STRATEGIES FOR DEVELOPMENT OF ASIAN RESERVOIR AND LAKE FISHERIES

Training Workshop on Capacity Building of Field Staff of National Aquaculture Development Authority of Sri Lanka on Scientific Aspects of Inland Fisheries Development and Effective Data Collection Methods

Sri Lanka

Institutions:
- *University of Kelaniya*,
- *National Aquaculture Development Authority of Sri Lanka*
- *Aquatic Resources and Quality Improvement Project*

Final Report

Prepared by: Upali S. Amarasinghe (Coordinator)

-August 2008-
Training Workshop on Capacity Building of Field Staff of the National Aquaculture Development Authority of Sri Lanka on Scientific Aspects of Inland Fisheries Development and Effective Data Collection Methods

Background:
During the past few decades, there has been a great accumulation of scientific information on inland fisheries development in Sri Lanka through various foreign funded and locally funded projects. However, there is an information gap between scientific research and the field extension staff of National Aquaculture Development Authority of Sri Lanka (NAQDA) due to lack of a suitable mechanism to disseminate this knowledge particularly to the field staff. Realizing this fact, the project was formulated to conduct two workshops for the field officers of NAQDA.

Report:
Two workshops were conducted for the field staff of National Aquaculture Development Authority of Sri Lanka (NAQDA) at the Aquaculture Development Centres (ADC) in Udagalawe and Dambulla. At the workshop in Udagalawe ADC, which was held on 16-17 June 2008, there were 29 participants. The lists of resource persons and the participants are given in Annex I.

The second workshop was held at Dambulla ADC on 26-27 June 2008. This workshop was attended by 39 participants. The lists of resource persons and the participants are given in Annex II.

In both workshops, the following aspects were covered.
1. Recent trends in the inland fisheries development in Sri Lanka
2. Scientific aspects of inland fisheries development
3. Sociological aspects of the culture-based fisheries
4. Mobilization of the communities and participatory rural appraisal
5. Effective data collection methods in inland fisheries
6. Objective-oriented planning

Individual presentations by the resource persons were discussed in detail by the participants. All participants were of the opinion that they have gained new knowledge on the aspects covered. In each workshop, there were three group activities on participatory rural appraisal, primary and secondary stakeholders, and mind mapping followed by a presentation by a member of each group on the outcome of the group discussion. Through the group activities, the importance of sociological knowledge in field activities pertinent to culture-based fisheries (CBF) development was emphasised.

The documentary film on culture-based fisheries, produced under the auspices of Australian Centre for International Agricultural Research (ACIAR) was also shown to the participants of the two workshops. The participants were provided with copies of the PowerPoint presentations (Annex III). During the discussion sessions, the following suggestions were made by the participants.

1. In Sri Lanka, the list of inland lentic waters that is used for official purposes contains a category of 100,000 ha of seasonal reservoirs. However, this figure is a wrong inclusion and has been used in all official documents on inland fisheries. As the development plans for CBF have been prepared based on
this erroneous figure, the field staff of NAQDA expressed their concern about this matter. The inaccurate over-estimated figure might result in unachievable targets from CBF. Accordingly, accurate estimation of the extents of village reservoirs which are suitable for the development of CBF was identified as one of the major research priorities. The methodology developed for the determination of the extent of reservoirs using remote sensing techniques under the ACIAR-funded reservoir fisheries management project was highlighted. As an immediate measure, it was decided to use the extents of reservoirs available in the database of the Department of Agrarian Development as approximately 50% of the area at full supply level.

2. Due to the high variability in catch per unit effort in the boats of reservoir capture fisheries, need for site-specific sampling schemes was considered. This aspect will be considered in the future revisions of sampling schemes in reservoir fisheries. The participation of fishers for accurate collection of fisheries statistics is presently taking place in several reservoirs. The participants have recognized the importance of organizing fishing communities for fisheries data collection as part of the participatory approaches in fisheries management.

3. In some reservoirs such as Udawalawe, peak catches of Indian carp species (e.g., *Catla catla*) occur only on a few days (about 3 days) during rainy season. The participants have correctly realized that extrapolation of average catch to the total number of fishing days in a month might lead to over-estimation of total fisheries production.

4. The participants have highly appreciated the documentary film on CBF, which was produced under the ACIAR-funded project. They were of the opinion that this video film could be used as a CBF extension material. Arrangements were made to make copies of the documentary film and distribute among regional aquaculture extension centres of NAQDA.

5. Isolated instances of political interferences for CBF were reported. However, the participants were convinced that through empowering communities within the existing legal provisions, most of these external problems could be minimized. Therefore, they have suggested developing an institutional mechanism to take efficient and effective intervention of Police when there is a conflict.

6. The participants have indicated that the participatory rural appraisal methods would be useful to change the top-down approaches of decision making for CBF development and reservoir capture fisheries management towards bottom-up approaches where rural communities are made active partners in decision making for resource uses and management.
The agendas of the two workshops were as follows:

**Workshop 1**

**Venue:** Udawalawe Aquaculture Development Centre

**Dates:** 16-17 June 2008

**Programme**

**16.06.2008 (Day 1)**

09.00 – 09.15: Introductory remarks  
Dr. D.E.M. Weerakoon (Director General, NAQDA)

09.15 – 10.30: Scientific Aspects of Inland Fisheries Development  
Prof. Upali S. Amarasinghe  
(Department of Zoology, University of Kelaniya)

10.30 – 11.00: Tea

11.00 – 12.30: Scientific Aspects of Inland Fisheries Development  
(Discussion)

12.30 – 13.30: Lunch

13.30 – 14.00: Sociological Aspects of the Culture-based Fisheries  
Dr. K. Karunatillake  
(Senior Lecturer, Department of Sociology, University of Kelaniya)

14.00 – 14.30: Discussion

14.30 – 15.00: Mobilization of the Communities and Participatory Rural Appraisal  
Dr. K. Karunatillake  
(Senior Lecturer, Department of Sociology, University of Kelaniya)

15.00 – 15.30: Tea

15.30 – 16.30: Discussion

**17 June 2008 (Day 2)**

09.00 – 09.30: Effective Data Collection Methods in Inland Fisheries  
Professor Upali S. Amarasinghe  
(Department of Zoology, University of Kelaniya)

09.30 – 10.30: Discussion

10.30 – 11.00: Tea

11.00 – 11.30: Objective-oriented Planning  
Dr. K. Karunatillake  
(Senior Lecturer, Department of Sociology, University of Kelaniya)

11.30 – 12.30: Discussion

12.30 – 13.30: Lunch

13.30 – 15.00: Documentary film on Culture-based Fisheries

15.00 – 15.30: Tea

15.30 – 16.00: Group Exercises on PRA and RRA
16.00 – 16.15: Closing down.

Workshop 2
Venue: Dambulla Aquaculture Development Centre
Dates: 26-27 June 2008
Programme

26.06.2008 (Day 1)
09.00 – 09.15: Introductory remarks
   Mr. H.M.U.K.P.B. Herath (Deputy Director/Freshwater Aquaculture Development, NAQDA)
09.15 – 10.30: Scientific Aspects of Inland Fisheries Development
   Prof. Upali S. Amarasinghe
   (Department of Zoology, University of Kelaniya)
10.30 – 11.00: Tea
11.00 – 12.30: Scientific Aspects of Inland Fisheries Development
   (Discussion)
12.30 – 13.30: Lunch
13.30 – 14.00: Sociological Aspects of the Culture-based Fisheries
   Dr. K. Karunatillake
   (Senior Lecturer, Department of Sociology, University of Kelaniya)
14.00 – 14.30: Discussion
14.30 – 15.00: Mobilization of the Communities and Participatory Rural Appraisal
   Dr. K. Karunatillake
   (Senior Lecturer, Department of Sociology, University of Kelaniya)
15.00 – 15.30: Tea
15.30 – 16.30: Discussion

27 June 2008 (Day 2)
08.30 – 09.00: Inland Fisheries Development Strategies in Sri Lanka
   Mr. P.N. Chandraratne (Director, NAQDA)
09.00 – 10.00: Effective Data Collection Methods in Inland Fisheries
   Professor Upali S. Amarasinghe
   (Department of Zoology, University of Kelaniya)
10.00 – 10.30: Discussion
10.30 – 11.00: Tea
11.00 – 11.30: Objective-oriented Planning
   Dr. K. Karunatillake
   (Senior Lecturer, Department of Sociology, University of Kelaniya)
11.30 – 12.30: Discussion
12.30 – 13.30: Lunch
13.30 – 15.00: Documentary film on Culture-based Fisheries
15.00 – 15.30: Tea
15.30 – 16.00: Group Exercises on PRA and RRA
16.00 – 16.15: Closing down.

