

Planning of Aquaculture Projects

(Aquaculture systems – site evaluation – management –
production inputs – production economics)

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Planning of aquaculture projects

This presentation aims to:

Demonstrate the role of planning in the success or failure of aquaculture projects

Highlight the technical features of aquaculture projects

Emphasize on the technical and economic dimensions of aquaculture projects

Relate the available natural resources (land and water) to chosen farming practices

Establish a common understanding in relation to aquaculture practices and key descriptive

& to

Provide introductory materials for group projects

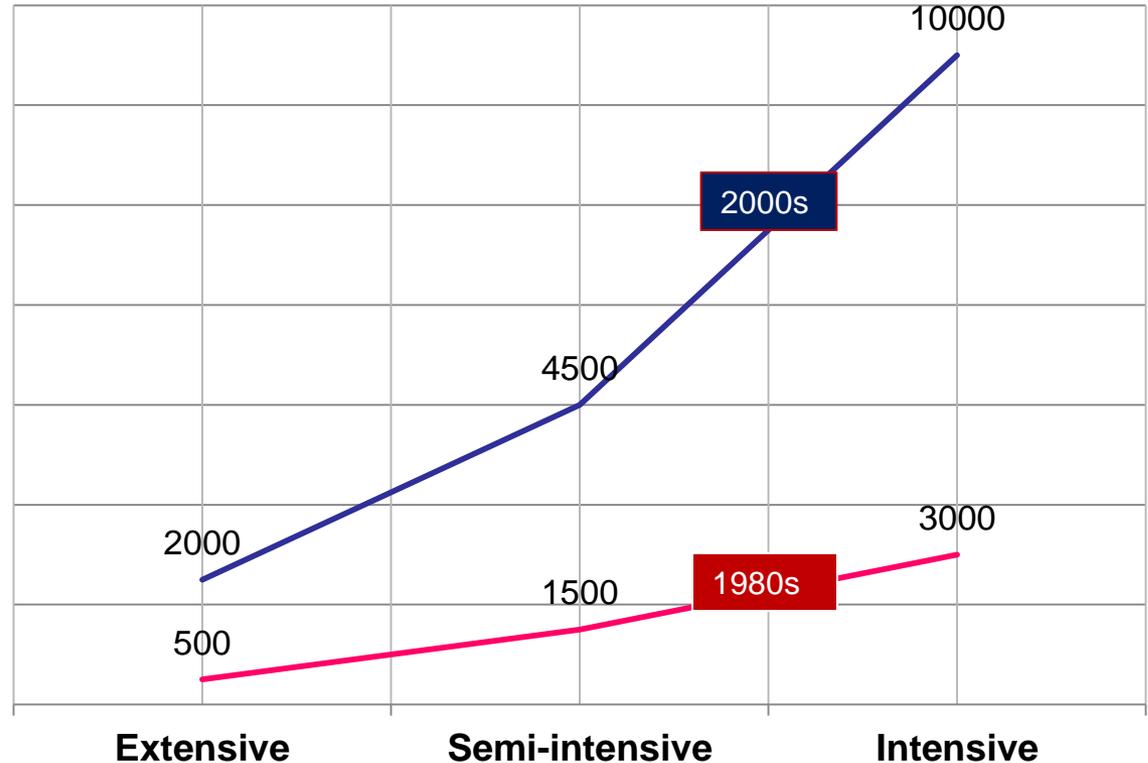
Aquaculture systems (productivity-based definitions) - kg/ha

Absolute versus Relative

In systems where various production levels could be obtained, no sharp line could be drawn for sorting farming systems indefinitely

Relative approach shows that during 2000s, a production of 2000 kg/ha is defined “extensive” while 1500 kg/ha during 1980s was considered “semi-intensive”

Systems planned for intensive farming are always defined “intensive”



Relative classification could be based on spatial dimension and could vary from country to country and from one region to another

Aquaculture systems – water quality-based definition (e.g. salinity)

Classic defining water in regard to salinity:

Fresh 0 - < 1 g/l (in agriculture)

Brackish < 1 – 33 g/l (**unrealistic range**)

Marine 33 g/l and above ✓

Defining fish species according to salinity systems may lead to some confusions.

