Key Fisheries Issues in the Mekong Region

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I. INTRODUCTION

The population of the Mekong Region - Yunnan province of China, Myanmar, Laos, Thailand, Cambodia and Viet Nam - exceeds 240 million with approximately 70 million people living in the Mekong River Basin (MRB). In spite of its rich biophysical attributes, the majority of the MRB inhabitants are living below the nominal economic poverty index of less than US$ 1 or 2 a day. Annual average income levels of each Mekong Basin inhabitant is between US$260 to US$ 450 (MRC, 2003).

For the majority of the rural people of the Mekong Region, aquatic resources (fish) play an important role in livelihoods and are the most important protein source to these communities. Fish together with rice are essential elements in food security for the region. Currently, the level of understanding of the role of natural resources in livelihoods and the likely impact of the forces of change on these components is limited and often fragmentary. The following narrative provides a general overview of the key issues related to the use and management of aquatic resources of the Mekong Basin. Most of the Mekong fisheries issues start from a problem of fit, especially the lack of the effectiveness of environmental and resource regimes to prevent and minimize undesirable changes and to solve problems once they arise (Young, 2002).

There are effectively three dominant issues that are and will continue to influence the sustainable management aquatic resources in the Mekong, namely, (1) resource utilization and there impact on the livelihoods of users; (2) institutional constraints; and (3) "limited availability and consumption of usable knowledge". The rest of this narrative is structured to address these three issues in a linear way.

II. RESOURCE USE AND LIVELIHOODS

A. Importance of aquatic resources for the livelihoods of lower Mekong Basin (LMB) communities

From the literature reviewed and individual interviews undertaken, there is little doubt in the importance of these aquatic resources in providing an important source of nutrition, income and employment for the large majority of rural dwellers in the basin. Rural families commonly harvest fish and other aquatic animals such as crabs, shrimps, snails, frogs, insects and plants from nearby fields, canals, ponds, rivers, streams, lakes etc. (CEMARE, 2002). Fish is the primary source of animal protein in the Basin and comprises between 40 to 80% of the total animal protein intake within these communities (FAO, 2004). The fisheries sector, in particular subsistence fisheries, is therefore crucial to the dietary requirements of people in the Mekong Basin (MRC, 2002).

The Mekong River stands third in the world as having the highest number of freshwater fish species and fourth in terms of tonnage caught. More than 1,200 different fish species have been identified in the Mekong basin with new species being discovered almost on a monthly basis (Baran, 2005). The freshwater capture fishery is one of the single most important economic activities in the basin. Socially, the Mekong fisheries range from individuals fishing part-time for subsistence, to medium and large-scale industrial operations.

The Mekong Region has one of the highest rates of freshwater fish consumption in the world and the most intensive fisheries in terms of catch per person. The average basin consumption of freshwater fish is 56 kg/person/year (MRC, 2002). This varies from 10 kg/person/year in mountainous areas of the basin to 89 kg/person and 60 kg/person in the flood plain respectively in Cambodia and Viet Nam (Baran, 2005). It has been assumed by some quarters that everyone is convinced of the importance of these resources in the livelihoods of communities in the basin. Nonetheless, its true value has often been ignored or given lower priority in the face of "economically and socially higher priorities", e.g. Hydro-power production or other water uses. Hence, there is a need to encourage decision-makers and resource developers to pay more attention to the important contribution of aquatic resources to rural livelihoods with particular reference to poverty alleviation, rather than considering it as an obstacle or bottleneck for the overall development in the Mekong Region (CEMARE, 2002).

B. Future demand and supply - Threat to Food security

Figure 1A depicts the growth in total fish catch in the basin from 1976 to 2003 and the predicted total catch in 2050 based on levels of consumption increasing by either 1 or 2.4% annually. The dramatic increase in total fish extraction between 1976 and 2003 is attributed in part to an increase in fishing pressure, but more importantly, our ability to measure the total catch extracted though

improved calculation techniques. Early estimates of total catch extracted were due to gross under reporting by commercial fishers and the previously unaccounted for small scale family and rice field fisheries (Baran, 2005). Hence it is projected that total demand for food fish in 2050 will be between 3.5 million to 4.7 million tons - about 0.4 to 1.28 million tons higher than the 2003 catch.

