Participatory Approaches and Extension Strategies

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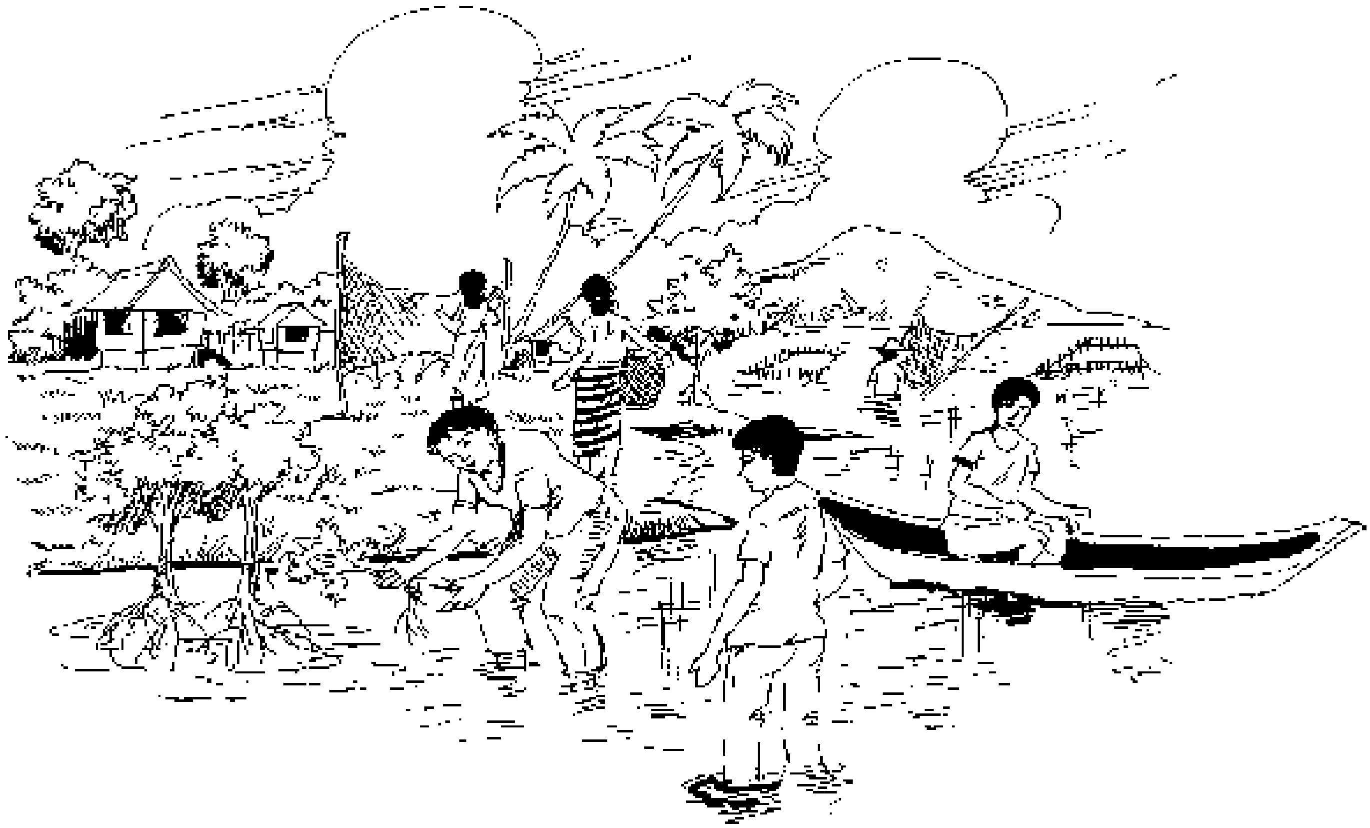
Participatory Approaches for Aquatic Resources Management and Development Thoughts and Lessons Collected by DFID and FAO during 2000

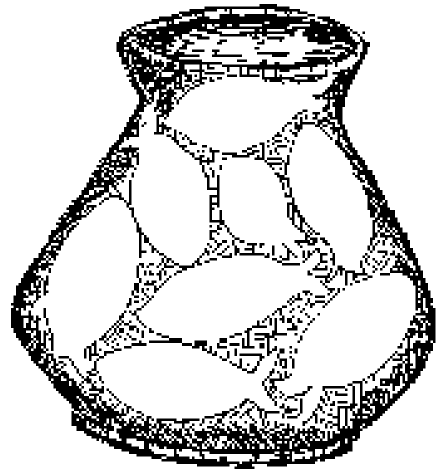


Aquatic resources management in the context of poverty is not limited to a particular technology or to different forms of aquaculture. It also includes the concentration and capture of wild fish and the foraging of aquatic resources such as crabs, prawns, snails, insects, aquatic plants, etc. in paddies and other water bodies. Many of these activities remain invisible to researchers and rural developers because dispersed and small-scale production data, which are difficult to collect by conventional approaches, do not appear in official statistics. As the emphasis in aquaculture development now shifts from purely technical to extension and poverty alleviation issues, there is a considerable need for more widespread application of participatory approaches.

The term "participatory approaches" is used to describe a wide range of development and research approaches, methods and tools that can improve the practice of development. Relatively novel approaches include the consideration of aquatic resources management in the context of livelihoods, working with poor aquatic resource-users, building on their strengths in the context of environmental, social and economic issues that impact on their livelihood strategies. Much can be learned not only from recommendations based on knowledge generated, but also on the methodologies used.

Guiding principles of participatory approaches

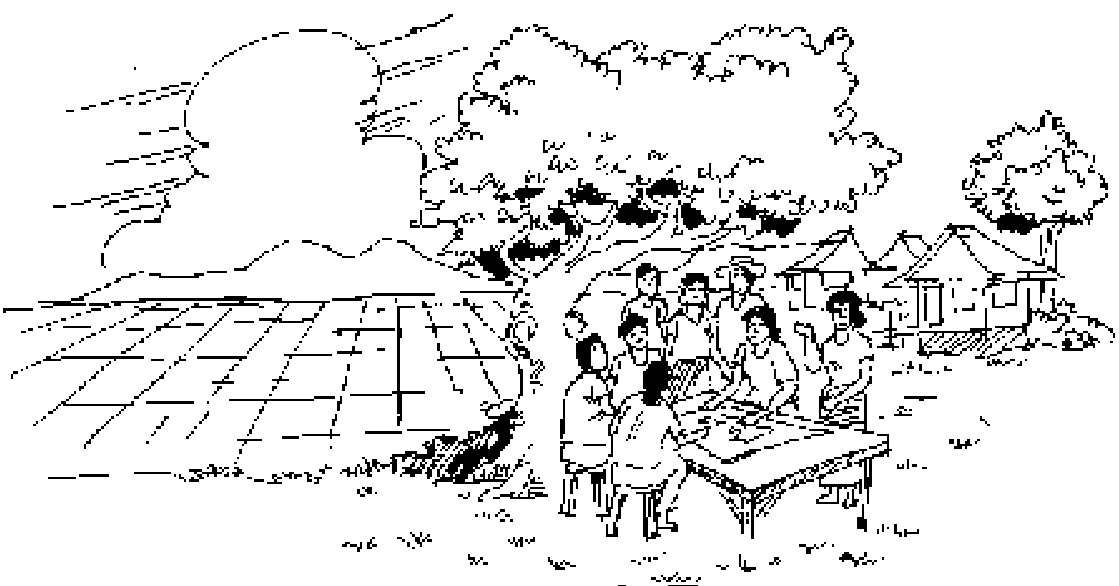
Participatory approaches might best be described as a set of "guiding principles" that can help practitioners develop a different kind of relationship with the people that are supposed to benefit from their work. The guiding principles that really make up participatory approaches were reviewed in the FAO Fisheries Report No. 630 (2000).



Guiding Principles of participatory approaches	
Organized process	While participatory approaches make use of a flexible "basket" of different methodologies, those methodologies are guided by objectives and responsive facilitation.
Systemic learning	The methods used in participatory approaches emphasize learning about systems and the relations between different elements in those systems. Participatory approaches need to be "holistic".
Multiple perspectives	Participatory approaches take into account the fact that different people have different perspectives and try to accommodate these different perspectives.
Group learning	Participatory approaches emphasize the value of learning in groups as a means of coming to consensus decisions regarding action to address commonly identified objectives. (Understanding the "group" and the power relations within the group is important so that "consensus" decisions reflect the needs of weak group members as well as the strong ones.)
Context specific	Each community and its context are different. Participatory approaches accommodate their specific characteristics. (From experience, the importance of recognizing the differences within communities, and between social and economic groups, is also being emphasized more and more.)
Facilitating	The use of participatory approaches by development practitioners involves the adoption of a facilitating or catalytic role, rather than a protagonists.
Leading to change	While participatory approaches accommodate local knowledge and skills, they are focussed on facilitating changes that people regard as appropriate.

The terms for participatory approaches and methodologies are as numerous as the locations where they have been put into practice. Being "context specific", there can be no "blueprint" for participatory approaches. They need to be constantly adjusted, refined and adapted based on the local setting.

A selection of participatory methods and their uses		
Participatory	**Brief description**	**Examples of particular use method**
Timelines	Historical profiles of longer-term events or trends	Fish catch over time, productivity changes, policy changes
Seasonal calendars	Graphical representation of seasonal events or trends	Labor availability, hydrographic changes
Transect walks and through particular areas	Land- and water-use maps based on walking capital, local knowledge of microhabitat, current use of aquatic resources	Quality and quantity of natural resource maps
Social maps	Maps locating key social features	Access to services and infrastructure
Wealth ranking	Socio-economic categorization of households	Assets, income
Preference ranking	Ordinal ranking, e.g. based on pairwise comparisons, based on defined criteria with scoring	Livelihood strategies, assets and matrix ranking access to services (e.g., fish for conservation)



Adaptability has led to a large number of variants in participatory approaches. This means there can be no single definition of what constitutes a "participatory approach". What is important is that the approach and methodology have been planned systematically, bearing in mind the guiding principles of participatory approaches. The following are two different examples of these approaches:

1.

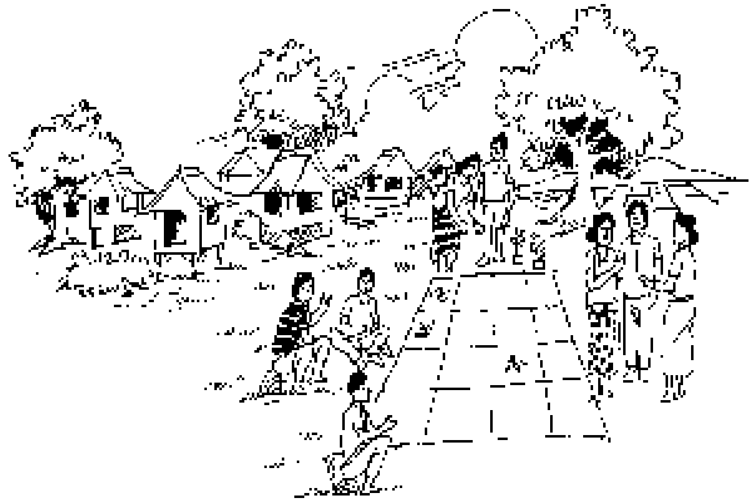
Experiential learning in farmer field schools in rice creates opportunities for the integration of aquaculture

- The approach to reach and enhance human expertise for better rice crop management, particularly in relation to integrated pest management (IPM), is via farmer field schools (FFS) with about 25 farmers each. Farmers in Bangladesh, Indonesia, Vietnam, Cambodia, Ghana, Burkina Faso, Mali, Côte d'Ivoire spend 5-6 hours together every week. Two hours are spent in the field observing the ecosystem. The process is facilitated by trainers, who themselves have spent a whole season in the field learning about the ecosystem and designing curricula for the FFS.

> The approach described here is from the FAO's Intercountry Program on Integrated Pest Management in Rice in Asia and draws much from the experience gained in the implementation of the National IPM Program in Vietnam.
>
> *Source*: Kenmore, P. and M. Halwart. 1998. Functional agrobiodiversity, Integrated Pest Management, and Aquatic Life Management in Rice. In: Proceedings of the FAO/CBD International Workshop on Opportunities, Incentives, and Approaches for the Conservation and Sustainable Use of Biological Diversity in Agricultural Ecosystems and Production Systems. FAO, Rome, Italy.

- The equipment needed in FFS are plastic bags, pencils and paper. Farmers put samples of arthropods in plastic bags and after the field work they discuss in small groups what they have observed, prepare poster diagrams, and present findings to their fellow farmers.

- Farmers observe populations in the field but also test their trophic linkages by setting up "insect zoos". These answer questions on "what eats what" and "how many are eaten", etc. Such experiments are interventions that advance farmers' knowledge and lead to further experimentation.



- Elimination of nearly all pesticides results in a higher biodiversity, which is frequently used by farmers in a sustainable manner. Snails, frogs, aquatic insects and others constitute an important part of the diet of many rice-farming households. Where wild aquatic resources are declining from habitat change then culturing fish in rice fields or adjacent water bodies becomes increasingly important.

- Farmers' advanced knowledge about rice field biodiversity, together with vastly reduced pesticide levels, opens new opportunities for food security and income generation; many rice farmers decide to double the use of their fields and the rice field aquatic ecosystem by raising fish.

- They experiment with different management options, growing a "crop" of fish together with the rice in the same field, using the field to grow a crop of fish between two rice crops, or growing fish after rice instead of a second rice crop.