Examples:

When seeds are produced in marine hatcheries but grown in different salinities including freshwater (e.g. mullet/shrimp/European seabass)

When seeds are produced in freshwater and grown in saline waters (e.g. tilapia)

Do definitions apply to hatcheries or farms?



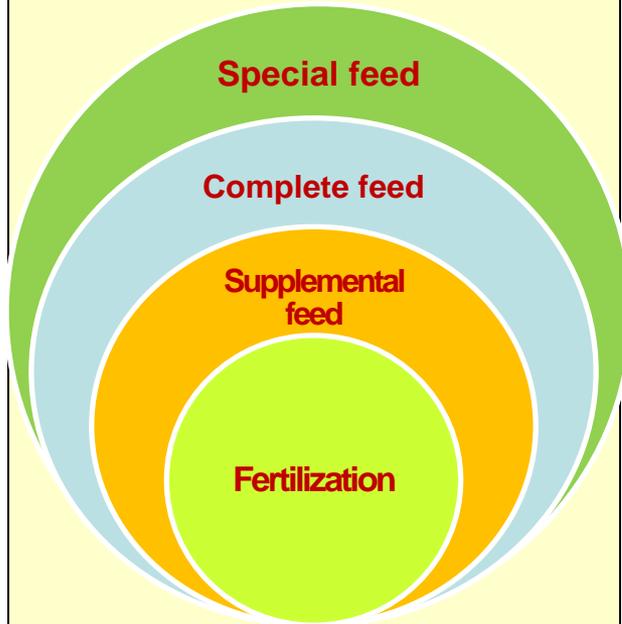
In order to eliminate any confusion related to salinity especially in brackish water:



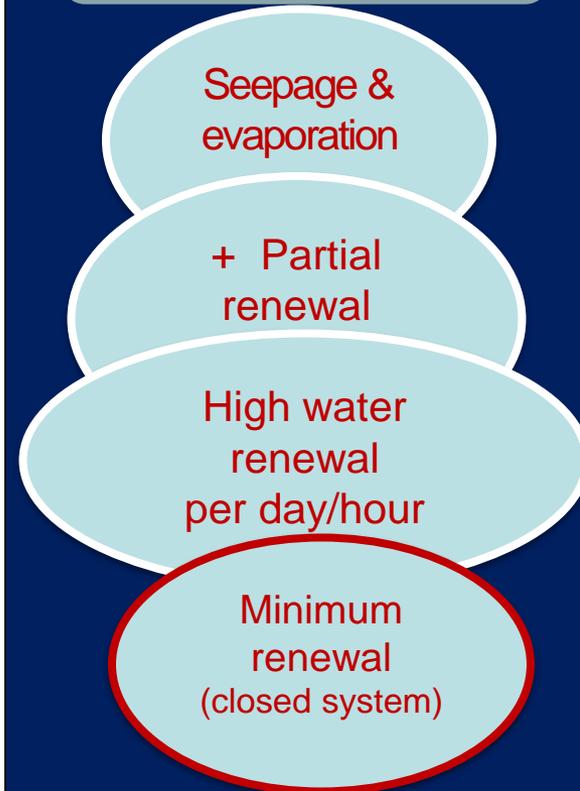
Tell actual reading

Aquaculture systems - management based definition

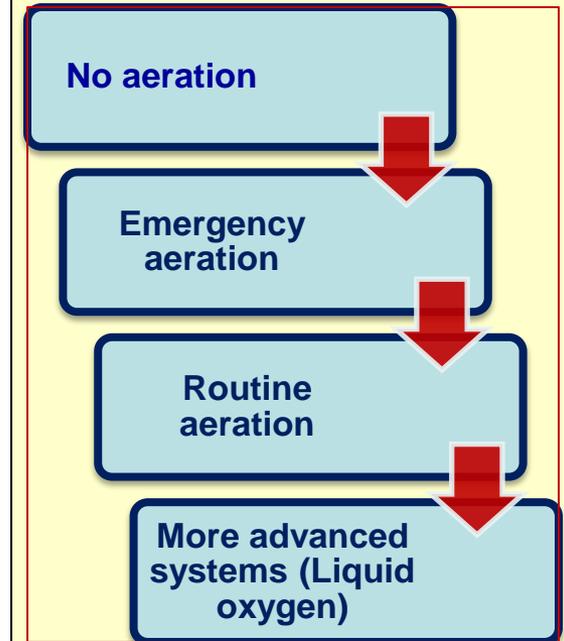
Nutrition



Water renewal



Aeration



Clarification of management systems

Criteria - clarification

Nutrition

Fertilization is applied in less intensive systems of low water renewal
Higher quality feed indicates intensified approach