Plate 1. Participants at Udawalawe workshop

Plate 2. Participants at Dambulla workshop

Plate 3. Presentation of the outcome of group exercise at Udawalawe workshop.
Plate 4. Group exercises at Dambulla workshop
Annex I – Lists of resource persons and participants at the Workshop No. 01

Venue: Udawalawe Aquaculture Development Centre
Date: 16-17 June 2008

Resource persons:
1. Prof. Upali S. Amarasinghe, Department of Zoology, University of Kelaniya
2. Dr. K. Karunatillake, Senior Lecturer, Department of Sociology, University of Kelaniya
3. Dr. D.E.M. Weerakoon, Director General, National Aquaculture Development Authority

Participants:
1. S.S. Chandrasekera (Regional Aquaculture Extension Officer, Monaragala)
2. W.A.J. Rohith Fernando (District Aquaculture Extension Officer, Uhana)
3. K.D. Sanjeewa (Aquaculture Extension Officer, Monaragala)
4. C.A.H.S.S. Chandrasekara (Aquaculture Extension Officer, Padiyathalawa)
5. P.M.S. Godage (Aquaculture Extension Officer, Monaragala)
6. K.W. Gamini (Regional Aquaculture Extension Officer, Bandaragama)
7. H.B.C. Lakmal (Aquaculture Extension Officer, Matara)
8. W.P. Milani Rasangika (Aquaculture Extension Officer, Galle)
9. N.B.S.N. Priyadharshani (Field Project Implementation Officer, Monaragala)
10. U.J. Jayasinghe (Aquaculture Extension Officer, Kalutara)
11. J.R.D. Sampath (Aquaculture Extension Officer, Monaragala)
12. A.D.K.S. Kularatne (Aquaculture Extension Officer, Udawalawe)
13. R.P. Gamage (Aquaculture Extension Officer, Angunawewa)
14. S.M. Ruwanpathirana (Aquaculture Extension Officer, Angunawewa)
15. L.M. Egodawattage (Aquaculture Extension Officer, Kattakaduwa)
16. N.P.P. Liyanage (District Aquaculture Extension Officer, Kattakaduwa)
17. H.D.S. Muditha Sudusinghe (Aquaculture Extension Officer, Hambantota)
18. D.P.N. De Silva (Field Project Implementation Officer, Udawalawe)
19. Vidath Dharmaratne (Senior Aquaculturist, Udawalawe)
20. P.M. Withanage (Aquaculturist, Udawalawe)
21. S. Jayawardena (Aquaculturist, Udawalawe)
22. M.K. Upali Kithsiri (Regional Aquaculture Extension Officer, Galle)
23. J.A. Pemasiri (Regional Aquaculture Extension Officer, Padukka)
24. H.M.U.K.P.B. Herath (Deputy Director, NAQDA)
25. P.B.T. Darmathri (Aquaculture Extension Officer, Kattakaduwa)
26. M.G.K. Niroshan (Field Project Implementation Officer, Hambantota)
27. Nishan Sakalasuriya (Dept of Geography, University of Kelaniya)
28. Asanka Muthukumarana (Aquaculture Extension Officer, Udawalawe)
29. I.U. Wickramaratne (Aquaculturist, Udawalawe)
Annex II – Lists of resource persons and participants at the Workshop No. 02

Venue: Dambulla Aquaculture Development Centre
Date: 26-27 June 2008

Resource persons:
1. Prof. Upali S. Amarasinghe, Department of Zoology, University of Kelaniya
2. Dr. K. Karunatillake, Senior Lecturer, Department of Sociology, University of Kelaniya
3. Mr. P.N. Chandraratne (Director, National Aquaculture Development Authority)
4. Mr. H.M.U.K.P.B. Herath (Deputy Director/Freshwater Aquaculture Development, National Aquaculture Development Authority)

Participants:
1. R.M.S. Bandara (Aquaculture Extension Officer, Mapakada)
2. I.M. Piyatillake (Aquaculture Extension Officer, Bingiriya)
3. I.M.G.B. Illukkumbura (Aquaculture Extension Officer, Digana)
4. D.M. Piyasena (Aquaculture Extension Officer, Dambulla)
5. M.H. Abeysinghe (Aquaculture Extension Officer, Manampitiya)
6. J.S. Wikesekara (Aquaculture Extension Officer, Naula)
7. A.A.A.P. Athauda (Aquaculture Extension Officer, Kantale)
8. R.S. Kapila Bandara (Aquaculture Extension Officer, Mapakada)
9. H.M.K.K. Herath (Statistical Officer, Baththulu Oya)
10. B.D.C. Sisitha Kumara (Aquaculture Extension Officer, Baththulu Oya)
11. A.M.J. Adikari (Field Project Implementation Officer, Dambulla)
12. D.M. Inoka Perera (Aquaculture Extension Officer, Baththulu Oya)
13. L.S. Hettiarachchi (Field Project Implementation Officer, Anuradhapura)
14. H.S.W.A. Liyanage (Regional Aquaculture Extension Officer, Anuradhapura)
15. N.M. Siriwardhana (Aquaculture Extension Officer, Anuradhapura)
16. A.M.M.T. Attanayake (Field Project Implementation Officer, Dekinda, Nawalapitiya)
17. D.M. Dissanayake (Aquaculture Extension Officer, Bingiriya)
18. M.G.G. Gunaseha (Regional Aquaculture Extension Officer, Bingiriya)
19. S. Suthaharan (Regional Aquaculture Extension Officer, Batticaloa)
20. Asela Fernando (Aquaculture Extension Officer, Bingiriya)
21. N.H.C.S. Premasiri (Aquaculture Extension Officer, Polonnaruwa)
22. A.H.M. Wimalarathne (Aquaculture Extension Officer, Polonnaruwa)
23. C.K. Sapumohotti (Field Project Implementation Officer, Kahatagasdigiliya)
24. Hemantha Ekanayake (Field Project Implementation Officer, Anuradhapura)
25. K.G.P.K. Koralagama (Aquaculture Extension Officer, Anuradhapura)
26. K.L. manel Renuka (Field Project Implementation Officer, Galgamuwa)
27. K.D.A.I.K. Kapuduwa (District Aquaculture Extension Officer, Nuwala Eliya)
28. J.P.K. Amarasekara (Aquaculture Extension Officer, Kegalle)
29. J.D. Chandradasa (Aquaculture Extension Officer, Polonnaruwa)
30. M.G.R. Tilakaratne (Aquaculture Extension Officer, gampaha)
31. R.M.D.K. Rajapakse (Aquaculture Extension Officer, Bingiriya)
32. D.G.U.C. Samarasena (District Aquaculture Extension Officer, Dambulla)
33. I.H.M.J.B. Jayapathma (District Aquaculture Extension Officer, Puttalam)
34. R.M.G. Ratnayake (Aquaculturist, Dambulla)
35. R.H. Pothuwila (Aquaculturist, Dambulla)
36. N.M.R.S. Rajasinghe (Senior Aquaculturist, Dambulla)
37. D.D. Sooriyaarachchi (Regional Aquaculture Extension Officer, Digana)
38. Sudharshani Tennakoon (Aquaculture Development Centre, Dambulla)
39. Ranjanee Ariyaratne (Aquaculture Development Centre, Dambulla)
Annex III – Presentations

1. Scientific aspects of inland fisheries development
2. Sociological aspects of the culture-based fisheries
3. Mobilization of the communities and participatory rural appraisal
4. Effective data collection methods in inland fisheries
5. Objective-oriented planning
6. Group activities
Scientific aspects of inland fisheries development

Slide 1

PRESENT STATUS AND FUTURE STRATEGIES FOR THE MANAGEMENT OF RESERVOIR FISHERIES IN SRI LANKA

UPALI S. AMARASINGHE
DEPARTMENT OF ZOOLOGY
UNIVERSITY OF KELANIYA
SRI LANKA

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Outline of the presentation

- A brief introduction to history Sri Lankan reservoirs & their fisheries
- Capture fisheries in perennial reservoirs
- Culture-based fisheries in village reservoirs
- Stock assessment, modelling & management
- Strategies for further development

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- Sri Lanka has one of the highest densities of reservoirs in the world; 2.7 ha km²
- Most reservoirs are located in the dry zone, which receives less than 187.5 cm of rainfall per annum
Slide 4

The reservoirs can be very old; >2000 yrs
- Most irrigational
- Often Earthen dams
- Fisheries in perennial reservoirs; >500 ha; a post 1952 development

Photo: W.S. Weliange

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Perimiyankulam stone inscription (67-111 A.D.)

Revenues from water and the share of fish caught in the channels of the reservoirs (Polonakaraka & Ketavalaka in the district of Thihalaka) were granted to the village assemblies at Thiragama and Amara for the purpose of spreading deer skins in the meditation halls of Buddhist temples in respective villages.

Enforcement of fishing rights and regulations in reservoirs during ancient times is evident from this stone inscription.

