through the outer activities of science when it is applied into society through 'scientific' techniques, as well as in the context of political decision making.

Recently, a large number of academic literature produced by development anthropologists concerning river ecology, knowledge in development, and water/river resource management issues especially in the Mekong region often criticize the roles of hydrologists and the negative impacts of using merely technical science in justifying water development projects. These anthropologists have done so, however, without considering themselves as outsiders to the scientific 'community'. As much as anthropologists are concerned with ethnographic study and the positioning of themselves as being insiders in the study of social community, ironically, there are only few attempts by anthropologists to socially immerse themselves and their study into the so-called community of science (Latour 1990, see also Franklin 1995). This article suggests that, besides merely criticizing the impacts of scientific practices on society from the outer position, there is also a need for anthropologists to really put themselves into the community of scientists to understand their background, practices, and cultures from within their science society. Based on such concern, this article recounts the author's reflexive experience during the time he attended a scientific training course and laboratory work on watershed hydrology at one of the leading hydrological science institutions in the Mekong subregion. The training was coupled with additional information gained from meetings and discussions with officials of Thailand's Royal Irrigation Department concerning the hydrological knowledge production in Mekong river management. As an anthropologist, this four-month scientific training allowed the author to immerse into the community of hydrologists and their hydrological practicum. This participation-observational experience, in turn, amounts to some reflexive ethnographic analysis of its methodology, epistemology, as well as sociology of scientific knowledge production. In this article, the author will explore the lives and works of training hydrologists, their engagement with classroom and laboratory works, as well as the production and utilization of its representation such as hydrographs, maps, and river classification charts.

The aim of this article is to show that hydrology as an applied scientific knowledge, instead of being universal and subjective-free as often claimed by hydrologists, does not escape the fact that it is culturally constructed. In other words, this article argues against the very idea that scientific epistemology and methodology are objective, universal and pure from any other cultural factors that enclose it. The argument that seeing scientific knowledge production as not bias-free, but rather paradigm-laden leads us to further question the sole domination of hydro-science and hydrologists in river resource management. The critique to sole acceptance of scientific hydrology as the only benchmark knowledge system in river management allows policy makers to see its limitations and drawbacks. Therefore, this opens up to other alternative knowledge on water to be recognized and integrated into practice.

Benchmarking Hydrology

Hydrology, according to the Federal Council of Science and Technology for Scientific Hydrology, is the 'science' that treats of the water of the earth, their occurrence, circulation, and distribution, their chemical and physical properties, and their reaction with their environment including their relation to living things. The domain of hydrology embraces the full life history of water on the earth (Federal Council of Science and Technology for Scientific Hydrology 1962, cited in Kazmann 1972). However, as in other branches of science related disciplines, there is no concerted agreement of what should be included or excluded in the studies of hydrology, not to mention of its applied and allied subjects such as those in engineering, biology, chemistry, geology, and resource management of river basins.

Under the current Mekong river basin management, the Mekong River Commission (MRC), as well as the Asian Development Bank and the World Bank which are the key international organizations in managing the Mekong still use conventional methods in their planning of river development (see MRC 2005a and 2005b, and WB 2004 for examples). Their interests in managing the river very much revolves around the issues of hydropower, inter-basin water diversion, domestic and industrial use, and irrigation. With this rationale of development, most of hydrological knowledge is based on selected technical methodologies that can be used to develop models to understand, calculate changes, and manage river for the purpose of development projects. As often shown in their publications, numbers of subregional Mekong river development schemes under the development agencies such as the MRC and the ADB are orienting toward the modeling of river regulations which are largely based on modern technical knowledge on hydrology. As the chief executive officer of the MRC has marked out in the report called ***Overview of the Hydrology of the Mekong Basin*** (MRC 2005a):

> 'The link between hydrological regime, riverine ecology, the riparian environment and the degree to which a river's water resources can be sustainably and equitably developed are complex. The starting point to unraveling this complex-

ity is an understanding of the hydrological regime and a consensus amongst policy makers of ***what represents the benchmark hydrology*** against which the magnitude of any changed can be measured**.** ***One of the MRC Water Utilization Project is the identification of this benchmark hydrology'***. (Emphasis added)

This report, which is set to 'uncover and describe the key patterns and features of the Mekong Basin hydrology and synthesize the results in a way that provide some basic insights into the regime of river system' (MRC 2005a), is however primarily aimed at bringing merely those 'applied scientists and engineers ranging from environmental analysts to water resource planners' in creating a workable 'Mekong hydrological knowledge'. The identification of what should be considered standard or 'benchmark' in hydrological knowledge for river management by the MRC, however, is problematic as it is exclusively based on a specific set of scientific observations and technical modeling. For the MRC, other alternative forms of river ecological knowledge such as local morphological understanding and river classifications stand outside their meaningful reference. The predomination of such expertise over the other existing forms of knowledge are in a crucial juncture where the closer examinations are needed in order to create an integrative approach to river development of the region.