Special feed includes feed formulated to be used in environmentally sensitive areas (e.g. cage aquaculture)

Water renewal

Compensation for seepage and evaporation is done to maintain water volume over the growing season; usually in less intensive system

The increase in water renewal helps to clean the system from wastes and ammonia in higher intensive system

Closed-recirculated system has lowest water exchange while ranks high in the intensification level

Aeration

Aeration intensity and mode indicates the management of production unit:.

Emergency aeration is applied to save farmed fish once oxygen drops to specific level

Routine aeration is included in the project planning of intensive systems

Features levels from extensive to intensive systems



Project finance	Personal or through limited arrangements	External financing may be considered
Project products	Locally oriented	Export may be considered if feasible
Technical assistance	Public extension is important	More link with research
Capacity building	On-farm basic training	Professional training & visits
Partnerships with organizations & centers	Often overlooked	Attractive and approached

More on aeration

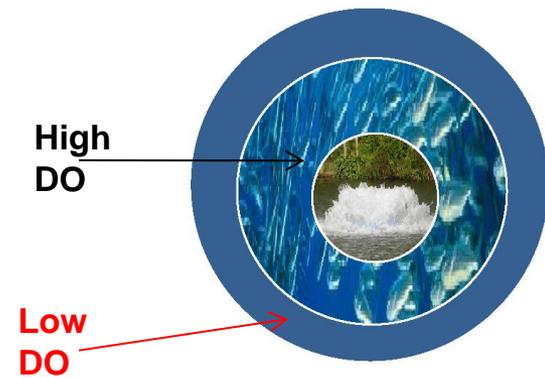
When oxygen drops, aeration is more effective than water supply

In emergency aeration in earthen ponds, aerating 1/3 of the pond will be sufficient

Aerators circulates/mixes the water top to bottom (important for bottom animals)

Moves aerated water from the area close to the aerator and drags un-aerated water

Allows harmful gases such as carbon dioxide to escape to the atmosphere



Turning-on aerators: should be done ahead of fish surfacing

Aeration systems (examples)

Pumps are
for filling
but not for
aeration



Aeration in such system
indicates intensity



Indicates routine
aeration



Planning of Aquaculture Projects

Objectives of the Project

Specific: ton/ha kg/m³ Number & size of fingerlings

Never as much as possible or we will do our best

Realistic: with some challenge

Unrealistic (non attainable goals) = discouraging

Too easy goals = relaxing & damaging

Resources to achieve the goals

Human resources is a key resource; select, train and treat them fairly

Adequate production inputs

Natural & environmental resources: Soil – water – climate – etc.

Aquaculture Planning

Natural resources and Site Selection

Appropriate versus Optimum sites

Optimum may never exist. Thus, We go for the appropriate that should be carefully evaluated.

Inadequate sites was behind the failure of many projects.

Failure stories spread fast
Discouraging future
developments



Project planning - Soil

We need to ask: How important the soil is to the selection process?

Soil is most important in earthen ponds while has less important in tank farms while could be totally ignored in soilless systems (e.g. cages – aquaponic).

Clay soil conserves water while sandy soil leaks water.

