Small-scale Aquaculture in Rural Development

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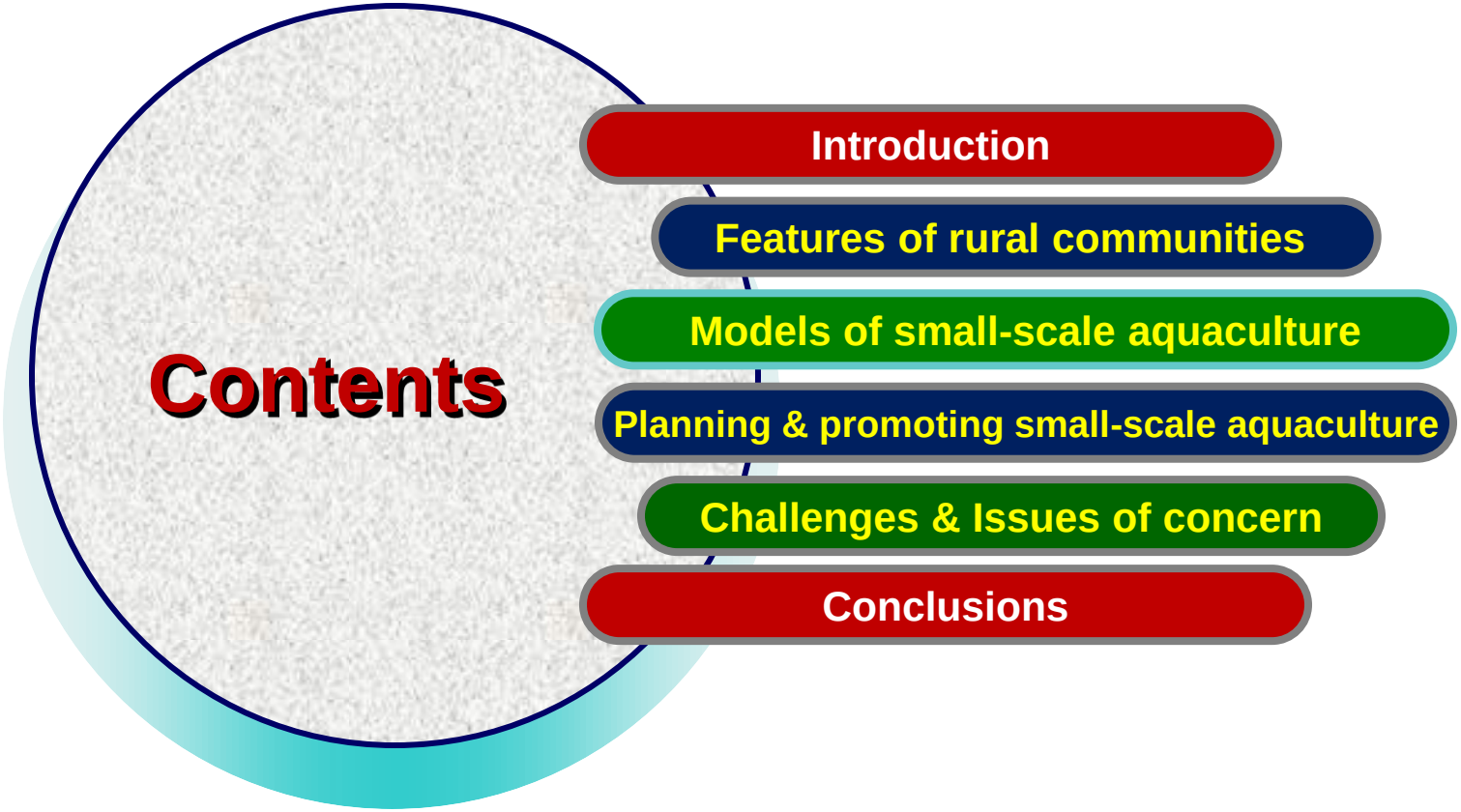


Introduction/1

- Commercial aquaculture is and -will remain- the principal producing system (in tonnage)
- Some social elements are usually overlooked in commercial aquaculture (nutrition, employment, gender)
- Quality fish at affordable prices will always be needed in rural areas where income is usually low and fish at high demand
- Over-looked issues could be addressed in small-scale aquaculture

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 meals
- Aquaculture has been incorporated in rural development programs either as a sole activity or integrated 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 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 aquaculture

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

Of particular importance when sites are not accessible by machinery

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

Features of rural communities (related to aquaculture)

- Definitions of rural aquaculture although vary, they still tend to be:
  - Simple with social dimensions
  - Caring more about low income communities
  - Family carry out most of farming practices
  - Some (especially women) can work in family projects **but will not accept** to work for others
  - Family demand of produced fish is met while **extra fish** is sold. If this is not the case, social problems must be serious
  - Sometimes, the extras are much more than family consumption or it is all sold (ornamental fish)