Hydro Technocracy as a Cultural Community

Paul Feyerabend, a leading philosopher of science, has commented that scientific knowledge, statements and achievements certainly are not independent of human thoughts and actions. They are, indeed, human products. As he argues, though scientific knowledge is ideally formulated to select only the 'objective' ingredients of our environment, nevertheless, they still reflect the peculiarities of the individuals, groups, societies from which they are arose (Feyerabend 1988). Hence, it is undeniable that, say, hydrological models which is produced within scientific domain, and is considered scientific achievement, cannot, and in fact never, stand alone. Rather, such scientific production and acceptance are relied so much in the social context that the producers and the users are embedded, making scientific knowledge a truly socially conditioned construct. In the followings, the article examines a hydrological science society, as well as their 'scientific' products of a science academic institution. This is to highlight the cultural aspects of the production process in scientific hydrology in the Mekong region.

Water Laboratory and Classroom: 'Out of Place, Out of Mind'

Concerning by and large that the ways of thinking, defining, mastering, and practicing of the water knowledge by hydrological 'experts' in the Mekong is essentially influenced by what we call a scientific hydrology paradigm to river management, in this section emphasis will be on the social behaviors of hydrologists in an academic institution fundamentally using technical scientific epistemology, methodology, and logical-positivist paradigm in teaching and producing knowledge on Mekong water. As claimed by Livingstone, science is concerned with ideas and institution, with theories and practices, and with principles and performance (Livingstone 2003: 12). It is of interest in this section to explore science classroom and laboratory as fundamental sites in the generation of hydrological knowledge. It is important to investigate contextual aspects of science and its practitioners as to understand the relations between science institution and the production of its agencies. As an anthropologist, the author approached the academy of science by considering science as a special 'culture' (Martin 1998), and science school as a distinct 'cultural unit' like other social groups such as civil movements, tribes, nations, or artists which is tied to their surroundings by language use, as well as social and material intervention (Feyerabend 1996). In other words, the author's purpose is to venture into the 'terra incognita of scientific culture' (Livingstone 2003: 16) in which most anthropologists and social scientists dealing with hydrological science rarely put themselves into.

For cultural analysis of this hydrological science community, the very concept of 'culture' is defined following Crick, as a process of acquiring and displaying knowledge--of rules, values, and beliefs (Crick 1982: 287). This section is then a reflection of ethnographic study in a science community just as the way many other anthropologists conduct their ethnographic fieldwork in a distinctive social community. Using ethnographic approach in the study of science community not only enable us to take a closer look of how scientist produce their knowledge in daily 'scientific' activities. It also allows an immersion into their social process of communication, ideological reaffirmation as well as personal indecision and confusion throughout the process of knowledge making. Such in situ participation (Woolgar 1982, 1988) will then permit anthropologists a firm ground to criticize scientists' action 'from the distance' from a closer stand point. The reflection in this part is very much influenced by Thomas Kuhn in his ***Structure of Scientific Revolutions*** (1996) as the author will apply some aspects of Kuhn's work to the elaboration of present Mekong scientific hydrology and one of its expertise communities in the Mekong region.

During August-December 2007, the author participated in the training on watershed hydrology at one of the regional-leading science academy, which from now on will be referred to, employing Kuhn (1996)'s term, as Normal Science Institution (NSI)[3]. The NSI is one of the most prominent technical institutions in the Mekong region in producing knowledge and human resource in hydrological development circles within the region. Founded in a regional graduate school of engineering, its mission has been to develop highly qualified professionals who will play a leading role in the technical and economic development of the region. The institute was set up during the Cold War by a then prominent international organization which primarily mission was to block further communist expansion in Southeast Asia. At its early stage, the NSI received funding and technical know-how from organizations and governments around the world; the US alone put USD 1 million into the establishment of the school (The Times 1968b). Its water science program, where the author was affiliated with, is one of the oldest water-related academic sectors in Thailand, with strong international recognition. This NSI often stresses that its alumni have played crucial roles in many hydrological projects pertaining to the Mekong and its tributaries[4].

