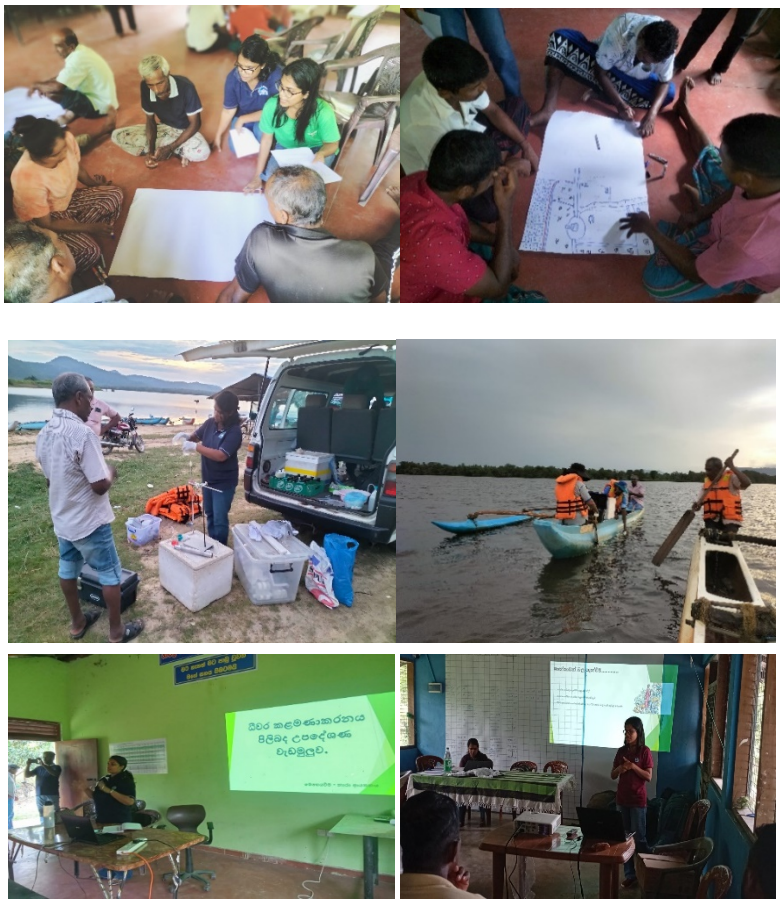
Technical Assistance for the Development of a Self-sustained Culture-based Inland Fisheries Cluster Model in the Ampara District

Final Report



A.M.A.N. Adikari, D.W.L.U. De Silva and P. P. M. Heenatigala

National Aquatic Resources Research and Development Agency (NARA)

Mattakkuliya, Colombo 1

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1. Executive Summery

This report provides an in-depth evaluation of culture-based fisheries management within Sri Lanka's reservoirs, drawing upon data on stocking, species-wise production and fishing intensity, complemented by socio-economic surveys and institutional assessments. The study critically examines the effectiveness of fish stocking programs, hydrological and environmental influences, fishing pressures, and governance capacities of Reservoir Fisheries Organizations (RFOs). The overarching objective is to advance sustainable fisheries management and improve the livelihoods of communities that depend on these aquatic resources.

The biological analysis highlights a clear positive relationship between carp stocking densities and fish yields, up to an optimal threshold beyond which overstocking diminishes productivity. This trend is particularly pronounced in medium-sized reservoirs, where tailored stocking densities are crucial to maximize yield. In contrast, tilapia stocking demonstrated negligible influence on fish production due to the species' self-recruiting nature, indicating that routine stocking for tilapia may be an inefficient allocation of resources. Freshwater prawn stocking remains underutilized, suggesting potential for expansion within culture-based fisheries. Although various hydrological and limnological parameters were assessed, their correlation with fish yield was largely inconclusive over the study period, underscoring the need for longer-term environmental monitoring and data collection. Additionally, fishing intensity measured as the number of fishers per hectare was found to interact significantly with stocking density, emphasizing the importance of managing fishing effort in conjunction with stocking programs to achieve sustainable yields.

From a socio-economic standpoint, the report underscores the critical role reservoir fisheries play in supporting rural livelihoods, often supplemented by subsistence agriculture such as paddy cultivation. The RFOs surveys exhibit robust community governance characterized by clearly defined membership, collective decision-making, and effective conflict resolution mechanisms, consistent with established institutional frameworks. Nevertheless, challenges remain in enforcing regulations, monitoring fishing activities, and maintaining cohesion within some organizations. Notably, the absence of proximate ice production facilities and insufficient fish storage infrastructure adversely affect post-harvest quality and market access, thereby limiting economic benefits for fishing communities. Furthermore, gaps in collaboration between RFOs and law

enforcement agencies weaken efforts to curb unauthorized fishing, a significant threat to resource sustainability.

In light of these findings, the report recommends the adoption of reservoir-specific stocking protocols that optimize fingerling densities, prioritizing carp species where positive yield responses are evident, while phasing out routine tilapia stocking practices. Empowering RFOs through capacity building to enhance resource monitoring and stronger partnerships with enforcement agencies are essential to effectively address illegal fishing activities. Investment in infrastructure, including establishing local ice production plants and community-managed freezing and processing facilities, is vital to reduce post-harvest losses and add value to fishery products at the community level.

Strengthening institutional frameworks within RFOs is equally imperative. This involves encouragement unity and commitment among members, instituting transparent fund management, and enforcing sanctions for non-compliance to uphold organizational discipline and efficacy. Finally, expanding collaborative research and training programs involving RFOs, governmental bodies, NGOs, and academic institutions will provide the necessary knowledge transfer and adaptive management support. Integrating biological, hydrological, institutional, and socio-economic dimensions will create a resilient and sustainable framework for reservoir fisheries, ultimately contributing to national food security and the socio-economic upliftment of rural communities reliant on these vital natural resources.

1. Introduction

The inland fisheries and freshwater aquaculture sector currently accounts for approximately 29% of the nation's total fish production. This sector is vital for bolstering the rural economy in the interior regions of Sri Lanka and plays a significant role in promoting food security, improving nutritional standards, and creating employment and livelihood opportunities. In 2022, the production of inland fish from reservoirs reached 100,930 metric tonnes, with a market value of Rs. 50,970 million. This figure represents 86% of the total inland fish and aquaculture output, which amounts to 116,980 metric tonnes. The industry directly and indirectly supports the livelihoods of over 65,000 individuals. Given that this industry operates primarily in rural areas, its promotion yields direct benefits for the rural population. In Sri Lanka, the extensive reservoir

resources, covering a cumulative area of 260,000 hectares, facilitate productive inland fisheries and culture-based fisheries (CBF).

Research indicates that the optimal utilization of perennial reservoirs for fish production through the establishment of self-sustaining culture-based fisheries presents a sustainable, low-input, and efficient approach to ensuring food security, particularly for rural communities in the interior of Sri Lanka. Studies have demonstrated significant increases in fish catches, improved livelihood opportunities, and enhanced income for fishers following the introduction of CBF.

The Government of Sri Lanka has consistently supported the advancement of inland fisheries by allocating funds for the stocking of reservoirs and enhancing fish seed production. However, challenges remain regarding the capacity to produce sufficient seed for stocking and the financial sustainability of maintaining this system without cost recovery. Therefore, Sri Lanka must transition towards a self-sustaining model for sustainable CBF that leverages the aforementioned strengths and encompasses the country's perennial reservoirs, which cover an estimated water area of around 200,000 hectares. The Government of Sri Lanka has prioritized this development initiative.

3.0 Output 2: Increased Fish Fingerling Stocking

3.1 Methodology

Data on stocking were obtained from the NAQDA database, covering the period from 2012 to 2022, for major and medium perennial reservoirs across the country. NAQDA executes a strategically designed stocking initiative that encompasses all inland reservoirs of the country, including both perennial and seasonal water bodies. The fin fish species such as Catla (*Catla catla* – Plate 3.1), Rohu (*Labeo rohita* - Plate 3.2*)*, Mrigal (*Cirrhinus mrigala*-Plate3.3), Silver Carp (*Hypophthalmicchthys molitrix* -Plate 3.4) Bighead Carp (*Hypophthalmicchthys nobilis*-Plate 3.5*)*, Grass Carp(*Ctenopharyngodon idella* -Plate 3.6*)*,Common Carp (*Cyprinus carpia*- Plate 3.7), *Tilapia nilotica* (Genetically Improved Farmed Tilapia-GIFT) (GIFT -Plate 3.8)and Hirikanaya (*Labeo dussumieri*- Plate 3.9) are normally stocked to the reservoirs. Except for fin fish species post larvae of Giant Freshwater Prawns (FWP) (*Macrobrachium rosenbergii* -Plate 3.10) are also stocked in reservoirs.

Plate 3.1 *Catla catla*

Plate 3.2 *Labeo rohita*

Plate 3.3 *Cirrhinus mirigala*

Plate 3.4 *Hypophthalmicchthys molitrix*

Plate 3.5 *Hypophthalmicchthys nobilis*

Plate 3.6 *Ctenophaaryngodon idella*

Plate 3.7 *Cyprinus carpia*

Plate 3.8 *Tilapia nilotica*- GIFT

Plate 3.9 *Labeo dussumieri*

Plate 3.10 *Macrobrachium rosenbergii*

The number of reservoirs used from the database for the present work was 31 major and 61 medium reservoirs. Total number of reservoirs was 92. The rationale for selecting these reservoirs for the present work was that stocking and production data of fin fish species and FWP were considered reliable based on well-organized fisheries societies in these reservoirs, likely to provide accurate data logs. In addition to stocking and production data of fin fish species and FWP (Table 3.1), information about the extent of the reservoir's supply level was gathered from the Irrigation Department (Table 3.2).

The fin fish species and FWP landed were caught in the gill net (mesh size ranges from 4- 16 inches). The data on production in the NAQDA database is derived from the annual catch figures for each species. It does not reflect production related to specific stocking activities. Therefore, in the present work production for the particular stocking was calculated. For this, in the case of fin fish species, it was assumed that stocked fish re-appeared as the size of consumer preference in the landing generally about 1 year after stocking and for the FWP it was considered 6 months after the stocking. Based on these assumptions species wise production was calculated.

3.2 Results

3.2.1. Evaluation of Culture-based Fisheries of the Medium Reservoir of Sri Lanka

The correlation between yield and the stocking of carp exhibits a non-linear pattern, as illustrated in Figure 3.1. This observation indicates that, during the past ten years, the culture-based fisheries of carp species in the medium reservoirs of Sri Lanka have been functioning at a level that exceeds the optimal threshold.R^2value of 0.3463 indicates that this model does not explain a large proportion of the variability in fish yield. There may be other important factors affecting fish yield

that are not included in this model. The ideal stocking density for medium-sized reservoirs appears to be around 1000 fingerlings per hectare.

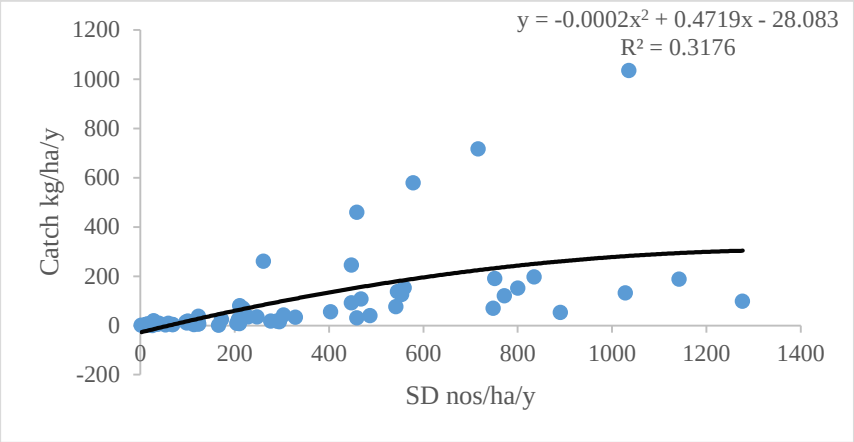


Figure 3.1 Relationship between stockings of fingerlings and yield of the Exotic carp species medium perennial reservoirs

The correlation between the stocking and yield of tilapia species was found to be insignificant in the medium reservoirs of the country (Figure 3.2). Given the biological traits of tilapia species, regular stocking is not advisable for these reservoirs. Consequently, over the last decade, efforts to implement culture-based fisheries for tilapia species in medium perennial reservoirs have proven to be ineffective.

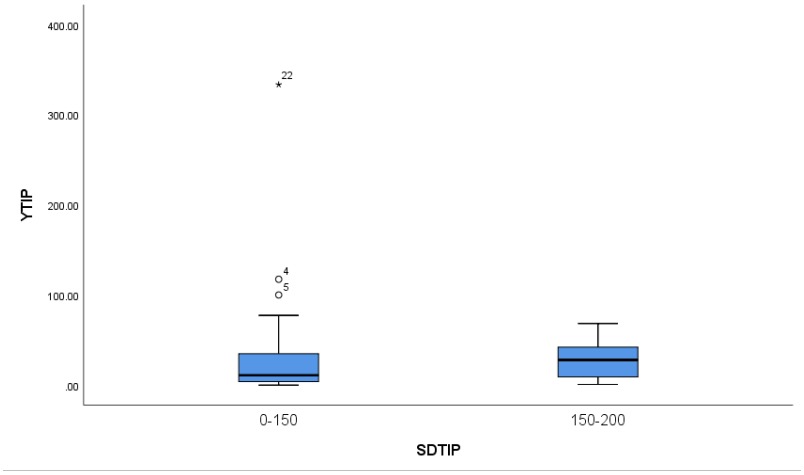


Figure 3.2 Relationship between stocking of fingerlings (Number of fingerlings/ha/y) and yield (Kg/ha/y) of Tilapia species in medium perennial reservoirs

A notable correlation was observed between the stocking of post-larvae of giant freshwater prawns and the yield in medium perennial reservoirs (Figure 3.3).

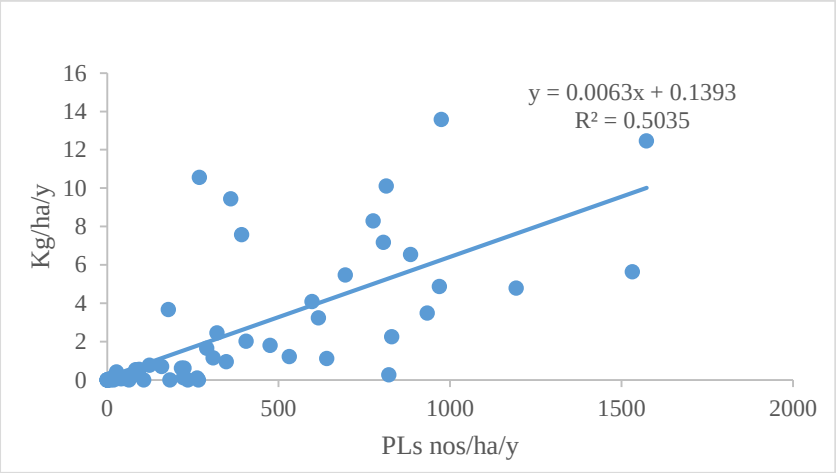


Figure 3.3 Relationship between stocking of post-larvae and yield of giant freshwater prawns in medium perennial reservoirs

Nevertheless, the stocking of these prawns was conducted at an optimal level, indicating a greater potential for further development of culture-based fisheries in medium perennial reservoirs.

NAQDA was unable to provide the reservoir-based data regarding the number of fishermen engaged in fishing activities and the annual or monthly count of canoes operated, despite having initially agreed to supply this information during the project's preliminary discussions. Consequently, we utilized the number of active fishermen in these reservoirs to establish a correlation between fishing intensity and the yield of cultured species. Here, fishing intensity was derived as a number of active fishers per ha per year. However, the alternative data did not yield more accurate results.

The regression analysis indicated that the reservoir areas at Full Supply Level (FSL) and the intensity of fishing were not statistically significant. (Figure 3.4)

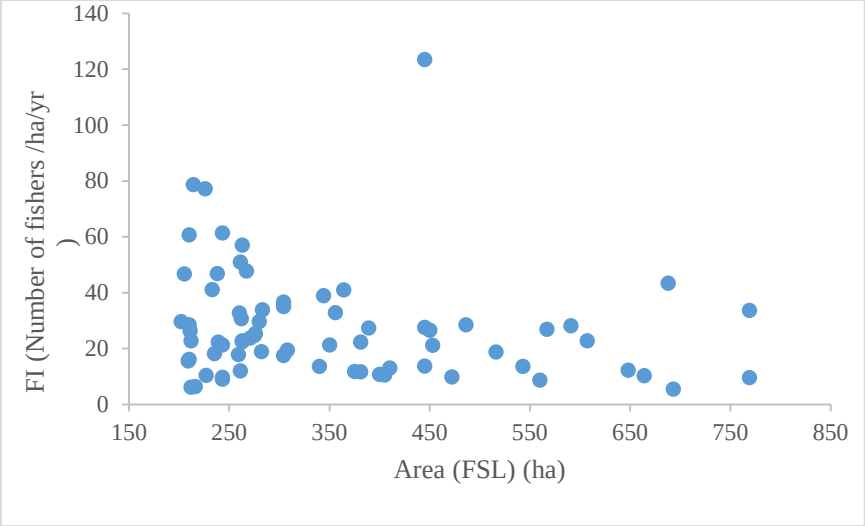


Figure 3.4 Relationship between area and the fishing intensity (FI) (number of fishers/ha/yr) of the medium perennial reservoirs.

No significant correlation was observed between any fish or shellfish species and the intensity of fishing. Additionally, the number of active fishermen in the reservoirs may not provide an accurate basis for this analysis.

Table 3.1 Average annual stocking and production of fin fish spp and Freshwater prawns in medium perennial reservoirs of Sri Lanka (Period 2012-2022)

Disrtict	Resevoir name	ReservoirType	Stocking/ha at FSL			Production kg/ha (kg/ha FSL)		
			Carp	Tilapia	FWP	Carp	Tilapia	FWP
Anuradhapura	Aluthdiulwewa	Medium	772.23±576.29	609.78±330.81	813.57±757.51	120.76±62.40	513.47±184.60	10.11±10.46
Anuradhapura	Angamuwa	Medium	122.65±176.75	54.38±96.51	266.74±565.76	5.69±13.06	52.07±104.84	0.00±0.00
Anuradhapura	Eru Wewa	Medium	295.12±746.46	197.88±438.88	63.85±127.71	15.57±30.09	37.81±77.82	0.00±0.00
Anuradhapura	Galkulama/Mahagalkulam	Medium	25.38±76.14	30.15±60.79	0.00±0.00	0.00±0.00	73.62±186.68	0.00±0.00
Anuradhapura	Horiwila	Medium	289.44±465.61	147.94±178.87	0.00±0.00	17.99±27.69	117.47±148.83	0.00±0.00
Anuradhapura	Kalankuttiya	Medium	403.44±256.89	152.58±248.58	43.05±122.38	55.87±86.22	100.05±121.93	0.06±0.20
Anuradhapura	Katiyawa	Medium	217.34±344.36	97.06±161.52	0.00±0.00	69.25±149.29	66.73±100.57	0.00±0.00
Anuradhapura	Manankattiya	Medium	541.72±546.80	361.15±219.09	404.90±426.98	75.93±74.97	289.37±139.14	2.02±3.30
Anuradhapura	Thuruwila	Medium	207.93±213.60	284.30±334.65	821.79±1679.10	23.28±35.84	151.63±145.97	0.26±0.65
Badulla	Ulhitiya	Medium	100.91±140.55	140.87±256.48	123.45±253.23	17.02±22.17	11.59±14.56	0.76±2.46
Mannar	Periyamadu	Medium	210.4±224.3	30.3±80.8	392.7±676.2	7.0±9.8	0.0±0	7.58±15.8
N'Eliya	Castlereagh	Medium	890.7±976.6	9.45±28.4	347.7±440.5	53.3±66.9	3.6±10.88	0.95±1.25
N'Eliya	Kotmale	Medium	247.22±242.8	44.21±109.4	158.97±249.4	33.92±33.6	2.66±5.39	0.69±1.15
N'Eliya	Maussakelle/ Maskeliya	Medium	459.3±412.5	0.00±0	217.23±272.54	30.34±32.56	0.00±0.0	0.63±0.93
Polonnaruwa	Ambagas Wewa	Medium	486.73±561.95	211.32±423.24	83.83±251.48	39.32±64.38	77.37±69.22	0.54±1.61
Polonnaruwa	Giritale	Medium	748.40±593.36	98.67±199.10	1572.51±983.98	69.89±94.57	23.07±69.22	12.45±16.62
Polonnaruwa	NDK	Medium	123.18±147.17	49.39±89.30	178.60±217.53	36.66±67.95	19.38±58.15	3.67±7.50
Ratnapura	Chandrika Wewa	Medium	1142.57±678.69	51.55±102.88	597.89±415.58	187.54±94.6	10.98±22.19	4.08±4.39
Ratnapura	Samanala wewa	Medium	447.85±385.93	56.90±116.62	309.44±384.17	92.02±79.40	4.16±8.30	1.14±1.98
Trincomalee	Janaranjana Weawa	Medium	35.44±106.33	15.80±47.40	255.14±435.65	8.41±25.23	0±0	53.26±126.95
Trincomalee	Maha Divul Wewa	Medium	328.90±225.36	51.16±111.46	204.62±282.98	33.51±38.81	141.07±363.66	49.05±140.62
Trincomalee	Morawewa	Medium	122.61±120.52	53.09±105.51	72.24±146.99	16.91±17.27	63.30±134.99	21.04±58.83
Trincomalee	Vendarasan	Medium	172.44±192.61	82.24±167.73	176.15±409.54	24.12±34.0	127.51±253.95	29.74±79.5
Vavunia	Bogas wewa	Medium	53.62±101.61	47.76±143.28	94.16±282.48	1.51±2.44	3.12±9.36	0.55±1.67
Vavunia	Irattaperiyakulam	Medium	303.46±591.43	15.72±47.1	320.75±483.57	42.53±84.1	0.13±0.41	2.44±5.67
Vavunia	Mamaduwa	Medium	228.61±300.05	96.86±184.74	640.14±875.66	34.89±55.62	0.00±0.00	1.11±1.99
Vavunia	Mohoththankulam	Medium	276.79±338.15	90.04±208.69	1192.73±1228.69	17.96±20.37	8.65±17.29	4.78±9.30
Ampara	Ampara Kulam/ Wewa	Medium	447.37±468.17	1642.47±1092.15	183.15±549.45	245.48±576.82	333.56±58.98	0.00±0.00
Ampara	Chadayantalawa	Medium	17.84±248.67	126.34±4339.8	0.00±0.00	3.32±47.22	8.98±145.97	0.00±0.00
Ampara	Ekgal Oya	Medium	33.19±746.79	15.99±359.91	8.49±191.22	5.72±128.91	2.72±61.30	0.06±1.39
Ampara	Henanigala	Medium	14.47±173.75	10.85±202.13	2.95±128.20	5.34±116.75	2.03±8.98	0.00±0.00
Ampara	Kondawattawana Tank	Medium	18.58±257.62	26.64±590.44	39.10±1034.09	3.44±57.63	6.74±119.03	0.06±1.96
Ampara	Malayadi Tank	Medium	28.26±504.23	22.89±228.10	1.35±53.19	19.23±493.17	7.68±85.54	0.01±0.29
Ampara	Namal Oya	Medium	13.31±353.73	7.51±304.43	10.00±449.91	3.80±104.74	1.45±53.68	0.01±0.58
Ampara	Pannalagama	Medium	17.79±112.96	24.81±371.79	13.84±596.34	2.81±51.06	5.21±80.97	0.04±2.30
Ampara	Rota Kulam	Medium	10.74±276.11	14.92±190.37	0.00±0.00	1.38±36.69	10.87±111.47	0.00±0.00
Ampara	Sagamam Tank	Medium	2.06±44.23	13.03±222.79	4.32±219.29	0.86±28.76	9.31±182.33	0.00±0.00
Ampara	Tampitiya	Medium	37.18±732.39	21.45±786.70	18.91±975.60	4.07±103.48	10.55±315.01	0.00±0.00
Batticaloa	Kaddumurippu	Medium	28.56±398.22	23.38±427.30	19.47±493.42	2.77±90.58	10.95±177.13	0.06±3.30
Batticaloa	Kadukkamunai	Medium	6.13±311.89	2.68±75.36	9.97±410.35	0.07±2.95	1.80±55.02	0.02±0.91
Batticaloa	Kithul Wewa	Medium	39.79±412.00	45.20±521.64	29.69±369.50	8.43±83.81	35.66±252.02	0.21±3.15
Batticaloa	Vakaneri Tank	Medium	10.94±239.31	6.85±164.28	12.29±335.91	1.45±36.78	5.85±118.90	0.032±1.24
Batticaloa	Wadamunai	Medium	59.63±437.33	30.84±393.83	30.84±569.10	7.86±57.83	25.85±210.38	0.20±4.07
Hambanthota	Badagiriya	Medium	835.28±534.46	237.28±520.42	1531.11±1348.40	96.36±1556.08	23.33±49.15	5.64±4.24
Hambanthota	Muruthawela	Medium	800.55±473.32	234.85±3755.28	884.49±869.50	51.09±124.02	20.49±38.88	6.53±13.65
Hambanthota	Tissa Wewa	Medium	467.97±410.97	253.88±405.84	805.91±87.48	106.61±141.27	142.42±368.59	7.17±14.82
Hambanthota	Udukiriwila	Medium	751.92±285.66	79.67±239.03	694.63±841.58	90.22±147.96	36.45±109.37	5.47±14.57
Hambanthota	Weerawila Wewa	Medium	545.40±394.92	151.52±307.85	968.63±1063.65	36.78±121.31	5.83±12.51	4.86±6.30
Hambanthota	Yoda / Yodakandiya Wev	Medium	211.09±308.99	0.00±0.00	360.35±54.17	80.28±128.35	0.00±0.00	9.43±13.24
Kurunagala	Ambakola Wewa	Medium	208.76±181.1	104.51±224.74	269.52±381.14	25.49±22.44	33.94±92.74	10.55±17.96
Kurunagala	Batalagoda	Medium	98.93±124.35	53.00±159.01	235.57±467.44	9.82±13.73	6.48±21.63	0.00±0.00
Kurunagala	Galgamuwa Wewa	Medium	68.46±136.17	19.30±57.91	107.25±218.22	3.39±9.58	50.57±1551.71	0.00±0.00
Kurunagala	Hakwatuna Oya	Medium	1028.50±521.45	92.34±277.03	362.95±503.12	131.68±70.02	14.95±44.87	09.04±120.07
Kurunagala	Kimbulwana Oya	Medium	1277.11±415.50	49.01±147.05	933.70±1816.68	98.19±66.04	14.72±66.0	3.48±6.60
Kurunagala	Magalle Wewa	Medium	205.00±256.24	26.19±78.58	222.22±666.66	8.08±8.45	12.33±37.01	0.11±0.33
Kurunagala	Palukadawala	Medium	96.77±159.08	0.00±0.00	27.46±82.38	14.23±366.73	0.00±0.00	0.41±1.23
Kurunagala	Siyabalangamuwa	Medium	868.10±586.34	267.85±119.04	2104.76±2298.75	44.16±175.09	52.27±150.32	4.30±6.01
Kurunagala	Usgala Siyabalangamuwa	Medium	404.47±490.94	7.02±152.20	1842.21±4524.93	70.22±48.18	8.01±24.04	3.10±5.08

Disrtict	Resevoir name	ReservoirType	Stocking/ha at FSL			Production kg/ha (kg/ha FSL)		
			Carp	Tilapia	FWP	Carp	Tilapia	FWP
Mulathivu	Koddai Kaddina kulam	Medium	1637.±1259.21	274.60±494.89	1999.92±1113.71	302.01±174.08	60.66±116.36	22.29±5.52
Mulathivu	Tenniyankulam	Medium	123.94±140.02	46.36±139.10	262.46±524.93	6.03±12.98	4.43±13.29	0.10±0.23
Mulathivu	Thannimurippukulam	Medium	69.33±91.36	45.39129.53	73.21±167.01	2.66±5.92	15.25±39.92	0.21±0.64
Mulathivu	Udayar kaddu kulam	Medium	114.01±167.52	74.92±171.93	475.14±699.95	3.67±6.29	0.81±2.44	1.79±3.56
Mulathivu	Visuamadu	Medium	166.34±199.93	44.65±89.26	531.63±1081.71	0.83±1.42	2.05±4.10	1.22±3.66
Mulathivu	Tenniyankulam	Medium	123.94±140.02	46.36±139.10	262.46±524.93	6.03±12.98	4.43±13.29	0.10±0.23
Mulathivu	Thannimurippukulam	Medium	69.33±91.36	45.39129.53	73.21±167.01	2.66±5.92	15.25±39.92	0.21±0.64
Mulathivu	Udayar kaddu kulam	Medium	114.01±167.52	74.92±171.93	475.14±699.95	3.67±6.29	0.81±2.44	1.79±3.56
Mulathivu	Visuamadu	Medium	166.34±199.93	44.65±89.26	531.63±1081.71	0.83±1.42	2.05±4.10	1.22±3.66
Matale	Ibbankatuwa Tank	Medium	578.68±397.45	169.00±394.46	224.29±299.30	52.50±37.98	6.67±17.16	0.62±1.57
Matale	Dewahuwa	Medium	458.86±365.72	111.07±245.88	290.69±402.99	68.21±79.38	20.69±42.48	1.65±2.76
Matale	Kandalama Tank	Medium	261.10±186.30	48.46±108.19	56.52±69.35	64.61±61.45	9.07±28.86	0.073±0.09
Matale	Kandepitawala	Medium	716.52±451.10	134.49±491.27	974.17±491.27	26.37±1703.52	27.86±88.83	13.56±8.57
Monaragala	Ethimale	Medium	1035.90±451.10	193.18±491.27	1371.23±491.27	36.42±1703.52	40.97±88.83	18.88±8.57
Monaragala	Hadapangala Wewa	Medium	1823.78±1956.09	240.04±476.93	775.81±807.54	333.55±337.71	42.15±125.66	8.29±8.558
Monaragala	Hambegamuwa	Medium	510.30±1035.20	143.61±285.43	2961.50±331	240.16±150.94	68.36±152.22	8.81±11.08
Monaragala	Kiriibban	Medium	559.43±449.35	192.13±383.03	615.76±704.04	52.23±112.90	37.54±73.63	3.23±5.58
Monaragala	Muthukandiya	Medium	554.21±349.26	3.96±11.90	830.15±108.27	4.82±1163.266	9.07±27.21	2.25±3.68
Monaragala	Urusita Wewa	Medium	1351.16±1259.21	223.70±404.53	1655.45±1113.71	250.21±174.08	50.03±116.36	18.39±5.52

Table 3.2 Area at Full Supply Level (FSL) and Fishing Intensity (FI) data of medium perennial reservoirs

District	Reservoir name	Reservoir Type	Area (ha)	Fishing Intensity(FI); No. of fishers per ha per yr
Anuradhapura	Aluthdiulwewa	Medium	239	22
Anuradhapura	Angamuwa	Medium	445	123
Anuradhapura	Eru Wewa	Medium	261	12
Anuradhapura	Galkulama/Mahagalkulama	Medium	350	21
Anuradhapura	Horiwila	Medium	243	21
Anuradhapura	Kalankuttiya	Medium	271	24
Anuradhapura	Katiyawa	Medium	261	51
Anuradhapura	Manankattiya	Medium	276	25
Anuradhapura	Thuruwila	Medium	280	30
Mannar	Periyamadu	Medium	227	10
N'Eliya	Castlereagh	Medium	275	25
N'Eliya	Kotmale	Medium	664	10
N'Eliya	Maussakelle/ Maskeliya	Medium	445	14
Polonnaruwa	Ambagas Wewa	Medium	243	61
Polonnaruwa	Giritale	Medium	308	19
Polonnaruwa	NDK/Nagolle Dee Kodiunne Wewa	Medium	591	28
Ratnapura	Chandrika Wewa	Medium	445	28
Ratnapura	Samanala wewa	Medium	693	6
Trincomalee	Janaranjana Weawa	Medium	450	27
Trincomalee	Maha Divul Wewa	Medium	543	14
Trincomalee	Morawewa	Medium	769	10
Trincomalee	Vendarasan	Medium	410	13
Vavunia	Bogas wewa	Medium	472	10

Vavunia	Irattaperiyakulam	Medium	212	6
Vavunia	Mamaduwa	Medium	243	10
Vavunia	Mohoththankulam	Medium	211	26
Ampara	Ampara Kulam/ Wewa	Medium	364	41
Ampara	Chadayantalawa	Medium	243	9
Ampara	Ekgal Oya	Medium	405	11
Ampara	Henanigala	Medium	260	33
Ampara	Kondawattawana Tank	Medium	356	33
Ampara	Malayadi Tank	Medium	235	18
Ampara	Namal Oya	Medium	648	12
Ampara	Pannalagama	Medium	340	14
Ampara	Rota Kulam	Medium	267	48
Ampara	Sagamam Tank	Medium	304	37
Ampara	Tampitiya	Medium	212	23
Batticaloa	Kaddumurippu	Medium	304	35
Batticaloa	Kithul Wewa	Medium	214	79
Batticaloa	Vakaneri Tank	Medium	453	21
Batticaloa	Wadamunai	Medium	205	47
Hambanthota	Badagiriya	Medium	381	22
Hambanthota	Muruthawela	Medium	516	19
Hambanthota	Tissa Wewa	Medium	233	41
Hambanthota	Udukiriwila	Medium	263	57
Hambanthota	Weerawila Wewa	Medium	567	27
Hambanthota	Yoda / Yodakandiya Wewa	Medium	486	29
Kurunagala	Ambakola Wewa	Medium	202	30
Kurunagala	Batalagoda	Medium	283	34
Kurunagala	Galgamuwa Wewa	Medium	259	18
Kurunagala	Hakwatuna Oya	Medium	389	27
Kurunagala	Kimbulwana Oya	Medium	238	47
Kurunagala	Magalle Wewa	Medium	263	23
Kurunagala	Palukadawala	Medium	263	22
Kurunagala	Siyabalangamuwa	Medium	210	29
Kurunagala	Usgala Siyabalangamuwa	Medium	769	34
Matale	Dambulu Oya / Ibbankatuwa Tank	Medium	344	39
Matale	Dewahuwa	Medium	688	43
Matale	Kandalama Tank	Medium	400	11
Matale	Kandepitawala	Medium	216	6
Monaragala	Ethimale	Medium	282	19
Monaragala	Hadapangala Wewa	Medium	226	77
Monaragala	Hambegamuwa	Medium	210	61
Monaragala	Kiriibban	Medium	375	12
Monaragala	Muthukandiya	Medium	560	9