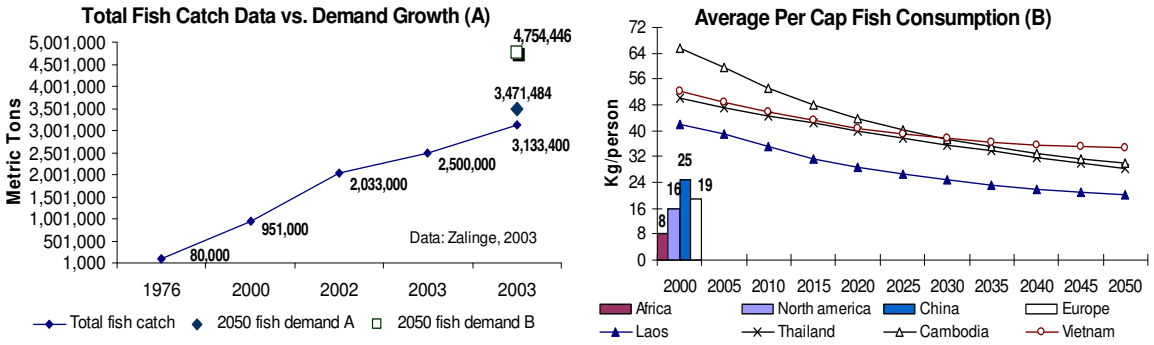

Figure 1 (a) growth in total fish catch over the period 1976 – 2003 with predicted growth for 2005 under two contrasting scenarios and (b) decline in per capita consumption of fish assuming 2003 catch levels.

There is concern that demand for fish may outpace the growth of total fish supply, resulting in a decrease in per capita fish supply. Figure 1 (B), shows the declining trend in per capita consumption of fish assuming that the level of catch will remain the same as of 2003 through to 2050. The average per capita fish supply in Thailand and Vietnam Mekong would be reduced by 11.4 kg/cap and 17 kg/cap respectively in 2050 from its 2003 values. Laos and Cambodia's per capita fish supply would be decreased by 2.2 to 2.4% annually proportionally to the population increase. The substantial reduction in this highly affordable source of animal protein will strongly affect those low income and subsistence populations the most.

The expected demand will definitely put further stress on the aquatic resources in the Mekong Basin. There is little prospect of finding new techniques or new stocks that may be exploited to provide significant increases in overall catch (FAO, 2004). Aquaculture fishery offers an opportunity to increase overall production levels however it faces several constraints. Figure 2A shows the trend in the production of aquaculture and reservoir fishery in selected Mekong countries during the period 1990-2003. In spite of the increase in production by other sources, the catch of wild fish remains dominant in the total fish catch in the Mekong Basin, since wild fish is highly productive and cheaper, and thus more affordable to many (Figure 2B).

While aquaculture is expected to make up for some of this shortfall, it is severely constrained by technology and extension service, financial viability of the poor and environmental issues. For instance, an expansion of aquaculture can contribute to increased environmental degradation when, for example, mangroves are cleared for pond systems as it is currently the case in the Mekong Delta (CEMARE, 2002). It is also worrisome that the inappropriate introduction of alien fish species may cause adverse impacts on the environment and biodiversity (ADB, 2005). From a food security perspective and given the high dependency of large numbers of people for their livelihoods on aquatic resources, the poorest households are likely to be heavily impacted by these changes.

