

Small-scale aquaculture in rural development

(Features- Models- Promotion- Examples)

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Introduction/1

Commercial aquaculture is and -will remain- the principal producing system (in tonnage)

In situations where commercial aquaculture does not exist, the small-scale aquaculture can be of great benefit to many families

Some social elements are usually overlooked in commercial aquaculture (e.g. mal-nutrition, un-employment, gender issues)

Over-looked issues could be addressed in small-scale aquaculture

Fish of good quality and affordable prices will always be needed in rural areas where income is usually low and fish is at high demand

Introduction/2

There are successful models of small-scale aquaculture (e.g. backyard hatchery for freshwater prawn in Thailand- during 1980s)



Promoting family aquaculture is justifiable for incorporating fish as good source of animal protein in family meal

Aquaculture has been incorporated in rural development programs either as a sole activity or in integration with other agricultural activities

Features of rural communities (related to aquaculture)

While the returns from fish farming are seasonal, low-income people generally require more of immediate income

Low income people may not be able to afford cash expenses even in small amounts.

When this is coupled with difficulties in accessing credits, this can be a solid barrier to sustaining small aquaculture projects

Sharing physical labor among farmers is a means to overcome a part of cash problem



Small-scale projects do often exist where roads are not suitable for heavy machinery or for transporting production inputs or fish produced



Credit of the above photo: Emmanuel Hahirwabasenga and Rwigiriza Augustin Kanimba (Rwanda)

Features of rural communities (related to aquaculture)

Although the definitions of rural aquaculture projects vary, they have something in common:

- Simple with social dimensions
- Caring more about low income communities
- Family may carry out most of farming practices
- Some family members (especially women) can work in family projects **but will not accept** to work for others
- Family demand of produced fish is always met while **extra fish** is sold. If this is not the case, social problems must be serious
- Ornamental fish projects are an example of cash projects of small-scale aquaculture



Family managed



Credit of above photo:
Kevin Fitzsimmons (USA)

Watch for the ongoing changes in the nature of rural communities

Labor involvement

Small projects are constructed with less or no machinery and more labor.

Women's role can exceed feed preparation or hapa making to pond management



in Mozambique



in
Bangladesh



Photos' Credit: Gabriel de Labra (Spain)

Vulnerability of small-scale beneficiaries

Small holders in rural areas are often vulnerable in many aspects:

- Limited access to natural resources and often **lose competition**
- Limited capacity to cope with **crisis situations and risks**
- Mostly prefer livelihood opportunities with **less perceived risks**
- Limited ability to meet specific requirements for technology adoption
- **Hesitant to try** but may apply what was found successful in their neighborhood
- Limited access to aid programs which could have been **designed for them** (e.g. credit)

Species criteria for small-scale aquaculture

- Farmers can deal with in ease
- Does not require neither exceptional skills or sophisticated husbandry arrangements
- For quick turn over, it is preferred to use fish species that have short generations
- Above all, the species should be widely accepted by target consumers



Credit: Eudes E. Sanchez (Colombia)



People like it



Species criteria – Preferably native species

Advantages

- Do not pose environmental threats to biodiversity, disease, etc.
- Known as a species and ways of preparation to local people
- Broodstock/fingerlings –when needed- can be obtained from natural waters
- **Theoretically**, its reproduction and husbandry is known at local level

Disadvantages

Often native species did not receive enough attention from NARS. This led to:

- Reproduction technology and seed production is often not well developed
- Not performing any genetic programs and so selected strains do not exist
- Absence of reliable data on its performance in aquaculture

NARS: National Agricultural Research System



The wrong choice: Golden Apple Snail

- A Big campaign to Introduce it to feed poor rice farmers in Asia. (came from Argentine in 1980 to Taiwan then to Asian countries).
- Farmers (target beneficiaries) did not like it: **Top-bottom planning**
- Began to infest rice fields and prey on little rice plants (7-15 days old) causing significant losses

Golden apple snail (GAS) in rice paddies (a useful case study)

- Has invested about 800,000 ha of rice in the Philippines in 1995
- In Vietnam, GAS invested about 110,000 ha of rice paddies in 1997. In some parts of “Thua Thein Hue” province, rice farmers had to reseed rice several times

A bigger campaign to get rid of it

Models of small-scale aquaculture

- Rice – fish culture
- Manure systems (ducks – chicken - rabbits)
- Cages

Rice-fish culture (features)