Photo: Upali Amarasinghe

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Development of the fishery of Polonnaruwa
There are two types of reservoirs in Sri Lanka:

- Small filling store reservoir
- Reservoir used for irrigation

Fishery is artesian

In most reservoirs, decaying submerged...
Major fish species landed in commercial fisheries in reservoirs of Sri Lanka
Culture-based fisheries (CBF) development in village reservoirs of Sri Lanka

- The village reservoirs dry-up for 3-4 months in the year
- the primary purpose is irrigation.
- CBF can be developed by stocking fingerlings after rains and subsequent harvesting.

HARVESTING STOCKED FISH BEFORE RESERVOIRS DRY-OFF DURING DRY SEASON IN SEPTEMBER-OCTOBER.
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**CALENDAR FOR SEASONAL TANK PROGRAMME**

<table>
<thead>
<tr>
<th>M J A S O N D J F M A M J J A S O</th>
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<tr>
<td>RAINS</td>
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<tr>
<td>GROWTH PERIOD</td>
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<tr>
<td>STOCKING</td>
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<tr>
<td>HARVESTING</td>
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<td>FINGERLING REARING</td>
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<td>FRY REARING</td>
</tr>
</tbody>
</table>

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- Agrarian Services Department
- National Aquaculture Development Authority
- Regional Extension Centres
- Fish Breeding Centres
- RAEOs
- AEOs
- ARDAs
- Frying Aquaculture Excess
- Seed Supply: Technical Resource
- Farmers Organizations
- Aquaculture Committees

**Induced Breeding of Major Carps**
- Fry-Fingerling Rearing through Community Participation
- Culture-based Fisheries in Seasonal Reservoirs

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- Fry rearing ponds in a state-owned fish breeding centre
- Involvement of state-owned fish breeding centres in CBF development
Culture-based fisheries in village reservoirs
Optimal SD = 27 fingerlings/ha
(27,000 fingerlings needed for 10 ha reservoir)

Number of cages needed to produce 27,000 fingerlings - 07

Cage culture (Rohu, C. carpio)
Cage size - 12.5 m³
Optimal SD = 400 m⁻³
Survival = 77%
Culture period – 77 days
No of fingerlings per cage = 400x12.5x0.77 = 3850 fingerlings

Number of ponds needed to produce 27,000 fingerlings - 05

Pond culture (Rohu, C. carpio)
Pond size = 250 m²
Optimal SD = 40 m⁻²
Survival = 60%
Culture period – 65 days
No of fingerlings per pond = 40x250x0.6 = 6000

Potential roles of various institutions for the sustainability of CBF

<table>
<thead>
<tr>
<th>Process</th>
<th>Induced breeding</th>
<th>Fingerling rearing in cages/ponds</th>
<th>CBF in village reservoirs</th>
<th>Marketing</th>
</tr>
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<tr>
<td>Management</td>
<td>Govt.</td>
<td>Community</td>
<td>Community</td>
<td>Community</td>
</tr>
<tr>
<td>Participation</td>
<td>Aquaculturists</td>
<td>Groups/Individuals</td>
<td>FOs</td>
<td>Fish vendors</td>
</tr>
<tr>
<td>Facilitator</td>
<td>Aquaculturist</td>
<td>Aquaculture Extension Officer (AEIO)</td>
<td>AEO, Agrit. Res. Dev. Assistant</td>
<td>Consumer</td>
</tr>
<tr>
<td>Role players</td>
<td>Aquaculture centres</td>
<td>Fish farmers</td>
<td>FOs</td>
<td>Fish vendors</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Developing links through strong extension mechanism</td>
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</tbody>
</table>
STOCK ASSESSMENT, MODELLING & MANAGEMENT

THREE APPROACHES

• SURPLUS PRODUCTION MODELS (BASED ON CATCH AND EFFORT DATA)

• SEMI-QUANTITATIVE METHODS (BASED ON EMPIRICAL RELATIONSHIPS)

• DYNAMIC POOL MODELS (BASED ON LENGTH-FREQUENCY DATA)

In Sri Lankan perennial reservoirs, due to the "open access" nature of resource exploitation, the fisheries are stabilized around the point of zero net economic revenue.

Fish yield is therefore linearly related to fishing intensity in perennial reservoirs of Sri Lanka.

Using this relationship, fishing intensity can be estimated for the potential fish yield in a given reservoir.
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka

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LAND USE MAP QUANTIFIED BY MEANS OF GIS

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POTENTIAL YIELD FROM CATCHMENT DATA

DYNAMIC POOL (YIELD-PER-RECRUIT) MODELS

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Oreochromis mossambicus in Sri Lankan reservoirs

In reservoirs with high fishing pressure, tilapias tend to stunt so that optimal mesh sizes of gillnets for tilapia fisheries in individual reservoirs should not be the same for all reservoirs in the country.
Body condition (i.e., relative healthiness) of Oreochromis mossambicus varies from reservoir to reservoir depending on the protein : energy ratio of ingested food (De Silva 1985).

Experience of resource users on the size structure of tilapia fish communities is therefore invaluable for making management decisions especially on mesh regulations.

Management decisions made by the centralized authorities are of little use for the management of capture fisheries in perennial reservoirs of Sri Lanka in spite of the fact that there are similarities between the fisheries of individual reservoirs.

As gillnet selection curves do not overlap, tilapias and small cyprinids can be differentially exploited in deeper (>1.5 m depth) areas of reservoir.
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka

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Figure: Decision-making models
- C – Community
- G – Government
- Decision models: Instructive, Consultative, Co-operative, Advisory, Informative

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Four pillars essential for successful co-management
- An enabling policy & legislative environment
- Empowerment of communities
- Effective linkages and institutions
- Adequate resources (e.g., Fishery, people)

CO-MANAGEMENT

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Enabling policy and legislative environment
- CBF Development:
  Legal provisions in Agrarian Development Act No. 46 of 2000 to establish the major rural institution, FARMERS’ ORGANIZATION (FO) and to develop fisheries and aquaculture in village reservoirs.
- Reservoir capture fisheries:
  Fisheries Extension Staff were appointed in place of the former Fisheries inspectors, whose major responsibility is to transfer technology, rather than enforcement of regulation.
Empowerment of communities

Culture-based fisheries (CBF) in village reservoirs are conducted by Farmer Organization (agrarian communities) rather than fisherman.

Community-based aquaculture is also within the organizational mandate of FOs, whenever a farmer community decides to adopt it.

There is a provision in the Fisheries and Aquatic Resources Act of 1996, to establish fisheries cooperative societies in perennial reservoirs.

Effective linkages and institutions

Culture-based fisheries:

- Induced Breeding of Major Carps
- Rearing P1 to Fry Stage
- Rearing Fry to Fingerling Size
- Stocking in Seasonal Reservoirs

Effective linkages and institutions

Induced Breeding of Major Carps

Rearing P1 to Fry Stage

Rearing Fry to Fingerling Size

Stocking in Seasonal Reservoirs

STATE OWNED FISH BREEDING CENTRES

POND OWNERS; FISHERS IN RESERVOIRS (CAGE CULTURE)

FARMERS' ORGANIZATIONS

Agrarian Services Department

National Aquaculture Development Authority

Regional Extension Centres

Fish Breeding Centres

Divisional Officers

ARDAs

AEOs

RAEO – Regional Aquaculture Extension Officer

AEO – Aquaculture Extension Officer

ARD - Agrarian Research & Development Assistant

Induced Breeding of Major Carps

Fry-Fingerling Rearing through Community Participation

Issuing Aquaculture Licenses

Seed Supply; Technical Know-how

Farmers' Organizations

Aquaculture Committees

Culture-based Fisheries in Seasonal Reservoirs
Effective linkages and institutions (Continued)

Reservoir capture fisheries:
As water level fluctuations affect recruitment, through strong coordination between irrigation and fisheries authorities, fish yield can be enhanced.

As catchment land-use characteristics influence reservoir productivity, fisheries authorities and those which are responsible for catchment land-use management (e.g., Forest Dept, Wildlife Dept) can collaborate for enhancing fisheries production.

Adequate resources

In the CBF development in village reservoirs,
- Group members become partners of community-managed enterprise;
- Benefits are shared on agreed basis;
- Group members invest in a commonly owned venture;
- Direct benefits go to all partners.

Adequate resources (Continued)

In capture fisheries development in perennial reservoirs,
- Fishing communities are willing to take collective decision to manage their resources;
- Reservoir fish yields support livelihood of rural communities;
- Reservoir fish production is a source of cheap animal protein for rural poor.
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Thank you!
Sociological aspects of the culture-based fisheries

Slide 1

Culture-Based Fisheries

Presented by
Dr. K. Karunathilake
Senior Lecturer in Sociology
Department of Sociology
University of Kelaniya
Kelaniya
Sri Lanka.