The class of hydrological science was scheduled for three-hour lectures twice a week on campus. Outdoor laboratory focusing on meteorological tools and techniques was also part of the training. Toward the end of the training, field trip was organized to visit several reservoirs, irrigation and urban sanitary projects as well as water supplying company in the eastern part of Thailand. The watershed hydrology class was part of the full-time regular program for graduate and post-graduate students in civil engineering. Even though not all of the students in class shared a civil engineering background, almost all of them were trained in scientific disciplines such as mathematics, physics, and chemistry in their undergraduate program. The class consisted of about 30 students from different Asian nationalities such as Thai, Vietnamese, Cambodian, Indian, Bangladeshi, Nepali, Indonesian, Sri Lankan, Bhutanese, and Pakistani. Most of the students were funded by organizations they worked for at home, and were committed to return and contribute the newly gained knowledge back to their offices. The students had varied prior experiences ranging from irrigation, hydraulic engineering, hydropower, coastal management, groundwater, water supply, and urban sanitary management. The teaching was conducted using English as a medium and taught solely by an Indian professor who had spent the past few decades working, researching and was involved in many hydrological development projects in Thailand and abroad.

In the watershed hydrology training, learning issues was organized to give the student of hydrology an understanding of the overall scope of what constitutes the 'science' of hydrology. Starting with hydrologic cycle, students were introduced to some primary 'facts' about the system of water in the world. This included basic understanding of hydrology and meteorology, precipitation, evaporation and evapotranspiration, infiltration and soil water, groundwater, and stream flow, flood and its routing system. The course then developed into a more profound understanding of water transport which covered the issues of water quality, erosion and sediment, hydrologic effects of land use change as well as contaminant transports. The last two sections of the course were integrated into application of knowledge with data collection, analysis, and available technology. This focused on statistical treatment of hydrologic data, frequency analysis and hydrological time series. Toward the end, the technical application part introduced students to some of the advanced treatment to real situations, such as hydrologic forecasting and hydrologic design for water use, urban drainage and flood control. Throughout this wide range of issues dealt within the course, however, only 2-3 textbooks were intensively used as reading material for lecturing as well as discussion in class.

Several times during hydrological training, students were assigned to conduct some 'scientific' experiments in laboratory settings. The idea was that students would be better equipped with what they have learned from textbooks and article assignments in classroom. Water laboratory is not only an exclusive geographical place for hydrological science students to exercise their knowledge and imagination. But, symbolically, entering into laboratory experiments also means a 'rite of passage' within scientific culture in which each scientist must struggle through to achieve mastery over studied nature (Livingstone 2003: 43). The significance of science lab is due to its function as a place where ideal environment for experiment can take place and sustain. It is a designated space where scientific equipments hydrologists need for their exploration are systematically

installed. In addition to hydraulic lab, meteorological field laboratory is also a part of hydrological training. This is an open, yet still restricted, space where some data in relations to changing environment such as rainfall, temperature, sunlight, humidity, evaporation, and wind direction and speed and so on, can be collected on a frequent basis. Livingstone considers laboratory as an emblematic space replete with cultural meaning. As he argues, by designated as a site of knowledge production, laboratory could function only by the geographically privileged who were permitted to conduct scientific practices (Livingstone 2003). It is that with the trust of people outside scientific laboratory could they warrant the credibility of the claims and knowledge made inside the laboratorial space. Without the faithful acceptance of wider public toward the inclusive practice of scientists in socially unobservable laboratory, it is by no mean that laboratory-induced knowledge can claim for its authority as universally scientific. Such social belief may hold true for one who never have chance to step inside scientific labs. From my participatory observation in both closed and field laboratories, however, it is simply without any effort to encounter a moment where science practitioners are often confused with their data, process, specialized equipments, as well as mismatched among their fellow scientists in conducting a collaborative research. Contrasted to generic social ideology toward scientism, the actual practice of laboratory here proves truly non-idealistic and baffled.