Monaragala	Urusita Wewa	Medium	262	31
Mulathivu	Koddai Kaddina kulam	Medium	210	16
Mulathivu	Tenniyankulam	Medium	381	12
Mulathivu	Thannimurippukulam	Medium	607	23
Mulathivu	Udayar kaddu kulam	Medium	304	18
Mulathivu	Visuamadu	Medium	209	16

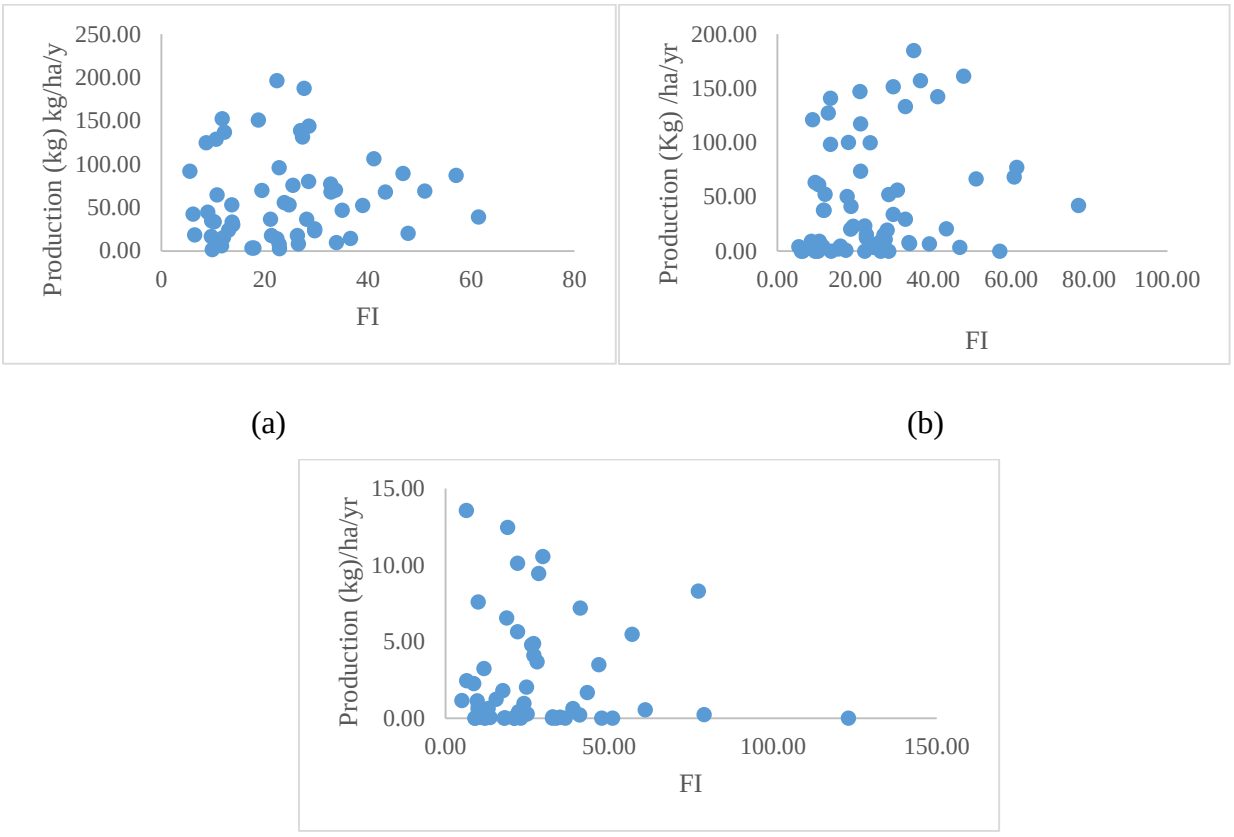


Figure 3.5 Relationships between production and Fishing Intensity (FI) (Number of fishers/ha/yr.) of medium perennial reservoirs

(a= relationship for carp species, b= relationship for tilapia species, c= relationship for FWP

3.2.2 Evaluation of Culture-based Fisheries of Major Reservoirs of Sri Lanka

The correlation between Carp fishing intensity (number of fishers per ha per year) and production in the 31major reservoirs exhibits a polynomial relationship. (Figure 3.6)

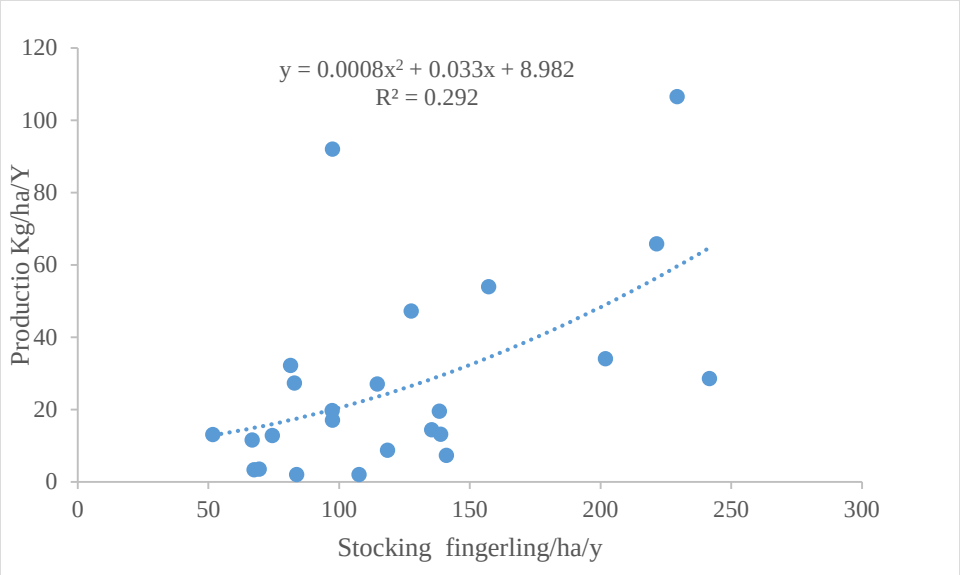


Figure 3.6 Relationship between carp fingerling stocking and production (Period 2012-2022)

A notable positive correlation was observed between the stocking of Tilapia fingerlings and the production levels in major perennial reservoirs. This finding may not solely be attributed to the stocking initiative, as tilapia possess a self-recruiting capability, and the extensive areas of these reservoirs provide additional breeding habitats for tilapia species. (Figure 3.7)

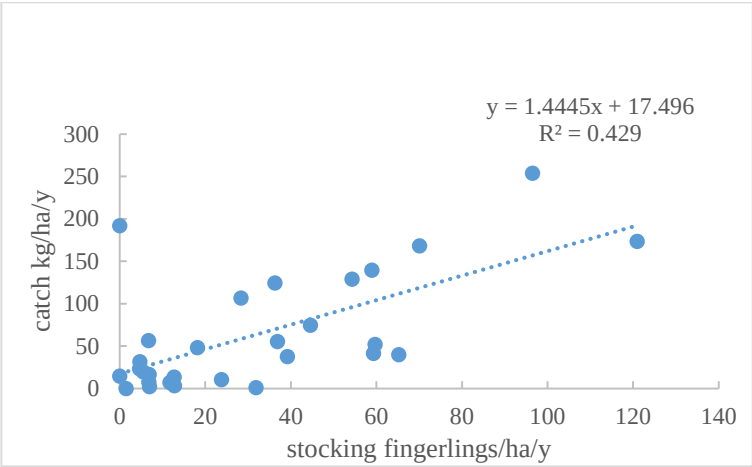


Figure 3. 7 Relationship between Tilapia fingerling stocking and production (Period 2012-2022)

FWP demonstrated a notable correlation between the stocking of post-larvae and the yield observed in the major perennial reservoirs. In the last decade, the stocking levels of FWP post-

larvae in these major reservoirs have consistently fallen short of their potential capacity. (Figure 3.8)

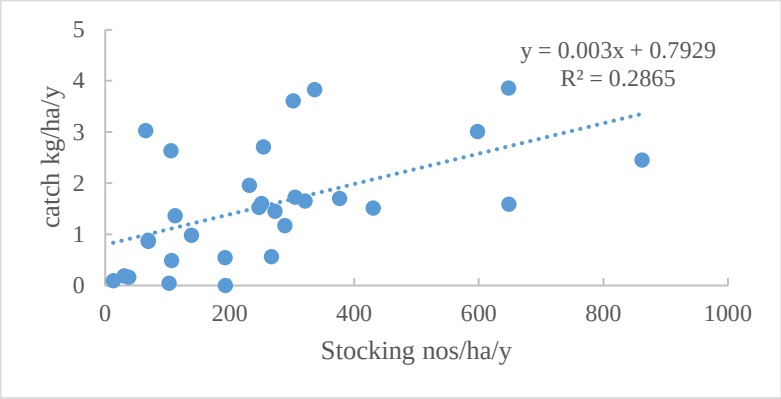


Figure 3.8 Relationship between FWP stocking and production (Period 2012-2022)

Monthly data regarding species-specific stocking, production, and the number of fishermen engaged in fishing activities were gathered through logbook records from five reservoirs: Namal Oya, Ekgal Oya, Konduwatuwana, Pannalgama, and Himidurawa, during field visits associated with the TCP project. Unfortunately, the computerized data entry system of NAQDA (In-fish) was non-operational in all five reservoirs throughout the study period. NAQDA officials indicated that historical data from the computerized system could not be retrieved. Consequently, only two years' worth of fish yield data and the number of participating fishermen were obtained from the Fisheries Society logbook. This limitation is likely to adversely impact the final outcomes of our study. Because the results therefore do not account for seasonal variations of FP due to other factors such as water level fluctuations, seasonal catchability variations due to wind patterns etc. These analyses should therefore be revisited once annual data for longer periods (i.e., >5 years) are available.

3.2.3 Namal Oya Reservoir

Figure 3.9 presents the stocking program of Namal Oya Reservoir for the years 2012 to 2022. The analysis of the stocking data for Namal Oya Reservoir indicates that, over the last decade, the performance of stocking fluctuated between 14% and 137%. In certain years, the amount of stocking was significantly lower than the reservoir's optimal capacity, while in other years, instances of over-stocking were observed.

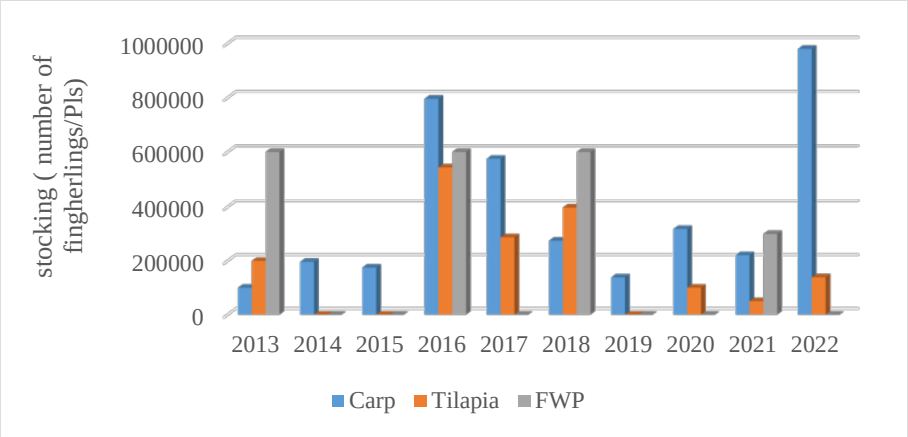


Figure 3.9 Stocking performance of the reservoir over the past ten years

Catla catla, *Labeo rohita*, *Cirrhinus mirigala* and *Oreochromis niloticus* (GIFT) only were stocked to the Namal Oya reservoir in 2012-2022, Figure 3.10 illustrates the stocked species composition of Namal Oya reservoir. In 2012-2022 period

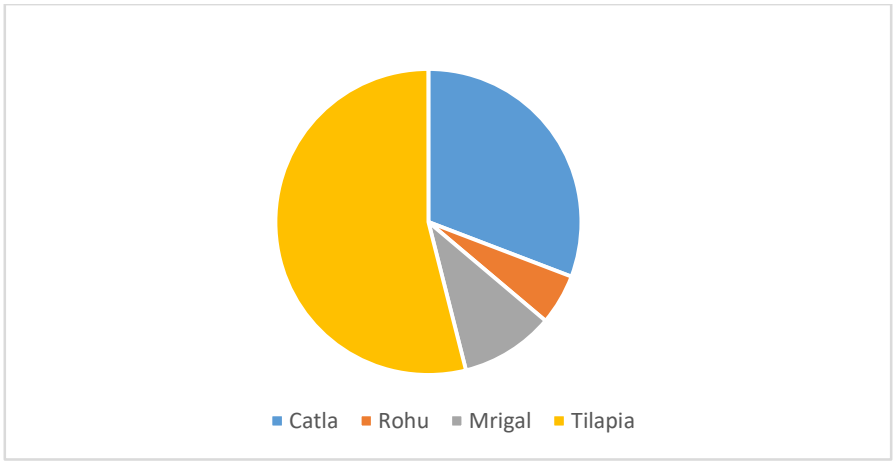


Figure 3.10 Species composition of Namal Oya reservoir

The contribution of carp and tilapia species to the overall stocking of the Namal Oya reservoir during the period from 2012 to 2022 is presented in Table 3.3, throughout several years, carp species accounted for a greater share of the total stocking (Figure 3.11), which reflects positively on the stocking program of the Namal Oya reservoir within the framework of culture-based fisheries. The cumulative percentages for carp and tilapia stocking were 69% and 31%, respectively.

Table 3.3 Percentage of the contribution of carp and Tilapia species to the total stocking of the Namal Oya reservoir

Year	**% Carp**	**% Tilapia**
2013	33.33	66.67
2014	100.00	0.00
2015	100.00	0.00
2016	59.45	40.55
2017	66.67	33.33
2018	40.89	59.11
2019	100.00	0.00
2020	76.12	23.88
2021	81.55	18.45
2022	87.58	12.42

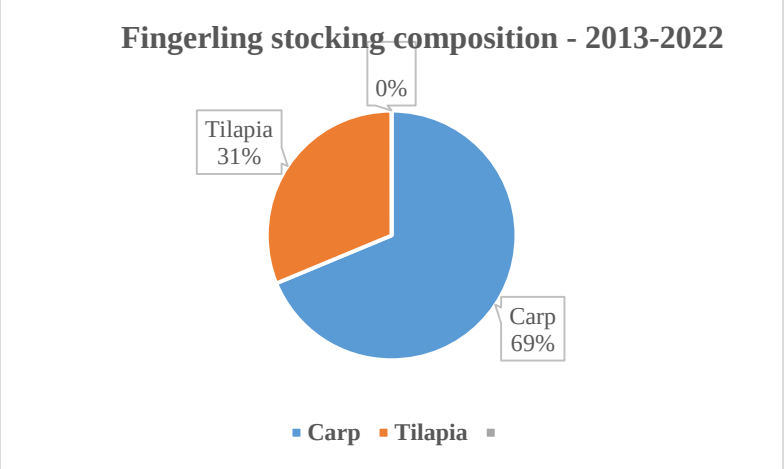


Figure 3.11 Fingerling stocking composition of Namal Oya reservoir

A parabolic correlation has been observed between the yield and stocking levels of the Namal Oya reservoir, with the optimal stocking density estimated to be around 2197 fingerlings per hectare per year. (Figure 3.12)

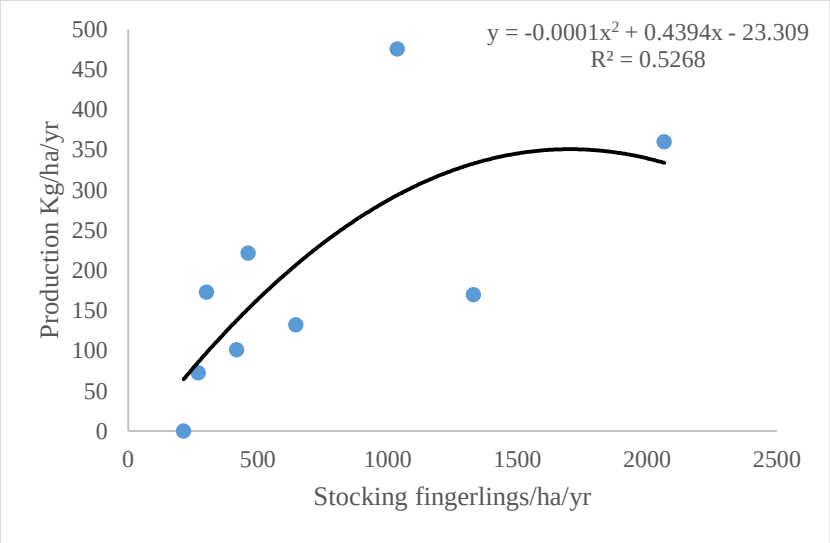


Figure 3.12 Relationship between production and stocking of finfish species - Namal Oya

This quadratic equation represents the relationship between fish yield (Y) and fishing intensity (x) in Namal Oya reservoir. The relationship between the fishing intensity of the Namal Oya reservoir and yield was significant and a strong correlation could be identified between FI and yield of finfish species (Figure 3.13)

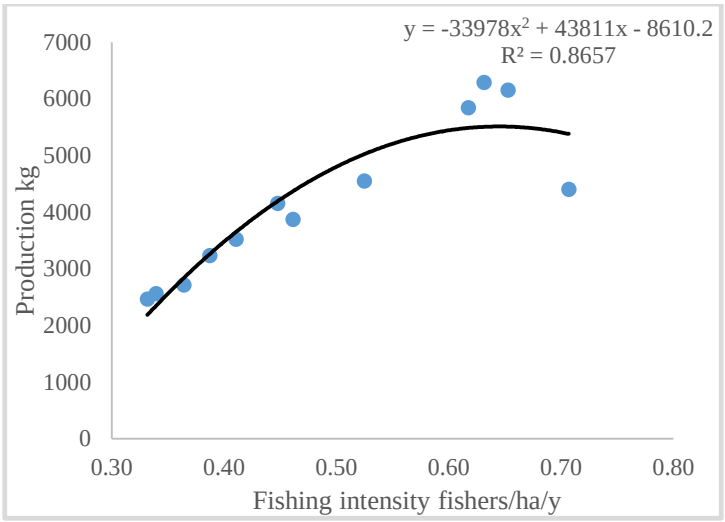


Figure 3.13 Relationship between FI and Fish yield of Namal Oya

The analysis presented indicates that the stocking program implemented at the Namal Oya reservoir is sufficient to attain the Maximum Sustainable Yield (MSY).The fishing intensity that provides the maximum sustainable yield is approximately 0.6449. The maximum sustainable yield

is approximately 5498.1 kg in Namal Oya reservoir. Presently used fishing intensity is at optimal level for the reservoir and further increase will cause to reduce the yield. The multiple regression analysis, which examines stocking and fishing intensity as independent variables, indicates that the dependent variable Y is significantly influenced by these two independent variables (R^2=0.989).

3.2.4 Ekgal Oya Reservoir

The stocking initiative for the Ekgal Oya reservoir over the previous ten years is illustrated in table 2.4 and Figure 3.14. The volume of fish introduced into this reservoir has consistently surpassed the ideal threshold. Over the last decade, there have been five instances of overstocking.

Table 3.4 Species composition percentage of stocking program implemented in Ekgal oya reservoir

	Carp %	Tilapia %
2013	38.33	54.81
2014	100.00	0.00
2015	74.38	66.89
2016	68.94	47.17
2017	75.00	14.81
2018	67.25	27.78
2019	64.97	32.59
2020	53.77	136.30
2021	93.69	8.36

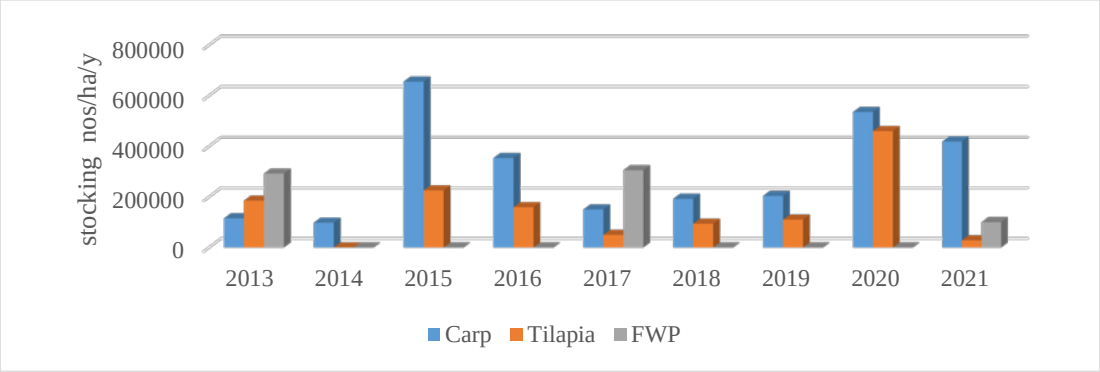


Figure 3.14 stocking amount of fingerling into the Ekgal Oya reservoir (2013-2021)

The reservoir's stock composition consists of 71% carp species and 29% tilapia species (Figure 3.15). In several years, the annual stocking of carp species greatly exceeds that of the naturally reproducing tilapia species. This trend highlights a positive aspect of the stocking program executed in the Ekgal Oya reservoir.

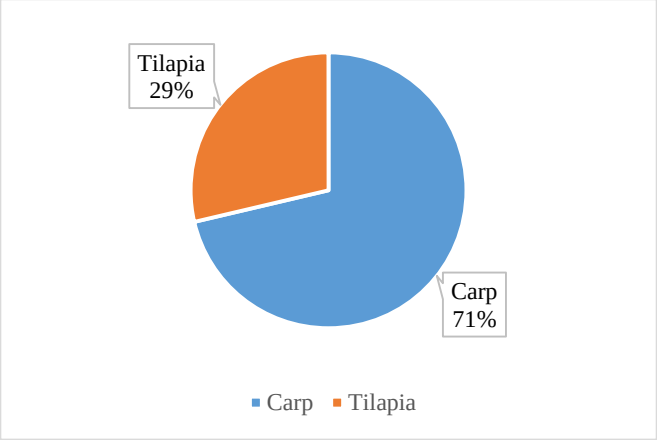


Figure 3.15 Fingerling stocking composition of Ekgal Oya reservoir

Figure 3.16 Illustrates the species composition of the stocking program of the Ekgal Oya reservoir. Mirigal is the highest stock fish species in the Ekgal Oya reservoir

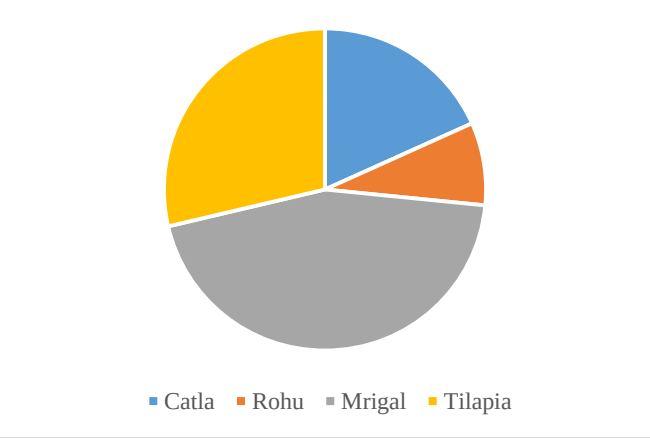


Figure 3.16 Species composition of Ekgal Oya Reservoir

The correlation between the stocking levels and production of the Ekgal Oya reservoir indicates a parabolic relationship, and a significant association between these variables could not be established (Figure 3.17).This phenomenon may be attributed to the overstocking of the reservoirs. The recommended optimal stocking amount for Ekgal Oya reservoir is approximately 1383.5 fingerlings/ha/yr.

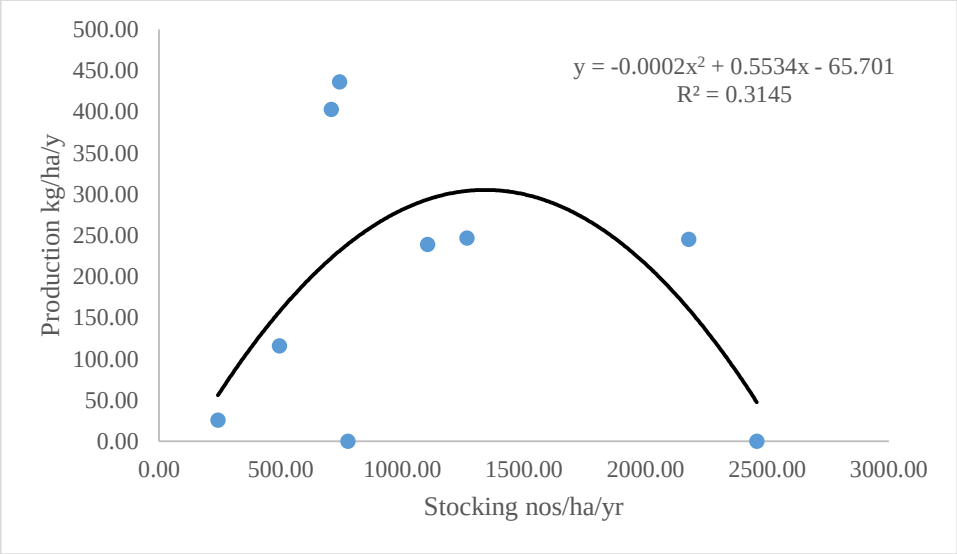


Figure 3.17 Relationship between production and stocking of finfish spp in Ekgal Oya

3.2.5 Konduwatuwana Reservoir

Figure 3.18 illustrates the fingerling stocking program of Konduwatuwana Reservoir from year 2012-2021. The analyzed stoking data of Konduwatuwana reservoir revealed that over the past ten years, the stocking performance of the reservoir varied between 61%-225% from the optimum stocking capacity of the reservoir. Overstocking of the reservoir was recorded in several years between 2013 to 2021 period.

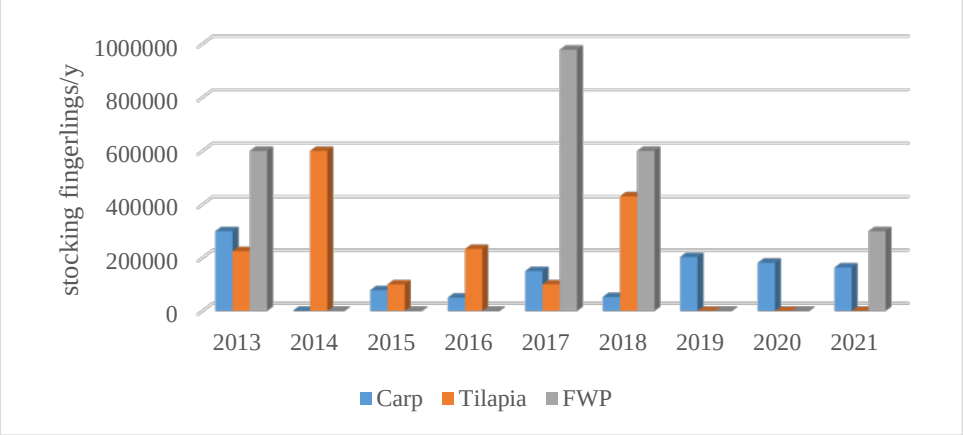


Figure 3.18 Fingerling stocking program implemented in Konduwatuwana reservoir2013-2021

An analysis of the species composition in the Konduwatuwana reservoirs reveals that Tilapia species account for 66% of the total stocking, while carp species contribute only 34%. (Figure 3.19) A significant drawback has been recognized in the decision-making process regarding

planning the stocking program for the Konduwatuwana reservoir over the past ten years. This erroneous decision could lead to a diminished production capacity of the reservoir.

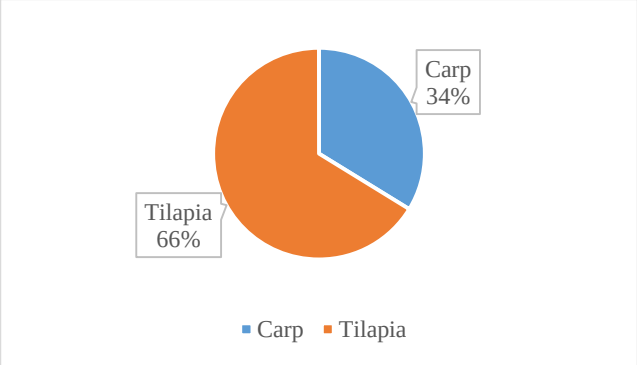


Figure 3.19 Percentage of the contribution of Carp and Tilapia species in stocking program implemented in Konduwatuwana reservoir

Figure 3.20 illustrates the species composition of the stocking program in the Konduwatuwana reservoir

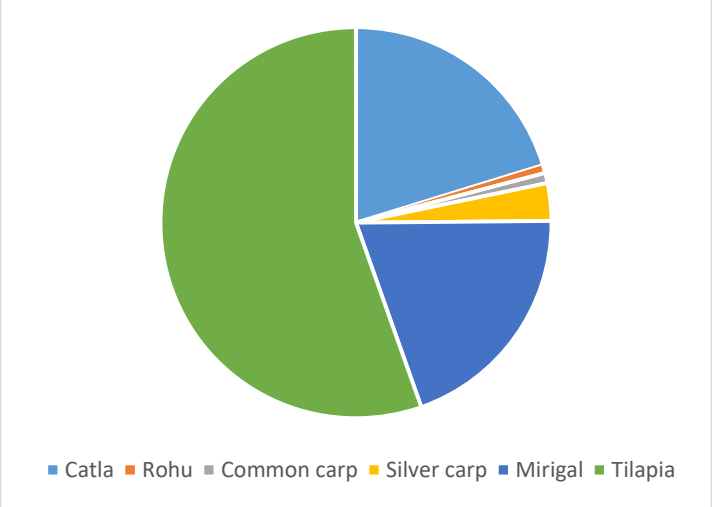


Figure 3.20 Species composition of Konduwatuwana reservoir

Over the past two years, carp production in the reservoir has exceeded that of Tilapia; however, in 2023, carp production has declined compared to the levels observed in 2022. (Figure 3.21)

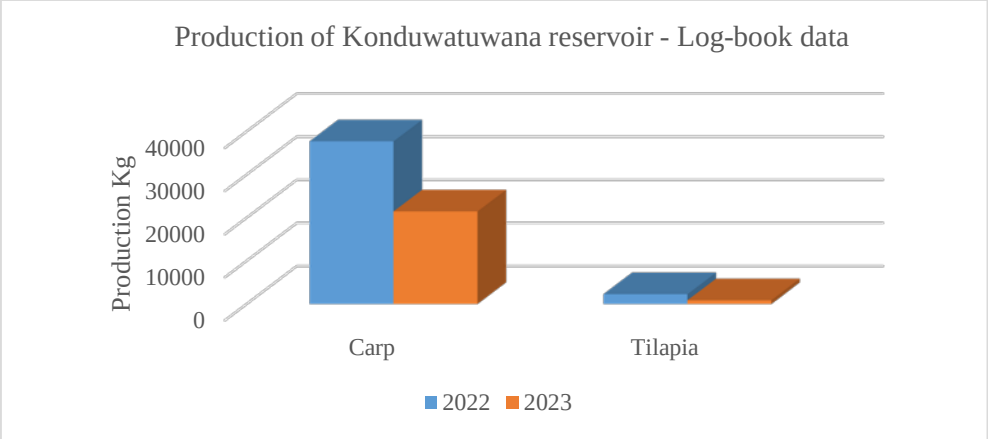


Figure 3.21 Production of Konduwatuwana reservoir from 2022-2023

The parabolic relationship between yield and stocking of fingerling indicated that overstocking of Konduwatuwana reservoir over the past ten years. (Figure3.22) The optimal stocking density of Konduwatuwana reservoir is approximately 1128.67 fingerlings/ha/yr.

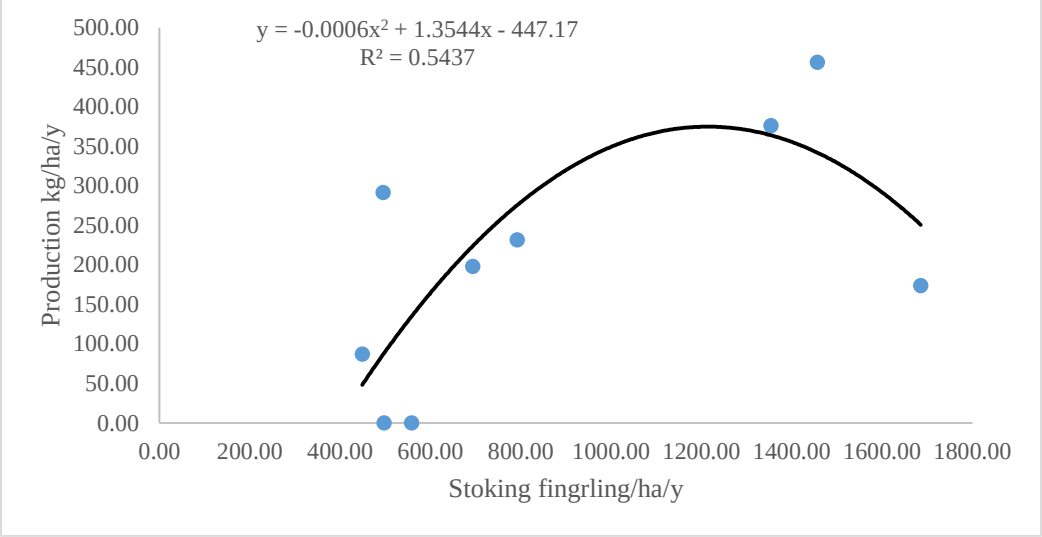


Figure 3.22 Relationship between stocking and production of the Konduwatuwana reservoir

3.2.6 Pannalgama Reservoir

The data presented in the figure indicates that the stocking program for the Pannalgama reservoir demonstrates an excessive introduction of Tilapia species (58% of the stocking amount) (Figure 3.23, Figure 3.24). This mismanagement has led to a decline in the overall production of the reservoir. Additionally, the introduction of Genetically Improved Farmed Tilapia (GFT) has been

noted; however, this particular species does not thrive in larger reservoirs, as it was specifically developed for aquaculture applications.