Slide 2

What are culture-based fisheries (CBF)

• CBF are essentially a form of extensive aquaculture, or a farming practice conducted in small water bodies (generally less than 100 ha.).
• Perennial and non-perennial water bodies selected for a CBF are stocked with suitable species in pre-determined proportions.
• A selected community/group who will have ownership of the stock, prepare the water body for stocking, procure seed stock, and care for the stocked fish, in particular by keeping watch over the stock.
• CBF are developed in common property resources but with fish stock ownership.

Slide 3

Culture-based fisheries are not entirely new, at least for some nations. Some attempts at culture-based fisheries development in the past have been unsuccessful due to many reasons.

• Lack of sufficient and effective community consultations.
• Lack of cooperation and/or consultation amongst multiple users of the water bodies, often resulting in conflicts amongst users and government authorities.
• Unavailability of suitable seed stock, often being a problem of timing to coincide with the periodic filling of the water bodies.
• Lack of suitable preparation of the water bodies prior to stocking, e.g. removal of unwanted fish species, including carnivorous species.
• Ineffective training of potential fish farmers.
• Heavily subsidized development.
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka

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Cont.
- Inadequate and inappropriate legislation, e.g. in Sri Lanka the small, non-perennial, water bodies, popularly referred to as 'seasonal tanks', are under the jurisdiction of the Department of Agrarian Services, but originally the Agrarian Services Act precluded any fisheries practices in such water bodies; and
- Poor marketing strategies;
- Physical and biological aspects of the water bodies;
- Socio-economic conditions of communities that live in the vicinity; and
- Socio-economic conditions of the potential practitioners and primary stakeholders of the planned activity.

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Why it is so important?
- Less resource-intensive
- Utilize existing water resources
- Technically far less complicated than conventional aquaculture and relatively easy to transplant it among farming communities
- A communal activity with the potential to generate synergies within and between communities
- Attractive to government and developing agencies of aquaculture
- Micro approach of improving socioeconomic and nutritional benefits among the community

Slide 6

Where CBF is developed?
- Typically and ideally, CBF are developed in small perennial and non-perennial water bodies.
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka

Slide 7

Few other examples for such water bodies in Sri Lanka

Slide 8

**Historical background of CBF**

- Traditional Sinhalese Village was organized on the basis of its physical (river, tank, range of mountain, canal, paddy field, etc.), climatic (dry, wet, intermediate), and social (caste, kinship, land ownership, religion, etc.) conditions.
- Almost all villages have had a habit of use resources in water bodies including fishing.
- Village leaders (Gamarala and then Vel Vidane) were more powerful and had right to intervene all activities take place in the village.
- Fish harvesting also was decided by the village leader.

Slide 9

**Case Study 1: Fish Harvesting in a Traditional Village of Anuradhapura District, Sri Lanka**

- "Bola Bandeema" (fix it in the tank) by Village Leader using a branch of Bolpana tree, symbolising the taboo and no accessibility to catch fish till he remove it. Usually this is fixed just after paddy cultivation. Fixing is done again when the tank water become unclear.
- Take 6-7 months to remove it.
- All fishes are locally originated varieties.
- Catching of fish using “Karaka” by “Maha Wariga”.

Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka
### Slide 10

**Method of Distribution of Fish Harvest among the Community**

<table>
<thead>
<tr>
<th>Day</th>
<th>Share</th>
<th>Entitled Group</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>First day</td>
<td>Half</td>
<td>Villager leader/Headman, elders, widows, pregnant ladies, and child rearing women</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Half</td>
<td>Fishermen from the same caste (temporal task for few days)</td>
<td></td>
</tr>
<tr>
<td>Second day</td>
<td>One third</td>
<td>Villager leader/Headman, elders, widows, pregnant ladies, and child rearing women</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two third</td>
<td>Fishermen from the same caste (temporal task for few days)</td>
<td></td>
</tr>
<tr>
<td>Third day</td>
<td>One third</td>
<td>Villager leader/Headman, elders, widows, pregnant ladies, and child rearing women</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two third</td>
<td>Fishermen from the same caste (temporal task for few days)</td>
<td></td>
</tr>
<tr>
<td>Fourth day</td>
<td>Total</td>
<td>Fishermen from the same caste (temporal task for few days)</td>
<td>Surplus will be dried up</td>
</tr>
</tbody>
</table>

### Slide 11

**Case Study 2: Fish Harvesting in a Traditional Village of Colombo District, Sri Lanka**

- Used natural water bodies, basically small ponds in the paddy fields or streams.
- Start harvesting just after paddy cultivation, usually twice a year.
- No particular organizational structure; a group/most of paddy land owners are doing it.
- They share the harvest among the participants. Sometime give a small portion to their relatives, breast-feeding mothers, etc.

### Slide 12

**Case Study 3: Fish Harvesting in a Traditional Village of Anuradhapura District, Sri Lanka**

- Based on small tanks and irrigation canals.
- Totally dependent on rainy days and during the spilling times (Van Domeema).
- Participate interested/skilled villagers only.
- Caught by hand or using sword or sharp knife.
- Distributed among family relatives and it depends on the size of the harvest.
Recent Developments of Inland Fisheries

- State interventions in fisheries; law enforcement, institutional development, research, introducing new varieties, community mobilization, organizational behaviour, etc.
- Fisheries activities vary with size of the tank; large tanks and small tanks.
- Two organizational structures can be identified;
  1. Fisheries Cooperative Societies – Managed by Fisheries Authorities
  2. Farmer Organizations – Managed by Agrarian Services Department

<table>
<thead>
<tr>
<th>Reservoir Category</th>
<th>Number</th>
<th>Extent (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major irrigation reservoirs (ancient)</td>
<td>73</td>
<td>70,850</td>
</tr>
<tr>
<td>Medium scale reservoirs (ancient)</td>
<td>160</td>
<td>17,001</td>
</tr>
<tr>
<td>Minor irrigation reservoirs (ancient)</td>
<td>&gt;10,000</td>
<td>39,271</td>
</tr>
<tr>
<td>Floodplain lakes (natural)</td>
<td></td>
<td>4,049</td>
</tr>
<tr>
<td>Upland hydroelectric reservoirs (ancient)</td>
<td>7</td>
<td>8,097</td>
</tr>
<tr>
<td>Mahaweli multipurpose system of reservoirs (recent)</td>
<td></td>
<td>13,650</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>17,023</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>169,941</td>
</tr>
</tbody>
</table>

Distribution of Small Reservoirs in the Administrative Districts
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka

### Slide 16

**Physical and Biological Aspects of the Water Bodies**
- Water retention period
- Depth and surface area
- Aquatic plants
- Submerged tree stumps and obstacles
- Presence of carnivorous species and piscivorous birds
- Productivity of the water body
- Cattle rearing practices around water bodies
- Catchment characteristics of water bodies
- Accessibility

### Slide 17

**Socio-economic Aspects**
- Willingness to be engaged in CBF practices
- Previous experiences
- Multiple use of water bodies
- Strength of community organizations
- Market demand for inland fish

### Slide 18

<table>
<thead>
<tr>
<th>Resource Characteristic</th>
<th>CBF in Village reservoirs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access rights</td>
<td>Common Property Resource (Res. Communes)</td>
</tr>
<tr>
<td></td>
<td>Often with usufruct (i.e. nontransferable) rights</td>
</tr>
<tr>
<td>Size</td>
<td>Smaller</td>
</tr>
<tr>
<td>Management authority</td>
<td>Social unit with defined membership boundaries and some common interests</td>
</tr>
<tr>
<td>Management System</td>
<td>Shared norms and sanctioned Customary rules</td>
</tr>
<tr>
<td>Incentives to participate in resource management</td>
<td>Economic and relational</td>
</tr>
<tr>
<td>Participation</td>
<td>Relatively homogeneous groups with most individuals affected by operational rules (hence compliance)</td>
</tr>
<tr>
<td>Excludability</td>
<td>Excludability determined by membership of community and multiple-use characteristics</td>
</tr>
<tr>
<td>Observability</td>
<td>High</td>
</tr>
<tr>
<td>Subtractability</td>
<td>By members of community or group mainly</td>
</tr>
<tr>
<td>Conflict resolution</td>
<td>Low cost, local arenas</td>
</tr>
<tr>
<td>Multiple-use</td>
<td>Activities in multiple layers with multiple rules</td>
</tr>
<tr>
<td>Costs of co-ordinating resource use</td>
<td>Low</td>
</tr>
<tr>
<td>Management outcome</td>
<td>Efficient/Sustainable</td>
</tr>
</tbody>
</table>
What Organizational Structure is Most Appropriate for CBF?