- Farmers experiment with physical modifications of the fields to accommodate the fish such as digging trenches in different shapes and sizes or small ponds at different locations. They are innovative in adapting their production systems to local market conditions – growing bigger fish for sale or their own consumption or smaller fish, if they can sell them to grow-out operations nearby.

- Better utilization of resources, increased income, and a healthy crop of rice and fish reinforce farmers' acceptance of integrated pest management and rejection of pesticides. Experience shows that many groups of farmers decide to continue the process of information exchange in self-organized "farmer clubs" long after the FFSs have ended.

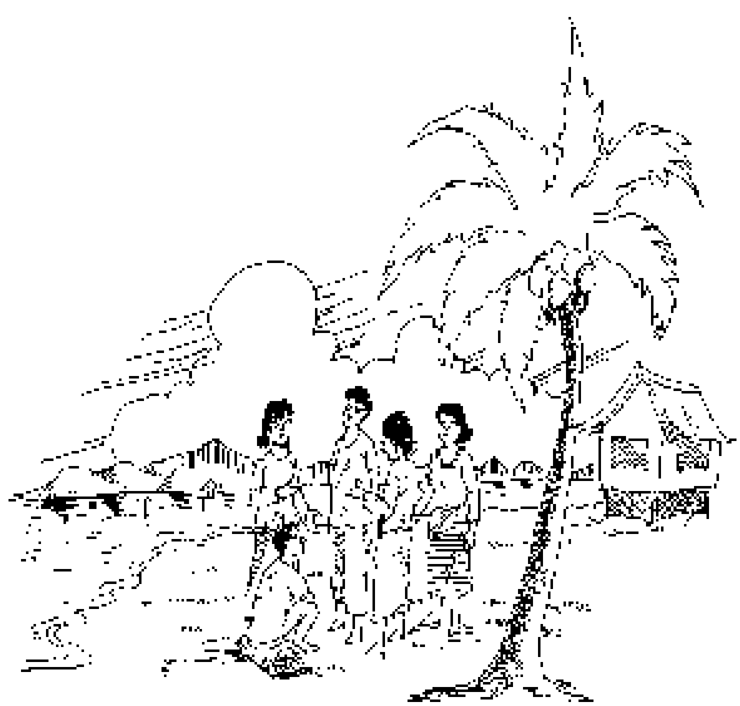
2. A participatory approach to aquaculture research and development in Laos

- The Lao People's Democratic Republic is very poor, and people depend heavily on the natural resource base, especially rice and fish consumption. The Provincial Livestock and Fisheries Section (LFS) provides support services including extension. It was anxious to become better equipped to fulfill its role. The UK researchers and the LFS agreed to develop recommendations together with the farm families who might use them. A participatory situation analysis was conducted in which LFS staff identified and characterized eight different rice paddy agro-ecosystems that could incorporate fish.

Experiences from a DFID research project coordinated by the Aquaculture Research Program, managed by the Institute of Aquaculture, University of Stirling and carried out in collaboration with the staff from the Livestock and Fisheries Section (LFS), of Savannakhet Province, Laos, the Lao Women's Union (LWU) and the AIT Aqua Outreach Laos project. The research aimed to address technical, social and economic constraints to rice fish culture in Laos.
Source: Haylor, G., A. Lawrence, E. Meusch, and K. Sidavong. 1999. Addressing technical, social and economic constraints to rice field fish culture in Laos, emphazising women's involvement. Final Technical Report DFID ARP Project R6380Cb.

With institutional strengthening support from AIT Aqua Outreach Laos and Stirling University, the LFS set up a formal procedure for formulating, recording, monitoring and upgrading recommendations, using the rice-fish recommendations as a test-case. Special forms (for recommendations and trials) were discussed and developed by LFS staff. A key change is that the district staff now records the recommendations they make in response to farmers needs. If a recommendation is a best-guess option (not the result of testing by farmers or other research), it is recorded as a trial and monitored. Recommendations and trials are discussed annually at village-based workshops so that an iterative process exists to upgrade and refine promising recommendations and discard or amend those that fail.

- To assess the wider implications of the recommendations, the Lao Women's Union developed indicators and a system of participatory monitoring and evaluation. Members of the farm-household compare their perceptions of the farming system before and after.



- This case highlights a novel mechanism, which encapsulates different roles for the key players and devolves the research and development process to farmers and field workers. It values local knowledge while acknowledging the role of outsiders and focuses on identifying and characterizing different recommendation domains. Sustainable impact is attempted by instigating an iterative process that leads to the documentation and refinement of the existing system of research and development support at a rate consistent with local capacity.

- The process is considered relevant to countries with developing economies that are characterized by NR research and development institutions at an early stage of development, with limited communication with the communities they have to work with, and where standardized or single technical recommendations are commonplace. It applies particularly to the communities that manage diverse, risk- prone natural resource systems.

Lessons learned

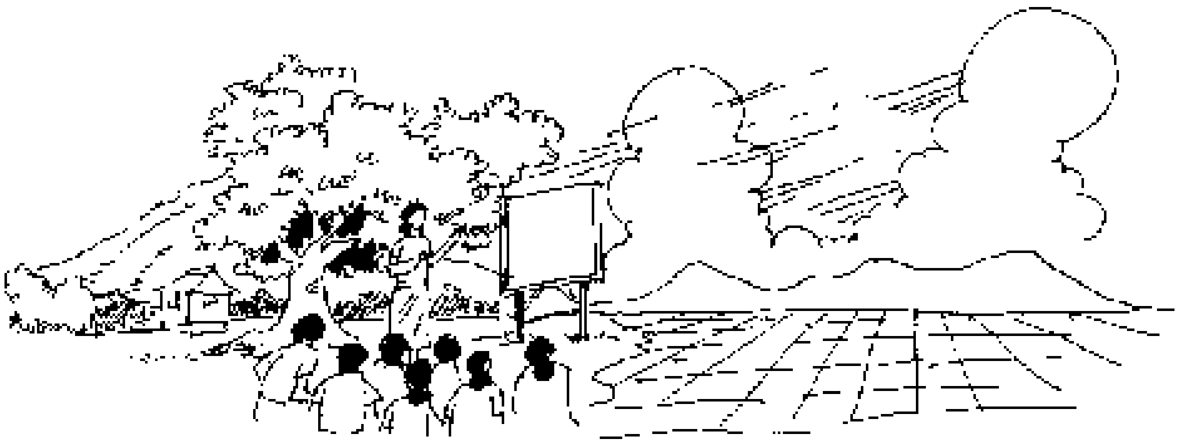
Significant lessons have been learned from participatory approaches related to aquatic resources management during 2000. Below lists learning gained as presented in an FAO workshop on participatory approaches used for aquaculture development held in Bangkok in March 2000. The issue of learning and communication processes also featured prominently in the recent E-Mail Conference on Aquatic Resources Management for Sustainable Livelihoods of Poor People in the SE Asia, in July 2000 (*see related topic on Aquatic Resources Management for Sustainable Livelihoods of Poor People, page 11*).

Clearly there can be no definitive "conclusion" regarding the appropriateness of using participatory approaches in aquaculture but the points listed below can be taken as issues and, in some cases, indicators that can help people decide how to incorporate participatory approaches into their work.

- The use of participatory approaches in aquaculture development activities can add value to those activities. During the research phase, they can ensure a better understanding of a wider range of issues and the context in which aquaculture is being considered or applied. They can also help ensure that aquaculture development addresses real issues and needs of potential users. During the implementation phase, they can ensure better implementation and better monitoring of impacts.

- Participatory approaches cannot be applied across the board to all types of research at all stages. They can make an important contribution to the identification of the research subject by helping researchers understand what the problems and priorities of potential users are. However, some forms of "basic" research are better carried out in a "non-participatory" way as participation by people in the field, particularly the poor, may expose them to increased risk. Once the results of basic research have been established, participatory approaches are an essential part of the adaptive research, which needs to refine solutions and make them appropriate to local conditions.

- In the implementation of aquaculture development activities, participatory approaches are important in ensuring that activities are implemented in an appropriate way and can increase the sustainability of activities by giving users the leading role in developing and adapting new activities. But participatory approaches require different forms of management compared to more "traditional" or top-down approaches. They require changes in skills and attitudes among those involved in aquaculture development, which require time.



- The adoption of participatory approaches, and the specific approaches used, need to take into account the capacity of the institutions and practitioners involved. Familiarity with the principles of participation, an acceptance of adaptive management of field activities, good planning and decentralized decision-making are all important in effectively supporting participatory activities. Time and resources have to be devoted to developing these skills and capacity.

- The adoption of participatory approaches is not a panacea. It does not make other approaches unnecessary nor is it always the best approach in all situations. The costs and benefits compared to alternatives need to be carefully assessed.

> Learning and communication processes are important in enhancing the capability of poor people to manage their resources. This issue featured prominently in the recent DFID SE Asia Aquatic Resources Management Programme E-Mail Conference. (See related topic on Aquatic Resources Management for Sustainable Livelihoods of Poor People)

- Participatory approaches in aquaculture have been used primarily to contribute to research. Their use as a means of improving understanding of conditions, problems and issues is important but, by concentrating on participatory research, some of the wider potential of approaches may be missed. The real potential of participatory approaches lies not just in the improvement of aquaculture development workers' knowledge, but in the building of the capability of the end-users to make decisions about aquaculture and its place in their livelihood strategies. This area of application of participatory approaches needs to be further developed in the aquaculture sector.

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Scaling Up the Impact of Aquaculture: The CARE Experience in Bangladesh

Aquaculture is contributing significantly to the total fish production of Bangladesh. To increase production from the aquaculture sector, it has been suggested that major shifts in extension strategies are necessary. The agriculture and natural resource sector of CARE-Bangladesh has been exploring alternative approaches to develop extension systems appropriate to the needs of small farmers. The processes experimented in promoting aquaculture development with small and marginal poor farmers have resulted in improved productivity from the different systems. The experiences gained in scaling up the impact of aquaculture indicate that to empower farmers and sustain development, it is necessary to change the focus of extension systems from technology transfer to helping farmers understand the principles and processes. With the knowledge acquired, farmers should be encouraged to develop by themselves systems appropriate to their farm using their own resources.

Why scale up the practice of aquaculture?

Aquaculture has been recognized as one of the activities that can have a significant impact on the livelihoods of the people and bring measurable changes. Scaling up such an activity would help in the efficient use of unused water resources or to improve existing practices, so that more people can derive benefit quickly from aquaculture and sustain the activity.

Research results obtained from partnerships with farmers were found to have substantial benefit to the farming community chosen for pilot scale testing. Based on the results obtained from the pilot phase, necessary adjustments were made for scaling up. Farmers are kept at the center in deciding what is appropriate for scaling up and sustaining the program.

Magnitude of scaled-up activities

On average, about 40,000 families annually are covered by a direct delivery system, where CARE extension staff directly work with farmers. Among these farmers, 20-30% only are generally involved in aquaculture activity, particularly rice-fish cultivation. There are six projects funded by DFID and European Union, with aquaculture as one of the components, and these are spread all throughout Bangladesh covering several hundred villages. Coverage through partnership is gradually increasing. Partnerships have been established with more than 150 NGOs and CBOs for the implementation of the activity either on contract basis or collegiate basis. Working through partners has different dimensions from working directly with farmers.

CARE-Agriculture and Natural Resource Program principles

- **Focus on people and not on technologies**. Understand the livelihoods of people and the contribution (or potential contribution) of aquaculture to livelihoods through the existing farming practice
- **Recognize and respect the innovative potentials of farmers** (Farmers are also scientists). Give them confidence and opportunity and do not underestimate the potential of farmers for innovation.
- **Provide farmers with the science behind the technologies and not just technologies**. Provision of principles encourages people to adapt/innovate technologies appropriate to their own farming system.
- **Do not promote risky systems**. Avoid heavy external input activities and help farmers to use locally available resources.
- **Organize farmers**. Help farmers to organize themselves and address problems on a community basis by establishing access to information: markets, formation of self-help groups, etc.

The scaling up process used by CARE can be grouped under two categories: horizontal scaling up (people to people) and vertical scaling up (institutions to people).

Horizontal scaling up

CARE has been involved in scaling up the aquaculture activities by directly working with farmers. About 800 staff members are involved in scaling up aquaculture activities throughout the country. However, these staff members are not exclusive to aquaculture, but are integrated agriculture development professionals who treat aquaculture as part of a larger farming system.

Vertical scaling up

To reach more people and ensure sustainability of the activity, partnerships with different institutions like non-government organizations (NGOs), community-based organizations (CBOs), youth/cultural organizations in the villages and government departments involved with agriculture/fisheries are developed.

Extension agents

CARE experience has demonstrated that farmer-centered and process-oriented approaches require staff with strong facilitation skills and a passion for participatory approaches. Staff with diverse backgrounds are recruited and trained to work as extension agents. Often experienced farmers can also play this role. There is a small group of technical staff for aquaculture, agriculture, forestry, environment, economics, sociology, monitoring and evaluation. These specialists help the extension agents in understanding the principles of technologies and issues. Extension agents with holistic approaches address the issues and provide support to farmers in solving the problems. This differs from the predominant extension approach wherein technical departments from each area like agriculture, horticulture, fisheries, provide support independently. The new approach is useful in reducing cost and meeting the needs of farmers.

Research/information partnership: Partnerships with universities, national and international research institutions, agencies involved in development work within and outside the country are developed. These partnerships have been mutually beneficial and will become productive when there are well-defined frameworks. The partners serve as good sources of information as well as good centers to disseminate information so that it will reach the right people involved in such activities.

Horizontal scaling (people to people)

This process' major focus is the transfer of information from people to people. For effective upscaling, good institutional structure and people with clear vision are essential.

