Mekong River Commission

Freshwater Aquaculture in the Lower Mekong Basin

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Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
AIMS	Aquaculture of Indigenous Mekong Species
AIT	Asian Institute of Technology
DfID	Department for International Development (of the United Kingdom)
DOF	Department of Fisheries
FAO	Food and Agriculture Organization (of the United Nations)
IPM	Integrated Pest Management
Lao PDR	Lao People's Democratic Republic
LARReC	Living Aquatic Resources Research Centre
MRC	Mekong River Commission
NACA	Network of Aquaculture Centres in Asia-Pacific
NGO	Non-governmental organisation
READ	Rural Extension for Aquaculture Development
STREAM	Support to Regional Aquatic Resources Management
VAC	Vietnamese words vuon (garden or orchard), ao (fish pond) and chuong (pig sty or poultry shed).

Table of Contents

Summary

1. Background

The farming of fish and other aquatic animals and plants or aquaculture, is an increasingly important rural activity and source of food and income for people living in the Lower Mekong Basin. This paper reviews the status of inland aquaculture in the Lower Mekong Basin countries of Cambodia, Lao PDR, Thailand and Viet Nam. It identifies key factors shaping aquaculture development and provides recommendations to increase its future importance in food production and rural development in the basin. The information contained in this report came through written contributions from and consultations with Mekong aquaculture and rural development experts. An initial draft was prepared in 2001 for the Mekong River Commission (MRC) Fisheries Sector Review, and subsequently edited into this separate MRC Technical Paper on aquaculture. The paper provides a timely and important review of aquaculture as a significant means of food production and a contributor to rural livelihoods in the Lower Mekong Basin.

2. Status of aquaculture

Aquaculture in the Mekong Basin is a diverse activity. It encompasses breeding, rearing and sale of fish fry and fingerlings, and growing of wild or artificially-reared fry and fingerlings in enclosed or semi-enclosed water bodies, such as ponds, rice fields and fish cages. The products from aquaculture are marketed, and often also used for home consumption. Supplying inputs for farming, such as fish seed and feed, and handling, processing, marketing and consumption of aquaculture products are important components in the livelihoods of men, women and children in many rural households in the Mekong Basin.

There has been a steady growth in inland aquaculture production in all countries of the Lower Mekong Basin over the past 10 years, from around 60,000 tonnes in 1990 to around 260,000 tonnes in 1999/2000. This equates to 12-13 percent of the total freshwater aquatic animal production in the Lower Mekong Basin (an estimated 2,036,000 tonnes). This does not include production of fish and shrimp in the brackish waters of the Mekong Delta. The development of aquaculture in the Mekong Basin has been uneven though. Most aquaculture production takes place in the Mekong Delta in Viet Nam and on the Korat Plateau in Northeast Thailand, with much less production in Cambodia and Lao PDR. Nevertheless, this review suggests that official government statistics probably underestimate the importance of small-scale aquaculture, and that it is increasingly widespread and of growing importance as a source of food and income for rural households.

Government policy has contributed significantly to the recent growth in aquaculture. Over the past 10 years governments in all Mekong countries have increased investment in research, infrastructure, education and extension. The governments of Thailand and Viet Nam have invested considerably

more resources in aquaculture, and Viet Nam has an ambitious plan for capacity building and extension. Research support has traditionally focussed on technical issues, and less on formulating and implementing farmer-driven research agendas, but recent shifts towards adaptive, farmer-needs-driven aquaculture development are evident.

The sustainability of aquaculture is closely linked to the natural resource base in the Mekong Basin. Small-scale aquaculture can contribute to environmental improvement, such as through dry season water storage and recycling of agricultural wastes through aquaculture ponds. Environmental concerns relate to water pollution from other sectors, such as agriculture, water shortages, spread of aquatic animal diseases, adverse impacts of intensive cage fish farming, trematode infections and loss of genetic diversity through poor breeding practice and ill-considered trans-boundary movement of stocks. These problems can be mitigated by adoption of better farm management practices and farming systems, and development strategies that integrate aquaculture into the farms and natural ecosystems of the basin. Where the objective is poverty alleviation, support based around an understanding of poor people's livelihoods can be a valuable development strategy.

3. Future of aquaculture

The future will see continuing expansion of aquaculture within the Mekong Basin. At the macro-level, population trends for the basin suggest an additional 400,000 tonnes of aquatic animal product will be needed in 10 years to maintain consumption at present levels. Aquaculture development will have a critical role in contributing to this demand.

Throughout the rural areas of the basin, experience shows that small-scale farm households make individually small but important contributions to aquaculture production. The potential for increasing the impact of aquaculture on rural development in the Mekong Basin is substantial. In some areas where wild fish supply is limited and there is serious food insecurity and poverty, such as the highland areas of Lao PDR and Viet Nam, and away from the Tonle Sap-Mekong River corridor in Cambodia, aquaculture can and should be used to improve food security. To increase the positive impacts of aquaculture throughout the basin, targeted support needs to be provided to small-scale aquaculture and to the special obstacles that poor people face, such as access to credit and extension support.

The technologies for small-scale aquaculture have been largely put in place over the past 10 years, which is a significant achievement. The technologies for small-scale aquaculture that work for poor rural households can be characterised as ones which require low investment, little risk and provide quick returns. They also are simple, easy to copy, easy to extend, trainers can be easily trained and they contribute to local fish supply. These aquaculture technologies may include ponds, nursing of fish in hapas in common water bodies, raising of fish in rice fields and simple cage culture technologies.

Aquaculture will require various inputs to support its anticipated growth, such as sufficient fish seed, feed for the fish (fertilisers and feeds), and land area and water. Services that support aquaculture are important, particularly at local levels. In rural areas where there is potential for aquaculture, services are needed to extend knowledge and build institutional support. Involving poor people requires a shift in extension thinking away from technology towards a more flexible people-centred and participatory approach using innovative communication mechanisms. Focusing government support on small-scale aquaculture and understanding and working with poorer rural households will provide a necessary balance to more commercially-oriented aquaculture.

Several regional, basin-wide, issues will also affect the future of aquaculture. These include sharing of experiences and knowledge on aquaculture development, particularly small-scale aquaculture and working towards common policy on basin-wide issues. Two issues that deserve particular attention are control of aquatic animal diseases and reduction of the risks to wild stocks from the introduction of exotics or, through trans-boundary movement, the mixing of genetically-different indigenous fish strains.

To date, development of aquaculture has been largely sectorally driven. In future, governments and supporting agencies will give more attention to the promotion of aquaculture within a rural development framework. MRC's focus on environmentally-sustainable development in sub-basins shared by more than one country provides an opportunity for testing more systematic approaches to aquaculture and for raising the profile of aquaculture as a tool for poverty alleviation.

4. Recommendations

4.1 Aquaculture within the framework of the Mekong Basin Development Plan. Dividing the Mekong Basin into catchments or clusters of catchments, as proposed by MRC, provides the opportunity for systematic support to aquaculture development that targets poverty and food insecurity. The catchment approach is quite new, therefore, a step-by-step approach should be adopted using the lessons learned from pilot projects to gradually extend knowledge to other catchments.

4.2 Support for small-scale aquaculture and services for aquaculture development. Future development support should build effective services that support the objectives of small-scale farms and poor households. This approach will require considerable capacity building among local, provincial and national institutions to encourage use of participatory approaches to planning and extension, improve access to knowledge and develop national planning processes and policy which focus on the needs of rural households.

4.3 Strategically analyse aquaculture development requirements. The potential for aquaculture is probably greatest in food insecure and remote areas of the basin. These areas include the highlands and areas away from the Mekong and large fishing grounds such as the Great Lake in Cambodia. To support this, a strategic analysis of aquaculture potential in sub-basins should be carried out.

4.4 Research cooperation. Regional research cooperation should be encouraged as a cost-effective means of addressing key constraints to aquaculture development, such as those identified in the review. Collaborative research should particularly include small-scale rural aquaculture practitioners from impoverished households in remote areas.

4.5 Development of common policy in the Mekong Basin. There are a number of aquaculture-related issues that transcend national boundaries, such as the movement of live aquatic animals between watersheds, and the use of exotic species. The former raises concerns about the loss of genetic diversity and the spread of aquatic animal diseases. Proliferation of exotic species in natural waterways will be detrimental for indigenous species. Cooperation among riparian countries is necessary to prepare common policy and management strategies that address such issues. It is hoped that MRC will continue to support the valuable work of the Technical Advisory Body on Fisheries Management and other riparian bodies that enhance communication and address common development concerns.

4.6 Communication and partnerships. There are opportunities to build more effective partnerships among various development agencies working in aquaculture and rural development in the basin. Cooperation and sharing of experiences between stakeholders through effective communication is important if the intellectual and capital resources available are to be used to the best advantage.

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4-6 TnakTngngPaBCÉdKr³

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ບົດສະຫລຸບຫຍໍ້

1. ປະຫວັດຄວາມເປັນມາ

ການລ້ຽງປາ, ການລ້ຽງສັດນ້ຳອື່ນໆ ແລະການປູກຝັງ, ແມ່ນເປັນວຽກງານ ທີ່ມີຄວາມສຳຄັນ ແລະ ເພີ້ມຂຶ້ນເລື້ອຍໆໃນເຂດຊົນນະບົດ ຊຶ່ງທັງເປັນແຫລ່ງອາຫານ ແລະສ້າງລາຍຮັບ ໃຫ້ແກ່ປະຊາຊົນ ທີ່ອາໄສຢູ່ໃນເຂດອ່າງແມ່ນ້ຳຂອງ. ບົດລາຍງານ ສະບັບນີ້ ໄດ້ກວດກາຄືນ ເຖິງສະພາບ ການລ້ຽງ ສັດນ້ຳຈືດ ໃນບັນດາປະເທດ ຢູ່ໃນອ່າງແມ່ນ້ຳຂອງຕອນລຸ່ມ ຄື: ກຳປູເຈ, ສປປ ລາວ, ໄທ ແລະ ຫວຽດນາມ; ຊຶ່ງໄດ້ພິສູດໃຫ້ເຫັນເຖິງປັດໄຈທີ່ເປັນປາຍແຫລມໃນການພັດທະນາການລ້ຽງສັດນ້ຳ; ໃຫ້ຂໍ້ສະເໜີແນະ ເພື່ອຍົກສະມັດຕະພາບໃນການຜະລິດອາຫານໃນອານາຄົດ ແລະ ການພັດທະ ນາຊົນນະບົດ ໃນຂົງເຂດອ່າງ. ຂໍ້ມູນຕ່າງໆ ຢູ່ໃນບົດລາຍງານສະບັບນີ້ ແມ່ນໄດ້ມາຈາກ ການປະ ກອບສ່ວນ ຂອງບັນດາ ຜູ້ຊ່ຽວຊານ ນັກວິຊາການ ທີ່ເຮັດວຽກກ່ຽວການພັດທະນາຊົນນະບົດ ແລະ ການລ້ຽງສັດນ້ຳໃນອ່າງແມ່ນ້ຳຂອງ. ຮ່າງເບື້ອງຕົ້ນ ຂອງບົດລາຍງານນີ້ ແມ່ນໄດ້ຂຽນຂຶ້ນໃນປີ 2001 ເພື່ອປະກອບໃສ່ບົດກວດກາຂະແໜງການປະມົງ ຂອງ ຄະນະກຳມາທິການ ແມ່ນ້ຳຂອງ ສາກົນ (MRC); ຈາກນັ້ນ ຈຶ່ງໄດ້ ປັບປຸງ ແລະ ຍົກຂຶ້ນມາເປັນ ບົດລາຍງານເຕັກນິກກ່ຽວກັບການ ລ້ຽງສັດນ້ຳ ຂອງ MRC (MRC Technical Paper on Aquaculture). ບົດລາຍງານໄດ້ຊີ້ ໃຫ້ຫັນໂອກາດ ແລະ ຄວາມສຳຄັນຕໍ່ການກວດກາຄືນ ກ່ຽວກັບຄວາມສຳຄັນ ຂອງການລ້ຽງສັດນ້ຳ ໃນການຜະລິດອາຫານ ແລະ ເປັນການປະກອບເຂົ້າໃນການດຳລົງຊີວິດ ຂອງຊາວຊົນນະບົດ ໃນ ເຂດອ່າງແມ່ນ້ຳຂອງ.

2. ສະພາບການລ້ຽງສັດນ້ຳໃນປັດຈຸບັນ

ການລ້ຽງສັດນ້ຳ ໃນອ່າງແມ່ນ້ຳຂອງຕອນລຸ່ມນີ້ ແມ່ນມີຫລາຍຮູບ ຫລາຍແບບ ຊຶ່ງລວມມີ: ການປະ ສົມພັນ, ການລ້ຽງ ແລະ ຂາຍລູກປາ, ການຈັບປາຈາກທຳມະຊາດມາລ້ຽງ, ການລ້ຽງແບບວິທະຍາ ສາດ ແລະ ເຄິ່ງວິທະຍາສາດ ເຊັ່ນ: ລ້ຽງໃນໜອງ/ສະ, ໃນນາເຂົ້າ ແລະ ລ້ຽງໃນຄອກ (ກະຊັງ). ຜົນ ຜະລິດ ແມ່ນຂາຍໃນທ້ອງຕະຫລາດ, ແຕ່ສ່ວນຫລາຍບໍລິໂພກພາຍໃນຄອບຄົວ. ການປະກອບ ສ່ວນໃນກິດຈະກຳ ການລ້ຽງສັດນ້ຳ ເຊັ່ນ ການປະສົມພັນ, ການໃຫ້ອາຫານ, ການຂົນສົ່ງ, ການປຸງ ແຕ່ງ, ການຕະຫລາດ ແລະຕະລອດເຖິງ ການບໍລິໂພກສັດນ້ຳ ແມ່ນມີຄວາມສຳຄັນໃນວິຖີຊີວິດ ຂອງທັ້ງຍິງ ແລະ ຊາຍ ພ້ອມທັ້ງ ເດັກນ້ອຍ ໃນເຂດຊົນນະບົດ ພາຍໃນອ່າງນ້ຳຂອງ.

ໃນ 10 ປີກ່ອາມານີ້ ຜົນຜະລິດ ຈາກການລ້ຽງສັດນ້ຳ ຢູ່ໃນບັນດາປະເທດ ໃນອ່າງແມ່ນ້ຳຂອງ ແມ່ນ ໄດ້ເພີ້ມຂຶ້ນເລື້ອຍມາ, ຈາກ 60,000 ໂຕນ ໃນປີ 1990 ເຖິງ 260,000 ໃນປີ 1999/2000.

ຊຶ່ງເທົ່າກັບ 12-13 ເປີເຊັນ ຂອງຜົນຜະລິດສັດນ້ຳຈືດທັງໝົດພາຍໃນອ່າງແມ່ນ້ຳຂອງ (ປະເມີນໄວ້ 2,036,000 ໂຕນ) ທີ່ບໍ່ທັນໄດ້ລວມ ຜົນຜະລິດ ປາ ແລະກຸ້ງ ໃນເຂດນ້ຳກ່ອຍ ທີ່ Mekong Delta. ບໍ່ຄາດຄິດວ່າ ການພັດທະນາ ການລ້ຽງສັດນ້ຳ ໃນເຂດອ່າງແມ່ນ້ຳຂອງ ຈະມີຜົນຜະລິດ ພົ້ນເດັ່ນຢ່າງນີ້ ການລ້ຽງສັດນ້ຳ ໂດຍສ່ວນຫລາຍແມ່ນຢູ່ໃນເຂດ Mekong Delta, ຫວຽດນາມ ແລະ ເຂດພູພຽງໂຄລາດ ພາກຕາເວັນອອກສ່ຽງເໜືອ ຂອງໄທ, ແຕ່ໃນ ສປປ ລາວ ແລະ ກຳປູເຈຍແມ່ນມີ ຜົນຜະລິດ ບໍ່ຫລາຍປານໃດ. ແຕ່ຢ່າງໃດກໍ່ຕາມ, ການກວດການີ້ ໄດ້ຊີ້ແນະວ່າ ສະຖິຕິທາງການ ຂອງ ລັດຖະບານ ແມ່ນ ອາດຈະປະເມີນບໍ່ໝົດ ເຊັ່ນ ຈາກຂະບວນ ການລ້ຽງປາ ຂະນາດນ້ອຍ ທີ່ກຳລັງມີການຂະຫຍາຍຕົວຂຶ້ນເລື້ອຍໆ ແລະ ມີຄວາມສຳຄັນຊຶ່ງກະຈາຍຢູ່ທົ່ວໄປ ທີ່ເປັນທັງ ແຫລ່ງອາຫານ ແລະ ແຫລ່ງລາຍຮັບ ຂອງ ຄອບຄົວ ຊາວຊົນນະບົດ.

ນະໂຍບາຍ ຂອງລັດຖະບານໄດ້ມີການ ປະກອບສ່ວນ ທີ່ ແຂງແຮງຕໍ່ ການ ຂະຫຍາຍ ການ ລ້ຽງສັດນ້ຳ ໃນຊ່ວງຜ່ານມານີ້. ໃນ 10 ປີ ຜ່ານມານີ້ ລັດຖະບານແຕ່ລະປະເທດໃນອ່າງ ນ້ຳຂອງ ໄດ້ເພີ້ມການລົງທຶນໃສ່ການຄົ້ນຄ້ວາ, ພື້ນຖານວັດຖຸເຕັກນິກ, ການສຶກສາ ແລະ ການຂຸກຍູ້ ສົ່ງເສີມ. ລັດຖະບານໄທ ແລະ ຫວຽດນາມ ໄດ້ລົງທຶນຈຳນວນ ອັນຫລວງຫລາຍ ໃສ່ໃນການ ລ້ຽງສັດນ້ຳ, ແລະ ຫວຽດນາມ ກໍ່ຍັງໄດ້ວາງແຜນສຳຫລັບການສ້າງ ບຸກຄະລາກອນ ແລະ ການຂຸກຍູ້ສົ່ງເສີມ. ຜ່ານມາ ການຄົ້ນຄ້ວາ ແມ່ນໄດ້ເນັ້ນໃສ່ ສະເພາະ ທາງ ດ້ານ ວິຊາການ, ສ່ວນພາກປະຕິບັດ ແລະ ການນຳໃຊ້ ລົງສູ່ຊາວກະສິກອນ ຍັງມີນ້ອຍ. ແຕ່ວ່າ ໃນຊ່ວງມໍ່ໆມານີ້ ໄດ້ມີການຫັນໄປສູ່ ການຄົ້ນຄ້ວາ ເພື່ອນຳໃຊ້, ຄວາມຕ້ອງການ ໃນການພັດທະນາ ດ້ານການ ລ້ຽງສັດນ້ຳ ຂອງຊາວ ກະສິກອນຍັງເປັນບັນຫາທີ່ພົ້ນເດັ່ນ ທີ່ຕ້ອງໄດ້ຮັບການປັບປຸງແກ້ໄຂ.

ການລ້ຽງສັດນ້ຳ ແບບຍືນຍົງ ແມ່ນມີ ການກ່ຽວພັນຢ່າງໃກ້ຊິດ ກັບ ແຫ່ລງ ຊັບພະຍາກອນທຳມະຊາດ ໃນອ່າງແມ່ນ້ຳຂອງ. ຂະບວນ ການລ້ຽງສັດນ້ຳ ຂະນາດນ້ອຍ ແມ່ນສາມາດ ປະກອບສ່ວນເຂົ້າ ໃນການປັບປຸງ ສະພາບແວດລ້ອມ ເຊັ່ນ: ການລ້ຽງປາໃນໜອງກັ້ນນ້ຳ (ນ້ຳຂັງ) ໃນລະດູແລ້ງ, ການນຳໃຊ້ສິ່ງເສດເຫລືອຈາກການກະສິກຳເປັນຕົ້ນ. ສິ່ງແວດລ້ອມທີ່ກ່ຽວພັນກັບ ການເຮັດໃຫ້ນ້ຳ ເປື້ອນ ຈາກ ຂະແໜງການອື່ນ ເຊັ່ນ ການກະສິກຳ, ການຂັງນ້ຳ, ການລະບາດຂອງພະຍາດສັດນ້ຳ, ຜົນກະທົບ ຂອງ ການລ້ຽງປາໃນກະຊັງທີ່ໜາແໜ້ນ, ການຕິດແປດຂອງພະຍາດ (ແມ່ທ້ອງ) ແລະການສູນເສຍ ທາງດ້ານກຳມະພັນເນື່ອງຈາກ ການປະສົມພັນທີ່ບໍ່ມີການຄວບຄຸມ ແລະ ການເຄື່ອນຍ້າຍແນວພັນ ຂ້າມເຂດແດນ. ບັນຫາເຫລົ່ານີ້ ແມ່ນສາມາດແກ້ໄຂໄດ້ ດ້ວຍການ ຈັດການ ລະບົບການລ້ຽງສັດນ້ຳ ທີ່ຖືກວິທີ ແລະ ເໝາະສົມ. ປັບປຸງ ແນວທາງນະໂຍບາຍ ປະສົມ ປະສານ ການລ້ຽງສັດນ້ຳ ໃຫ້ດຸ່ນດ່ຽງ ແລະ ເໝາະສົມກັບລະບົບນິເວດຂອງທຳມະຊາດພາຍ

ໃນອ່າງ. ຈຸດປະສົງ ແມ່ນແນໃສ່ການຫລຸດຜ່ອນຄວາມຍາກຈົນ, ຊຸກຍູ້ ພື້ນຖານ ແລະ ເຂົ້າໃຈ ເຖິງ ຊີວິດ ການເປັນຢູ່ຂອງປະຊາຊົນທີ່ທຸກຍາກ ແລະສາມາດພັດທະນາແນວທາງທີ່ມີຄຸນຄ່າ.