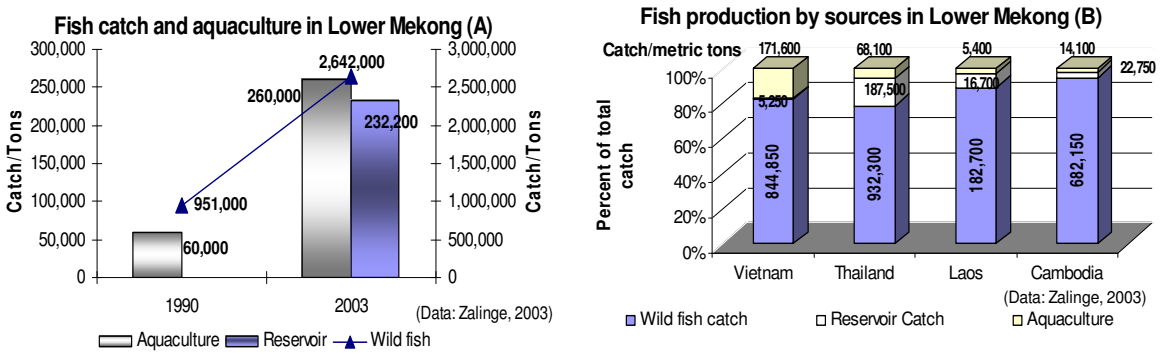

Figure 2 (A) Growth in aquaculture fish production vs. wild fish catch and reservoir fishery; (B) Fish production by sources (data sources: varied).

C. Its Social and Economic values are severely undervalued

Another key problem facing fisheries is that the value of the fisheries resource is usually ill defined and poorly represented from an economic and social perspective. This is born out by the paucity of information on the economic value of fisheries and institutional constraints such as lack of appropriate capacities to collate and analyse relevant data and information. A large number of recent studies underline the high potential of different scales of fishing activities for economic development (both at local and national levels) but systematically highlight how poorly the true (economic) value of this sector is reflected in official statistics and discussions of food security and livelihoods (Ian, et al, 2003). As a consequence, fish and fisheries are generally not considered of sufficiently high priority or value and thus suffer in the face of economically and socially higher priorities, e.g. Hydro-power production or other water uses.

Baran (2005) highlighted some contradictory figures about freshwater fish catch, and its economic values that appear in different publication and reports. He explained quoting Coates (2002) that "none of the countries reviewed derive their statistics based upon direct observation, report verification, sampling of catch or landing, or any other form of independent monitoring". Even in the preliminary estimates, the economic values of fish and other aquatic animals are considerable.

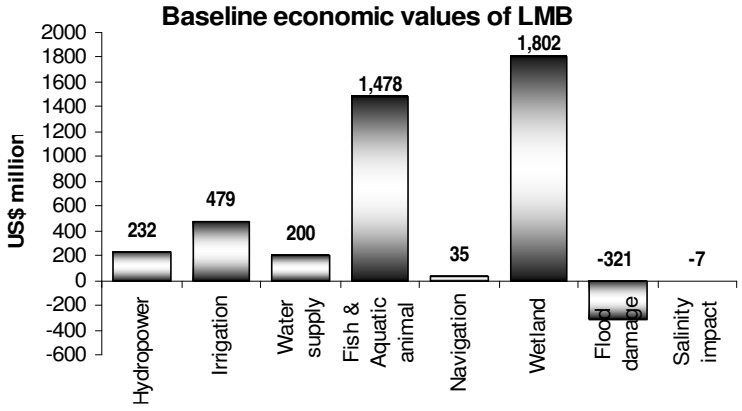

Figure 3 . Baseline values for LMB resources (data sources: MRC, 2006; Baran, 2005)

As shown in Figure 3, the economic values from aquatic resources and wetlands are extremely high. The economic values (first sale values) of freshwater fish and aquatic products are estimated ranging from US$ 1 billion (MRC, 2006) to over 1.478 billion (MRC 2002, Baran, 2005, Navy, Leang & Chuenpagdee, 2006). Baran (2005) maintained that if including all multiplier effects, the fishery is worth several times more than this figure and its replacement value is far higher.

If fisheries are to be promoted in the future, there is an urgent need to provide robust, defensible, social and economic valuation of aquatic biodiversity and fisheries (Ian, et al, 2003). Accurate valuation of the fisheries considering the upstream economic value in terms of aesthetic and conservation value and the provision of goods and services, or the downstream value associated with

the service sectors and livelihood must find its way into the decision making process with respect to development (Ian, et al, 2003). The recent inclusion of its social and economic values in considering the impacts from the hydrological changes by the MRC Integrated Basin Flow Management presents a step forward (MRC, 2006), though it remains to be seen how far it would go.