DISCUSSION ................
Mobilization of the communities and participatory rural appraisal

Slide 1

Mobilization of the Community and Collection of Data (Participatory Rural Appraisal) in Objective Oriented Planning

Presented by
Dr. K. Karunathilake
Senior Lecturer in Sociology
Department of Sociology
University of Kelaniya
Kelaniya
Sri Lanka.

Slide 2

What is Rapid Appraisal?

Rapid Appraisal is one of many ways for outsiders to learn, in a short, limited period, about a community or an area or an activity or specific problem they feel they do not know enough about.

Rapid Appraisal describes a repertoire of rapid approaches to collecting information and not a single, fixed methodology.

Slide 3

Salient Features

- Rapid Appraisal is an approach
- It is shorter than a full-fledged, questionnaire-based statistical survey and does not collect detailed statistics, but it can obtain a good qualitative and indicative (quantitative) picture of the situation.
- It is longer, more in-depth and less prone to bias than the fly visits to location to ‘get an idea’ of what’s going on (‘rural development tourism’).
- Rapid Appraisal cannot be done by one person. It should preferably be done by an interdisciplinary team.
- The size of the appraisal team depends on the size of the area to be studied, the topic to be studied and the complexity of the understanding to be reached by the team.
- Rapid Appraisal is systematic but flexible.
- It is not a structured survey with preset question and formats, but a selection from a repertoire of techniques which can be used, as and when required, to investigate topics which you want to lean about.
Rapid Appraisal has these Basic Features

- It is fairly Quick
- It will help you to learn what you need to know and not more
- It will help you to learn from local people
- It will help you to get many points of view and many different angles on each issue.
- It will use the views of a team made up of different disciplines to get a better overall understanding of the situation.
- It will help you to be flexible and adaptable.
- It will help you to understand seasonal differences.
- It will require you to work in the field.
- It will help you to help local people explain their ideas in ways that are easy to understand and easy to communicate.
- It will help you to avoid biases.
- It will help you to be systematic
- If you are planning to work in the area you are investigating, it will help you to involve local people right from the start.

Types of Appraisal

- Exploratory appraisals
- Participatory appraisals

Who does Rapid Appraisal?

- Post-harvest specialists (fisheries and agriculture);
- Fish economists;
- Aquaculture specialists;
- Extension and communications specialists;
- Agronomists; and
- Anthropologists.

Rapid Appraisal Techniques

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary data review</td>
<td>1. Planning appraisal. 2. Identifying objectives and coverage of appraisal. 3. Checking on need for appraisal. 4. Identifying possible topics and issues.</td>
</tr>
<tr>
<td>Preliminary workshop</td>
<td>1. Finalising objectives and coverage of appraisal. 2. Finalising topics and issues. 3. Drawing up checklists of topics and issues. 4. Selection of team members. 5. Training team members appraisal techniques. 6. Organising practical aspects of appraisal.</td>
</tr>
</tbody>
</table>
### Slide 8

**Contd:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Steps</th>
<th>Duration</th>
</tr>
</thead>
</table>
| Direct Observation            | 1. Identifying different zones within appraisal area.  
                              | 2. Identifying economic activities.  
                              | 3. Identifying key indicators of conditions.  
                              | 4. Identifying new topics or issues for discussion.  
                              | 5. Noting differences between reported conditions and real conditions. | All through fieldwork.  |
| Semi-Structured Interviews    | 1. Collection of general information on area and community.  
                              | 2. Discussion of specific topics or issues with concerned people.  
                              | 3. Identifying and ranking priorities, needs and problems.  
                              | 4. Cross-checking information and impressions.  
                              | 5. Building up case studies.  
                              | 6. Collecting historical information. | All through fieldwork.  |

### Slide 9

**Contd:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Steps</th>
<th>Duration</th>
</tr>
</thead>
</table>
| Group Interviews              | 1. Collection general information on area and community.  
                              | 2. Identifying social norms and accepted views.  
                              | 3. Identifying special interest groups.  
                              | 4. Eliciting participation of local people.  
                              | 5. Cross-checking information and fieldwork impressions.  
                              | 6. Identifying Collective views and feeling. | All through fieldwork.  
                              |                                                            | At end of fieldwork to check on information. |
| Diagrams                      | 1. Collection information  
                              | 2. Recording information  
                              | 3. Stimulating discussion with local people.  
                              | 4. Illustrating and communicating ideas and findings. | All through fieldwork.  
                              |                                                            | For reporting. |

### Slide 10

**Contd:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Steps</th>
<th>Duration</th>
</tr>
</thead>
</table>
| Ranking                       | 1. Identifying priorities of need and problems.  
                              | 2. Analysing specific topic and issues.  
                              | 3. Identifying new topics and issues. | All through fieldwork.  |
| Participatory exercises       | 1. Identifying priorities of need and problems.  
                              | 2. Eliciting participation of local people.  
                              | 3. Analysing local participation problems and potential.  
                              | 4. Identifying viable solutions.  
                              | 5. Planning future action.  
                              | 6. Cross-checking findings. | All through fieldwork.  |

### Slide 11

**Contd:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Steps</th>
<th>Duration</th>
</tr>
</thead>
</table>
| Regular reporting and brainstorming by team members | 1. Updating checklists of topics and issues for appraisal  
                              | 2. Cross-checking findings.  
                              | 3. Recording and reporting important findings.  
                              | 4. Reviewing methods and techniques used.  
                              | 5. Planning further work.  
                              | 6. Monitoring progress of appraisal. | All through fieldwork.  |
| Workshops for analysis and report | 1. Discussing and analysing findings.  
                              | 2. Sharing information and analysis with local community.  
                              | 3. Evaluating methods and techniques used.  
                              | 4. Identifying topics and issues for further investigation or research.  
                              | 5. Identifying and planning action based on finding  
                              | 6. Participatory decision making. | All through fieldwork.  
                              |                                                            | At end of fieldwork. |
How We Organize a Preliminary Workshop?

• The following persons are involved in the meeting/Workshop:
  1. All the team members;
  2. whoever it is that has asked for the Appraisal to be done;
  3. Anyone else who has a direct interest in the conduct or findings of the Appraisal; and
  4. Preferably, someone with first-hand knowledge of the area to be studied.

• As this may well be the first time that all the team members have met, generate the discussion of the team through explaining why it is needed, who is being done here and what questions it hopes to answer.

• Briefly present the finding of the secondary data review. Discuss important features and decide what questions have already been answered and what information is lacking.

Contd:

• Either in the workshop, or as a team, prepare the following:
  1. A revised list of the ‘critical questions’ which you hope to answer during the appraisal;
  2. A preliminary checklist of information to be collected during the appraisal;
  3. Issues to be investigated;
  4. Places and people to be visited; and
  5. key contacts in the area.

Sample preliminary list for Rapid Appraisal in Fisher Rural Communities

• Population
  I. Total number of inhabitants/households.
  II. Occupation groups/ethnic groups/religious groups/ castes’ by number.
  III. Age groups
  IV. Proportion of men to women.
  V. Number of women who are heads of household.
  VI. Number of children below the age of 14 (to estimate population growth rate).

Economic activities

I. Different economic activities in the area and their relative importance.
II. The Number of households involved in and dependent on each activity.
III. Locations of different activities.
IV. Proportion of men/women involved in activities.
V. Distribution of benefits among men/women.
VI. Ethnic/caste/religious groups in each activity.
VII. Seasonal changes.
VIII. Resource requirements of economic activities, their location, problems of access, and relative abundance.
Fishing Practices
I. Number/types of craft.
II. Number/types of gear
III. Craft/gear combinations and the fish species each targets (with seasonality specified).
IV. Fishing areas/species.
V. Changes over time in methods/gear/crew and the reasons for them.
VI. Interaction between fisheries.
VII. Problems.

Fisheries resources & Landings
• Species caught/sizes/catch rates/season.
• Quantities caught.
• Local knowledge of resources/location of resources.
• Alternative resources
• Local classification of species.
• Seasonal changes.
• Changes over time in quantities/species caught/marine conditions.
• Problems.

Marketing & Processing
I. Role of men/women in marketing.
II. Marketing channels.
III. Prices/revenue.
IV. Demand/customer preferences.
V. Infrastructure.
VI. Processing methods.
VII. Post-harvest and causes.
VIII. Knowledge of alternatives.
IX. Role of middlemen.
X. Seasonal changes.
XI. Changes over time.
XII. Problems.

Conflicts
I. Fishing rights.
II. Land rights.
III. Customary laws.
IV. Caste/ethnic-religious/political conflict.
V. Mechanisms for conflict resolution.
VI. Changes over time.
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka

Slide 20

Credit
I. Formal/informal credit channels.
II. Indebtedness.
III. Links to ethnic/caste/religious groups.
IV. Relative access of men/women to credit.
V. Seasonal changes.
VI. Changes over time.
VII. Problems.