- Not a new practice to most rice farmers
- Low-risk technology
- Minimum skill will be sufficient
- Very low investment required if any (ditch & screen)
- Minimum conflicts with other farm activities – if any



Credit: Deepak Bhusal
(Nepal)

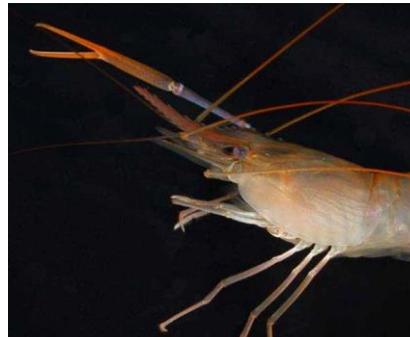
As rice is the main crop, fish has to cope with rice requirements and practices

Rice - fish aquaculture - Benefits

- About 5-15% increases of rice production
- Fish can control algae and soft plants and their seeds and hence reduce the need for algaecides
- Control mosquito larvae and snails
- Consume rice insects (e.g. brown plant hopper)
- Higher net revenue due to the saving on fertilizers and pesticides
- Harvested fish when **consumed**, supports fish consumption of families (even seasonal)
- A way to magnify the benefits

Africa's top rice producing countries have a total rice land area of more than 7 million ha. Nigeria has the largest rice area, followed by Madagascar and then Guinea.

Fish species in rice fields – Based on their: (food habits – acceptance for consumption – adaptability to the system)



Rice – fish culture (challenges and considerations)

Challenges	Considerations
Harmonizing fish growth (production) with the calendar of the short season of rice strains	Proper choice of fish & size upon stocking Consider feeding Could target fingerlings rather than table fish
Shallowness of water and fluctuation of temperature & dissolved oxygen	Construction of refugee ditch Proper selection of tolerant fish (e.g. air breathers, tilapia)
Possible applications with chemicals or pesticides	Rice varieties resistant to insects and disease Partly drain the field to guide fish to the ditch Change water after 3-4 days
Risk of grazing on rice seedlings or seeds	Safe size of chosen species after rice is well established

Fish-duck farming

Historic background

Has expanded rapidly in Central Europe after World War II to offset the shortage in animal protein

Afterwards, the practice has expanded to Asia and beyond

Suits rural development where ducks are traditionally consumed

With the exception of France, most of duck consumption takes place in Asia

Ducks are left on water surface for most of the day and sheltered during night

Applications

Stocking density of ducks could be:
Low: in **Germany**, 300 ducks/ha led to 100 kg/ha of common carp

High: in **Hong Kong**, ducks are stocked at 2500-3500/ha to yield 5 to 6 t/ha of meat and 2750-5640 kg/ha of fish

What is the leading crop?

30 ducks are
Required to fertilize
1000-m² pond
14-m² duck shelter



Fish-duck farming

Benefits

Fertilize water (non-labor manuring machines)

Suppress the undesirable aquatic vegetation

Water aeration through swimming (biological aerators)

Pond water provides about 25% of duck's diet (plants, insects, aquatic larvae, and earthworms)

Loosen pond bottom and release soil nutrients (phosphorous)

Challenges

Compatibility between warm-blooded birds and cold-blooded fish (system)

Less value where ducks are not traditionally eaten

Ducklings have to be grown somewhere till they can swim



Fish-chicken farming (Not water birds)

Chicken when raised in a shelter (0.5m above water level):

Maximize the use of space

Saves manuring labor **OR**

Adjacent to the ponds; poultry excreta are recycled to fertilize the fishponds

Could be either for broilers or laying hens

With few exceptions, the ratio between numbers of animals which suit specific aquaculture operations is based on personal experience (the same is true for ducks)



Fish-chicken farming

Considerations

One-day chicks are nursed for at least 14 days before being used in this system



Photo credit: Innocent Zambou (Cameroon)

Each broiler requires 1.5 ft² floor area; each layer requires 3 ft²

Enough cross ventilation should be maintained

Floors should have 1 cm gap, to allow excreta to fall into the pond, but not to trap the chicken's feet.