D Problems affecting fish productivity

The Mekong fishery's high productivity level is a function of the high biodiversity, large accessible floodplains, and high exploitation rates in many parts of the Mekong Basin; hence its annual fish production depends on a combination of different factors (Baran, 2005):

- Hydrological factors (water level and quality, flood duration and extent, flood timing, natural fluctuation);
- Habitat factors (type of inundated forest/vegetable, land cover, dry season refuge, turbidity);
- Biological factors (fish migration route/ access); and
- Fishing practice and management.

While production has almost doubled since the 1940s, the amount of fish caught per fisher, or the amount of fish per unit of effort, has declined as competition for the resource has become more intense. The size and quality of the fish caught is changing (Baran, 2005). Despite the lack of clear evidence of a decline in the overall production of the Mekong fish catches in the past, there are actual reasons why one should fear such a decline in the future. These threats are multiple, and they affect to varying degrees, the Mekong Basin as a whole (Baran, 2005).

Among the threats that can be listed here are:

- Destruction of spawning grounds or dry season refuges by habitat alterations (e.g. river bed blasting, dredging, removal of rapids or siltation, removal/alteration of vegetation).
- Construction of dams, weirs or diversions which act as physical barriers to fish migrations, and substantially affecting natural flow patterns and flood extent;
- Changes in the quantity and quality of water available for sensitive habitats and the timing of hydrological events, and pollution from industry, agriculture and urban development (MRC, 2002).

However, as confirmed by numerous studies, the hydrological cycle is the most important influence affecting fish ecology and productivity (MRC, 2002, Baran, 2005, Sokhem, Kengo, Tanaka, 2005).

III. POLICY AND NATURAL RESOURCE MANAGEMENT ISSUES

Management of the Mekong basin occurs within two contrasting broad domains, namely the political and biophysical. The political domain results from the historical division of the region into countries, provinces and districts and the biophysical defines the basin as a whole and the sub-basin units that comprise it (CEREMARE, 2002). This section presents briefly the key institutional issues at the Mekong regional and national levels that are typically dominated by political domain.

A. Regional Management - inadequate natural resources management capacities

There are numerous international agreements and organizations whose mandate is to deal with the sustainable development and management of the rich resources of the Mekong Region. Each of them has its own set of membership, focus, principles or norms that determine how it operates and defines its strategic direction and priority. Coordination and integration among these organizations have been regrettably minimal. The major Mekong related regional institutions are the Mekong River Commission (MRC), the Greater Mekong Sub-region (GMS), the Association of the Southeast Asian Nations (ASEAN), and the inter-governmental body set-up under the Agreement on Commercial Navigation on Lancang-Mekong River, 2000 (Upstream Navigation).

A.1 Mismatch in Organizational Jurisdiction, Basin Boundaries and Constraints in Governance

The institutional analysis by the authors based on an extensive analysis of the literature, and based on experts' observation shows a severe mismatch between organizational Jurisdiction and Basin natural boundary and the limitation of "Governance beyond governments" (see e.g., Badenoch & Dupar, 2001; Badenoch, 2002; ADB, 2002; Frost, 2005; Hirsh & Jensen, 2006). The analysis selected five simplified institutional variables, including: i) the level of access to the decision-making (starting from head of states to the grass-root level); ii) availability of permanent technical and administrative body; iii) structuring of the agenda setting and management system; iv) the organisation of the science-policy-

management interface; v) public participations, and vi) verification and compliance mechanisms. The overall grade of effectiveness was written as a numerical value.