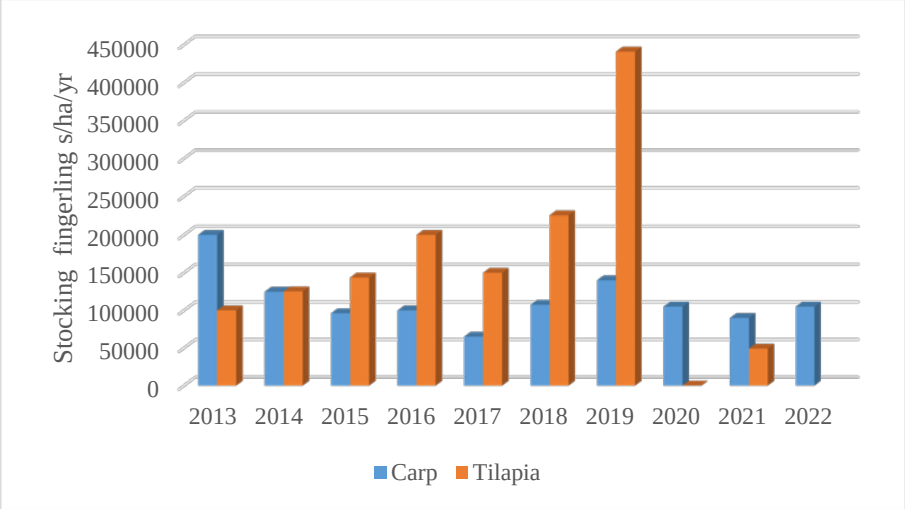


Figure 3.23 stocking program implemented in Pannalgama reservoir 2013-2022

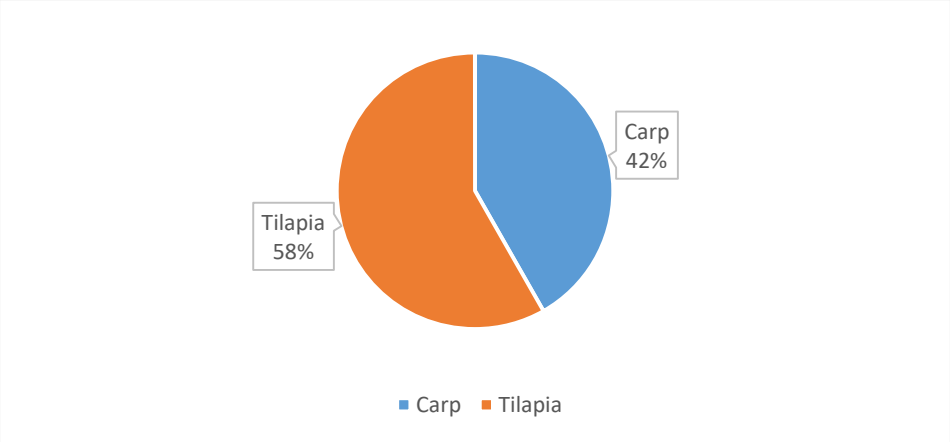


Figure 3.24 Percentage of the contribution of Carp and Tilapia species in the stocking program implemented in Pannalgama reservoir

The impact of mismanagement in the stocking program is also illustrated in the figure, which shows a decline in reservoir production as the quantity of stocked fish increases. This decline is primarily attributed to the significant presence of tilapia species in the stocking amounts.

The analysis of the quadratic function within the parabolic relationship suggests that the ideal stocking density is approximately 999.17 fingerlings per hectare per year. (Figure 3.25)

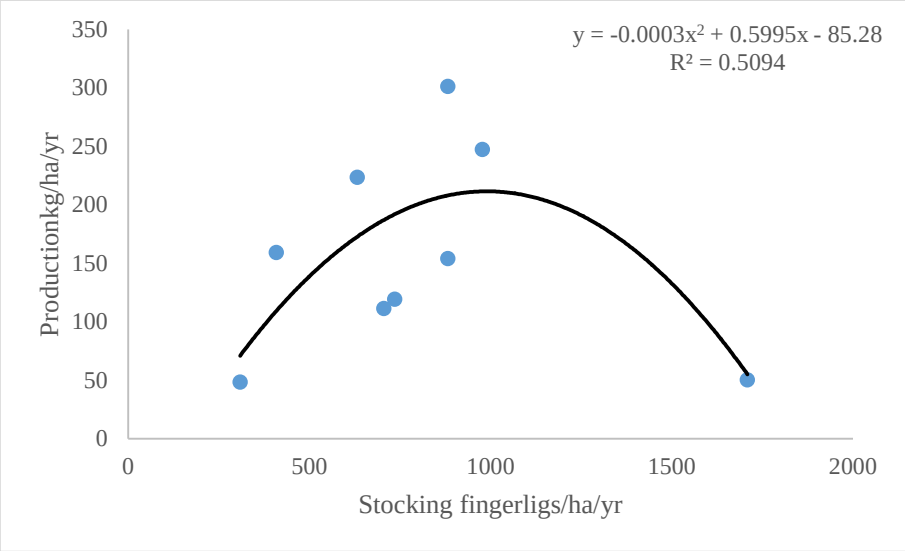


Figure 3.25 Relationship between stocking and production of the Pannalgama reservoir

However, the production of the reservoir has a strong correlation with fishing intensity and the reservoir does not reach to the optimum production level. (Figure 3.26)

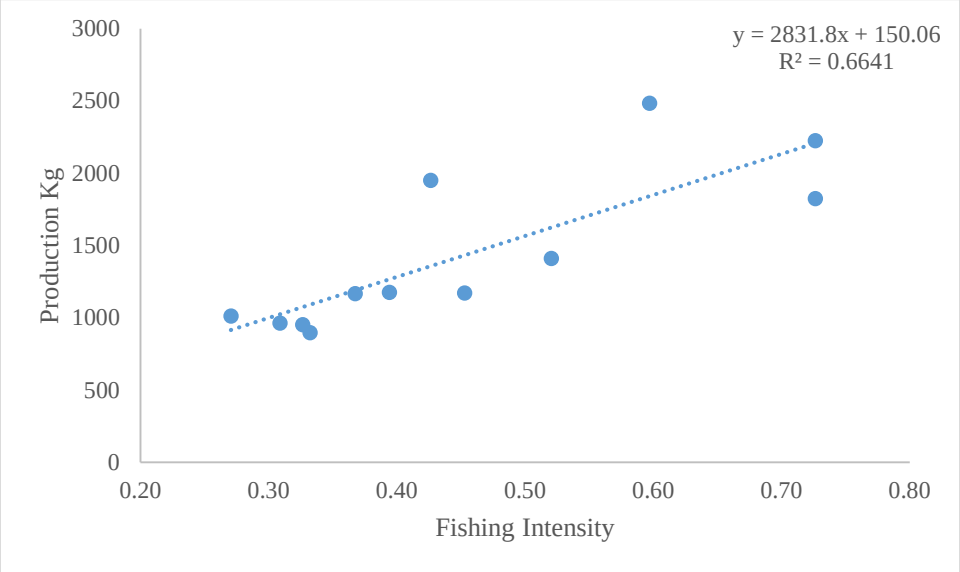


Figure 3.26 Relationship between stocking and production of the Pannalgama reservoir

3.2.7 Himidurawa Reservoir

The data for this figure was derived from the lob book records of the Himidurawa reservoir for the years 2022 to 2023. The carp species exhibited the highest production levels, while tilapia production was comparatively low. (Figure 3.27)

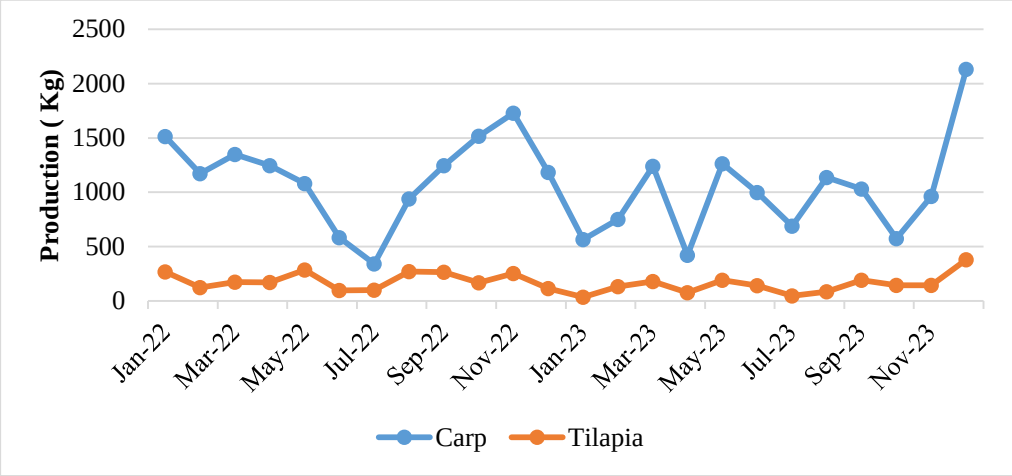
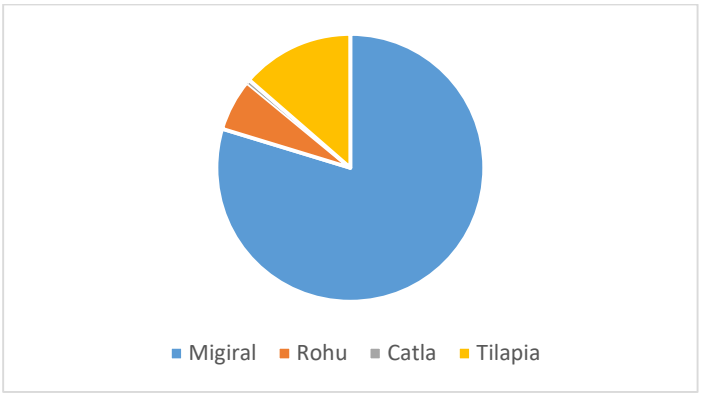


Figure 3.27 Production variation of Himidurawa reservoir 2022-2023

The species composition of the Himidurawa reservoir was predominantly made up of Mirigal species, while the contribution of other carp species to the overall production was relatively minimal (Figure 3.28).



3.28 Species composition Himidurawa reservoir

3.2.8 Hydrological Variables

Hydrological data—including water level, inflow, outflow, reservoir capacity, and catchment area—were obtained from the Department of Irrigation (Fig 3.29). Ten years of historical data were available for only four reservoirs. Using this data, the following indices were developed based on appropriate equations.

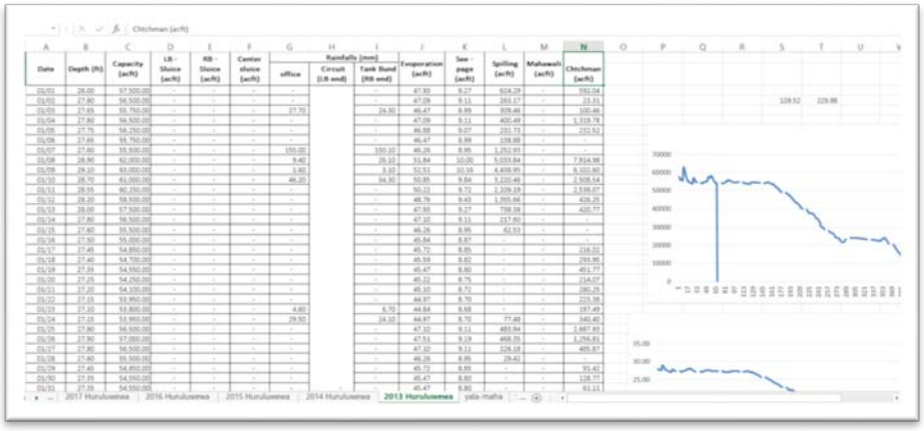


Figure 3.29 Hydrological data of selected reservoirs

Index 1- Mean annual reservoir water level fluctuation (RRLF) index

Mean annual water level fluctuation of each reservoir was calculated (Kolding & Zwieten, 2006).

$$RRFL=\frac{ZMax-ZMin}{\text{Mean depth}}X100$$

where,

Z_{Max}= Maximum water level in m

Z_{Min}= Minimum water level in m

Mean depth in m

Index 2- Hydraulic retention time or water residence time (HRT)

HRT values of each reservoir was estimated using the following equation (Rennella & Quiros 2006).

$$HRT=\frac{\text{Reservoir volume (MCM)}}{\text{Annual outflow } (\frac{\text{MCM}}{\text{yr}})}$$

where,

Reservoir volume= m^3

Annual out flow= m^3/day

Index 3- Catchment area (CA) and Reservoir capacity (RC) ratio

CA/RC of each reservoir was calculated.

Table 3.5 Different hydrological indexes in selected reservoirs

Reservoir name	Reservoir area (ha)	Catchment area (km^2)	Reservoir capacity (km^3)	CA/RC ratio	RRFL
Konduwatuwana reservoir	356	91.32	0.0148	6170.2	
Normaloya reservoirs	648	1000	0.1073	9319.6	
Ekgaloya reservoir	405	456	0.0125	36480	
Pannalgama reservoir	306	1813	0.0178	101853	

The CA/RC ratio of the Konduwatuwana, Narmaloya, and Ekgaloaya reservoirs showed a positive linear relationship with fish yield (Figure 3.30).

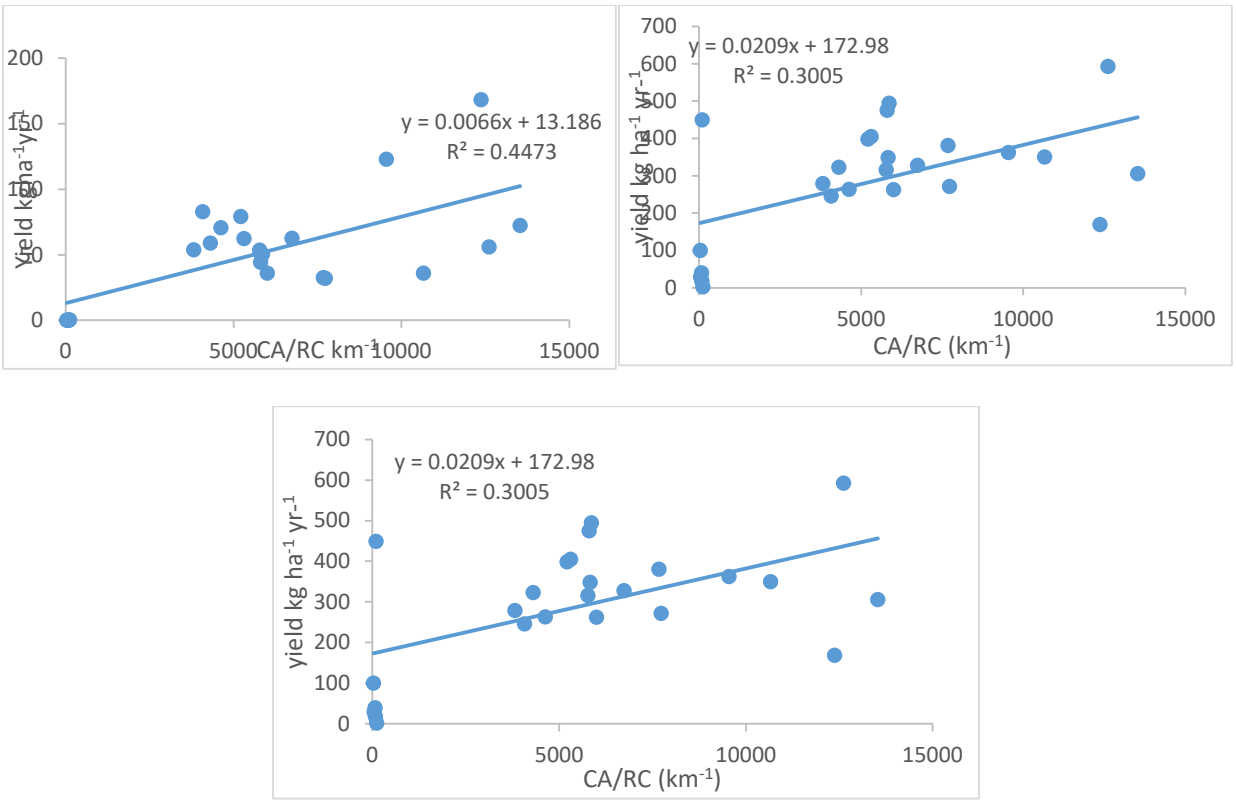


Figure 3.30 Relationship between CA/RC ratio and fish yield of selected reservoirs

Table 3.6 presents the hydraulic retention time of the selected reservoirs for the period 2012–2021. However, the hydraulic retention time did not exhibit a significant relationship with fish yield.

Table 3.6 Hydraulic retention time of Konduwatuwana, Narmaloya and Ekgaloya reservoirs for the period 2012–2021.

Year	Reservoir name		
	Konduwatuwana	Narmaloya	Ekgaloya
2012	3.14	-	-
2013	1.87	-	-
2014	0.79	-	0.28
2015	2.8	-	0.67
2016	26.99	65.13	0.82
2017	-	12.59	2.03
2018	1.33	152.37	1.59
2019	0.95	13.39	0.62
2020	3.85	93.26	0.87
2021	0.88	10.56	0.75

3.2.9 Development of Indices to Estimate Fish Production Potential

The fish yield of reservoirs is primarily governed by four major variables: stocking density (SD), fishing intensity (FI), limnological factors, and hydrological factors. To estimate the fish production potential effectively, appropriate indices were developed by analyzing the relationship between these variables and observed yields.

Among these, a significant positive correlation was identified between carp stocking density and fish yield, indicating that increased stocking of carp tends to result in higher production, up to an optimal threshold. (Figure 2.31) This finding highlights the critical role of stocking strategies in enhancing reservoir fisheries. Additional analysis incorporating fishing effort, water quality parameters (e.g., nutrient levels, dissolved oxygen), and hydrological patterns (e.g., water retention time, inflow rates) can further refine the predictive capability of the proposed indices.

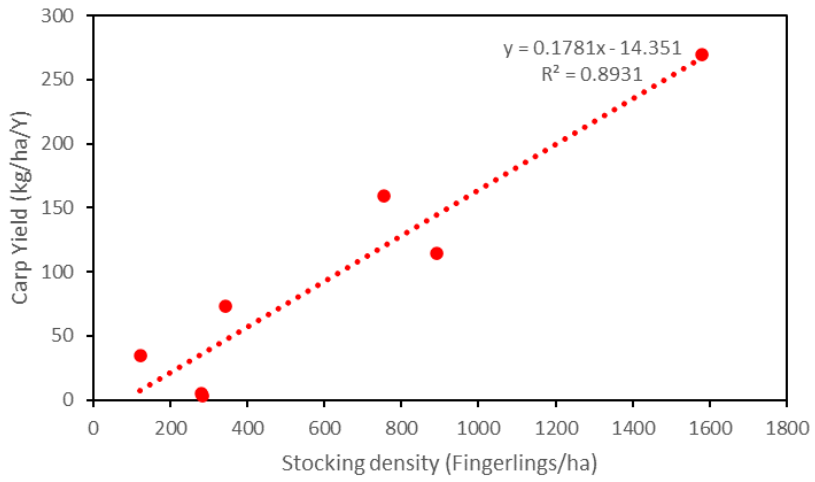


Figure 2.31 Relationship between carp yield and stocking density

This relationship is exhibited as:

Carp Yield (Y) = 0.1781 × Stocking Density (SD) – 14.351

This regression equation suggests that stocking density (SD) can be effectively used as a predictive variable for estimating carp yield in the selected reservoirs.In addition to stocking density, the fishing intensity (FI) of the selected reservoirs also shows a significant relationship with carp yield. The regression relationship for this correlation is represented as:

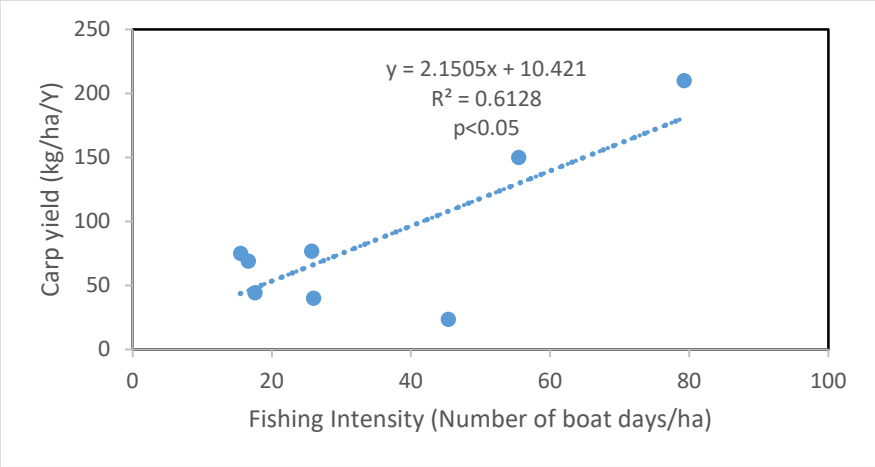


Figure 2.32 Relationship between carp yield and fishing intensity

Carp Yield (Y) = 2.1505 × FI + 10.421

Past studies have shown that several limnological variables—chlorophyll-a, total phosphorus, the morphoedaphic index for alkalinity, and the morphoedaphic index for conductivity—can serve as predictors of reservoir fish yield. However, in the current study, no statistically significant relationships were found between these limnological variables and carp yield. This may be attributed to the short study period and resulting insufficient data. Similarly, no significant correlations were observed between carp yield and various hydrological indices.

Given the significant individual effects of both stocking density and fishing intensity, a multiple regression analysis was performed to evaluate their combined influence. The resulting model indicated a significant interaction, with the following regression equation:

Carp Yield (Y) = 4.472 + 0.554 × SD + 0.923 × FI
($p < 0.05$, $R^2 = 0.741$)

This equation can be used as a predictive tool to estimate the potential carp yield of the selected reservoirs.

In contrast, tilapia species did not show any significant relationships with either stocking density or fishing intensity. Furthermore, tilapia yield exhibited weak correlations with both limnological and hydrological variables. This lack of association is likely due to the self-recruiting nature of tilapia populations, making their yield less dependent on stocking interventions.

4.0 Output 03 Improved Reservoir Fisheries Management

4.1 Methodology

The study employed two primary data collection methods for socio-economic assessment: Participatory Rural Appraisal (PRA) and individual surveys using a semi-structured questionnaire. PRA techniques were used to gather qualitative data, involving 10-12 participants in each group. The semi-structured questionnaire covered socio-economic data, fishermen's perceptions of the functioning of RFOs and fishing activities, and Ostrom's modified design principles to assess institutional robustness and resource management. The sample size was determined using the saturation technique, a common approach in qualitative research (Pushpalatha et al., 2020). As data collection progressed, the sample size was gradually increased, with volunteer participants being interviewed. In total, 19 fishers from Namal Oya, 18 from Konduwatuwana, and 10 from Ekgal Oya, 12 from himidurawa and 8 from Pannalgama Reservoir were interviewed individually.

4.2 Results

4.2.1 Namal Oya Reservoir

Reservoir	: Namal Oya (Figure 4. 1)
Date	: 06/07/2024
Administrative District	: Ampara
Divisional Secretariat	: Ampara
Grama Niladari Division	: Dambethalawa

Figure 4. 1 Namal Oya Reservoir

4.2.1.1 Background

Namal Oya is a reservoir situated about 20 km north of Senanayake Samudraya, created by the Gal Oya Development Board between 1961 and 1962 by damming the Namal Oya stream. It has a catchment area of 52 km², with a boundary approximately 2 km long. At full supply level, it covers around 648 hectares. The reservoir is fed by Namal Ara, Imbigale Ara, Unupila Ara, and Idella Oya, supporting livelihoods like fishing and paddy cultivation. Access to the landing site is via a gravel road from the Ampara-Bibila main road. The surrounding area is a wildlife conservation zone, protected by an elephant fence to safeguard the nearby village (Figure 4.2).

Figure 4.2 Village and reservoir map produced by RFO members

The RFO of Namal Oya Reservoir is "Namal Oya Miridiya Deewara Samithiya." As the reservoir is in a wildlife conservation area, fishing activities require an operational license from the Department of Wildlife Conservation. The department permits a maximum of 36 canoes on the reservoir, with licenses issued and renewed annually. The RFO comprises 45 members, including three widows who do not engage in fishing. Out of the total membership, around 37 fishers actively participate in fishing and also engage in paddy cultivation during the Yala and Maha seasons. The fishers come from Namal Oya village, living between 500 meters and 2 kilometers from the landing site. Membership and licensing restrictions are carefully managed through discussions with NAQDA authorities to prevent competition.

Since its inception, the fishery at Namal Oya Reservoir has undergone significant changes. Initially, there was no formal community organization; instead, a small group of 12-15 fishers would gather informally to make collective decisions. With the establishment of NAQDA, the fishers began seeking guidance from the NAQDA Extension Officer (EO). During the first 2-3 years, they convened near the Lord Buddha statue by the reservoir. Eventually, they started holding monthly meetings on holidays at a building owned by Namal Oya School, with the principal's consent, reflecting the village's growing recognition of the fishing community (Figure 4.3).

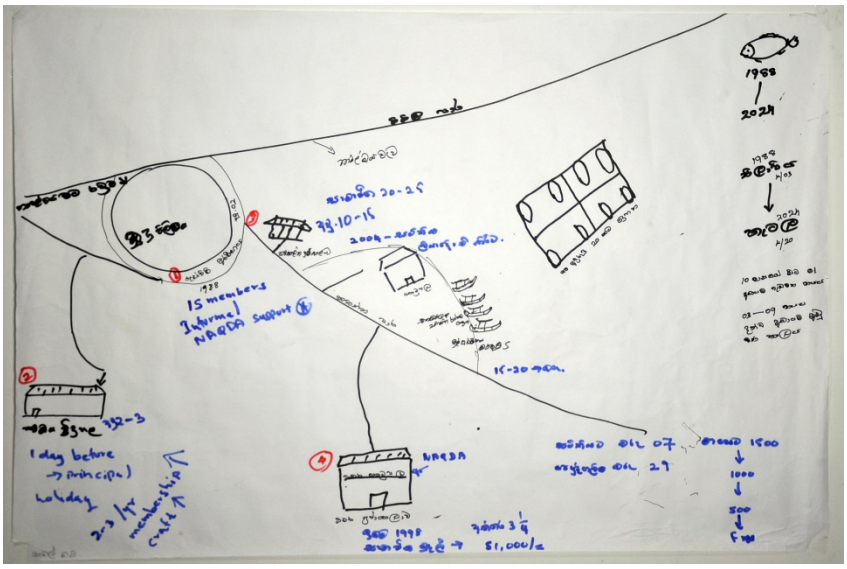


Figure 4.3 Group activity on development milestones of RFO Namal Oya

Under the supervision of the NAQDA Extension Officer (EO), the fishermen at Namal Oya Reservoir have established a levy system to raise funds for purchasing fingerlings for restocking the reservoir and for other welfare initiatives. The funds are generated from a levy on the marketing of fish, which is exclusively managed by the RFO's Manager, a woman. All fishermen bring their catch to the weighing point at the landing site, where the manager records the quantities and species of fish caught by each boat. The priority for selling fish is given to the villagers, with the remaining catch sold to a fish buyer. Common fish species in the reservoir include Catla, Mirigal, Tilapia, and Rohu, with Tilapia being the most lucrative. However, fishermen are currently facing a significant reduction in Tilapia catches. Tilapia are typically found near incoming water streams

where the depth is around 15 feet, while Catla fish are more abundant in areas where the depth reaches about 40 feet.

The fish marketing system at Namal Oya Reservoir is organized with a single fish buyer, who is also a member of the RFO and serves as an assembler for external fish vendors. This buyer transports the fish to areas such as Akkareipattu, Kalmunai, and Udawalawa, and, for larger quantities, to the Paliyagoda central market. A levy of LKR 10 per kilogram is collected at the weighing point from the fish buyer and added to the revolving fund.

When compensating the fishers, LKR 60 per kilogram is deducted, with LKR 30 allocated to the RFO and the remainder deposited into the RFO savings account for the fishers, which can be withdrawn as needed. The manager overseeing these transactions is authorized to keep up to LKR 50,000 for fish purchasing, works daily from 6:00 am to 8:00 am, and receives a monthly salary of LKR 25,000 for her services.

In 1998, the Namal Oya RFO acquired a 0.25-acre plot of land near the reservoir for Rs. 51,000 using their revolving fund. With government support of LKR 2,500,000, a community building was later constructed on this land. Initially, fishers used wooden canoes, but they have since upgraded to fiberglass canoes, with the RFO currently owning seven canoes.

The revolving fund has been instrumental in funding various improvements, such as installing a solar panel worth LKR 15,000 (Figure 4.4), purchasing an OFRP boat for LKR 120,000, and acquiring a deep-freezer for LKR 80,000. The treasurer deposits LKR 100,000 to 150,000 per month into the revolving fund at the Bank of Ceylon. Although there was previously an annual membership fee, this has been discontinued, as all fishers now contribute through a levy from fish sales.

Figure 4.4 Solar panel located at the landing site of Namal Oya

The community organization at Namal Oya Reservoir operates under a written constitution that outlines established rules, entry procedures, and sanction procedures. While monthly meetings are intended, this schedule is not always consistently followed.

Membership eligibility is tightly controlled to limit participation in fishing activities. Each fisher is required to nominate a beneficiary, usually their wife, to inherit their membership upon their death. The wife can choose to retain the membership or transfer it to another person, subject to the organization's approval during a general meeting.

New members of the RFO are accepted only from villagers without a permanent income source and are required to pay a fee. If a membership is transferred without an operational license, a fee of LKR 25,000 is charged, and if both the membership and operational license are transferred, the fee is LKR 50,000. Members who miss three consecutive meetings face sanctions, though they can excuse up to two absences by formally notifying the president or secretary. Misbehavior is fined based on its severity and frequency, with the amount determined during a general meeting.

Fishing times at Namal Oya Reservoir are regulated, with net setting allowed only after 3:00 pm, and the catch must be landed by 8:00 am the following day. Each fishing unit, consisting of a boat and crew, is permitted to use a maximum of six gill net pieces, with mesh sizes ranging from 4.5 inches to 12 inches. Previously, fishers in this RFO used gill nets with mesh sizes as small as 2¾ inches.

Unauthorized fishing activities by non-members have become a significant challenge for resource management at Namal Oya Reservoir. Although fishers initially agreed to form groups for regular observation visits to monitor these activities, the measure has proven ineffective due to a lack of commitment. During the spilling period, Mirigal and Rohu fish often escape through the spillway gates. To address this, fishers installed a net with a 1.5-inch mesh size, costing LKR 150,000, but it did not produce the desired results. Additionally, a smoked dried fish processing unit was donated to the RFO by NARA. However, the fishers are not currently using the unit, citing that its mechanism does not suit their needs.

There are some community welfare provisions are carried out by the RFO of Namal Oya. They provide fish on a request for nutrition programs in pre-school of Namal Oya village. They provide

fish to funerals happened in the village regardless of the membership of the RFO up to 30kg for each. They organize a “Dansel” each year and support temple and village school for almsgivings.

4.2.1.2. Socio-demographic Profile of Namal Oya fishing community

Figure 4.5 Questionnaire survey with RFO members of Namal Oya

Figure 4.6 shows the summarized detail of socio-demographic feature of the fishers in Namal Oya reservoir. All fishers in the sample were Sinhala and Buddhist. Of these, 68.4% are generational reservoir fishers, while 31.6% gained membership by transfer. The majority (36.8%) are aged 51-60, followed by 31.6% aged 41-50. Most fishers (41.2%) have an education level between grades 6-10. All are married, with an average family size of 4. Additionally, 68.4% have a secondary income from paddy cultivation (63.2%) and labor work (5.3%). The average monthly fishing income is LKR 37,263, with a maximum of LKR 65,000 and a minimum of LKR 8,000. Those engaged in agriculture primarily cultivate paddy during both Yala and Maha seasons, usually for home consumption, and typically harvest crops worth LKR 200,000 per season. Additionally, 94.7% of the fishers live 1-2 km from the reservoir.