3. ສະພາບການລ້ຽງສັດນ້ຳໃນອານາຄົດ

ອານາຄົດຂອງການລ້ຽງສັດນ້ຳແມ່ນກຳລັງມີການຂະຍາຍຕົວຂຶ້ນພາຍໃນອ່າງແມ່ນ້ຳຂອງ.
ໃນລະດັບ ມະຫາພາກ, ປະຊາຊົນ (ຈຸລະພາກ) ແມ່ນຈະມີຄວາມຕ້ອງການເພີ້ມຜົນຜະລິດຕື່ມ 400,000 ໂຕນ, ເພື່ອ ຕອບສະໜອງໃຫ້ແກ່ການບໍລິໂພກສັດນ້ຳພາຍໃນອ່າງແມ່ນ້ຳຂອງ ໃນ 10 ປີຂ້າງໜ້າ. ສະນັ້ນການພັດທະນາການລ້ຽງສັດນ້ຳແມ່ນມີບົດບາດອັນໃຫຍ່ຫລວງ ເພື່ອຕອບສະ ໜອງຄວາມຕ້ອງການດັ່ງກ່າວ.

ເຖິງແມ່ນວ່າ ຂະບວນການລ້ຽງສັດນ້ຳ ຂະນາດນ້ອຍ ລະດັບຄອບຄົວ ສ່ວນບຸກຄົນ ທີ່ກະແຈກ ກະຈາຍຢູ່ໃນເຂດຊົນນະບົດ, ແຕ່ມັນກໍ່ໄດ້ປະກອບສ່ວນອັນສຳຄັນ ຕໍ່ຜົນຜະລິດ ຂອງການລ້ຽງ ສັດນ້ຳໂດຍລວມ. ໃນເຂດຊົນນະບົດ ຂອງອ່າງແມ່ນ້ຳຂອງ ແມ່ນຍັງມີ ທ່າແຮງໃນການຂະຍາຍ ການລ້ຽງສັດນ້ຳສູງ. ໃນບາງເຂດ ການຕອບສະໜອງປາ ຈາກທຳມະຊາດແມ່ນມີຈຳນວນ ຈຳກັດ, ແລະມີບັນຫາກ່ຽວກັບ ການຮັບປະກັນສະບຽງອາຫານ ແລະ ຄວາມທຸກຍາກຢ່າງຮ້າຍແຮງ, ເຊັ່ນ ເຂດພູດອຍ ໃນ ສປປ ລາວ ແລະ ຫວຽດນາມ, ແລະ ເຂດທີ່ຫ່າງໄກ ຈາກ ທະເລສາບ - ແມ່ນ້ຳ ຂອງ ກຳປູເຈຍ, ການລ້ຽງ ສັດນ້ຳ ສາມາດ ປະກອບສ່ວນໃນການ ປັບປຸງ ການຮັບປະກັນສະບຽງ ອາຫານ ໃນທ້ອງຖິ່ນ ດັ່ງກ່າວ. ເພື່ອເພີ້ມທະວີ ຜົນກະທົບທາງບວກຂອງການລ້ຽງສັດນ້ຳ ໃນ ທົ່ວທັງອ່າງ, ແມ່ນຈະຕ້ອງຊຸກຍູ້ ສິ່ງທີ່ຈຳເປັນໃນການລ້ຽງສັດນ້ຳ ຂະນາດນ້ອຍ ແລະ ບັນຫາ ຂໍ້ຫຍຸ້ງຍາກສະເພາະ ທີ່ປະຊາຊົນປະເຊີນຢູ່ ເຊັ່ນ: ແຫລ່ງທຶນ ແລະ ການບໍລິການ ດ້ານການ ສົ່ງເສີມ.

ເຕັກໂນໂລຊີ ສຳຫລັບ ການລ້ຽງສັດນ້ຳ ຂະນາດນ້ອຍ ແມ່ນໄດ້ມີການແພ່ຂະຫຍາຍຢ່າງກ້ວາງ ຂວາງມາແລ້ວ ຫລາຍກ່ວາ 10 ປີ, ຊຶ່ງເຫັນວ່າໄດ້ຮັບຜົນສຳເຫລັດດີ. ເຕັກໂນໂລຊີ ສຳຫັລບ ການ ລ້ຽງສັດນ້ຳ ຂະນາດນ້ອຍ ແມ່ນສາມາດນຳໃຊ້ໄດ້ດີ ກັບ ຄອບຄົວ ທີ່ທຸກຍາກ ໃນເຂດຊົນນະບົດ ຊຶ່ງສາມາດເປັນນຶ່ງໃນກົດຈະກຳທີ່ມີການລົງທຶນຕ່ຳ, ຄວາມສ່ຽງໜ້ອຍ, ໄດ້ທຶນຄືນໄວ, ງ່າຍ ແລະສະດວກສະຍາຍ ໃນການ ຖອດຖອນບົດຮຽນ ທັງເປັນການ ສະໜອງຜົນ ຜະລິດ ປາໃນທ້ອງ ຖິ່ນ. ເຕັກໂນໂລຊີ ການລ້ຽງສັດນ້ຳນີ້ລວມມີ: ການລ້ຽງປາໃນໜອງ/ສະ, ການອະນຸບານ ລູກປາໃນມຸ້ງ, ການລ້ຽງປາໃນນາເຂົ້າ ແລະ ການລ້ຽງປາໃສ່ ກະຊັງແບບງ່າຍດາຍ.

ເພື່ອຈະເຮັດໃຫ້ການການລ້ຽງສັດນ້ ໄດ້ຮັບຜົນດີນັ້ນ ຈະຕ້ອງມີສ່ວນປະກອບຫລາຍຢ່າງ ເຊັ່ນ: ມີ ລູກປາພຽງພໍ, ອາຫານປາ (ຝຸ່ນວິທະຍາສາດ ແລະອາຫານ), ມີສະຖານທີ່ ແລະແຫລ່ງນ້ໍທີ່ດີ. ການບໍລິການ ຂຸກຍູ້ ແກ່ ການລ້ຽງສັດນ້ ກໍ່ມີຄວາມສໍາຄັນເປັນຢ່າງຍິ່ງໂດຍສະເພາະໃນ ເຂດທ້ອງຖິ່ນ. ໃນເຂດຊົນນະບົດ ບ່ອນທີ່ມີເງື່ອນໄຂ, ການບໍລິການແມ່ນມີຄວາມຈໍາເປັນ ເພື່ອນໍາ ເອົາຄວາມຮູ້ ແລະສ້າງຕັ້ງຂະບວນການຂຸກຍູ້ ທີ່ມີການເຂົ້າຮ່ວມຂອງປະຊາຊົນທີ່ທຸກຍາກ ໂດຍຫັນປ່ຽນທິດທາງໃນການສົ່ງເສີມ ຫ່າງຈາກເຕັກໂນໂລຊີທີ່ສັບສົນ ມາເປັນການໝູນໃຊ້ໂດຍມີ ປະຊາຊົນເປັນໃຈກາງ ແລະ ນໍາໃຊ້ແນວທາງການມີສ່ວນຮ່ວມ ໃຊ້ວິທີການ ການພົວພັນແບບໃໝ່. ເໜັ້ນໜັກໃສ່ ການຂຸກຍູ້ຂອງລັດ ຕໍ່ການລ້ຽງສັດນ້ ຂະນາດນ້ອຍ ແລະຄວາມເຂົ້າໃຈ ແລະເຮັດວຽກ ກັບປະຊາຊົນຜູ້ທຸກຍາກໃນເຂດຊົນນະບົດ, ຊຶ່ງຈະເຮັດໃຫ້ມີຄວາມດຸ່ນດ່ຽງ ກັບການການລ້ຽງສັດນ້ ແບບ ເປັນສິນຄ້າ.

ໃນຫລາຍໆຂົງເຂດທົ່ວອ່າງ, ຈະມີຜົນກະທົບຕໍ່ການລ້ຽງສັດນ້ໃນອານາຄົດ. ຊຶ່ງໃນນັ້ນ ລວມທັງ ການແລກປ່ຽນ ຄວາມຮູ້ ແລະປະສົບປະການ ໃນການ ພັດທະນາ ການລ້ຽງສັດນ້, ໂດຍສະເພາະ ການລ້ຽງສັດນ້ຂະນາດນ້ອຍໃນກອບຂອງການພັດທະນາຊົນນະບົດ, ແລະ ກ້າວໄປເຖິງ ການສ້າງ ນະໂຍບາຍ ໃນລະດັບພູມີພາກ ໃນອ່າງ ແມ່ນ້ໍຂອງ. ສອງບັນຫາໃຫຍ່ ທີ່ສົມຄວນເອົາໃຈໃສ່ ຄື: ການຄວບຄູມພະຍາດສັດນ້, ແລະ ນະໂຍບາຍໃນການຫລຸດຜ່ອນຄວາມສ່ຽງ ຕໍ່ແນວພັນປາທໍາ ມະຊາດຈາກການນໍາແນວພັນປາຕ່າງປະເທດເຂົ້າມາລ້ຽງ ຫລື ບັນຫາເລື້ອງການເຄື່ອນຍ້າຍຂ້ວາມ ເຂດແດນ (Trans -boundary) ແລະ ການປະປົນດ້ານການມະພັນ ຂອງແນວພັນປາພື້ນເມືອງ ທີ່ແຕກຕ່າງສາຍພັນກັນ.

ມາເຖິງ ປັດຈຸບັນນີ້ ການພັດທະນາ ການລ້ຽງສັດນ້ ແມ່ນມີຫລາຍພາກສ່ວນ ໄດ້ໃຫ້ການ ສະນັບ ສະໜູນ ຢ່າງກ້ວາງຂວາງ. ໃນອານາຄົດ ລັດ ແລະ ອົງກອນທີ່ຊ່ວຍເຫືລອ ຈະຕ້ອງໄດ້ເອົາໃຈໃສ່ຕື່ມ ອີກ ໃນດ້ານການພັດທະນາຊົນນະບົດ, ນັ້ນແມ່ນໝາຍເຖິງ ການວາງຍຸດທະສາດໃໝ່ ເພື່ອຊຸກ ຍູ້ການລ້ຽງສັດນ້ເຂົ້າໃນກອບຂອງແຜນການພັດທະນາຊົນນະບົດ. MRC ແມ່ນເໜັ້ນໜັກໃສ່ ດ້ານສິ່ງແວດລ້ອມແບບຍືນຍົງໃນການພັດທະນາອ່າງໂຕ່ງທີ່ມີຫລາຍປະເທດຮ່ວມກັນ ຊຶ່ງເປັນໂອ ກາດໃນການທົດສອບທີ່ເປັນລະບົບຕໍ່ການລ້ຽງສັດນ້ ແລະ ຍົກເອົາການລ້ຽງສັດນ້ ໃຫ້ເປັນ ເຄື່ອງ ມືອັນນຶ່ງໃນການຫລຸດຜ່ອນຄວາມຍາກຈົນ.

4. ຄຳເຫັນ ແລະຂໍ້ສະເໜີແນະ

4.1ການລ້ຽງສັດນ້ຳ ພາຍໃຕ້ໂຄງປະກອບຂອງ ແຜນການພັດທະນາອ່າງແມ່ນ້ຳຂອງ. ການແບ່ງອ່າງ ແມ່ນ້ຳຂອງ ເປັນອ່າງໂຕ່ງ ຫລື ກຸ່ມໆຂອງອ່າງໂຕ່ງ ອີງໃສ່ສາຂາໃຫຍ່ໆ ໃນອ່າງ ທີ່ສະເໜີໂດຍ MRC ນັ້ນ ແມ່ນເປັນໂອກາດສ້າງ ໃຫ້ເປັນລະບົບ ເພື່ອ ຊຸກຍູ້ ການພັດທະນາ ການລ້ຽງສັດນ້ຳ ແນໃສ່ ຮັບປະກັນສະບຽງອາຫານ ແລະ ຫລຸດຜ່ອນຄວາມທຸກຍາກ. ແນວທາງພັດທະນາ ອ່າງໂຕ່ງ ແມ່ນຍັງໃໝ່. ດັ່ງນັ້ນ ແນວທາງການປະຕິບັດ ເປັນເທື່ອລະກ້າວໄປ ຈະຕ້ອງພິຈາລະນານຳມາໃຊ້ ພ້ອມກັບປະສົບປະການຈາກຕົວແບບແລ້ວຈຶ່ງຂະຍາຍ ອອກໄປສູ່ອ່າງໂຕ່ງອື່ນຕໍ່ໄປ ໂດຍອີງໃສ່ ບົດຮຽນ ທີ່ ຖອດຖອນໄດ້.

4.2 ຊຸກຍູ້ ການລ້ຽງສັດນ້ຳ ຂະນາດນ້ອຍ ແລະ ບໍລິການ ການພັດທະນາ ການລ້ຽງສັດນ້ຳ.
ໃນອານາຄົດ ການພັດທະນາ ຄວນເລັ່ງໄປໃສ່ ການບໍລິການທີ່ມີປະສິທິພາບ ທີ່ມີຈຸດປະສົງ ຊຸກຍູ້ ການລ້ຽງສັດນ້ຳທີ່ເປັນຟາມຂະນາດນ້ອຍ ຂອງຄອບຄົວ ທີ່ທຸກຍາກ. ແນວທາງດັ່ງກ່າວ ແມ່ນຕ້ອງການ ສ້າງບຸກຄະລາກອນພາຍໃນອົງກອນ ລະດັບທ້ອງຖິ່ນ, ແຂວງ ແລະ ລະດັບຊາດ ເພື່ອລະດົມໃນການນຳໃຊ້ແນວທາງ ການມີສ່ວນຮ່ວມ ເຂົ້າໃນການວາງແຜນ ແລະ ການສົ່ງເສີມ, ປັບປຸງ ການເຂົ້າຫາແຫລ່ງຂໍ້ມູນຄວາມຮູ້ ລະບົບການວາງແຜນການ ພັດທະນາ ແຫ່ງຊາດ ແລະນະໂຍບາຍ ທີ່ເລັ່ງໃສ່ຄວາມຕ້ອງການຂອງຊາວຊົນນະບົດ.

4.3 ຄວາມຕ້ອງການ ໃນການວິໄຈຍຸດທະສາດ ການພັດທະນາ ການລ້ຽງສັດນ້ຳ. ຄວາມອາດສາມາດຂອງການລ້ຽງສັດນ້ຳ ແມ່ນອາດຈະເປັນ ສິ່ງຍິ່ງໃຫຍ່ ຕໍ່ທາງດ້ານສະບຽງອາຫານຂອງ ປະຊາຊົນໃນເຂດຊົນນະບົດພາຍໃນອ່າງ. ຊຶ່ງລວມເອົາ ເຂດພູດອຍ ແລະ ເຂດຫ່າງໄກຈາກ ແມ່ນ້ຳຂອງ ແລະເຂດທີ່ອຸດົມສົມບູນໄປດ້ວຍປາ ເຊັ່ນ ທະເລສາບນ້ຳຈືດໃນປະເທດກຳປູເຈ. ເພື່ອຊຸກຍູ້ບັນຫາດັ່ງກ່າວ, ຈະຕ້ອງໄດ້ທຳການວິໄຈ ຍຸດທະສາດ ຄວາມອາດສາມາດ ຂອງການລ້ຽງສັດນ້ຳ ໃນ ພັດທະນາອ່າງໂຕ່ງ.

4.4 ການຮ່ວມມື ດ້ານການຄົ້ນຄ້ວາ. ການຮ່ວມມືໃນການຄົ້ນຄ້ວາລະດັບພາກພື້ນ ຄວນໄດ້ຮັບການຊຸກຍູ້ ເພື່ອຍົກສູງປະສິດທິພາບ ໃນການສະເໜີ ບັນຫາຫຍຸ້ງຍາກຕົ້ນຕໍ່ ໃນການພັດທະນາ ການລ້ຽງສັດນ້ຳ ເຊັ່ນ ການກຳນົດບັນຫາຢູ່ໃນການກວດກາຄືນ. ການຮ່ວມມືກັນຄົ້ນຄ້ວາ ຄວນລວມເຖິງການຄົ້ນຄ້ວາ ການລ້ຽງສັດນ້ຳ ຂະນາດນ້ອຍ ໃນຊົນນະບົດ ເພື່ອແນໃສ່ ປັບປຸງ ລະດັບ ຄອບຄົວໃນເຂດຫ່າງໄກຊອກຫລີກ.

4.5 ສ້າງນະໂຍບາຍຮ່ວມກັນ ໃນອ່າງແມ່ນ້ຳຂອງ. ມີຫລາຍກິດຈະກຳ ທີ່ຕໍ່ເນື່ອງຈາກການລ້ຽງ ສັດນ້ຳ ຊຶ່ງເປັນບັນຫາ ຂ້ອນເຂດແດນ ພາຍໃນອ່າງນ້ຳຂອງ ເຊັ່ນ ການເຄື່ອນຍ້າຍ ສັດນ້ຳ ທີ່ຍັງມີຊີວິດ ລະຫ່ວາງ ອ່າງໂຕ່ງ, ການໃຊ້ແນວພັນປາຕ່າງປະເທດ ຊຶ່ງອາດກໍ່ໃຫ້ເກີດບັນຫາ ທາງດ້ານການ ສູນເສຍສາຍພັນ ແລະ ການແພ່ຜາຍຂອງພະຍາດສັດນ້ຳ. ການແພ່ຂະຫຍາຍ ຂອງ ແນວພັນປາຕ່າງປະເທດໃນແຫລ່ງນ້ຳທຳມະຊາດ ຈະເກີດຄວາມເສງຫາຍໃຫ້ແກ່ແນວ ພັນປາພື້ນເມືອງ. ການຮ່ວມມືຂອງບັນດາ ປະເທດສະມາຊິກ ທີ່ຢູ່ ໃນອ່າງແມ່ນ້ຳຂອງ ເຫັນວ່າ ມີຄວາມຈຳເປັນ ຕ້ອງໄດ້ສ້າງນະໂຍບາຍຮ່ວມກັນ ແລະຕົກລົງວາງຍຸດທະສາດໃນລະດັບ ພາກພື້ນ ເພື່ອການແກ້ໄຂບັນຫາດັ່ງກ່າວ. ຫວັງວ່າ MRC ຈະສືບຕໍ່ຊຸກຍູ້ ວຽກງານຂອງ ສະພາທີ່ປຶກສາ ດ້ານເຕັກນິກການປະມົງ (Technical Advisory Body) ແລະ ອົງກອນ ອື່ນໆ ເພື່ອເສີມ ຂະຍາຍ ການພົວພັນ ແລະການພັດທະນາຮ່ວມກັນທຸກບັນຫາທີ່ກ່ຽວຂ້ອງ.

4.6 ການຕິດຕໍ່ພົວພັນ ແລະ ການສ້າງພັນທະມິດ. ຍັງມີຫລາຍຊ່ອງທາງໃນການສ້າງ ສາຍສຳພັນທີ່ ມີປະສິດທິຜົນ ໃນບັນດາ ອົງກອນພັດທະນາ ທີ່ ເຮັດວຽກກ່ຽວກັບ ການລ້ຽງສັດນ້ຳ ແລະ ການພັດທະນາຊົນນະບົດພາຍໃນອ່າງແມ່ນ້ຳຂອງ. ການຮ່ວມມື ແລະ ການແລກປ່ຽນ ປະສົບປະການ ລະຫ່ວາງ ພາກສ່ວນກ່ຽວຂ້ອງ ໂດຍມີການພົວພັນຢ່າງສະນິດແໜ້ນ ແມ່ນມີ ຄວາມສຳຄັນເປັນຢ່າງຍິ່ງເມື່ອຫາການຳໃຊ້ສະຕິປັນຍາແລະຊັບພະຍາກອນ ແຫລ່ງທຶນທີ່ມີຢູ່ໃນ ທາງທີ່ເໝາະສົມ.