Slide 21

Earnings
I. Costs/earnings for various economic activities.
II. Share systems in fish/agriculture/other professions.
III. Differences in earnings of men/women.
IV. Hired labour/earnings.
V. Seasonal changes.
VI. Important changes over time.

Slide 22

Asset ownership
I. Land ownership patterns.
II. Differences in ownership by man/women.
III. Rental of assets.
IV. Other assets owned.
V. Links to ethnic/caste/religious groups.

Slide 23

Labour
I. Labour/time required for different activities.
II. Division of labour between men and women.
III. Labour requirements for household work.
IV. Migratory Labour.
V. Seasonal changes.
VI. Shortages/excess Labour.
Slide 24

**Organization**
- Formal/ informal organizations.
- Leadership.
- Activities.

**Living Conditions**
- Health care facilities.
- Education facilities.
- Sanitation.
- Housing quality.
- Nutrition status.
- Water availability and quality.
- Transportation/ Access.

Slide 25

**Outside Linkages**
- Immigration/ emigration
- Kinship
- Communications/ transport.
- Government/ NGO activities.
- Information sources.

**Women's Role**
- Women's activities.
- Women's earnings/ control of earnings.
- Status at home/ in community.
- Role in fish marketing/ processing.
- Expectations
- Education.
- Women's organizations.

Slide 26

**Conditions Observable First-hand**
Here is a sample list of possible indicators of conditions which could be observed first-hand

**Housing**
- Types of walls/floors/roofing.
- Their relationship to professing/ ethnic group/ earnings.

**Levels of Consumption**
- Numbers and types of radios/TV/ bicycles/motorbikes/utensils.
- Goods available in local shops.

**Nutrition**
- Signs of under/ malnutrition among children.
- Signs of disease/ infections/skin conditions.
- Signs of iron deficiency among women.
- Types/ quantity of food available for sale.

Slide 27

**Family planning**
- Numbers of children/ age groups/ distribution.

**Fishing Practices**
- Size/condition/age of craft.
- Construction of new craft/ types of craft.
- Condition/ age of gear.
- Types of gear/ equipment available for sale.
- Age of fishermen and crew.

**Fisheries resources**
- Indicator species.
- Sizes of species caught.
- Relative quantities/ different species.
- Gear used/ species caught.
Cont:

Post - harvest
I. Types of processing.
II. Species processed.
III. Location of landings.
IV. Prices actually being paid.
V. Use/ availability of ice.
VI. Relationship between fisherman/ buyer.

Women's role
I. Activities of women.
II. Freedom of movement.
III. Responsibility for water/ fuel collection.
IV. Distance to water/fuel.
V. Women heads of household.
VI. Businesses run by women.
VII. Age/proportion of girls in school.
Effective data collection methods in inland fisheries
Slide 1

Capacity building of field staff of NAQDA: Effective data collection methods

Upali S. Amarasinghe
Department of Zoology
University of Kelaniya
Kelaniya

Slide 2

Fish yield predictive models

In fisheries management, it is necessary to know the amount of fish that can be harvested from a stock without destroying it.

With increasing fishing effort, yield increases up to a certain level and thereafter yield declines.

Slide 3

The decrease in stock size with increasing fishing effort occurs in two ways.

"growth overfishing" - removes too many small fish and limits the stock below the range for maximum yield (mean size of fish in harvest is too small)

"recruitment overfishing" - removes too many adult fish, thereby reducing the reproductive contribution such that the stock is limited below the range for maximum yield
**Slide 4**

Uniform distribution

Random distribution

Clumped distribution

---

**Slide 5**

Fish stocks are not uniformly distributed. They are either randomly distributed or exhibit clumped (patchy) distribution.

Quadrats are used for determining distribution of small insects in a sampling site. Here, quadrat is the sampling device.

---

**Slide 6**

Fishing gear unit can also be considered as a sampling device of fish populations in a reservoir.
If more or less similar number of fishing gear units is used in each boat, number of boats is proportional to number of fishing gear units.

If each boat is manned by similar number of fishermen, number of fishermen is also proportional to fishing gear units.

Therefore, various expressions can be used as fishing effort (Number of nets x fishing days, Number of boats x fishing days, Number of fishermen x fishing days).

If the efficiency of fishing gear unit is higher, it catches more fish.

Therefore, in fisheries data collection, it is necessary to identify the fishing gear units which are more or less equally efficient.

Discussion on the selection of the most appropriate measure of fishing effort .............

Number of insects in the quadrat is proportional to insect abundance.

Amount of fish caught in fishing gear is proportional to fish stock abundance.

Catch per unit effort is an index of fish stock abundance.
Importance of fisheries statistics for fisheries management

- For planning welfare activities of fishing communities;
- For human nutritional studies;
- For fish stock assessment (to determine optimal fishing strategies for sustainable utilization of fishery resources.)

Surplus yield models
Surplus yield models are based on the population growth curves.

The growth in biomass of the population is sigmoid and reaches to a maximum level. This maximum level is determined by the "carrying capacity" of the habitat for that population.

In the surplus yield models, we consider only the 'input' (i.e., fishing effort) and the 'output' (i.e., fish yield).

Therefore, this is a "black-box" approach.

When the biomass at the carrying capacity level ($B_\infty$) is achieved, biomass does not increase further. Also when the biomass is zero, biomass growth is also zero.
Maximum rate of biomass increase occurs when the biomass = 0.5*B∞

When the biomass at time t is plotted against biomass at time t+1, the surplus biomass is given above the replacement line.

The maximum surplus biomass is at the biomass level of B∞/2.

At any biomass level, the surplus biomass can be harvested without harming the population size because population regenerates to its original level.

The relationship between the biomass and surplus yield is a symmetrical parabola. The maximum surplus yield is achieved at B∞/2.

This is called “Maximum sustainable yield” (MSY).
In a virgin (un-exploited) fish stock, biomass is $B_\infty$. When this stock is fished, biomass reduces. If the amount of harvesting is exactly the surplus yield, at a given level of fishing effort, stock size remains at the same level from year to year.

The maximum surplus yield is achieved when the fishing effort harvests the biomass to reduce it to the level of $B_\infty/2$. MSY is therefore achieved at this fishing effort ($f_{opt}$).

This symmetrical parabola relationship is mathematically expressed as, $Y = af - bf^2$ where, $Y = yield$, $f = fishing$ effort, and $a, b$ are constants.

By rearranging this equation, $Y/f = a - bf$

Therefore, CPUE = $a - bf$

MSY = $a^2/4b$

$f_{opt} = a/2b$

Yield for a given effort = $af - bf^2$

This is called Schaefer surplus yield model (W.E. Schaefer, 1954).

In surplus yield models, the units chosen to express fishing effort do not matter as long as they remain consistent.

The unit of effort ($f$) should be a one that is proportional to fishing mortality ($F$).

That means, the catchability coefficient ($q$) of the unit of fishing effort chosen should be constant.

$F = q^*f$
If the fishing effort is expressed as boat-days (number of boats * number of fishing days), CPUE is expressed as kg per boat-day.

If the fishing effort is proportional to fishing mortality, CPUE gives an index of abundance.

When there are several fishing methods with different efficiencies, fishing effort for each fishing method should be standardized to a "common currency."

Fishing effort of various fishing methods can be converted to standard units by estimating relative fishing power (RFP)

\[ \text{RFP} = \frac{\text{CPUE of fishing method } i}{\text{CPUE of standard fishing method}} \]

<table>
<thead>
<tr>
<th>Fishing method</th>
<th>Effort (boat-days/yr)</th>
<th>Catch (kg)</th>
<th>CPUE (kg/boat-day)</th>
<th>Relative fishing power</th>
<th>Standard effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gillnet</td>
<td>( f_1 )</td>
<td>( C_1 )</td>
<td>( C_1/f_1 )</td>
<td>( f_1 * \text{RFP} = f_{\text{std1}} )</td>
<td>( f_{\text{std1}} )</td>
</tr>
<tr>
<td>Beach seine</td>
<td>( f_2 )</td>
<td>( C_2 )</td>
<td>( C_2/f_2 )</td>
<td>( f_2 * \text{RFP} = f_{\text{std2}} )</td>
<td>( f_{\text{std2}} )</td>
</tr>
<tr>
<td>Cast net</td>
<td>( f_3 )</td>
<td>( C_3 )</td>
<td>( C_3/f_3 )</td>
<td>( f_3 * \text{RFP} = f_{\text{std3}} )</td>
<td>( f_{\text{std3}} )</td>
</tr>
</tbody>
</table>

Total effort in standard units = \( f_{\text{std1}} + f_{\text{std2}} + f_{\text{std3}} \)

= \( \frac{C_1 + C_2 + C_3}{C_1/f_1} \)

Advantages of surplus yield models:
- They require only catch and effort data. These data are accumulated over many years in the official databases of most fisheries.
- MSY and optimal effort are easy to calculate. It is not necessary to employ a biologist for the purpose. The fishery managers do not have to observe actual catches. [The model can be calculated without getting hands and feet wet in examining fish catches.]
- These models are useful to set limits to total catch and effort in fisheries.
- They are useful as the first "rough-cut" in fisheries management in the fisheries where there are no any management procedures.
Achieving MSY and optimal effort is the biological objective of fisheries management using surplus yield models.