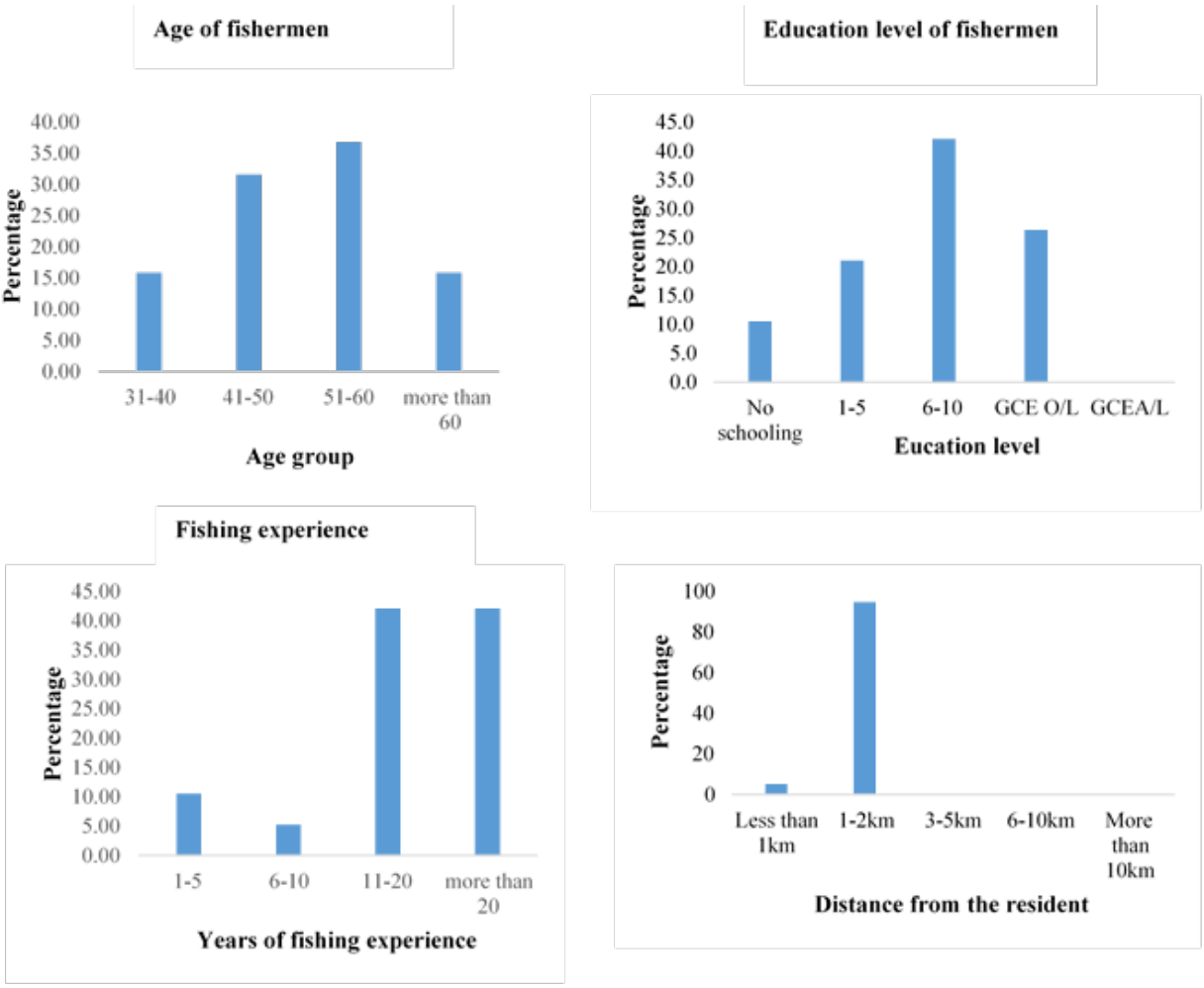


Figure.4.6 Socio-demographic Profile of Namal Oya fishing communities

4.2.1.3 Fishery Related Information

Fishermen in this reservoir fish for an average of 24 days per month, with a maximum of 28 days and a minimum of 20 days. Vendors do not visit the landing places for two days, thus fishermen do not fish the day before or on the full moon Poya day. Typically, fishermen participate in fishing operations alone. The average participation rate at the RFO meeting is 91.3%, which is determined by the advantages and services provided by the organisation as well as satisfaction with its smooth working. Among the fishermen, 77.8% are highly satisfied with the RFO's operation, with the remaining 22.2% satisfied.Fishers and farmers are the most typical users of these reservoirs. All fishermen (100%) reported no conflicts with farms. However, non-members' illicit and unauthorized fishing activities cause major tension within the fishing community.

Fishers stated that their society has bargaining power over fish prices and they receive market prices from vendors in different areas of the country. However, when marine fish is abundant in the markets, their prices fall significantly. All fishermen (100%) responded that their primary expectation of the RFO is to strengthen the fish stocking program by increasing the RFO's fund.

Table 4.1 evaluates the compliance of the Namal Oya fisher community with Ostrom's modified design principles to assess the institutional robustness. All principles, except for Principle 04 (4A and 4B), show high or prominent compliance, indicating a generally satisfactory status in terms of organizational robustness and resource management. Principle 4 is at a moderate level due to the absence of a well-organized committee within the RFO to systematically monitor and control fishing activities, violations, and violators. The current approach is more ad hoc than systematic. Resource monitoring is also at a moderate level, with insufficient actions to effectively secure resources. For example, the prevention of fish escape during the spilling period through spillway gates has been less effective.

Table 4.1 Summary of compliance of Namal Oya RFO with the Ostrom's modified design principles

Element	Design principal	Level of compliance
1A	Clearly defined user boundaries	Prominently exist
1B	Clearly identified resource boundaries	Prominently exist
2A	Congruence with local conditions	Highly exist
2B	Appropriation and provisions	Highly exist
3	Collective-choice arrangements	Prominently exist
4A	Monitoring users	Moderately exist
4B	Monitoring the resources	Moderately exist
5	Graduated sanctions	Prominently exist
6	Conflict resolution mechanism	Prominently exist
7	Minimal recognition of the right to organize	Highly exist
8	Multi-level institutional structure	Highly exist

4.2.1.4 Institutional Relations

Several key institutions and organizations have an impact on the operation of the Namal Oya reservoir During the PRA exercise, participants produced a Venn diagram depicting these links, their nature, and strength (Figure 4.7). The National Aquaculture Development Authority (NAQDA) is the most closely related entity to Namal Oya RFO, with a 100% favorable link for seamless operation. The Department of Wildlife makes a satisfactory contribution in issuing operating licenses at an annual fee of LKR 300 without delay. However, the overall opinion of wildlife relations was 50/50 good and negative. Fishers expect that Dept. of wildlife conservation should involve actively against the unauthorized fishing activities by non-members of RFO as entering to a wildlife area is an offence without proper permit. One of other most impactful entities is unauthorized fishing communities, however, pose a significant challenge to the RFO, with a 100% negative impact.

The Bank of Ceylon, where the RFO's revolving fund is deposited, and the hatcheries providing fish fries (Inginiyagala NAQDA station, Ekgaloya, and Raja Wewa) have positive relationships with the RFO. Feed is purchased from the Raja Wewa feed factory.The local police station is crucial for supporting the RFO with raids and legal actions against illegal fishing activities. However, despite the RFO’s expectation of a strong relationship, this connection is rated as 50% negative due to the police's frequent delays in responding to reports of unauthorized fishing.

The RFO's relationship with the Department of Irrigation is mixed, with 50% positive and 50% negative aspects. The RFO is dissatisfied with the lack of advance notice for water release schedules, which disrupts fish stocking and leads to annual fish catch losses. However, the department has allowed the RFO to attach a net to the spillway gate during spilling to reduce fish escape. The RFO's relationship with the Ampara District Fisheries Organization is not very close or strong but is considered useful for achieving government demands and for national representation. The RFO values research from the National Aquatic Resources Research and Development Agency (NARA) and universities for its impact on their livelihoods, despite limited direct collaboration. They seek more training and research support from these institutions, believing it will be beneficial. NGOs are recognized for their contributions, providing donations and development support. The Department of Fisheries is also mentioned by RFO members as collaborating with NAQDA to address issues faced by the RFO. (Table 4.2)

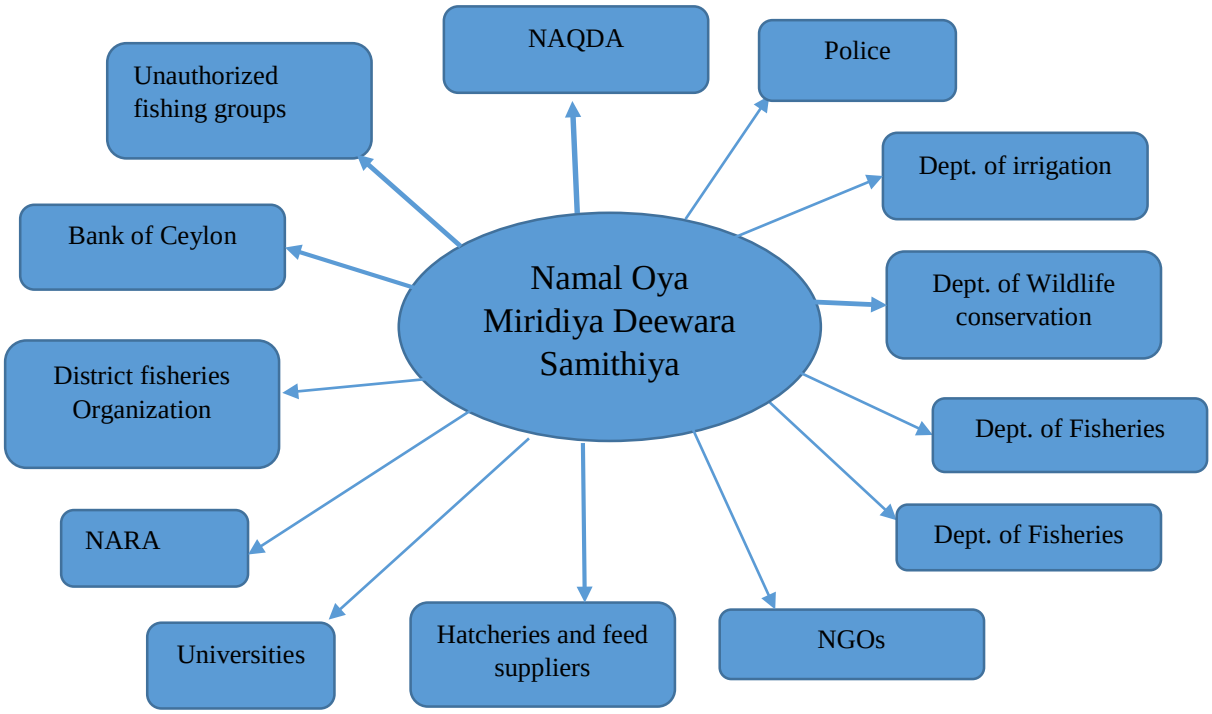


Figure 4.7. Venn diagram – Institutional relations

The RFO faces significant constraints related to ice procurement and storage. The fish buyer, who is a member of the RFO, encounters major difficulties obtaining ice due to the absence of a nearby ice plant. He must travel approximately 60 km to Oluvil to purchase ice, costing LKR 5,000 every two days. The buyer uses 750 kg of ice for every 3,000 kg of fish, totaling about LKR 58,000 every two days for ice. On days when the fish buyer cannot purchase fish, the RFO must store fish, which requires additional ice. This issue is compounded by insufficient freezing facilities, making ice procurement and storage a considerable challenge for the RFO.

Table 4.2 Constraints identified and solutions suggested by RFO

Rank	Constraints identified	Remedial measures suggested	Responsibility
01	No nearby ice plant to purchase ice	Establishment of an ice processing plant near to the reservoir	Ministry of Fisheries CFC
02	Unauthorized fishing activities by non-members of RFO	Strengthening the raid program against	RFO members

		unauthorized and illegal fishing activities Improve the engagement of relevant authorities in enforcing law against unauthorized and illegal fishing activities and take prompt actions	Police NAQDA
03	Lack of fish storage facility	Purchase/ donation of a freezer	NAQDA (Financial Support) RFO NGO
04	Lack of commitment and unity of RFO members in common welfare works	Improvement of the team spirit	RFO

The RFO has identified several key areas for improvement. The effectiveness of raids and actions against unauthorized fishing activities is currently unsatisfactory. Strengthening monitoring programs and improving support from NAQDA and the police for prompt actions are crucial. Unauthorized fishers heavily exploit Tilapia, particularly in areas where water streams converge and near the reservoir's borders. Additionally, there is a need to enhance unity and commitment within the RFO, as team spirit and cohesive action are lacking. Building team spirit and collective effort is essential for better management and protection of the reservoir’s resources.Namal Oya Stocking program agreed after the initiation of the FAO project (Figure 4.8),

Fish Stocking Plan මසුන් තැන්පත් කිරීමේ සැලැස්ම

		Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25
Tilapia තිලාපියා	Purchased මිල දී ගත්		25000	25000		25000				20000		20000	15000		10000			
	Cage කූඩුව			0	35000		35000		0		17500		0	17500	0	0	17500	0
	Total එකතුව	0	25000	25000	35000	25000	35000	0	0	20000	17500	20000	15000	17500	10000	0	17500	0
Catla කැට්ලා	Purchased මිල දී ගත්		15000	15000		15000		5000	5000	20000		15000	15000		20000			20000
	Cage කූඩුව			0	12000		12000		0		24000		0	24000		0	24000	
	Total එකතුව	0	15000	15000	12000	15000	12000	5000	5000	20000	24000	15000	15000	24000	20000	0	24000	20000
Rohu රෝහු	Purchased මිල දී ගත්		5000	5000		5000				5000		5000	5000		5000			10000
	Cage කූඩුව			0	5400		5400		0	0	5400		0	5400		0	5400	
	Total එකතුව	0	5000	5000	5400	5000	5400	0	0	5000	5400	5000	5000	5400	5000	0	5400	10000
Mrigal මිරිගල්	Purchased මිල දී ගත්		5000	5000		5000				5000	5000	10000	10000	5000	15000		15000	20000
	Cage කූඩුව			0	5400	0	5400		0	0	5400	0	0	5400		0	5400	
	Total එකතුව	0	5000	5000	5400	5000	5400	0	0	5000	10400	10000	10000	10400	15000	0	20400	20000

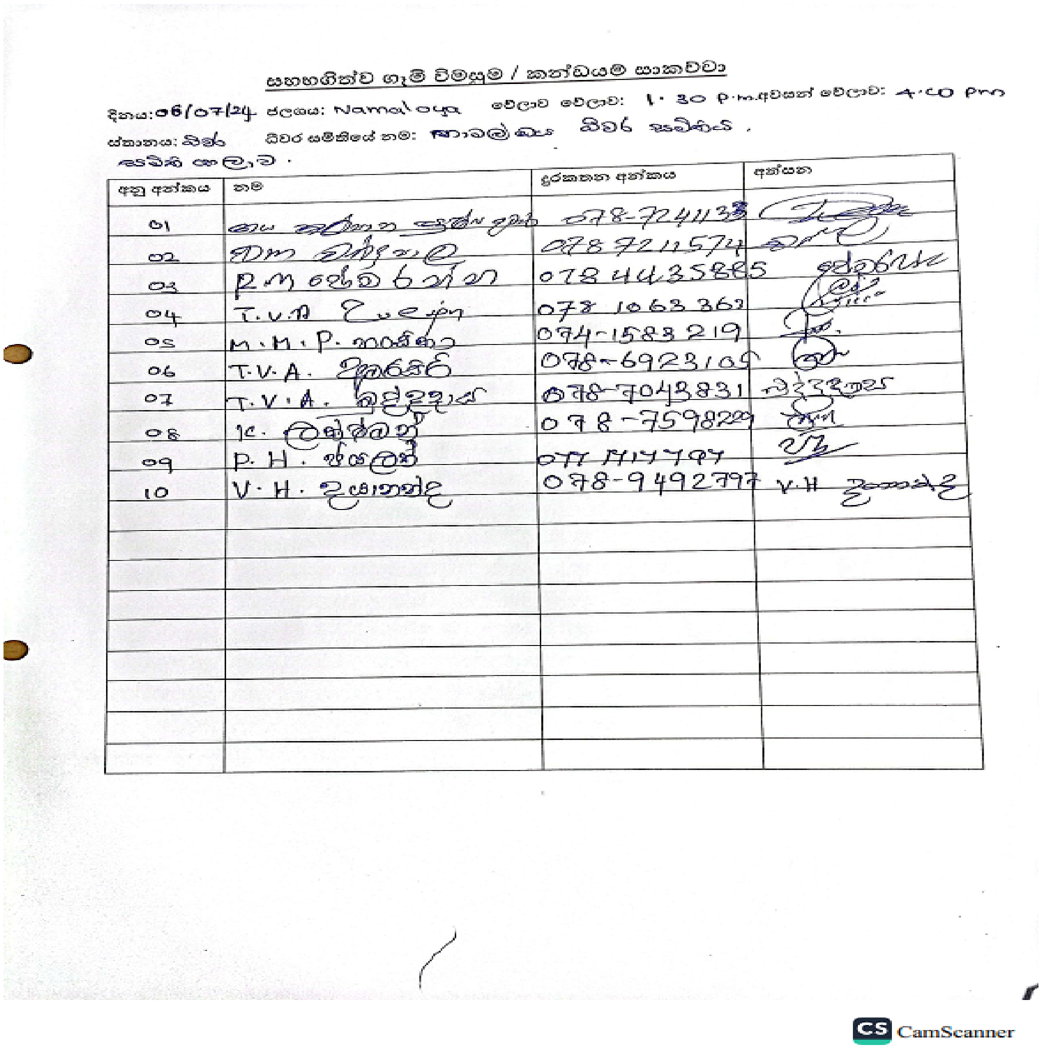
Fry Stocking Plan for Cages ඇසිරිතන් තැන්පත් කිරීමේ සැලැස්ම

		Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25
Tilapia	තිලාපියා		50000			50000			25000			25000			25000			25000
Catla	කැට්ලා		20000			20000			40000			40000			40000			40000
Rohu	රෝහු		9000			9000			9000			9000			9000			9000
Mrigal	මිරිගල්		9000			9000			9000			9000			9000			9000
Total		0	88000	0	0	88000	0	0	83000	0	0	83000	0	0	83000	0	0	83000

Figure 4.8 Fish stocking program agreed by RFO after initiating the FAO project

Figure 4.9 Discussion with society members and recording socio economic data

Attendance Sheet – Namal Oya



සහභාගිත්ව ගැමි විමසුම / කන්ඩායම් සාකච්ඡා

දිනය: 06/07/24 ජලාශය: Namal oya වේලාව: 1.30 p.m. අවසන් වේලාව: 4.00 pm

ස්ථානය: [illegible] ධීවර සමිතියේ නම: [illegible]

අනු අංකය	නම	දුරකතන අංකය	අත්සන
01	[illegible]	078-7241138	[illegible]
02	[illegible]	078 7211574	[illegible]
03	R.M. [illegible]	078 4435885	[illegible]
04	T.V.A [illegible]	078 1063362	[illegible]
05	M.M.P. [illegible]	074-1583219	[illegible]
06	T.V.A. [illegible]	078-6923109	[illegible]
07	T.V.A. බුද්ධදාස	078-7043831	[illegible]
08	K. [illegible]	078-7598229	[illegible]
09	P.H. ජයලත්	077 1114797	[illegible]
10	V.H. දයානන්ද	078-9492797	V.H [illegible]

CamScanner

Figure 4.10 Participants list- Namal Oya

4.2.2 Konduwatuwana Reservoir

Reservoir	: Konduwatuwana (Figure 4.11)
Date	: 07/07/2024
Administrative District	: Ampara
Divisional Secretariat	: Uhana
Grama Niladari Division	: Sasmapura, Himidurawa, abayapura

Figure 4.11. Konduwatuwana Reservoir

4.2.2.1. Background

The Konduwatuwana Reservoir is located on the Ampara-Inginiyagala main road, about 4 km from Ampara town. This was originally constructed under the Patipola Aru Scheme, later incorporated into the Gal Oya Scheme and restored in 1912. Its main water sources include an inlet channel from the Himidurawa tank, the Gal Oya Scheme L.B. channel, and drainage from its catchment area. It has a catchment area of 46.6 km², and the reservoir spans about 364 hectares at full capacity. It supports various livelihoods, primarily benefiting fishers and paddy cultivators, and also supplies water to the Ampara Reservoir. The surrounding area is a wildlife conservation zone, and an elephant fence was erected to prevent elephants from entering the nearby village. The National Water Supply and Drainage Board also has a water filtering center in front of the Samagipura landing site. An army camp is also located near the Abeypura area, adjacent to the reservoir.

The Konduwatuwana Reservoir has a well-formed and active Rural Fisheries Organization (RFO) known as Konduwatuwana Shakthi Miridiya Deewara Samithiya and gathered in a meeting once a month. Currently, 70 fishermen are members of this fisheries society, with around 40 actively engaged in fishing activities. As this reservoir is located in a wildlife conservation area, an operation license should be obtained from the Dept. of Wildlife Conservation and annual renewal is mandatory. Only the members of RFO can engage in fishing activities. The Konduwatuwana Reservoir has three landing sites: Abeypura, Dolahe-ela, and Samapura. Fishers from Kotawehera, Suduwella, and Hardyniwasa villages use the Samapura landing site, while those from Dolahe-ela, Ekolahe-ela, and Dahaye-ela use the Dolahe-ela landing site. Fishers from Abeypura village use the Abeypura landing site. There are 28 fishers operating at the Samapura landing site, 16 at Abeypura, and 26 at Dolahe-ela. The distances to the reservoirs from fishing villages are as follows: 3 km from Abeypura, 2.5 km from Ekolahe-ela, 1 km from Kotawehera, 0.5 km from Suduwella, 1 km from Dolahe-ela, and 0.5 km from Hardyniwasa**.** (Figure 4.12)

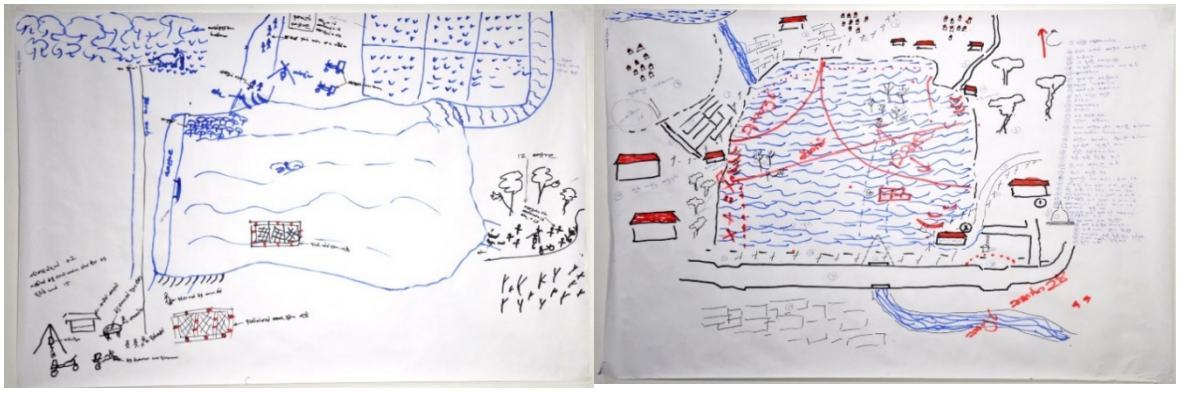


Figure 4.12 Village map and the reservoir map of Konduwatuwana

The RFO of Konduwatuwana Reservoir has seen significant developments since its inception. At the beginning fishing had been carried out using self-made wooden canoes. Over time, they transitioned to fiberglass canoes, and currently, Konduwatuwana Shakthi Miridiya Deewara Samithiya owns 23 canoes. In total, 45 fiberglass canoes are in operation, with 22 donated by various institutions. (Figure 4.13)

Figure.4.13. Group activity on development milestones of RFO Konduwatuwana Reservoir

Formal registration of the RFO was challenging due to the nearby military base and training school, heightening security concerns during the war period. Despite these difficulties, the RFO was officially registered on June 21, 2007, with government support. At that time, the RFO had 84 members, and the membership fee was LKR 6125 per person per year.

From the beginning, fish marketing at the Konduwatuwana Reservoir has been conducted separately at each landing site. Fishers themselves weigh the fish and sell to the buyer. There is a member for each landing site to keep fish marketing records. Initially, LKR 10-15 was deducted per kilogram of fish as a levy, with LKR 5 paid to the member responsible for keeping marketing records. The rest of the money were deposited as a fund for RFO and used for welfare activities, primarily for releasing fingerlings. However, due to the rising cost of fingerlings, the RFO decided to increase the commission to LKR 50 per kilogram of fish, with LKR 5 going to the record keeper and the remaining LKR 45 to the RFO fund. Tilapia, Catla, Rohu, and Mrigal are the most common fish caught in the reservoir. The record keepers from each landing site meet with the treasurer on the second day of each month, presenting their bill books and handing over the collected funds. (Figure 4.14)

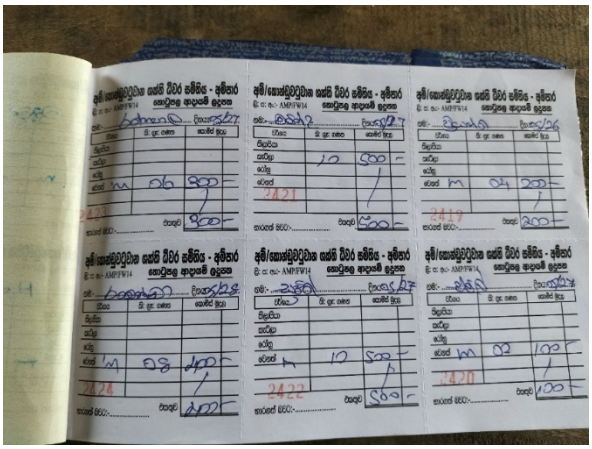


Figure 4.14.Bill book use in fish selling

The treasurer then deposits the money into the RFO savings account at the Rural Development Bank (RDB). Priority in fish marketing is given to local consumers. After meeting local demand, any remaining fish is sold to mobile vendors. Each landing site has two regular fish buyers. Two Muslim vendors frequent the Samapura landing site, transporting fish 30-40 km to areas like Samanthurai, Akkareipattu, and Kalmune, primarily for dried fish processing. Sinhala vendors come to the Abeypura and Dolahe-ela landing sites, bringing fish to nearby areas such as Himidurawa, Galahitiyawa, Uhana, Dematamalpelassa, Paragahakele, Abeypura, and Wawinna, maximum 10-15 km away from the reservoir.These vendors lend money to needy fishermen and gradually recover the amount when purchasing fish from them.

The RFO fish stocking program has not been conducted regularly or according to a planned schedule. Instead, it has been managed in an ad hoc manner, occurring either when there is sufficient funding or when there is a significant drop in fish catch.In 2012, the RFO used its funds to establish a community building on land owned by the wildlife department at the Samapura landing site. That same year, the government donated four cages to the organization for raising fingerlings, helping to reduce the cost of fingerling stocking programs. In 2021, the RFO purchased an OFRP boat and an engine worth LKR 134,000 for conducting raids against illegal and unauthorized fishing activities. Additionally, the RFO installed four CCTV cameras at the Samapura landing site to secure fishing equipment at the cost of LKR 120 000. RFO use money from their fund to purchase and transport feed for cages and around LKR 25 000 per month spent on this task. In addition, the Reservoir Fisheries Organization (RFO) donates LKR 10,000 as a welfare responsibility for the funeral of a member or a member's family.

The community organization operates under a written constitution with established rules and sanction procedures. Each member has a personal file containing their application form with personal details, the nomination of a beneficiary, fishing craft and gear details, and records of any misconduct along with corresponding fines and punishments. (Figure 4.15)

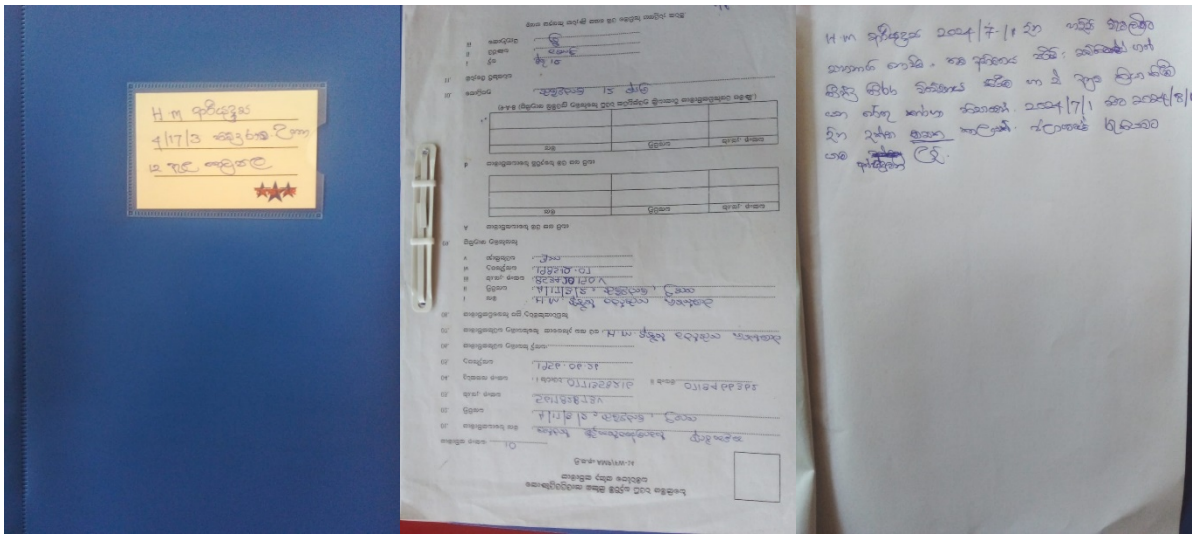


Figure 4.15 Sample of a personal file of RFO members of Konduwatuwana

Membership eligibility for fishing activities is strictly controlled. Every member must nominate a beneficiary, typically their spouse, to inherit their membership upon their death. The spouse can either retain the membership or transfer it to another person with the organization's permission during a general meeting. If the spouse transfers the membership to another family member, the new member must pay LKR 5,000 to the RFO. If it is transferred to a completely different person, that person must pay LKR 50,000 for the new membership and nominee also charge a reasonable cost for transferrin the permit to that particular person.

Members who miss three consecutive meetings face sanctions, though they can excuse up to two consecutive absences by formally notifying the president or secretary. Misbehavior incurs a fine determined in a general meeting, based on the severity and frequency of the misconduct. Fishing times are restricted, with net setting starting after 4:00 pm and the catch needing to be landed by 8:00 am the following day. A fishing unit (boat and crew) is allowed a maximum of six net pieces, with mesh sizes between 4 inches and 12 inches. Fishers who do not engage in fishing activities

in regular basis have to pay an amount worth of 20Kg of fish (approximately LKR 1000) per month to continue their membership and contribution to the RFO fund.

Fishers at each landing site operate under a verbal agreement regarding fishing sites. Those at the three landing sites have specific areas that are mutually exclusive. Although these boundaries are agreed upon verbally and are not legally enforceable, fishers generally respect these agreed-upon limits and do not cross them.Fishers operating from Abeypura and Dolahe-ela are restricted from fishing during shooting training sessions at the Konduwatuwana Army camp. This restriction, which was frequent during the war period, has become less common now. The army camp informs the fishers in advance of any firing sessions to ensure they avoid fishing activities during those times therefore fishers well understand the routine of these sessions and importance of these sessions which has minimized the conflicts.

The RFO holds the responsibility of monitoring unauthorized fishing activities carried out by non-members. However, this task currently faces many challenges. There are no organized groups for conducting raids, and no regular schedule is followed. Instead, ad hoc monitoring visits are carried out by the office bearers, with little active participation and involvement from the organization's members. Despite these challenges, there have been some successful attempts by the RFO to take action against such conflict groups with the support of NAQDA officials and police officers.

4.2.2.2 Socio-demographic Profile of Konduwatuwana Fishing Community

Figure 4.16 shows the summarized detail of socio-demographic feature of the fishers in Konduwatuwana reservoir. All fishers in the sample were Sinhala and Buddhist. Of these, 55% are generational reservoir fishers, while 45% gained membership by transfer. The majority (44.4%) are aged 51-60, followed by 33.3% aged 41-50. Most fishers (55.6%) have an education level between grades 6-10. All are married, with an average family size of 4. Additionally, 60% have a secondary income from paddy cultivation. The average monthly fishing income is LKR 31,222, with a maximum of LKR 50,000 and a minimum of LKR 8,000. Those engaged in agriculture primarily cultivate paddy during both Yala and Maha seasons, usually for home consumption, and typically harvest crops worth LKR 200,000 per season. Additionally, 90% of the fishers live 1-2 km from the reservoir.