Human resource development

Importance is attached to human resources since the extension system revolves around the staff's capacity to enhance the knowledge of farmers and their interest in learning from each other. To bring the fundamental change in the attitude of staff from "I know everything" to "I learn with you" requires considerable amount of time and energy.

Foundation training for the staff usually covers one full crop cycle (like rice-fish, about 120 days). It focuses on improving facilitation skills; building staff skills in using the experiential learning cycle; self discovery; enhancing staff knowledge on the livelihoods of people, social and gender issues; discovering the principles of technologies; gaining confidence in the use of extension strategies.

Staff development is considered a continuous process and resources are allotted to build staff capacity. Self-evaluation at the end of each crop cycle is undertaken (What was achieved? What could not be achieved?). An enabling environment must be created where staff members feel free to express themselves without fear and where they are encouraged to learn from mistakes. Staff development and management are core elements of scaling up activities.

Working with farmers

Working with farmers generally consists of the group approach following a farmer field school strategy, wherein farmers meet at regularly to learn together, through action-oriented educational approaches. CARE projects treat aquaculture as a component of the farming system. In a village where groups of 25-30 farmers are formed, there could be only four to five farmers who might be interested in aquaculture. In such occasions, small sub-groups are formed. The general principles in farmer field school approaches are as follow:

- **Learning contract**. Each group is encouraged to establish a learning contract in which the commitment of all parties is included.
- **Field is the classroom**. Farmers identify the problems and areas where issues have to be addressed. Plans are developed by the farmers to meet their own needs.
- **Curriculum focuses on science, not just technology**. Based on the identified needs of the farmers, curriculum is developed to increase their knowledge. Sometimes, progressive farmers are used to develop a curriculum appropriate to the village. Learning sessions could vary in

number depending on the importance farmers attach to the issue.

- **Meet on set days and set time**. Generally, each group meets at least once in a fortnight and undertakes observations collectively. In addition to these fixed meetings, extension staff also provides follow-up support.
- **Make time for analysis and synthesis**. At the end of the session, results are analyzed by the farmers and shared with others. Farmers' science congress is also becoming popular. In these meetings, farmers share and analyze results with other farmers.
- **Working duration**. The cycle of direct interaction with the farmers generally covers 12-24 months. This provides opportunity to cover 2-3 cycles of rice-fish and at least one full cycle of annual crops like pond fish.

Extension agents

Consider these processes in scaling up aquaculture

1. Farmer field school extension strategy – group learning opportunity for adults organized in fields.
2. Family approach – involve both male and female from each community.
3. Community approach – help bring more areas under aquaculture like in community fish culture. Also, it is a tool to create community harmony.
4. Farmer leaders – choose farmer leaders acceptable to community and help them establish access to information on a sustainable basis.
5. Aquaculture education to children – incorporate lessons in aquaculture in schools and help children to learn about aquaculture through practice. Children are powerful vehicles for information dissemination.
6. Farmer participatory research – encourage farmers to conduct research using their own resources to develop technologies appropriate to each area. Help farmers to analyze and disseminate the information .
7. Participatory monitoring, evaluation and planning – use tools and development indicators acceptable to farmers to measure progress.
8. Opportunities for discussion where farmers learn from each other.
9. Mass communication approaches – newsletters, posters, radio, TV programs, billboards in local languages are good ways to create awareness. But to ensure action, support is required and this should be planned.
10. Cross visits – a most effective strategy: farmers can communicate in their own language.
11. Farmers science meet – apart from field days (which give an opportunity for the farmers to see): organize village fora to discuss the results obtained.

Increasing secondary adoption rates

Farmers are encouraged to teach other farmers. Although successful activities are adopted easily by other farmers in the village, conscious efforts are necessary to increase adoption rates.

Consider these processes in scaling up aquaculture

■ Farmers are viewed as development partners and not beneficiaries.

■ Staff are viewed as knowledge and learning catalysts and not information givers.

■ Projects are viewed as educational programs not a technical intervention.

■ Focus on learning skills and mechanisms for learning and not on giving information.

Vertical scaling up

Partnership with NGOs

To reach larger areas and more people, partnerships with other NGOs and CBOs, youth organizations, etc., are useful.

While fostering partnership, remember:

1. Partners should have shared vision and values.
2. Adequate time is necessary in the selection of partner NGOs.
3. Capacity building of NGOs/CBOs should be a priority. Long term strategies and building collegiate types of relationship should receive priority.
4. All transactions should be transparent. Adequate support should be provided to improve program and financial management of the organizations.
5. Inclusion of local farmers in various trainings would be useful.
6. Partnership should focus on long-term institutional linkages.

Why rice-fish has been spreading widely in CARE project areas

The success of rice-fish has been attributed to the promotion of cultivation of both rice as well fish by the same extension agent. When these two components are promoted by two different extension agents, the result is poor.

Rice-fish culture is generally sustained by the farmers. In areas, where the activity was not sustained, poor participation of women was a major factor. Involvement of both male and female farmers from the same family assures sustainability.

Partnership with government agencies

Working with the Department of Agricultural Extension/Department of Fisheries achieves wider coverage. As there are many differences in the working environment and approaches used, strengthening of these partnerships require an understanding of each other. Some of the challenges encountered are: bureaucratic systems, hierarchical attitudes, non-acceptance of NGOs as equal partners, poor pay structure in the public sector and lack of pro-poor policies.

Partnership with research and development

Partnership with the universities and research organizations has helped in addressing many issues and in stimulating research for farmers. Many of the findings of these research institutes are transferred to farmers for further testing and adaptation. On the other hand, practical problems encountered by the farmers are fed back to researchers.

Consider these criteria in scaling-up aquaculture

1. Aquaculture should be a felt need of farmers
2. Inputs should be easily and locally available
3. Activity should not add undue risks to farmers
4. Socially and culturally acceptable
5. Environmentally-sound
6. Economic benefit derived should be high
7. Market opportunity
8. Technology should be gender sensitive
9. Favorable policy environments
10. Appropriate institutional structures

Conclusion

Aquaculture can make a significant impact on people. To achieve such an impact, changes are necessary in the extension processes. Following are the major lessons learned from the scaling up processes.

1. Scaling up is sustainable when education processes are adopted and participatory approaches are employed at all levels.
2. Scaling up should not be mistaken for replication. Every farmer should be encouraged to investigate and adapt the new information to suit his farming system.
3. Scaling up can have maximum impact on people with good policy environment. Hence, partnerships with government agencies, that can influence policy changes, would be useful.
4. Scaling up is faster and sustainable when holistic and integrated approaches are used. Treat aquaculture as a component of the farming system.
5. Scaling up quality entirely depends on the staff and, hence, staff development should be given the highest priority.
6. Scaling up requires an assurance of male and female participation.
7. Scaling up success and sustainability also largely depend on community participation in the activity and, hence, the use of community approaches as appropriate.
8. Scaling up can be enhanced and sustained by using participatory planning, monitoring and evaluation.

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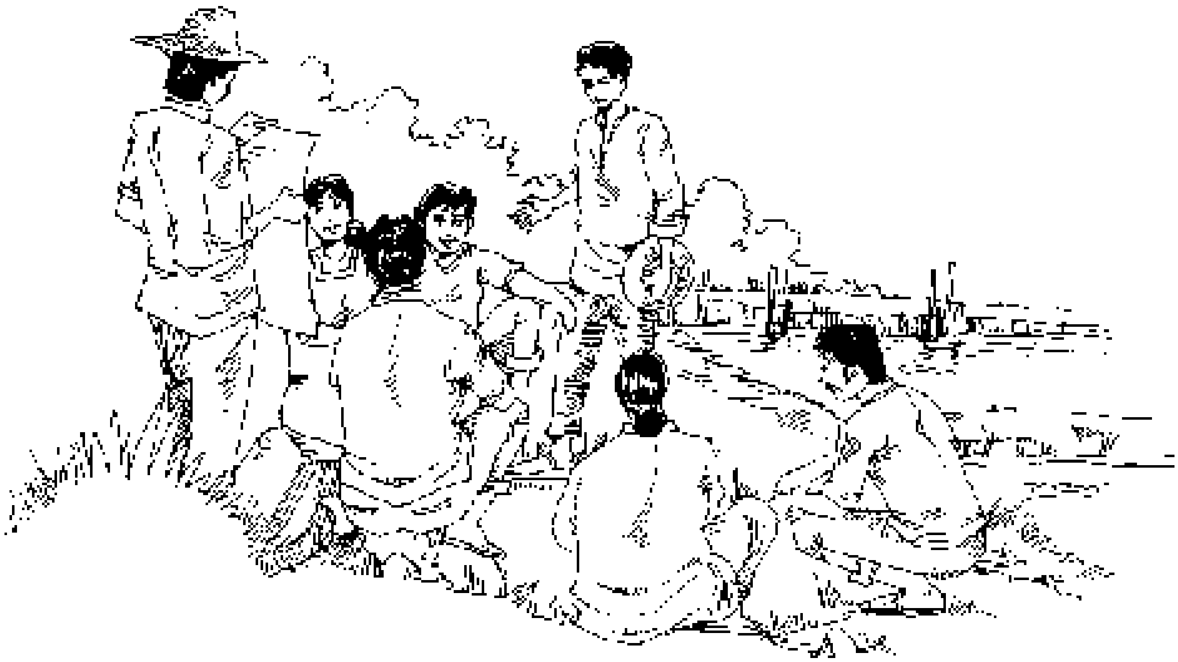
Scaling Up the Impact of Aquaculture: AquaOutreach at Asian Institute of Technology



Horizontal scaling up through distance extension

The Asian Institute of Technology AquaOutreach Program's (AOP) approach to horizontal scaling up is based upon careful on-farm testing of technologies with representative farmers, i.e., trial and not demonstration. The approach, however, has been at individual farm level, rather than in a group, although several farm trials may have been conducted in a particular village. Technology is modified according to farmers' needs and verified with a larger group of farmers before it is considered ready for dissemination.

However, with a limited budget and a small staff, based in a regional university, the Program has not been able to operate as a separate development project, at least since the beginning of 1993 when it expanded its scope beyond Northeast Thailand. Partly by default, partly by choice, it has had to work through government institutions, which also had very few, if any, extension workers.

In its initial work in Northeast Thailand, therefore, AOP analyzed the extension options available and concluded that for wider dissemination of information, a distance extension approach had to be adopted, with heavy emphasis on the use of mass media. It was important, however, that the medium of dissemination, just like the technology (the message of extension), was carefully designed and tested with farmers. For example, the AOP:

- Tested various forms of mass media in its experimental extension trials, including television and radio, as well as posters and leaflets.

- Examined which radio channels farmers listened to and when they were most likely to watch TV, to create awareness of the new technical options available.
- Tested draft posters and leaflets both with trial farmers and those who have not been exposed to the project to ensure understanding of the language and pictures used.
- Used the feedback received to make several drafts of the materials before they were declared ready for publication.
- Disseminated the printed materials through non-specialist channels like local schools, health centers and agricultural extension offices (AOP, 1994; Demaine et al, 1994; Demaine and Turongruang, 1996; Turongruang and Demaine, 1997).

> The AOP tested this approach in several contexts where it did not have any direct contact with farmers. Results appeared to be remarkably consistent. Follow-up by the staff showed as many as 40% of farmers who received the leaflets followed at least one of the technical recommendations, although many followed the principle, rather than the exact practice. Around 70% were still following the recommendations several years later. Similar results were achieved where extension materials were handed out during training. Of course, such an approach could not specifically target poor people. The assumption is that if a technology has been tested successfully by the poor, having been applied for a number of years, then it should also be accessible to other poor people with the same level of resources. Evaluation, which looked into indicators of socio-economic status, suggested that those adopting aquaculture through this system were no better off than the regional average. Given the amount of materials distributed, AOP estimates that use of carefully developed and tested extension materials, which were based on equally carefully tested technical recommendations, has spread to well over 10,000 households in the region.

Vertical scaling-up: Capacity building and provincial networks

A capacity building approach has been at the heart of the AOP. The program has worked through national government research and development institutions, primarily at the provincial level, to introduce new approaches to small-scale aquaculture research and development and new management systems.

- In Thailand, for example, the AOP acted as the catalyst to draw together the staffs of research stations and provincial fisheries officers into a single system focused on rural aquaculture. Provincial officers do research through on-farm trials while research stations collect data on the social and economic conditions of farmers to establish the focus of their activities.

AIT's Outreach Program's approach has evolved over time through the following phases:

1. Campus-based scientists working individually
2. Teams of natural and social scientists doing field research and working on development problems
3. Teams of natural and social scientists assisting national institutions in capacity-bulding for institutional development
4. National governments adopt policy changes based on results of field-based research and improved curricula.

By improving and adapting what already exists, the AOP enables systems to be transferred within and between provinces. This is like translating the farmer-to-farmer extension mode described above into aquaculture support services.

- In the Lao People's Democratic Republic, systems were developed in Savannakhet province, which then became the model for Khammouan and Champassak in the north and south. Now a network of six provinces in south central and southern Laos works together in planning, implementing and reviewing activities. A training unit in Savannakhet has developed skills which can serve all six provinces.
- A slightly different mode has developed in southern Vietnam, where AOP's initial phase of operations concentrated on building capacity at the Faculty of Fisheries in the University of Agriculture and Forestry (UAF) in Ho Chi Minh City. The UAF group slowly expanded project activities to several provinces in southeast Vietnam, which now constitute a network that develops and sets the annual work program, with technical backstopping from the university. With limited resources, the provinces are now seeking ways to expand the initial experience to wider groups of farmers.