บทคัดย่อ

๑. ที่มา

การเลี้ยงปลาหรือสัตว์น้ำและการปลูกพืชน้ำชนิดอื่น ๆ หรือการเพาะเลี้ยงสัตว์น้ำ เป็นกิจกรรมที่ทวีความสำคัญในชนบท เป็นแหล่งอาหารและแหล่งรายได้สำหรับประชาชนที่อยู่อาศัยในลุ่มน้ำโขงตอนล่าง รายงานฉบับนี้ทบทวนสถานภาพของการเพาะเลี้ยงสัตว์น้ำของลุ่มน้ำโขงตอนล่างในพื้นที่ราชอาณาจักรกัมพูชา สาธารณรัฐประชาธิปไตยประชาชนลาว ราชอาณาจักรไทย และสาธารณรัฐสังคมนิยมเวียดนาม โดยบ่งชี้ปัจจัยสำคัญที่กำหนดรูปแบบการพัฒนาการเพาะเลี้ยงสัตว์น้ำ พร้อมทั้งเสนอแนะข้อคิดเห็นในการขยายความสำคัญในอนาคตที่จะมีต่อผลผลิตอาหารและการพัฒนาชนบทในลุ่มน้ำ สารสนเทศในรายงานฉบับนี้ได้จากการร่วมเขียนและปรึกษาหารือกับผู้เชี่ยวชาญด้านการเพาะเลี้ยงสัตว์น้ำและการพัฒนาชนบทในลุ่มน้ำโขง รายงานเบื้องต้นฉบับร่างจัดทำขึ้นใน พ.ศ. ๒๕๔๔ เพื่อใช้เป็นส่วนหนึ่งของการทบทวนงานภาคการประมงของคณะกรรมาธิการแม่น้ำโขง เอกสารฉบับนี้ให้ข้อมูลที่ทันต่อเหตุการณ์และอธิบายความสำคัญของการเพาะเลี้ยงสัตว์น้ำในฐานะวิธีการสำคัญวิธีหนึ่งในการผลิตอาหารและช่วยยกระดับความเป็นอยู่ของชาวชนบทในลุ่มน้ำโขงตอนล่าง

๒. สถานภาพของการเพาะเลี้ยงสัตว์น้ำ

การเพาะเลี้ยงสัตว์น้ำในลุ่มน้ำโขงเป็นกิจกรรมที่มีความหลากหลายกิจกรรมหนึ่ง มีความเกี่ยวข้องกับการเพาะขยายพันธุ์ การเลี้ยงและจำหน่ายพันธุ์สัตว์น้ำทั้งวัยอ่อนและวัยรุ่น การขุนเลี้ยงลูกปลาจากธรรมชาติและลูกปลาที่เพาะขึ้นได้ในแหล่งน้ำปิดหรือแหล่งน้ำกึ่งปิด เช่น บ่อ นาข้าว และกระชัง ผลผลิตจากการเพาะเลี้ยงสัตว์น้ำถูกใช้ประโยชน์ทั้งส่งเพื่อจำหน่ายและมักใช้บริโภคในครัวเรือนด้วย การใช้ปัจจัยการผลิตในการทำฟาร์ม เช่น พันธุ์สัตว์น้ำ และอาหารสัตว์น้ำ ตลอดจนการดูแลรักษา การแปรรูป การตลาด และการบริโภคผลิตภัณฑ์จากการเพาะเลี้ยงสัตว์น้ำเป็นส่วนประกอบสำคัญในการดำรงชีวิตของประชาชนทุกเพศ วัย ทั้งชาย หญิงและเด็กในครัวเรือนชนบทจำนวนมากในลุ่มน้ำโขง

ตลอดระยะเวลา ๑๐ ปีที่ผ่านมา ผลผลิตการเพาะเลี้ยงสัตว์น้ำเพิ่มขึ้นเป็นลำดับในทุกประเทศของลุ่มน้ำโขงตอนล่าง จากประมาณ ๖๐,๐๐๐ ตัน เมื่อ พ.ศ. ๒๕๓๓ เป็นประมาณ ๒๖๐,๐๐๐ ตัน ในปี พ.ศ. ๒๕๔๒/๒๕๔๓ ซึ่งเท่ากับร้อยละ ๑๒-๑๓ ของผลผลิตสัตว์น้ำจืดทั้งหมดในลุ่มน้ำโขงตอนล่าง (ที่มีปริมาณประมาณ ๒,๐๓๖,๐๐๐ ตัน) ตัวเลขนี้ไม่รวมผลผลิตปลาและกุ้งจากพื้นที่น้ำกร่อยบริเวณสามเหลี่ยมแม่น้ำโขง การพัฒนาการเพาะเลี้ยงสัตว์น้ำในลุ่มน้ำโขงมีการกระจาย

ไม่สม่ำเสมอ ส่วนใหญ่ดำเนินการในพื้นที่สามเหลี่ยมแม่น้ำโขงในเวียดนามและบนที่ราบสูงโคราช ในภาคตะวันออกเฉียงเหนือของประเทศไทย โดยประเทศกัมพูชาและสาธารณรัฐประชาธิปไตยประชาชนลาวมีผลผลิตจากการเพาะเลี้ยงสัตว์น้ำน้อยกว่ามาก อย่างไรก็ตาม รายงานฉบับนี้ตั้งข้อสังเกตว่า สถิติอย่างเป็นทางการของภาครัฐ อาจประเมินความสำคัญของการเพาะเลี้ยงสัตว์น้ำรายย่อยต่ำกว่าความเป็นจริง ซึ่งการเพาะเลี้ยงสัตว์น้ำรายย่อยมีการขยายตัวกว้างขวางและมีความสำคัญเพิ่มขึ้นทั้งในฐานะแหล่งอาหารและแหล่งรายได้ในครัวเรือนชนบท

นโยบายของรัฐบาลมีความสำคัญอย่างยิ่งในการเติบโตของการเพาะเลี้ยงสัตว์น้ำที่ผ่านมา ตลอด ๑๐ ปีที่แล้ว รัฐบาลของทุกประเทศในลุ่มน้ำโขงได้เพิ่มการลงทุนทั้งในการวิจัย โครงสร้างพื้นฐาน การศึกษาและการส่งเสริม รัฐบาลไทยและเวียดนามมีการลงทุนทรัพยากรต่าง ๆ ในการเพาะเลี้ยงสัตว์น้ำเป็นอันมาก ในเวียดนามมีการกำหนดแผนงานในการพัฒนาบุคลากรและการส่งเสริมไว้อย่างชัดเจน การสนับสนุนด้านการวิจัยที่ผ่านมามักมุ่งสู่ประเด็นทางวิชาการมากกว่าการวางแผนและดำเนินงานวิจัยที่ผลักดันโดยผู้เพาะเลี้ยงสัตว์น้ำ แต่ได้มีการเปลี่ยนแปลงในระยะหลังที่การพัฒนาการเพาะเลี้ยงสัตว์น้ำตามความต้องการของผู้เพาะเลี้ยงสัตว์น้ำเริ่มมีความชัดเจนยิ่งขึ้น

ความยั่งยืนของการเพาะเลี้ยงสัตว์น้ำมีความเกี่ยวพันใกล้ชิดกับฐานทรัพยากรในลุ่มน้ำโขง การเพาะเลี้ยงสัตว์น้ำรายย่อยอาจช่วยปรับปรุงคุณภาพสิ่งแวดล้อม เช่น เป็นแหล่งน้ำในฤดูแล้งและการใช้ประโยชน์จากเศษเหลือทางการเกษตรในบ่อเลี้ยงสัตว์น้ำ เป็นต้น ความกังวลด้านสิ่งแวดล้อมที่เกี่ยวข้องกับการเพาะเลี้ยงสัตว์น้ำ ได้แก่ มลพิษทางน้ำที่มาจากภาคการผลิตอื่น เช่น ภาคการเกษตร การขาดแคลนน้ำ การแพร่กระจายโรคสัตว์น้ำ ผลกระทบเสียหายจากการเลี้ยงปลาในกระชังแบบหนาแน่น การระบาดของพยาธิใบไม้ การสูญเสียความหลากหลายทางพันธุกรรมอันเนื่องมาจากการเพาะขยายพันธุ์ที่ไม่มีการจัดการอย่างเหมาะสม และการขนย้ายสัตว์น้ำป่วยข้ามพรมแดน ปัญหาเหล่านี้สามารถบรรเทาได้โดยการยอมรับและปฏิบัติตามหลักการจัดการฟาร์มและระบบการทำฟาร์มที่ดี รวมทั้งยอมรับยุทธศาสตร์การพัฒนาในการบูรณาการการเพาะเลี้ยงสัตว์น้ำเข้าเป็นส่วนหนึ่งของฟาร์มและระบบนิเวศตามธรรมชาติของลุ่มน้ำ โดยมีวัตถุประสงค์เพื่อยกฐานะประชาชนจากความยากจน การสนับสนุนที่มีพื้นฐานความเข้าใจของความเป็นอยู่ของประชาชนผู้ยากจนอาจเป็นยุทธศาสตร์การพัฒนาที่ทรงคุณค่า

๓. อนาคตของการเพาะเลี้ยงสัตว์น้ำ

ในอนาคตจะพบเห็นการขยายตัวของการเพาะเลี้ยงสัตว์น้ำในลุ่มน้ำโขงอย่างต่อเนื่อง ในระดับมหภาค แนวโน้มการเติบโตของประชากรในลุ่มน้ำใน ๑๐ ปีข้างหน้า จะมีความต้องการผลผลิตสัตว์

น้ำเพิ่มเติมเพื่อรักษาระดับการบริโภคให้เท่าเทียมปัจจุบันอีก ๔๐๐,๐๐๐ ตัน การพัฒนาการเพาะเลี้ยงสัตว์น้ำจึงจะมีบทบาทสำคัญยิ่งเพื่อตอบสนองความต้องการนี้

ประสบการณ์จากชนบททุกพื้นที่ในลุ่มน้ำแสดงว่า แม้ครัวเรือนที่ทำการเพาะเลี้ยงสัตว์น้ำรายย่อยแต่ละรายจะมีขนาดเล็ก แต่มีส่วนสำคัญในภาพรวมผลผลิตด้านการเพาะเลี้ยงสัตว์น้ำ ศักยภาพของผลกระทบที่เพิ่มขึ้นจากการเพาะเลี้ยงสัตว์น้ำต่อการพัฒนาชนบทในลุ่มน้ำโขงมีสูงมาก ในบางพื้นที่ที่ซึ่งมีปลาธรรมชาติจำกัดทั้งมีปัญหาความไม่แน่นอนของแหล่งอาหารอย่างรุนแรงและมีความยากจน เช่น พื้นที่สูงในสาธารณรัฐประชาธิปไตยประชาชนลาวและสาธารณรัฐสังคมนิยมเวียดนาม รวมทั้งพื้นที่ที่ห่างไกลจากโตนเลสาปและแม่น้ำโขงในประเทศกัมพูชา การเพาะเลี้ยงสัตว์น้ำสามารถและสมควรใช้เป็นวิธีในการปรับปรุงความมั่นคงด้านอาหาร หากต้องการเพิ่มการเพาะเลี้ยงสัตว์น้ำทั้งลุ่มน้ำ ต้องมีการสนับสนุนโดยมุ่งเป้าหมายสู่ผู้เพาะเลี้ยงสัตว์น้ำรายย่อย และแก้ไขอุปสรรคเฉพาะที่ประชาชนผู้ยากจนเผชิญอยู่ เช่น การเข้าถึงแหล่งทุนและการส่งเสริม

ในช่วง ๑๐ ปีที่ผ่านมา เทคโนโลยีการเพาะเลี้ยงสัตว์น้ำรายย่อยได้แพร่กระจายในพื้นที่อย่างกว้างขวางและได้ผลดี เทคโนโลยีสำหรับการเพาะเลี้ยงสัตว์น้ำรายย่อยที่เหมาะสมกับครัวเรือนยากจนในชนบท ได้แก่ เทคโนโลยีที่ต้องการการลงทุนน้อย มีความเสี่ยงต่ำ และให้ผลตอบแทนรวดเร็ว ทั้งยังต้องเป็นเทคโนโลยีที่ไม่ซับซ้อน เลียนแบบได้ ถ่ายทอดได้ สามารถฝึกผู้สอนได้ง่าย และช่วยให้มีปลาในท้องถิ่นเพิ่มขึ้น เทคโนโลยีเหล่านี้ ได้แก่ การเลี้ยงสัตว์น้ำในบ่อ การอนุบาลสัตว์น้ำในกระชังมุ้งในแหล่งน้ำสาธารณะ การเลี้ยงปลาในนาข้าว และการเลี้ยงปลาในกระชังแบบพื้นบ้าน

การเพาะเลี้ยงสัตว์น้ำต้องการปัจจัยการผลิตหลายอย่างเพื่อให้สัตว์น้ำมีการเจริญเติบโตตามที่คาดหวัง เช่น มีพันธุ์สัตว์น้ำพอเพียง มีอาหารสำหรับสัตว์น้ำ (เช่น ปุ๋ยและอาหารสมทบ) ที่ดิน และน้ำ การบริการสนับสนุนการเพาะเลี้ยงสัตว์น้ำเป็นสิ่งจำเป็นโดยเฉพาะอย่างยิ่งในระดับท้องถิ่น ในพื้นที่ชนบทที่ซึ่งมีศักยภาพในการเพาะเลี้ยงสัตว์น้ำ บริการเหล่านี้เป็นที่ต้องการเพื่อถ่ายทอดความรู้และเสริมสร้างการสนับสนุนด้านโครงสร้างองค์กร การที่จะทำให้คนยากจนเข้ามีส่วนร่วมต้องมีการเปลี่ยนแปลงแนวคิดในการส่งเสริมจากเรื่องที่เน้นทางวิชาการ เป็นวิธีการมีส่วนร่วมโดยมีประชาชนเป็นศูนย์กลางที่มีความยืดหยุ่นกว่าโดยผ่านกระบวนการสื่อสารแบบใหม่ การสนับสนุนจากภาครัฐที่มุ่งเน้นการเพาะเลี้ยงสัตว์น้ำรายย่อย มีความเข้าใจ และสามารถทำงานร่วมกับครัวเรือนยากจนในชนบทจะช่วยนำไปสู่การเพาะเลี้ยงสัตว์น้ำที่มีเป้าหมายเพื่อการพาณิชย์เพิ่มขึ้น

กิจกรรมระดับภูมิภาคและระดับลุ่มน้ำหลายอย่างจะมีผลกระทบต่ออนาคตของการเพาะเลี้ยงสัตว์น้ำ เช่น การแลกเปลี่ยนประสบการณ์และองค์ความรู้ด้านการพัฒนาการเพาะเลี้ยงสัตว์น้ำ โดยเฉพาะอย่างยิ่ง การเพาะเลี้ยงสัตว์น้ำรายย่อยและการทำงานร่วมกันภายใต้นโยบายร่วมเกี่ยวกับประเด็นระดับลุ่มน้ำต่าง ๆ กิจกรรมหลักสองประการที่ควรให้ความสนใจเป็นพิเศษ ได้แก่ การควบคุมโรคระบาดสัตว์น้ำ และการลดความเสี่ยงที่มีต่อประชากรสัตว์น้ำในธรรมชาติจากการนำเข้าสัตว์น้ำต่างถิ่น หรือการปะปนทางพันธุกรรมของสัตว์น้ำพื้นเมืองสายพันธุ์ต่าง ๆ อันเนื่องมาจากการขนย้ายสัตว์น้ำข้ามพรมแดน

ปัจจุบัน การพัฒนาการเพาะเลี้ยงสัตว์น้ำยังคงเกิดจากการผลักดันเฉพาะสาขาเป็นส่วนใหญ่ ในอนาคต รัฐบาลและหน่วยงานสนับสนุนต่าง ๆ ควรจะให้ความสนใจในการส่งเสริมการเพาะเลี้ยงสัตว์น้ำภายใต้กรอบงานการพัฒนาชนบท การพัฒนาโดยคำนึงถึงความยั่งยืนของสภาพแวดล้อมในระดับลุ่มน้ำย่อยที่ร่วมกันใช้ประโยชน์มากกว่าหนึ่งประเทศของคณะกรรมาธิการแม่น้ำโขง เอื้อโอกาสให้มีการทดสอบวิธีการที่เป็นระบบต่าง ๆ เกี่ยวกับการเพาะเลี้ยงสัตว์น้ำ และยกระดับบทบาทความสำคัญของการเพาะเลี้ยงสัตว์น้ำในฐานะที่เป็นเครื่องมือหนึ่งที่สามารถในการแก้ไขปัญหาความยากจน

๔. ข้อเสนอแนะ

๔.๑ การเพาะเลี้ยงสัตว์น้ำภายใต้กรอบงานแผนพัฒนาลุ่มน้ำโขง

การแบ่งลุ่มน้ำโขงเป็นลุ่มน้ำย่อยหรือกลุ่มลุ่มน้ำย่อยที่นำเสนอโดยคณะกรรมาธิการแม่น้ำโขง เอื้อโอกาสสำหรับการสนับสนุนอย่างเป็นระบบต่อการพัฒนาการเพาะเลี้ยงสัตว์น้ำที่มีความยากจนและความไม่แน่นอนของแหล่งอาหารเป็นเป้าหมาย วิธีการพัฒนาระดับลุ่มน้ำย่อยเป็นเรื่องใหม่ ดังนั้น ควรดำเนินการเป็นขั้นตอน โดยใช้บทเรียนจากโครงการนำร่องนำไปขยายผลในพื้นที่ลุ่มน้ำย่อยอื่นอย่างค่อยเป็นค่อยไป

๔.๒ การสนับสนุนการเพาะเลี้ยงสัตว์น้ำรายย่อยและการบริการเพื่อพัฒนาการเพาะเลี้ยงสัตว์น้ำ

การสนับสนุนการพัฒนาในอนาคตควรสร้างบริการที่มีประสิทธิภาพที่สนับสนุนวัตถุประสงค์ของการเพาะเลี้ยงสัตว์น้ำรายย่อยและครัวเรือนที่ยากจน วิธีการนี้จะต้องมีการพัฒนาบุคลากรขององค์กรทั้งระดับท้องถิ่น ระดับจังหวัดและระดับชาติเป็นอย่างมาก ทั้งนี้ เพื่อกระตุ้นให้มีการใช้วิธีการมีส่วนร่วมในการวางแผนและการส่งเสริม ปรับปรุงการเข้าถึงองค์ความรู้และพัฒนากระบวนการวางแผนระดับชาติ รวมทั้งนโยบายที่เน้นความต้องการของครัวเรือนที่ยากจน

๔.๓ วิเคราะห์เชิงยุทธศาสตร์เกี่ยวกับความต้องการในการพัฒนาการเพาะเลี้ยงสัตว์น้ำ

ศักยภาพของการเพาะเลี้ยงสัตว์น้ำอาจจะสูงสุดในพื้นที่ของลุ่มน้ำที่ขาดความแน่นอนด้านแหล่งอาหารและห่างไกล พื้นที่เหล่านี้รวมถึงพื้นที่สูงและพื้นที่ที่อยู่ห่างจากแม่น้ำโขงและแหล่งประมงขนาดใหญ่ เช่น บึงโตนเลสาปในประเทศกัมพูชา จึงควรมีการวิเคราะห์เชิงยุทธศาสตร์เกี่ยวกับศักยภาพของการเพาะเลี้ยงสัตว์น้ำในพื้นที่ลุ่มน้ำย่อยต่าง ๆ เพื่อสนับสนุนแนวคิดนี้

๔.๔ ความร่วมมือด้านการวิจัย

ควรสนับสนุนให้มีความร่วมมือด้านการวิจัยระดับภูมิภาคเนื่องจากเป็นวิธีการที่ประหยัดในการระบุอุปสรรคปัญหาสำคัญในการพัฒนาการเพาะเลี้ยงสัตว์น้ำ ดังตัวอย่างในรายงานฉบับนี้ โดยเฉพาะอย่างยิ่ง การวิจัยร่วมควรดำเนินการร่วมกับผู้ประกอบการเพาะเลี้ยงสัตว์น้ำรายย่อยจากครัวเรือนยากจนที่อาศัยอยู่ในพื้นที่ชนบทห่างไกล

๔.๕ การพัฒนานโยบายร่วมในลุ่มน้ำโขง

มีประเด็นที่เกี่ยวข้องกับการเพาะเลี้ยงสัตว์น้ำหลายกรณีที่เป็นประเด็นข้ามพรมแดน เช่น การเคลื่อนย้ายสัตว์น้ำมีชีวิตข้ามลุ่มน้ำ และการเลี้ยงสัตว์น้ำต่างถิ่น การเคลื่อนย้ายสัตว์น้ำมีชีวิตข้ามลุ่มน้ำอาจทำให้มีการสูญเสียความหลากหลายทางพันธุกรรมหรือมีการแพร่กระจายของโรคสัตว์น้ำ การแพร่ขยายพันธุ์ของสัตว์น้ำต่างถิ่นในแหล่งน้ำธรรมชาติอาจส่งผลกระทบเสียหายต่อสัตว์น้ำพื้นเมืองได้ ความร่วมมือระหว่างชาติภาคีสมาชิกในการจัดเตรียมนโยบายร่วมและการกำหนดยุทธศาสตร์การจัดการกับประเด็นเหล่านี้เป็นเรื่องจำเป็น จึงเป็นที่หวังว่า คณะกรรมาธิการแม่น้ำโขงจะสนับสนุนการทำงานที่มีคุณค่าของคณะที่ปรึกษาทางวิชาการเพื่อการบริหารจัดการทรัพยากรประมง และหน่วยงานอื่นในชาติภาคีสมาชิก ในอันที่จะเสริมประสิทธิภาพการติดต่อสื่อสารและเสนอความคิดเห็นเกี่ยวกับการพัฒนาที่มีความสนใจร่วมกัน

๔.๖ การติดต่อสื่อสารและความร่วมมือ

มีโอกาสที่จะเสริมสร้างความร่วมมือที่มีประสิทธิภาพยิ่งขึ้นระหว่างองค์กรเพื่อการพัฒนาต่าง ๆ ที่ปฏิบัติงานเกี่ยวกับการเพาะเลี้ยงสัตว์น้ำและการพัฒนาชนบทในลุ่มน้ำโขง ความร่วมมือและการแลกเปลี่ยนประสบการณ์ระหว่างผู้มีส่วนได้ส่วนเสียผ่านกระบวนการสื่อสารที่มีประสิทธิภาพเป็นสิ่งสำคัญหากต้องการใช้ทรัพยากรทั้งทางภูมิปัญญาและเงินทุนอย่างสมประโยชน์ที่สุด

NUÔI CÁ NƯỚC NGỌT Ở HẠ LƯU SÔNG MÊ CÔNG

Michael J. Philips

Mạng lưới các Trung tâm nuôi cá châu Á - Thái Bình Dương

Tóm tắt

1. Tình hình chung

Canh tác chăn nuôi cá và các động thực vật thuỷ sinh khác hay gọi là nuôi thuỷ sản là hoạt động ngày một quan trọng ở nông thôn và là nguồn cung cấp thực phẩm và thu nhập của người dân sống ở hạ lưu sông Mê Công. Bài viết này tổng kết tình hình nuôi thuỷ sản nội địa của các nước hạ lưu sông Mê Công là Căm Pu Chia, Lào, Thái lan và Việt nam. Bài viết xác định những yếu tố then chốt bao trùm sự phát triển nghề nuôi thuỷ sản và đưa ra những đề xuất nhằm nâng cao tương lai quan trọng của nó của nó đối với sản xuất thực phẩm và phát triển nông thôn trong lưu vực. Tài liệu dùng trong bài viết này lấy từ các bài viết và báo cáo tư vấn của các chuyên gia nuôi thuỷ sản và phát triển nông thôn sông Mê Công. Bản thảo đầu tiên được viết vào năm 2001 nhằm đánh giá Chương trình nghề cá của Uỷ ban sông Mê Công, sau đó đã được sửa chữa và đăng riêng trong Báo cáo kỹ thuật về nuôi thuỷ sản này của Uỷ hội sông Mê Công. Bài viết đưa ra đánh giá quan trọng đúng lúc về nuôi thủy sản như là một phương thức sản xuất thực phẩm và là nguồn cung cấp cho nông thôn ở hạ lưu sông Mê Công.