In addition to the laboratories, the author's classroom experience with the training of hydrologists at NSI confirmed Kuhn's argument that the successes of normal science are recounted by science textbooks. Unlike many social science classes where many debatable ideas and texts are explored with no definitive answer to social complexities, only one main textbook could be used in watershed hydrology class, and this seems to be sufficient enough to provide a very linear thinking about how the scientific hydrological knowledge is accumulated through time. As Kuhn argues, many science curricula do not suggest even graduate students to read the work not written especially for them. The science textbooks, according to Kuhn, expound the body of accepted theory, illustrate many or all of its successful applications, and compare these applications with exemplary observations and experiments (Kuhn 1996: 165).

Not only are science students poorly equipped with non-scientific readings about the society and environment they have to work with. Even the history of the scientific field itself is lacking in the classroom to provide students a background of what they are advancing at. Hydrologists have very little knowledge of their heritage, and historically erroneous statements can frequently be seen in hydrologic literature (Biswas 1970). Kuhn ironically asked why, after all, science students need to read the classical works of science philosophers such as Newton and Einstein, when everything they need to know is recapitulated in a far briefer form in an up-to-date textbook (1996:165). Nevertheless, even with ***History of Hydrology*** (Biswas 1970), one among the very few books that aims to provide a history of hydrology written by a hydrologist itself, the development of the field of hydrology is disappointingly portrayed as linear and accumulative in nature through a chronological timeline. In this regard, scientific development merely becomes a piecemeal process by which discovered facts, theories, and methods have been added to the ever-growing stockpile that constitutes scientific knowledge and techniques (Kuhn 1996: 2).

Textbooks act as a confirmation to the students of scientific hydrology that their learning knowledge is progressively linear and consist of well-connected components despite the fact that in reality hydrology relies so much to randomness of data being available at a specific time and place. Though it is well accepted among worldwide hydrologists that the information or data sufficient to be used to justify any project's decision-making or the prediction of river changes need to be carefully collected over a period of at least 30 years, but this common 'scientific' acceptance is rarely practiced especially when rapid development of watershed areas is a pressing need.

Less obvious, but by no means less essential, than science textbooks is what Kuhn called a 'paradigm'. A paradigm is what the members of a scientific community share, and, conversely, a scientific community consists of people who share a paradigm (Kuhn 1996: 176). In scientific knowledge, a paradigm may consist of the general theoretical assumptions, laws and techniques for application that the members of a particular scientific community adopt. The author's training fellows were mostly from organizations which worked on the 'technical' aspects in water management, such as from their respective irrigation departments of several different countries in Asia. Most, if not all, of them were well equipped with prerequisite knowledge in mathematics, physics and chemistry. Only the author, himself, had social science background and this would make them doubt his presence in this applied science training. It could be said that these people were prepared to take an advanced step in the study of scientific hydrology paradigm here at the NSI. The study of paradigm, as Kuhn discussed, is what mainly prepares the students for the membership in the particular scientific community which they will later practice. It is because that they join same-mined fellows who learned the bases of their field from the same concrete models, their subsequent practice will seldom evoke overt disagreement over fundamentals (Kuhn 1996: 11). The essence of paradigm here is that it sets the standards for legitimate work within the science it governs. In that regard, what counts as a problem can change from paradigm to paradigm and the standard set of techniques to solve problems also vary based on distinctive paradigms each scientist holds. Hydrology as one branch of science and the practices of hydrologists, then, can be said to govern by a sort of paradigm that is dependent to some specific theory to knowledge.

From the author's participation in the training, technical knowledge in scientific hydrology with fixed paradigm is expressed through rigid mathematical equations and conclusively defined factor calculations to understand, predict, and manage changes in rivers. Many times in class, the science instructor would stress the necessity that all students be familiar and comprehended with the 'conceptual' framework of the overall picture each particular aspect hydrology aims to represent. The 'concept' of hydrology here, however, is not what we may expect as some sort of general explanation about the hydrological condition at interest. Rather, it is basically a mathematical equation that is being considered as the concept in understanding the nature of water world. By substitute the 'conceptual' understanding of waters into mathematical equations, hydrological science reduced the complexity of nature and the relations to its surroundings, including human activities, into a mere numerical calculation. In addition to that reductionism hydrological science enjoys in its practicum, mathematical equations and, to the greater extent, scientific law of nature, can be considered as 'symbolic generalizations' (Kuhn 1996) understandable only within a science-cultured community. The very basic hydrological equation, say, '$P - Q - ET - G = \Delta S$' is a language or expression that cannot be known to ones outside the science community. As Kuhn argues, without this generalization to represent law of nature, there would be no points at which group members could attach the powerful techniques of logical and mathematical manipulation in their puzzle-solving enterprise (Kuhn 1996: 183). I had no surprise that most of the time in class, when equations like this were presented, community members would know what P, Q, and ET stood for. Furthermore, these shared symbolic representations were not merely a language for communication. More importantly, they would give hydrology students ideas about the behaviors of water precipitation, evapotranspiration, and hydrologic cycle as a whole. Such symbolic generalization truly acts as a language in communicating and cognitively confirming of their theoretical paradigm in science.