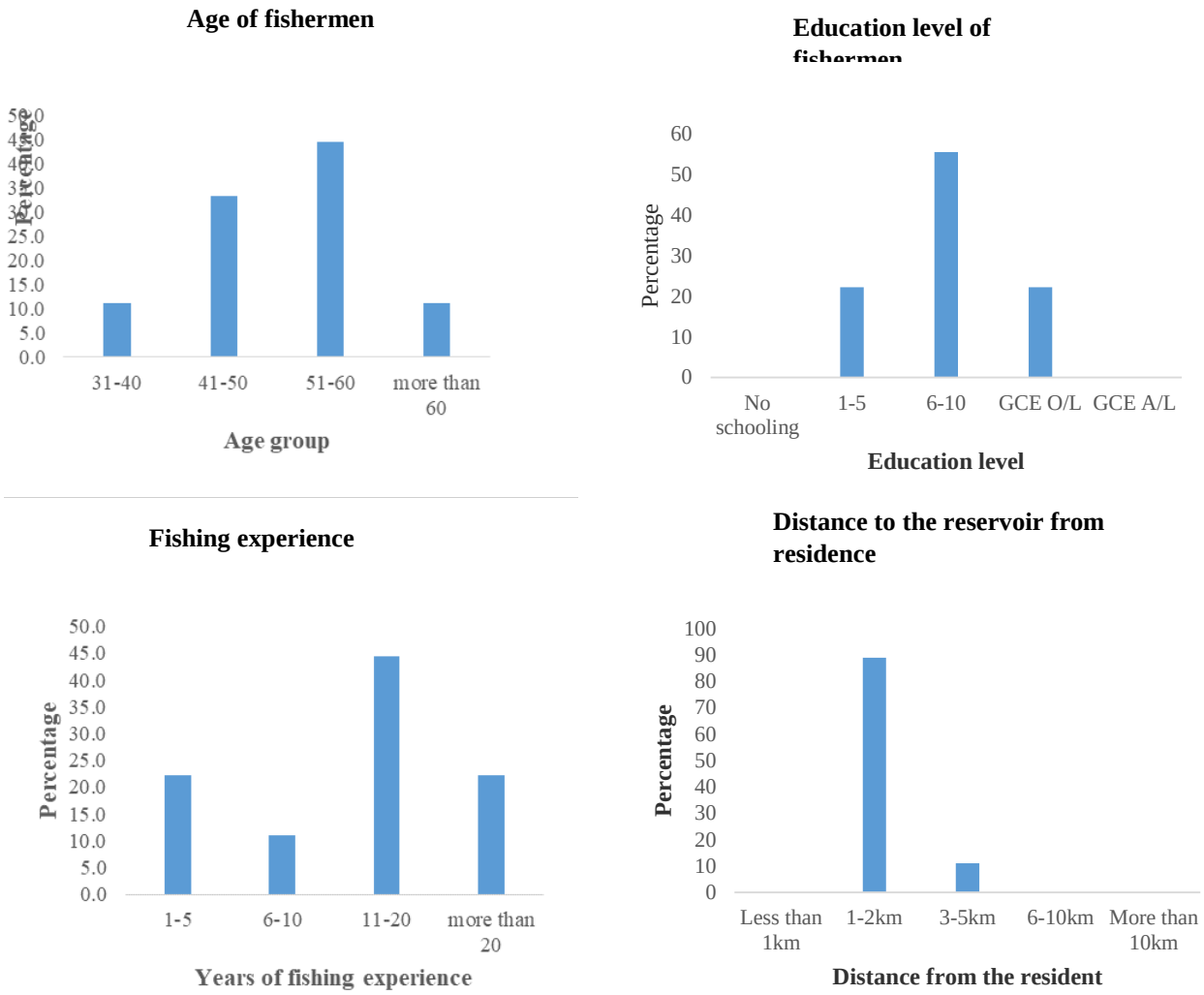


Figure 4.16 Socio-demographic profile of Konduwatuwana fishing communities

Figure.4.17.Questionnaire survey with RFO members

4.2.2.3 Fishery Related Information

The fishers in this reservoir engage in fishing activities for an average of 23 days per month, with a maximum of 28 days and a minimum of 22 days. Vendors do not come to the landing sites for two days, so fishers do not fish the day before and on the full moon Poya day. Typically, fishers engage in fishing activities individually. Participation in the RFO monthly meeting is 91% on average, influenced by the benefits and services received from the organization and satisfaction with its smooth functioning. Among the fishers, 77.8% are strongly satisfied with the RFO's functioning, while the remaining 22.2% are satisfied.

The main common resource users of these reservoirs are fishers, farmers, and the water supply and drainage board. All fishers (100%) reported no conflict between farmers and the water supply and drainage board. However, the significant conflict within the fishing community is the illegal and unauthorized fishing activities by non-members.

Fishers stated that their society has bargaining power over fish prices and they receive market prices from vendors in different areas of the country. However, they face significant price drops when marine fish is abundantly available in the markets.All fishers (100%) stated that their major expectation from the RFO is to strengthen the fish stocking program by enriching the RFO’s fund.

Table 4.3 shows the compliance of Konduwatuwana fisher community with Ostrom’s modified design principals to determine the institutional robustness.

Table 4.3 Summery of compliance of Konduwatuwana RFO with the Ostrom’s modified design principles

Element	Design principal	Level of compliance
1A	Clearly defined user boundaries	Highly exist
1B	Clearly identified resource boundaries	Highly exist
2A	Congruence with local conditions	Highly exist
2B	Appropriation and provisions	Highly exist
3	Collective-choice arrangements	Highly exist
4A	Monitoring users	Moderately exist
4B	Monitoring the resources	Moderately exist
5	Graduated sanctions	Prominently exist
6	Conflict resolution mechanism	Prominently exist
7	Minimal recognition of the right to organize	Highly exist
8	Multi-level institutional structure	Highly exist

Except for Principle 04 (4A and 4B), all other elements have shown high or prominent compliance, indicating a satisfactory status of the RFO fishing community in terms of organizational robustness and resource management. Principle 4 is at a moderately existing level due to the lack of a strong and organized committee within the RFO for monitoring and controlling fishing activities, violations, and violators. Currently, the mechanism in place is ad hoc rather than systematic. Additionally, resource monitoring is also at a moderate level, with actions not being sufficient to secure the resources effectively. One example is the less effective prevention of fish escape during the spilling period through spillway gates.

4.2.3.4. Institutional Relations

Several important institutions and organizations impact the functioning of the Konduwatuwana reservoir. In a Participatory Rural Appraisal (PRA) exercise, participants created a Venn diagram illustrating these relationships, their nature, and their strength (Figure 4.18).The most closely connected institution to the Reservoir Fisheries Organization (RFO) of Konduwatuwana is the National Aquaculture Development Authority (NAQDA), with a relationship described as 100% positive for smooth functioning. The Department of Wildlife has a satisfactory relationship with the RFO, rated 100% positive. It provides the operational license for fishers under annual charge of LKR 300 without any delay. One of the other most impactful entities is unauthorized fishing communities, however, pose a significant challenge to the RFO, with a 100% negative impact.

Next, the Rural Development Bank, where the RFO's revolving fund is deposited, and hatcheries that provide fish fries are also important, with both relationships considered positive. The RFO buys fries from the Inginiyagala NAQDA station, hatcheries operated by Ekgaloya, and Raja Wewa. Feed is purchased from RAJA wewa feed factory. The relationship with the local police station is also significant for the RFO. Police support is crucial for conducting raids and taking legal action against individuals involved in illegal and unauthorized fishing activities. Even though the RFO expects a strong relationship with the police, this relationship is rated as 75% negative because the police often fail to respond promptly when the RFO reports unauthorized fishing activities.

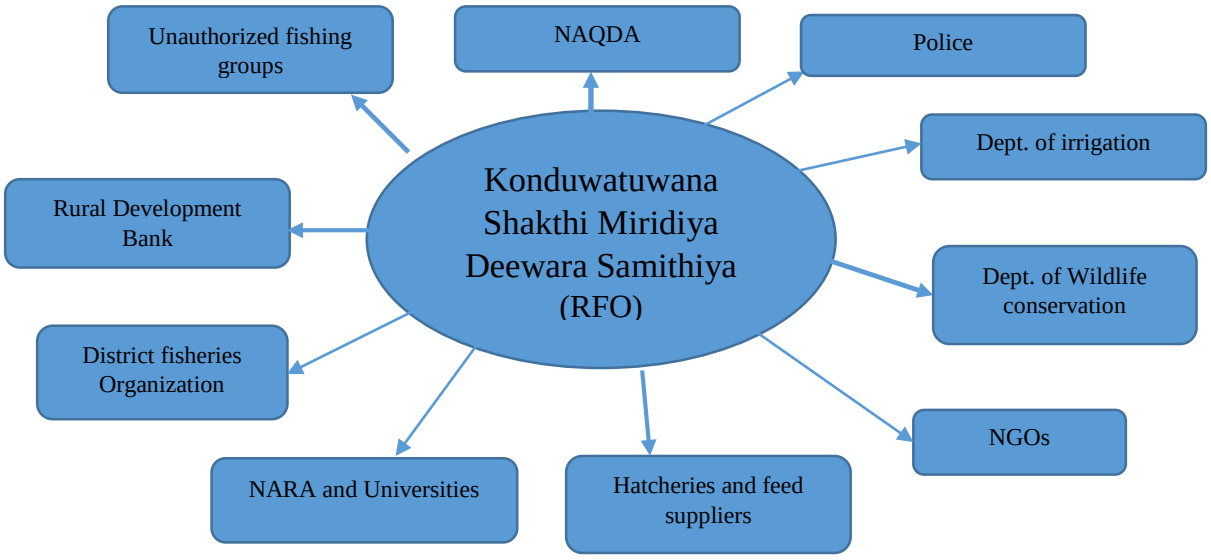


Figure 4.18 Venn diagram – Institutional

The RFO's relationship with the Department of Irrigation is mixed—50% positive and 50% negative. The RFO is dissatisfied with the water release procedures from the reservoir, as they are not informed about the schedule, affecting fish stocking programs and leading to significant annual fish catch losses.The RFO works with the Ampara District Fisheries Organization, but according to their view, this relationship is not very close or strong. However, they find this membership useful for achieving certain demands from the government and for representation at the national level.They have found that research work from the National Aquatic Resources Research and Development Agency (NARA) and some universities is also important for their livelihoods, even though they do not work closely with these entities. NGOs have been identified as contributing organizations, as the RFO has received donations and development support from them.

During the PRA, the RFO collectively identified the major problems they face in resource harvesting and management. They also prioritized the issues and identified possible solutions and the responsible authorities for taking remedial actions for these issues (Table 4.4).

Table 4.4. Constraints identified, and solutions suggested by RFO

Rank	Constraints identified	Remedial measures suggested	Responsibility
01	Fishing by unauthorized people (non-members of RFO)	Strengthening the raid program against unauthorized and illegal fishing activities	RFO members
		Improve the engagement of relevant authorities in enforcing law against unauthorized and illegal fishing activities and take prompt actions	Police, NAQDA
02	Very low Tilapia catch due to less responsiveness to the currently using nylon gears	A study should be conducted to identify the true reason behind the low Tilapia catch	NARA, Universities
		Introduction of other tilapia species responsive for fishing gears currently use (Nile Tilapia)	NARA, NAQDA
03	Loss of fish during spilling period	Fix an appropriate net to the spillway gates to avoid releasing of fish during spilling period, There are two spilling mouths	RFO NAQDA (for financial support)
04	High cost and poor quality of fishing gears	Standardize the quality of fishing gears Control price for fishing gears	NARA Dept. of fisheries
05	Drastically price drop when marine fish abundant in the markets	A proper price mechanism should be established	NARA Ministry of Fisheries Dept. of Consumer Affairs

4.2.3.5. Follow-up Findings

After conducting awareness programs, workshops, and surveys under the FAO project during June and July, the RFO of Konduwatuwana reservoir has taken several constructive decisions. These decisions aim to support the program and ultimately enhance resource management, improve income, and boost overall wellbeing. These all decisions have been taken at a special general meeting on 19.06.2024 by member's full consent.

First, starting from August 1, 2024, operational groups of 5 members each will be established, with each operational group represented in the selection of office bearers for the RFO. Duties and responsibilities related to resource management will be equally divided among these groups, and each member will be accountable to their team. Second, effective August 1, 2024, fishing gears with mesh sizes smaller than 6 inches will be prohibited in fishing activities at Konduwatuwana reservoir. Third, beginning March 1, 2025, only nets with mesh sizes of 6, 10, and 12 inches will be permitted for fishing activities. Fishing locations will be demarcated and allocated to each member, with prohibitions on crossing into others' allocated locations. This clause will be implemented after stocking programs and increases in fish catch quantities. The number of fishing nets a fisherman can use at once will be restricted to four. Special fish varieties' harvesting, or prohibition will be monitored and advised by NAQDA. If a member withdraws, no new member will be substituted for a certain period. The sanction procedure is strengthened and as follows:

- First Incident: The person will be advised at the monthly meeting.
- Second Incident: The fishing permit will be suspended for one month.
- Third Incident: The individual will be terminated from RFO membership.

If a group of five members fails to control unauthorized or illegal fishing activities, they will be accountable for the RFO. Additionally, if a member of a small operational group is unable to participate in RFO common activities, a substitute can be deployed from another group. The cost of the substitute will be covered by the members of the responsible group.

However, there are practical challenges in implementing these rules among the fishers at Konduwatuwana reservoir. Most notably, many fishers need to acquire new fishing gear to comply with the new regulations, as most have previously used nets with mesh sizes smaller than 6 inches. Currently, around 25 fishers are operating under the new rules, while the rest are still in the process of obtaining nets with the required mesh size. Additionally, fish catches are lower due to the use of larger mesh sizes and a previous poor stocking plan (Figure 4.19).With the initiation of the FAO project and guidance from consultants, the RFO of Konduwatuwana now has a well-planned fish stocking strategy. The RFO has successfully carried out two stocking programs in June and July using their funds.The RFO has applied for a loan facility of 2 million rupees to support fish stocking programs until the revolving fund is sufficiently replenished. They plan to repay the loan installments using the commission received from fish sales.

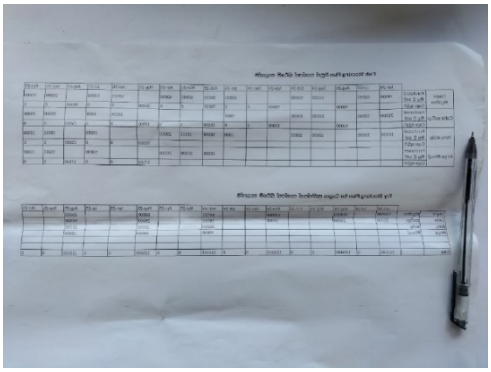


Figure 4.19. Fish stocking program agreed by RFO after initiating the FAO project - kondukaduwawa

Figure 4.20 PRA -Kondukaduwawa

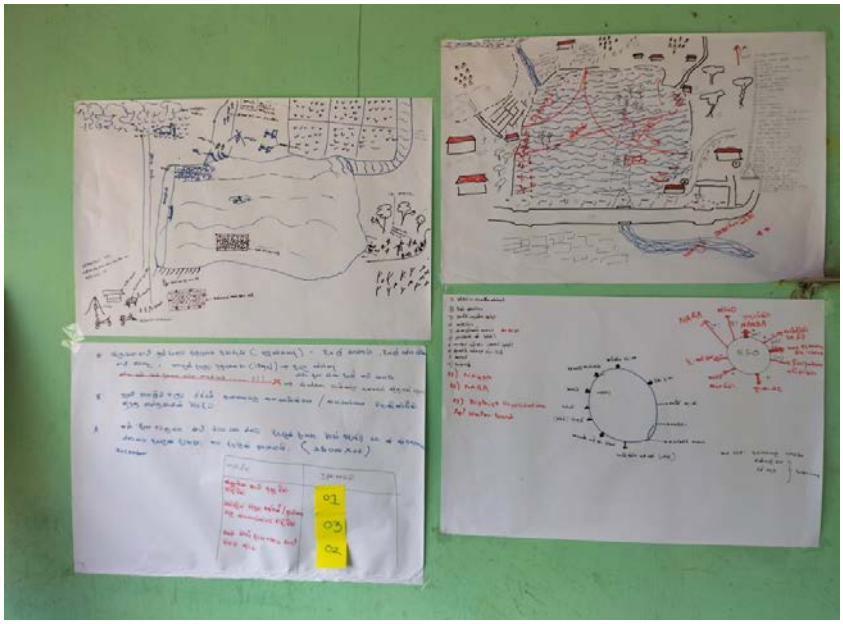


Figure 4.21 Outputs of PRA

Attendance Sheet- Konduwatuwana

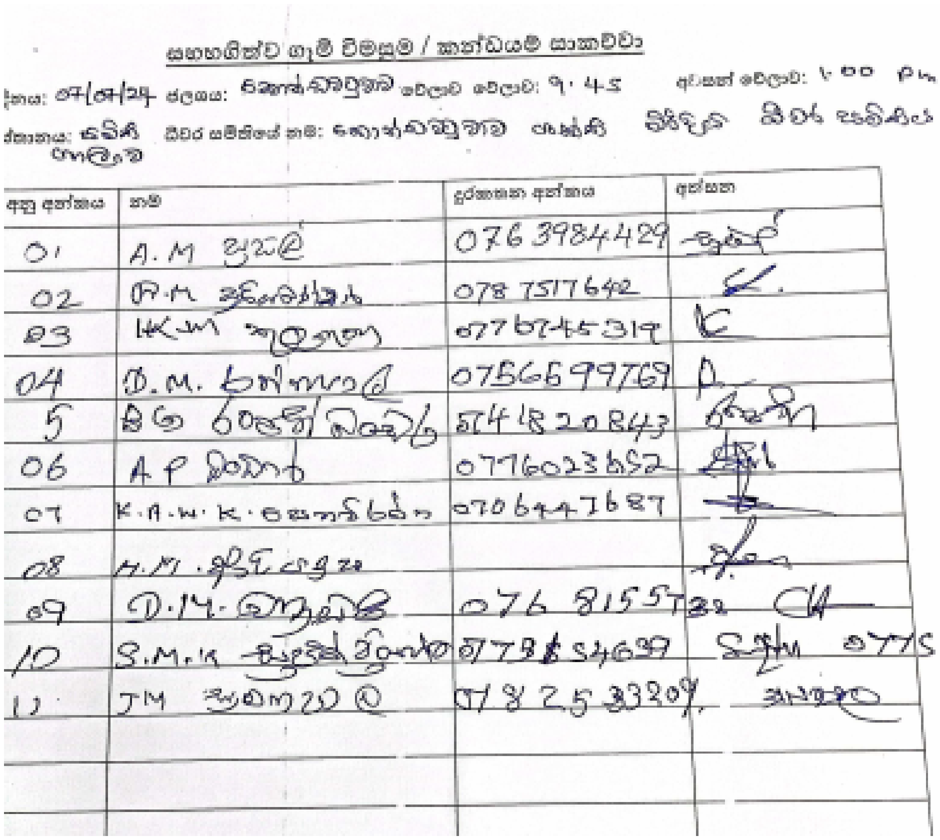


Fig 4.22 Participants list- Kondukaduwawa

4.2.3 Ekgal Oya Reservoir

Reservoir	: Ekgal Oya
Date	: 08/07/2024
Administrative District	: Ampara
Divisional Secretariat	: Damana
Grama Niladari Division	: Damana

4.2.3.1 Background

Ekgal Oya is a reservoir situated east of Senanayake Samudraya in the Ampara District. Built by the Gal Oya Development Board between 1995 and 1997, the reservoir impounds the Ekgal Oya stream. It features a bund that extends approximately 3,700 feet and covers about 1,000 acres at full supply level. The reservoir has a single spill and is located in a wildlife conservation area, protected by an electric fence. It is conveniently close to the Ampara-Matara main road.

The RFO of Ekgal Oya is named "Ekgal Gramiya Miridiya Deewara Samithiya." Due to the reservoir's location in a wildlife conservation area, an operational license from the Department of Wildlife Conservation is required for fishing activities. The RFO has 22 male members, which is the maximum number allowed for fishing in this reservoir. These fishers are also involved in agricultural work, including paddy and sugarcane cultivation.The sole landing site for the reservoir is the Ekgal Oya landing site. Fishers come from five villages: Kethsirigama (3 fishers), Koknahara (8 fishers), Ekgal Oya (6 fishers), Galkanda (2 fishers), and Damana (3 fishers). Ekgal Oya village is the closest to the landing site, located 500 meters away, while Galkanda village is the furthest at 13 kilometers. Koknahara, Kethsirigama, and Damana are situated 4-5 kilometers from the landing site.(Fig43.23)

Figure 4.23 Village and reservoir mapping by RFO members at the PRA

Since the inception of fishing activities at the Ekgal Oya reservoir, the RFO has reached several significant development milestones (Figure 4.24) Initially, Muslim fishermen from Wadduwa in the Panadura District were the first to engage in fishing at the reservoir. Over time, Sinhala people from surrounding villages joined them, and by 1980, there were three Sinhala fishers alongside the Muslim community, bringing the total number of active fishers to around 20. In 1989, under the guidance of an Extension Officer from NAQDA, fishers began informal meetings at a location known as “Merundu Kade.” During this period, fishing was focused solely on Tilapia, and self-made wooden canoes were used. Approximately 50 kg of Tilapia was processed daily for dried fish production. By 2002, the Muslim community ceased fishing activities at the reservoir. Previously, fishing was conducted with nylon nets of 3.5 inches or larger mesh size. After 2002, the reservoir was stocked with Catla, Mirigal, and Rohu fish. In 2004, the fishers restructured their efforts, forming a more active and organized society compared to previous years.

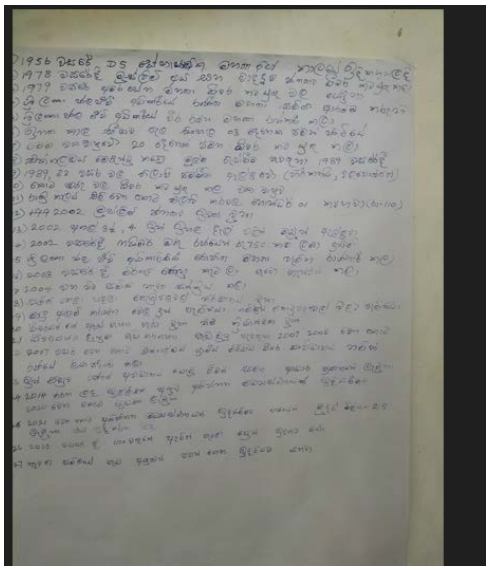


Figure 4.24 Group activity for listing development milestone of RFO of Ekgal Oya

The community building at Ekgal Oya was constructed on land owned by the Department of Irrigation, with financial support from the government. The labor for the construction was provided by the fishers themselves. In 2007, the RFO was formally established. Since then, fishers have received training from NAQDA to improve their knowledge of fish, fishing practices, and fisheries management. Fish marketing was initially managed by an RFO member, with a revolving fund established from a levy on fish sales. A levy of LKR 30 per kilogram was deducted and added to the RFO fund. Recently, the President of the RFO has taken on the role of the sole fish buyer at the landing site, given his ability to purchase fish directly from the fishers. Approximately LKR 500,000 to 600,000 from the RFO fund was used for the community building's construction. In 2014, the RFO requested government assistance to build a hatchery. By 2020, the government allocated land for the hatchery, and in 2021, they provided LKR 2,500,000 for its construction. Additionally, the RFO secured a bank loan of LKR 2,000,000 from RDB Bank. Initially, the monthly installment was LKR 56,000 but was later revised to LKR 180,000 every three months.

The hatchery at Ekgal Oya (Figure 4.25), now constructed, includes three brood stock tanks; Tilapia (100 fish), Mirigal (40 fish), and Catla (110 fish) and nine rearing tanks.It is situated 1.25 km from the landing site. However, the facility still lacks an electricity supply, relying instead on a generator. Operating the generator for one production cycle incurs a cost of about LKR 30,000,

which is proving to be economically unfeasible. As a result, fingerling production has been temporarily halted while awaiting electricity installation.

Figure 4.25 Hatchery owned by Ekgal Oya RFO

The initial estimate for electricity supply was LKR 2,000,000, but this has been re estimated to LKR 450,000. Maintenance of the hatchery is challenging due to the mud ponds, and daily maintenance is performed by 18 fishers after their fishing activities. Currently, the hatchery is not operational due to the electricity issue.Despite these challenges, the hatchery has generated income by selling fingerlings. They earned LKR 400,000 from selling fries to nearby reservoirs and have released 100,000 fingerlings into their own reservoir. Additionally, sales of fingerlings brought in another LKR 600,000. The hatchery has supplied fingerlings to Ambalan Oya, Inginiyagala, and Jayanthi Wewa reservoirs, with orders reaching up to 50,000 fingerlings at a time.

When selling fish, priority is given to local consumers. There are 10-12 regular local buyers at the landing site, each purchasing an average of 1-2 kg of fish. If the catch exceeds 500 kg, the fish buyer transports it to Hambantota (185 km away) to sell to a middleman who supplies the Negombo market. For smaller catches, the buyer takes the fish to Kalmunai (35-40 km away). He also purchases ice from Kalmunai. He buys 350 kg of ice at a time, sufficient for 3-4 days, spending around LKR 60,000 per week on ice and transportation. The catch of Tilapia is relatively low in this reservoir, with an average of 250 kg of Mirigal and Catla each per day. During peak periods, only about 50 kg of Tilapia is collected daily.

The RFO of Ekgal Oya reservoir operates under a written constitution that mandates monthly meetings on the 22nd of each month, with all 22 members required to attend. Members who miss three meetings can avoid penalties by formally notifying the president or secretary. For a second absence, a fine of LKR 1,500 is imposed. If a member misses a third meeting consecutively, their membership is canceled, and the vacant permit is offered to an eligible person selected through a notice published within the GN division. Interested individuals must apply to the RFO with a character certificate issued by the GN. If multiple applications are received, the RFO selects the best candidate. The transfer fee is LKR 130,000, which is added to the revolving fund. Membership of a deceased or ill member is automatically transferred to their nominee. Other forms of misconduct result in fines determined by a general meeting, based on the severity and frequency of the offense. Fishing regulations include net setting starting after 4:00 pm, with the catch needing to be landed by 8:00 am the following day. Each fishing unit (boat and crew) is permitted a maximum of six nets, with mesh sizes ranging from 4 to 12 inches. However, due to reduced catches, fishers have recently used 8-10 nets per operation. During dry periods when water levels drop, the six-net rule is generally observed. The revolving fund is used for the welfare of fishers, with the primary focus on releasing fingerlings, although this has not been conducted in a scheduled manner.

4.2.3.2 Socio-demographic profile of Ekgal Oya fishing community

Figure 4.26 Questionnaire survey with RFO members

Figure 4.27 shows the summarized detail of socio-demographic feature of the fishers in Ekgal oya reservoir. All fishers in the sample were Sinhala and Buddhist. Of these, 55% are generational reservoir fishers, while 45% gained membership by transfer. The majority (40%) are aged 51-60. All are married, with an average family size of 4. Additionally, 80% have a secondary income from paddy cultivation. The average monthly fishing income is LKR 42 200, with a maximum of LKR 95,000 and a minimum of LKR 15,000. Those engaged in agriculture primarily cultivate paddy and sugar cane and earn average of LKR 400 000 per season. Additionally, 100% of the fishers in the sample are lived 1-2 km from the reservoir. Majority of fishers have 6-10 years of fishing experience.

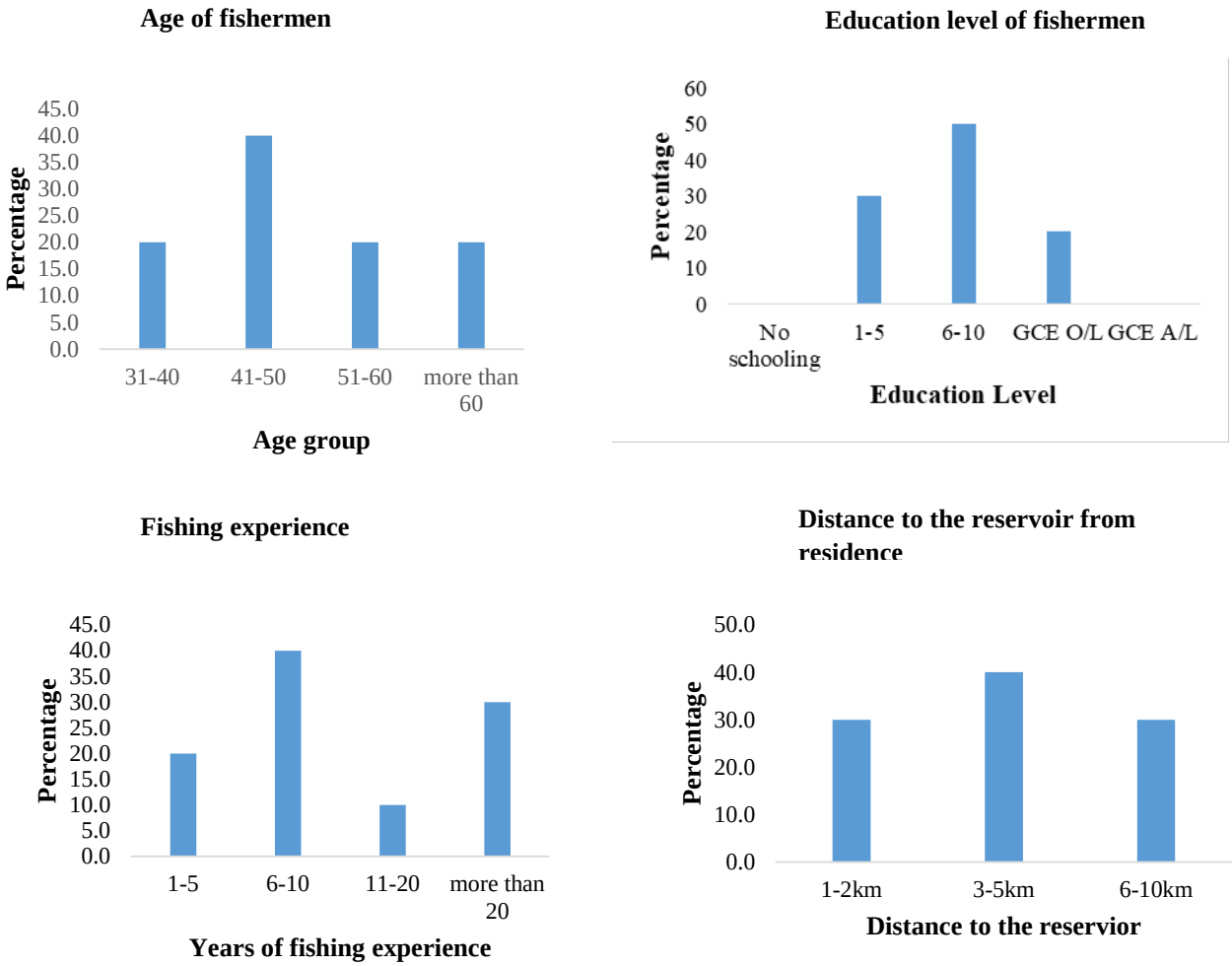


Figure 4.27 Socio-demographic profile of Ekgal Oya fishing communities

4.2.3.3 Fishery Related Information

The fishers in this reservoir engage in fishing activities for an average of 22 days per month, with a maximum of 25 days and a minimum of 20 days. Vendors do not come to the landing sites for two days, so fishers do not fish the day before and on the full moon Poya day. Typically, fishers engage in fishing activities individually. Participation in the RFO monthly meeting is 99% on average, influenced by the benefits and services received from the organization and satisfactionwith its smooth functioning. Among the fishers, 60% are strongly satisfied with the RFO's functioning, while 305 are satisfied and only 10% are unsatisfied.

The main common resource users of these reservoirs are fishers, farmers. All fishers (100%) reported no conflict between farmers. However, the significant conflict within the fishing community is the illegal and unauthorized fishing activities by non-members.

Fishers stated that their society has bargaining power over fish prices and they receive market prices from vendors in different areas of the country. However, they face significant price drops when marine fish is abundantly available in the markets.All fishers (100%) stated that their major expectation from the RFO is to strengthen the fish stocking program by enriching the RFO's fund. Currently 60% are satisfied with the stocking program while rest are unsatisfied.

Table 4.5 shows the compliance of Ekgal Oya fisher community with Ostrom's modified design principals to determine the institutional robustness.

Table 4.5 Summery of compliance of Ekgal Oya RFO with the Ostrom's modified design principles

Element	Design principal	Level of compliance
1A	Clearly defined user boundaries	Highly exist
1B	Clearly identified resource boundaries	Highly exist
2A	Congruence with local conditions	Highly exist
2B	Appropriation and provisions	Highly exist
3	Collective-choice arrangements	Highly exist
4A	Monitoring users	Prominently exist
4B	Monitoring the resources	Prominently exist
5	Graduated sanctions	Highly exist
6	Conflict resolution mechanism	Highly exist
7	Minimal recognition of the right to organize	Highly exist
8	Multi-level institutional structure	Highly exist

Except for Principle 04 (4A and 4B), all other elements have shown high compliance, indicating a satisfactory status of the RFO fishing community in terms of organizational robustness and resource management.

4.2.3.4 Institutional Relations

Several key institutions and organizations influence the operation of the Ekgal Oya Reservoir. During a Participatory Rural Appraisal (PRA) exercise, participants developed a Venn diagram to illustrate these relationships, their nature, and their strength (Figure 4.28). The most positively connected institution to the Reservoir Fisheries Organization (RFO) of Ekgal Oya is the National Aquaculture Development Authority (NAQDA), with a 100% positive relationship that ensures smooth functioning. The Department of Wildlife also maintains a satisfactory relationship with the RFO, providing operational licenses for fishers with an annual fee of LKR 300, without delay. However, unauthorized fishing communities present a significant challenge to the RFO, having a 100% negative impact on its operations.

Next, the Rural Development Bank and the Bank of Ceylon, which manage the RFO's revolving fund and provide loan facilities, are also crucial institutions. The nearby reservoirs that purchase fingerlings and fries from the hatchery owned by Ekgal Oya Reservoir have a 100% positive relationship with the RFO. Additionally, the relationship with the local police station is significant. The police provide essential support for conducting raids and taking legal action against illegal and unauthorized fishing activities, with the reservoir community reporting a 100% positive relationship with the police station for their assistance in raids.