Photo credit: Alain Murekambanze (Burundi)



Challenges

If water turns deep green due to plankton blooms, dissolved oxygen may get drop and could cause fish kill

If this happens, plastic sheets are placed below the chicken shelter to prevent chicken excreta from reaching water

Fish feeding may be suspended for enough time

Refresh the pond with freshwater whenever possible

Unless chicken treatment or vaccination is carried out in special facilities away from water, there will be always a chance for contaminating pond water with residues of drugs and chemicals

Rabbit-fish farming

- Field observations in Rwanda showed that 10 rabbits are sufficient to provide enough organic fertilization to 1-acre fish pond
- The only source of fish nutrition in this system could be the natural food which is stimulated and maintained by the organic fertilization by the excreta of rabbits
- Although rabbits are not traditionally eaten in many countries, there are significant national efforts to promote the consumption of rabbit meat which is low-fat, low-cholesterol and rich in proteins
- This type of integration has potential application in world rural development programs especially whereas rabbits are consumed



Integrated rabbits with mix-sex Nile tilapia in Rwanda

Rabbit-fish farming

The advantages of the rabbit component in this integrated system include:

High quality meat, short generation, high productivity, fast growth rate, and low production costs

Rabbits being herbivores, they can utilize on variety of farm byproducts. Forage, cassava, and sweet potato vines are examples

Job creation especially after some training

Highest rabbit meat consumption occurs in the Mediterranean Countries whereas Italy has the world lead in rabbit consumption (about 6 kg/capita/year)

Although there is no religious taboos against eating rabbit meat, in some cultures, rabbits are looked at as cute and fuzzy animals which initiates an aversion in many people to rabbit consumption



Photos credit: Fidele Kampayana & Emmanuel Hahirwabasenga and Rwigiriza Augustin Kanimba (Rwanda)

Integration scenarios

Fish ↔ Others



Proper integration should yield benefits either to both systems or to one of the systems

Fish → Others



Others → Fish



Cage aquaculture

Benefits

Ideal for landless people who get an access to water resources

Could be used to produce table fish or fingerlings

Investment cost is usually low

Women can have an active role especially in feed preparation

Ease of handling and harvesting

Challenges

Compatibility with environmental standards

Vulnerability to poaching if not properly secured



Marketing the extra produced fish

- Often marketed fish is in small quantities
- Small quantities lack bargaining capacity
- Often sold within the community or through middlemen
- Consumer believes in its freshness (they may witness the harvest)
- It is expected to be at affordable prices
- If difficulties in fish marketing is detected, a community fish market would help
- Direct marketing eliminates the traditional layers in marketing

Seaweed farming and marketing in Tanzania:

Seaweed farming was introduced in Tanzania in the early 1980s.

Farmers are depending on their buyer company for the supply of seed, stakes, and ropes, so they have no negotiating power on price

So-far, sea weed is processed by women for soap making



Photo credit: David Sykora
(Paraguay)



Photo credit: Evelyn Ame
(Philippines)

Planning & promoting small-scale aquaculture projects

Promoting small-scale aquaculture

Ensuring initial success

Choose the appropriate technology

Select target beneficiaries based on transparent criteria

Choose the right species of fish

Consider all production related issues (e.g. marketing)

Ensure that activities meet existing regulations (e.g. environment, food safety)

Develop a special credit line for the project

Plan for project sustainability (afterwards)

All efforts should be spent towards the success of these projects

These projects should not be subject to trials & errors

Promoting small-scale aquaculture (approaches)

Top-bottom approach

- Planning is done by the central government "which knows better than beneficiaries"- theoretically
- This approach lacks the two-way information flow whereas only one side generates the information

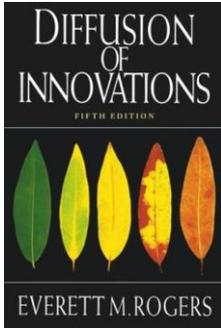
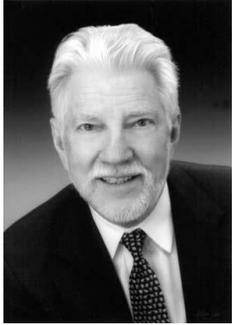
GAS is an example