However, from economic point of view, achieving maximum profit is important. The surplus yield models can be used to estimate Maximum Economic Yield (MEY).

If the value of a unit weight of fish (kg) remains constant, value of the catch is proportional to catch. Similarly, if the cost of unit effort is constant, cost of fishing is proportional to fishing effort.

The maximum profit can be achieved when the difference between cost and revenue is maximum. This is called Maximum Economic Yield (MEY).

When the fishery has ‘open access’, the fishery tends to be stabilized at the zero profit level.

Data Collection & Sampling Process

- Data obtained by Extension Officers from Log book entries of well established Fisheries Societies of perennial reservoirs.
- Data collected by EOs by regular visits to reservoirs through physical verification and sampling of catches from boats.

Sampling process:
EO—Reservoir—8 boats/day/week—32 boats/month
- Each EO is assigned to sample 2 reservoirs/month (minimum/District)
- Data of all 64 samples collected/month from 2 reservoirs are sent to Head Office for analysis.
Collecting fisheries data from one landing site is not sufficient. Stratified sampling (area-wise) is necessary.

Sample size (number of boats to be sampled) depends on the variability of CPUE.

When there is no variability, number of boats to be sampled for accurate yield estimate is less.

Which one requires less number of samples to be taken to estimate abundance accurately?
Community participation for accurate data collection.
Muthukandiya reservoir
Urusitawewa reservoir
Inginiyagala Senanayaka Samudra

Discussion on the possibilities of effective data collection
Objective-oriented planning

Slide 1

Objective Oriented Planning

Presented by
Dr. K. Karunathilake
Senior Lecturer in Sociology
Department of Sociology
University of Kelaniya
Kelaniya
Sri Lanka.

Slide 2

The Stages of Developing a Project

<table>
<thead>
<tr>
<th>ANALYSIS PHASE</th>
<th>PLANNING PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem analysis – Identification of problems; determining cause and effect relationships</td>
<td>Log frame – Defining the project structure; testing its internal logic, formulating objectives in measurable terms, defining means and cost (overall)</td>
</tr>
<tr>
<td>Objective analysis – Developing objectives from the identified problems; identifying means to end relationships, assessing acceptability of identified relationships. Stakeholder analysis – Identifying stakeholders, their key problems, and interests.</td>
<td>Activity scheduling – Determining the sequence and dependency of activities; estimating their duration, setting milestones and assigning responsibility</td>
</tr>
<tr>
<td>Option analysis – Identifying the most suitable strategy to achieve Objective; Appraisal of different strategies</td>
<td>Resource scheduling – From the activity schedule, developing input schedules and a budget log frame</td>
</tr>
</tbody>
</table>

Slide 3

Logical Frame

Specific Objective I: Strengthening the community through participatory approach

<table>
<thead>
<tr>
<th>Activity/Sub Activity</th>
<th>Input</th>
<th>Output</th>
<th>Means of verification</th>
<th>Risk Assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Mobilization</td>
<td>Interaction with stakeholders</td>
<td>Discussions</td>
<td>ED-field records</td>
<td>Claims of ownership, access to water, individual interests.</td>
</tr>
<tr>
<td>Discussion with FO and FOs</td>
<td></td>
<td>Villagers Consent for CMB</td>
<td>FO records</td>
<td></td>
</tr>
<tr>
<td>Form a Functional Group</td>
<td>Formal discussions with FO and other CBOs</td>
<td>Forms a functional group</td>
<td>ED-field records</td>
<td>Individual interest and fragmentation among villagers.</td>
</tr>
<tr>
<td>Make an agreement with FO</td>
<td></td>
<td></td>
<td>Field records Sub-Committee Records</td>
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</tr>
<tr>
<td>Legalized the Functional Group and its tasks</td>
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</tbody>
</table>
The Analysis Phase of OOP

Stakeholder Analysis
Objectives analysis
What Objectives need to be achieved to 'solve' the Problem?

Options analysis
Which option is the most suitable to achieve the Objective?

Problem Analysis
What is the Problem?

Objective Oriented planning - outline

I. Problem analysis
II. Objectives analysis
III. Stakeholder analysis
IV. Options analysis
Slide 7

The Definition of a Problem

A Problem is the discrepancy between the desired situation and existing situation

Where you are now (Objective) Where you want to be

Problem

The situation as is The situation as desired

Slide 8

When is Problem a Problem?

What some people view as Problem may Not be a Problem at all to someone else.

Different stakeholders will have different Ideas about what is a Problem.

Slide 9

When is Problem a Problem? Situation: it is Raining

Yes NO

• Tourist: holiday is ruined • Seller of umbrellas: good business
• Shops in the market: • Farmer/ gardener: rain is good for the crops/garden
• customers stay at home • Sportsman: football game is cancelled • Bowling alleys/cinemas
The Steps in Problem Analysis

1. Identify major existing Problems, based on available information (PRA Exercise)
2. Select one main Problem for the analysis
3. Identify important direct causes
4. Identify important and direct effects of the focal Problem
5. Review the entire Problem tree

Identify the Existing Problems

At the start of the Problem analysis list all the Problems that you can identify

List only existing Problems

Select the Focal Problem

Determine which of the Problems you have Listed is your main Problem.

In other words: the Problem that your project will try to solve or will address.
**Identify Causes of the Problem**

Identify the causes by asking the question: why?

In determining the causes of the focal Problem it is important to make sure that we do not skip any steps in the relationship between the Problem and the causes of the Problem.

Peter was bored yesterday played outside with Peter was not prepared for his exam

Peter asked John to play outside John played outside with Peter

John did not study for his exam

John failed his exam

**Identify Causes of the Problem**

Place the cause and effect relationship in Problem Tree which shows the relationship between the Problem and causes

![Problem Tree Diagram]

**Identify Effect of the Problem**

This step is to step 3... but instead of asking “why?” a Problem exists, the question is what does this Problem lead to?

![Effect Tree Diagram]
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**Review the Entire Problem Tree**

In the final step, the entire tree should be reviewed to make sure that it is valid and complete.

The tree should ‘read’ like a logical sequence of cause and effect relationships.

---

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**The step in a Problem Analysis**

1. Identify major existing Problems, based on available information
2. Select one main Problem for the analysis
3. Identify important direct causes
4. Identify important and direct effects of the focal Problem
5. Review the entire Problem tree

---

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**ABD Project Designing and Monitoring Framework**
**Design Steps**

1. **Determine key stokeholders**
   Identify people and organizations who are directly or indirectly involved in or affected by the development problem that will be the proposed project.

2. **State the development problem**
   Describe in terms of observations or symptoms. Do not describe in terms of a solution - “jumping to the solution.”

3. **Prepare a problem tree**
   Establish causes and effects of problems by asking why?

4. **Change problems to objectives**
   Restate all problems in positive terms describing future solution to the problem.

5. **Develop an Objectives Tree**
   Review objectives, checking that all means-ends relationships are valid and that there is no means-ends relationships missing.

6. **Select Alternative Solutions**
   Identify alternative means of achieving the desired situation or Development objective – the project outcome.

---

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Cont.

7. **Screen Alternatives through REESI**
   - **Relevance:** Effectiveness; Efficacy; Sustainability; Institutional Development
   - Weigh up the risks of each alternative and discuss options and associated costs with stakeholders.

8. **Transfer Objectives Tree to Design Monitoring Framework.**

9. **Select Performance targets and Indicators**
   The indicator outlines What will be measured. The performance target specifies quantity, and time - how much by when.

10. **Determine Data Sources and Reporting Mechanism**
    Data sources show where information on the status of each indicator can be obtained, who provides the information, and who it is collected. Reporting mechanisms state where the information is Documented.

11. **Identify Assumption and Risks and Determine Risk Responses**

---

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**Design and Monitoring Framework Approach**

- **Design and Monitoring Framework**
- **Reference Version**
- **Design Summary**
- **Performance targets/ Indicators**
- **Data Sources/ Reporting Mechanisms**
- **Assumption/ Risks**
- **Impact**
- **Outcome**
- **Outputs**
- **Activities With Milestones**
- **Inputs**
Situation Analysis

There are two Analytical tool used to conduct the situation Analysis:

1. Stakeholder Analysis (Primary and Secondary Stakeholders) and
2. Problem Analysis

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- Stakeholder analysis may comprise a series of focus-group meetings/Discussions, Key-Informant Interviews, and workshops.
- Define group categories narrowly or broadly, depending on the situation.
- Make sure to have all fundamental information of the key Stakeholders.
- Perform detailed analysis of the key Stakeholders.
- Keep Stakeholder analysis updated during project implementation because this is a vital source information. This process can be integrated into regular project review missions.