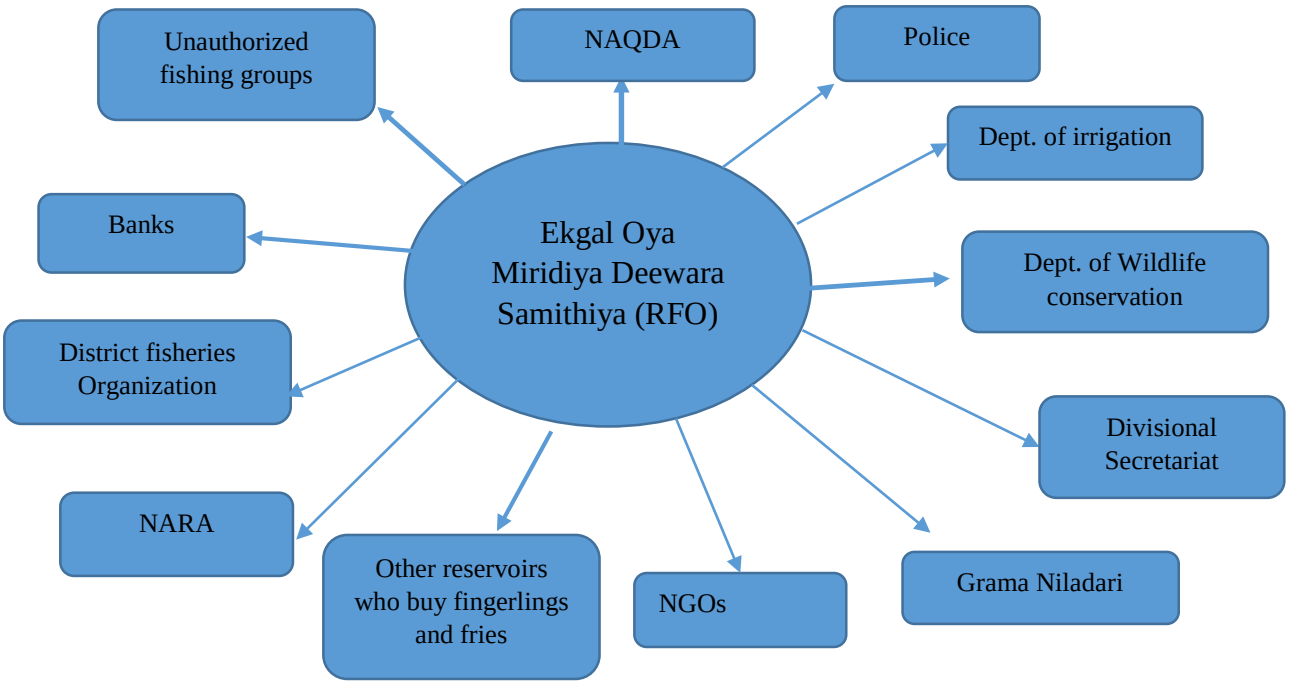


Figure 4.28 Venn diagram – Institutional relations

The RFO's relationship with the Department of Irrigation is rated as 100% positive. However, there is dissatisfaction with the water release procedures from the reservoir, as the RFO is not informed about the schedule, which impacts fish stocking programs and results in significant annual fish catch losses. The RFO's relationship with the Ampara District Fisheries Organization is considered useful but not very close or strong; it helps with achieving certain government demands and national representation. The RFO values research contributions from the National Aquatic Resources Research and Development Agency (NARA) and has identified NGOs as key contributors, providing donations and development support. Additionally, the RFO maintains positive relationships with the Grama Niladari and the Divisional Secretariat.

During the PRA, the RFO collectively identified the major problems they face in resource harvesting and management (Figure 4.29). They also prioritized the issues and identified possible solutions and the responsible authorities for taking remedial actions for these issues (Table 4.6)

Table 4.6 Constraints identified and solutions suggested by RFO

Rank	Constraints identified	Remedial measures suggested	Responsibility
01	Unavailability of electricity to function hatchery	Supply electricity	MoF NAQDA CEB
02	Lack of intervention from authorities for controlling unauthorized fishing activities	Enhance the support of authorities who have legal powers to interfere and take action against unauthorized fishing activities	NAQDA Police
03	Poor fish catch	Strengthening stocking program	RFO NAQDA
04	High cost and poor quality of fishing gears	Standardize the quality of fishing gears Control price for fishing gears Donation of fishing gears	NARA Dept. of fisheries
05	Drastically price drop when marine fish abundant in the markets	A proper price mechanism should be established	NARA Ministry of Fisheries Dept. of Consumer Affairs
06	Poor conditions of canoes	Provision of canoes at a subsidized price	NAQDA MOF NGOs
07	Lack of security at the landing site	Installation of CCT cameras	RFO

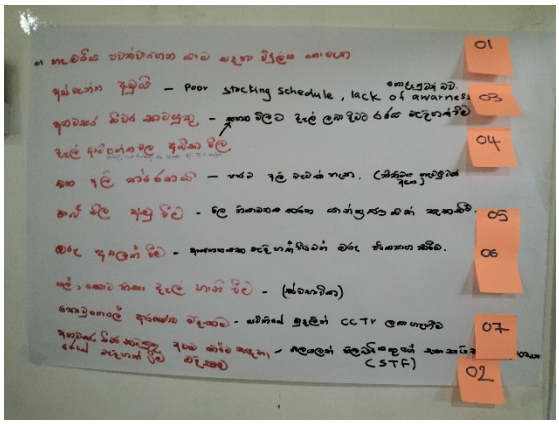


Figure 4.29 Problem identification and ranking

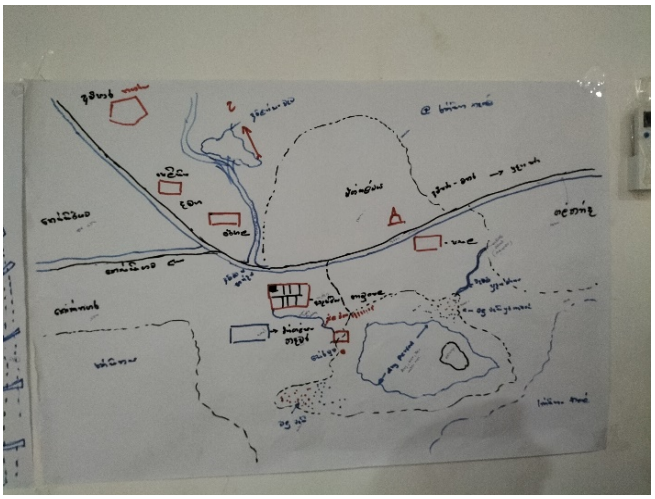
The hatchery is struggling due to the unavailability of electricity supply and required a prompt action. Despite having a good monitoring and raid system, the RFO feels that intervention and support from relevant authorities are inadequate. They need more prompt and effective action to control unauthorized fishing activities. The RFO believes that stronger cooperation from authorities with arresting and punishing offenders is essential. The RFO attributes low fish catch rates to unplanned stocking programs and faces price uncertainty due to higher demand for marine fish. They need a better fish pricing mechanism to stabilize prices and manage the impact of fluctuating marine fish supply. Many canoes are old and in poor condition. The RFO cannot afford to purchase new canoes through their revolving fund or personal finances. They seek financial support from donor agencies to buy new, safer canoes. There have been incidents of fishing gear being stolen at the landing site. To address this issue, the RFO plans to install a CCTV system at the landing site to enhance security.

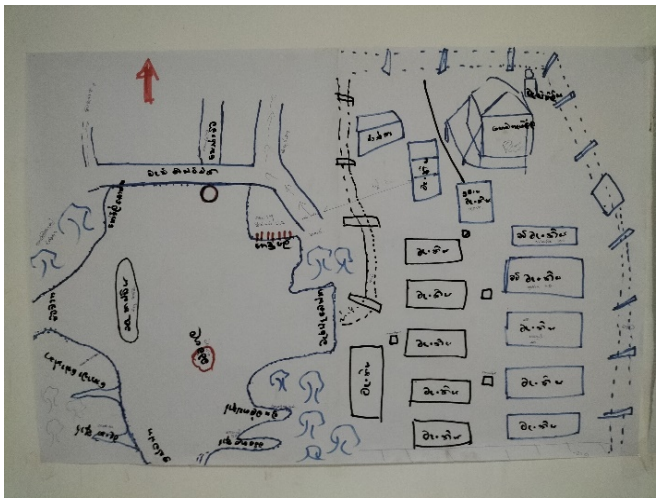
These issues highlight the need for improved support from various stakeholders and financial assistance to ensure the effective functioning and sustainability of the RFO and its operations.

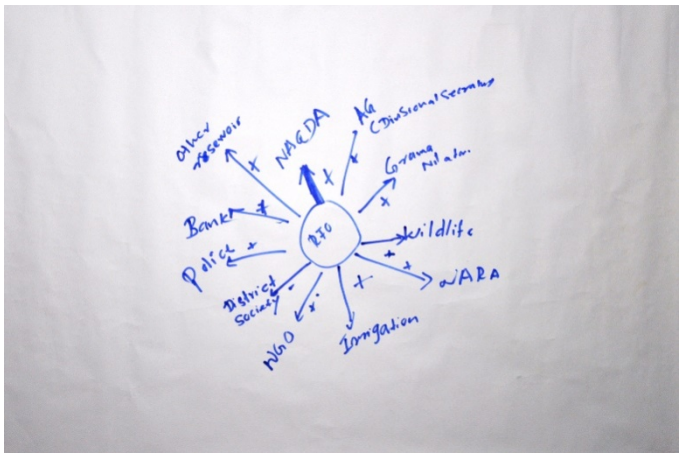
4.2.3.5 Follow up findings

After conducting awareness programs, workshops, and surveys under the FAO project during June and July, the RFO of Konduwatuwana reservoir has taken several constructive decisions. These decisions aim to support the program and ultimately enhance resource management, improve income, and boost overall wellbeing. These all decisions has been taken at a special general meeting by member's full consent.

After 1st of September 2024, no any fisherman allowed to use fishing gears with mesh sizes less than 6 inch. However, majority of fishers have to make new fishing gears under this new rule but all of them have fully agreed to make nets according to the new specifications with their own finance. After September 1st the maximum allowable number of fishing gears that a fisherman can use in one operation has been limited to 6. (Figure 4.30)







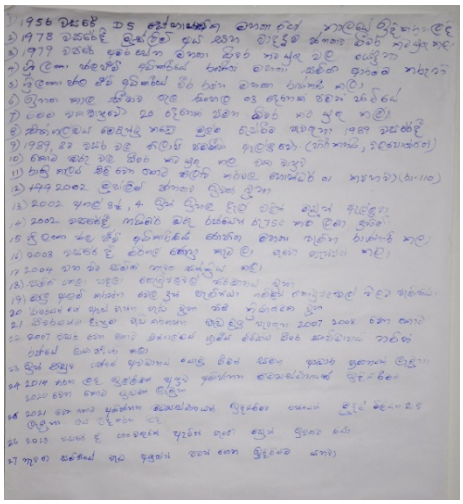
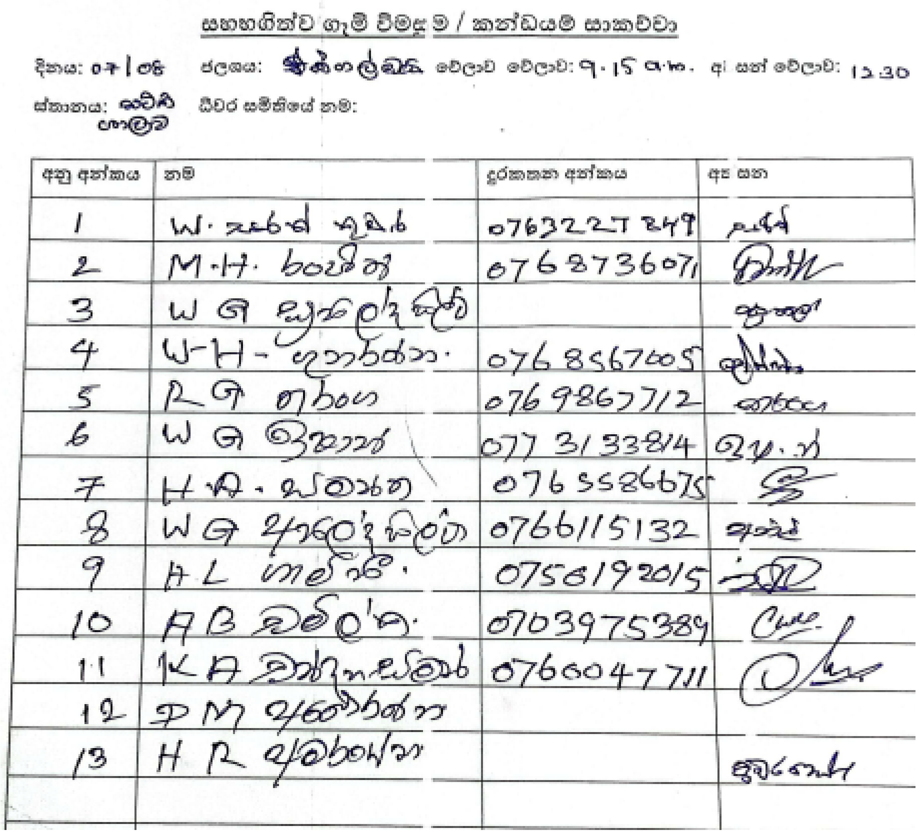


Figure 4.30 Discussion with society members and output of PRA -Ekgal Oya

Attendance sheet – Ekgal Oya



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1	W. [illegible]	0763227349	[illegible]
2	M.H. [illegible]	0768736071	[illegible]
3	W G [illegible]		[illegible]
4	W-H- [illegible]	0768567605	[illegible]
5	R G [illegible]	0769867712	[illegible]
6	W G [illegible]	077 3133814	[illegible]
7	H.A. [illegible]	0765586675	[illegible]
8	W G [illegible]	0766115132	[illegible]
9	A L [illegible]	0756192015	[illegible]
10	A B [illegible]	0703975389	[illegible]
11	K A [illegible]	0766047711	[illegible]
12	D M [illegible]		
13	H R [illegible]		[illegible]

Fig 4.31 Participants list- Ekgal Oya

4.2.4 Himidurawa Reservoir

Reservoir	: Himidurawa
Date	: 07/07/2024
Administrative District	: Ampara
Divisional Secretariat	: Uhana
Grama Niladari Division	: Abeypura (W-C-1)

4.2.4.1 Background

Himidurawa is a reservoir in Ampara District on 9th mile L.B. main channel, Gal Oya scheme. It is built during the 1951-1952 period. The Konduwatuwana Tank surrounds it to the East and the Gal Oya Valley North East Sanctuary to the West.

The RFO of Himidurawa is named "Himidurawa Gramiya Miridiya Deewara Samithiya." Due to the reservoir's location in a wildlife conservation area, an operational license from the Department of Wildlife Conservation is required for fishing activities, while another part is also under the Forest Department. The RFO has 40 fishers, of which 20 are active male fishers, and the other 20 are wives of those fishers. These fishers are also involved in agricultural work, including paddy and Chena cultivation and animal husbandry. Fishers from two fishing villages are coming to Himidurawa Reservoir for fishing. 13 are from Abeypura, and 7 are from Paragahakele. There are 19 fishing canoes available at the landing site.

Figure 4.32 Village and reservoir mapping by RFO members at the PRA

Since the inception of fishing activities at the Himidurawa reservoir, the RFO has reached several significant development milestones (Figure 4.32). Around 1978, fishers were involved in fishing activities with wooden canoes. At that time, fishers had an informal type of organization. However, with the guidance and support of NAQDA officials, they evolved into formal RFOs in 2006. At that time, there were 39 fishers. At the beginning of the RFO, they collected Rs.5 from each kg of fish for the revolving fund. Using this fund, they carried out stocking programs and supported the welfare events of fishers and their family members.

They had temporarily built a hut for community gatherings, which was later appropriately built with government funds and fishermen's labour. After years, fishers started to collect Rs.10 from 1kg of fish. After growing funds, RFO could get the electricity facility to their community hall and purchase an OFRP boat for raids. Unfortunately, some outside people ruined that boat, and they had to purchase another OFRP boat for the second time. They later acquired a toilet facility for the community hall. After some years, they could increase the contribution to the revolving fund, which reached Rs.50 from 1lk of fish. They have fixed barricade nets for two spill gates with their RFO funds, and each year, they carry out social works such as damsel on Wesak Full Moon Poya Day and deliver Rs. 5000 worth of dried food items for Sinhala and Hindu New Year festival to members. RFO provides breakfast for members' funerals or the dismissal of a family member. RFO has installed a CCTV system in the community hall also.

The RFO of Himidurawa Reservoir operates under a written constitution that mandates monthly meetings, with all 40 members required to attend. Members who miss three meetings can avoid penalties by formally notifying the president or secretary. For a second absence, a fine of LKR 3,500 is imposed. Suppose a member misses a third meeting consecutively. In that case, their membership is canceled, and the vacant permit is offered to an eligible person selected through a notice published within the GN division. Interested individuals must apply to the RFO with a character certificate issued by the GN. If multiple applications are received, the RFO selects the best candidate.

Membership of a deceased or ill member is automatically transferred to their nominee. Other forms of misconduct result in fines determined by a general meeting based on the severity and frequency of the offence. Fishing regulations include net setting starting after 4:00 pm, with the catch needing to be landed by 8:00 am the following day. Each fishing unit (boat and crew) is permitted a

maximum of six nets, with mesh sizes ranging from 5 to 12 inches. However, with the increase in mesh size, fishers experienced sudden fish catch reduction; therefore, fishers have recently used 8-10 nets per operation. The six-net rule is generally observed during dry periods when water levels drop.

4.2.4.2 Socio-demographic profile of Himidurawa fishing community

The figure 4.33 summarizes the socio-demographic features of the fishers in the Himidurawa reservoir. All fishers in the sample were Sinhala and Buddhists. Of these, 57% are generational reservoir fishers, while 43% gained membership by transfer. The majority (43%) are aged 41-50. All are married, with an average family size of 4.

Additionally, all have a secondary income from crop farming, animal husbandry, or unspecified labor work. The average monthly fishing income is LKR 30 000, with a maximum of LKR 45,000 and a minimum of LKR 15,000. Additionally, they earn LKR 16 000 per month on average from secondary income sources. 63% of the fishers in the sample live 1-2 km from the reservoir. The majority of fishers have more than 20 years of fishing experience.

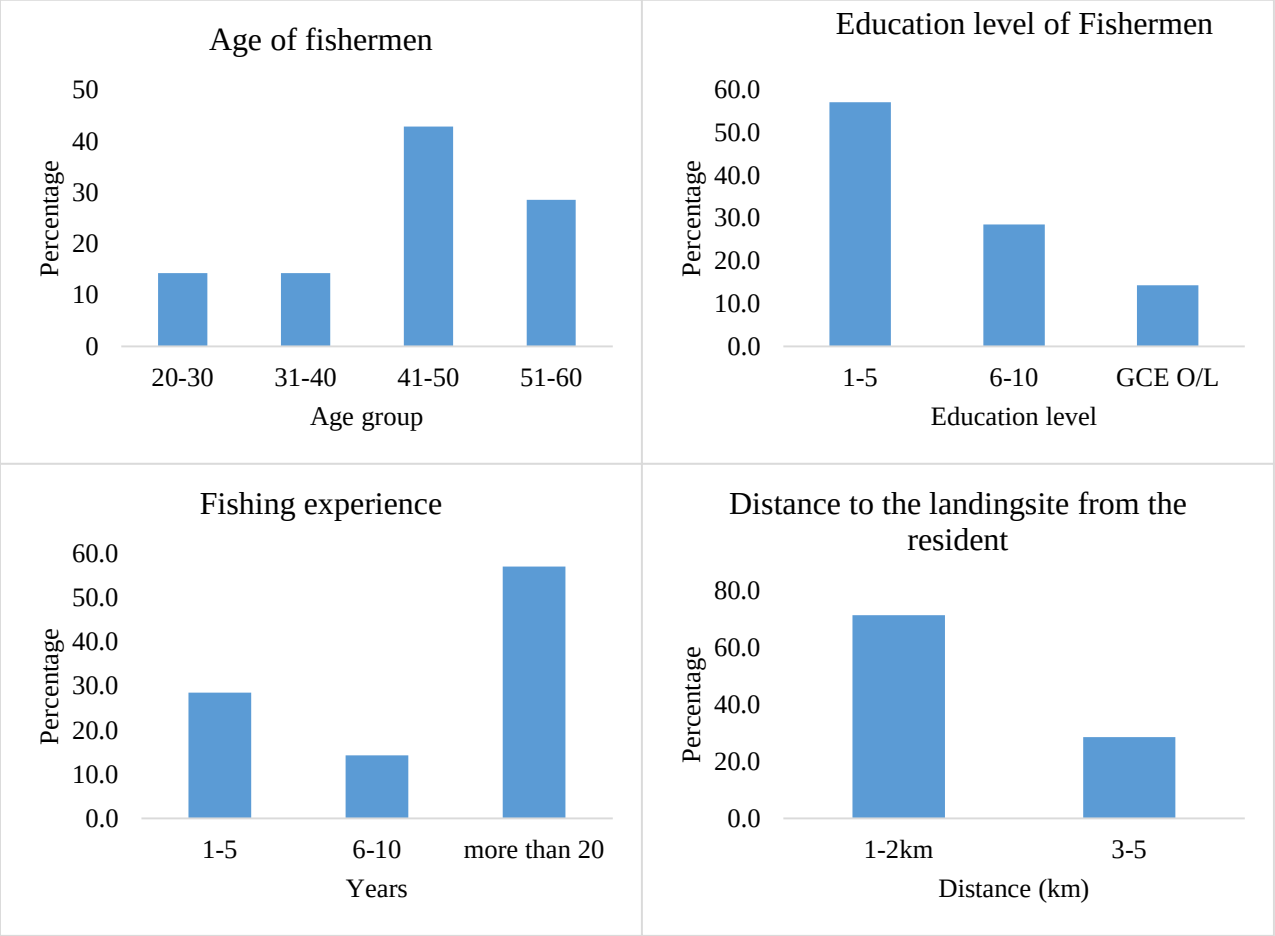

Figure 4.33 Socio-demographic Profile of Himidurawa fishing communities

Figure 4.34 Socio-economic data collection from RFO members in Himirurawa Reservoir

4.2.4.3 Fishery Related Information

The fishers in this reservoir engage in fishing activities for an average of 24 days per month, with a maximum of 25 days and a minimum of 20 days. Vendors do not come to the landing sites for two days, so fishers do not fish the day before and on the full moon Poya day. Typically, fishers engage in fishing activities individually. Fish catch of each member weights by treasurer. Rs. 50 from each kg of fish is taken for revolving fund and another Rs.30/kg deposited to fisher's bank account. Another Rs. 20/kg is deducted as the service fee for the treasure. Altogether fishers contribute Rs. 100/kg of fish. The priority of fish selling should be for local consumers. The rest is sold to the fish collector. There is only one fish collector coming to the reservoir.

Participation in the RFO monthly meeting is 95% on average, influenced by the benefits and services received from the organization and satisfaction with its smooth functioning. Among the fishers, 90% are delighted with the RFO's functioning.

The main common resource users of these reservoirs are fishers and farmers. All fishers (100%) reported no conflict between farmers. However, they mentioned an unfair land delegation for rubber cultivation for a biased selected group of people (4 fishers), where the said land is very close to the reservoir but belongs to the forest department. There is a significant conflict with people engaged in illegal and unauthorized fishing activities. This incident is seriously happening in the area called Bakininhethththewa.

Fishers stated that their society has bargaining power over fish prices and receives market prices from vendors in different areas of the country. However, they face significant price drops when marine fish is abundantly available in the markets. All fishers (100%) stated that their major expectation from the RFO is to strengthen the fish stocking program by enriching the RFO's fund. Currently, 60% are satisfied with the stocking program, while the rest are unsatisfied.

The table 4.7 shows the Himidurawa fisher community's compliance with Ostrom's modified design principles, which determine institutional robustness.

Table 4.7 Summery of compliance of Himidurawa RFO with the Ostrom's modified design principles

Element	Design principal	Level of compliance
1A	Clearly defined user boundaries	Highly exist
1B	Clearly identified resource boundaries	Highly exist
2A	Congruence with local conditions	Highly exist
2B	Appropriation and provisions	Highly exist
3	Collective-choice arrangements	Highly exist
4A	Monitoring users	Prominently exist
4B	Monitoring the resources	Prominently exist
5	Graduated sanctions	Highly exist
6	Conflict resolution mechanism	Highly exist
7	Minimal recognition of the right to organize	Highly exist
8	Multi-level institutional structure	Highly exist

Except for Principle 04 (4A and 4B), all other elements have shown high compliance, indicating a satisfactory status of the RFO fishing community in terms of organizational robustness and resource management.

4.2.4.4 Institutional Relations

Fishers in Himidurawa RFO identified Several key institutions and organizations that influence the operation of the Himidurawa Reservoir. During a Participatory Rural Appraisal (PRA) exercise, participants developed a Venn diagram to illustrate these relationships, their nature, and their strengths (Figure 4.35). The most positively connected institution to the Reservoir Fisheries Organization of Himidurawa is the National Aquaculture Development Authority (NAQDA), with a 100% positive relationship that ensures smooth functioning. The Department of Wildlife also maintains a satisfactory relationship with the RFO, providing operational licenses for fishers without delay. However, unauthorized fishing communities present a significant challenge to the RFO, having a 100% negative impact on its operations.

Next, the NARA has been identified as a supportive stakeholder that helps monitor water quality and raise awareness for them. Additionally, the relationship with the local police station is significant. However, they still have more negative views than positive ones towards police. The

water board and Forest department have also been identified as key stakeholders. However, they had neutral views on them as they still have not been directly involved with this institution for their conflicts or demands.

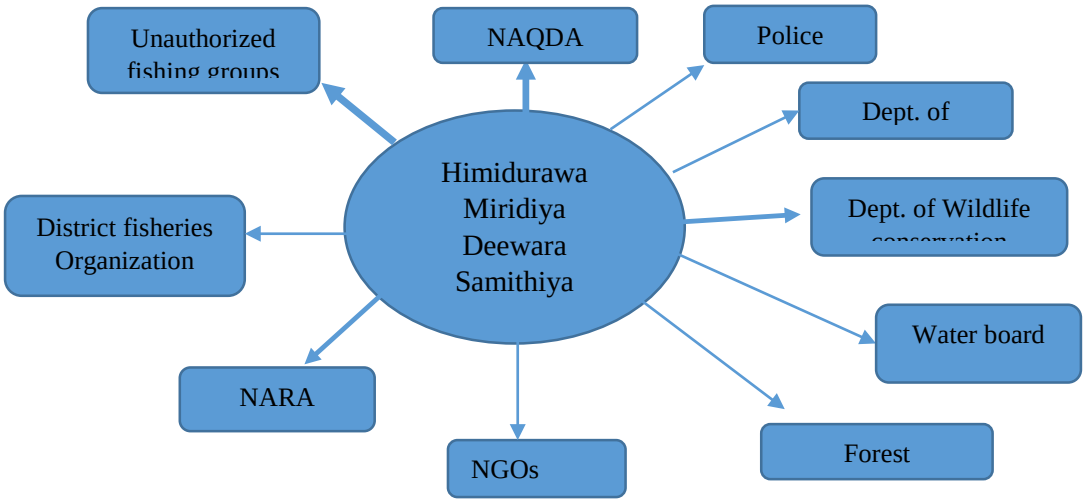

Figure 4.35 Venn diagram – Institutional relations

During the PRA, the RFO collectively identified the major problems they face in resource harvesting and management (Figure 3.29). They also prioritized the issues and identified possible solutions and the responsible authorities for taking remedial actions for these issues (Table 4.8)

Table 4.8 Constraints identified and solutions suggested by RFO

Rank	Constraints Identified	Remedial Measures Suggested	Responsibility
1	Fish escape due to spilling	Three barricade nets must be installed	Irrigation Department, NAQDA, Ministry of Fisheries
2	Lack of fish fry in centers causing irregular fish stocking and decreased income	Improve breeding programs in hatcheries	NAQDA, Hatcheries
3	Illegal fishers poaching	Strengthen raids	RFO, NAQDA, Police
4	Decreasing presence of traders due to reduced fish availability	Regularization of fish storage	RFO
5	Poor condition of canoes	Need subsidies for purchasing canoes	Ministry of Fisheries, NGOs

6	Low price of fish	Introduction of price mechanism	NAQDA, Consumer Affairs Authority
7	Deterioration in the condition of Tilapia fish due to deformities	Introducing high-quality fingerlings	NAQDA, RFO

Overflow or spilling of the reservoir causes fish to escape, reducing the available fish stock and negatively impacting the sustainability of fishing activities and the income of fishers. Installing three barricade nets will act as physical barriers to prevent fish from escaping during overflow events, helping maintain the reservoir's fish population and ensuring a more stable supply for fishers. The hatcheries responsible for producing fingerlings face challenges that lead to irregular and insufficient fish stocking in the reservoir, resulting in inconsistent fish availability and decreased income for the fishing community. Improving hatchery breeding programs will ensure a continuous and healthy supply of fingerlings, stabilizing fish populations and supporting the livelihoods of reservoir fishers. Unauthorized fishing or poaching undermines the efforts of legal fishers by depleting fish stocks unfairly and reducing overall yield. Strengthening raids and enforcement by relevant authorities will help deter illegal fishing practices and protect the community's resources. The decline in fish stocks has led to fewer traders coming to the reservoir to buy fish, limiting sales opportunities and income for fishers. Regularizing and improving fish storage facilities will help maintain fish quality and availability, making it more attractive for traders to operate in the area and thus supporting the local fishing economy. Many fishers rely on old or poorly maintained canoes, which negatively impacts their ability to fish effectively and safely, limiting productivity and increasing safety risks. Providing subsidies or financial assistance for purchasing new or improved canoes will enhance fishing operations and improve safety and efficiency. Reservoir fish generally fetch lower prices than sea fish due to market dynamics and competition, reducing the income potential of reservoir fishers. Introducing a price mechanism or regulation to maintain fair prices for fish will ensure fishers receive adequate compensation for their catch, improving their economic well-being. Finally, deformities in Tilapia fingerlings affect fish health and market acceptance, leading to lower yields and potential financial losses. Introducing high-quality, genetically superior, and disease-free fingerlings will improve fish stock condition, increase productivity, and enhance marketability

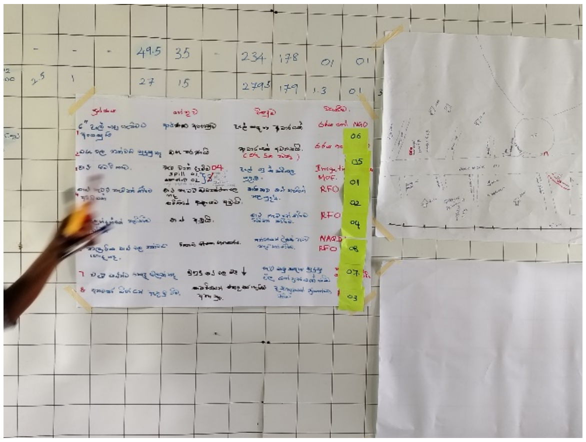

Figure 4.36 Conducting PRA with RFO members in Himidurawa reservoir

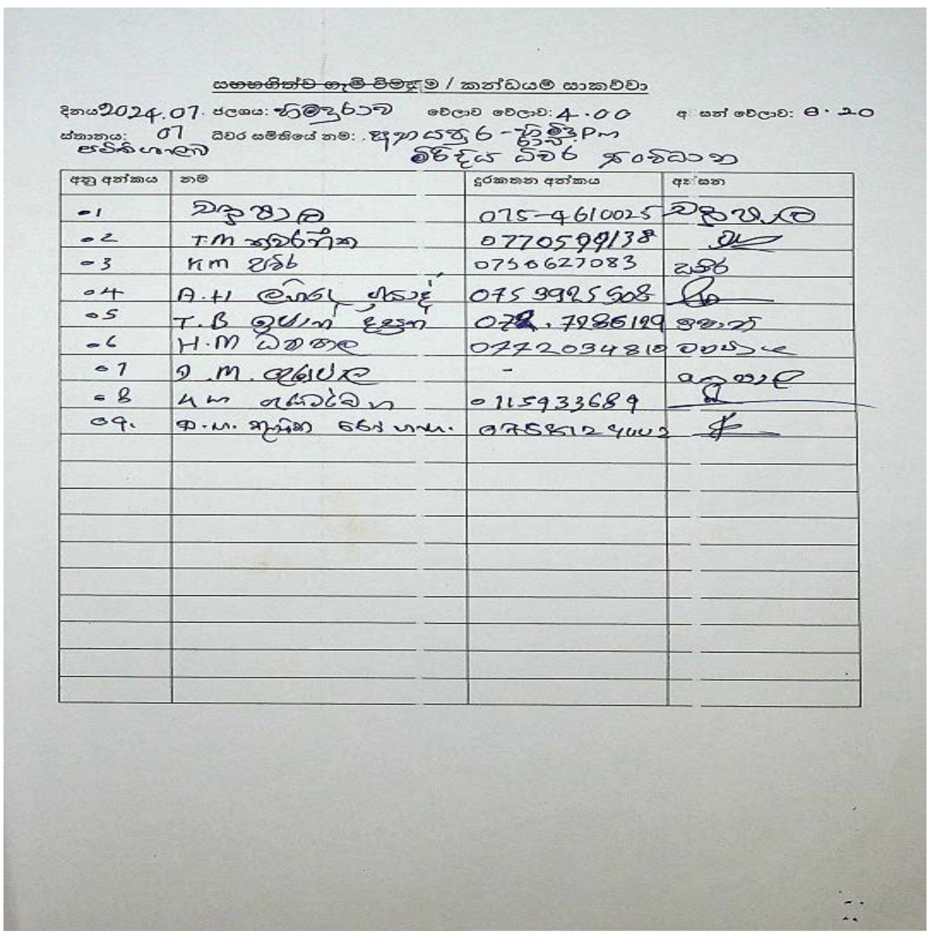

Figure 4.37 Participants list- Himidurawa

4.2.5 Pannalgama Reservoir

Reservoir	: Pannalgama
Date	: 07/07/2024
Administrative District	: Ampara
Divisional Secretariat	: Damana
Grama Niladari Division	: Pannalgama (W-25-A)

4.2.5.1 Background

Pannalgama reservoir impounds the water of Pannel Oya. It is located near Pannalgama, and more than 3500 AC benefits through this reservoir. This reservoir has been classified as a medium reservoir. Pannalgama RFO consists of 20 fishers, of which 18 are males and among females, two are widowed late fishermen. 2 women are actively engaged. All are living near to Pannalgama village. The membership is transferred to the wife automatically after the fisherman's death free of charge.