2. Tình hình nuôi thuỷ sản

Nuôi thuỷ sản ở lưu vực sông Mê Công là hoạt động đa dạng. Nó bao gồm cả việc cho đẻ, nuôi và bán cá bột, cá giống, ương cá bột và cá giống cá vớt được ở tự nhiên hay sinh sản nhân tạo trong các vùng nước kín hoặc nửa kín như: ao, ruộng, lồng bè. Sản phẩm thu được đem bán và thông thường là tự tiêu dùng. Cung ứng sản phẩm đầu vào để canh tác như cá giống và thức ăn, và buôn bán, chế biến, tiêu dùng các sản phẩm nuôi thuỷ sản là sinh kế quan trọng của đàn ông, đàn bà và trẻ con ở rất nhiều hộ nông dân sông Mê Công.

Sản lượng nuôi thuỷ sản ở tất cả các nước hạ lưu sông Mê Công đã tăng lên nhanh chóng trong thời gian 10 năm trở lại đây, từ khoảng 60 ngàn tấn năm 1990 đã tăng lên 260 ngàn tấn năm 1999/2000, bằng 12-13% tổng sản lượng cá nước ngọt hạ lưu sông Mê Công (ước tính khoảng 2.036.00 tấn). Đấy là chưa kể đến sản lượng cá, tôm vùng nước lợ. Nhưng sự phát triển này là không đều. Sản phẩm nuôi thủy sản tập trung ở

đồng bằng sông Cửu Long của Việt Nam và cao nguyên Cò Rat đông bắc của Thái Lan, còn ở Cam Pu Chia và Lào thì ít hơn. Tuy nhiên tác giả cho rằng số liệu thống kê chính thức của nhà nước còn thấp do chưa đánh giá hết tầm quan trọng của nghề nuôi cá qui mô nhỏ hiện đang phát triển khá rộng và là nguồn cung cấp thực phẩm và thu nhập quan trọng của các hộ nông dân.

Chính sách của nhà nước đã đóng góp to lớn cho sự tăng trưởng nghề nuôi cá hiện nay. Khoảng trên 10 năm trở lại đây, các nước thuộc sông Mê Công đã tăng cường đầu tư vào nghiên cứu, xây dựng cơ sở hạ tầng, giáo dục và truyền bá khoa học kỹ thuật. Chính phủ các nước Thái Lan và Việt Nam đầu tư vào nuôi thuỷ sản mạnh mẽ hơn cả. Việt Nam có cả kế hoạch đầy tham vọng về xây dựng nguồn nhân lực và truyền bá khoa học công nghệ. Hỗ trợ cho nghiên cứu từ trước đến nay thường tập trung vào các vấn đề kỹ thuật và ít chú ý đến lập và thực hiện các chương trình nghiên cứu hướng dẫn nông dân. Nhưng hiện nay đã chuyển hướng rõ ràng sang vận đông ngư dân áp dụng phát triển nuôi thuỷ sản theo nhu cầu của họ.

Nuôi thuỷ sản bền vững có quan hệ rất mật thiết với nguồn lợi tự nhiên sông Mê Công. Nuôi thuỷ sản qui mô nhỏ giúp cải thiện điều kiện môi trường như giữ nước trong suốt mùa khô và quay vòng sử dụng nước thải nông nghiệp trong ao nuôi cá. Những vấn đề về môi trường liên quan đến ô nhiễm nguồn nước do các nguyên nhân khác như nông nghiệp, thiếu nước, lan truyền bệnh động vật thuỷ sản, ảnh hưởng do nuôi cá lồng tăng sản, lây nhiễm giun, và thất thoát đa dạng gene do kỹ thuật sản xuất giống tồi và không đánh giá hết tác dụng xấu do vận chuyển con giống qua biên giới. Có thể giảm bớt ảnh hưởng xấu bằng cách áp dụng hệ thống quản lí canh tác hữu hiệu hơn và triển khai chiến lược nuôi thuỷ sản tổng hợp vào nông trại và hệ sinh thái tự nhiên của lưu vực. Ở nơi nào có mục tiêu là xóa đói giảm nghèo thì sự giúp đỡ dựa trên sự hiểu biết về kế sinh nhai của người nghèo sẽ trở thành chiến lược phát triển có giá trị.

3. Tương lai nghề nuôi thuỷ sản

Trong tương lai, nghề nuôi thuỷ sản lưu vực sông Mê Công sẽ tiếp tục phát triển. Về tầm vĩ mô, cho thấy trong vòng 10 năm tới do xu hướng tăng dân số cần thiết phải có thêm 400 000 tấn sản phẩm thuỷ sản để đáp ứng nhu cầu tiêu thụ của người dân như ở mức độ hiện nay. Phát triển nuôi thuỷ sản sẽ đóng vai trò cực kỳ to lớn nhằm đáp ứng nhu cầu này.

Kinh nghiệm chỉ ra rằng canh tác qui mô nhỏ theo hộ gia đình ở hầu hết vùng nông thôn lưu vực sông Mê Công tuy từng hộ một thì nhỏ nhưng tổng thể lại làm ra sản lượng thuỷ

sản rất lớn. Tiềm năng nâng cao vai trò của nghề nuôi thuỷ sản trong sự phát triển nông thôn lưu vực sông Mê Công là một thực tế. Ở một số nơi mà khai thác cá tự nhiên còn hạn chế và dân còn nghèo, vấn đề an ninh lương thực nghiêm trọng chẳng hạn như các vùng cao nguyên của Lào và Việt Nam, nơi xa biển hồ Tông Lê Sáp và sông Mê Công ở Cam Pu Chia, thì nghề nuôi thuỷ sản có thể và cần được sử dụng nhằm đảm bảo an ninh lương thực. Để nâng cao ảnh hưởng tích cực của nghề nuôi thuỷ sản trong toàn lưu vực cần hỗ trợ nghề nuôi thuỷ sản qui mô nhỏ và tiếp cận nhằm mục tiêu giải quyết những khó khăn đặc biệt mà người nghèo phải đương đầu như vốn tín dụng và mở rộng qui mô.

Công nghệ nuôi thuỷ sản qui mô nhỏ đã được áp dụng rộng rãi hơn 10 năm trở lại đây và đã đạt thành tựu quan trọng. Đặc điểm của công nghệ nuôi thuỷ sản qui mô nhỏ áp dụng cho các hộ gia đình nghèo ở nông thôn là đầu tư ít, ít rủi ro, quay vòng nhanh. Nó còn đơn giản, dễ áp dụng, dễ chuyển giao, tuyên truyền viên dễ đào tạo và nó cung cấp sản phẩm cá tại chỗ. Kĩ thuật nuôi thủy sản này có thể bao gồm nuôi cá ao, ương cá trong giai ở các vùng nước thông thường, nuôi cá ruộng lúa và cả kỹ thuật nuôi cá lồng đơn giản.

Nghề nuôi thuỷ sản đòi hỏi nhiều loại đầu vào để có được sự tăng trưởng mong muốn như con giống, thức ăn (phân bón và thức ăn) vùng đất và chất nước nuôi cá phù hợp. Các loại dịch vụ phục vụ cho nuôi thuỷ sản đặc biệt là dịch vụ tại chỗ rất quan trọng. Ở vùng nông thôn có tiềm năng phát triển nuôi thủy sản thì việc chuyển giao kỹ thuật và xây dựng tổ chức là rất cần thiết. Thu hút người nghèo đòi hỏi phải chuyển từ truyền bá công nghệ sang những vấn đề linh hoạt hơn, xoay quanh con người và cùng tham gia nhờ sử dụng cơ chế thông tin mới. Sự tập trung chú ý của chính phủ giúp đỡ cho nghề nuôi thuỷ sản qui mô nhỏ và những hộ nông dân nghèo sẽ tạo sự cân bằng cần thiết đối với nghề nuôi thuỷ sản chỉ mang tính thương mại.

Nhiều vấn đề về khu vực và lưu vực cũng ảnh hưởng đến nghề nuôi thuỷ sản trong tương lai. Đó là vấn đề như trao đổi kinh nghiệm, kiến thức về phát triển nuôi thuỷ sản, đặc biệt là nuôi thuỷ sản qui mô nhỏ và triển khai nó trong khuôn khổ phát triển nông thôn, trao đổi kinh nghiệm về chính sách chung của khu vực về các vấn đề thuộc phạm vi lưu vực. Có hai vấn đề đáng được đặc biệt quan tâm là quản lí bệnh động vật thuỷ sản và chính sách làm giảm nguy cơ lẫn giống do di nhập các loài thuỷ sản ngoài lưu vực hoặc vận chuyển từ nước này qua nước khác làm pha trộn nguồn gien các đàn cá bản địa.

Ngày nay phát triển nuôi thuỷ sản đã được đẩy lên thành một ngành lớn. Trong tương lai, các chính phủ và cơ quan tài trợ cần phải chú trọng hơn đến phát triển nuôi thủy sản trong khôn khổ phát triển nông thôn. Uỷ hội sông Mê công chủ trương phát triển môi trường bền vững trong các tiểu vùng giữa 2 hay nhiều nước đang tạo cơ hội thử nghiệm cho một loạt các kiểu tiếp cận nghề nuôi thuỷ sản và cho việc đưa nghề nuôi thủy sản trở thành công cụ xóa đói giảm nghèo.

4. Đề xuất

4.1 Nghề nuôi thuỷ sản trong khuôn khổ chương trình phát triển lưu vực sông Mê Công. Uỷ hội sông Mê Công chia lưu vực sông Mê Công ra làm nhiều lưu vực nhỏ hay gọi là tiểu lưu vực theo các nhánh chính của nó tạo cơ hội cho một tiếp cận hệ thống hỗ trợ cho phát triển nuôi thuỷ sản nhằm mục đích xoá đói giảm nghèo và đảm bảo an ninh lương thực. Thuật ngữ tiểu lưu vực là hoàn toàn mới, vì vậy phải áp dụng theo cách triển khai từng bước, từ kinh nghiệm học được của các mô hình, triển khai một cách từ từ sang các tiểu lưu vực khác.

4.2 Giúp đỡ nghề nuôi thuỷ sản qui mô nhỏ và các dịch vụ phục vụ cho phát triển nuôi thuỷ sản. Sự giúp đỡ cho phát triển tương lai là phải xây dựng dịch vụ phục vụ cho mục tiêu nuôi thuỷ sản qui mô nhỏ và giúp các hộ nghèo. Việc này đòi hỏi phải đào tạo nguồn nhân lực lớn lao cho các cơ quan địa phương, tỉnh, nhà nước nhằm áp dụng biện pháp cùng tham gia xây dựng kế hoạch, truyền bá, nâng cao khả năng học hỏi, và nhằm xây dựng chương trình kế hoạch và chính sách quốc gia dựa trên cơ sở sự cần thiết của các nông hộ.

4.3 Phân tích chiến lược về nhu cầu phát triển nuôi thuỷ sản. Tiềm năng nghề nuôi thuỷ sản là rất lớn đối với an ninh lương thực và vùng xa xôi của lưu vực. Đó là những vùng cao nguyên, nơi xa sông Mê Công và những vùng khai thác cá chính (như Biển hồ ở Cam Pu Chia). Muốn vậy cần phải tiến hành phân tích chiến lược về tiềm năng nuôi thuỷ sản của tiểu vùng.

4.4 Hợp tác nghiên cứu. Cần phải thúc đẩy sự hợp tác nghiên cứu trong khu vực như là biện pháp kinh tế để giải quyết những vướng mắc cốt lõi đối với phát triển nuôi thuỷ sản như đã nêu ra trong phần tổng quan. Hợp tác nghiên cứu về nuôi thuỷ sản đặc biệt cần phải có sự tham gia của những người đang nuôi thủy sản qui mô nhỏ là những hộ nghèo ở vùng xa.

4.5 Xây dựng chính sách chung cho lưu vực sông Mê Công. Có hàng loạt các vấn đề liên quan đến nuôi thuỷ sản ở sông Mê Công vượt ra ngoài khuôn khổ biên giới quốc

gia, thí dụ như động vật thuỷ sinh di cư từ nhánh sông này sang nhánh sông khác hay sử dụng những loài di nhập. Điều này làm gia tăng lo ngại về tổn thất đa dạng di truyền và lây lan bệnh động vật thủy sinh. Phát triển không kiểm soát nổi của các loài di nhập ở các sông tự nhiên sẽ chèn ép các loài bản địa. Hợp tác giữa các nước thành viên ven sông là việc cần thiết để cùng nhau hoạch định chính sách chung, thoả thuận với nhau trong khu vực về chiến lược quản lí những vấn đề chung này. Hy vọng rằng Uỷ hội sông Mê Công tiếp tục ủng hộ công việc có giá trị của *Ban Tư vấn kỹ thuật về quản lý nghề cá* và các cơ quan của các nước ven sông khác nhằm thúc đẩy trao đổi thông tin và giải quyết các vấn đề phát triển chung.

4.6 Thông tin và đối tác. Có rất nhiều cơ hội để xây dựng đối tác hữu hiệu từ vô số các cơ quan phát triển hoạt động trong lĩnh vực nuôi thuỷ sản và phát triển nông thôn thuộc lưu vực. Hợp tác và trao đổi kinh nghiệm giữa các đối tác thông qua thông tin tốt cũng là điều quan trọng nếu như nguồn kiến thức và tài chính cho phép được dùng vào chỗ lợi thế nhất.

Status of aquaculture in the Lower Mekong Basin

1

1.1 Background

Aquaculture is a diverse and important rural activity in the Lower Mekong Basin. It encompasses production and sale of fry and fingerlings and the raising of wild or artificially-reared fry and fingerlings in enclosed or semi-enclosed water bodies, such as ponds, rice fields and fish cages, for both sale and home consumption. Supply of inputs, such as fish seed and feed, and the handling, processing, marketing and consumption of products from aquaculture are an important feature of the livelihoods of many rural households, some of which are located in remote parts of the basin.

Aquaculture and capture fisheries have often been treated as separate activities, but the reality is they are closely inter-related in many ways. This paper identifies some of these links and analyses the role and importance of aquaculture within the wider context of fisheries and rural development in the basin. Information on the status of the capture fisheries sub-sector and reservoir fisheries, as well as a short synthesis on aquaculture, is given in a separate document (Sverdrup-Jensen 2002).

1.2 Aquaculture production in the Lower Mekong Basin

Over the last ten years, there has been a steady growth in inland aquaculture production in the Lower Mekong Basin areas of all riparian countries from an estimated 60,000 tonnes in 1990 (Interim Committee for the Coordination of Investigations of the Lower Mekong Basin, 1992) to around 260,000 tonnes (1999/2000 figures). These totals are based on official government statistics and household consumption surveys which are presented in Table 1. The farm gate value of aquaculture products in 1999/2000 was around US$ 263 million.[1] Production from aquaculture appears to represent around 12-13 percent of the estimated 2,036,000 tonnes of aquatic products produced in the Lower Mekong Basin.

In the brackish water areas of the Mekong Delta, aquaculture contributed another 135,179 tonnes of aquatic products, including 71,536 tonnes of high value shrimp (Tran and Tran 2000). Although very important to Viet Nam and the people living in this delta region as a source of income and national export earnings, brackish water culture systems and species are not considered further in this report.

[1] Includes additional estimates from Northeast Thailand for the value of unreported small-scale aquaculture.

Aquaculture is unevenly developed in the Mekong Basin. Most production takes place in the Mekong Delta in Viet Nam and the Korat Plateau in Northeast Thailand. There are also some aquaculture operations in Cambodia and in the central plains and highlands of Lao PDR, but their production is small in volume and value. Small-scale aquaculture is probably under reported, and more widely practiced among rural households than official aquaculture production figures suggest.

Table 1: Inland aquaculture production in the Lower Mekong Basin (based on 1998-2000 data)

	Estimated total number of rural households	% of rural households engaged in aquaculture	Estimated annual inland aquaculture production (tonnes)	Estimated value ($)[1]
Thailand	2.6 million	approx. 7	38,115[2]+30,000[3]	20,400,000[4]
Lao PDR	667,900	8.3[5]	5,378[6]	7,000,000
Cambodia	N/A	N/A	14,100[7]	17,200,000
Viet Nam	2,675,900[8]	N/A	171,570[9]	200,000,000
Total			**259,163**	**244,600,000**

Notes:

[1] This value is the theoretical cash value of production and does not reflect the actual income/expenditure on aquatic resources

[2] DOF 1998 official production statistics for northeast Thailand (DOF 2001)

[3] Estimated unreported small-scale aquaculture production

[4] Estimated from 1997 DOF data on the average freshwater fish price of Baht 27/kg and 1997 annual production figures and an exchange rate of 1US$=Baht 45

[5] Lao Agricultural Census, 1998/99. Steering Committee for the Agricultural Census Agricultural Census Office. Vientiane, February 2000.

[6] Pond production estimated as: Estimated pond area x average productivity 800 kg/ha, Rice fish culture area x 120 kg/ha.

[7] Official DOF figures for 1998 (also value)

[8] 1999 figures (from READ) based on the population of the 12 provinces of the Mekong Delta in Viet Nam being 13.38 million in 1999 and assumes a mean household size of 5.

[9] The figure excludes shrimp production. Ministry of Fisheries data give 71,536 tonnes of shrimp/prawn in 2001.

1.3 Producers and the role of aquaculture in food security and livelihoods

There are a few large-scale commercial farms in the Lower Mekong Basin, such as the cage culture farms that produce river catfish in the Bassac River in the Mekong Delta, and the large integrated fish farms near urban centres in Northeast Thailand. However, most aquaculture production in the basin comes from the small-scale operations of rural households. At the household level, aquaculture is becoming more important throughout much of the basin, particularly in poor and fish deficit areas away from major wild fisheries, a fact not usually captured in official statistics. In Northeast Thailand, for example, 170,000-200,000, or 6.5-7.6 percent of the 2.6 million rural households are involved in small-scale aquaculture. In Lao PDR, although the annual production of 5,000 tonnes seems quite low, 55,200 rural families (8.3 percent of rural households) engage in some form of aquaculture. It is clear that aquaculture does have an important role to play in poverty alleviation.

Small-scale aquaculture contributes to food supply in areas of the basin where opportunities to catch wild fish are limited and in seasons when wild fish are not readily available. It also provides income-earning opportunities for rice farmers who lack other opportunities to generate income. Aquaculture can provide both food and opportunities for low risk income generation. Farmed fish and other cultured aquatic products can be sold live at the village level, ensuring freshness and a good taste. In rural areas that are not electrified and lack ice, being able to sell live fish is a considerable marketing advantage over wild-caught fish that may have been out of the water for some time since capture.

Aquaculture can also contribute to improving human nutrition. Rural diets in the Mekong Basin rely on rice as the predominant form of carbohydrate and for a significant amount of protein. This rice diet is deficient in the essential amino acid, lysine. Fish, however, is a rich source of lysine.