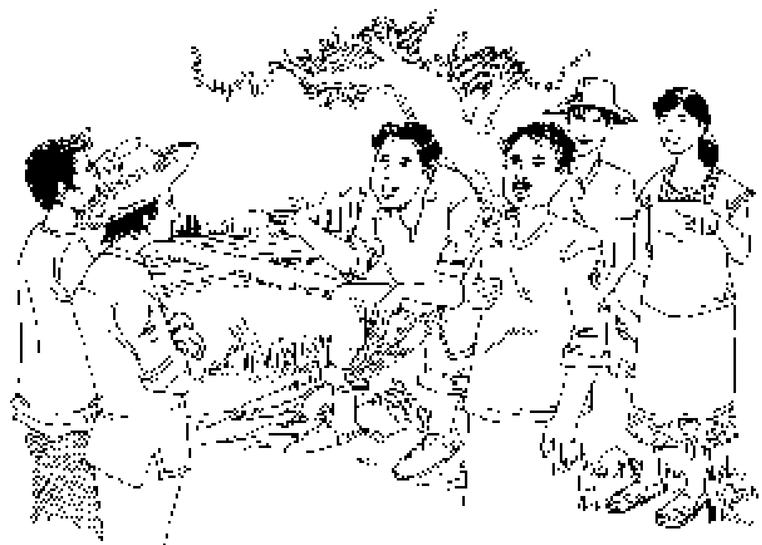
The next step is the adoption of the approach as national policy. In the case of the AIT Aqua Outreach Program, the evidence that the technical recommendations can have a positive impact on the livelihood of small farmers and that the approach is appropriate given the resources available to local administrations led to a growing acceptance by policy makers that the model can be adopted as national policy. (Demaine and Edwards, 1998)

- In the Lao PDR, the Regional Development Committee has been designated as the organization responsible for developing a strategy for the livestock and fisheries sector in southern Laos.
- In Cambodia, evidence offered by AOP and similar projects have persuaded the Department of Fisheries to establish a separate Aquaculture Office to consolidate efforts in the sector.
- In Vietnam, the work of Aqua Outreach and the United Nations Development Program (UNDP) has led to the formulation of a strategy for Sustainable Aquaculture for Poverty Alleviation in the Ministry of Fisheries.

The acceptance of this approach as policy has been based on a clear demonstration of impact and relevance through pilot projects, not through advocacy of such approaches at national level.

Conclusion

The two dimensions of scaling-up – horizontal and vertical – involve the testing of possible technologies with the participation of farmers to make sure the innovations are acceptable to clients before they are disseminated through farmer-to-farmer interaction.



In AOP, the trial has been on an individual farm basis. Extension materials were later produced using the results from the trial and with farmer participation. Like the CARE project described in another paper, the extension effort involves non-specialists in the on-farm research dissemination process. Both projects recognize the need to develop networks for vertical spread. In AOP's case, the project works within the government system, emphasizing capacity building at provincial and district levels to reach small-scale farmers on a country or region-wide basis.

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Prepared by:
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Participatory Approach to Extension and Training in Aquaculture

The fundamental objective of extension is development which is not limited to physical and economic
aspects alone. Extension emphasizes development of peoples' overall capacity to help themselves. One such successful extension approach is known as the **trickle down system** (TDS) of aquaculture.

Genesis and concept

Experience gained from extension services of the food farming sector indicated that, in addition to a dedicated and efficient extension services network, an appropriate extension approach is also needed to provide a definite direction to the program operation and to amplify its impact.

The approach was designed based on two core principles:

1. Get closer to the client groups and get a firsthand insight of their socio-economic settings, farming practices, level of knowledge and skills, needs, opportunities and constraints.

2. Foster participation of the client groups in planning and implementation of the

agreed program.

Trickle down system (TDS)

This approach was developed and successfully demonstrated on a limited scale in Bangladesh through the FAO/UNDP project "Institutional Strengthening in the Fisheries Sector" in 1990-1993. The approach was piloted in 52 (out of 64) districts of the country in 1994-1996 through the FAO project "Strengthening Pond Fish Culture Extension". The pilot project helped to fine tune the approach. Subsequently TDS was applied on a national scale by the Department of Fisheries (DoF) in Bangladesh, Northern Vietnam and some parts of Sri Lanka.

The TDS approach is a participatory, farmer-to-farmer extension approach, which involves bottom-up participatory planning and implementation of the extension program. This results in the "trickling down" of knowledge and skills of improved technology from result demonstration farmers (RDFs) to fellow fish farmers (FFs).

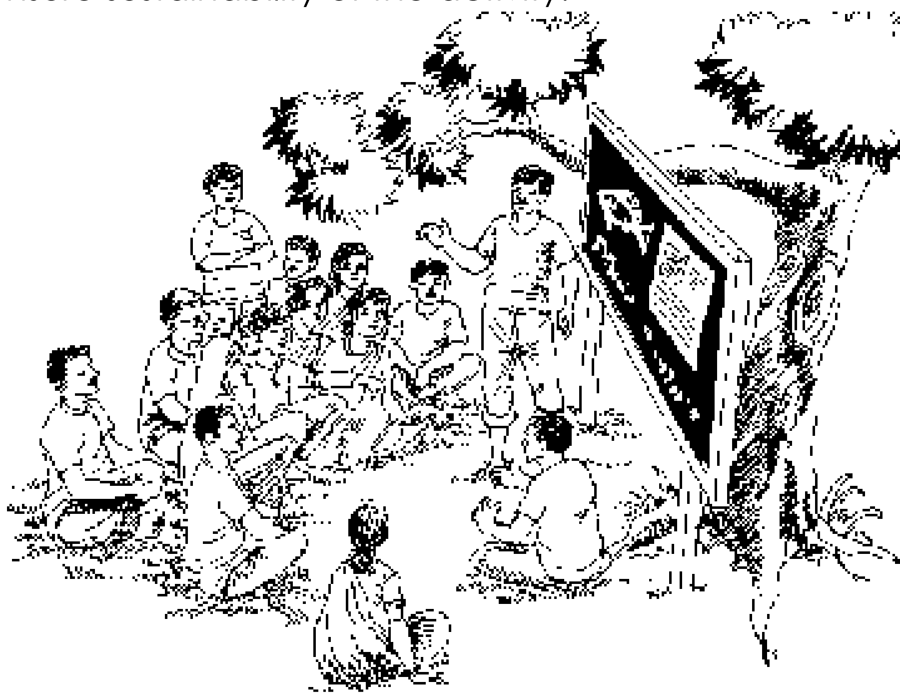
Clientele

Families with their own pond or any other type of aquaculture facility or have access to such a resource.

Functional design

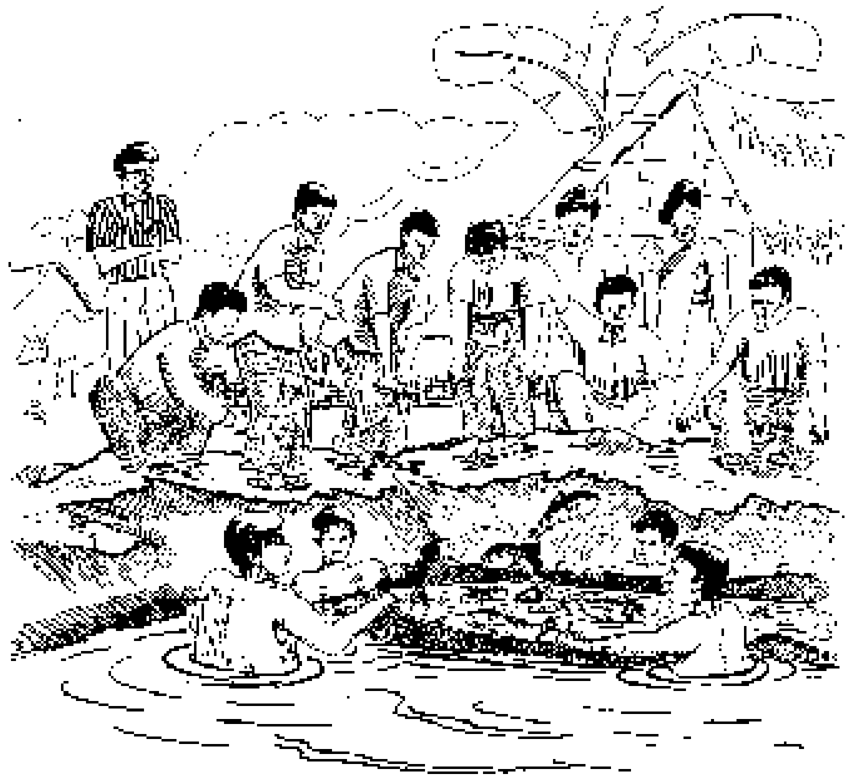
- Once a site is identified, village communities and opinion leaders/social workers, including progressive farmers, are approached and a local level assembly is organized in the form of a field level training session. This method was subsequently replaced by a combination of rapid rural appraisal (RRA) and field training. Finally it was found that the participatory assessment, planning and action (PAPA) approach at individual and community levels was more effective.
- By using the PAPA, a broad participatory assessment is made of the size and type of aquaculture resources, local availability of essential inputs, range of farming practices, local farming skills, ability to mobilize the extraneous inputs, constraints, etc. With this information and giving due consideration to the existing socio-economic environment, a plan is prepared for development through aquaculture. Measures are discussed to improve existing practices. In addition, the appropriateness of certain alternative technology packages is assessed.
- Before a planning workshop or training is organized, it is made clear that no form of monetary incentive can be expected.

- Once the plan is prepared, one or two RDFs are selected by the group to undertake an improved/appropriate culture technology trial. The rest of the participants are designated as fellow farmers (FFs). They watch and wait for the outcome of the trial. Again, before the RDFs are chosen, it is made clear that, except for on-site training and technical advice, no material or financial support will be given to those selected. This is meant to avert future complications and ensure sustainability of the activity.
- Adequate extension support is given to the RDFs through repeated short-term instructional training and periodic home/site visits to demonstrate the improved aquaculture technologies in their ponds. RDFs get on-site practical training using method demonstrations at least two to three times in the course of a complete cropping cycle. Home/site visits are made once or twice a month depending on the specific need and nature of the culture practice. Participation of both men and women family members is ensured.



- Emphasis is also given to developing leadership qualities as well as technical and extension skills.
- Once the crop attains a presentable stage, RDFs are encouraged and assisted in organizing practical trainings for the FFs by demonstrating the various steps of culture technology. The role of the RDFs is constantly highlighted and appreciated, enhancing his/her status in the community. This was a valuable incentive for them. RDFs were,thus, groomed as voluntary extension workers of the Department of Fisheries (DoF). This inspired the RDFs to take more interest in propagating the aquaculture technology in their area.
- In subsequent cropping cycles, some FFs came forward to take up the culture practice and act as demonstration farmers, thereby becoming RDFs, with their own FFs. This process continues in the locality with little support from the extension services system.
- Extension training tools and materials were specially designed to make the training more participatory, effective and useful.
- Certain incentives were given to RDFs in the form of medals, public felicitations, etc., in recognition of their services to the farming community. This encourages them to take up extension work as a social responsibility.

- The process emphasizes the facilitation of the learning process. Instead of using the conventional technology transfer method, extension volunteers are encouraged to "walk the learning path," think and try new ideas for improving their farming practices and facilitating collective development actions. When farmers and communities are involved from the very beginning, they become active partners in the implementation of programs. This approach prevents the entry of vested interest groups that would mislead and exploit the farmers.



The approach helped inculcate an "extension" culture among the senior and field-level staff of the DoF and institutionalized the department's aquaculture extension services system. It is worth mentioning that unlike the agriculture sector, where the primary activity is extension, the fisheries sector has multi-faceted responsibilities ranging from management of fisheries and aquaculture resources under state/public ownership such as rivers, lakes, reservoirs, flood plains, etc.; enforcement of fisheries acts and regulations; and providing extension services to farmers and fishers. Most of these resources are in remote places, not easily accessibille to the public transport system. With RDFs serving as local extension volunteers, the pressure on government extension personnel is reduced. This approach, based on "farmer to farmer" principles, was used for the first time in Bangladesh and was received positively by government and non-government organizations (NGOs).

Local variation in

Vietnam

The approach takes advantage of the strength of existing local level community institutions by involving them in participatory extension activities. Various organizations such as Women's Union, Youth Union, Farmers' Association, and People's Committee are strong and active even at the local level (commune). A commune action group (CAG) is organized to develop aquaculture in the community. It is composed of one member from each of the existing local organizations, including one local aquaculture farmer. CAG members are trained in participatory resource and constraints assessment, planning and action for individual and cooperative level initiatives to develop aquaculture. After training, CAG members take the lead in organizing a commune level participatory planning exercise and select Demonstration Farmers. This approach is being used in the "Aquaculture Development in Northern Uplands" project in Vietnam of the Food and Agriculture Organization and United Nations Development Program (FAO/UNDP).

The impact of this extension approach was demonstrated by the FAO-TCP project prompting the Government of Bangladesh to launch a five-year nationwide project exclusively through national funding. An inter-ministerial evaluation was conducted during the last phase of the project. The group was highly satisfied with the program and its impact on the development of pond aquaculture in the country. Based on the body's recommendations, another five-year phase is now being implemented and will be integrated into the Department of Fisheries as a regular activity.