This RFO is currently unorganized, though it has been functioning well for years. However, they do not hold regular monthly meetings. Fishers are allowed to set nets from 3.0 pm- 6.00 pm and start fishing on the following day at 6.00 am and continue until 8.00am. Fishers, as a norm, have agreed upon the division of specific fishing locations for fishers during high water periods. There was no net pieces restriction during the rainy season, and during the dry season, they were allowed to set nets at any place, and fishing net pieces were restricted to 04. However, after the FAO project's inception, they agreed upon a maximum of 6 net pieces during the high-water period and 4 pieces during the low water levels. They were using nets with mesh sizes ranging from 4.5 to 13 inches. After the FAO project, they were advised to use 6-inch or above nets, but they strictly resisted that and have negotiated to a minimum of 5-inch mesh size. All fishers have canoes either owned by themselves or RFO property.

Fishers in this reservoir are not regularly engaged in fishing activities because the reservoir does not provide enough fish catch. This has happened due to poor and irregular fish stocking programs. The RFO collected Rs. 40 from 1kg of fish to the revolving fund and Rs.2.50 for treasure for the service provided at fish marketing. However, the revolving fund is hardly enriched due to significantly low fish catch. Therefore, they do not have sufficient funds to continue regular fish

stocking programs. Their data recording system is also not at an appreciable scale. Vendors have not visited this reservoir recently as the fish catch is very low, and they have to come to a larger distance to reach the reservoir, which is not worth it.

According to the observation, community participation is minimal among the fishers in Pannalgama. The primary reason might be that all fishers are engaged in paddy cultivation as labour work; hence, they do not have time to participate in training, awareness programs, and monthly meetings for fishery-related works. They are disappointed with the functioning of RFO and think of their greater frustration with their main livelihood. It is an immense tragedy and very challenging to bring back and rebuild the trust in the fishery, enhance the reservoir production and regulate the functioning of RFO.

4.2.5.2 Socio-demographic profile of Pannlgama fishing community

The figure 4.38 summarizes the socio-demographic features of the fishers in the Pannalgama reservoir. All fishers in the sample were Sinhala and Buddhists. The majority (50%) are aged 41-50. All are married, with an average family size of 4.

Additionally, all have a secondary income, especially labour for paddy cultivation. The average monthly fishing income is LKR 9 000, with a maximum of LKR 12,000 and a minimum of LKR 4,000. Additionally, they earn LKR 15 000 per month on average from secondary income sources. The majority live closer to the reservoir. The majority of fishers have 11-20 years of fishing experience as regular active fishermen.

The table 4.9 shows the Pannalgama fisher community's compliance with Ostrom's modified design principles, determining institutional robustness.

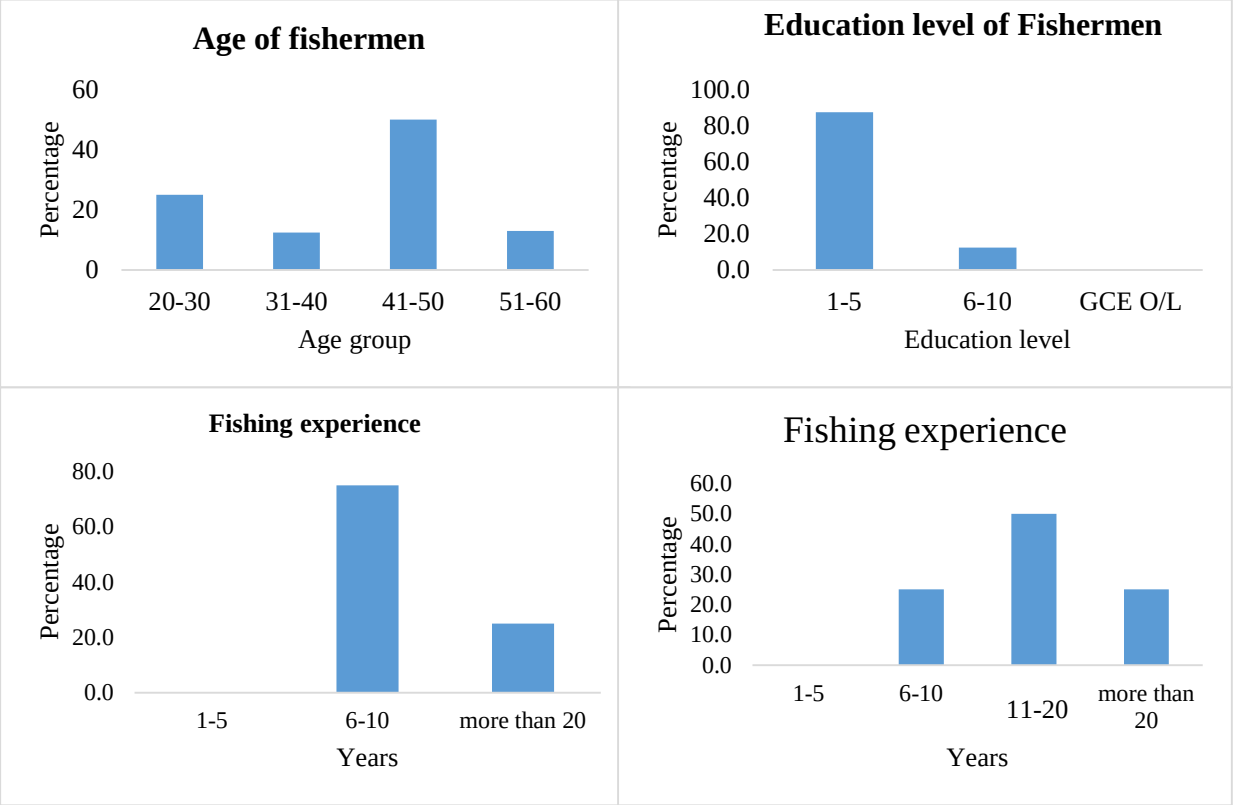

Figure 4.38 Socio-demographic Profile of Pannalgama fishing communities

Compared to other reservoirs under this study, the organizational robustness of Pannalgama RFO is poor, and they have to improve their internal systems and strengthen resource monitoring and raid programs. Their capacity in decision-making is currently at a lower level. Though such a flat form exists, the community is not motivated to link with multi-level institutional affairs. The overall performance of this RFO is weak, and the potential for upgrading depends on the engagement in fishing activities and their satisfaction with fish catch.

Table 4.9 Summery of compliance of Pannalgama RFO with the Ostrom's modified design principles

Element	Design principal	Level of compliance
1A	Clearly defined user boundaries	Highly exist
1B	Clearly identified resource boundaries	Highly exist
2A	Congruence with local conditions	Highly exist
2B	Appropriation and provisions	Highly exist
3	Collective-choice arrangements	Slightly exist
4A	Monitoring users	Slightly exist
4B	Monitoring the resources	Not exist
5	Graduated sanctions	Not exist
6	Conflict resolution mechanism	Slightly exist
7	Minimal recognition of the right to organize	Slightly exist
8	Multi-level institutional structure	Slightly exist

4.2.5.3 Institutional Relations

Fishers in Pannalgama RFO identified key institutions and organizations that influence the operation of the Pannalgama Reservoir. The most positively connected institution to the Reservoir Fisheries Organization of Pannalgama is the National Aquaculture Development Authority (NAQDA), with a 55% positive relationship that ensures smooth functioning. They expect more contribution from NAQDA officials than what they received. As this reservoir is far away from a main city access for the reservoir is difficult hence NAQDA official's regular visits and immediate participation in their needs is inefficient as fishers stated. The Department of Wildlife also maintains a satisfactory relationship with the RFO, providing operational licenses for fishers without delay. However, unauthorized fishing communities present a significant challenge to the RFO, having a 100% negative impact on its operations. Next, the NARA has been identified as a supportive stakeholder that helps monitor water quality and raise awareness for them. However, they expect more support from government agencies such as financial support for fingerling stocking programs and purchasing fishing equipment's. Additionally, the relationship with the local police station is significant. However, they still have more negative views than positive ones towards police. They expect more involvement in raids. (Figure 4.39)

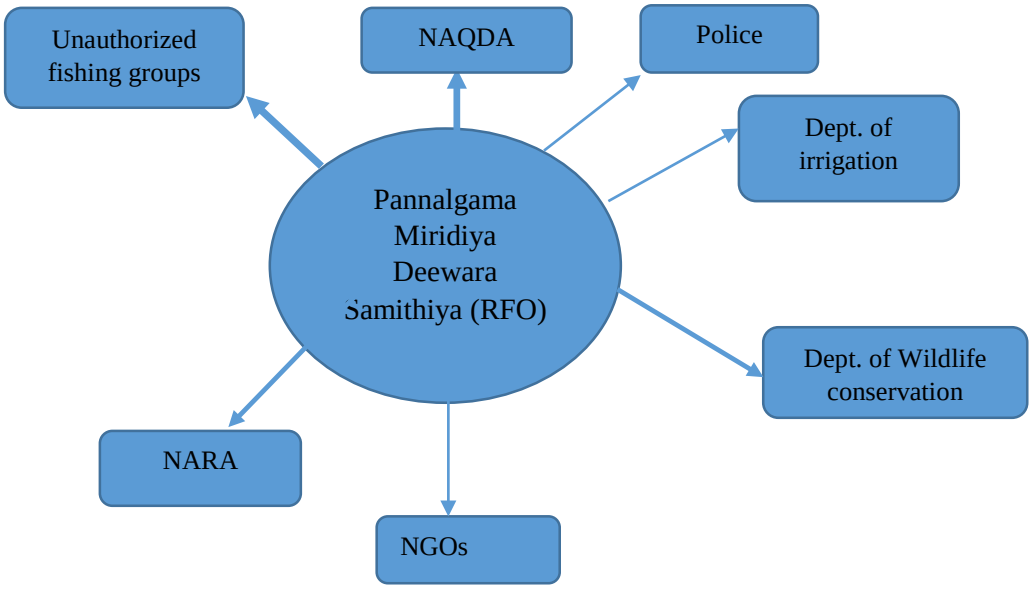

Figure 4.39 Venn diagram – Institutional relations

The RFO collectively identified the major problems they face in resource harvesting and management. They also prioritized the issues and identified possible solutions and the responsible authorities for taking remedial actions for these issues (Table 4.10) one significant issue is the escape of fish due to spilling, which threatens the sustainability of fish stocks. To address this, it is recommended to install two barricade nets, with responsibility assigned to the Irrigation Department, NAQDA, and the Ministry of Fisheries. Another major constraint is the inability to carry out fish stocking programs regularly due to financial limitations. This can be mitigated through financial support from government and non-governmental organizations for fingerling releasing programs to boost the current collapsed situation, while RFO get sufficient efforts to enhance the financial capacity of the RFO. These initiatives fall under the purview of NAQDA, NGOs, and the RFO themselves. Lastly, the lack of community participation and motivation is recognized as a challenge that undermines effective fisheries management. This condition has happened with the poor return they received from fishing. Empowering community members is suggested to foster greater involvement and stewardship, with the RFO, NAQDA, and NARA responsible for driving this empowerment.

Table 4.10 Constraints identified and solutions suggested by RFO

Rank	Constraints Identified	Remedial Measures Suggested	Responsibility
1	Fish escape due to spilling	Installation of two barricade nets	Irrigation Department, NAQDA, Ministry of Fisheries
2	Inability to carry out fish stocking program regularly due to financial problems	Government and NGO support for fingerling releasing programs; increase financial capacity of RFO	NAQDA, NGOs, RFO
3	Lack of community participation and motivation	Empowering community members	RFO, NAQDA, NARA

Figure 4.40 Conducting PRA and scoio-economic data collection from Pannalgama reservoir

4.3 Fisheries co-management

Co-management represents one of several innovative and alternative approaches that have gained prominence in recent years within fisheries management. (Figure 4.41) Over the past decade, there has been a significant shift in fisheries governance towards a more inclusive framework that acknowledges the vital role of fishers' participation, local stewardship, and shared decision-making processes. This evolution empowers fishers to engage actively as integral members of the fisheries management team, balancing rights and responsibilities while fostering cooperative partnerships with government agencies rather than adversarial relationships. This collaborative framework is commonly referred to as co-management.

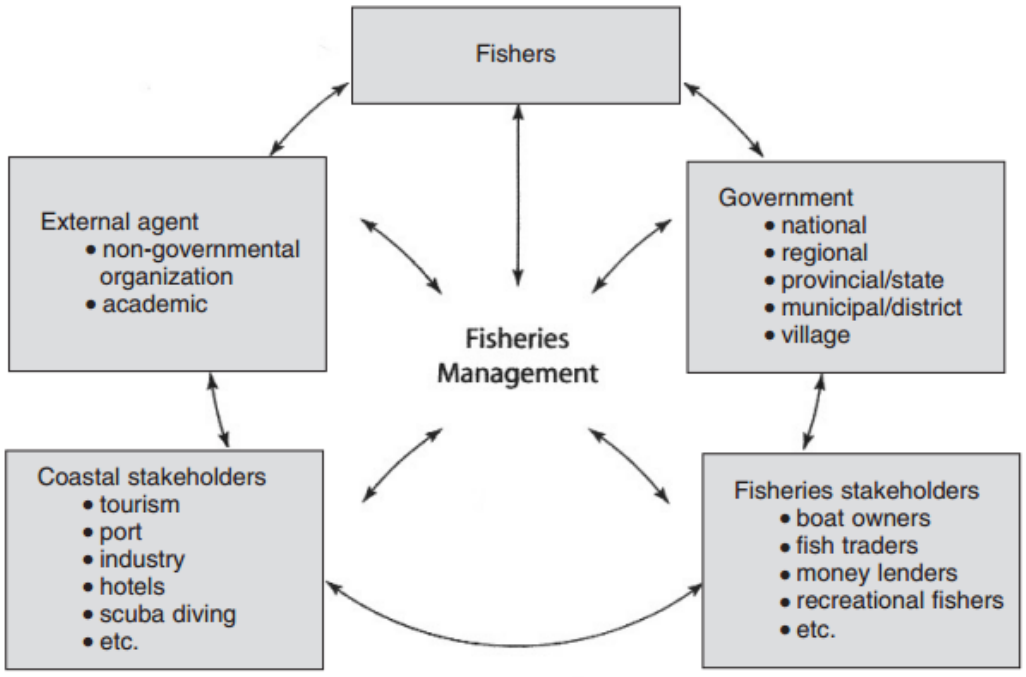

Figure 4 .41 Co-management in typical fishery environment (Source: Pomeroy and Rivera-Guieb (2006)

It is widely recognized that governmental institutions alone cannot address all challenges faced by fishers. Consequently, greater responsibility is increasingly expected from local communities, who are the primary users of aquatic resources. Importantly, there is no universal or “one-size-fits-all” blueprint for fisheries management; instead, management strategies must be tailored to the unique ecological, social, and economic characteristics of each fishery. Co-management, therefore, is a dynamic and adaptive learning process, where government bodies and local communities collaboratively identify and implement contextually appropriate management approaches within a shared governance framework.

According to Pomeroy and Rivera-Guieb (2006), co-management is defined as a "partnership arrangement in which the community of local resource users (fishers), government, other stakeholders (such as boat owners, fish traders, boat builders, business people), and external agents (including non-governmental organizations, academic, and research institutions) share

responsibility and authority for managing the fishery" (Figure 4.42). This multi-stakeholder approach reflects the diverse interests and expertise involved in fisheries management.

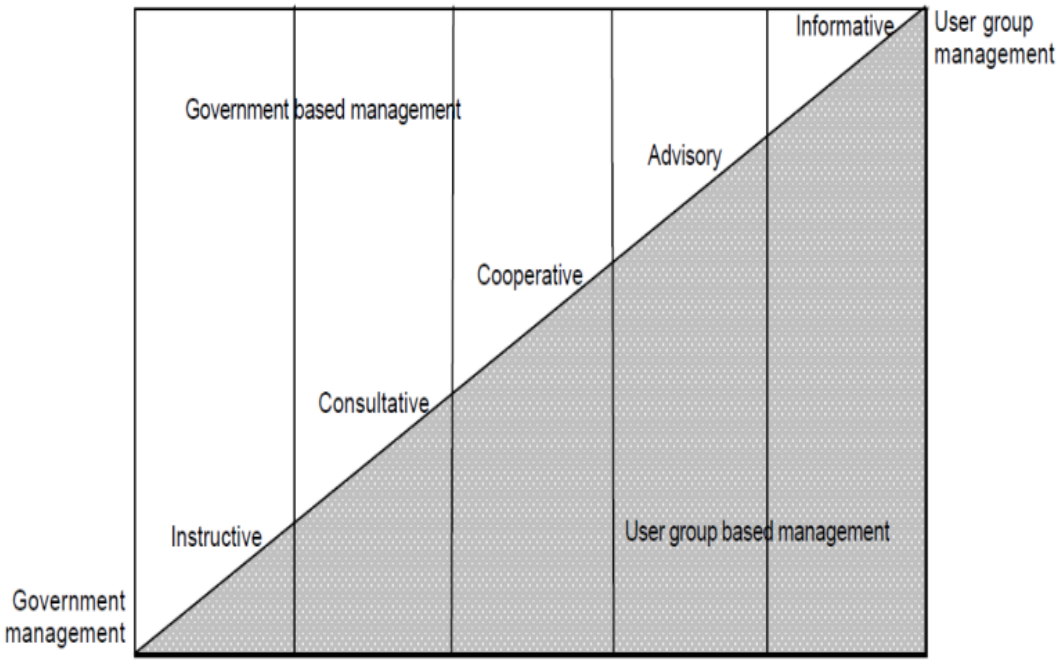

Figure 4.42 Co-management type classification

Fisheries co-management can be classified into five broad categories based on the respective roles and levels of involvement of government and fishers (Sen and Nielsen, 1996)

1. **Instructive**: Characterized by minimal information exchange, where government primarily informs fishers of decisions to be made. Dialogue mechanisms exist but are largely one-sided, with limited fisher input.
2. **Consultative**: Government consults fishers through established channels; however, all final decisions remain under government control.
3. **Cooperative**: Government and fishers engage as equal partners in the decision-making process, collaboratively shaping management outcomes.
4. **Advisory**: Fishers provide advice on decisions to be taken, which government subsequently endorses.

5. **Informative**: Decision-making authority is delegated to fisher groups, who are responsible for informing government of their management decisions.

An empirical assessment of co-management across five reservoir fisheries revealed varying degrees of participation and decision-making authority. The Namal Oya and Konduwatuwana Reservoir Fishermen's Organizations (RFOs) exhibit advanced levels of influence, exercising substantial decision-making power and effectively advising government officials particularly those from the National Aquaculture Development Authority (NAQDA) to endorse their decisions. Conversely, the Ekgal Oya and Himidurawa fishing groups operate under a cooperative co-management model, with fishers and NAQDA officials participating equally in decision-making processes. In contrast, the Pannalgama fishing group remains at the consultative stage, wherein they accept decisions made by NAQDA officials despite having opportunities to communicate their perspectives.

4.3.1 SWOT Analysis – Namal Oya Reservoir

Strengths	Weaknesses
• Long-established community organization with formal governance and functioning levy system. • Proximity to villages facilitates active community involvement and resource access. • Located in a protected wildlife zone promoting sustainability under regulation.	• Inconsistent enforcement against unauthorized fishing. • Lack of systematic resource and user monitoring. • Infrastructure shortcomings like inadequate ice and fish storage increase losses. • Fragmented community commitment affects monitoring and welfare.
Opportunities	**Threats**
• Strengthen monitoring committees and enforcement mechanisms. • Upgrade cold storage and ice production facilities near reservoir. • Better management of levy system and revolving fund to support stocking and welfare. • Engage research institutions for technical support and innovation.	• Persistent illegal fishing threatening stock sustainability. • Fish escape during spill events risks depleting populations. • Market competition causing price volatility impacting incomes. • Weak enforcement cooperation with police and irrigation authorities.

4.3.2 SWOT Analysis – Konduwatuwana Reservoir

Strengths	Weaknesses
• Well-structured and active RFO with distributed landing-site system. • Community willingness to adopt improved governance and gear regulations. • Strong cultural norms minimizing intra-community conflicts. • Established institutional relationships (e.g., NAQDA).	• Irregular monitoring and enforcement with low participation. • Financial burdens related to gear replacement and new stocking program • Inconsistent stakeholder coordination affects effectiveness.
Opportunities	**Threats**
• Formalize monitoring and enforcement groups with clear accountability. • Access loans and government subsidies for gear and infrastructure. • Community education to improve compliance and collective action.	• Unauthorized fishing and resource poaching remain threats. • Transition to larger mesh sizes may temporarily reduce catches. • External disturbances (army training, variable institutional support). • Market price fluctuations affect economic stability.

4.3.3 SWOT Analysis – Ekgal Oya Reservoir

Strengths	Weaknesses
• Strong organizational compliance with institutional principles including effective collective decision-making and conflict resolution. • Presence of government-supported hatchery offers sustainable fish stocking and revenue potential. • Good institutional relationships facilitating cooperative management.	• Costly and inefficient fish storage and ice supply logistics. • Ongoing illegal fishing and fish escape challenges. • High cost involvement in hatchery maintainance
Opportunities	**Threats**
• Resolve infrastructure bottlenecks for sustainable fish production. • Leverage positive institutional relations for funding and upgrades. • Expand community welfare and training programs. • Improve cold chain infrastructure for better market access.	• Hatchery dormancy risks fish stock depletion and income loss. • Persistent unauthorized fishing. • Market price instability driven by marine fish availability. • Dependency on external funding exposes reservoir to budget and political risks.

4.3.4 SWOT Analysis – Himidurawa Reservoir

Strengths	Weaknesses
• Mature institutional development with strong welfare programs and community participation. • Proactive resource management • Strong relations with NAQDA and wildlife authorities.	• Persistent illegal fishing and insufficient enforcement support. • Social tensions over land use and resource allocation. • Aging fishing equipment and limited subsidies. • Irregular and underfunded stocking programs.
Opportunities	**Threats**
• Improve enforcement cooperation with police and agencies. • Subsidies for fishing gear and canoes to increase safety and productivity. • Expand community-led monitoring and conflict resolution. • Strengthen and follow stocking schedules.	• Ongoing illegal fishing and poaching undermining stock sustainability. • Market competition and price fluctuations affecting fishers' well-being. • Financial commitment needed for infrastructure maintenance and upgrades.

4.3.5 SWOT Analysis – Pannalgama Reservoir

Strengths	Weaknesses
• Some community organization and shared understanding of fishing schedules despite limited formal governance. • Local importance for rural livelihoods.	• Weak organization with irregular meetings and low participation. • Poor fish stock due to insufficient stocking. • Limited data management and vendor interest. • High dependence on secondary income reducing fishery commitment.
Opportunities	**Threats**
• Rebuild trust and capacity through community development and training. • Introduce structured stocking programs with external funding. • Engage fishers in welfare and participatory management. • Strengthen relationships with institutional partners for support.	• Risk of fishery collapse without active governance. • Economic pressures eroding participation. • Vulnerability to exploitation due to lack of infrastructure. • Low institutional support.

4.4 Recommendations and way forward

Based on the study below, recommendations and future directions are suggested to enhance culture-based fisheries in the selected reservoirs of Ampara District and to strengthen the co-management and institutional robustness of Reservoir Fisheries Organizations (RFOs), aligning them with co-management principles and achieving the desired management outcomes.

1. Strengthening resources monitoring

The escape of fish through spill gates is a significant issue affecting all reservoirs and requires prompt attention. Although fish stocking programs have been scheduled and fishers are increasingly willing to comply with these schedules, their motivation is undermined by frequent fish losses during spilling events. This results in substantial economic losses for the fishing communities. Therefore, it is imperative that NAQDA and the Department of Irrigation collaborate to identify and agree upon feasible solutions, such as installing barricade nets or similar barriers, to prevent fish from escaping through spillways. Without addressing this problem, the full benefits of stocking programs cannot be realized, ultimately compromising fishery sustainability and fisher livelihoods.

To enhance fisheries management and protect reservoir resources, it is essential to strengthen joint patrols and raid programs that actively involve RFO members, NAQDA, and the police to effectively control unauthorized fishing activities. Establishing dedicated enforcement committees within the RFOs, with clearly defined responsibilities and accountability mechanisms, will further ensure systematic monitoring and compliance. While this mechanism has been partially established through the project, ongoing and sufficient support from relevant authorities is crucial until RFOs become fully capable of independently managing enforcement activities. Continued collaboration and capacity building will be key to firmly institutionalizing these enforcement efforts.

2. Enhance Fish Stocking and cage operations

Securing sufficient funds for a scheduled, regular fish stocking program is vital to ensure smooth operations and achieve the established goals. However, the current revolving funds are insufficient to fully support the stocking schedule, leading some RFOs to implement it only partially based on available finances. Therefore, a proper backup funding mechanism should be established or introduced to guarantee consistent stocking activities. Additionally, monitoring the outcomes of stocking programs through participatory approaches that involve fishers and stakeholders will enable adaptive management, ensuring that strategies remain effective and responsive to both ecological conditions and community needs. Stocking should be carried out in accordance with the optimal stocking density recommended by this project for the specific reservoir. Furthermore, routine stocking of tilapia should be discontinued in future stocking programs. The proportion of tilapia in the total stocking composition should be maintained at or below 30%

3. Multi-stakeholder coordination

Fishers currently have limited understanding of the key stakeholders they can engage with in fishery operations, and the involvement of these stakeholders in supporting fishers is minimal. Therefore, it is essential to educate fishers on the roles and responsibilities of these key stakeholders within culture-based fisheries. Action plans developed by stakeholders should comprehensively address the issues and concerns of reservoir fishers to effectively improve their livelihoods. In particular, fostering open and continuous dialogue between RFOs, NAQDA, and the Department of Irrigation is crucial for collaborative water management decisions, as well as better planning of stocking programs and fishing activities. Enhanced dialogue among stakeholders can further support RFOs in exploring diverse funding sources to sustain their fish stocking programs, including government allocations and donor grants until they become financially strong enough to sustain fish stocking programs through their revolving funds.

4 Market development and price stabilization

Collaborating with government bodies to implement supportive policies can help protect inland fish prices during periods of marine fish surpluses. Additionally, utilizing market data to forecast marine fish abundance enables better planning of reservoir fish supply, reducing direct competition.

Establishing storage facilities such as cold storage units and ice plants will allow fishers to hold fish during market gluts and release them gradually, thereby stabilizing supply and fishers' incomes.

` Encouraging value-added processing methods, such as drying, smoking, or packaging reservoir fish, can significantly increase their shelf life and market value. Developing ready-to-cook or convenience fish products further attracts urban consumers seeking quick and easy meal options, expanding market opportunities.

Moreover, developing strong branding that emphasizes the unique qualities of reservoir fish such as freshness, sustainability, and local origin can help differentiate these products in the market. Promoting inland fish as a specialty or premium product will attract niche buyers willing to pay higher prices, thereby enhancing fishers' income and market positioning.

Facilitating direct marketing channels enables fishers to sell their catch directly to consumers through farmers' markets, cooperatives, or online platforms, effectively bypassing middlemen who often reduce prices. Additionally, exploring institutional markets such as schools, hospitals, and restaurants that prioritize locally sourced fish can create stable demand and new revenue streams for reservoir fishers.

5 Strengthen capacity and unity of RFO members

Providing capacity-building programs focused on reinforcing team spirit, leadership skills, and conflict resolution within RFOs will strengthen their organizational effectiveness. Encouraging inclusive membership policies and equitable benefit-sharing mechanisms is essential to maintaining community cohesion and trust. Additionally, enhancing transparency and communication around fund management and decision-making processes will build confidence

among members and promote sustained participation. Furthermore, disseminating technical knowledge on value addition and product development, alongside empowering women within fisher societies, will enhance productivity and contribute to the socio-economic upliftment of the fishing communities.

6 Stocking strategies

Optimize fish yield, the following fingerling stocking densities are recommended based on the size category of perennial reservoirs:

- Minor perennial reservoirs (<200 ha): 2,500 fingerlings per hectare
- Medium perennial reservoirs (200–800 ha): 1,500 fingerlings per hectare
- Major perennial reservoirs (>800 ha): 800–1,000 fingerlings per hectare

The Species Composition for Optimal Trophic Utilization should be managed as

- Surface feeders (30%): Bighead carp (*Aristichthys nobilis*) and/or Catla (*Catla catla*)
- Mid-water column feeders (30%): Rohu (*Labeo rohita*)
- Bottom feeders (30%): Mrigal (*Cirrhinus mrigala*) and/or Common carp (*Cyprinus carpio*)
- Generalist/Opportunistic feeders (10%): Nile tilapia (*Oreochromis niloticus*)

The GIFT (Genetically Improved Farmed Tilapia) strain of *O. niloticus* is not recommended for stocking in reservoirs intended for culture-based fisheries due to its potential ecological impacts.

4.5 Remarks on FAO project

The FAO program has made significant steps in institutional strengthening by helping RFOs formalize their governance structures, establish bylaws regulating fishing activities, membership, and sanctions, and foster participatory decision-making processes. These efforts have enhanced organizational robustness and legitimacy among fishers. Improved resource management has also been achieved through awareness and training programs and workshops that encourage fishers to adhere to mesh size regulations, limit the number of fishing nets, and form operational groups to monitor fishing activities. These measures closely align with Ostrom’s principles, particularly

collective-choice arrangements and graduated sanctions. Additionally, fish stocking programs under FAO guidance have become more strategic and consistent, with reservoirs such as Konduwatuwana and Namal Oya implementing planned fingerling releases supported by revolving funds and loans to sustain these activities. This approach holds promise for improving fish availability and increasing fisher incomes in the medium term. Community participation is notably high, with over 90% attendance in RFO meetings and widespread satisfaction regarding organizational operations and benefits, reflecting strong community buy-in for the FAO-supported management system. However, enforcement remains a challenge, as unauthorized fishing persists due to limited commitment, inadequate law enforcement support, and occasional monitoring lapses, highlighting the need to strengthen collaboration with police and NAQDA officials. Furthermore, economic constraints continue to hamper many fishers' ability to purchase compliant fishing gear or upgrade equipment, as revolving funds are often insufficient, underscoring the necessity for additional external financial assistance.

4.6 Enhancing Co-Management, Data Recording, and Regulatory Compliance in Reservoir Fisheries- Awareness programs (3.1a,3.1b,3.1c)

Introduction

This series of awareness programs aimed to strengthen co-management, data recording, and regulatory compliance in reservoir fisheries. Conducted on the 16th,17th and 18th of May 2025, the training targeted 75 fishers from five reservoirs in Ampara District: Namal Oya, Konduwatuwana, Ekgal Oya, Himidurawa, and Pannalgama, with 15 fishers participating from each reservoir.. The training contained financial management practices, marketing strategies, regulatory environment and community empowerment to promote sustainable fisheries management. This training aimed to enhance the capacity of fishers to effectively manage communal resources, improve data-driven decision-making, and motivate entrepreneurial initiatives within the reservoir fisheries sector.

Content of the awareness program

1. **Tragedy of the Commons and Community-Based Management**

Participants were introduced to the concept of the Tragedy of the Commons through a video clip, highlighting how unregulated access to open resources like reservoir fisheries can lead to depletion and unsustainable practices. This set the stage for discussions on why communal ownership and community-based management are essential for resource sustainability in reservoir fisheries.

2. **Evolution and Levels of Co-Management**

The awareness addressed the transition from traditional community-based management to co-management, focusing on the rationale behind power-sharing between the government and resource users. Co-management levels – Instructive, Consultative, Cooperative, Advisory, and Informative were defined, and participants were informed of the current co-management levels of their respective reservoirs based on data analysis and PRA results. Strategies to elevate to higher co-management levels were discussed, emphasizing stakeholder engagement, capacity building, and improved data management.

3. **Data Recording and Financial Management**

Emphasis was placed on the importance of maintaining high-quality data records for monitoring catch volumes, financial performance, and resource sustainability. Participants were trained on data recording practices, including new data entry formats inspired by best practices in well-established RFOs in Sri Lanka. Additionally, they were educated on financial record-keeping, cash flow management, and financial accountability to enhance transparency and secure funding opportunities.

4. **Marketing Strategies for Reservoir Fisheries**

Participants were introduced to marketing strategies tailored for reservoir fisheries, focusing on the 4Ps concept – Product, Price, Place, and Promotion. Examples from successful marketing campaigns in Sri Lanka and internationally were presented to demonstrate how to effectively position fishery products in competitive markets. Branding, product differentiation, and promotional strategies were emphasized.

5. **Entrepreneurship Development in reservoir fisheries**

Entrepreneurship was presented as a viable pathway for economic empowerment and community development. Participants learned the core qualities of successful entrepreneurs, methods for

transforming entrepreneurial ideas into viable businesses, and the importance of creating an enabling environment for fisheries-based enterprises. Real life examples of successful fisheries entrepreneurs in Sri Lanka were showcased to inspire participants.

6. **Community Empowerment and Gender Inclusion**

The training underscored the importance of community empowerment in sustainable fisheries management. Women's participation in decision-making processes and resource management was emphasized, with discussions on methods for promoting women's involvement through targeted training, finance access, and leadership development initiatives.

7. **Regulatory Framework and Legal Awareness**

Participants were provided with an overview of the regulatory framework governing reservoir fisheries. They were informed of their legal rights and obligations, conflict resolution mechanisms, and how to navigate regulatory challenges effectively.

The list of participants and the presentation slides used during the training sessions are provided in the Appendices for reference.