Aquaculture is a source of cash and food for rural households. Cash outlay may be required for fingerlings, so some form of income is usually necessary (earned through the sale of fish produced or from other farm products). In poor households, the families that engage in aquaculture often consume the fish, and this may spare other livestock for income generation (especially chickens and pigs). In Lao PDR, experience from a Food and Agriculture Organization (FAO) project shows that the majority of fish farmers engage in aquaculture primarily for household food security, with income generation as an added bonus where surplus fish are produced (Funge-Smith 1999a). Fish production for food security generally requires little labour once the pond is established. It is therefore not only the tonnage that makes aquaculture important in the basin – it is the number of households engaged in production.

The spectrum of people involved in aquaculture is wide, and includes low income and poor people, as well as the better off with more assets to invest. For the better off, aquaculture can offer a lucrative return on investment, as can be seen, for example, in freshwater cage farms in Viet Nam. The basin's people are also involved in the supply of inputs, such as fish seed and feed, and in post harvest activities. In the Mekong Delta, for example, factories processing river catfish fillets for export provide employment for a significant number of women.

Even though some assets are needed to invest in aquaculture production, poor landless people can become involved and benefit from well-targeted aquaculture interventions. For example, in Lao PDR, landless poor people who did not have access to ponds were involved in a successful and sustainable fish-nursing network (Lithdamlong *et al.* 2002).

To date, the approach to aquaculture development has emphasised increasing aquaculture productivity, but such production and technology-oriented approaches have not always focussed on poor people. In some cases, such an approach may even disadvantage poor people (Haylor 2001). Projects in Lao PDR and Cambodia over the past few years demonstrate that a focus on the participation of poor groups in aquaculture can make significant contributions to improving rural livelihoods. Frequently, the rural poor will readily enter aquaculture if the basic constraint of reliable fingerling supply can be overcome.

Women, men and children are all involved in small-scale aquaculture, although each may have different roles. In the basin, there are few cultural constraints on women's participation. In Viet Nam, for example, women are actively involved in routine feeding and fertilisation, and are involved in harvesting for consumption and marketing. In Lao PDR, women are actively involved in marketing (Funge-Smith 1999a). Moreover, experiences with the MRC's Rural Extension for Aquaculture Development (READ) project suggest that the role of women is greater in poorer households, where men often have to work away from home on a seasonal or daily basis. In some areas, the distance of the aquaculture operation from home is a constraint, and domestic chores may conflict with the requirements for feeding and management. Overall, women play an active role and are important participants in small-scale aquaculture in the Mekong Basin.

1.4 Aquaculture systems and species

Most fish cultured within the basin are farmed in ponds and rice fields (Table 2), usually as part of a rice-based agricultural farming system. But, there are distinct differences between fish culture practices throughout the basin, and between peri-urban and rural areas. Peri-urban areas have better access to agricultural inputs (feed), and more intensive livestock production (particularly pigs and chickens) provides useable wastes. Technical information and fish seed are also more readily available

due to the proximity of government fisheries stations and fish seed supplies. In Thailand and the Mekong Delta of Viet Nam, better infrastructure allows farmers better access to inputs, markets and information than is the case in more remote rural areas in Cambodia and Lao PDR.

The number of aquaculture farms and land allocated to aquaculture has grown over the past 10 years. In Northeast Thailand, there has been substantial digging of fish ponds since 1997, influenced in part by Thailand's economic crisis, and through the self-sufficiency and food security principles and projects promoted by His Majesty, the King of Thailand. In Cambodia, large numbers of household ponds have been dug by NGOs and donor agencies over the past 10 years, although only some of these multiple purpose ponds have been used for aquaculture, and productivity of many remains low. The available statistics on farms and land cover, summarised in Table 2, certainly underestimate small-scale aquaculture scattered throughout the rural areas of the basin.

Table 2: Aquaculture production areas and estimated fish fingerling production in the Lower Mekong Basin (based on 1998-2000 statistics)

	Pond culture (ha)	Cage/pen culture (ha)	Rice-fish culture (ha)	Estimated fingerling production
Thailand[1]	25,862	8.96	6,519	190.6 million[2]
Lao PDR	5,150[3]	N/A	1,896[4]	<15 million[5]
Cambodia	315	14.25 (3561 cages, 9,870 t)	N/A	7.1 million in 1999, estimated >10 million in 2000[6]
Viet Nam[7]	51,264	39	79,750	595 million

Notes:

[1] Northeast Thailand. DOF official statistics for 1998. Excludes 30 ha of 'ditch' culture.
[2] Personal communication from Dr Khamchai Lawonyawut, based on DOF estimates of production of 38,114,790 kg of fish, and 1 kg fish requiring 5 fingerlings (in 1998) (DOF 2001).
[3] Estimated as 51,500 households x average pond size of 0.1 ha
[4] Estimated as 6,320 households x average stocked area of 0.3 ha
[5] Government estimate from 1997, but probably less
[6] So Nam and Nao Thuok (1999)
[7] Tran Thanh Xuan *et al*. 2000

Aquaculture is taking off around the basin in response to demand for aquatic products within households, from local or urban markets, and for export of some species, such as the river catfish and freshwater prawns. In the Mekong Delta, cage culture of pangasiids has expanded rapidly in recent years, due to expanding export markets. Aquaculture has particularly good potential where there is water and food insecurity, and in areas where wild fish supply is insufficient to meet demand, either seasonally or throughout the year. The important factors influencing aquaculture development include infrastructure, access to markets, supply of inputs, particularly fish seed, and access to extension and other support services. In Lao PDR, for example, economic factors such as the poorly developed market economy outside of towns, poor road communications, the largely subsistence rural economy and limited access to long term credit, play an important role in constraining aquaculture development.

Box 1: Factors affecting small-scale aquaculture development

- Local wild fish supply, including seasonal and yearly variations
- Availability of inputs, particularly water, fish seed, feed/fertiliser inputs and suitable land (or water area)
- Local market demand, particularly in remote rural areas
- Availability of support services credit, information and infrastructure.

There are more than 30 fish and prawn species cultured in the Lower Mekong Basin, a diverse collection of both exotic and indigenous species. A brief overview of the systems and species is provided below, divided into different regions to illustrate the variation that occurs from the lowland delta areas of Viet Nam and Cambodia, to the central plains in Northeast Thailand and Lao PDR, to the upland areas in northwest Cambodia, Lao PDR and in the Central Highlands in Viet Nam. Additional references are provided for readers seeking more information.

1.4.1 Mekong Delta in Viet Nam

The Mekong Delta in Viet Nam has the largest aquaculture area in the basin, covering 329,225 ha. Total production (fresh, brackish and marine) in 1999[2] was 291,457 tonnes, worth an estimated US$ 305 million (Tran and Tran 2000). Of this, freshwater aquaculture production made up 171,570 tonnes. The total for pond culture was 80,980; cage culture was 58,410, fish-fish culture was 29,840 and *Macrobrachium* (prawn) culture was 2,340 tonnes. There were 51,264 ha of ponds in the Mekong Delta region of Viet Nam in 1999, though only 16,877 of these, or 33 percent, were cultured. Production per unit of water area is high, with a mean annual pond production rate of 4.8 tonnes/ha. Ponds are small, typically 100-500 m^2 in area, and are often created when earth is excavated to elevate land for house construction. In 1999, in the Mekong Delta of Viet Nam, 111 hatcheries produced an estimated 1,615 million fry and 595 million fingerlings. Silver barb, Chinese and Indian carp, tilapia and river catfish were the most abundant fish seed produced. With support from the MRC READ[3] project, there has been a recent increase in hatchery production of fish seed from snakeskin, kissing and giant gourami and climbing perch. Cages are commonly found in the river, with the largest concentrations at Chau Doc in An Giang Province, and smaller numbers at Long Xuyen.

The most commonly cultured fish species in Mekong Delta ponds are river catfish *P. hypophthalmus*, silver barb *Barbodes gonionotus*¸ common carp *Cyprinus carpio*, tilapia (mainly *O.niloticus* and *O.mossambicus*), giant gourami *Osphronemus gourami*, sand goby *Oxyeleotrix marmoratus*, hybrid catfish *Clarias gariepinus, C. macrocephalus*, silver carp *Hypophthalmichthys molitrix*, Indian carps and snakehead *Channa striatus*. Polyculture is the norm with stocking regimes and densities varying with feed availability, water quality and market price. Fish pond farming in the Mekong Delta is normally integrated under the VAC system, an acronym for the Vietnamese words for "livestock, pond and vegetables". Extensive use is made of agricultural and fisheries by-products, some human wastes from over-hung latrines, and abundant cheap labour, which keeps fish prices relatively low. The MRC READ project estimated that 240,000 tonnes of farm-made feeds are used annually in the Mekong Delta, and so far, only minimal (but growing) use is made of formulated pellet feeds. Viet Nam, therefore, has a rich experience with farm-made feeds.

In the Mekong Delta, 79,750 hectares of an estimated potential area of 209,670 ha, are presently under rice-fish culture. Trenches 1.5-2.0 metres wide and 0.8-1.0 metres deep, and occupying 10-15 percent of the total rice field area, are dug around the rice field periphery. Silver barb, common carp, silver carp, tilapia, Indian carp, climbing perch, and snakeskin gourami are most frequently stocked in rice-fish systems. Mean annual production from rice-fish systems in the Mekong Delta is 0.37 tonnes/ha, with the fish being held in the rice fields for two or three successive rice crops.

[2] Ministry of Fisheries estimates for 2001 are 372,578 tonnes, consisting of 137,043 tonnes of pond fish, 64,908 tonnes of cage culture fish, 63,643 tonnes of clam and blood cockle, 71,536 tonnes of shrimp/prawn and 35,448 tonnes of other items.

[3] Rural Extension for Aquaculture Development (READ) MRC project.

In 1999, there were 4,639 fish cages in four Mekong Delta provinces, each ranging from 50 to 400 m^3 in size, with larger cages commonly consisting of living quarters on top and the submerged cage portion below. River catfish, snakehead, red-tail tin foil barb (*Barbodes altus*), silver barb and common carp are most often reared in cages, stocked with one major species, plus a few common carp to utilise uneaten feed. For river catfish and snakehead, stocking densities for nursing and grow-out are 200-300 and 80-150 fish/m^3 respectively, at a size of 5-6 g. Other species are stocked at 80-100 fish/m^3. Fish are fed wet sticky balls of mixed rice bran, broken rice and trash fish, costing US$ 0.10-0.14/kg. Vegetables were previously used for river catfish, but are no longer used as ingredients as they contain carotenoids, which caused the flesh of the now dominant species, *P. hypophthalmus,* to turn yellow and be rejected by fillet processing plants. Fish are cultured for between 10-14 months and yields range from 80-120 kg/m^3. Cage culture of high value species requires investment levels beyond the reach of poor and marginal farmers. The fish cages are heavily dependant on the supply of so-called "trash" fish, from wild fisheries in Viet Nam and Cambodia. Using trash fish as feed transforms a low economic value product into a higher value product – the cage reared fish. Amounts of "trash" fish collected from the wild are substantial. No figures regarding trash fish were available to the review, but concerns have been raised over the impact of expanding demand on the environment and the availability of fish for poorer consumers.

The government of Viet Nam has recently begun promotion of giant freshwater prawn culture in the Mekong Delta region. In 1999, there were 2,940 *Macrobrachium* ponds. These were typically 50-200 m^2 in area and stocked with 1-5 post larvae/m^2. There were also 6,730 hectares of rice-prawn plots, which were stocked with 1-2 post larvae/m^2. *Macrobrachium* culture is dependant on wild seed fish, though hatcheries are being developed. In ponds, *Macrobrachium* are fed a mixture of rice bran, broken rice, fishmeal or trash fish, while no feed is provided in rice-prawn systems. Mean annual production in 1999 was 0.33 tonnes/hectare.

The parts of the Central Highlands in Viet Nam that drain into the Mekong River have some small-scale pond culture and cage culture. Cage culture of grass carp started in Dak Lak province in 1993 in the Ea Soup Reservoir. The number of cages in the reservoir increased rapidly, but declined in 1996 due to outbreaks of grass carp disease (Phillips 1998). Major problems affecting cage culture in the area included water pollution, fish disease and market[4] constraints.

1.4.2 Mekong Delta and Tonle Sap system in Cambodia

In Cambodia, over 80 percent of aquaculture production comes from cages and pens in the Tonle Sap Great Lake and the Tonle Sap, Mekong and Bassac River systems. Cage and pen culture originated in the Mekong Delta and Tonle Sap system, and has a long history. Major species cultured in cages include the river catfish *Pangasianodon hypophthalmus* and giant snakehead *Channa micropeltes*. Minor species include *Barbodes* sp., *Clarias batrachus*, *Oxyeleotris marmorata*, *Cirrhinus* sp. and *Leptobarbus hoevenii.* Cage culture in Cambodia is in the "transition" zone between capture and culture fisheries. Some farmers use cages solely for transporting fish. Others may hold fish in cages or pens for a few months for fattening and marketing when fish are scarce. Still others may use cages and pens, or combinations, to grow fish from juvenile to market size. Juvenile river catfish and snakeheads are often collected from the wild, illustrating the heavy dependence on the wild fishery.

[4] For example, disease problems in cage culture in the Ea Soup reservoir in 1997 led to farmers selling large quantities of grass carp, with a consequent reduction in price due to limited local market capacity for fish. Interestingly the drop in price of cultured grass carp had a "knock on" effect on prices of wild fish, with reductions in prices received by local fishermen.

Raising fish in ponds and rice fields is less developed in Cambodia, although importance has been increasing in recent years following promotion by NGOs and international agencies. The contribution from the two systems is some 15-20 percent of total aquaculture production. There are two pond systems in Cambodia. One is the intensive *Pangasius* culture, common around Phnom Penh and in Kandal, a province that is near the markets of Phnom Penh. Fish fingerlings are collected from the wild and held in small ponds and fed rice bran, or trash fish when wild fish are abundant. The second type is low-input pond culture, rice-fish and other integrated fish/livestock/vegetable culture techniques involving both exotic and indigenous fish species. Here, although pond and rice-fish culture make a limited contribution to national fish production, they are important for poor households in fish-deficit areas away from the Tonle Sap and major rivers.

1.4.3 Lao PDR

In Lao PDR, fish culture in ponds and rice-fields is practiced in many areas, and a variety of systems are used, depending upon the agro-climate of the area. The main areas are the plains bordering the Mekong River, and the valleys in highland areas (which cover about 85 percent of Lao PDR). There are still considerable areas of land that could be developed for seasonal aquaculture, either as pond or rice-fish culture. Aquaculture appeals to rural farmers in circumstances where capture fisheries are inaccessible or require excessive effort for a limited catch. There is a small amount of cage culture in reservoirs, and growing investment in cage culture in the Mekong River and major tributaries, but so far this culture system makes a relatively small contribution to aquaculture production. The majority of Lao PDR fish ponds are rainfed and shallow, with water depths of less than 50 cm. The ponds, constructed by hand, are small. Fish pond development is often rapid in areas where road building results in excavated ponds or ditches, but production is frequently constrained by lack of fingerlings.

The productivity of rural aquaculture ponds is low in Lao PDR and reflects the limited amount of inputs (feeds, manures) applied to ponds, and the lack of fingerlings for stocking. In colder areas, the reduced grow-out season also limits productivity. A diversity of fish species are cultured in Lao PDR including tilapia, exotic carps (Indian carp, Chinese carp and common carp), and also indigenous silver barb (*Barbodes gonionotus* and other *Barbodes* species). The diversity of wild fish species (including snakehead, *Anabas*, catfish, eels, *Carassius auratus*, *Cyprinus carpio*[5] and others) and the common occurrence of other small aquatic creatures (*Rasbora*, small shrimp, frogs, and snails, which sometimes self-recruit in ponds), provide an important source of additional nutrition for farm households. This small-species by-catch does not have a high market value and is usually used for household consumption only.

Rural areas of Lao PDR are typified by their self-reliant subsistence agriculture systems, where agricultural surpluses are minimal and livestock typically forage on their own. As a result, farmers lack the manures that could be used as fish feed. They also lack seed, supplemental feed, technical information or even awareness of the potential for aquaculture. Because the population density is low, and communications between villages are poor, the extension services that could promote aquaculture and provide technical information are limited.

Rice fields in Lao PDR are an important source of aquatic products both from fishing and from aquaculture. However, raising fish in rice fields is more difficult in upland areas. Rainfed and irrigated rice fields often require terracing, and because this limits the size of individual paddy

[5] There are wild feral populations of *Carassius auratus* and *Cyprinus carpio* in the mountain areas of Lao PDR, including several variants (morphotypes) of *Cyprinus carpio* as described in Vietnamese literature.

fields, farmers are reluctant to cut channels or construct refuges (as recommended by most rice-fish culture experts). Where irrigation is available (usually from stream diversion), the requirement for deep water and refuges is reduced due to the continual flow of water into the paddy. Deep water and refuges are also less important in upland areas because temperatures are cooler.

Where irrigation is available, rice fish culture is more successful, principally due to the increased availability of fish fry. In upland Lao PDR, *Cyprinus carpio* and *Carassius auratus* spawn naturally in the rice fields and adjoining ponds. In some areas, farmers can produce their own fish seed and this is extremely popular as cash is not required. An FAO project found that rice-fish culture rapidly expanded once farmers were given some basic training in fingerling production. Previously, fingerling shortages had been a major constraint. A DfID research project in Savannakhet found that simple rice field aquatic resource production systems were accessible to very poor farmers.

Fingerling production is popular because it requires little investment or risk, and profits are made quickly. Few modifications to ponds are required other than raising their walls. Once fingerling fish are produced, they are transferred to adjoining ponds for on-growing. If farms are close to a provincial or district market, income can be easily generated from raising fish. Fish are raised during the rice-growing period (typically 90-100 days), harvested at the same time as the rice, and often used to reimburse labour or to celebrate the harvest. Having fish available is also popular since there is no time to fish during the rice-harvesting season.

The size of the fish harvested varies according to the size stocked. Farmers prefer to stock a larger 5-10 g fish, although smaller fish are stocked in some cases due to their cheaper price. Stocking densities are typically low, reflecting the high price of fish fingerlings and the limited amount of money farmers have to invest. Since most farmers do not generate cash, the purchase of fish fingerlings is frequently not possible.

Rice-fish culture is also practiced in lowland areas; primarily for household consumption. Species include *Cyprinus carpio* and *Carassius auratus* and *Oreochromis* sp. Risks to non-irrigated rice-fish culture are principally flooding, drought and theft. Access to a water supply increases the reliability of the system. Lack of success with rice-fish culture is typically due to the problems previously mentioned. This demonstrates that not all rice fields are suitable for fish culture, even though they may still provide a valuable source of other wild aquatic animals.

1.4.4 Korat Plateau in Northeast Thailand

In Northeast Thailand, aquaculture has expanded significantly over the past 10 years, and the Korat Plateau is the second largest area for aquaculture production in the basin, after the Mekong Delta. Fish culture in ponds, rice fields, ditches and cages contributes over 38,000 tonnes according to official Department of Fisheries statistics for 1998 (DOF 2001). These statistics certainly under-estimate the contribution made by large numbers of small-scale producers. There are 2.6 million farm holdings in Northeast Thailand. In the last five years, some 60,000 ponds have been dug in the region, although not all of these are used for aquaculture. It is now estimated that more than 200,000 households may be involved in small-scale aquaculture and annual production from these small-scale households is estimated as 30,000 tonnes or more. This makes a total production about 68,000 tonnes per year if the 30,000 tonnes for small-scale production is added to the 38,000 tonnes that DOF officially estimated in 1998.

Pond culture predominates on the Korat Plateau. Species include a mixture of tilapia (several strains), exotic and indigenous carp, including silver barb (*Barbodes gonionotus*), common carp (*Cyprinus carpio*), Indian major carp, Chinese carp, catfish and snakeheads. Pond culture is based largely on

the use of agricultural by-products, such as manures and vegetable matter, and increasingly on commercially-made pellet feeds. Integrated farming is also found around urban centres where organic waste from pigs and chickens is more readily available.

Rice-fish culture is found in Northeast Thailand, although it has not expanded significantly in recent years. Cage culture of tilapia, supported by larger agro-industrial concerns, has expanded in the past three years in reservoirs, in the Mekong mainstream and in major tributaries, particularly the Moon River. Cage culture of river catfish can also be found in the Mekong River, based on wild caught seed. This will likely expand if the breeding technologies of the higher value *Pangasius bocourti* become more widely adopted. Northeast Thailand is also important in the supply of seed and feed to areas in Lao PDR that border the Mekong River.

1.5 Consumers and markets

Aquaculture products are becoming a more important feature in the basin's fish markets, particularly in Viet Nam and Thailand. The availability of markets for aquaculture products influences the success of aquaculture, and the availability of products from capture fisheries also has a strong influence on markets. For example, the influx of wild fish from the Great Lake of Cambodia during early 2001 depressed Northeast Thai markets for cultured fish – snakeheads, catfish and tilapia. This is largely a consequence of high catches in 2001 and improvements in infrastructure linking Cambodia with markets in Thailand.