Local level variation in Sri Lanka

In Sri Lanka where seasonal tanks hold vast potential for the development of inland aquaculture, TDS is largely a group-to-group approach. Local communities involved with any specific seasonal tanks are organized for planning and development of aquaculture through collective actions. Other groups associated with nearby seasonal tanks are invited to observe the development process and plan their development program in the subsequent season.

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Prepared by:
A. K. M. Reshad Alam and Kevin Kamp

A "Farmer Field School" for Aquaculture

Many extension strategies are limited to demonstration of technologies or providing advice via workshops and individual farm visits. Often the fundamental issue is a technology that has been packaged for farmers. Farmers are required to remember and replicate these systems on their farms. This may be one of the primary reasons why aquaculture successes have spread more slowly than expected.

It is about time that an alternative model of extension is considered, one which encourages a holistic understanding of aquatic ecosystems, and embraces farmers as partners in technology development. The alternative approach should address livelihoods and empower farmers with greater planning, monitoring and decision-making abilities. This can be achieved through a "farmer field school" approach to aquaculture.

Production technologies: refocusing on the basics

Many aquaculture technologies in Bangladesh are promoted in a conventional manner, focusing on how to increase yields. The approaches do not consider the current level of knowledge, capabilities and opportunities of small-scale farmers. Too often, the technology focuses specifically on systems that require high levels of external and internal inputs (piscicides, supplementary feeds, inorganic fertilizers, etc.) applied in a very specific manner.

Extensionists will do well to contextualize the content of their demonstrations and the methodology they use to ensure their relevance to the situation of farmers they work with.

By listening and learning from the farmers, extensionists can recommend those techniques and technologies most suited to the farmers' situations.

Rather than introducing a predetermined technology and its accompanying practices, providing farmers an array of practices to choose from generally results in greater adoption rates. Farmers can select and adapt those practices that suit their own unique needs. They are actually involved in the development not only of the technology system, but of the practices that define it.

Alternative approaches help the farmers gain a fundamental understanding of aquatic ecology. They can then work with the extension professionals to design, implement and evaluate the impact of potential new practices and to develop appropriate, farmer-specific technologies. Learning approaches should be experiential, discovery-based and need-driven as well as tailored to the goal of transforming farmers into experts of their own aquatic systems. The first step in this transformation is to help farmers understand the aquatic system.

Farmers as experts

Farmers can be experts of their own ponds. What would it take to make them experts?

1. **Extensionists must believe that farmers can be experts.** Without this fundamental belief in the capabilities of farmers, it is unlikely that a program to enhance their abilities will succeed.

2. **Rethink technologies and practices.** Focus learning efforts on understanding the basics of aquatic ecosystems.

3. **Make the invisible visible**. Develop methods that will allow farmers to actually see, feel and hear what is going on under the surface of the water.

4. **Provide opportunities for farmers to put concepts together**. Develop possible practices and technologies and test them with the farmers as a group . Encourage farmers to set the research agenda. This may mean ensuring a number of small pits, ditches or ponds are available. Planning, implementing, monitoring and evaluating together can be a powerful experience for farmers and can provide them with valuable skills. Group work also acts as an information, education and communication tool. More people will be reached by this method and will want to take part in the learning process.

5. **Develop strong management tools that farmers know how to use**. Farmers need tools to quickly and easily monitor the "health" of the pond, the results of which will encourage and support management decisions.

6. **Enhance farmers' expertise to ensure the sustainability of aquaculture and institute a process by which farmers take the lead in innovation and development of new technologies.** The role of the extension worker will be to support the farmers' learning opportunities on a regular basis.

Extensionists have to learn how to communicate more effectively to enable farmers to easily grasp the alternative practices (and hence learn what is best for them).

By demonstrating and asking the farmers to carry out simple practical "experiments" and by giving concrete visible examples, farmers can quickly grasp the philosophy behind a new technology/technique being introduced.

By listening to and learning from the farmers, the introduction of new technologies would be much simpler and enjoyable. Both extensionists and farmers will easily notice that the new technologies do result in higher levels of yield and profit and actually match the goals and specific resources of individual farmers.

Discovery-based, experiential learning

1. Farmers learn the effect of fertilizers on phytoplankton

Farmers easily discover this when asked to do the following.

- Put some water in a number of plastic jars.
- Add different types of fertilizers and manure to each plastic jar.
- Experiment with different amounts of fertilizer and manure in each jar.
- No fertilizer or manure should be put in some of the jars, which will serve as

control jars.

- Expose the mixtures to sunlight for four to six days. By carrying out this simple experiment on his own, a farmer will learn about the impact of organic and inorganic fertilizers on phytoplankton growth. He may even go so far as to test the nutrient levels in his pond's water by adding various doses of different nutrients to see which has the most impact on phytoplankton growth. He can document for himself if indeed nitrogen is not limiting and phosphorus is.

2. But so what if he can produce more phytoplankton?

The farmer now needs to understand how phytoplankton is consumed by the fish or how it increases the production of zooplankton (next organisms up in the fish food chain). To test this: Ask the farmer to put zooplankton in plastic jars with the fish and to observe closely to be sure that the fish are actually eating the organisms.

3. Farmers learn the benefits/effect of using lime over water

Apply small amounts of diluted lime in plastic bottles containing different types of water generally found in the village (e.g., turbid water, polluted water, water with a high organic level, etc.) After applying the lime into the bottles, the farmers should be able observe how, in 10 minutes, different types of water become clear. This exercise should strengthen their belief that lime can purify water.

4. Farmers become empowered to make the best decision on managing predators and small fish

Help farmers learn about the range of predatory fishes that exist in ponds by sampling small pits in rice fields. Farmers will be able to learn about the diversity of species found in small water bodies. They will find not only fish species, but various snakes, insects, and other benthos organisms in such dynamic water bodies. By draining a small pit and removing the fish, they will understand the impact of drying such an aquatic ecosystem and how quickly it is reestablished with invertebrate and vertebrate organisms. By netting the pits before they are drained and dried, farmers will also learn the efficiency of netting to remove predatory and small fishes, and how many times it had to be done.

5. Farmers will only be able to decide on the best supplementary feed to use if they

are provided with pits and small ditches where they can experiment

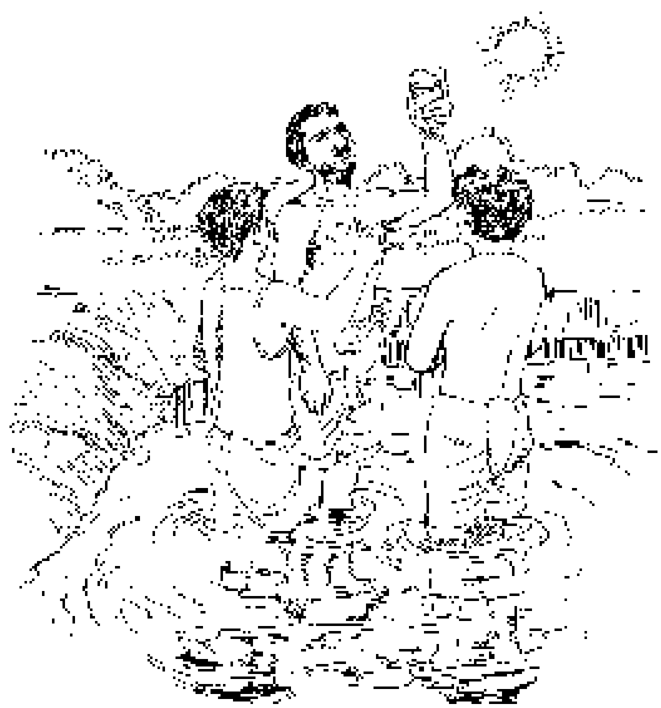
The recommended supplementary feed items in Bangladesh usually involve rice bran and oil cake. Both can be expensive and might not actually be needed. How does a farmer decide?

The use of small ditches where groups of farmers can plan, implement, monitor and evaluate their own experiments is important, not only for learning specific concepts, but for putting together practices based on these concepts, trying them out in the real world, and continuing the learning process long after the extensionist has moved to another district. Design and observation skills are critical for this process.

Remember!

It is important to use methods and examples relevant to the farmers' situation that they can relate to. This will increase their self-confidence to make observations and decisions based on the observations. Their observations and experiences will enable them to calculate doses and to learn about the appropriate types/levels of fertilizers to use in ponds.

Farmers, who want to evaluate the effectiveness of rice bran and oilcake compared to pond fertilization food production strategies, would need a place to do it. They can discover the real answer for themselves depending on the quality of the pond.



Conclusion

A "Farmer Field School" approach is an empowering process to enhance the decision-making capabilities of farmers. Through the process, farmers can relate to the technology that the extension worker is trying to introduce. This approach requires that farmers be recognized as experts in their own ponds.

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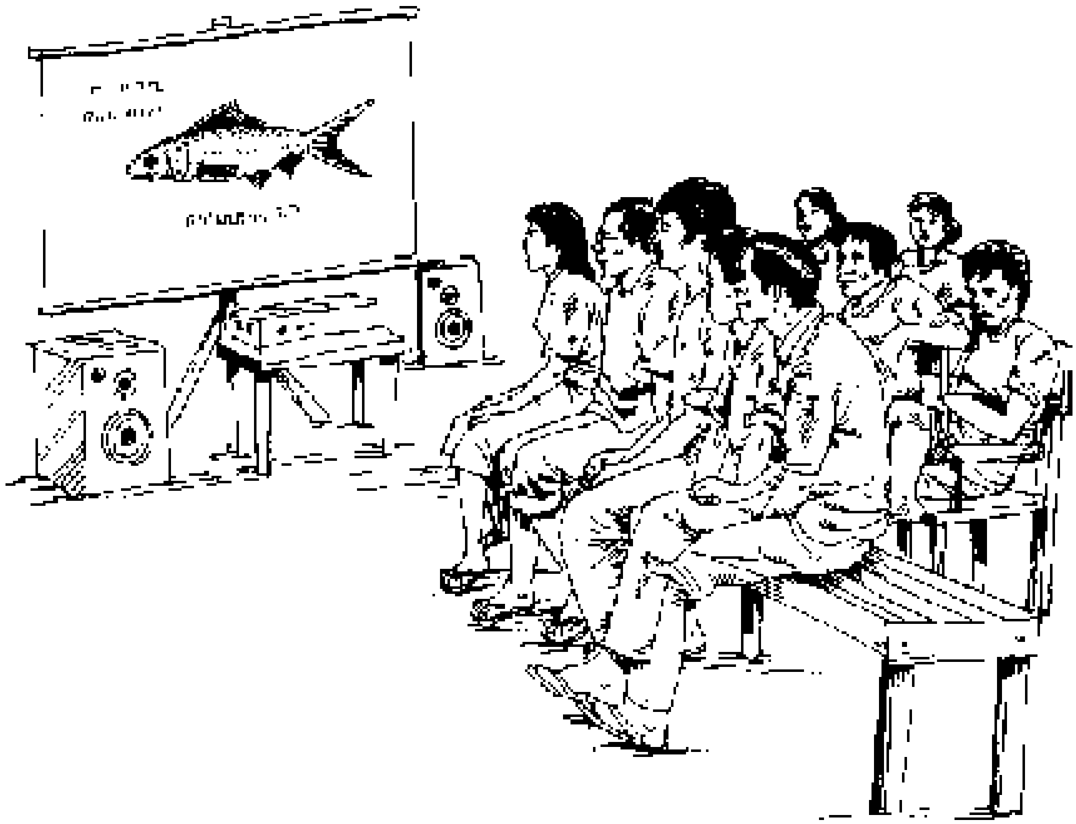
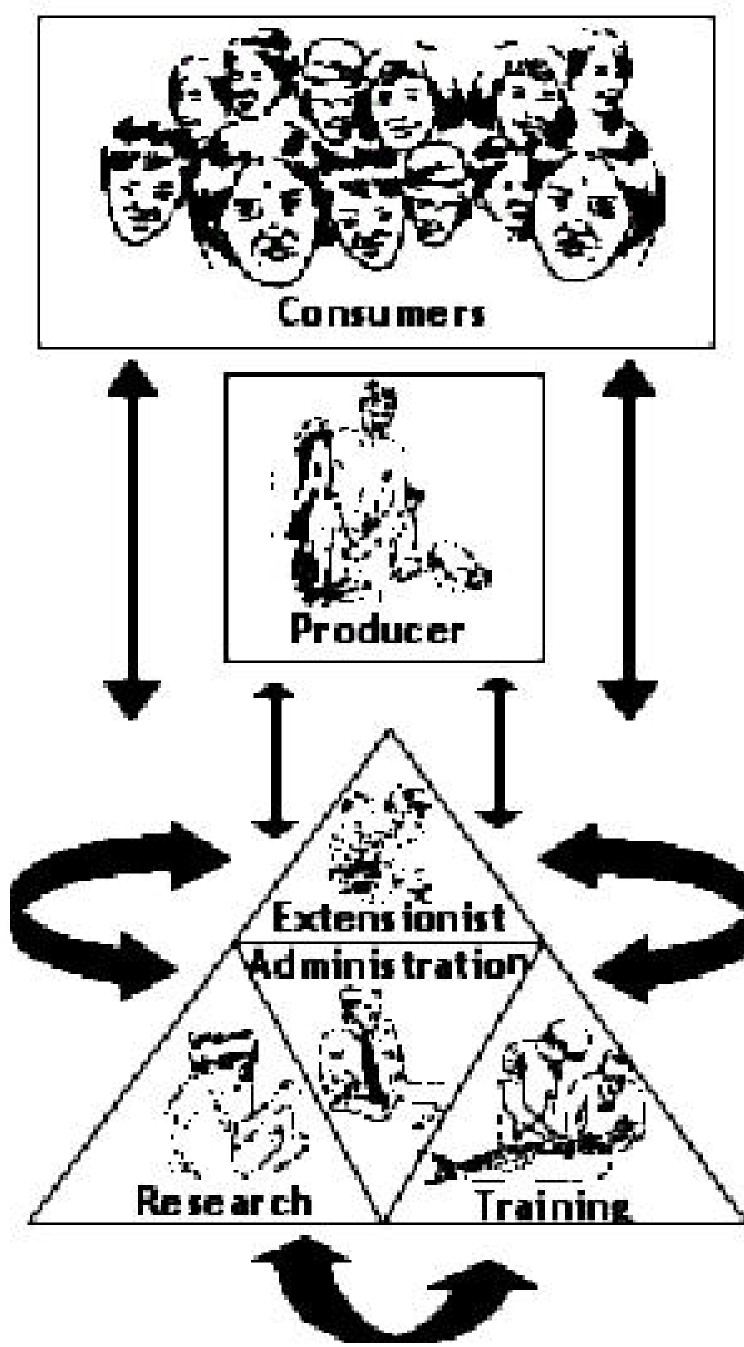
Aquaculture Development and Information Processes



The challenge in aquacultural development is to assure and be able to verify that target populations have actually benefited from such efforts. Even successful programs have had to face these challenges. Enough poor results exist to justify a brief examination of the previous and current models and processes for aquaculture development.