Table 1. Institutional Arrangements and Level of Participation

Level of Access	ASEAN Mekong	GMS	MRC	Upstream Navigation
Membership (MS)	5	5	2	2
Summit (SM)	5	4	0	0
Ministerial (MIN)	4	5	4	0
Executive (EX)	3	4	4	2
Technical meetings (TWS)	5	5	5	2
Permanent bodies (PB)	4	4	5	0
Public-Private dialogue (PPD)	4	4	1	0
Science-policy interface (SPI)	3	2	3	0
Public participation (PP)	2	2	2	0
Compliance & verification (CVP)	0	0	2	0
Total score	***34***	***34***	***28***	***6***

(Scoring: 0 = none, 1 = lesser frequent or important, 2 = low, 3 = Moderate, 4 = High, 5 = Very high)

Table 1 shows the results from this analysis of the institutional effectiveness of the four selected regional organizations. ASEAN Mekong and GMS get most of the scores from their active engagements at summit, ministerial, and senior official level, for the presence of a permanent body, and private and public dialogue. But, as shown in the scores of all studied organizations are extremely low for public participation (PP), compliance and verification Process (CVP), and science-policy and management interaction (SPI). In recent years, some of these inter-state institutions attempted to introduce some form of public participation, mainly at the insistence of major donors and lending institutions. In general, all studied institutions do not have an effective verification and compliance mechanism. All studied organizations have their greatest strength in convening hundreds of meetings annually. However, they have a common weakness in compliance and verification of the implementation of the agreed policies and agreements (Badenoch, 2002).

As shown in Table 1, MRC and Upstream Navigation's effectiveness scores are severely compromised by the lack of full participation by all Mekong countries. To solve issues of highly dependency of the social and environmental systems in the Mekong Region requires an active cooperation on the part of all countries whose jurisdictions the MRB pass through as well as those states exercising jurisdiction over users whose development activities result in transboundary implications (Young, 2002).

A.2 Effectiveness of existing international legal institutions (Law and policies):

Currently there are two Mekong related international agreements and one key political declaration, namely, the 1995 Mekong Agreement, and 2000 Agreement on Commercial Navigation on the Lancang-Mekong River, and 2005 Kunming Declaration of the 2nd GMS summit.

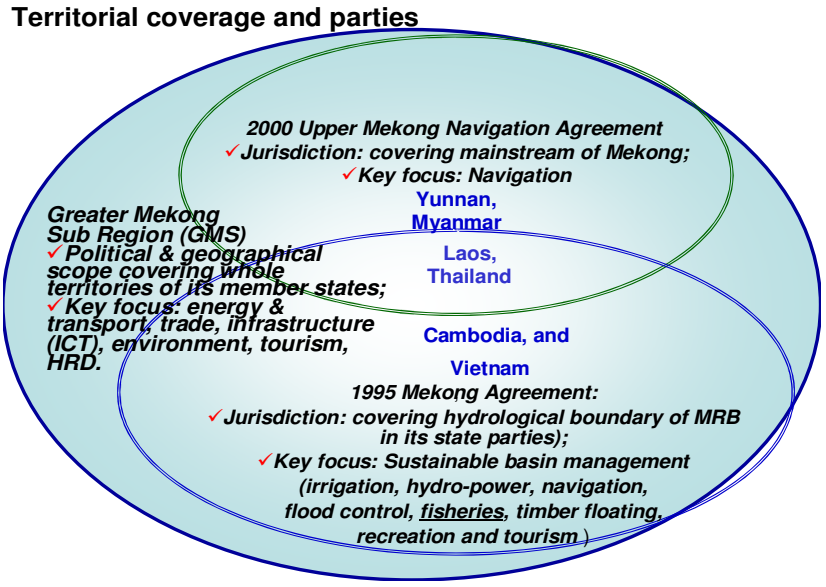

Figure 4 Territorial coverage, membership and strategic focus

The obligations (legal) contained in the first two Agreements form the basis for enabling cooperation, planning and implementation of projects. The 1995 Mekong Agreement while focusing on cooperation in various sectors (Figure 4) has specific provisions on the fisheries resources and maintenance of ecological balance. However, as observed, with no detailed regional regulatory mechanisms or any indication of what legally-backed environmental standards and sustainable development that are to be achieved, the provisions are dependent on the making of additional rules and the preparation of procedures. That creates another level of uncertainty and different expectations.