The use of generalized symbols to represent natural factors and the logical-positivist paradigm trained in science classes often give hydrologists a difficult time when accessing into the real complex situations of the ecological system in social contexts. The difficulties are caused by undetermined factors such as human intervention, unknown natural changes both at local and watershed scales, lacking of long-term data, and limited access to measure water quality and quantity. This often leads hydrologists to use simple ways of solving problems or, even worst, simplify river ecological system to fit their equations or scientific laws. Also, with fixed paradigm gained from scientific training, scientists can rarely see some other aspects of local practice in regard to water.

Another aspect of scientific paradigm training is what Kuhn called 'metaphysical paradigm' (Kuhn 1996: 184). This is a shared commitment to certain beliefs such as the hydrologists' faith in their hydraulic models. The model here can be both technical models used to capture natural phenomena as well as the cognitive models in thinking about nature. As mentioned earlier, Mekong river management is mainly done by using certain types of models to understand and control of changes. The seed of such commitment is unmistakably being planted in this hydrology training at the NSI. Beyond such technical models, also covered by models of thinking such as the strong belief that flood is a 'disaster' instead of a natural phenomenon (see Nikula 2008). Not only the case of flood, water scarcity is also intriguing example of how the technocratic point of view has generalized and simplified such natural phenomena as 'technical problem' hence applies technical knowledge to solution (Lebel and Sinh 2007; Molle 2007a). This kind of thinking may also relate to the value, circulated among NSI members in their training as well as their communication outside the class, which Kuhn considered to be another aspect in sustaining scientific paradigm within their community.

The site of scientific production like the classroom and laboratory mentioned above is very crucial in understanding the way scientific paradigm is constructed, confirmed, and installed in the mentality of fellow water scientists. It is within these spaces that students learn the questions to be asked, the appropriate methods of tackling problems, the accepted codes of interpretation as well as the very place where they are socialized into their respective scientific communities (Livingstone 2003). Next section, the article further investigates the products of hydrological science and the ways they are manipulated in the external use beyond science classrooms and laboratories.

Hydrological Mapping and Classication: Beyond Stable Charted Water

The very concept of 'river basin' to most of the people seems as a 'natural' or 'given' geographical feature on earth's landscape. It is an accepted idea in geophysical science as well as natural resource management that rarely, if not never at all, been questioned or problematized. This article, however, argues that the very concept of 'river basin' as well as other allied concepts of river classifications are in fact a matter of socially constructed technology of water science. By tracing back to its derivation and application in present usage, it shows political and sociological agendas behind the presumptive concept of 'natural' river classification in hydrological knowledge and practices.

It was in the later half of the 19th century that the concept of river basin was introduced as a knowledge system in order to cope with the complexity of flowing water course. The configurative scheme in mapping and identifying river's geographical features was mainly derived from the very belief in human's desire and capability in knowing, managing and even controlling 'wasted' runoff rivers, especially the large ones. The idea in seeing rivers as pivotal resources of the industrial revolution, promoted by scientists and political leaders in countries particularly Spain, France and the United States, led to the crucial step in natural history in subduing natural running rivers and, to certain extent, amounted to western missions in colonization and promotion of scientism in other parts of the world (Molle 2007b).

A hydrographic survey of the lower Mekong basin was initiated in 1961 with the aim to provide information in facilitating a plan of mainstream

river navigation (Jacobs 1996). The emphasis was then to map out characteristics of riverbed configuration and geo-morphological features in different sites along the river. Seeing the significance of large-scale, year-round river navigation as a stimulation of regional economy, the Mekong Secretariat was involved in updating hydrographical information in the late 1980s and early 1990s. In addition to the understanding of riverbed transformation, the Mekong Secretariat has given attention to accumulating data on rainfalls and runoff throughout the basin. This can be considered as one of the most persistent achievement of the MRC in preparing the region for hydrological engineering projects to be implemented in the future. By the early 1990s, at least 450 hydrological gauging stations were established along with more than 340 meteorological stations installed (Jacobs 1996) to cope with basin-wide climatic and hydraulic changes.