Causes of failure

There are plenty of examples of the failure of aquaculture development efforts to live up to expectations in spite of the good intentions of those who designed and implemented the projects. In some cases failure resulted from inappropriate technology (e.g., trout facilities in the tropics) or lack of appreciation of the complexity of farming systems in which aquaculture is to be introduced (e.g., assuming labor or animal wastes do not have competing opportunities). More often, however, failures are linked to external forces (e.g., breakdown in law and order) or the inability to cut through ineffective and under-funded governmental systems (e.g., failure to release budget support on time).



Another problem is failure to build a comprehensive system needed for aquacultural development. The following diagram is a conceptual model of a holistic system that highlights the interconnectivity of different elements and functions. Any specific development effort might address part of the model but ultimately, all the supporting functions must be addressed for an aquaculture industry to be sustainable. An extension system can be temporarily enhanced but without an effective training mechanism to bring new people into the system and a research source to infuse new and proven technology, it will eventually collapse. Similarly, research needs new scientists from training programs and, in turn, should provide updated information to keep education relevant. Research-based aquaculture technology is vital to guide extension, education and development efforts. It is also essential to have an administration system that provides an environment that allows the different functions to operate, including the legal framework and public infrastructure.

The model should make it clear that the support systems have to be sustainable. All too often a program that is introduced, often with foreign assistance, runs for a few years then fades at the end of the project. Program planners are generally aware of the problem but political urgency and unrealistic expectations about the pace of development and institutional capabilities undermine the sustainability of support functions.

Another problem is where and how support assistance is spent. Salaries, allowances, and overhead charges for specialists from the more developed countries can eat up a good portion of foreign development support. The program processes imposed by donor agencies can also be formidable and costly. Off-shore training of local scholars can be very expensive, time consuming, and may contribute more to the brain drain than to home country development. Many host country governments are notorious for their cumbersome bureaucracies (a feature also of some donor organizations) and sometimes outright graft. The net result is that little of the support actually trickles down to the truly needy.

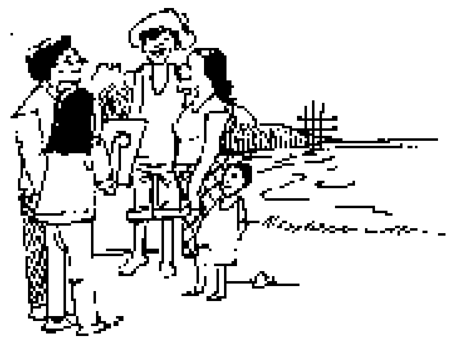
Paradigm shifts

Past efforts to develop small-scale aquaculture have generally focused on helping rural poor and landless people, with particular emphasis on production and nutrition. Although these are important considerations, development planners are now thinking more in terms of profits and enhanced business success. An aquaculture product may be too valuable for a farmer to eat, but the income from its sale may enable the farmer to purchase other items such as health services, education for children or less expensive alternative food items, and to enhance their livelihood and help them overcome poverty.

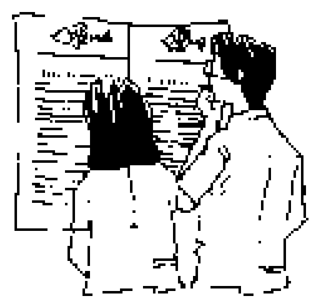
Information

delivery

The question really is what does it take for a resource-limited person to take advantage of the inherent opportunities of small scale aquaculture and how can the information be delivered efficiently? This assumes that small-scale aquaculture is economically viable in that particular setting, that soil, water and climatic conditions are not limiting, the technology is within the grasp of the adopter, there are markets, credit, seed stock, feeds or fertilizers, etc. All these factors, along with social considerations like water use rights, poaching risks, labor demands and so forth, should be considered before pushing for aquaculture development.



One problem in development work is defining who should convey new information to farmers. In America, the land-grant university system has this responsibility and most countries, to some extent, charge their agricultural universities with some rural extension work. In the less developed world, typically this responsibility is given to some ministry or ministries like the Ministry of Agriculture. The agencies are often under-funded and ineffective in actually getting out and among the rural constituency. Official development assistance is often restricted to government channels. This is where external money goes (and sometimes siphoned off). A thriving NGO system has developed in some countries to help facilitate rural development through outreach and credit activities, particularly where public programs have left a void.



A participatory approach, now considered essential, suggests asking the potential adapters how they would like to learn about and assess the opportunities for them in small-scale aquaculture. Establishing a continuing presence and an effective feedback mechanism can also lead to building information transfer processes. Working with groups such as a village women's organization may help facilitate the processes.

The classical "extension method" suggests that the first step is to create an awareness that such possibilities exist. Traditional approaches include mass meetings, information leaflets, media programs, on-farm demonstrations and gatherings, etc. Working with groups may be the only approach that is practical and efficient .

There is a whole discipline dealing with extension education and lessons learned from that discipline should be understood and incorporated into rural development planning.

It is one thing to work with college-educated farmers and another to work with landless peasants. In many places, the latter have low literacy rates, little formal education and limited exposure to mass media. The resources they bring to the tasks of aquaculture are basically their hands and perhaps some traditional knowledge picked up from their rural upbringing. Obviously, strategies to create awareness have to be tailored to the prevailing conditions in the target area.

The time honored approach of guiding an "opinion leader" type person, perhaps one selected by a community through a participatory process, to adopt a given practice and share his experience with neighbors is still regarded as a good method for creating an awareness in a community. Sign boards, portable loud speakers, radio and television programs and curriculum models for schools have also been employed.

A recent study in Bangladesh (FEEP), for example, asked fish farmers where they got their best advice. The most credible source identified was government personnel but it turned out that actual contact with government agents was minimal because they were few and were being diverted to functions other than extension outreach. Another project in the same country involves small fry/fingerling dealers in the belief that virtually every fish farmer comes in contact with them as they procure fish stocking material.

In more industrial societies the private sector may also get involved both through vertical integration and market development. Thus, a fish feed manufacturer may have his own pond production facilities and also guide other farmers to assure their success and to expand his market for the feed.

Where many interests promote aquaculture, there might be some contradictions on recommendations about how the farming should be done. Unscrupulous and ill-informed promoters are all too common in the aquaculture world. Poor peasant farmers are generally ill-equipped to sort through conflicting claims and tend to take the conservative approach of not changing their practices when their tolerance for failure is very low.

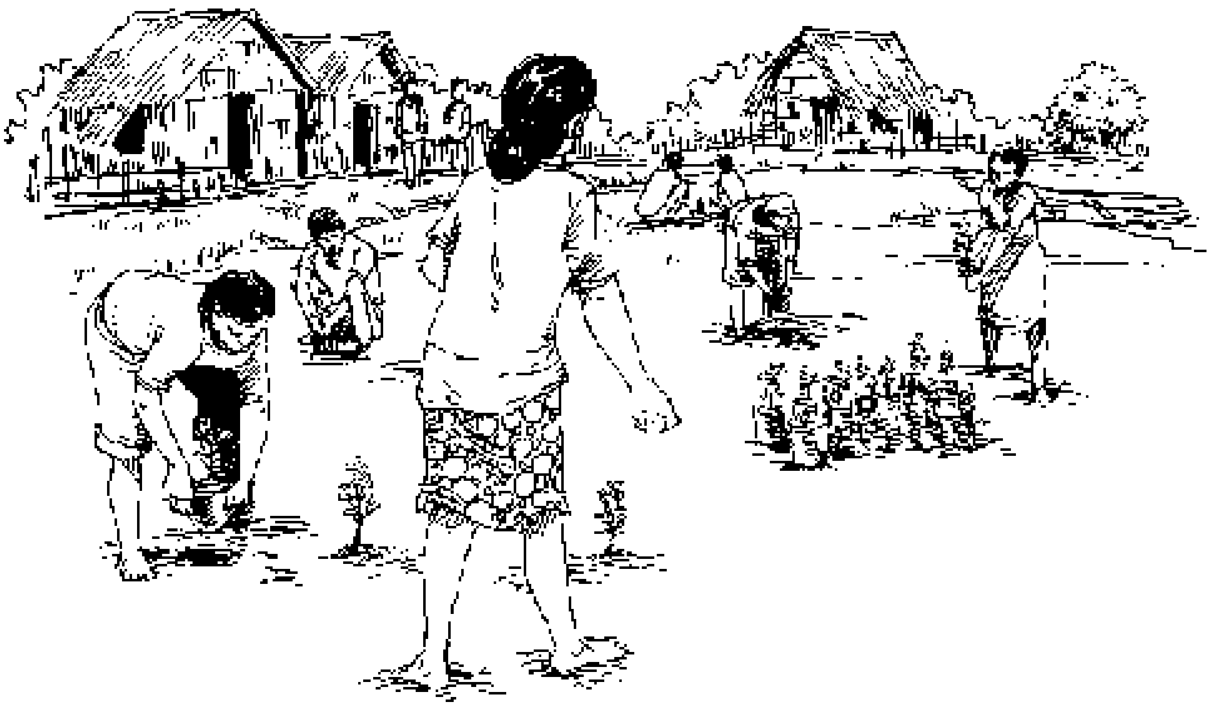
Subtle cultural features may help or destroy the effectiveness of the information transfer process. In the design of one project, for example, the purchase of bicycles for extension agents was discouraged because the mode of transport lowered the agents’ social status and credibility in the rural communities. It was better to have the money for pubic transportation and to walk than to ride a bicycle in this particular setting.

> The type of person charged with extension responsibilities is also very important. Some personalities are just better at some tasks than others. Technical knowledge and experience are desirable but these must be coupled with personal characteristics suited to the tasks of information transfer. Local individuals historically have had the most success as "farm agents" assisting with the adoption of new farming practices.

Although there is some appreciation of information transfer processes, they are often poorly implemented, partly because the resources just do not trickle down adequately to support farmer-level operations. Outreach efforts have to assess where resources are spent and to ensure that field people and their operational needs are given priority.

Prepared by:
John Grover

Rural Aquaculture Development and Mangrove Conservation Projects (Initiated by Fishers in Collaboration with Various Institutions in Sri Lanka)



This is a story on the positive impact of a unique and successful partnership between local communities, NGO's and government institutions that launched recently a major program for the development of the aquaculture industry in Sri Lanka. The uniqueness of the approach lies in its eco-friendly rural aquaculture development projects aimed at the rural poor.

The present per capita consumption of fish in Sri Lanka is estimated at 18 kg per year as against a required average of 21 kg per year. Faced with communal disharmony in the North and East of the country, fish flows and transportation to the cities and other parts of the island have decreased. As many villagers do not have easy access to the high seas, the only fish available for the rural poor is, decidedly, freshwater fish.

Linkages have been established among the following organizations in an effort to boost the local production of fish: the Small Fishers Federation (SFF), a non-government organization (NGO); the National Aquaculture Development Authority of Sri Lanka (NAQDA), a statutory body under the Ministry of Fisheries and Aquatic Resource Development (MFARD); and the Food and Agricultural Organization of the United Nations (FAO).

The SFF grew from a development network set up in 1984 called "Fisher Folk-Based NGOs". The federation, funded by NORAD (a Norwegian goverment agency), played a pivotal role in the national food production program in the country and achieved optimum results through a community-based participatory approach. It effectively expanded and grew, becoming a Federation, through active participation. It has launched many beneficial programs such as crab culture and mangrove conservation projects in the northwestern province of Sri Lanka. Thus, SFF is rich in experience that can be shared with grassroot level organizations worldwide.