Heads of Governments have acknowledged that the GMS by having placed over-emphasis on the economic development has not paid adequate attention to the development of social and environmental infrastructure and monitoring capabilities (paragraphs 27 and 29, Kunming Declaration, 2005). It further admits the need to address equitable distribution of its benefits derived from the rich resources of the Mekong River Basin (paragraph 23, Kunming Declaration, 2005). Hence the aforementioned acknowledgement demonstrates transboundary impacts, distributional issues and social equity are yet to be adequately addressed in most of the Mekong regional State organizations. The controversy surrounding the environmental impact assessments (EIAs) executed by Chinese scientists in the Upper Mekong Navigation Channel Improvement Project (UMNIP) under the 2000 Navigation Agreement are a case in point (Deeter, 2005). Its proponent asserted that the (UMNIP) program would not negatively affect the river's biodiversity or the downstream environment (Zirun, 2003). Yet, an independent evaluation of the UMNIP EIA, performed at the request of the MRC, stated:

> … Basically, from the perspective of the fish fauna of the Mekong River, the virtual total absence of either investigation of biological values in the river, or the lack of any quantitative data on these values in the river, leaves a reader trying to evaluate the EIA without anything of substance to evaluate. Statements made are unsupported assertions which may or may not be correct. That being so the EIA lacks credibility (McDowell, 2002).

> [the] EIA is unacceptable in many respects. Far too much of the content is based on speculation, the data that is used is patently inadequate, longer-term impacts are almost entirely overlooked, and the cumulative impacts both social and environment, are essentially ignored (Cocklin and Hain, 2001).

Unfortunately, very few, if not any, EIAs of other major development projects have been made available for public review or scrutiny. Credible EIA process and opportunities for input from interested communities, groups and individuals through a well-structured public participation and multi

stakeholders dialogues, are urgently needed in order to promote inclusion of the views of all stakeholders or potential stakeholders, and early consideration of multiple interests and impacts.

B. National and local Management - inadequate natural resources management capacities

While natural resource management activities function at a rudimentary level in many countries, some of the riparian countries are doubly afflicted in that they lack some of the basic institutional elements to even begin. This, in turn, reduces the capacity of the governments to manage and administer their affairs and constrains development, and limits ability to assess and integrate the 'real' values of natural resources (CEMARE, 2002). Hirsch and Jensen (2006) found that existing national institutions are used very ineffectively due to lack of capacity and overlapping of responsibilities. In particular, several reports emphasise the shortage of people trained in practical aspects of data collection, data analysis and integrated, cross-sectoral basin management, including the ability to assess the 'real' values of natural resources.

For example, in Cambodia, the national institutional arrangement for the management of the Mekong Basin is rather complex and complicated with certain rivalries, mismatches and overlaps. The regional congestion of Mekong initiatives and institutions also unfortunately leaves its marks in the national institutional set-up (Sokhem and Kengo, 2006).

IV. "LIMITED AVAILABILITY OF USABLE KNOWLEDGE"

Efforts to match institutional arrangements governing human actions to the properties of bio geophysical systems cannot succeed in the absence of usable knowledge regarding the ecosystems in questions. It requires the development of usable knowledge in one form or another (western scientific tradition and the informal knowledge of the sort accumulated by indigenous peoples living in close contact with the same ecosystems of the MRB over long periods of time).

From a review of the literature and interviews of various stakeholders, it appears that one major constraint facing national and regional/international institutions responsible for the MRB's development is the lack of data. This lack of data leads to a failure to fully understand and correctly evaluate:

- ✓ economic value of the river *as it naturally flows*,
- ✓ ecological and livelihoods benefits of the rivers and its floodplain environment for the local population (and in particular the poorest); and
- ✓ sustainability tests to quantify the relationship between development and impacts, and to support consideration and integration of multiple stresses and magnitude and multiple risk/degree of vulnerabilities.

A. Information gaps and lack of its application

There exists a large and growing literature on the Mekong Basin and its aquatic resources. However, given the size and complexity of the resource system at all levels, it is not surprising that there are important information gaps. From a preliminary analysis of the literature, there appears to be an adequate understanding of the physical (e.g. hydrology), environmental (e.g. land/water use) and biological (e.g. fish stocks) characteristics of the Mekong Basin. The biggest gaps remain in the areas of economic, social, institutional, policy and political knowledge (CERAME, 2002).