Soil may be amended if this practice is economically justified

For fish ponds, about **20-30% clay** is the minimum; also sand should not exceed 30%

Soil laboratories are not only specialized in soil analysis but also provide recommendation in regard to the validity of soil amendments

Soil amendments/lining

Bentonite: (clay type product): Bentonite has the ability to absorb water and expand in size and hence can fill the pores between coarse soil particles. Imported bentonite should be thoroughly mixed into the top 10-15 cm at a rate of 5–15 kg/m². (soil analysis will determine quantity needed)

Clay blanket: 30 cm thick to spread on pond bottom



Water proof lining:
factors to consider:
Durability & cost -
environmental effects
(e.g. temperature)

Project planning – Water quantity

Water requirements: should be compared very early in the planning process. In temperate regions: 30,000 - 40,000 m³ /ha will be required (in earthen ponds) for filling and compensating for seepage and evaporation. Water renewal should be added to the above water budget.

If pumping is used, pump capacity should consider the peak of demand. **The average is not sufficient.**

In general: a pond is preferred to be fillable in about 3 days and should be drainable in 24-48 hours.

Water supply in intensive systems

In intensive systems whereas water renewal is highly required, continuous supply should be considered.



Water renewal and salinity



In fresh water fish farms, and in low-input system, water renewal could be kept to minimum (just to make-up for water loss due to seepage and evaporation); salinity is not an issue

In brackish/marine farms, water renewal with the right rate is a must to avoid salt accumulation –due to evaporation- during the growing season

Thus, water renewal would vary in different climates

Project planning – Water quality

Quality and species

Fish for water or water for fish (example: salinity)

Tolerance versus optimum (example: D.O and African catfish)

Quality and water sources

Surface: (e.g. pollution)

Under-ground: sustainability, limitations (heavy metals, dissolved gases)

Quality and aquaculture types

Farm – hatchery – cage -etc

Water quality (Examples)

Gas super-saturation

The saturation of nitrogen of more than 110% is considered problematic.

If de-gassing is not possible in cases of high super saturation, it is better to re-evaluate the proposed project

If water quality is found very much inappropriate to the proposed project:

Simply Drop IT



Heavy metals



Case study: This gravel filter for surface water has been a practical solution of the high iron content in the underground water

Influencing factors & project planning

Influencing factors vary according to the nature of the projects and could be natural resources, climate, social elements, human resources, ...etc.

Some of these factors could be handled easier than others (e.g. training)

Other factors are beyond the ability of planners to handle or cannot be economically justified (e.g. water quality, climate)

The recommended technology should be economically feasible

It is not wise to continue correcting for mistakes resulting from improper project planning instead of enhancing productivity



Tilapia hatchery in Japan

Under such freezing, tilapia spawning could be technically done for research; but commercial production seems difficult to justify economically

Project Planning – issues to consider

Plans have to consider all production aspects (technical, economical, social, .. etc)

Example: plans of a fish farm should include:

Source of fingerlings

Outside sources (hatchery): timing & reliability

In-house hatchery: rationality, capacity, extras

All-males? All-females?

Special infrastructures: over-wintering facilities, etc.

Outputs (specific biomass/numbers, social benefits, etc.)

Economics (standard analysis)

Project Planning – Fish species

Fish applies to finfish – crustacean – ornamentals - others

One species (monoculture) or polyculture? In regard to:

Management such as feed requirement

Environmental issues (e.g. DO, temperature)

Length of the growing season and limiting species (e.g. tilapia in cold weather)

System economics determines the feasibility of fish combinations in a polyculture system (e.g. carps in Egypt)



The cost of shrimp feed is much higher than that for their partner (mullet) in polyculture system

Utilization of farmed species

Should be determined early in the planning process indicating the utilization of the farmed species whether:

marketed in local market

processed

exported

Grown in other facility or

Released in stock

enhancement programs

Example:
Seaweed
culture



Human food
Agar-agar

Soap making



Management of production units

Water filling & discharging in earthen ponds

Gravity in filling and draining of a fish pond is an ideal situation

Land survey is essential for determining water flow system (filling/draining)

If only one operation is chosen for gravity, it should be draining

If pumping is used for both operations, project economics should be analyzed



Gravity filling

Gravity draining



Earthen ponds – filling & draining systems



Bottom draining
removes harmful
substances (ammonia,
wastes)



Drying pond bottom saves
most of preparation
treatments



Filling

Pumping

Capacity - maintenance

Axial Flow Pump



Selecting proper pumps considers its efficiency, operation and economics

Get technical opinion



Pumping discharge is influenced by:
Pump horse power
Head



Centrifuge Pump



Traditional water wheel



Project Planning (sustainability concerns)