Family managed

Credit of above photo: Kevin Fitzsimmons (USA)

Vulnerability of small-scale beneficiaries

Small holders in rural areas are usually 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 generation

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 (biodiversity, disease, etc.)
- Local people are familiar with
- Broodstock and sometimes fingerlings can be obtained from natural waters
- Theoretically, its reproduction and husbandry is known at local level

Disadvantages

Native species in many situations 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

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)
- Involves few conflicts with other farm activities – if any

Credit: Deepak Bhusal (Nepal)

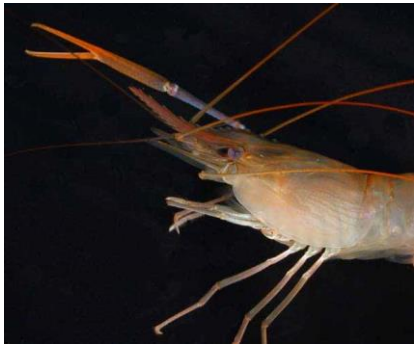
As rice is the main crop, fish has to cope with rice requirements and practices

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,** it support fish consumption of families (even seasonal)
- A way to magnify the benefits

Fish species in rice fields – Based on their:

(food habits – acceptance for consumption – adaptability to the system)



The wrong choice: Golden Apply 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).
- People did not like it; they preferred their native species
- Began to infest rice fields and prey on little rice plants causing significant losses

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

- Farmers (target beneficiaries) did not like it: **Top-bottom planning**
- Began to infest rice fields and prey on little rice seedlings (7-15 day old)
- 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

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
Wild fish stocks which farmers like most are negatively affected	Chosen species should be also accepted by farmers

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

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 carp crop

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-m^2 pond

14-m^2 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 else 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 14 days before being used in this system

Each broiler requires 1.5 ft^2 floor area; each layer requires 3 ft^2

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, 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 meat rich in proteins
- This type of integration has potential application in world rural development programs especially whereas rabbits are consumed
- 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

Integrated rabbits with mix-sex Nile tilapia in Rwanda

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

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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 pouching 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

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 and upgrade their skills
- 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
- Set criteria for target beneficiaries

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

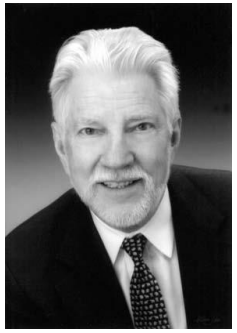
- Planning is done by the central government "which knows better than beneficiaries"- theoretically
- This approach lacks the two-way information flow whereas only one side generates the information

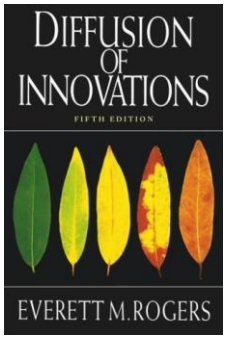
The recent shift is towards greater farmer participation

Integrated Participatory approach

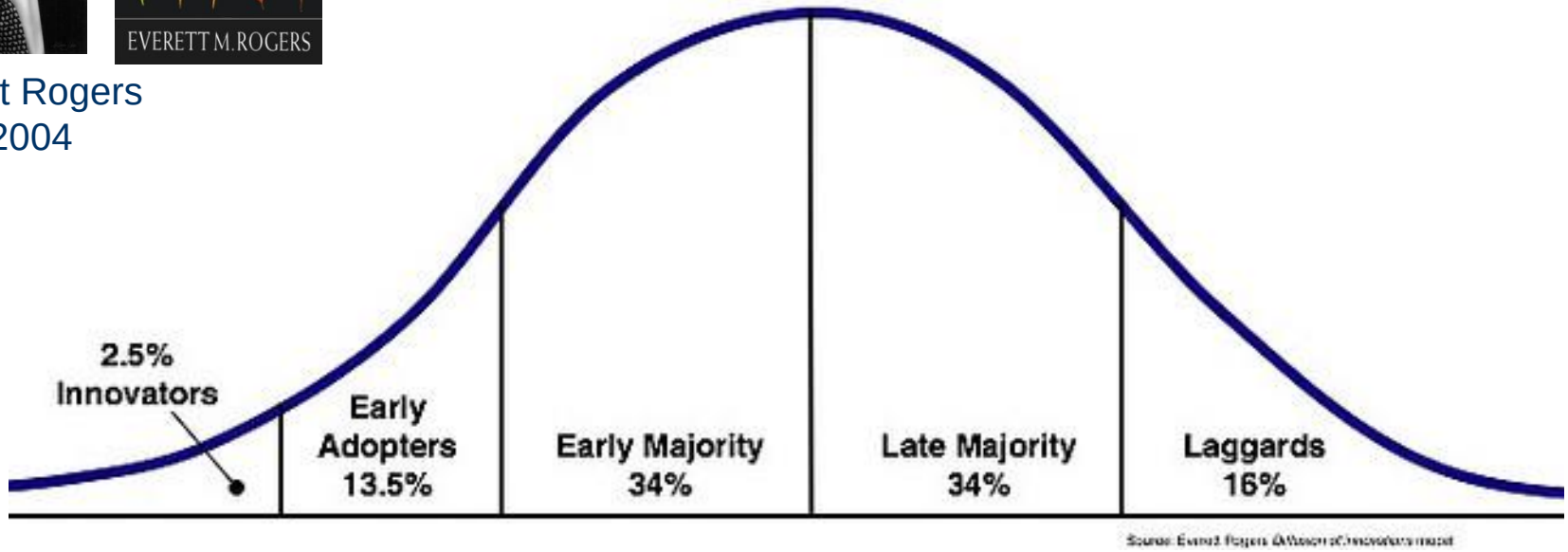
- Participation of farmers, researchers and extension agents – all are winners
- Farmers adopt the outcomes of their own programs
- Success indicators include the number of active farmers, and the continuity of the program
- Extension agents act as catalysts and stimulate group efforts

