Small-scale aquaculture in rural development
(Features- Models- Promotion)

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Small-scale aquaculture in rural development

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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
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)
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

Watch for the ongoing changes in the nature of rural communities
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)
Species criteria – Preferably **native species**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tr>
<td>• Do not pose environmental threats to biodiversity, disease, etc.</td>
<td>Often native species did not receive enough attention from NARS. This led to:</td>
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<td>• Known as a species and ways of preparation to local people</td>
<td>• Reproduction technology and seed production is often not well developed</td>
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<td>• Broodstock/fingerlings – when needed – can be obtained from natural waters</td>
<td>• Not performing any genetic programs and so selected strains do not exist</td>
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<tr>
<td>• <strong>Theoretically</strong>, its reproduction and husbandry is known at local level</td>
<td>• Absence of reliable data on its performance in aquaculture</td>
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NARS: National Agricultural Research System
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

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

Credit: Deepak Bhusal (Nepal)
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
Fish species in rice fields – Based on their:
(food habits – acceptance for consumption – adaptability to the system)
## Rice – fish culture (challenges and considerations)

<table>
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<tr>
<th>Challenges</th>
<th>Considerations</th>
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| 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
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

Suits rural development where ducks are traditionally consumed
Ducks are left on water surface for most of the day and sheltered during night
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

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

Photo credit: Innocent Zambou (Cameroon)
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
- 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
Proper integration should yield benefits either to both systems or to one of the systems.
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 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

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

The recent shift is towards greater farmer participation
Adoption curve and potential beneficiaries

Adoption Curve

Everett Rogers
1931-2004
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.

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
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)

**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

Careful planning & securing project requirements eliminate unpleasant outcomes

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.

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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
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.

**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.

**Compost or silage** improves plant material’s quality, digestibility and subsequent use safety.
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
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 undersized 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 Mulaleyia (Malawi)
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)

Subsidies & 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.
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.
## 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 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

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.
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.