The recent shift is towards greater farmer participation

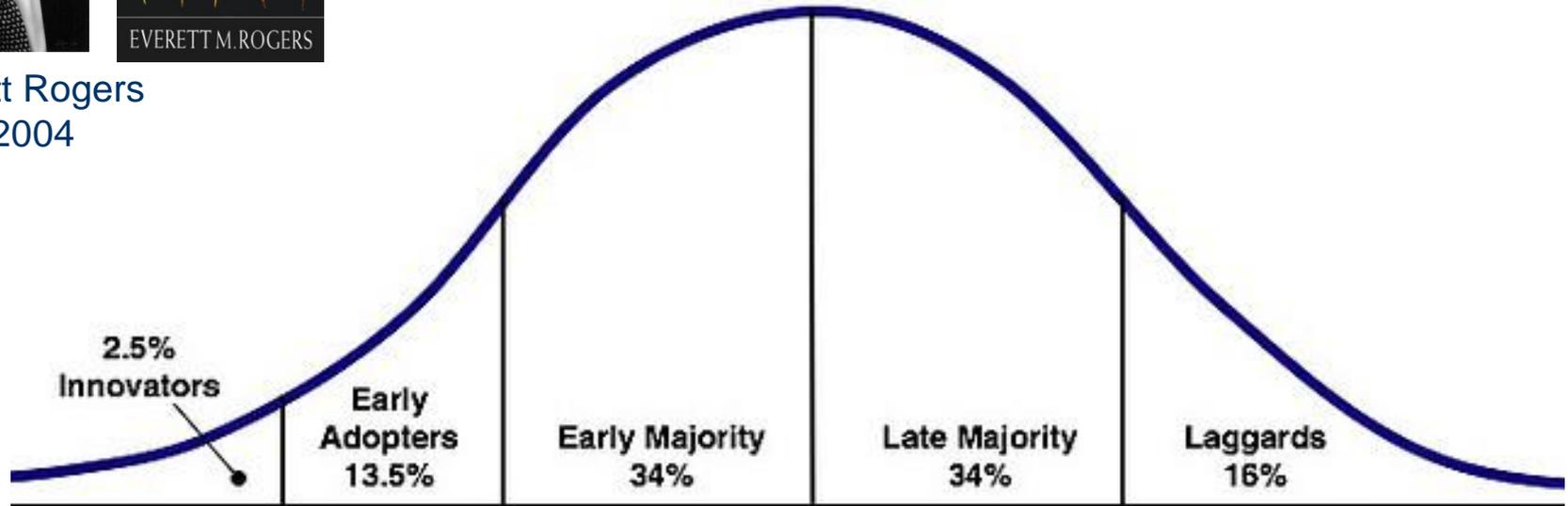
Participatory approach

- Participation of farmers, researchers and extension agents – all are winners
- Farmers adopt the outcomes of their own programs
- Success indicators include the number of active farmers, and the continuity of the program
- Extension agents act as catalysts and stimulate group efforts

Adoption curve and potential beneficiaries



Everett Rogers
1931-2004



Source: Everett Rogers (Diffusion of Innovations model)

Adoption Curve

Planning and threat & risk assessment (case studies)

Fish cages in Kaptai Lake (Bangladesh)

Project: Promotion of fish cage farming of carps at Kaptai Lake

Disaster: cyclones damaged fish cages, surviving cages experienced poor fish growth, and operators did not repair or replace damaged cages

Careful planning should include risk assessment

The analysis of stakeholders' willingness and capacity to face such risks will be also needed

Fish pens and cages in Laguna de Bay (Philippines)

Project: Promotion of fish pens and cages in Laguna de Bay

Project aim: improve the socioeconomic conditions of small-scale fish farmers

Disaster: In 1986 and 1987 the site was hit by two typhoons that damaged 95% of the fish pens and cages in the bay. The disaster left behind **heavy losses and debt burdens** on project beneficiaries.



Source: Asian Development Bank, 2004, Special evaluation study on small-scale freshwater rural aquaculture development for poverty reduction.

Simplicity concept and sustainability

By definition; these are simple projects

However; simplicity does not apply to the planning

Insisting on the use of poor quality farm inputs may lead to **unsustainable** projects

Simplicity concept is still based on scientific information and established technologies



2 million
tilapia fry

Simplifying advanced technology (Example: Aquaponic)

A simple version of hi-
technology operations

It is very easy to operate,
inexpensive, optimum for
people with limited economic
resources



Credit: Edwin Gómez Ramírez
(Colombia)

Criteria and definitions: (family or small-scale aquaculture) – (Philippines)

Fish hatchery

- Production is less than 30,000 fingerlings/month
- Surface area is less than 1000 m²
- No ability to nursing fry
- Incomplete security regarding the area under utilization (via lease, partnerships and others)
- Vulnerable to the risk of flood/ or draught

Meeting three of the above means, the hatchery is a small one

Criteria and definitions: (family or small-scale aquaculture) – (Philippines)