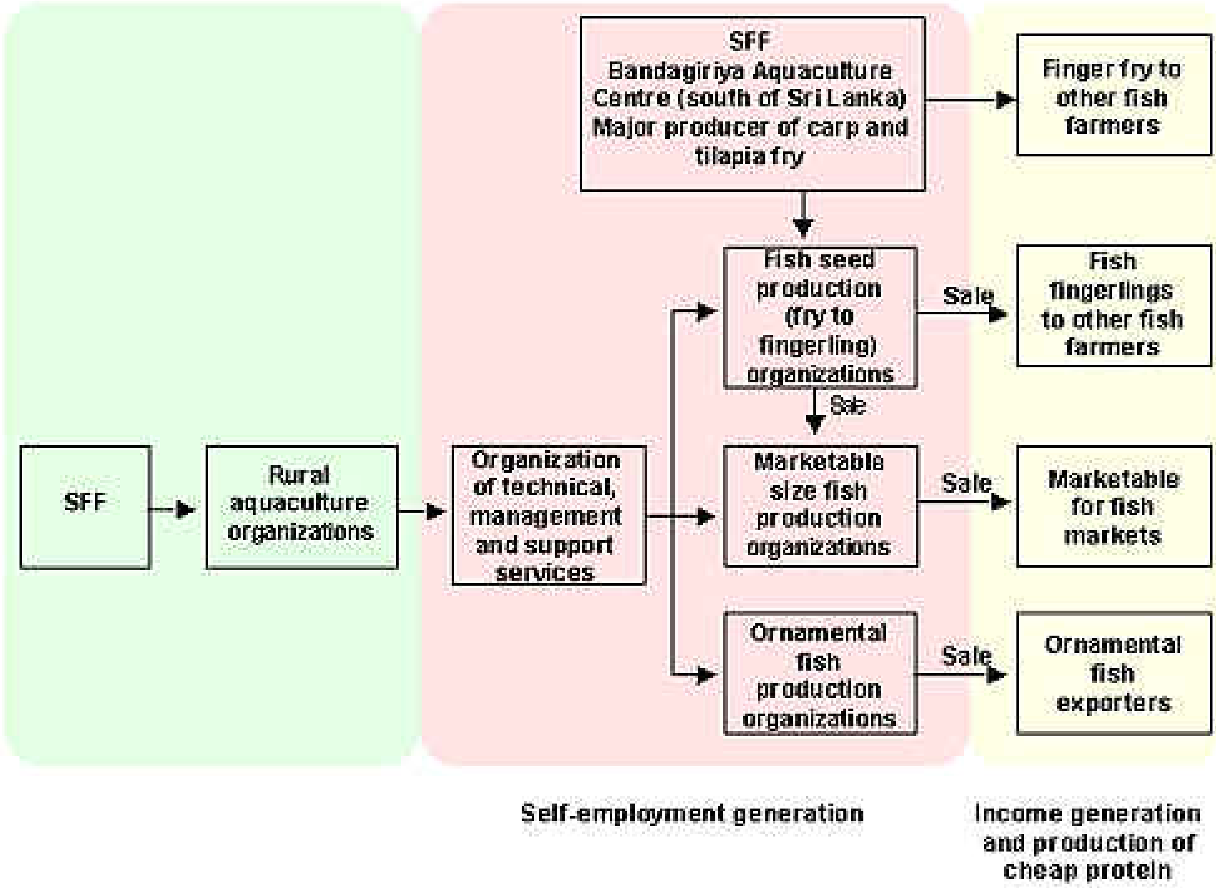
Reasons for success

- Honesty and good leadership qualities demonstrated by SFF members
- Wise use of credit funds
- Proper site selection
- Application of appropriate (farmer-friendly) training methodologies

At present, the SFF, together with government institutions, actively seeks community participation and extends assistance in solving individual and communal issues in the field of fisheries through the development and conservation of aquatic resources in island waters, coastal wetlands, offshore areas and the lagoons.

SFF's success stems from the strong institutional links it has formed with government and semi government institutions. The first step in this strong partnership was MFARD's waking up to the reality of the severely limited and rapidly declining fisheries resources. It decided to collaborate with SFF. MFARD, finding that the SFF had a wide fishing community network on the island, formally invited the Federation to participate in the national endeavor to improve aquaculture fisheries. This was indeed a giant step. Before 1994, NGOs and communities working with government departments was unheard of in Sri Lanka .

Another milestone was a comprehensive legislation, the amended Fisheries and Aquatic Resources Act of 1996, which contained measures for "protection of fish and other aquatic resources" and raised concerns about the "sustainable use of aquatic biodiversity" in the fishery sector.



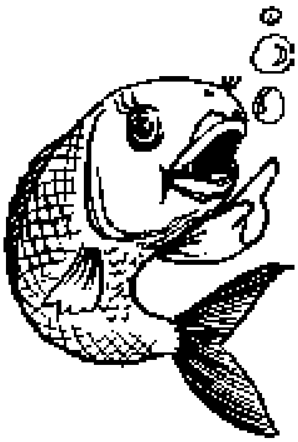
However, the rural poor were not actively involved until 1999 when NAQDA was established. NAQDA invited NGOs and the private sector to participate in its aquaculture projects. Although NAQDA works with many NGOs, such as Seva Lanka (Service to Lanka), Sri Lanka-Canada Development Fund and SFF, it is their partnership with the latter that proved to be the most successful.

Of the many functions of NAQDA, the following are important for rural poor communities with access to communal waterways:

1. Promotion of the optimum utilization of aquatic resources through environmentally-friendly aquaculture programs.
2. Conservation of biodiversity.
3. Promotion and development of small, medium and large-scale private sector investment in aquaculture.

By actively seeking and inviting NGOs and rural communities to take part in small-scale aquaculture projects, an immediate sense of ownership was fostered. Projects started with a transfer of skills and technologies. Training kits were provided to participants. Technical support was extended to this government/NGO partnership with the implementation of the FAO/TCP/SRL/6712(A) – Aquaculture Development Project. The Inland Aquaculture Consultant of this project assisted the rural development program by training trainers, providing on-the-spot technical advice, helping in the design of mini-hatchery projects, and promoting innovative strategies.

One of these strategies was the promotion of low-cost carp production in undrainable ponds enabling the rural poor to gain additional income by selling carp fingerlings. (*For additional information on this project refer to the paper on Low-Cost Aquaculture in Undrainable Homestead Ponds*). Small-scale aquaculture in mangroves is now being promoted by providing support to poor coastal communities to start small-scale coastal aquaculture technologies.



The Small Fisheries Federation (SFF) recognized that mangrove reserves were strategically important for many species including various types of fish, aquatic birds, shrimp, crab, mollusks and worms. The destruction of mangroves had adversely affected the local resident fishermen in these areas, with their daily hauls of fish in the Pambala lagoon in the north east coast drastically dropping on an average from 4 kg to 1½ per day in the past three years. Also, the proliferation of unauthorized shrimp farms in the area posed a major threat to indigenous fishery in the Puttalam district (It was said that one third of all shrimp ponds were located on former mangrove land resulting in the loss of about 600 hectares of mangrove forest).

Responding to a request to form a working-alliance by actively networking, building links and seeking support, the Small Fishers Federation, Mangrove Conservation Center, Pambala, Chilaw formally affiliated with the Mangrove Action Project (MAP) based in Seattle, Washington. The center was designated as the MAP-South Asian Resource Center Facility in Sri Lanka.

With assistance from the FAO and extensive pilot tests, NAQDA was able to effect the technology transfer of three successful small-scale aquaculture projects in mangrove ecosystems:

- mud crab fattening in wooden cages with PVC netting and culture in ponds;
- sea bass/grouper culture in cages; and
- mollusk culture

The future is looking very bright indeed for this unique collaboration. Right now there are only three NAQDA-owned fish breeding centers and demand is much higher than supply. The project cannot supply the requirements of the entire island. Aquaculture projects of the rural poor have a huge untapped potential market.

The Mangrove Conservation Center

- SFF Staff and members of a nearby local fishing community collaborate in running this Center. Community members actively participate in mangrove reforestation projects and small-scale silvi-culture including crab and oyster culture.
- A graphic description of the Mangrove Conservation Center's activities in the past two years (1998-1999) is displayed on a large board. It proudly announces the planting of 144,000 mangrove saplings at the Pambala lagoon area.
- The Center has become an active educational/training facility and a meeting place where fisher groups and academics often gather.
- A total of 186 seminars and conferences have been conducted with the participation of 9,000 school children, 860 government officials, 900 fisherfolk leaders and 500 mangrove lovers.
- Cooperatives formed by widows manage small revolving bank loans. Local school children learn coastal ecology and acquire natural resource management skills.
- The center has mounted15 exhibitions depicting mangroves, with a total of 27,000 students attending, together with some government officials and mangrove specialists. Some 2,500 fisherfolks participated at the exhibitions.
- Seven research projects have been carried out to date.

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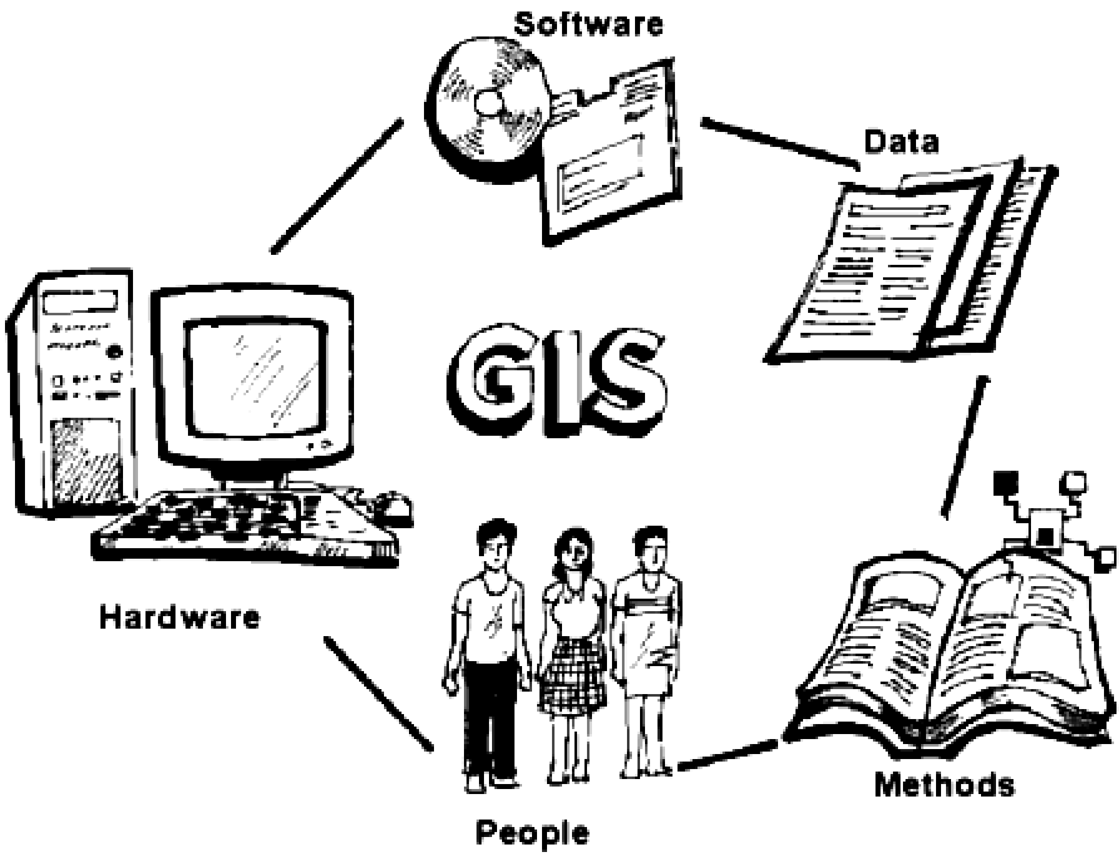
Use of Geographic Information Systems (GIS) for Planning and Management of Aquaculture



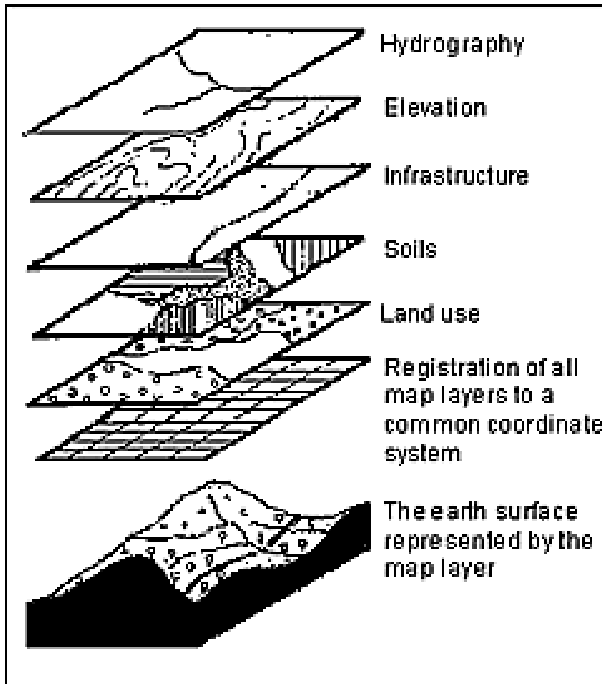
Maps have been in existence for thousands of years. However, in their traditional form, they suffer from a number of problems. First, maps are static and therefore difficult and expensive to update. To cite an example, maps exist as single sheets. In most cases, an area of interest lies on the corner of four adjacent sheets. In addition, maps are often very complex and an expert may be required to extract a particular data.

> Geographic Information Systems (GIS) can be regarded as the high-tech equivalent of a map. GIS provide the facility to extract different sets of information from a map (vegetation, soils, lakes, roads, settlements, etc.) and to use these as required. This provides great flexibility, allowing a paper map to be quickly produced.

Geographic Information Systems (GIS) portray the real world. A view of the world as represented on a paper map reveals that the surface consists of points, lines or polygons. Thus, cities are usually represented by points, roads by lines and lakes or fields by polygons.

The difference between a paper map and a GIS map is that in the latter information comes from a database (i.e., set of data stored in a given file) and it is shown only if the user wants to see it. The database stores information like where a point is located, how long a road is, and even how many square kilometers a lake occupies.