There are also circumstances where the available knowledge is simply ignored or questioned. It is also a source of mismatch, especially when it is combined with an attitude of dominance that licenses or even encourages human exploitation of natural resources unless and until the consequences become demonstrably destructive. In other cases, ignorance involves a lack of understanding of the causal mechanisms at work in large, dynamic systems (Young, 2002).

The main social knowledge need, in addition to the knowledge on the natural conditions and trend, includes:

- ✓ Economics: What is the economic value of the aquatic resources and the river under natural flows? What contribution do the resources make to livelihoods?
- ✓ Social: What is the composition of the stakeholder groups? What is the relationship between these groups?
- ✓ Institutional: What are the main institutional and organisational arrangements which affect the management and use of the aquatic resources?

- ✓ Policy: What are the current policy arrangements? What is the performance of policy in terms of economic, social and development indicators?
- ✓ Politics: How do different stakeholder groups in society affect policy-making and implementation? What incentives could lead to changes in policy and policy-making in order to promote sustainable development? (CERAME, 2002)

The extent to which the knowledge gaps above could be filled within the short-term depends on a number of factors. From a positive perspective, there are a large number of research and development projects operating in the region, both national and international, some of which have research components (although environmental and ecological research predominates). From a negative perspective, the size and complexity of the science knowledge gaps within the Mekong Basin are considerable. Many of the subject areas are also sensitive and difficult to research. Finally, there is a limited local research capacity which will need to be addressed (CERAME, 2002).

B. Gap between Knowledge Generation and Consumption

It is true that there are huge gaps in useable knowledge. Another equally critical issue is the poor linkage between knowledge generation and its consumption. The knowledge needs and hierarchy plotted in Figure 5 place an emphasis on generating information and analysis which will help to promote a better understanding of key issues – multi-functionality of resources, societal demands and sustainability threshold.

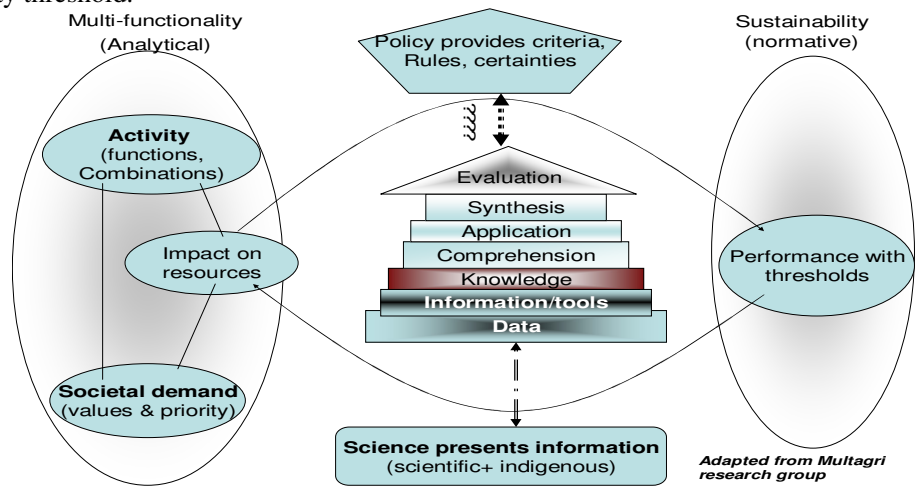

Figure 5 Formalization of links between bio-geophysical properties, sustainability, policy and science

Under the linear model of policy-making and implementation, benign policy-makers are assumed to utilise the information and better understanding to improve policy design for the benefit of society. In this situation, research and research scientists play the traditional role of information providers for policy-makers, who make policy decisions and then hand these decisions down to administrators (managers) for implementation through various management arrangements (CERAME, 2002). Unfortunately in the Mekong Region, the relationship between Science-Policy and Management does not always conform to this linear model. There are also circumstances where the available knowledge is simply ignored or questioned. It is a source of mismatch, especially when it is combined with an attitude of dominance that licenses or even encourages human exploitation of natural resources unless and until the consequences become demonstrably destructive. In other cases, ignorance involves a lack of understanding of the causal mechanisms at work in large, dynamic systems (Young, 2002).