Pond/ pen/cage farms

- **Size**
 - **Earthen farm:** size of each pond is less than 1000 m² in less than 1-ha farm
 - **Pens:** less than 1000 m²
 - **Cages:** less than 200 m²
- Financial resources are not sufficient. And no access to formal credit
- Quantity sold in cash does not exceed 30% of produced fish
- Utilization instability (lease/utilization) of land lack stability
- Water resources are either insufficient or seasonal

Meeting three of the above, the project is a small one

Criteria and definitions: (family or small-scale aquaculture) – (Malawi)

Integrating of aquaculture in agriculture systems (IAA).
Most of criteria classifying small-scale farms included:

- Small land holding
- Low land productivity
- External inputs (such as new varieties, fertilizers and pesticides) are limited
- Credit is generally unavailable
- Fish production from family farms is a must

Note

- The criteria for small-scale beneficiaries which are considered in a country may not have the same weight or seen irrelevant in another country (e.g. flood, draught, etc.)
- This requires site/country-specific criteria
- Based on their activities, financial institutions may have a different definitions to small or very small aquaculture projects

Setting success indicators and identify requirements

Success indicators

- The sustainability of the projects beyond the end of the development programs is the most important indicator
- More reproductions of original projects
- Incidences of reaching beyond small-scale criteria (upgrading)

Careful planning & securing project requirements eliminate unpleasant outcomes

Requirements

Careful planning for the project, having in considerations:

- Small-scale beneficiaries do not have access to consultancy services (they may run simple assessment)
- Extension service is highly required
- If beneficiaries lose trust, **there may not be a second chance**

Women (producers) and extension agent



Extension service and small-scale projects

General

Extension agents –who will be the trainers- should be well trained themselves on the subject matter

Careful selection of trainers and beneficiaries is a must

Chosen trainers should have the ability to communicate with beneficiaries

Trainers should admit **not knowing** sometimes instead of giving wrong advices

Challenges

Farmers do not trust agents who offer poor advice

Extension agents get readily discouraged if they are not accepted

Lead farmers could be selected to receive special training to enable transferring farming technology to fellow farmers (e.g. Bangladesh, China, Congo and Liberia)

Cultural issues should be identified and respected

Photo credit: Manuel Cano
(Guatemala)



Photo credit: Kanwal Odhejo
(Pakistan)



Challenges and issues of concern

Feed and small-scale aquaculture

Types of fish feed

Ranges from natural food (high in protein), to:

- Supplemental feed (low cost & high in energy), to:
- Specialized feed if technically and economically justified

Cost of feed will remain an important issue to consider in promoting rural aquaculture



Feed and small-scale aquaculture

Some of farm byproducts could be used while others **should not** be used

Most farmed fish have difficulty in digesting plant materials

The use of external feed should be an option especially when economically feasible

Many farmers do not use artificial feed as their first reaction based on its high cost **without economic evaluation**

If artificial feed is used, feed storage will be needed or batch supply of feed should be followed

Compost or silage improves plant material's quality, digestibility and subsequent use safety



Water hyacinth



Water hyacinth is an example of plants that have nutritional imbalance or carries possible toxicity. It may be good for other usages but **NOT** as feed.

Fish seed and small-scale aquaculture

Good quality fry = good harvest

No attempt should be taken to give up the quality of fry for the sake of reducing production costs

Fry costs are usually marginal when compared to other production inputs



Small-scale aquaculture can use the best quality seed available

Credit and small-scale aquaculture

In many cases, small-scale aquaculture projects could be implemented without external loans, because of:

- its small size
- lack of collaterals (rural families are not familiar with banking systems and often they do not enjoy credit history)

Some producers do not prefer bank credits as well as interests for personal believes

Social dimension should be always the responsibility of governments and not commercial banks

Credit accessibility (target and actual beneficiaries)

Small-scale farmers do not/ cannot borrow from banks because of collateral requirements and various loan requirements; some of which are very difficult or **unrealistic** (e.g. salary depositing; money against money)

Bank requirements are frequently not in favor of the landless and small-scale farmers

Instead of banks, farmers may rely on informal credit from other sources, including suppliers' credit.