Each piece of information on a GIS map sits on a layer, and the users turn the layers on or off according to their needs. One layer could be made up of all the roads in an area. Another could represent all the lakes in the same area, yet another could represent all the cities. More importantly, a GIS combines layers of information about a place for a better understanding of that area. Determining how the layers of information combine depends on the user's needs. For example, to find areas with potential for fish farming, it would be necessary to combine data like water, soil, land use, markets, cities, roads and population density.



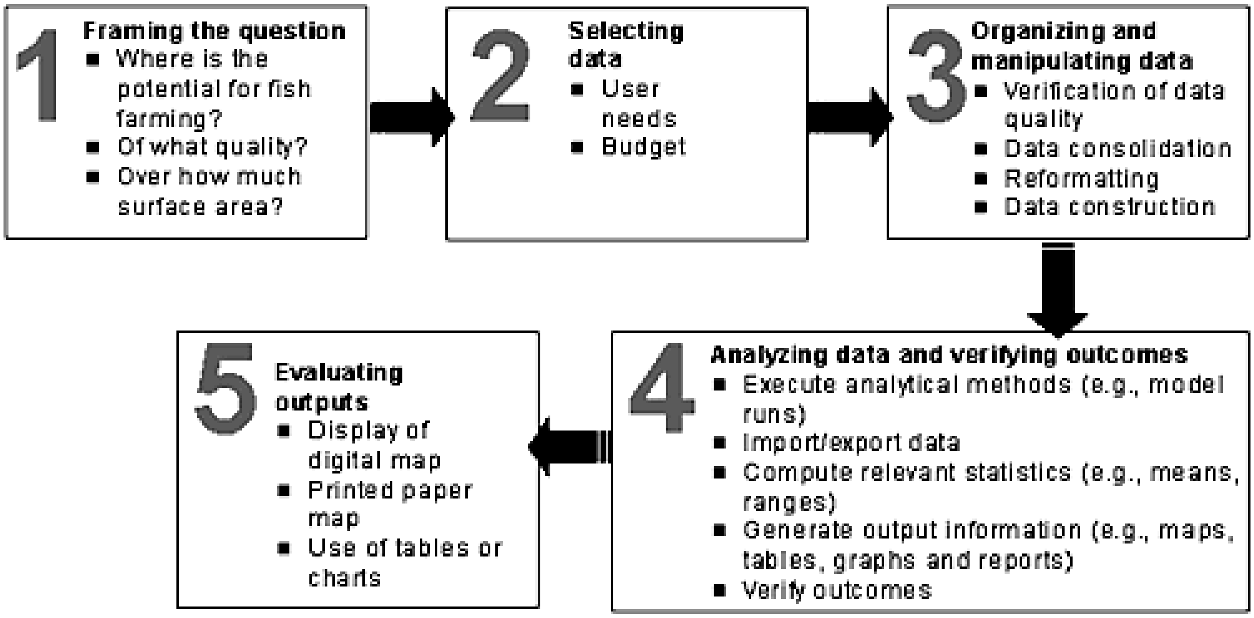
The capability of combining different map layers in an operation known as "overlaying" is one of the most important GIS functions.

In both vector and raster systems, a geographic coordinate system is used to represent space. Many coordinate systems have been defined, ranging from simple Cartesian X-Y grids to spatial representations that correspond to the real world as latitude/longitude pairings.

GIS has the potential for an enormous range of applications (e.g., business, defense, education, engineering, government, health, food security, transportation, natural resources, fisheries and aquaculture).

Analysis methods

Basically, any GIS study consists of five phases.



Software

GIS software provides the functions and tools needed to store, analyze, and display geographic information. It ranges from low-end software for simple map display to high-end software capable of handling sophisticated models, Internet mapping and 3D visualization.

Factors in selecting GIS software

- Intended use of the chosen application
- Software and maintenance cost
- Software "learning curve"
- Current technical expertise of agency personnel

Software availability in Asia

GIS have developed rapidly in recent years. This development has been paralleled by a massive increase in low-cost computing power. As a result, very comprehensive tools for handling GIS data are now available to a wide range of users.

A large number of GIS software are available ranging from free easy-to-use software to highly sophisticated and expensive packages. Countrywise, GIS activities and major GIS software vendors in the Asia-Pacific region can be located at: http://www.gisdevelopment.net/regional/. Available on the Internet at present are some free and easy-to-use GIS software such as Arc/Explorer (http://www.esri.com/software/arcexplorer/), and Windisp4 (http://www.fao.org/giews/english/windisp/windisp.htm).

An important consideration is that if an expensive GIS software is chosen, its cost declines substantially as the tools and techniques are used for additional projects and data are shared among different departments (e.g., fisheries, agriculture, forestry, etc.).

Hardware

Hardware selection must relate to personal preferences, software, functional requirements, capital available, number of users, and the degree of interaction with other computer systems.

The hardware components of a GIS include units that are common to any general purpose.

- Computer such as several disk drives for storing data and programs
- Tape drives for back up copies of data
- Color graphic display units
- Other general purpose computer peripherals

In addition, GIS have several specialized hardware components. These include: digitizer or scanner used to convert the geographical information from maps into digital form to be sent to the computer; a plotter, which prints out the maps and other graphic outputs of the system; and a visual color graphics workstation on which spatial data editing and display can be performed.

Sources of data

- **Primary data** gathered in the field, such as direct mapping and field sketching, photography, interviews, questionnaires and measurements.
- **Secondary data** are primary data that have been converted into a more accessible form (e.g., database within an organization, the Internet, mapping data providers, government organizations).
- **Proxy data** refer to information derived from another data source, with which relationships have been established. Examples include estimation of water temperature from air temperature or extraction of semi-quantitative texture from FAO soil distribution maps.
- **Satellite data** are in digital form and provide a rich source of information in a form suitable for use in GIS.

Cost effectiveness

The access to free or low cost GIS data is rapidly expanding, mainly via the Internet. Hardware and software are also developing rapidly and are becoming more powerful and affordable.

Evaluating outputs

The final step is to look at the results of the analysis and take action based on those results.

Results can be displayed as a digital map, printed as a paper map, combined with tables or charts or displayed as such.

Trained users

Whether the use of GIS is for casual or professional purposes, some form of education or technical training is highly recommended. Good training will equip people to better understand the process of GIS to apply it properly.

Four main methods of learning GIS

- Formal GIS degree or certificate programs
- Instructor-led training
- Internet learning
- Self-study

Main benefits derived from the use of GIS

- **Improved planning and management**

A GIS can link sets together by common data, such as locations, helping departments and agencies share information. By creating a shared database, one department can benefit from the work of another. That is, data can be collected once and used many times.

- **Make better decisions**

A GIS is not just an automated decision-making system but a tool to query, analyze, and map data in support of the decision-making process.

- **Making maps**

Making maps with GIS is much more flexible than traditional manual or automated cartography approaches. A GIS creates maps from data pulled from database and existing paper maps can be translated into the GIS as well.

> GIS can be used to help reach a decision about the location of a new fish farm in a suitable environment (e.g., good climate and soils). The information can be presented clearly in the form of a map and accompanying report, allowing decision-makers to focus on the real issues rather than trying to understand the data. Moreover, because GIS products can be produced quickly, multiple scenarios can be evaluated efficiently and effectively. Managers can test the consequences of various actions before mistakes are made in the landscape itself.

Who uses GIS?

GIS can be used by Fisheries Departments, applied research institutes, banks and private individuals to better plan their own aquaculture development or investment activities. On the commercial side, GIS can be used to reduce risks and for site selection. On the government side, GIS will be used increasingly for administration and regulation to promote the development of aquaculture.

GIS use in aquaculture

Aquaculture is a notably diverse activity, which requires secure access and rights to large areas of terrestrial and aquatic "space". Planning activities to promote and monitor the growth of aquaculture in individual countries (or larger regions) inherently take into account the differences among biophysical and socio-economic characteristics from location to location.

Biophysical characteristics

- Water quality (temperature, dissolved oxygen, alkalinity, salinity, turbidity and pollution)
- Water quantity (volume and seasonal profiles of availability)
- Soil type (slope, structural suitability, water retention, capacity and chemical nature)
- Climate (rainfall distribution, air temperature, wind speed and relative humidity)

Socio-economic characteristics

- Administrative regulations
- Competing resource users
- Market conditions (demand for fishing products, accessibility to markets)
- Infrastructure support

- Availability of technical expertise

GIS have been applied in aquaculture for the last 13 years. The scale of investigation varied greatly and GIS have been used at different planning levels with appropriately different spatial resolutions, depending on the intended purposes. GIS use in aquaculture has also varied significantly with regard to the complexity of the analytical methods used (i.e. ranging from simple map displays, simple and weighted combinations, to use of relatively sophisticated models).

Continental studies of aquaculture potential have been made for Africa and Latin America. Likewise, several national or state-level studies have been conducted successfully. These studies are particularly useful for decisions related to:

- environmental protection and sustainable resource use;
- national planning activities;
- assessing food security issues; and
- investigating trade-offs pertaining to land allocation among different economic activities.

GIS have also been used for site-level investigations after a preliminary choice of a site has been made. In conjunction with remote sensing and direct data collection, GIS can form the basis for continued monitoring of a site.

Case study

Following is a case study to illustrate basic GIS methodology applied for aquaculture in Asia.

Microcomputer spreadsheets for the implementation of geographic information systems in aquaculture: A case study of carp in Pakistan

This study was chosen because it shows a method of attaining limited GIS functionality through the use of a more readily obtainable, and usually more familiar, spreadsheet package. Spreadsheets are simply a two-dimensional array of cells, they can serve as an x and y coordinate system of geographical references, so they can be very suitable for simple GIS work, provided that the source data can be arranged in raster format.

A 1:2 000 000 scale topographic map of Pakistan was used to trace an overlay which divided the country into 172 cells each representing a 75 km x 75 km area. The following factors were chosen as selection criteria relevant to the development and location of carp culture:

- Air temperature
- Surface water availability
- Soil type
- Precipitation
- Availability of underground water
- Slope
- Availability of fish seed
- Distance from wholesale markets
- Access to road transportation

Data sources

Most data for each of these factors were obtained from a series of maps published by the Pakistan government, though in some cases additional data were obtained from specific government ministries.

Data for each factor, in each cell, were scored on a scale of 1 to 5, with 5 representing the highest suitability of the parameter and 1 the lowest. The scored data were then entered into a spreadsheet package in a layout that spatially represented the country. After scoring the cells, a value was given to each factor according to how important it was seen to be compared to other factors. Values varied between 0 and 1. Scores were then multiplied by their relevant values and aggregated. The overall score represented the rating of the suitability of each cell for carp culture.

Figure 1 shows the calculated sheet and Figure 2 is the graphic representation of Figure 1 using shaded blocks. It appears that the most suitable areas for carp culture are in central-eastern Pakistan where many tributaries of the River Indus converge across a wide flood plain.

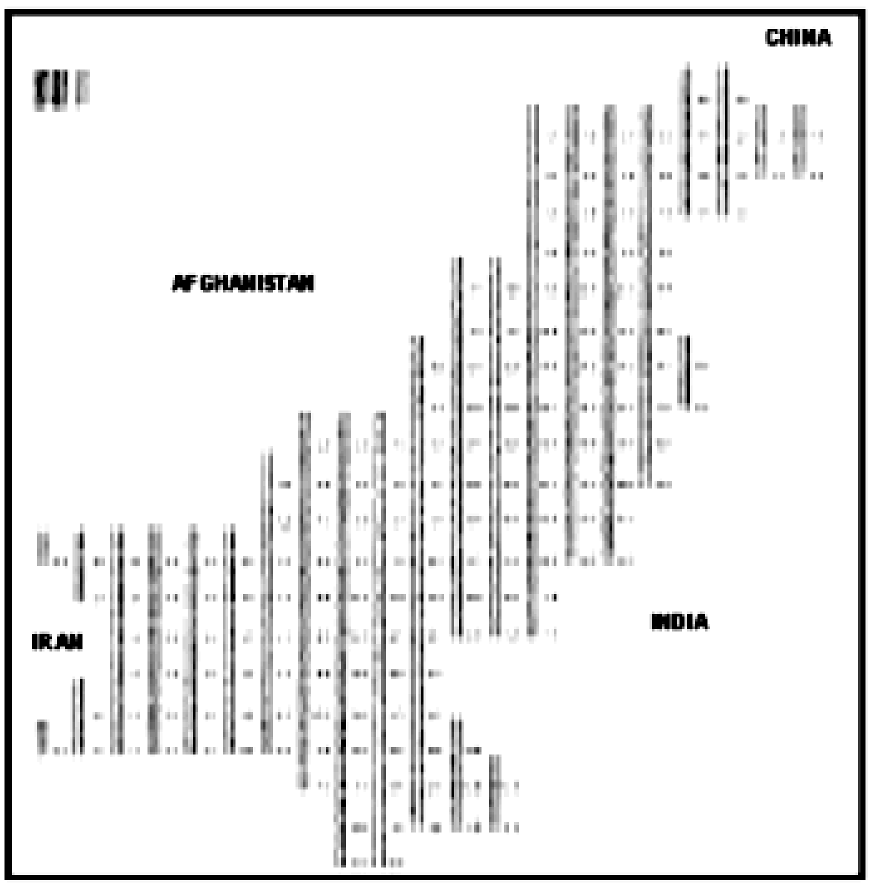


Figure 1. Scored cells showing suitability for carp culture in Pakistan

Figure 1. Scored cells showing suitability for carp culture in Pakistan

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