Aquaculture fish have a number of advantages when compared to wild fish: cultured fish can be marketed live, providing a fresher product; and cultured fish can be marketed when there is insufficient wild fish and market prices are favourable. In Svay Rieng Province in Cambodia, for example, the lowest prices are early in the year, when there is a large wild catch. Farmers with sufficient water in their ponds to last the dry season can keep fish into the rainy season, and sell when prices are higher.

Infrastructure and the availability of wild fish have an important influence on markets for aquaculture products. Aquaculture may allow flexibility in marketing, taking advantage of dry season shortages and traditional festival periods. Prices of cultured fish are at their best during the Lao and the Cambodian New Year periods, which take place during the dry season when fresh fish are in short supply. As stated previously, cultured fish can also be sold live at the village level ensuring freshness and a good taste. In rural areas that are not electrified and often lack ice, being able to sell live fish is a considerable advantage over wild-caught fish that may have been out of the water for some time since capture.

A proportion of cultured fish may be consumed at home, or at least not directly marketed. It is typical for a family in Lao PDR, for example, to purchase fish from a neighbour in order to acquire fish for celebrations or festivals. According to data from a FAO project in Lao PDR (FAO/LAO/97/007 – Funge-Smith 1999a), 70 percent of households involved in aquaculture sold some farmed fish. Most of the products produced from aquaculture are consumed in the basin, or nearby markets. There are some exports from the basin, perhaps the most notable being pangasiids (presently mainly *Pangasianodon hypophthalmus*) from Viet Nam. These river catfish have a growing market in the United States and Europe as fillets. Some tilapia fillets are also exported from Viet Nam, and there is growing commercial interest in tilapia production for export.

So far there is very limited value added to most aquaculture fish. Wild fish tend to be dried, smoked and fermented, but in contrast, aquaculture is more focussed on growing a premium product and selling fresh as needed.

In the case of cage culture in Cau Doc, An Giang Province, the changing role of traders is of particular interest. Different trading networks supporting this cage culture have emerged in parallel. The provision of small freshwater cyprinids from nearby traps has reached around 1,000 tonnes per day in the wet season. This is traded through Cau Doc town on a daily basis to feed pangasiid and snakehead being raised in the surrounding area. *Pangasius bocourti* and snakehead (*Channa* spp.) fingerlings caught in *dai* traps, mainly in Cambodia, are also sold for grow out in cage culture operations in Viet Nam. The trading networks that supply feed fish for aquaculture appear to have developed outside the table fish networks[6].

1.6 Institutional support to aquaculture

1.6.1 Policy and legislation

Government policy in all Mekong riparian countries has been supportive of aquaculture, and some governments have production and earnings targets for future development. These pro-aquaculture policies have supported investments in research, infrastructure, education and extension that have contributed significantly to the growth of aquaculture in the past 10 years. As a result of this support, there has probably been less attention paid to issues of inland fisheries. Thailand and Viet Nam have invested the most resources in aquaculture; investments appear to have been less in Lao PDR and Cambodia. In Cambodia, most institutional support has been directed to wild fisheries, and only in the late 1990s was aquaculture recognised in policy and a specialised aquaculture unit formed within the Department of Fisheries.

Governments have also recognised aquaculture within the context of rural development and poverty alleviation policies. For example, the Prime Minister's office in Viet Nam has recently established a policy regarding aquaculture for poverty alleviation. This is part of the national *Hunger Eradication and Poverty Reduction* programme. In Thailand, the new constitution promulgated in 1997 emphasises decentralisation of governing power to local institutions in order to support local development. In Lao PDR, the new Agricultural Policy of the government recognises the role of aquaculture in rural development and income generation.

The policy environment outside the fisheries sector has a major influence on the development of aquaculture. For example, to alleviate poverty, conversion of rice fields to aquaculture ponds has been stimulated in Viet Nam and Lao PDR through changes in land use policy. Tenure and land use issues are also important in the management of village or community fish ponds in northeast Thailand and Lao PDR. Government policies promoting international and regional trade and infrastructure development have influenced aquaculture development as well by leading to greater movement of fish fingerlings, feeds and fertilisers, and of fish to markets.

Box 2: Experiences with farmer groups and aquaculture extension in Lao PDR

Aquaculture in rural areas is an activity that can be adopted by households with quite different resource bases. Traditional development approaches have focused on a narrow technical package for aquaculture that excludes many families. An FAO project (FAO/LAO/97/007) took a farmer group approach that recognised the diverse situations of farmers. Supporting farmers by enabling access to fingerlings, coupled with an exploratory approach to what was practically achievable, allowed farmers to develop their culture system in accordance with a risk level that they found acceptable. Households with better water resources or greater interest in fish culture, were trained in fingerling production. Decentralising fingerling production is a crucial factor in sustaining stocking activities in remote areas that cannot access fingerlings produced by provincial hatcheries.

[6] Personal communication from Simon Bush, based on an unpublished report to MRC.

Laws and regulations have been developed at various levels, but there is no separate legislation on aquaculture in any Mekong riparian country. Aquaculture tends to be considered as part of national fisheries legislation. Fisheries legislation has recently been revised, or is undergoing revision in Cambodia, Thailand and Viet Nam to reflect changing circumstances. In Cambodia, a new law is being developed that will place more emphasis on the management of aquaculture, as well as co-management of fisheries resources. In Thailand, a new law is being considered that will place more emphasis on community-based management in line with the new constitution. In Viet Nam, a fisheries law has been drafted that places more emphasis on aquaculture as a sub-sector within fisheries. Development of specific regulations on aquaculture will be prepared under the fisheries law.

At present, most line agencies involved with aquaculture are in a transitional state, driven by a sectoral perspective. The development of new institutional mechanisms and governance strategies is, however, required to accommodate the shift in emphasis towards local development and governance.

At the regional level, the *1995 Agreement* that established the Mekong River Commission provides a framework for cooperation among riparian countries in the basin, and indeed there has been some increased cooperation in research, development and education in the past 10 years that has contributed to aquaculture development in the basin. There are, however, trans-boundary policy issues relevant to aquaculture that have yet to be addressed. These include issues related to the introduction of exotic species, cooperation in controlling the spread of fish diseases, and genetic issues related to movement of indigenous cultured fish. In the future, such cooperation may become important for management of genetic resources and aquatic animal health within the basin.

1.6.2 Institutional support

Government institutions supporting extension, research, education, and training exist in all riparian countries. Thailand and Viet Nam have invested considerably more resources in aquaculture, and Viet Nam has an ambitious plan to support capacity building and extension for aquaculture. Investment in government hatcheries has also been substantial in Thailand. Research support has traditionally focussed on technical issues, and less on formulating and implementing farmer-driven research agendas. Similarly, extension has largely been prescriptive rather than farmer-needs based. It is only more recently that more adaptive, farmer-needs-driven aquaculture has been piloted (Box 2). Awareness of the need for such approaches is growing. For example, in the Mekong Delta, the government of Viet Nam has just completed a policy document that emphasises creating an enabling environment to overcome technological constraints. However, the paradigm shift from technology transfer to supporting and empowering farmers and rural households will take time.

Governments, and to a lesser extent non-government institutions, are involved in extension support, a critical factor for the success of aquaculture. Without access to appropriate extension and input supplies, aquaculture can suffer failures. For example, large numbers of ponds were dug by NGOs and international agencies in Cambodia during the late 1980s and 1990s, but without any training and extension, that led to poor practice and limited success. Extension support also has to be sensitive to the needs of the target audience; for example women (see Box 3) or those who do not speak the national language well.

Box 3: Targeting women in aquaculture extension

While women are invariably involved in many of the stages of aquaculture, targetting of women in extension is often problematic. Training activities and meetings often take place during the day when women are busy with household activities. Women may not travel between villages and do not have long periods of time available to attend training. Seed production is an activity that can be highly suitable for women's involvement, provided that the production site is located near to the house.

A feature of extension in the basin is the relatively small number of extension workers compared to the number of rural farmers. In Tien Giang Province in Viet Nam, the READ project estimated there are 10 aquaculture extension staff for 350,000 households, while typically in Cambodia and Lao PDR, there is at most one aquaculture extension officer per province. This situation is unlikely to change much in the future, and therefore innovative extension approaches and partnerships must be developed. There has been some success with alternative approaches, such as using private seed suppliers to supplement traditional government extension activities. In Lao PDR, farmer groups have been established and appear to have been successful as a means of self-help and a focus for government extension (Box 4). The past 10 years has seen some success in extension in the Mekong Basin, and there are now better innovative techniques than before. To meet the needs, future work will have to concentrate on innovative approaches.

The large number of agencies, donors and NGOs supporting aquaculture, either as a sector, or increasingly as part of rural development, makes the need for coordination and effective communication increasingly important.

1.7 Aquaculture and the environment

Aquaculture operations can impact the surrounding environment and in turn be impacted by it. Small-scale aquaculture can contribute to environmental improvement but on- and off-farm environmental interactions need consideration in the promotion of aquaculture in the Mekong Basin.

Box 4: Seed producers as an extension resource

Group approaches to extension facilitate exchange of ideas, and concurrent development of supply and distribution systems for fingerlings. Typically, once fingerling supplies are developed, demand far outstrips production capacity. This encourages other farmers to become involved in fingerling production. Lack of resources for long-term extension support requires that farmers become independent within one or two crops. Focusing on seed production limits the numbers of farmers that need extension support, but can still impact a wider, less-accessible target group. When governments support seed production in remote areas, farmers from even more remote areas may access this resource. Seed producers can be effectively used as trainers since they usually have a good appreciation of what is possible under local conditions. It should be recognised that seed producers and traders may not fit poverty criteria for assistance, however they may be a critical resource in helping poor households to engage in low risk aquaculture. Long-term strategic support to fingerling producers through access to quality broodstock and support with fish health issues, can reduce the cost of extension, while still impacting a much wider target group.

1.7.1 Positive environmental benefits from aquaculture

Small-scale aquaculture ponds store water that can be used for livestock, watering vegetables, and as a domestic water supply during the dry season. Integration of fish ponds into irrigation networks can increase the benefit of water prior to discharge into fields. The income generated from fish production per unit area is greater than that of rice production, and generally requires less water. Ponds also provide a means of recycling nutrients and organic matter. As part of the household livelihood strategy, a pond is an important natural asset for small-scale farm households.

1.7.2 Environmental impacts arising from outside the aquaculture sector

Environmental conditions impact significantly on aquaculture, due to natural climatic fluctuations or man-made changes. For example, in Lao PDR, most fishponds are seasonal due to the six month dry season. Ponds are shallow and dry quickly, and high temperatures may be a problem. Heavy rain during the monsoon season can cause flash flooding, which enables fish to escape.

In the Mekong Delta area of Viet Nam, heavy flooding has caused significant damage to aquaculture, although household losses were reduced by a corresponding increase in the wild catch in culture ponds. Poorly sited ponds, such as "barrage ponds" in dammed streams in mountainous areas of Lao PDR are particularly prone to flood damage. Floods and droughts, which occur naturally in a monsoon climate, can be exacerbated by deforestation and ill-considered water management schemes. Equally, diversion of water to create aquaculture ponds may adversely impact other users of water resources.

Other human activities can also severely affect aquaculture. The disposal of polluting wastes into shared river and canal systems by upstream users can have devastating effects on aquaculture ponds downstream. This is a particular concern in the highly populous Mekong Delta, and in parts of the Korat Plateau in Northeast Thailand. Potentially damaging wastes in the basin include pesticides, and tannery and sugar processing effluent. Pesticide use in rice fields can also have a major impact on fish being raised in rice fields. However, adoption of Integrated Pest Management (IPM) techniques can substantially decrease pesticide use and improve fish and rice yields. Such approaches deserve further attention in the Mekong Delta region of Viet Nam, where pesticide use and consequent health and environmental problems appear to be particularly significant (Anon. 2002).

1.7.3 Environmental impacts arising from within the sector

Aquaculture can lead to adverse impacts on the environment, including impacts on wild fisheries. These environmental issues, while less significant than impacts arising from outside the sector, need to be properly assessed and managed.

Aquaculture production within the basin relies heavily on exotic (introduced) carps and tilapias, which often escape to the wild and may pose a risk to wild fisheries (Welcomme and Vidthayaonon 1999). Government policy in some riparian countries emphasises promotion of indigenous species aquaculture. The argument for culturing indigenous species rather than exotics is to reduce potential risks to the biodiversity of the basin caused by introduction of alien (non-native) species. The success to date shows that some indigenous species are more profitable than exotics and may be readily adopted by farmers. For example, *Barbodes* (*Puntius*) in Lao PDR was readily adopted by hatchery operators and farmers when simplified hatchery techniques became available.

The use of indigenous species for aquaculture has to be accompanied by broodstock management programmes that contribute to maintaining genetic diversity. In Thailand, for example, there is some evidence of loss in genetic diversity through widespread hatchery breeding of *Barbodes*. Thus, while favouring indigenous fish is a positive environmental move, the approach needs to be supported by effective broodstock management strategies incorporating genetic concerns and species policies that reduce the movement and mixing of genetically-different stocks and strains.

There have been a number of fish disease outbreaks in the Mekong Basin, and it is likely that such problems will increase in future with further expansion and intensification of aquaculture. While the occurrence of large-scale fish disease outbreaks has been rare since the spread of epizootic ulcerative syndrome in the 1980s, occasional serious outbreaks and low-level, chronic, health problems are known to be a constraint to small-scale pond culture. Recently, there have been outbreaks of disease in *Macrobrachium* in the Mekong Delta, and cage culture in the Mekong and Bassac Rivers, and reservoirs in central Viet Nam have suffered fish losses in the past five years.

The infection of humans from liver flukes (trematodes) is a serious human health concern in parts of the Mekong Basin where raw fish is consumed (WHO 1999). Aquaculture can be a means to reduce infection of trematodes, but may also be a source of infection. In Lao PDR, trematode

infection of wild fish occurs where rivers and streams and paddies are used as latrines. But in Lao PDR, infection from cultured fish is less likely since nightsoil fertilisation of ponds is not practiced. Although there are over-hung latrines in ponds in the Mekong Delta, epidemiological studies into their role in causing infections are lacking. Risk factors and preventative management strategies require further research. Human nightsoil has been used as a pond fertiliser in Viet Nam, although the practice has now been banned by the government. Indeed, it may be environmentally better to use ponds as latrines rather than to randomly dispose of nightsoil around the farm.

The conversion of wetlands and even parts of rice fields to fish ponds can lead to losses in wetland habitat and wild fisheries. Such problems have to be avoided through better planning approaches that consider both aquaculture and wild fisheries. Aquaculture should "add-value" to natural resources and the livelihoods of people that depend on natural resources.

There is an environmental concern regarding the culture of predatory fish species that require supplies of wild fish to sustain culture. This mainly concerns snakehead and pangasiid cage culture in Cambodia and Viet Nam. The environmental or human food implications of the use of such large quantities of fish as feed are not understood. Is the practice, for example, taking food away from poorer groups of people? Would availability of cheap ice improve the quality of the catch so that it could be better used? Could the fish be marketed in another way? Could more resource-efficient feeds be developed? Better understanding of such issues, through feed and bio-economic studies, is required to support policy decisions for efficient resource use.

The majority of stocked fish seed comes from hatcheries, though some species, for example, *Pangasius* and snakeheads in Cambodia, *Macrobrachium* in Viet Nam, and a small number of other species such as sand goby, are collected from the wild. In Viet Nam, recent successes in *Pangasius* breeding (*Pangasianodon hypophthalmus* and *Pangasius boucourti*) have led to more farmers stocking hatchery-reared catfish, although some farmers still prefer wild-caught seed. Increasingly in the Mekong Delta, prawns are coming from hatcheries, as demand for post-larvae rises. Whether this is because of diminishing wild supply, or high demand, or a combination of both, is not known. From the limited information available, there appears to be no evidence that juvenile collection is a wasteful use of the resource, although other species are discarded in the process.

As widely found throughout the Mekong Basin, water and sediments from fertilised semi-intensive aquaculture ponds can be recycled and efficiently used on agricultural crops without environmental concern. By contrast, more intensive farming practices, particularly those associated with large concentrations of cage farms where wastes are discharged directly into the water body without treatment, risk localised water pollution. This has led to deterioration of water quality and fish disease outbreaks, for example, with grass carp cage culture in the reservoirs in Dak Lak. Larger-scale developments of cage culture may also result in traditional fishers losing access to fishing grounds. Such problems can be addressed through better cage culture management practices that reduce feed losses, better site location for cages, and localised management arrangements that reduce conflicts and maintain the number of cages and production within the assimilative capacity of the water body.

Aquaculture sub-sector analysis 2

2.1 Developments, opportunities and threats

2.1.1 Aquaculture and its role in food security and livelihoods

Inland aquaculture will continue to contribute to food security and poverty alleviation among people living in the Lower Mekong Basin, at macro- and micro-levels.

At the macro-level in the basin, the overall demand for aquatic products for human consumption over the next 10 years will require additional sources of fish, and aquaculture will have a critical role in meeting this demand. Preliminary calculations based on figures supplied by the MRC, suggest demand in 10 years time of around 2,440,000 tonnes (Box 5). Thus, an estimated additional 440,000 tonnes of aquatic animal product will be required in the Lower Mekong Basin to even maintain consumption at present levels. This estimate is highly uncertain, as there are several unknowns, but it provides an indication of the scale of the issue.

Box 5: Population growth and fish production estimates

With a projected population growth in the Mekong basin of 2 percent/year, the demand for fish is expected to grow correspondingly, and in 10 years time, the demand for fish will have risen by 22 percent. Based on current estimates of supply at around 2 million tonnes per year, this means that an additional 440,000 tonnes of fish (or aquatic products) will be required. These figures require verification by research and more detailed analysis, but suggest that fish supply must increase by over 40,000 tonnes per year in the next decade, just to maintain present consumption levels. It is uncertain whether production from wild capture fisheries can increase at this rate and aquaculture production, culture-based fisheries and possibly imports are all expected to contribute to the growing demand. It is therefore likely that aquaculture will become be a major contributor to fish supply and with the Mekong basin's current aquaculture production levels at around 260,000 tonnes per year, substantial increases in aquaculture will clearly be necessary. If aquaculture alone is required to "fill the gap", then by 2010 an annual production of 700,000 tonnes will be required.

The growing demand for aquatic products will be met in various ways. Capture fisheries represent one source, and although sustainable yields are not known, there has been an apparent increase over the past 10 years. Stocking and harvesting of fish from reservoirs may also contribute. Infrastructure improvements will have an affect, offering opportunities for the import of fish (as is the case with transport of marine and freshwater fish from central Thailand to urban centres in Northeast Thailand). If there is less fish, then people may also substitute other protein sources, although this is nutritionally not ideal because of deficiencies with other forms of animal protein.

Aquaculture is certainly a key to significant increases in fish production in the future, though it is difficult to predict the amount. For aquaculture to meet the predicted demand gap, as indicated in Box 5, an increase of around 40,000 tonnes per year would be required. Current rates of expansion over the past 10 years suggest a four-fold increase from around 60,000 in 1990 to 260,000 in 2000. Further expansion at this rate would certainly help fill the gap, although considerable constraints exist.

At the micro-level, there are considerable differences in supply and demand for fish throughout the basin, and the potential for aquaculture is very uneven. Within areas close to the large floodplains, large supplies of wild fish may meet demand for aquatic products. In areas where wild fish supply is limited, and there is food insecurity (such as in the highland areas or away from the Tonle Sap-Mekong River corridor in Cambodia), aquaculture can contribute to meeting local demand. These remote areas contain some of the poorest people in the basin (Haylor 2001).

Experience suggests that where there is market demand, and inputs (particularly fish seed) and support services are available, aquaculture is rapidly adopted by farmers. In MRC READ project areas in Cambodia, for example, there has been a 20-30 percent increase in the number of rural households practicing aquaculture in the past two years. Similar high rates of expansion have been seen in parts of the mountainous areas of northern Lao PDR. With provision of inputs, particularly fish fingerlings and support services, aquaculture can contribute significantly to meeting future needs.

It is important to emphasise that aquaculture and wild fisheries management should not be considered as separate, unrelated activities, since households are often involved in both. The direction of policy and development efforts towards aquaculture, as an "easy" means of increasing fish production, could result in a dramatic loss of wild fisheries resources. Unless attention is paid to both wild fisheries and aquaculture, food security could be reduced, in particular for poor people.

Box 6: Rice and fish

On average the protein requirement in adults lies between 0.8-1.0 g protein/kg body weight/day, which in the Mekong River region is often satisfied or close to satisfied on an annual basis, although seasonal malnutrition is common in some areas. However, total protein requirement is only part of the story in human nutrition and cases of malnutrition. Firstly, over half of the daily protein requirement is provided by the rice in the diet. Secondly, in lowland areas (where the bulk of the population lives) around 40-80% of animal protein comes from aquatic animals (Interim Committee for the Coordination of Investigations of the Lower Mekong Basin, 1992; Gregory and Guttman 2002). Thirdly, the nutritional quality of the protein differs greatly and has an impact on human health.