Scientific knowledge and practice not only have been shaped by regional factors such as political and economic fluxes as mentioned earlier, they have also been instrumental in fashioning regional identity (Livingstone 2003). The classification of river basin in terms of bounded upper and lower Mekong allows riparian states to cooperate within the logic of territorialized riverscape instead of the whole river basin. It can be said that the separation of Mekong river basin into two sub-basins, represented by and large through MRC maps, is not primarily based on the real nature of river feature. Rather, since the beginning of its establishment, it was political backdrop of former colonized states and Thailand that could permit cooperation for river management, while the upper stream in China territory was left out due to its distinctive political ideology. Only once 'Lower Mekong Basin' is territorially identified and virtually designated by maps, the emerging political aspiration along with regional cooperation and technical operations could then follow.

As we have seen from the early development of the Mekong region, the division of Mekong into distinctive upper and lower basin parts was crucial meant not only for making shared regional identity among members states watered by the downstream Mekong. But the division of river basin also encouraged other non-riparian states and organizations to get involve in transferring their modern technologies and knowledge into the lower region with confidence. The divide between upper and lower basin provide legitimate logic of managing the river exclusively at lower basin without much consideration of what was going on upstream. In other words, map production, as well as other scientific endeavors that follows, impose at once rational order on the seemingly chaos nature. This give governments and regional organization a sense of territorial coherence and hence supply technical science practitioners with geographical boundary essential for stimulating economic growth, exploiting resources, and even maintaining regional logic to defense political threats from outside (Livingstone 2003).

Hydrological Modeling: Seeing River for Water

In river management, it is often that scientific knowledge predominates decision-making and policy implementation, hence hydrologists are the main actor in dealing with 'technical' account in producing and justifying knowledge. Taking the current Mekong development for example, the mainstream approach in understanding river morphology, ecology, and its related applied knowledge concerning resource management among the river 'experts' has mainly focused on studies of scientific hydrology as a basis in river development projects such as dams, irrigation, and river navigation. The knowledge for river basin development has centered on developing numerical simulation 'models' of hydrological process. Computer simulations have become a common methodology in environmental sciences in which it can be used as a framework for formulating and testing theories as well as to make predictions for practical applications in response to demands from policy and decision makers (Beven 2002). Many hydrological techniques and models are concerned with the measurement, correlation and prediction. Models mainly involve the monitoring of water quality and quantity. The criteria used to identify water quality are temperature, oxygen solubility, turbidity, and chemical contamination while quantifiable aspect of water looks mainly for rainfall and river runoff. Most of the hydrological models developed for Mekong river basin management are based upon the knowledge gained from such data of physical approximation and computational understanding of the river.

The paradigm of scientific hydrology in Thailand and the Mekong basin as a whole is, since the beginning, framed with the hydrodynamic technical methods and engineering approach dominated by government's irrigation department and MRC scientific-trained hydrological experts. The data collected as inputs for hydrological models are primarily concerned with the measurement of mainstream flows and discharge, riverbank flood, rainfall, sediment load, water diversion, and chemical and well as biological components such as dissolved hydrogen, nutrients and aquatic animals in the water. The hydraulic model is a set of methodologies and simulation tools to understand the nature and predict changes in river geography, in particular area while the hydrological model may involves larger space of catchments or basin. Typically, most of the data used and the application of each model will be limited to location specificity of each section of river basin classified as sub-basins or tributaries. Each part of the river will be applied with different models and techniques depending on the priority or significance of the problems being managed, such as flood, hydropower, fishery, navigation, and irrigation. In addition, models are designed to use selected scientific methodologies to fit the purpose of a particular development project. For example, the hydrological model of rainfall-runoff type, involving mathematical data and calculation that reflect catchments storage and the amount and timing of the runoff response, would be used for hydropower dam and irrigation projects.