Wells may turn dry/salty – Need to consult water authorities

Environmental



Great start – **random** expansion
Banning – Reviving attempts

Culture Units

Factors to Consider – earthen ponds

For management purposes:

It is preferred to have equal size ponds with few ponds of different sizes

Size of culture units:

Equal versus Different sizes

Different sizes  More flexibility

Large versus small ponds

Large ponds  More productive area at lower cost/unit of area

Small ponds  Better for fry nursing, broodfish maintenance
Easier to manage

BUT productive area is reduced at higher cost/unit

Planning for much smaller ponds should not be targeted as long as larger ones are quite manageable.

Defining large/small pond is a relative & changeable issue

Depth of fish pond

Relation of water depth in relation to temperature, salinity and acid rains

Pond depth although still within a range, optimum one is still debatable. (for grow out)

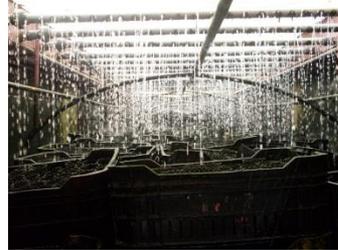
Deeper ponds are preferred in very hot climates and/or high salinity (ratio between surface and volume), and a must for over-wintering

Shallow waters lack enough buffering capacity

Filtration in relation to farming systems



UV sterilizer in oyster hatchery - Morocco



Tilapia project - Egypt



Freshwater prawn hatchery - Thailand



Gravel filter- Egypt



Babylon hatchery – Thailand
Credit: Proyrat and Ong



In fish-horticulture - Egypt

Filtration should meet the requirements of the system and the organisms

No need to over-equip

Soil utilization: respect its nature

How many years will be required for leaching such salt crust?

Aquaculture –using marine fish species- is the wise approach for utilizing such land

Once salt is leached production economics determine the future of these lands (agriculture or aquaculture)



Farming Systems (other than earthen ponds)

Farming systems in relationship to:

Water availability

Scarce: (intensive, integration)

Abundant: (raceways)

Environmental factors

(temperatures and closed systems)

Location

Desert: integration

Integration: compatibility

Investments: not necessarily high



Greenhouses & purposes

Green house construction and insulation capacity will depend upon climatic conditions and types of target activities

For small-scale aquaponic (Colombia)



Credit: Edwin Ramirez (Colombia)

For over-wintering tilapia (Egypt)



For grow-out of whiteleg shrimp (Peru)



Credit: Victor Hugo (Peru)

Integration concept

If properly done:

Better use of resources (water & land)

Benefits at levels:

food

environment

economy

If done wrong: could lead to a disaster

(e.g. golden apple snail in rice fields in Asia)

Golden apple snail



More on integration is found in a special lecture on small-scale aquaculture

More on Integration

Leading crop



In order to conserve water, a 90-day rice strains were developed

If the grow out of fish would require more than 90 days – leading crop would not wait and fish has to adopt

Compatibility

Warm blood animals swim over a cold blooded system



Integration & economics

Economics determines the feasibility of proposed integration

The following items are considered:

Additional labor, cost and/or facilities required for the integration

Evaluating the integrating components versus the whole project (e.g. how to value the water discharged from a fish tank to the agricultural crops?)

The idea of Integrated tilapia with olives was not welcomed by olive producers who found that the revenue of such integration is not justifiable compared to their expensive olive oil

Thinking of organic olive oil led to reviving the rejected idea

Rotation (win-win situation)



Rotating crops should consider crop seasonality

Wheat and alfalfa are just examples which could rotate with tilapia

This example could justify a revisiting to land use policy



Small-scale Aquaculture

Has social goals (nutrition, employment, reduce migration)

Family can contribute to especially women

Main criteria is the ability to carry out the project with fair returns; food fish, fry, ornamental fish, ... etc.