Rice is, for human consumption, deficient in lysine, an essential amino acid (one that cannot be synthesised from other sources) and although meats (poultry, beef and pork) have a higher lysine content than rice it is only about ¾ of the concentration in fish and other aquatic products (Garrow and James 1993). If the fish and other aquatic animals in a typical rural lowland diet (where 52 percent of protein derived from rice, 36 percent from aquatic animals and 12 percent from other meats, is replaced with other meats, the result is a lysine deficient diet.

Although this may not seem like a likely scenario in the short term, a government policy that promotes intensification of rice production with associated increased use of pesticides, as well as concurrent support for conversion of 'swamplands' into irrigated rice lands, a decline in fish in the diet is a likely result. The importance here is that other livestock products do not readily replace this decline as they are nutritionally different in terms of lysine, the amino acid rice is most deficient in from a human nutritional perspective. Policies to manage the fisheries resources (including small scale fisheries) and promotion of small scale aquaculture can ensure that the rural diet remains nutritionally balanced.

2.1.2 Who will grow the fish?

Rural areas of the basin, and in particular farm households involved in rice culture, offer the greatest potential for expansion of aquaculture. Small-scale farmers involved in aquaculture will sell some of the fish they produce and use some for household consumption. Specialised aquaculture farms will sell all of their product. The development of aquaculture is strongly influenced by market demand, particularly in local markets. Market demand will, to some extent, depend on the availability of consumers who can pay the price, often US$ 0.75-1.00 per kg or more. Rural per capita income is often in the range of US$ 120-150 per year, although Lao PDR and Cambodia are lower in cash terms. This may limit the scope for aquaculture development in some areas, and closely tie it to development of infrastructure and urban expansion. This will probably come gradually, and in some areas cautious development is advised, based on understanding of local markets.

In promoting aquaculture, there is a choice between production or producers. Throughout the rural areas of the basin, experience shows that small-scale farm households make individually-small, but important, contributions to aquaculture production. In the households of small-scale farmers, aquaculture contributes income through sale of fish, but ponds also provide household food. This is augmented sometimes through the catching of wild fish in nearby streams and rivers and the harvesting of small self-recruiting aquatic species that enter the pond. The recommended approach is to emphasise small-scale aquaculture for rural households, and to promote equitable participation in aquaculture production within the basin. Such an approach can contribute to food security among poor households, poverty alleviation and rural development. Too much emphasis on commercial large-scale export-oriented aquaculture can diminish support to the small-scale sector, lead to inequity in rural development, and create environmental problems through conversion of wetlands and pollution from intensive farming.

There is an argument that poor people cannot enter aquaculture because they do not have assets. However, experience in the Mekong Basin shows that poor people can become involved and benefit from aquaculture, provided they have access to land or water bodies where fish can be raised. Indeed, aquaculture may provide a low risk means for helping poor households make better use of their land. In the case of landless people, there are opportunities for them to provide services to the aquaculture sector (such as seed collection, fingerling nursing or collection of inputs for ponds). However, the approach has to be targeted to address the special obstacles that poor people face, such as access to credit and extension support. The approach to aquaculture development focusing on poverty alleviation should be incremental, participatory, adaptive, and support the building of basic husbandry and management skills among risk-adverse poor and landless people, with limited financial capital (Haylor 2000).

2.1.3 How will the fish be grown?

The technologies for small-scale aquaculture that work for poor rural households can be characterised as ones which require low investment, little risk and provide quick returns. They also are simple, easy to copy, easy to extend, trainers can be easily trained and they contribute to local fish supply. These aquaculture technologies may include ponds, nursing of fish in hapas in common water bodies, raising of fish in rice fields and even simple cage culture technologies. Concentration should be on technologies that integrate with the rice-based farming systems, which predominant in the basin.

In Viet Nam and Lao PDR, households practicing aquaculture can increase income and improve food security by introducing fish culture into their farming systems. In order to improve farmers' incomes, it is government policy in these countries to promote aquaculture as an addition to other forms of farming. There are choices regarding how to diversify rice farming systems. If diversification

involves growing a second or third crop of rice, fish production will have to be sacrificed because the varieties of rice used require less water and more pesticides. Raising fish in conjunction with fewer rice crops and using traditional varieties of rice, may actually be more effective in terms of income and/or food production (Box 6). There is a strong nutritional argument for maintaining a balance between fish and rice because between them, they provide a balanced diet. Policies to manage fisheries resources (including small-scale wild fisheries) and promotion of small-scale aquaculture can ensure that the rural diet remains nutritionally balanced.

2.1.4 What inputs are required to support aquaculture?

There are a number of important inputs required to support aquaculture, particularly sufficient fish seed, feed for the fish (fertilisers and feeds), and land area and water to grow fish. Will these be sufficient to support the anticipated growth in aquaculture?

Fish seed and fingerlings

The availability of good quality and healthy fish fingerlings is a pre-requisite for the development of aquaculture. The supply of seed for aquaculture has increased substantially in the past 10 years, especially in Thailand and Viet Nam, where significant hatchery and nursery development has occurred involving both the government and private sector. In Northeast Thailand, fish fingerlings are sold at the farm gate (government also supplies some seed, but their emphasis is shifting to stocking of public waters). Fingerlings are also sold in the Mekong Delta of Viet Nam through extensive networks of hatcheries, nursing stations and fry and fingerling traders. In Cambodia and Lao PDR, many ponds are not regularly stocked because of the lack of access or availability of fish fingerlings, although with an increasing number of farmers involved and improving infrastructure, the market incentives and supply of seed will increase. The widespread adoption within the basin of the 'hapa' technology (nursing of fry to large fingerling size in small net cages), has contributed to the availability of larger fingerlings that are less vulnerable to predation when stocked in ponds.

There are at least two billion fingerlings[7] used for producing around 250,000 tonnes of aquaculture product within the basin. For aquaculture to grow, a significant expansion in hatchery and nursing capacity will be required. Rural aquaculture is constrained by access to fingerlings, but experience suggests that local small-scale hatcheries can have a big impact. The Asian Institute of Technology (1997) considers that the centralised, large, government hatchery model has not been successful. Local small-scale hatcheries, hapa nursing and trading networks, and on-farm breeding have proven to be a better catalyst for rural, small-scale aquaculture. Further development of hapa nursing and nursing networks will therefore be essential to support aquaculture, particularly in areas of Cambodia and Lao PRD that lack good infrastructure. Without local networks, seed will be transported over large distances between cathchments, with an attendant risk of genetic mixing of fish stocks and spread of disease.

There are also constraints on small-scale hatcheries that need to be addressed, such as inbreeding problems and difficulties in breeding some species (such as *Pangasius*) due to lack of pond space, and lack of breeding technology and broodstock management. Therefore, the emphasis should be on small-scale hatcheries supplying local needs, supported by local hapa and nursing networks, and with some back-up by larger hatcheries or broodstock centres that maintain diverse genetic stocks

[7] Roughly estimated as 50 percent survival of fingerlings, reaching an average market size of 250g. There is some disagreement in the figures in Table 2, and research is required on this issue.

Box 7: Decentralised private fish seed supply in southern Lao PDR (based on the work of RDC/ AIT – see Haylor 2001).

Proven system for:

- Promoting decentralised private sector seed production, and networking amongst sectors of small-scale producers.
- Providing functional requirements similar to existing livestock vaccination systems.
- Communicating aquaculture extension messages.
- Supporting operational budget at the local institutional level in line with work done.
- Building local management capacity.

Addresses following development issues:

- The need for fish seed for people interested in small-scale aquaculture.
- The lack of productivity of large-scale public sector hatcheries and their competing with the private sector.
- The need for communication that is a key requirement in an emerging industry.
- Limited operational budget of line agencies available at local level.
- Limited management capacity of local level line agencies.

and broodstock of larger species. The role of government and private sector investment in such centres needs to be carefully analysed as the basis for development of effective genetic management and species strategies for the basin. Governments, in particular, may have an important role to play in genetic conservation, although incentives to encourage the private sector to invest more in such activities need to be explored as well.

Species to be cultured

The fish to be cultured should be lower in the food chain as this will allow rural farmers to use more readily available feeds, and because it is more ecologically efficient. The bulk of existing aquaculture production is from omnivorous and herbivorous species, both indigenous and exotic, which can be grown in ecologically efficient ways. The emphasis should continue, although markets will dictate demand. In many rural areas of the basin there is a preference for indigenous species, and this should be supported by broodstock management strategies that preserve genetic diversity. For carnivorous species, such as snakeheads, that will continue to be cultured, emphasis should be on improving efficiency of feeding systems to ensure that: fish diets do not contain wild fish that are consumed by poor people; they make efficient use of fish protein; and they reduce pollution loads on the environment. Research work on indigenous species, such as that supported by the AIMS project of MRC, is also to be encouraged.

Feed and fertilisers

The feed required for fish is supplied directly or through stimulating productivity in ponds and rice fields by the addition of organic or inorganic fertiliser. Inputs come from on-farm, although because many rice-based farms are constrained by lack of inputs to aquaculture ponds, intensification of aquaculture will require off-farm inputs. Rice bran is an important fertiliser, but other inputs are suitable as well, depending on local resources. Suitable resources include vegetation, chemical fertilisers, human "night soil" and the waste from integrated livestock/vegetable production. The inputs are likely to be diverse and will change over time, depending on what farmers grow and their resource limitations. Geographically, off-farm inputs are more readily available in Viet Nam and Thailand, but not in Cambodia or in Lao PDR, although both the latter two countries will have access to more inputs as infrastructure improves and as markets for agriculture inputs (fertilisers and lime) develop.

In rural areas of Cambodia and Lao PDR, farmers are likely to continue to use a diverse choice of feeds for some time. The species raised will also have an influence. For example, the widely promoted green water system using chemical fertilisers is more suitable for exotic tilapia than for indigenous species. Integrating fish culture with livestock represents an opportunity, but mainly in peri-urban areas where livestock are kept in pens. With the exception of the Mekong Delta in Viet Nam, rural livestock are usually not penned. The constraints imposed by competition for manure, bran and other agricultural by-products need to be addressed through an analysis of current and future needs and appropriate extension support.

Water and land

Water of sufficient quality and quantity is required for aquaculture. Most of the small-scale aquaculture ponds in the basin are rainfed, and therefore use and success can vary from year to year, depending on rainfall. The use of water is not likely to be a constraint with rainfed ponds, unless the climate in the basin changes dramatically. In irrigated farming areas, or where there is multiple use of water, other considerations may arise. The policy for water use is changing in the Mekong Basin, and more emphasis is being given to making the most economic use of water. Aquaculture will have to be considered in this process where it is part of a multiple use environment (e.g. ponds in irrigated areas, cage culture). Aquaculture can be an efficient user of water, particularly when integrated with agriculture. The MRC water utilisation programme will provide a forum for discussion on policy issues related to the use of water, and aquaculture, though a small user, should be considered.

Water quality may become a concern in future. Ponds in several parts of the basin are faced with turbidity and productivity problems due to poor and acidic soils, and inappropriate management practice. Such problems can be addressed through adoption of better water management practices. In more 'open' farming systems such as cages in lakes, rivers and reservoirs, or the culture of fish in rice fields, pollution is a concern. Integrated pest management (IPM), which reduces the use of pesticides in farming, should be explored. In cage and pen culture located in open access waters, more attention will be required to ensure that industrial or human effluent does not affect aquaculture.

The availability of land in some parts of the basin may be a local constraint, but overall, land is available to support aquaculture development. Rice-growing land or marginal land in rice-growing areas can be used for pond construction, although in some areas, such as the uplands in Lao PDR, the scarcity of flat land restricts land use to rice cultivation. Although Lao PDR has a low population density, the availability of good agricultural land and land suitable for wet rice cultivation is at a premium. The approach for aquaculture should be to add value, promote diversity and make better economic use of land wherever possible.

2.2 What support services are required?

With the basic technologies for small-scale aquaculture largely put in place over the past 10 years, future support should emphasise extension of knowledge and building of institutional support for rural households where there is potential for aquaculture. Evidence from the basin shows that a major impediment to poor people's involvement in aquaculture is the lack of understanding of their livelihoods and objectives. Involving poor people requires a shift away from technology towards a more flexible people-centred and participatory approach in both extension and research. Policies, institutions and processes should all support poor people's involvement in aquaculture (Haylor 2001).

2.2.1 Local and community level

The building of support services at the local level is crucial in expanding aquaculture. Experiences from the basin indicate that aquaculture has failed where it was promoted without effective extension support, or focused too much on technology, without understanding the socio-economic constraints of rural households.

Because lack of people and resources are a constraint to extension systems, government should partner with both the private sector and NGOs. Mass media could be used, along with other new approaches to spreading information. For example, in Lao PDR, partnerships between local government, farmer groups, fry traders and nursing networks were effectively used for extension. Women's organisations, such as the Women's Union, have also been used in Lao PDR and Viet Nam.

There is also a need for integrated approaches to extension and service provision at the local level. The decentralisation processes now being seen across the basin provide an entry point for this.

An important constraint to poor people's involvement in aquaculture is lack of savings and lack of access to credit. Credit systems in rural areas are undeveloped and difficult to access in Lao PDR and Cambodia, but relatively well developed in Thailand and Viet Nam. The Viet Nam Bank for Agriculture and Rural Development, for example, provides loans for freshwater fish culture, provided farmers have a "red book" demonstrating "ownership" of the land as collateral. Credit should be analysed as part of the process to support farm households entering into aquaculture. The special difficulties faced by poor households have to be recognised and addressed by supporting agencies.

2.2.2 National level issues and policy

Building local capacity and adopting new approaches to extension within an integrated rural development or catchment management approach, will require policy change. Aquaculture policy is different from that required for wild fisheries, as it is more about extending information and more easily defined than capture fisheries policy. Capture fisheries policy is likely to be more focused on co-management. National level policy development for aquaculture will need to emphasise building of capacity and supporting local institutions, processes and general governance that support rural farmers. There is certainly scope for further development of policy, which supports small-scale aquaculture within a rural development framework. There are also considerable opportunities to share experiences in policy development within the basin, as all countries are working within this changing environment.

2.2.3 Regional level issues

There are regional basin-wide issues that affect aquaculture and opportunities for cooperation among riparian countries in mutual support and policy development. These include national issues that are common to the region, and regional issues that are common to each of the countries.

The common national issues related to aquaculture mainly concern the need for sharing of experiences and expertise in small-scale aquaculture and its growth within a rural development framework. There are considerable opportunities for riparian countries to share such information, improve communication, promote technical and research cooperation, and discuss new approaches. There may also be opportunities for networking and sharing among small-scale producers, although language will clearly be a constraint.

Two regional issues that deserve particular attention are aquatic animal disease control and policies that reduce the risks to wild stocks from introduction of exotics or trans-boundary movement and mixing of genetically-different indigenous fish strains.

Cooperation in aquatic animal disease control

Aquatic animal diseases can rapidly spread across catchments and national boundaries, leading to loss of fish stock and producers' livelihoods. Also, expertise in fish disease control varies between countries, so some sharing will be beneficial. Among the various components of an effective aquaculture health management plan, advance planning (contingency planning), can significantly reduce the social and economic impacts of a serious disease outbreak. Prompt action is crucial. Often disease spreads because of lack of action rather than lack of scientific knowledge. Therefore, a practical trans-boundary action plan incorporating the following elements is recommended: i) develop effective disease surveillance and reporting systems; ii) strengthen diagnostic services; iii) improve human resources and build national and regional capacity to engage in disease management activities; iv) strengthen emergency preparedness for facing newly-emerging diseases; v) support development of appropriate policy, legislation and regulatory frameworks; vi) promote consensus building, community participation, and private sector involvement; and vii) empower local communities with knowledge and tools to better understand and reduce the risks of diseases.

Management of genetic resources

There is a need to develop joint policy or strategies for the management of exotic fish species because of concern about their impact on the natural ecosystem. Where practical, indigenous fish species should be used for aquaculture, but they too may be subject to inbreeding and mixing of strains unless care is taken. To preserve genetic diversity, polices concerning broodstock management and trans-boundary movement are needed.

2.3 Information needs and gaps to be filled for aquaculture

As the technologies for small-scale aquaculture are now readily available, there is less need for technical research. More emphasis should be given instead to communication and extension of existing knowledge in ways that are relevant to rural households. Examples of "best practice" approaches are available, and there is a need to share such experiences more widely.

Better coordination and exchange of information and experiences is becoming increasingly necessary, as is the need to engage all relevant stakeholders, including poor households, in more inclusive dialogues.

Official fisheries statistics on aquaculture still underestimate small-scale aquaculture, although censuses and household surveys demonstrate its increasing importance. To reflect the importance of the small-scale aquaculture sector, government fisheries agencies should consider collaborating with other sectors in order to get data in rural areas, as has worked well in Lao PDR.

To support small-scale aquaculture, research agendas should utilise participatory approaches and be driven by farmer and development needs. Better linkages are also required between research, extension and education providers and focus should be on the needs of small farmers. These include:

- Promoting indigenous fish aquaculture through research on husbandry and genetics, and development of appropriate policy;
- Developing suitable feeds and making efficient use of feeds and fertiliser;

- Conducting bio-economics research on the use of wild caught fish as feed for predatory fish;
- Encouraging rice farmers to add aquaculture to their production and adopt integrated pest management methods to avoid harmful pesticides. This would include demonstrating the economic benefits of both IPM and aquaculture, and providing relevant technical information. A study could be conducted which would demonstrate how the methods used by farmers in Bangladesh, which combine IPM farming with aquaculture, could usefully be applied in the basin;
- Reducing risks to rural livelihoods from aquatic animal diseases;
- Developing poverty-focussed aquaculture systems, including appropriate cage culture systems; and
- Developing environmental management systems for more intensive aquaculture systems such as cage culture.

2.3.1 Research on rice-based farming systems

Increasing rice production is often promoted by national and international agencies, without considering other ways of using the land. Raising fish in rice fields may give a higher return to the farmer than growing a second or third rice crop. Common property floodplain areas may have a higher value for the community in general as breeding or feeding habitats for fish, than if wetlands are drained and managed for agriculture purposes. Research cooperation is needed between agriculture, fisheries and rural development programmes and agencies to determine which options provide the best livelihoods for farm households and for the community in general.

There is a need to promote effective collaboration with the agricultural sector because it has proven methodologies for technology transfer and farmer-focused participatory extension and training techniques, including IPM, which the fishery sector could usefully adopt.

2.3.2 Development of indigenous fish species

Indigenous fish species are often preferred by Mekong consumers and should be promoted for aquaculture. This will require support for the development of broodstock management plans that prioritise prevention of inbreeding and maintenance of genetic diversity. Consideration should also be given to the role of the private sector (which dominates hatchery and nursery systems), and government hatcheries, and their roles and financial incentives in conserving genetic material for selected species.

2.4 The need for integrated planning and regulation

The approach to development of aquaculture to date has largely been a sectoral one. Governments are now giving more attention to promoting aquaculture within a rural development framework. The promotion of aquaculture should use food insecurity and poverty as a starting point for aquaculture interventions. This means using participatory research to identify and overcome the constraints to establishing aquaculture initiatives; building capacity in institutions (particularly local ones) for extension and management; and integrating aquaculture into fisheries projects and wider rural development strategies.

The catchment management approach promoted by the MRC as part of the Basin Development Plan, provides an opportunity to develop and test more systematic approaches to support aquaculture development, within a broader capture fisheries and rural development framework.

The following general points should be considered in promoting aquaculture within the context of rural development:

- Support capacity building in local, provincial and national institutions for participatory approaches to extension and research;
- Encourage effective partnerships among government, NGOs and the private sector that address the needs of rural households;
- Increase use of mass media and experiment with other cost-effective approaches to extension;
- Share information on best policy and practices; and
- Strengthen the voice of poor aquatic resource users in the policy development process.

2.5 Threats to aquaculture and possible solutions

Threats to the development of aquaculture and possible solutions can be summarised as follows:

- Extension activities by government institutions are constrained because they lack staff and resources. Human resources are available at the local level, but they need training in participatory approaches. To overcome these constraints, new extension partnerships incorporating all available resources and expertise must be created.
- The policies needed to support an integrated approach to aquaculture and fisheries are not yet in place, developing them will take time and progress will be slow as experience builds. Selected pilot studies and opportunities to exchange experiences can contribute to policy development.
- Degradation of the environment is an important threat both to aquaculture and wild fisheries in the basin. Aquaculture is affected by natural disasters, aquatic animal diseases, escape of exotic species and water pollution. Management strategies need to be put in place to deal with these issues.
- Sectoral approaches hinder cross-sectoral integration, as does the lack of coordination among donors that sometimes occurs. Cross-sectoral coordination and cooperation is traditionally difficult, but may improve where agencies are working together at the local level.
- Markets and market access have been little studied in the basin, compared to the more technical aspects of aquaculture development. Better understanding of markets and market routes can provide a basis for improving producers' access to markets, and also maximising opportunities for other employment and income generation within aquaculture.

Recommendations for aquaculture within the context of Mekong fisheries and the basin's development

3

Aquaculture development within the Mekong Basin is essential to meet future demand for aquatic products, and should be used for alleviation of food insecurity and poverty in the basin. To maximise its potential contribution to the basin's development, aquaculture should be supported as a component of the fishery sector and as part of development planning in the basin. The following recommendations have been made for the MRC and member governments.