The first use of mathematical models, developed by the Secretariat of Mekong Interim Committee, was successfully introduced in 1979. Called DELTA and TIDAL models, these two modeling systems were designed to forecast water levels, discharge and salinity in the delta area during the dry season (Thammongkol 1986). With support of several development agencies, many computer-based models have been developed over the years to describe the hydrology and hydraulics of the river and its geographical changes of the Mekong basin. During 2002-2004, the MRC has developed its own package called 'Decision Support Framework' (DSF) to select and calibrate the models for Mekong river basin development under its Water Utilization Project (WUP). The DSF itself is funded by the Global Environment Facility through the World Bank. This DSF is considered by the MRC as 'a powerful analytical tool for understanding the behavior of the river basin and for making planning decisions on how best to manage its water and related natural resources' (MRC 2005b). The DSF system is made up of three main elements: Knowledge Base, Simulation Model, and Impact Analysis Tools. The Knowledge Base part containing information on the historical and existing resources and is hoped, as claimed by MRC, to collect relevant information on socio-economic and environmental conditions and prediction of how the situation may change in the future. A package of Simulation Models is used to predict the possible impacts of changes within the basin on the river system. The last element of DSF is a set of Impact Analysis Tools which are set for prediction of impacts response to changes in river system. Within the MRC's Decision Support Framework, unfortunately, the integration of alternative methods to hydrological knowledge, especially those arisen from socio-cultural perspectives, is very limited. Those socially relevant modes of water knowledge, though widely expressed and promoted by academics from several different fields, NGOs, media, and local peoples[5], are still finding its way to be merged into the mainstream hydrological knowledge in regional development circle.

Recently, a group of hydrologists working in the lower Mekong basin has expressed their concern that mathematical models and their results are often mistrusted, underutilized, or misused in management and decision making. For this, the role of models in water management seems to be both controversial and unclear (Sarkkula et al. 2007) In addition, several hydrologists and other academics working on the issues of Mekong water management asserted that some scientific information nowadays are simplified and misused by fellow experts and policy makers. In justifying feasibility and impacts of river development projects, people often look for 'simple truths' in understanding the complexities of natural world, hence creating what they called 'modern myths' of the Mekong hydrological knowledge (Kummu et al. 2008). Such modern myths cover wide ranges of information and technical knowledge in relations with hydrology such as flow alteration, bank erosion, floods, as well as the application of hydrology to development practices such as the issues of dam, population and integrated water resource management. On top of that, though choosing the right hydrological methodology and model is seemingly a matter of technical calculation, but, in fact, the decision of such choices in real application remains subject to diversified values and interests (Imamura 2007). For this, taking more realistic account of inherent uncertainties in modeling the environment is not only a matter of devoting greater effort and computer resources, but also involves a variety of other issues in the sociology of science, policy, and decision-making (Beven 2001 and 2002). In this sense, it is not only the technical aspect that matters, but also spiritual side of it that makes mathematical modeling acceptable and satisfactory to all (Sarkkula et al. 2007).

Hydrology in Fluid Societal Morphology

As the article has recounted contextual as well as brief historical development of Mekong hydrological science, it argues that the scientific hydrological knowledge and practice never enjoy its status in regional and local cultural vacuum. In fact, there has been, and still are, ideological, social, economic as well as political factors that always at work in shaping the production and articulation of water science in the region. The very idea that claims for the 'placeless' of science -- that the enterprise of science is untouched by local condition-- is truly obsolete here. Scientific knowledge is always modified when it moves and it is transformed as it travel (Livingstone 2003) to serve some kind of purposes of the knowledge providers or recipients especially in such a high political stake of Mekong region. In short, Mekong hydrology is by and large a very human enterprise situated in time and space of regional making process.

The article has pointed out that knowledge on water is epistemologically and sociologically problematic. If we approach water issues from the perspective of positivists' scientific relations, water management narrowly becomes mere technical matters. But, in fact, there is also a landscape where socio-political factors play crucial, and ubiquitous, roles (Chaiyan 2006) in determining what should be defined as problems, and what approaches should be taken to the problem of water knowledge production and policy implementation. To Kuhn (1996), a revolution in knowledge involves not merely a change in the general laws but also a change in the way the world is perceived, and a change in the standards that are brought to bear in appraising knowledge. In that sense, if hydrological knowledge in the Mekong is to be altered from merely based on mainstream scientificity to integrate the very aspect of sociology into knowledge production and practice, the open-minded scientists would be a very crucial agent of change in allowing the knowledge integration to really happen.