Utilize what is available and safe of farm wastes and byproducts

Integration is mostly applied

Back-yard hatchery in Thailand is a success story



There is a special lecture on small-scale aquaculture

Production & marketing (case studies)

Influence of media & local names on marketing (e.g. freshwater prawn)

Unrealistic market estimates (e.g. seabass and seabream)

Reputation and unfair views (e.g. African catfish in Egypt);
educate consumers first

Community consideration: Improving the project image among local community led to the stocking of some tilapia galilaea in Nile tilapia ponds (to produce smaller size tilapia as required by local consumers)

Produced size: depending on household income and feeding habits, premium size fish may not attain highest prices unless needed for further processing (e.g. filleting)



Project Planning (Hatchery Project)

A Need to remember

Hatchery is not a farm

Evaluation of a hatchery will be seen on the farm (later)

Hatchery is the place for genetic enhancement

What could be tolerated by a farm may not be accepted to hatcheries (e.g. fluctuated temperature or salinity)

Information here is for the purpose of planning; there is a special lecture on hatchery management

Efficiency of a system (example: tilapia hatchery)



Efficiency depends on:

Goals of the hatchery

Available investments

Technology in practice



Egg
collection

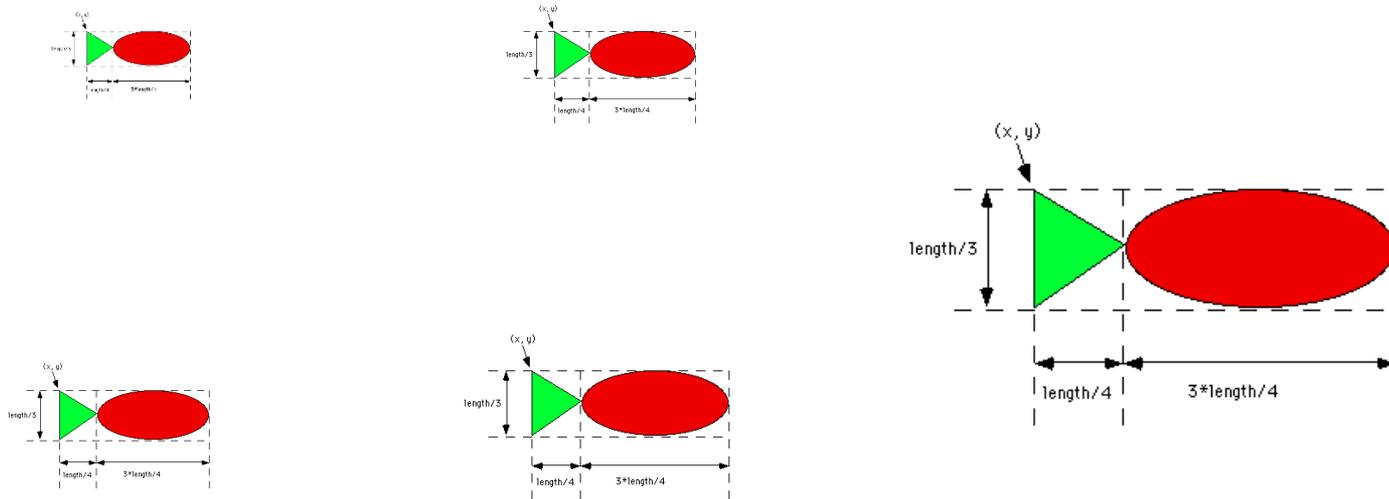
Fry
collection

Credit:
Mohammad
Iqbal (Pakistan)



Hatchery

Number versus size & compensatory gain



Compensatory growth: an acceleration of the growth rate following a period of growth retardation caused by husbandry practices such as high stocking density which may lead to increased competition over food or space

Production inputs (feed)

Availability (quantity, quality)

Commercially or on-farm produced

Feed (Sinking/floating) in relation:

management and labor

feeding habits (shrimp as bottom feeder)

Wind - Birds

Unconventional feed (relative)

Daily allowance (*ad libitum*? Less? More? How?)