Supplier's credit made fish farmers to accept a modest quality fish feed while they are aware about that

During 1980s, the small-scale farmers in Nepal were unable to lease water bodies for fish farming. They were unable to acquire credit without timely access to water bodies or fulfill collateral requirements

Larger and wealthier farmers were, however, **ready and qualified** to receive project services which is the case in many parts of the world

Credit for small-scale projects (Egypt)

A credit line has launched in mid 1990s to provide soft loans to agricultural sectors including aquaculture

Small/medium projects have been the immediate target to such credit line

Target groups: not familiar with banking system, lack collaterals and no credit history

Credit officers in collaborating banks were not familiar with aquaculture activities which were in their views a risky business

Commercial companies were well-prepared for benefitting from the credit line



Educating bankers



Size of the small-scale aquaculture projects in governmental & aid programs

Increasing the number of beneficiaries could be done for political reasons. Although this may look a noble intention, it could threaten the sustainability of small-scale projects



Beneficiaries may lose interest in case of under-sized projects (e.g. 1-cage project)



Social studies are necessary for these small projects
Often, beneficiary are not aware or cannot afford feasibility studies

It is more valuable to have fewer but successful projects than more of abandoned ones

Small-scale aquaculture & family livelihood

Cages in Mymensingh River in Bangladesh



Aims to provide a protein rich food for families and to generate some income

Photo credit: Abu Sayed Talukder & Zahangir Alam (Bangladesh)

Small fish ponds in Thailand



The production goes first to family consumption while exceeded quantities –if occurred- could be exchanged with neighbors or sold

Photo credit: Worawut Koedprang (Thailand)

Small earthen ponds in Malawi



The outputs form an important part of household livelihoods

Photo credit: Gaves Mulaleya (Malawi)

Small-scale aquaculture & production inputs

Integration with large animals in Rwanda



Ponds are owned by cooperative farmers in Nyagasambu site. The number of animals is sufficient to produce enough manure as required by the fish farm

Photo credit: Emmanuel Hahirwabasenga and Rwigiriza Augustin Kanimba (Rwanda)

Cages in Mymensingh River in Bangladesh



Fresh natural foods (e.g. duckweed, snails), household vegetable wastes, low cost feeds (e.g. rice bran and oilcake). In some cases, commercial feed could supplement the traditional feed

Photo credit: Abu Sayed Talukder & Zahangir Alam (Bangladesh)

A program for small fish holders in Narino, Colombia



Fish feeds primarily on azolla while banana, yucca, bore are alternatives food sources

Photo credit: Andres Delgado (Colombia)

Subsidies and support - Conflicting opinions

Free production inputs

Fish seed are the common free or subsidized inputs (e.g. sea bass in Thailand, common carp in Sri Lanka & Egypt and tilapia in Mexico)

Case studies showed that many aquaculture projects stopped immediately when subsidies discontinued (Thailand and Egypt)

In the launching phase, subsidy may be required. This should be done for a fixed period. Beneficiaries should know that ahead

Technical/ economic tools

Training is important for project success

Courses should be carried out in centers; **only** parts of the courses could be done on project site

Technical and extension services are required for project sustainability

Governments can provide various packages to support these projects (e.g. lease-taxation)

Source: Asian Development Bank, 2004, Special evaluation study on small-scale freshwater rural aquaculture development for poverty reduction.

Subsides & supply of production inputs

- Governments may feel responsible for providing some essential inputs especially when producers have extremely limited resources
- Production inputs could be “all”: (e.g. Rwanda, Thailand and Colombia)
- Production inputs could be “only seed”: (e.g. Cameroon, Zimbabwe, and Guatemala) – In India, Indian carp seed has been distributed at 50% of its cost.

Why fish seed?

- Fingerling production may be out of the ability of target beneficiaries or may represent a substantial cost especially for subsistence farmers
- Providing fish seed would eliminate doubts related to seed quality in regard to project performance

Sometimes subsidized fry targets to justify the establishment of governmental hatcheries

Subsidies and credit facilities (Case studies)

China

- The government does not subsidize farm inputs except in very few cases
- The government offers a 200 yuan/mu subsidy to encourage shrimp farmers (1 yuan=0.16 US\$; 1 mu=666 m²)
- Fish farmers obtain credit through the Agriculture Bank of China (ABC) and Agriculture Credit Cooperation (ACC)
- Credit policy targeted to support national agriculture development strategy and has been used to support specific crop production. (Economic tool)

Panama

- Cost sharing approach has been adopted - a part of the cost should be tolerated by beneficiaries
- Success is measured by farmers' acceptance to provide their share of the cost (not necessarily equal shares)
- Ministry of Agricultural generally provides bulldozers for earthmoving
- Project participants provide labor, housing, and food for the bulldozer operators, diesel fuel for the bulldozer, and all other materials needed to construct the ponds

Subsidies and credit facilities (Case studies)

India

- In the Scheme "**Development of Aquaculture 1000 pond**", beneficiaries received 75% subsidy and 25% Bankable loan.
- The subsidy is in form of inputs like fish seeds, feeds, equipment, medicines etc.
- **Technical training is provided** by Fishery Department officers and also by the resource persons from research institutions
- The species cultured are limited to Indian major carps i.e. catla, roho, and mirgala and exotic carps i.e. grass carp, silver carp and common carp.