3.1 Planning and implementation approach

3.1.1 Use of a catchment-based approach

The division of the Mekong Basin into 10-20 catchments or clusters of catchments for planning purposes, is being proposed by MRC as part of the Basin Development Plan. This new approach provides an opportunity for systematic support for the development of aquaculture and wild fisheries management, within a broader basin development framework.

It is ***recommended*** therefore:

- That aquaculture development be supported as part of the catchment approach.
- That an understanding of people's livelihoods and their relations to aquatic resources be used as the starting point for aquaculture and fishery management interventions in the respective catchments.
- That aquaculture potential be identified within catchments in a participatory manner and integrated with assessments of fisheries status and requirements for institutional support.

Within the catchments of the Mekong Basin, capture fisheries and aquaculture (including culture-based fisheries in reservoirs) are strongly interdependent. The development of aquaculture is closely related to the availability of and access to wild fish. If wild fish are not readily available, then aquaculture will have more success provided that farmers have access to markets, adequate seed and

infrastructure. In areas of the basin where fish are always or seasonally scarce, aquaculture has shown success in tackling poverty and providing protein. In areas where wild resources are abundant, aquaculture may be less important. In such areas, fisheries development efforts should target better management of existing wild fish resources and securing poor people's access to them. Dividing the Mekong Basin into selected catchments provides a logical starting point for targeted interventions that address poverty and food insecurity in the basin. From a fisheries resources perspective, it allows those locations most influenced by water management interventions, such as dams, to be identified and management actions taken. This approach is therefore in accord with MRC's efforts to develop a Basin Development Plan. As the catchment approach is quite new, a step-by-step approach to implementation is suggested.

It is ***recommended*** therefore:

- That pilot catchments be selected for testing the approach, depending on the aquatic resources available and the extent of poverty
- That lessons learned from pilot projects should be gradually extended to other catchments.

3.2 Supporting small-scale aquaculture

There is a need to support future development of aquaculture within the Mekong Basin, but the emphasis should be changed. Over the past 10 years, technology development has been emphasised and technologies for small-scale aquaculture are now largely developed, with the exception of some work on indigenous species.

It is ***recommended*** therefore:

- That the main thrust of future aquaculture development should be directed towards small-scale aquaculture.
- That emphasis be given to building effective support services for small-scale aquaculture.
- That planning processes and policy reflect the needs of rural households and support improved access to extension services.
- That research agendas of national institutions, and indeed the MRC's own agenda of support, should evolve, based on the needs and livelihoods of rural households.

There are some experiences already (e.g. in the MRC READ project areas, in southern Lao PDR, the NACA regional STREAM Initiative), but there is a need to further share and extend these approaches to other areas.

The greatest potential for small-scale aquaculture to contribute to development probably lies in the food insecure and remoter areas of the basin, such as the highlands, or in areas away from major fisheries of the Mekong and the Great Lake in Cambodia. Potential varies throughout the basin, and should be assessed in a coordinated way.

It is ***recommended*** therefore:

- That as part of a catchment planning approach, strategic analysis of aquaculture potential should be undertaken to support aquaculture in key areas.

3.2.1 Building extension capacity

For participatory approaches to planning and extension to be successful, donor and other support agencies have to shift their focus from a technical one to an approach which emphasises capacity building, learning and communications.

It is ***recommended*** therefore:

- That priority be given to developing the capacity of local, provincial, and national institutions in order to foster their adoption of participatory approaches to planning and extension that reflect the needs of rural households.
- That building of capacity be a part of a systematic approach to developing aquaculture extension within the catchments of the Mekong Basin.
- That the needs for capacity building and institutional responsibilities should be evaluated as part of the catchment development approach.

3.2.2 Building farmer-driven aquaculture research agendas

Many national institutions in the Mekong Basin remain strongly oriented towards technical research, development and verification. This should shift towards support of small-scale aquaculture within the context of rural development.

It is ***recommended*** therefore:

- That with limited personnel and budgets, research capacity should be directed more towards rural development and poverty alleviation, through participation of intended beneficiaries in identifying needs, design and implementation of projects; in training and extension; and in monitoring and evaluation.
- That the development of research agendas be based on the needs of rural households and supported by developing researchers capacity to undertake participatory research, monitoring and evaluation.
- That the active participation of aquaculture researchers be encouraged within rural development initiatives and catchment-focused approaches.
- That because the catchment approach itself will generate considerable research needs, that it be used as an opportunity for aquaculture researchers to join in and closely influence a rural development process.

There are a number of research needs and issues identified in this review, such as indigenous fish culture, rice-based farming systems, and others. The development and implementation of these research activities can be effectively tackled through further strengthening of research cooperation, both within and between countries.

It is ***recommended*** therefore:

- That opportunities for effective research cooperation and networking among riparian countries and research institutions should be encouraged wherever possible, such as being promoted within the STREAM Initiative and the AIMS project.

3.2.3 Regional cooperation in development of policy

There are a number of aquaculture-related issues that transcend national boundaries within the Mekong Basin, such as the trade in fingerlings and movement of aquatic animals between catchments, which raise genetic and health concerns. Introduction of new species or strains without proper precautions may also lead to unintended negative impacts. Cooperation among the riparian countries will be essential in preparing common and agreed-upon policy and strategies for addressing such issues.

It is ***recommended*** therefore:

- That cooperation between riparian countries be promoted to develop strategies or policies of mutual interest and shared experiences in aquaculture development.

There are a number of key issues that emerge from this review where cooperation and common policy development might be promoted.

Support of low-input aquaculture suited to the context of poor-peoples' livelihoods.

There are opportunities for poverty-foccused low-input aquaculture throughout the basin, and opportunties to promote effective sharing of experiences and expertise among Mekong countries to support such developments.

Exotics, indigenous species and trans-boundary movement of aquatic animals

The use of exotic fish species, due to concern over their impacts on the natural ecosystem, should be avoided, where possible. Research is needed to assess risk and develop appropriate management strategies and agreed-upon common policies for exotics. The use of broodstock of indigenous fish species may be subject to some constraints, due to genetic differences among stocks. Such issues might be addressed, for example, by using wild fish caught relatively close to the area of use, or encouraging local hatcheries. Again, common policy should be prepared and adopted.

It is ***recommended*** therefore:

- That risk analyses be carried out to evaluate the impact of the introduction of exotic species and formulate appropriate policies.
- That a policy to promote the use of Mekong Basin species for aquaculture should be prepared by the riparian countries to improve broodstock management. This approach can be closely coordinated with catchment-based development approaches to aquaculture and fisheries.
- That a Mekong Basin policy for trans-boundary movement of aquatic animal species, including introduction of species, be formulated for catchments and Mekong countries.

Establishment of a Mekong aquaculture health management plan

Increased aquaculture development in the Mekong Basin will probably lead to more aquatic animal disease outbreaks, and pathogens could easily spread beyond catchments and national boundaries. In addition to adversely impacting the livelihoods of small-scale farmers, these may adversely impact wild fish species.

It is ***recommended*** therefore:

- That an aquatic animal health management plan be established in the Mekong Basin, in accord with the recommendations of the FAO/NACA Asia Regional Project, "Assistance for the Responsible Movement of Live Aquatic Animals", and in accordance with the provisions of the "Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy"(FAO/NACA 2000).
- That a Mekong health management plan should be practical and seek to address the risks associated with outbreaks of aquatic animal diseases and the spread of serious pathogens within the basin.

3.2.4 Improving access to learning, communication and policy development

There are also considerable opportunities for the sharing of experiences and knowledge and the promotion of cooperation among institutions and donor agencies within the lower Mekong Basin, and also for the sharing of experiences outside of the basin (e.g. on IPM and rice field aquaculture/ fisheries, promotion of co-management, and the use of indigenous species).

It is ***recommended*** therefore:

- That further communication and exchange of information and learning experiences should be given a high priority in support of the development of aquaculture.
- That communications should also seek to allow better access to knowledge by resource users in support of building of capacity and policy development.

Government and donor resources to support aquaculture development are likely to be constrained in coming years. This emphasises the importance of effective cooperation among national institutions to support extension and research activities.

It is ***recommended*** therefore:

- That more cooperation among supporting agencies (donors, development banks) should be promoted to support riparian institutions.
- That more emphasis should be given to development led by riparian country institutions, and with coordinated support of these institutions from donors and other regional and international organisations.
- That the catchment approach should be used to provide lessons for better coordinated institutional arrangements and lessons for more effective donor coordination in particular.

References and reading 4

The following provides references to key aquaculture works quoted in the text and to other more detailed technical information on aquaculture in the Mekong riparian countries.

Agricultural Census. 2000. Lao Agricultural Census, 1998/99 – highlights. Agricultural Census Office, Ministry of Agriculture and Forestry and National Statistics Centre, Vientiane. 62 pp.

Ahmed, M., H. Navy, L. Vuthy & M. Tiongco. 1998. Socio-economic assessment of freshwater capture fisheries of Cambodia. Report on a household survey. Mekong River Commission, Phnom Penh.

Ahmed, M. & P. Hirsch. Editors. 2000. Common property in the Mekong – Issues of sustainability and subsistence. *ICLARM Studies Review*, **26**.

AIT. 1997. Policy Paper No. 1: issues in developing fish seed supply. AIT Aqua Outreach, Asian Institute of Technology, Bangkok. 4 pp.

Anon. 2002. Vietnam Environment Monitor 2002. The World Bank, National Environment Agency, World Bank in Vietnam and Danish Agency for International Development (DANIDA). World Bank, Hanoi, 43pp.

Bush, S. R. 2001. Review of fish marketing in Cambodia: assessment of Mekong Fisheries. Component of the MRC Fisheries Programme, Working Paper No. 2. Mekong River Commission, Phnom Penh.

Coates, D. 2001. Biodiversity and fisheries management opportunities in the Mekong River Basin. Blue Millenium Conference Paper. Assessment of Mekong Fisheries Component of the MRC Fisheries Programme. Unpublished report, MRC, Phnom Penh.

Coates, D., A. F. Poulsen & S. Viravong. 2000. Governance and trans-boundary fish stocks in the Mekong River Basin. 2nd MRC Technical Symposium on Fisheries, Mekong River Commission, Phnom Penh.

DOF. 2001. Freshwater fish farm production. Freshwater Aquaculture Statistics Analysis Sub-Division. Fisheries Economic Division 5/2544 No. 5/2001. Department of Fisheries, Government of Thailand, Bangkok.

Funge-Smith, S. J. 1999a. Small-scale rural aquaculture in Lao PDR (Part I). *FAO Aquaculture Newsletter*, August 1999. **22**.

Funge-Smith, S. J. 1999b. Some lessons learned in aquaculture extension. Provincial Aquaculture Development Project (LAO/97/007). Lao PDR. FAORAP, Bangkok.

Funge-Smith, S. J. 1999c. Small-scale rural aquaculture in Lao PDR (Part II). *FAO Aquaculture Newsletter*, December 1999, **23**:17-21**.**

Funge-Smith, S. J. 2001. Activity planning and hatchery renovation, Viet Nam, Aquaculture of indigenous Mekong species. Component (AIMS), Mekong River Commission, Phnom Penh. 56pp.

Funge-Smith, S. J. & P. DuBeau. 1999. Aquatic animal health management issues in rural aquaculture development in Lao PDR. In: Proceedings of DfID/FAO/NACA Regional Scoping Workshop on Primary Aquatic Animal Health Care in Rural, Small-scale Aquaculture Development in Asia, 27-30th September 1999. Dhaka, Bangladesh, NACA, Bangkok, Thailand.

Garaway, C. 1999. Small water body fisheries and the potential for community led enhancement: case study in Lao PDR. Imperial College of Science Technology and Medicine, University of London, London. Ph.D. thesis. 413 pp.

Garrow, J. S. & W. P. T. James. Editors. 1993. *Human nutrition and dietetics*, 9th ed. Churchill Livingstone, Edinburgh, UK.

Gregory, R. & H. Guttman. 2002. The rice field catch and rural food security. Pp. 1-13. In: P. Edwards, D C. Little & H.Demaine. Editors. 2002. Rural Aquaculture. CABI Publishing, Wallingford, UK.

Gupta, M. V., B. Saphakdy & L. Khamsivilay. 2000. Review of aquaculture support to Lao PDR during 1975-2000. LARReC Technical Report No. 4, Vientiane.

Guttman, H. & S. J. Funge-Smith. 2000. The role of aquaculture in rural subsistence livelihoods in Lao PDR. Provincial Aquaculture Development Project (LAO/97/007). STS Field Document 9. FAORAP, Bangkok.

Hambrey, J. 2002. Financial analysis and risk assessment of selected aquaculture and fishery activities in the Mekong basin. MRC Technical Paper No. 5, Mekong River Commission, Phnom Penh. 66 pp.

Haylor, G. 2000. Eight successful systems for promoting sustainable livelihoods through developing aquatic resource management systems that benefit the poor in SE Asia. Aquatic Resources Management Programme Briefing Paper 2. DfID Southeast Asia, Bangkok (www.streaminitiative.org/virtuallibrary)

Haylor, G. 2001. Report of the email conference on poverty and aquatic resources. Aquatic Resources Management Programme. DfID Southeast Asia, Bangkok (www.streaminitiative.org/virtuallibrary)

INFOFISH. 2000. The potential of Cambodian fishery products in the international market: a market study. INFOFISH, Kuala Lumpur.

Interim Committee for the Coordination of Investigations of the Lower Mekong Basin. 1992. Fisheries in the Lower Mekong Basin, Main Report and Annex 5-8. Interim Committee for the Coordination of Investigations of the Lower Mekong Basin, Bangkok.

Khanh, P. V., N. Tuan, N. V. Hao, Z. Jeney, T. Q. Trong & N. M. Thanh. 2000. Review of biology and breeding of some indigenous fish species in the Mekong Delta of Viet Nam. Management of Reservoir Fisheries in the Mekong Basin II. Component Report, Number 3. Vientiane.

LECS 2. 1999. The households of Lao PDR – social and economic indicators from the Lao Expenditure and Consumption Survey 1997/98. National Statistics Centre, State Planning Committee, Vientiane. 67 pp.

Leelapatra, W., P. Srisakultiew & N. Sukumasavin. 2000. Biology and breeding of indigenous fish species in Thailand. Management of Reservoir Fisheries in the Mekong Basin II. Component Report, Number 2. Mekong River Comission, Vientiane.

Lithdamlong, D., E.Meusch & N.I. Taylor. 2002. Promoting aquaculture by building the capacity of local institutions: developing seed supply networks in the Lao PDR. p. 155-166. *In:* P. Edwards, D.C. Little & H. Demaine (Editors). 2002. Rural aquaculture. CABI Publishing, Wallingford, UK.

MAF. 1999a. The government's strategic vision for the agricultural sector. Ministry of Agriculture and Forestry, Vientiane. 76 pp.

MAF. 1999b. Agricultural Statistics of Lao PDR – 1998. Permanent Secretary Office of the Ministry of Agriculture and Forestry, Vientiane, 146 pp.

Meenakarn, S. 1998. Mini-hatchery development. Provincial Aquaculture Development Project (LAO/97/007), STS Field Document 1, FAORAP, Bangkok.

Meenakarn, S. 1999. Farmer training in small-scale hatchery techniques. Provincial Aquaculture Development Project (LAO/97/007). STS Field Document 6. FAORAP, Bangkok.

Murray, U. Sayasane, K. & S. J. Funge-Smith. 1998. Gender and aquaculture in Lao PDR: a synthesis of a socio-economic and gender analysis of the UNDP/FAO Aquaculture Development Project LAO/97/007. Provincial Aquaculture Development Project (LAO/97/007), STS Field Document, FAORAP, Bangkok.

Nam, S. & N. Thuok. 1999. Cambodia. Aquaculture sector review (1984-1999): an outline of national aquaculture development plan (2000-2020). APCU/DOF, Phnom Penh.

Nho, Pham Van & H. Guttman. 1999. Aquatic resources use assessment in Long An province, Viet Nam (results from 1997 survey). AIT Aqua Outreach Working Paper No. SV-52, Bangkok.

Phillips, M. 1998. Freshwater cage culture development in the reservoirs of the Central Highlands of Viet Nam. Report to the Mekong River Commission. Phnom Penh. 124 pp.

Phuong, N. T. 1998. *Pangasius* cage culture in the Mekong Delta – current situation and study for feeding improvement. Can Tho University, Viet Nam. Ph.D thesis.

Phovinsay, A. & S. R. Bush. 2001. Baseline study of the fish trade from the Siphandone Fishery in Champassak Province. LaRREC Research Report No. 4. Vientiane.

Potipitak, K. 1996. Aquaculture Extension Services Review: Thailand. FAO Fisheries Circular No. 910. FIRI/C910. FAPRAP, Bangkok.

Sen, A.K. 1999. *Development as freedom.* Oxford University Press, Oxford, UK.

Sjorslev, J. G. Editor. 2001. An Giang Fisheries Survey, Viet Nam. Research Institute for Aquaculture No. 2 and Assessment of Mekong Fisheries Component of the MRC Fisheries Programme. Mekong River Commission, Phnom Penh.

Sverdrup-Jensen, S. 2002. Fisheries in the Lower Mekong Basin: status and perspectives. MRC Technical Paper No. 6, Mekong River Commission, Phnom Penh. 103 pp.

Tan, B., H. Choundara & H. Guttman. 1999. Mid-term evaluation report of LAO/97/007, FAO STS Field Document 8. Provincial Aquaculture Development Project LAO/97/007. Vientiane. 92 pp. FAO, Vientiane.

Tran T. X. & T. H. Tran. 2000. Report of status of aquaculture in the Mekong Delta of Viet Nam. Research Institute for Aquaculture No.2, Ministry of Fisheries, Hanoi. 42 pp.

Welcomme, R. & C. Vidthayaonon. 1999. Report on the impacts of introduction and stocking in the Mekong Basin and policies for their control. Mekong River Commission, Vientiane. 66 pp.

WHO. 1999. Food safety issues associated with products from aquaculture. Report of a joint FAO/ NACA/WHO study group. WHO Technical Report Series 883, World Health Organisation, Geneva.

Wysocki, J. & R. Friend. 1998. Aquatic Resources and Rural Livelihood. Report to the ToR Regional Aquaculture Approach Assessing Potential for Poverty Reduction. DfID Southeast Asia, Bangkok. 39 pp.

MRC Technical Papers

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Van Zalinge, Nicolaas; Lieng Sopha, Ngor Peng Bun, Heng Kong, and John Valbo Jorgensen. 2002. Status of the Mekong *Pangasianodon hypophthalmus* resources, with special reference to the stock shared between Cambodia and Viet Nam. MRC Technical Paper No. 1, Mekong River Commission, Phnom Penh. 29 pp.

Status of Pangasiid aquaculture in Viet Nam : MRC Technical Paper 2

Trong, Trinh Quoc, Nguyen Van Hao and Don Griffiths. 2002. Status of Pangasiid aquaculture in Viet Nam. MRC Technical Paper No. 2, Mekong River Commission, Phnom Penh. 16 pp.

Mekong giant fish species: on their management and biology : MRC Technical Paper 3

Mattson, Niklas S., Kkongpheng Buakhamvongsa, Naruepon Sukumasavin, Nguyen Tuan, and Ouk Vibol, 2002. Mekong giant fish species: on their management and biology. MRC Technical Paper No. 3, Mekong River Commission, Phnom Penh. 29 pp.

Deep pools as dry season fish habitats in the Mekong Basin : MRC Technical Paper 4

Poulsen, Anders, Ouch Poeu, Sintavong Viravong, Ubolratana Suntornratana & Nguyen Thanh Tung. 2002. Deep pools as dry season fish habitats in the Mekong Basin. MRC Technical Paper No. 4, Mekong River Commission, Phnom Penh. 24 pp.

Financial analysis and risk assessment of selected aquaculture and fishery activities in the Mekong Basin : MRC Technical Paper 5

Hambrey, John. 2002. Financial analysis and risk assessment of selected aquaculture and fishery activities in the Mekong Basin. MRC Technical Paper No. 5, Mekong River Commission, Phnom Penh. 66 pp.

Fisheries in the Lower Mekong Basin: status and perspectives : MRC Technical Paper 6

Sverdrup-Jensen, S. 2002. Fisheries in the Lower Mekong Basin: status and perspectives. MRC Technical Paper No. 6, Mekong River Commission, Phnom Penh. 95 pp.

Freshwater aquaculture in the Lower Mekong Basin : MRC Technical Paper 7

Phillips, M. J. 2002. Freshwater aquaculture in the Lower Mekong Basin. MRC Technical Paper No. 7, Mekong River Commission, Phnom Penh. 62 pp.

Fish migrations of the Lower Mekong Basin: implications for development, planning and environmental management : MRC Technical Paper 8

Poulsen, A. F., Ouch Poeu, Sintavong Viravong, Ubolratana Suntornratana & Nguyen Thanh Tung. 2002. Fish migrations of the Lower Mekong Basin: implications for development, planning and environmental management. MRC Technical Paper No. 8, Mekong River Commission, Phnom Penh. 62 pp.