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- Mind Mapping. Mind Mapping, a semi structured form of brainstorming, can be a powerful tool during this stage. While the software for recording mind maps is available, it is best to hand-draw your drafts to stimulate thinking and maximize group participation. Other brainstorming method and tools to identify problems, such as SWOT Analysis, may also be used.
- Thinkature is a virtual pin board ideal for creating problem tree. http://thinkature.com
- Specificity and Clarity. The usefulness of Problem Analysis is enhanced by clear and Specific Problem statements; for example: agricultural productivity is low is more clearly stated as agricultural production dependent on manual labor.
- Short-circuit Analysis. Most Problem have multiple causes. Make sure that preconceived Problem or solutions of one Stakeholders, including the ADB team, do not dominate the Problem Analysis.
Cause-effect Loose. There are occasions when the same Problem is stated twice within the Problem hierarchy. This results in a cause-effect loop; for example high incidence of poverty may be the cause of malnutrition. It is the effect of few income earning opportunities. Apart from some exceptions, this should be seen as indication that the Problem Analysis needs to be future defined. This is particularly the case when the statements have some similarity.

Review. The Problem tree, the product of Stakeholder consensus, is likely to undergo various revisions for the following reasons: (1.) Problem statements may need factual verification (e.g., Are Problem statement true? Do they reflect what is actually happening now?); (2.) Cause–effect links may need verification through research or further consultation with stakeholders or technical experts; (3.) a second or third key Problem may need to be addressed in the analysis to give a full picture; or (4.) other stakeholders may need to be consulted as new issues uncovered during the analysis.

Mind Mapping

Process Agriculture Education

Determine the basic indicator - what is to be measured?

Decide on the quality - how much (increase/decrease)?

Describe the quality - what kind of change?

Add the time frame - by when?

Step in Determining Performance Indicators
Data Sources/ Reporting Mechanisms of the Transport Project

<table>
<thead>
<tr>
<th>Design Summary</th>
<th>Performance Targets/ Indicators</th>
<th>Data Sources/ Reporting Mechanisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td></td>
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<tr>
<td>Outcome</td>
<td></td>
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<tr>
<td>Outputs</td>
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</tr>
</tbody>
</table>

Impact

The Impact, also termed goal or longer-term objective, refers to the sectoral, subsector, or in some cases national objectives.

a) Ensure that there is a direct means-end relationship between the outcome and the impact.
b) Clearly state a desired result and do not phrase in action such as “to develop”, “to contribute to”, etc.
c) Do not summarize the logic of the project by using connecting words such as “through” or “by” or “for”.
d) Express the expected beneficial consequences or Impact on a defined group of people, reflecting that development is about conferring benefits on people.
e) Describe results that can be measured.
f) Note that poverty reduction should not generally be treated as the “impact” of a project because there are many steps between project and the ultimate goal of poverty reduction.

Project Outcome

The project outcome is the key anchor of the project design. It describes what the project intends to accomplish by the end of project implementation and by doing so makes it clear what development problem the project will address.

i. Limited to one succinct statement to ensure clarity and focus. More than one outcome implies that there are a number of subprojects/components under the umbrella of a more generalized project. These need to be either rephrased into outputs or summarized into a single statement associated with several indicators outlining the dimensions of the outcome;

ii. Expressed in in change language instead of action language to reflect accomplishments;

iii. Phrased as an improvement over a baseline situation, which is described in the performance target and indicators column;

iv. Reasonably achievable- subject to assumption and risks by the end of the project implementation to be reported on in the project or TA completion report (PCR/TCR); and

v. Necessary but not sufficient to achieve the impact.
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### Outputs

Outputs are the physical and/or tangible good and/or services delivered by the project and describe the scope of the project.

I. Each output has to be necessary to achieve the stated outcome.

II. Include only outputs that can be delivered by the project and are feasible with the resources available.

III. Do not use the infinitive tense (e.g., To assess, to prepare) at the beginning of output statements; these imply activities.

IV. Components are not outputs; Components are a collection of outputs conveniently grouped for finance or administrative purposes.

V. For Complex projects and programs, Include an output for project management, e.g., project management system operational. This output summarizes routine events and activities of the project implementation team or unit, including planning, monitoring and evaluation, procurement, and reporting. Tasks can also include communicating with stakeholders, providing input on strategic and policy issues, and instigating mitigation measures in the event that a risk hinders project implementation.

VI. Examples of outputs for capacity development approved,

- Government policy on capacity development approved,
- Capacity development plans finalized,
- Agency leadership in place, and
- Agency staff skills upgraded.

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### Activities

Activities are the groups of tasks carried out using project inputs to produce the desired outputs. Points to note are:

I. List only those activities that present the main steps in the transformation process, turning inputs into outputs. They should not be a restatement of an output as an action.

II. Activities should be possible with the available inputs.

III. Include completion dates and/or important milestones for each Activity.

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### Inputs

Inputs are the main resources required to undertake the activities and to produce the outputs.

I. Inputs by financier and main cost categories financial and/or physical terms.

II. In-kind contributions from other stakeholders.
Assumptions and Risks Matrix

<table>
<thead>
<tr>
<th>A: Probability of failure</th>
<th>R: Expected Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Mitigate</td>
</tr>
<tr>
<td>Medium</td>
<td>Mitigate and create contingency plan</td>
</tr>
<tr>
<td>Low</td>
<td>Ignore</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
</tr>
<tr>
<td></td>
<td>Mitigate</td>
</tr>
</tbody>
</table>

Criteria for Success (REESI)

Relevance: Consistency of a project’s impact’s outcome, and outputs with the government’s development strategy, ADB country strategy and program, and ADB’s overall strategic objectives; assessed for time of approval and also for time at which project is completed.

Efficacy: Achievement of outcome as specified in the design and monitoring framework and/or formally modified during implementation.

Efficacy-Compares Achievement of project outcome with use of inputs, based on implementation performance with consideration of the economic internal rate of return or cost effectiveness.

Sustainability: Likelihood that human, institutional, and financial resources can support and sustain the Achievement of results and benefits beyond the life of the project.

Institutional Development and other impacts - the extent to which the project has contributed to the improvements of the enabling environment of the country, so that its human, financial, and natural resources may be used more effectively.
Strategies for development of Asian reservoir and lake fisheries: Activity – Capacity Building - Sri Lanka

Group activities

Slide 1

Group Works

• Group One – Stakeholder Analysis
• Group Two – Develop a Logical Frame work
• Group three – Mind Mapping

Slide 2

Group One - Stakeholder Analysis

<table>
<thead>
<tr>
<th>Primary Stakeholders</th>
<th>Responsibility/cooperation Expected</th>
<th>Secondary Stakeholders</th>
<th>Responsibility/cooperation Expected</th>
</tr>
</thead>
<tbody>
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</table>

Slide 3

Group Two - Logical Frame

<table>
<thead>
<tr>
<th>Specific Objective</th>
<th>Activity/Sub Activity</th>
<th>Input</th>
<th>Output</th>
<th>Means of verification</th>
<th>Risk Assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Community Mobilization</td>
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<tr>
<td></td>
<td>Review secondary sources</td>
<td></td>
<td></td>
<td>Interaction with stakeholders</td>
<td></td>
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<tr>
<td></td>
<td>Identify stakeholders</td>
<td></td>
<td></td>
<td>Discussions</td>
<td></td>
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<tr>
<td></td>
<td>Conduct a meeting with stakeholders</td>
<td></td>
<td></td>
<td>Villagers Consent for CBF</td>
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<td>FO field records</td>
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<td>FO records</td>
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<td></td>
<td>Form a Functional Group</td>
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<td>Conduct a PRA</td>
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<td></td>
<td>Discuss with FO</td>
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<td>Identify a suitable active member</td>
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<td>Form a sub committee responsible to FO</td>
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<tr>
<td></td>
<td>Make an agreement with FO</td>
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</tbody>
</table>

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### Slide 4

**Objective Analysis**

**Main Objective** – Introduce and expansion of culture based fisheries in seasonal tanks in Sri Lanka.

**Specific Objectives**
- To strengthen rural community through participatory approach in utilizing village resources, specially village tank
- To form and strengthening FO and its Sub-Committee for CBF
- To design an appropriate plan
- To implement the plan developed by the community/functional group or sub-committee
- To find out suitable market accessibility which makes high profit

### Slide 5

**Group Three - Mind Mapping**

**Form a Functional Group**
- Develop a design/Plan

**Community mobilization for CBF in a seasonal tank**
- Implementation harvesting & Marketing