Adoption curve and potential beneficiaries





Everett Rogers
1931-2004



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 including risk assessment for similar projects is absolutely required

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 apply to the planning or management

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

Simplicity concept is still based on scientific information and established technology

2 million tilapia fry

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

Fish hatchery

- Production is less than 30,000 fingerlings/month
- Surface area of the project is less than 1000 m^2
- No ability to nursing fry
- Incomplete security regarding the area under utilization (via lease, partnerships and others)
- Vulnerability of the hatchery to the risk of flood or draught

Meeting three of the above, the hatchery=small one

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

Pond/ pen/cage farms:

- Earthen farm: size of each pond is less than 1000 $m^{2.}$ in less than 1-ha farm. In regard to pens, less than 1000 m^2.
- In regard to cages, the area is less than 200 m^2
- Financial resources are not sufficient. (no access to formal credit)
- Quantity sold in cash does not exceed 30% of fish produced
- Ownerships (lease/utilization) of land lack stability
- Water resources are either insufficient or seasonal

Meeting three of the above, the hatchery=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 landholding
- 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

Criteria for Donor-funded small-scale Aquaculture Development Project (cage culture in Ghana)

Low input / low operating costs: a production system that is not dependent on high-cost inputs has better chance to survive in case of market problems or losses due to theft or mortality

Production methods tailored for small-scale operators must be **reproducible** by farming families who have minimal access to capital or operating funds

Farm product is to be accessible to all. **This criteria may be overlooked if the other two criteria are met (**This is because high-value product generates higher revenues for the family or the community while the product would still be available at low or no cost for this group).

Notes

- The set of criteria for small-scale beneficiaries which are considered in a country may not have the same weight or 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

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)

Photo credit: Manuel Cano (Guatemala)

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

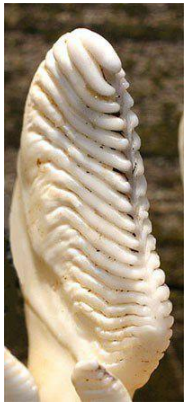
Most farmed fish have difficulty in digesting plant materials

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** 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**

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. Such informal credit may carry higher interest than bank loans

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

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
productive projects than more of abandoned ones

Subsidies and support - Conflicting opinions

Free production inputs

Fish seed are the common free or subsidized inputs (e.g. fry of sea bass in Thailand and common carp in Sri Lanka and Egypt)

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

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
- providing fish seed would eliminate doubts related to seed quality
- fingerlings may represent a substantial cost for subsistence or semi-subsistence farmers

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 (666 m^2) subsidy to encourage shrimp farmers
- 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

Supply of production inputs

Conflicting opinions

- According to FAO study on selected African and Asian countries, number of free fingerlings delivered was frequently **lower than reported one**
- 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 a fingerling production industry
- Unfortunately, it may be easier for the extension agent to supply free seed rather than train farmers to produce their own
- Instead of free fingerlings, the transfer of seed production technology should rank high whenever applicable (e.g. 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 the project indecency and sustainability
- If a government terminates the free gifts for whatever reason, the continuation of projects could be threaten
- Subsidies (free gifts) are usually counterproductive. If suspended, farmers feel that, if they wait long enough, the government will resume the subsidy
- Farmers who are not getting such incentives may develop jealousy feelings
- Could lead to unnecessary **corruption**

Possible role of associations, cooperatives & other umbrellas

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

These farms are engaged in ornamental fish production.

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

In turn, the production from the homestead farms will be taken back by 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.

Photo credit: G. Venkata Raju (India)

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

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

Extension 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 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 donor requirements

Concerns

External fund is not always a blessing especially in work atmosphere

When the external funding ends, it becomes difficult to operate and maintain facility which 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)

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 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