Free supply of production inputs

Negative opinions

- According to FAO study, the number of free fingerlings delivered was frequently **lower than reported numbers**
- Dependence of producers on free supply of seed has been reported to be a major cause of the failure of aquaculture projects
- Free seed from governmental hatcheries may hinder the development of private seed industry especially for the provided species
- Unfortunately, it seemed easier for the extension agent to supply free seed rather than train farmers to produce their seeds
- The transfer of seed production technology should be attempted before the free supply of seed whenever applicable (Panama)

- Real farm economics may be difficult to assess in the light of subsidies
- Beneficiaries will get used to it. Efforts will be spent for its continuation rather than trying to produce their own seeds
- If a government terminates or suspends the free gifts for whatever reason
- Farmers feel that, if they wait long enough, the government will resume the subsidy
- If the termination of subsidies continues, the sustainability of projects could be threaten
- Farmers who are not getting such incentives may develop jealousy feelings
- Could lead to unnecessary **corruption**

Role of associations, cooperatives & other umbrellas

Case study in Kerala India: A model of homestead ornamental fish farms that are run by rural unemployed people in their homes

Farms are linked to satellite farms that provide fish seedlings as well as the infrastructures

The production from the homestead farms will be taken by the satellite farms

This activity comes under the umbrella of a Kerala government initiative; Kerala Aqua ventures International Limited (Kavil)

The initiative targets to produce and export ornamental fish of particular species to meet the growing demands

Small producers should get fair returns for their efforts

Associations and cooperatives could endorse small-scale producers when buying production inputs

Cooperatives could act on behalf of small producers who lack collaterals for accessing credits



Photo credit: G. Venkata Raju (India)



External - funded priorities (national & international perspectives)

Advantages

External funds intend to bring international experiences into national programs

National systems are responsible to highlight the country needs

Working on and resolving areas of conflicts –if occur- was successful in most cases (but not all)

It turns sad when national systems modify priorities or insert some parts in order to fit the donor interests

Concerns

External fund is not always a blessing especially in work atmosphere

When the external fund ends, it becomes difficult to operate and maintain facility that begins to deteriorate

National extension priorities that are often placed on food security and quality of life may not agree with the interest of international donors

Poaching

- Although it is a sad incidence, it happens
- Incidences increase as fish ponds or cages are far from farmers' households
- Security arrangements may be needed (e.g. clustering operations, anti-theft or planting sticks)
- Guarding arrangements among producers is found effective



Guarding and
anti-theft
arrangements



Credit of above photos:
Kevin Fitzsimmons (USA)

Examples of small-scale aquaculture projects

Rice-fish culture in Madagascar



Photo credit: BE Jean Jacques (Madagascar)

The integration between rice and fish is an old practice in Madagascar that goes back to around 1900.

The practice began with several fish species which are namely common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), and black diamond cichlid (*Paratilapia pollen*).

Recently, tilapia is being integrated in the system.

The adaptability of fish species to the rice system as well as the demand on these fish has been the main criteria in selecting these species.

The involvement of private sector has been found essential in regard to overcoming the system obstacles such as the limitation of fish fry.

There are about a million hectares of rice fields in Madagascar.

Rural aquaculture in Malawi

Communal/rural fish ponds



Photo credit: Carolyn M. Chinguo (Malawi)

Stocking of fish fingerlings in a communal fish pond located in Nangwangwa village, Nkhonkhot District in central region of Malawi
In such communal system, members are helping each other in fish farming operations.

The stocked fish species are *Oreochromis shiranus* (Nkhututu) and *Tilapia rendalli* (Nungutchale).

The area in the pond shown is about 400 m²

Women are involved in this activity

Photo credit: Gaves Mulaleya (Malawi)



Based on published survey report:

There are about 4,000 small-scale fish farmers in Malawi

A typical farmer has 1-2 small pond and harvests about 13 kg of fish/year

Ponds are normally constructed by family members and sometimes with hired labor

The majority of farmers use maize bran as feed and green compost for pond manuring.