Feyerabend, in his book Science in a Free Society (1978), argues against any monolithic method to knowledge. He holds that any methodology, including scientific ones, has its limits and biases, hence tradition of thought and practice in which some particular method is situated should not be suppressed nor should any one method be canonized (Feyerabend 1978). Science, as Feyerabend explicitly contends, is inherently not superior

to any other kinds of knowledge. In fact, he proposes in his later work that knowledge can be both stable or in a state of flux which is also available in the form of public beliefs or reside in individuals as an ability to treat new situations in an imaginative way (Feyerabend 1988: 161). This is a kind of knowledge that Berger and Luckmann treat as 'common-sense' in humanistic approach in sociology of knowledge (Berger and Luckmann 1991). Thinking of knowledge in that sense, it allows the integration and liberalization of many subordinated knowledge systems that do not fit into scientific paradigm into consideration.

Levi-Strauss (1966 and 1978), among many, sees the possibility of integration of diversified knowledge for practical usage in society. He suggests that it is productive, for example, instead of contrasting magic and science, to compliment them as modes of acquiring knowledge. Both science and magic suggest the same sort of operations as they both approach the way we understand surrounding natures. For such matter, there are no fixed rational criteria of theory evaluation but, in fact, the assessment of knowledge still goes on with values (Russell 1983). Scientific reasoning is one amongst other values that constitute what we can consider as knowledge, but not the only one (Feyerabend 1975). In Feyerabend's Against Method, he writes (1975: 305-306):

> Everywhere science is enriched by unscientific methods and unscientific results, ... the separation of science and non-science is not only artificial but also detrimental to the advancement of knowledge. If we want to understand nature, if we want to master our physical surroundings, then we must use all ideas, all methods, and not just a small selection of them.

As mentioned in the earlier part of this article, to fix hydrological knowledge based merely on scientific methodology as a benchmark in river management is then an unjust treatment of the rest of varied knowledge on water.

The roles of epistemology and methodology to knowledge are not only that they should guide practices but, vice versa, be guided by practices (Feyerabend 1975). Social and physical environment are crucial factors in determining the relevance and reasons of existence to knowledge system. That is, knowledge are produced and changed as a result of decisions and actions which are influenced by complex social and materials conditions (Feyerabend 1975 and Russell 1983). The case of accumulated local knowledge on surrounding ecological system in relations to people's use of natural resources is an obvious example of how knowledge and practices are pragmatically interwoven. The knowledge in this sense is a source of information that does not stand in isolation from its context of practices. The articulation of local knowledge on natural resource use, for example, does not restrict to only one fixed methodology to knowledge, allowing what so-called methodological pluralism to permit flexible, innovative, and even imaginative approaches and opportunities to create knowledge. Furthermore, scientific methodology should be used neither to discriminate other form of existing knowledge nor to prohibit non-scientists to actively involve themselves in scientific production and implementation in our society. It is very important, as Feyerabend (1978) argues, whenever scientific practice affects the welfare of the lay people, the society should be given a power to challenge and examine it. For that, I argue, it is very important for our society to understand that not merely 'science' would only change the world. Rather the world itself, where the 'scientific' knowledge is very much entangled in its multi-cultures, should closely determine how science is to be raised in our society, and, needless to say, in relations to other forms of prevalent knowledge.

The article has investigated some crucial aspects in sociology of hydrological knowledge in the Mekong region. The science of Mekong hydrology, as the article shows, is always the product of specific time and spaces where sociology of knowledge plays a crucial role in determining

it production and use. These critical examinations point to the argument made at the early stage of this article that the presumption of universality and impartiality of scientific knowledge need to be seriously taken into account as to understand how certain scientific-founded scheme failed when undergoing humanized context. The sole acceptance of scientific hydrology as a benchmark in defining the regional water knowledge at large is problematic, and needs to be accompanied by thorough analysis of cultural factors that this article has unraveled.

Endnote

[1] This working article is part of an ongoing postgraduate research entitled 'Ethnohydrology and the Mekong riverine resource management'. Financial support is from Mekong Program on Water, Environment and Resilience (M-POWER)

[2] PhD candidate, Resource Management in Asia-Pacific Program, Research School of Pacific and Asian Studies, The Australian National University.

[3] My intention here is to use 'Normal Science Institution' as a pseudonym to represent academic institutions that, by and large, deal with techno-science in teaching, researching, and its practicum.

[4] The vice president of Italian-Thai Development, Mr.Thanin Bumrungsap, concurrently director of Nam Thuen2 power company in Laos and is involved with other hydropower projects in South Asia, is one of the well-recognized alumni invited by the institution to give a speech and share experiences in water project business during the student orientation at the start of the academic year.

[5] See some villagers research projects and publications related to their 'local' riverine knowledge at http://www.livingriversiam.org and NGO's campaign on www.terraper.org

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