The key concerns are as follows:

1. The generation on information on the social, economic and natural aspects of aquatic resources in the Mekong is important
2. As non-linear policy-making model tends to predominate in the countries of the Mekong Basin, the framework for promoting the effectiveness of systems that links knowledge to action for sustainability (science-policy-management interface) is needed;
3. It is necessary for simultaneously promoting the salience (meet the needs), credibility and legitimacy (acceptance) of the knowledge.

4. As non-linear model of policy-making is also characterised by a lack of participation in decision-making by a majority of stakeholders also needs to be addressed. Greater participation, in particular by primary stakeholders (e.g. fishers, farmers) is essential for the successful design and implementation of appropriate resource management policies (CERAME, 2002).

This narrative concludes with a few words of wisdom from Lebel - "Scientists, policy-makers and resource managers must recognize we will always be dealing with multiple, conflicting, constraints and incomplete, uncertain, information….. Bridging the gaps in understanding and communication is the key to improving the capacity of Southeast Asian nations to adapt to global environmental change. General strategies for improving links between science and policy need to focus on creating opportunities for more frequent communication, the promotion of better understanding, and encouraging greater participation" (Louis Lebel, 1996).

V. CONCLUSION

There is a need to understand the contribution of aquatic resources to rural livelihoods and as an integral part to sustainable livelihood development framework with particular reference to poverty alleviation, rather than considering it as an obstacle or bottleneck in the overall development in the Mekong Region. We need to understand the impact of current natural resource management strategies and policies both on local populations and the environment and to use this as a basis to develop appropriate strategies and policies in the future.

The expected fish demand will definitely put further stress on the aquatic resources in the Mekong Basin. There is little prospect of finding new techniques or new stocks that may be exploited to provide significant increases in overall catch. The aquaculture fishery is growing constantly, but it faces significant challenges. Food security-wise and given the high dependency of large numbers of people for their livelihoods on aquatic resources, the poorest households are likely to be heavily impacted by these changes.

Another key problem facing fisheries is that the value of the fisheries resource is usually ill defined and poorly represented from an economic and social perspective. As a consequence, fish and fisheries are generally not considered of sufficiently high priority or value and thus suffer in the face of economically and socially higher priorities, e.g. hydro-power production or other water uses.

Accurate valuation of the fisheries considering the upstream economic value in terms of aesthetic and conservation value and the provision of goods and services, or the downstream value associated with the service sectors and livelihood must find its way in the decision makers' development equations.

Despite the lack of clear evidence of a decline in the overall production of the Mekong fish catches in the past, there are actual reasons why one should fear such a decline in the future. These threats are multiple, and they affect to varying degrees, the Mekong Basin as a whole. However as confirmed by numerous studies, the hydrological cycle has the greatest influence on fish ecology and productivity.

The institutional analysis of the major Mekong related regional institutions shows a severe mismatch between organizational jurisdiction and basin natural boundaries and the limitation of "Governance beyond governments". Credible EIA process and opportunities for input from interested communities, groups and individuals through well-structured public participation and multi stakeholders' dialogues, are urgently needed in order to promote inclusion of the views of all stakeholders or potential stakeholders, and early consideration of multiple interests and impacts.

The national capacity constraints in natural resource management reduces the capacity of the governments to manage and administer their affairs and constrains development, and limits the ability to assess and integrate the 'real' values of natural resources.

There exists a large and growing literature on the Mekong Basin and its aquatic resources. However, given the size and complexity of the resource system at all levels, it is not surprising that there are important information gaps. It is true that there are huge gaps in useable knowledge. Another equally critical issue is the poor linkage between knowledge generation and its consumption.

Bridging the gaps in understanding and communication is the key to improving the capacity for managing environmental change. General strategies for improving links between science and policy

need to focus on creating opportunities for more frequent communication, the promotion of better understanding, and encouraging greater participation.

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