Partial harvesting is the norm

The current outputs from fish farming –although modest- form an important part of household livelihoods and provide an additional option for increasing the overall value of the farming system

Aquaponics in a house porch



A small-scale aquaponic project has been designed and run for family consumption.

Regardless the small size of this project, almost all principal components of aquaponics do exist including, water and fish tanks (100-gallon each), plant grow-bed, water pump, air pump, lightening system, tubing, etc.

Blue gill (*Lepomis macrochirus*), was the chosen fish species especially the introduction of tilapia to specific counties of California –including Sacramento- is banned.

In order to ensure a better growth for the blue gills, arrangements are taken to maintain water temperature at 16 C and above. Fingerling feed with 50% protein is used in this particular operation.

Plants and herbs have been chosen based on family consumption pattern

Small-scale aquaponics

Vertical aquaponic system



Credit: Edwin Gomez (Colombia)



floating raft system

Typically, in aquaponic projects, fish waste fertilizes plant crops and hence there is no need for external fertilizers .

Leafy vegetables (e.g. lettuce), tomatoes and herbs are commonly used in such systems, and so do flowers.

In regard to the fish, several species are commonly used with tilapia being frequently recommended.

Because of the simplicity of the design, simplicity to construct, easiness to operate, and its relatively low cost, the models shown here have been designed for people with limited resources especially in situations without much horizontal space.

Outcome of small-scale aquaponics have been encouraging towards potential applications in rural communities especially in regard to improving the nutritional status to poor families in addition to providing some cash.

Small-scale projects and human health

There is a long historical record of nutritional merit and safe use of spirulina

Spirulina is rich in beta-carotene and hence can overcome eye problems caused by Vitamin A deficiency.

Very digestible and has very high 65% protein, B-vitamin complex, iron and trace minerals

Has a substantial GLA, an essential fatty acid that helps regulate the hormone system.

Spirulina culture in Burkina Faso

Some of small-scale spirulina operations of 8-m² pools have been built at some hospitals such as Saint Camille of Ouagadougou.

The product received the approval of Ministry of Health in 2005.

A spirulina provides the portion that goes rehabilitation and health centers is subsidized and sold at loss

Spirulina culture in Farende village (Togo)

Dried paste of spirulina was distributed at the health clinic whereas undernourished children took it as a daily supplement.

One 100m² pond could supplement the diet of 100 children a day.

It has been claimed that undernourished children when taking a tablespoon a day mixed with water brought remarkable results

Small-scale projects and human health

Culture of “Mola” in rice fields (Bangladesh)

Mola (*Amblypharyngodon mola*) is a small indigenous fish that do exist in household ponds and natural waters in Bangladesh.

In addition to the animal protein content, mola is rich in vitamin A (20 times higher than commonly cultured fish species). Mola is also rich in calcium, iron, zinc, and phosphorus.

Including mola as part of the diet can help those suffering from malnutrition and micronutrient deficiencies, especially pregnant and lactating women and children younger than 2 years of age.

Human nutritionists claimed that “mola” can play a major role in lowering the incidence of child blindness, night blindness and infant mortality in Bangladesh.

Production features of “mola”:

Feeds on natural food organisms stimulated by fertilization

Spawns naturally two to three times a year (no need for sophisticated hatchery facilities)

When cooked as a whole and processed into a paste, and mixed with rice and vegetables, turns to a child-friendly one-pot meal (*khichuri*) which is high in micronutrients .

Notice that focus has been placed on health benefits rather than biomass produced or monetary revenue achieved



Photos' credit: World Fish Center



Conclusion (1)

Integrating aquaculture in rural development programs through family farms could generate significant social benefits when carried out properly

Simplicity concept of small-scale projects means simple operations **but never simple planning**

Improper or easy planning was behind the failure and the non adoption of these projects as been hoped

Earlier studies have indicated that small-scale farmers can potentially benefit from the advances of research. GIFT tilapia performed well enough when disseminated

Conclusion (2)

Although the social dimension in rural aquaculture is of top importance, the economics of these projects determines its sustainability

Social nature of these projects should not come into conflict with environmentally practices or quality standards

Total and unlimited dependence on external assistance threatens the sustainability of these projects

It should be remembered that subsidies and support should be of temporarily nature

Although rural aquaculture, implies simple practices and modest outcomes, there should be some room for development even if beneficiaries move out of this category