Credit: Khamis
killei (South Sudan)

Production inputs (fertilizers)

Fertilizers (organic/chemical)

Relationship with:

Water management & renewal

Farmed species and food habits

Intensification level

Possible health hazards? (e.g.
organic manure & Bird flu)

Residues (chemicals and drugs)

Availability and comparable cost



Issues to consider

Fishery regulations & practices

Hatcheries have difficulty to compete with wild fry especially when:
abundant
at affordable price

Whether the collection of wild fry is regulated or illegal, the impact is the same

For a hatchery to operate, wait and hope for a poor wild fry season is not a wise approach

A hatchery success should not depend on the failure of the nature



Millions of wild caught mullet fry (catch of the day)

Issues to consider

Governing regulations

Environmental regulations

A sustainable project has to comply with the law in force in regard to:

Quality of effluent (vary according to the activity)

Farmed species (whether allowed in the country/location)

Biosecurity (e.g. escapees)

Others

Land tenure – water use

Mode of land use: (owned, leased, temporary)

Land tenure and project development

Water use permission (surface water or underground water)

Insufficient or changing water quality could ruin the project (example: salt intrusion in underground water)

Issues to consider

Avoid over-equip & over-staff

Over-equip would affect the project economics: (Initial investment – depreciation)

It is unwise to purchase costly equipment which has no use in the near or mid-term future

Does not include standby equipment

This does not apply to some infrastructure (roads, pipes, etc.)

Should be treated as case by case

Over-staffing adds pressure on the operation cost

Over-staffing occurs more in governmental projects compared to private ones

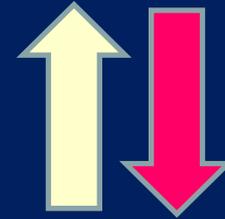
Developing job descriptions for all categories would help avoid over-staffing

Staff training would improve the efficiency and possible mobilization of staff

Fair and transparent treatment is a must

Issues to consider

Very abnormal prices



Temporarily abnormal high or low farm-gate price should not be treated as normal in the planning or the analysis of the project.

Examples:

Exceptional high prices of a given fish species in particular season or for unusual market event.

The very low price –if any- for crawfish in Egypt may not remain as such if a project for collecting and processing the species does exist.



Project personnel (safety issues)

Potential threats

Nature of aquaculture projects needs to be considered including:

Locations: Often in harsh and remote areas

Water-borne diseases: for pond workers (e.g. Schistosomiasis)

Direct exposure to chemicals: (e.g. hormones in tilapia sex reversal)

Greenhouse humidity: for hatchery operators and workers

Safety actions (examples)

Limiting the matter to paying project workers extra incentives against harsh environment is unfair

Enforcing the occupational safety should be done.

Providing protective clothes (e.g. waders, gloves)

Periodic medical checks is important

Project planning

For a sustainable and feasible project, all elements need to be considered and fairly evaluated (Physical, environmental, human, etc.).

The planning process should be based on reliable information with no biased views.

Proper economic analysis is a must – its outcomes should be respected.

Business plan is not be rigid and should be periodically reviewed and adjusted if necessary.

Production economics

In order for a project to be sustainable, it has to be economically feasible

Highest production versus economic production

Marketable Size & best economical size

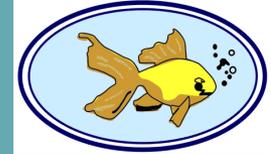
Opportunities and possible risks should be considered in the economic analysis

Key parameters

IRR

NPV

Pay back period



SWOT Analysis

Strengths Experienced and committed management staff	Weaknesses Inadequate number of staff
Opportunities Government policy supportive, support to farmers through training and material inputs.	Threats Regulation and compliance risks, Water pollution, Fish diseases, Cost inflation, Industry consolidation/ transition, consumer demand shifts, global financial shocks, theft, floods, energy shocks, corruption, late timing for current donor funds.

SWOT analysis is a planning tool used to evaluate the **Strengths**, **Weaknesses**, **Opportunities**, and **Threats** related to a project

Competition?

Source: Training team, EICA. Hatchery establishment for African catfish fry production in Mukono district, Uganda

Conclusion

The success or failure of aquaculture project – like any project- is directly related to proper/improper planning

Technical/economical sides should be equally considered during planning

Projects of social benefits are usually supported by governments (e.g. mal-nutrition, employment, migration)

People are the most precious resources to be considered in the planning process

Proper planning ensures stable applications and avoids unpleasant surprises