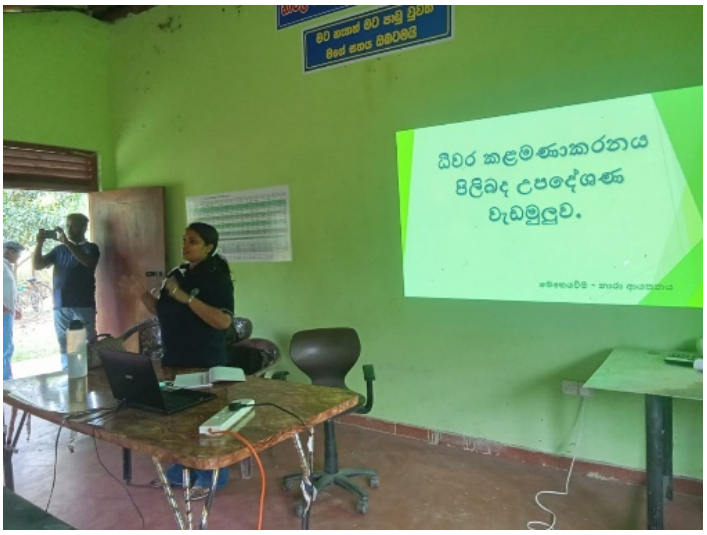
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Figure 4.43: Conducting awareness programs for RFO members of Namal Oya, Konduwatuwana, Himiduawa, Ekgal Oya and Pannalgama reservoirs

4.7 Project Monitoring and Evaluation of Culture-Based Fisheries of selected reservoirs

This section presents a comprehensive evaluation of the culture-based fisheries project implemented across multiple reservoirs, including Namal Oya, Konduwatuwana, Pannalgama, Ekgaloya, and Himidurawa. The assessment focuses on fishing gear usage, catch data, financing, fingerling stocking programs, financial management, fisher participation, rule compliance, and monitoring ,control measures and water quality monitoring of the reservoirs.

- **Fishing Gear and Catch Data**

Across the monitored reservoirs, the number of fishing nets in use varied between 6 and 12, with mesh sizes generally conforming to the new specifications (>5 inches). Average catch per fishing trip has declined since the program's inception, with many sites reporting smaller catches compared to pre-program periods. Daily active fishermen ranged from 8 to 40 depending on the reservoir. Catch volumes reported daily ranged from approximately 2 kg to 24 kg, with notable fluctuations attributed to seasonal variations and spill events.

- **Financing**

The cost of fishing gear production according to new standards varied widely. For example, net costs for net making to meet with newly agreed specification ranged from Rs. 5,500 to Rs. 72,000,

with many fishers financing purchases through loans or self-funding. Interest rates for borrowed funds ranged between 5% and 10%, with repayment schedules predominantly monthly.

- **Fingerling Stocking Program**

The fingerling stocking initiatives were conducted at intervals ranging from monthly to bi-monthly, although some interruptions occurred due to spills or funding shortages. While some reservoirs successfully implemented regular stocking, others reported program delays or absence of stocking due to resource constraints During the first visit, fishers in Ekgal Oya emphasized their difficulty in accessing electricity facilities. However, by the time of the follow-up visit, they had received electricity.

- **Revolving Fund and Financial Management**

Funds of revolving account used for fish stocking programs. Costs for stocking programs ranged from Rs. 30,000 to Rs. 95,000, often shared between government bodies and fishing societies. The number of stocking programs conducted largely adhered to scheduled intervals, although with occasional deviations. However, now government funds are not available for stocking program.

- **Fisher Participation and Society Membership**

Fisher participation remained relatively stable, with the introduction of new program rules. Overall perceptions of the program were mixed; while the initiative was generally regarded positively, many fishers expressed concerns about reduced income due to lower catch volumes and restrictive regulations.

- **Rules and Regulations Compliance**

A series of new fishing rules were introduced, including restrictions on net mesh size, limits on the number of nets used, and designated fishing periods. Initially, the increase in minimum mesh size from 4.5 to 6 inches caused significant difficulties for fishers, as catch rates declined sharply. This change led to considerable frustration, stress, and pressure among the fishing communities, impacting their livelihoods and morale.

Responding to these concerns, NAQDA engaged with the fishers, and a revised minimum mesh size of 5 inches was adopted across the five monitored reservoirs. This adjustment has since

resulted in improved catch satisfaction among fishers, who now report better yields aligning with sustainable fishing objectives. Enforcement of these regulations is managed jointly by NAQDA and fishing societies, with compliance levels varying but generally improving following the mesh size revision.

- **Monitoring and Control Measures**

To control illegal fishing and support sustainable practices, multiple monitoring groups were formed, typically consisting of five members per group. Raid programs and daily or weekly patrols were conducted, with varying degrees of support from authorities such as police and NAQDA. Measures to prevent fish escape during spill seasons included barricade net installations, though maintenance challenges such as net breakage during rains were reported.

- **Water quality monitoring**

Water quality in the reservoirs was monitored during each site visit as part of the assessment program. Key physico-chemical parameters, including water temperature, dissolved oxygen, pH, electrical conductivity, Secchi disk depth, ammonia, nitrate, orthophosphate, and chlorophyll-*a*, were measured at predetermined sampling locations. These measurements were conducted to evaluate the suitability of the reservoir environments for culture-based fisheries. Table 4.11 presents the variation in water quality parameters observed throughout the monitoring period.

Table 4.11 Water quality monitoring report

Visit No	Resevoir name	T	DO	pH	CON	Alk	NH3	NO3	OP	Chl a
1	Narmal Oya	31.9	8.4	8.3	97.3	56.7	0.02	8.02	0.02	4.2
	Konduwatuwana	34.2	10.8	7.7	100.8	43.3	0.02	21.93	0.02	1.3
	Ekgaloya	31.8	6.7	7.4	72.6	36.7	0.01	2.20	0.02	1.8
	Himidurawa	31.9	5.6	7.5	97.3	60.0	0.02	2.72	0.02	1.2
	Pannalgama	33.0	10.4	7.6	83.0	40.0	0.01	2.71	0.19	2.9
2	Narmal Oya	30.5	8.2	7.9	24.9	40.0	0.47	2.77	0.01	2.6
	Konduwatuwana	30.7	9.8	9.1	106.8	60.0	0.31	5.85	0.02	2.6
	Ekgaloya	30.2	9.8	8.1	75.1	40.0	0.15	2.31	0.02	0.8
	Himidurawa	30.3	8.0	7.8	40.5	60.0	0.20	1.42	0.01	1.1
	Pannalgama	30.1	8.1	7.2	84.1	40.0	0.01	2.45	0.01	1.5
3	Narmal Oya	33.2	8.2	8.7	109.7	40.0	0.14	7.59	0.01	0.9
	Konduwatuwana	32.3	9.5	8.4	106.8	60.0	0.14	7.59	0.01	9.5
	Ekgaloya	32.3	6.7	8.4	83.1	40.0	0.11	10.07	0.02	3.7

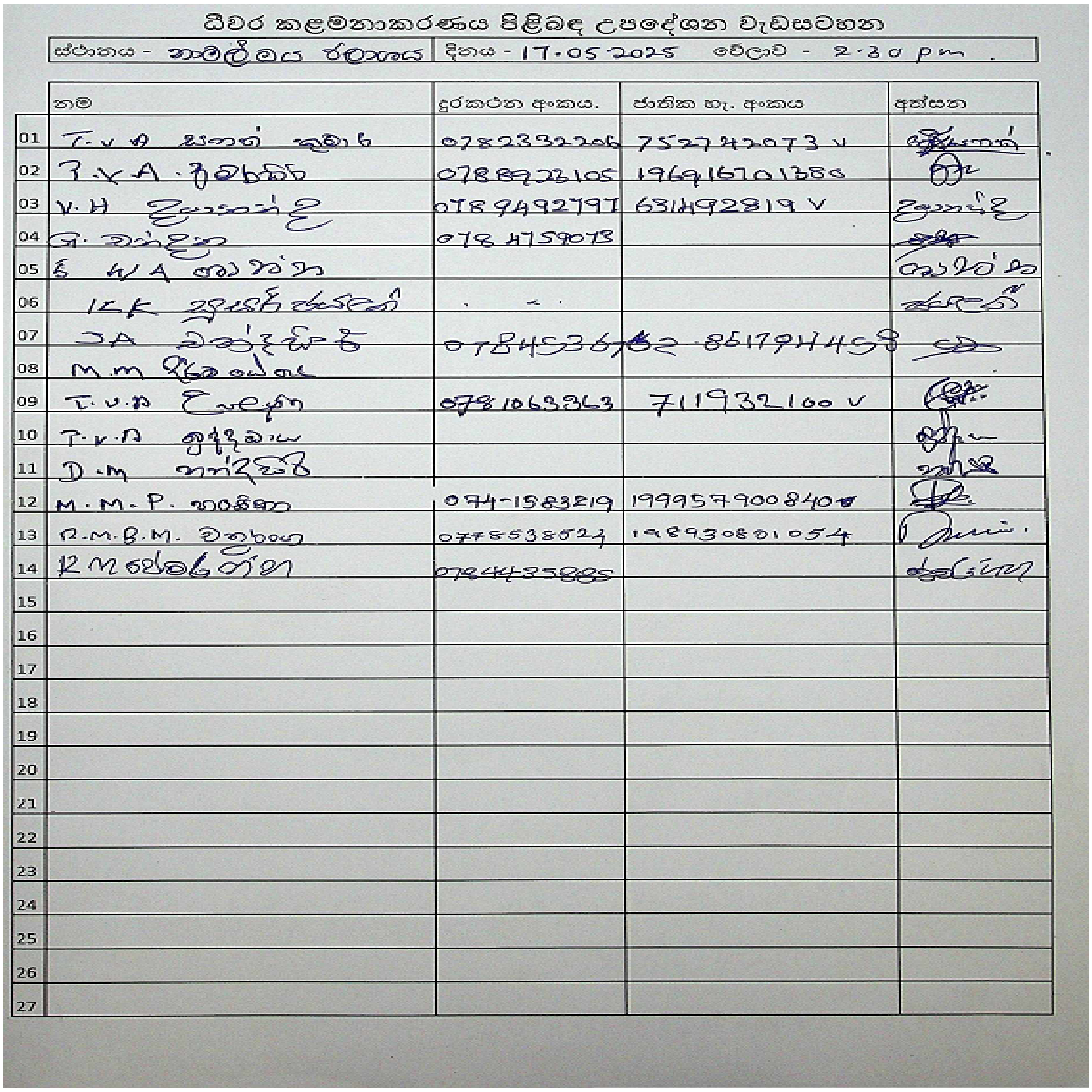
	Himidurawa	33.2	9.4	8.7	71.5	40.0	0.14	7.59	0.01	9.5
	Pannalgama	30.5	5.3	7.7	74.5	60.0	0.13	2.93	0.01	1.2
4	Narmal Oya	31.3	6.0	7.1	57.1	20.0	0.02	8.50	0.02	4.5
	Konduwatuwana	32.3	6.9	8.5	88.2	20.0	0.01	17.50	0.01	3.2
	Ekgaloya	31.5	6.5	7.5	65.3	20.0	0.01	2.98	0.02	5.8
	Himidurawa	29.3	5.8	7.2	88.0	40.0	0.02	2.84	0.01	1.9
	Pannalgama	30.5	6.5	7.5	84.9	20.0	0.01	2.71	0.01	2.6

T- Temperature ^{0}C , DO- Dissolved oxygen (mg/l), CON- Conductivity (µs cm^{-1}), Alkalinity (mg/l), NH_3- Ammonia (mg/l), Nitrate (NO_3), OP- Orthophosphate (mg/l), Chlorophyll a (µg/l)

4.8 Awareness Programme Presentation – Appendix 16

Appendix 01

Attendance sheet of Namal Oya RFO members for the awareness program conducted by NARA.



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02	T.V.A. [illegible]	0788922105	196916701380	[signature]
03	V.H [illegible]	0789492797	631492819 V	[signature]
04	G. [illegible]	0784759073		[signature]
05	K W.A [illegible]			[signature]
06	IKK [illegible]	. - .		[signature]
07	JA [illegible]	0784536782	8517944598	[signature]
08	M.M [illegible]			
09	T.V.A [illegible]	0781063363	711932100 V	[signature]
10	T.V.A [illegible]			[signature]
11	D.M [illegible]			[signature]
12	M.M.P. [illegible]	074-1583219	199957900840	[signature]
13	R.M.B.M. [illegible]	0778538524	198930801054	[signature]
14	R M [illegible]	0784435885		[signature]
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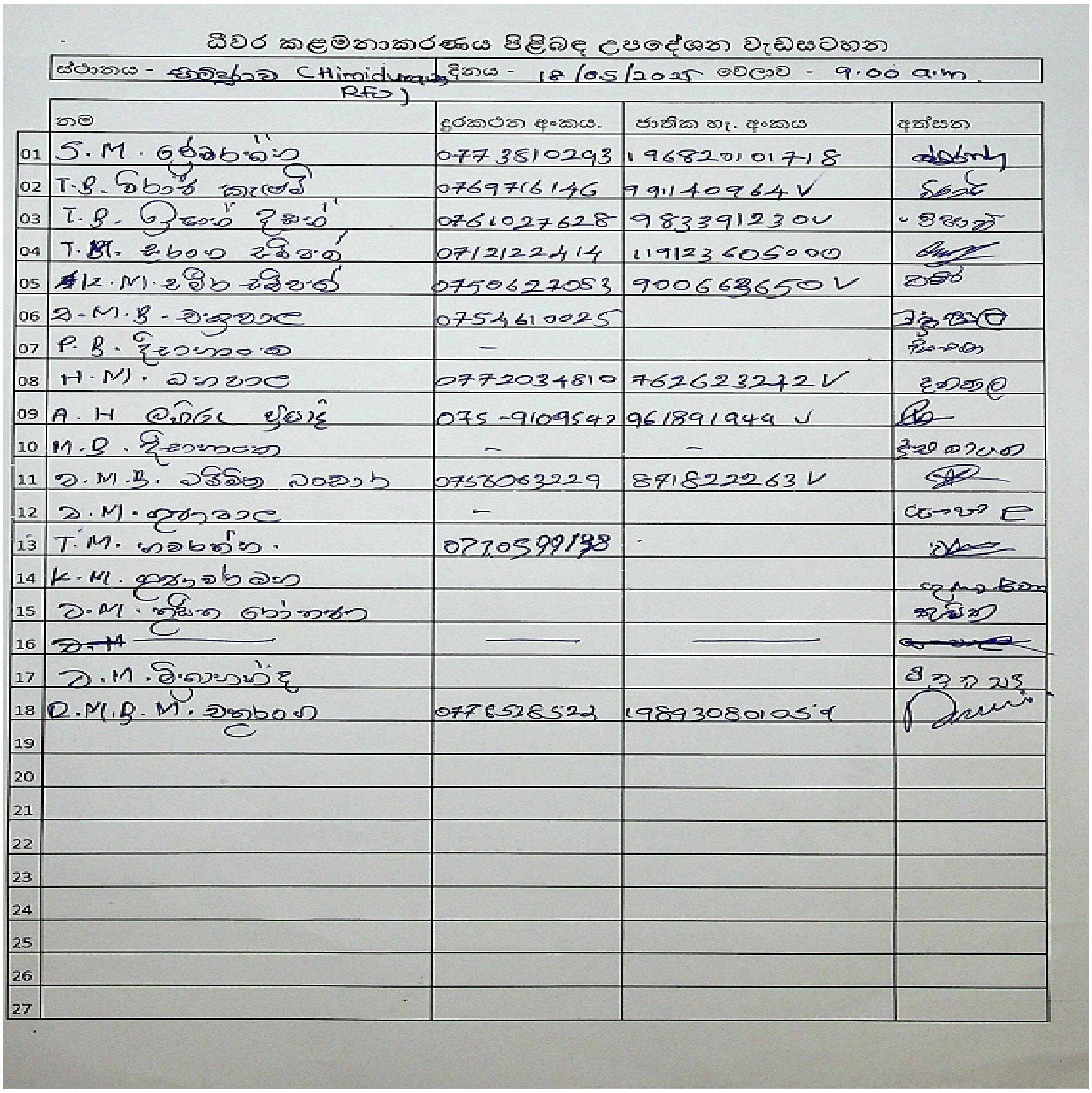
Appendix 02

Attendance sheet of Himidurawa RFO members for the awareness program conducted by NARA.



ධීවර කළමනාකරණය පිළිබඳ උපදේශන වැඩසටහන

ස්ථානය - හිමිදුරාව (Himidurawa RFO) | දිනය - 18/05/2025 | වේලාව - 9.00 a.m.

	නම	දුරකථන අංකය.	ජාතික හැ. අංකය	අත්සන
01	S.M. [illegible]	0773810293	196827101718	[illegible]
02	T.B. [illegible]	0769716146	991140964V	[illegible]
03	T.B. [illegible]	0761027628	983391230V	[illegible]
04	T.M. [illegible]	0712122414	119123605000	[illegible]
05	R.M. [illegible]	0750627053	900663650V	[illegible]
06	D.M.B. [illegible]	0754610025		[illegible]
07	P.B. [illegible]	–		[illegible]
08	H.M. [illegible]	0772034810	762623242V	[illegible]
09	A.H [illegible]	075-9109547	961891944V	[illegible]
10	M.B. [illegible]	–	–	[illegible]
11	D.M.B. [illegible]	0756063229	891822263V	[illegible]
12	D.M. [illegible]	–		[illegible]
13	T.M. [illegible]	0770599138		[illegible]
14	K.M. [illegible]			[illegible]
15	D.M. [illegible]			[illegible]
16	~~D.M~~	—	—	—
17	D.M. [illegible]			[illegible]
18	D.M.B.M. [illegible]	0776526524	198930801059	[illegible]
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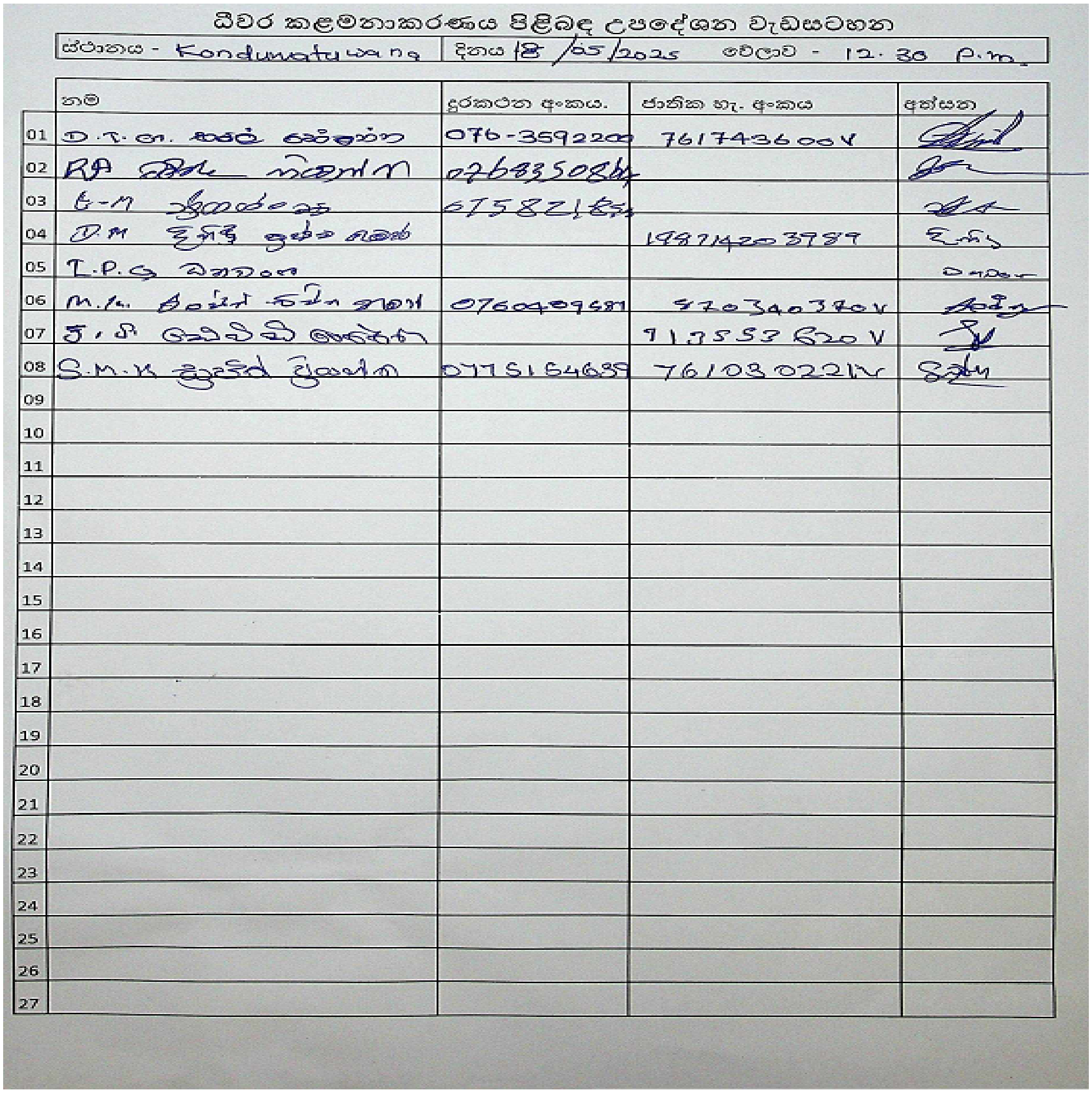
Appendix 03:

Attendance sheet of Konduwatuwana RFO members for the awareness program conducted by NARA.



ධීවර කළමනාකරණය පිළිබඳ උපදේශන වැඩසටහන

ස්ථානය - Konduwatuwana | දිනය 18/05/2025 වේලාව - 12.30 p.m.

	නම	දුරකථන අංකය.	ජාතික හැ. අංකය	අත්සන
01	D.T.G. [illegible]	076-3592200	761743600V	
02	RA [illegible]	0768350864		
03	E-M [illegible]	0758218[illegible]		
04	D.M [illegible]		199714203789	
05	I.P.G [illegible]			
06	M.K. [illegible]	0760409481	570340370V	
07	[illegible]		713553[illegible]20V	
08	S.M.K [illegible]	0775154689	761030221V	
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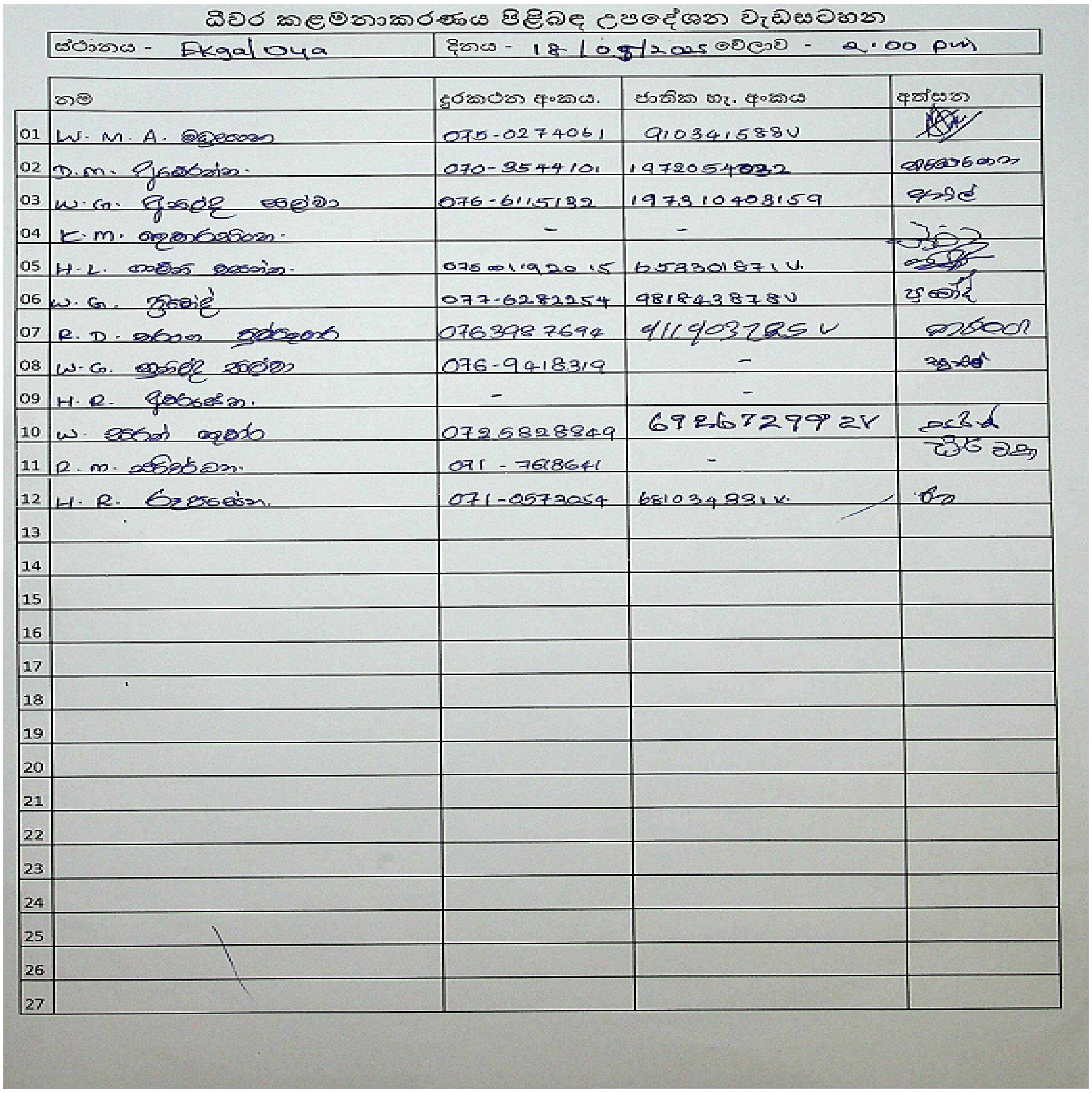
Appendix 04:

Attendance sheet of Ekgal Oya RFO members for the awareness program conducted by NARA.



ධීවර කළමනාකරණය පිළිබඳ උපදේශන වැඩසටහන

ස්ථානය - Ekgal Oya | දිනය - 18 / 0[illegible] / 2015 වේලාව - 2.00 pm

	නම	දුරකථන අංකය.	ජාතික හැ. අංකය	අත්සන
01	W. M. A. [illegible]	075-0274061	910341588V	[illegible]
02	D. M. [illegible]	070-2544101	19720564[illegible]2	[illegible]
03	W. G. [illegible]	076-6115132	197310408159	[illegible]
04	K. M. [illegible]	-	-	[illegible]
05	H. L. [illegible]	075 [illegible]	652301871V	[illegible]
06	W. G. [illegible]	077-6282254	981843878V	[illegible]
07	R. D. [illegible]	0763987694	911903725V	[illegible]
08	W. G. [illegible]	076-9418319	-	[illegible]
09	H. R. [illegible]	-	-	
10	W. [illegible]	0725828849	692672792V	[illegible]
11	R. M. [illegible]	071-7628641	-	[illegible]
12	H. R. [illegible]	071-0573054	681034891V	[illegible]
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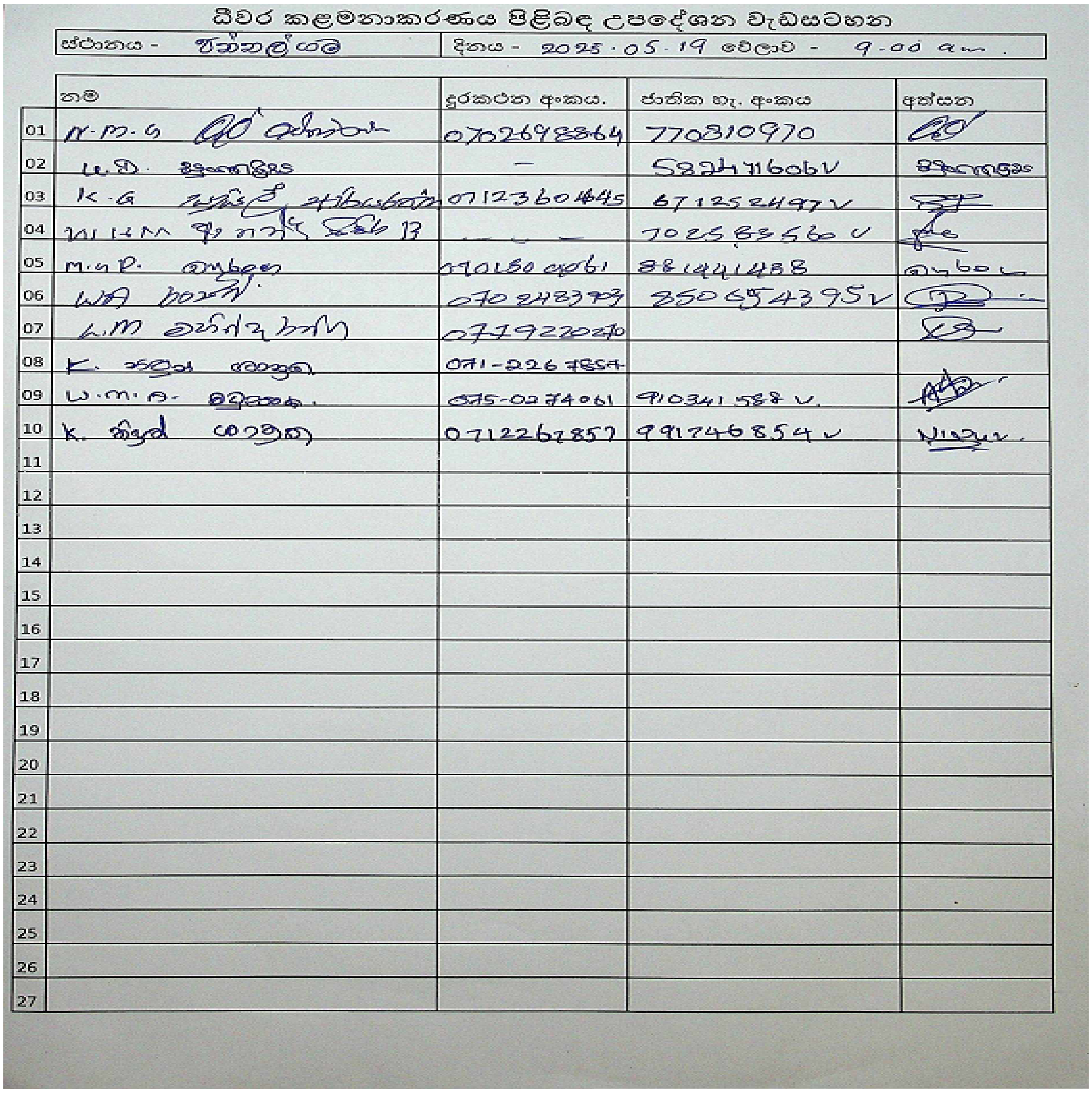
Appendix 05:

Attendance sheet of Pannalgama RFO members for the awareness program conducted by NARA.



ධීවර කළමනාකරණය පිළිබඳ උපදේශන වැඩසටහන

ස්ථානය - පන්නල්ගම	දිනය - 2025.05.19 වේලාව - 9.00 a.m.

	නම	දුරකථන අංකය.	ජාතික හැ. අංකය	අත්සන
01	N.M.G [illegible]	0702698864	770810970	[illegible]
02	W.D. [illegible]	—	582471606V	[illegible]
03	K.G [illegible]	0712360445	671252497V	[illegible]
04	W.H.M [illegible] 13	— — —	702583560 V	[illegible]
05	M.G.P. [illegible]	[illegible]	881441488	[illegible]
06	W.A [illegible]	0702483[illegible]	250654395V	[illegible]
07	L.M [illegible]	0719220[illegible]		[illegible]
08	K. [illegible]	071-2267854		
09	W.M.A. [illegible]	075-0274061	910341588 V.	[illegible]
10	K. [illegible]	0712262857	991746854 V	[illegible]
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Appendix 06:

Improved data recording formal specimen 01

මිරිදිය ධීවර සංවිධානය

Month වියදම් ලෙජරය ආකෘතිය -

අ ව	විස්තර	ව ඉ	දී ක ව	ප අ ඉ	ග ඇ	ද	ර	EPF (if	අ	ව	(	සද කිරි ගම	සු ගෙ තී	වි ඉ
එකතුව														

_____ _____ _____

සභාපති භාණ්ඩාගාරික ගණකාධිකාරී

Appendix 07:

Improved data recording formal specimen 02

..... මාසික ආදායම් ප්‍රකාශය	
විස්තරය	**ශේෂය**
ඇතුලත් වීමේ ගාස්තු	
මාළු පැටවු වගාවෙන් ආදායම	
සාමාජික ඉතුරුම්	
ඉස්සන් සදහා මූලු ආදායම	
දඩ මුදල්	
ණය එකතු කිරීම	
සාමාජික ගාස්තු	
ඉතුරුම් තීරුවේ ශේෂය	
බැංකු ශේෂය (ජංගම ගිණුම)	
සේවක අර්ථසාධක අරමුදල (E.P.F)	
කුලී ආදායම	
වෙනත් ආදායම්	
එකතුව	

Appendix 08

Improved data recording formal specimen 03

මූල්‍ය තත්ත්වය	
ගිණුම් විස්තර	ප්‍රමාණය
වක්‍රීය අරමුදල් ගිණුම	
ස්ථාවර තැන්පතු	
ජංගම ගිණුම	
එකතුව	

_____ _____ _____

සභාපති භාණ්ඩාගාරික ගණකාධිකාරී

Appendix 09

Improved data recording formal specimen 04

මාසය			
පිරිවැය විස්තරය	ඒකක ගණන	ඒකක පිරිවැය	මුළු පිරිවැය
මූලූ එකතුව			

Appendix 10

Improved data recording formal specimen 05

පැමිණීමේ ලේඛණය

මාසය:

අංකය	නම	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	එකතුව
	එකතුව (ක්‍රියාකාරී දිවරයන්)																																

Appendix 11 Improved data recording formal specimen 06

මිරිදිය ධීවර සංවිධානය						
ඉතුරුම් විස්තර.....						
අනු අංකය	නම	ඉස්සන් kg	ඉස්සන් දායක මුදල්	මාළු kg	මාළු දායක මුදල්	මුළු ඉතුරුම්
එකතුව		0	0.00	0	0.00	0.00

_____ _____ _____

සභාපති භාණ්ඩාගාරික ගණකාධිකාරී

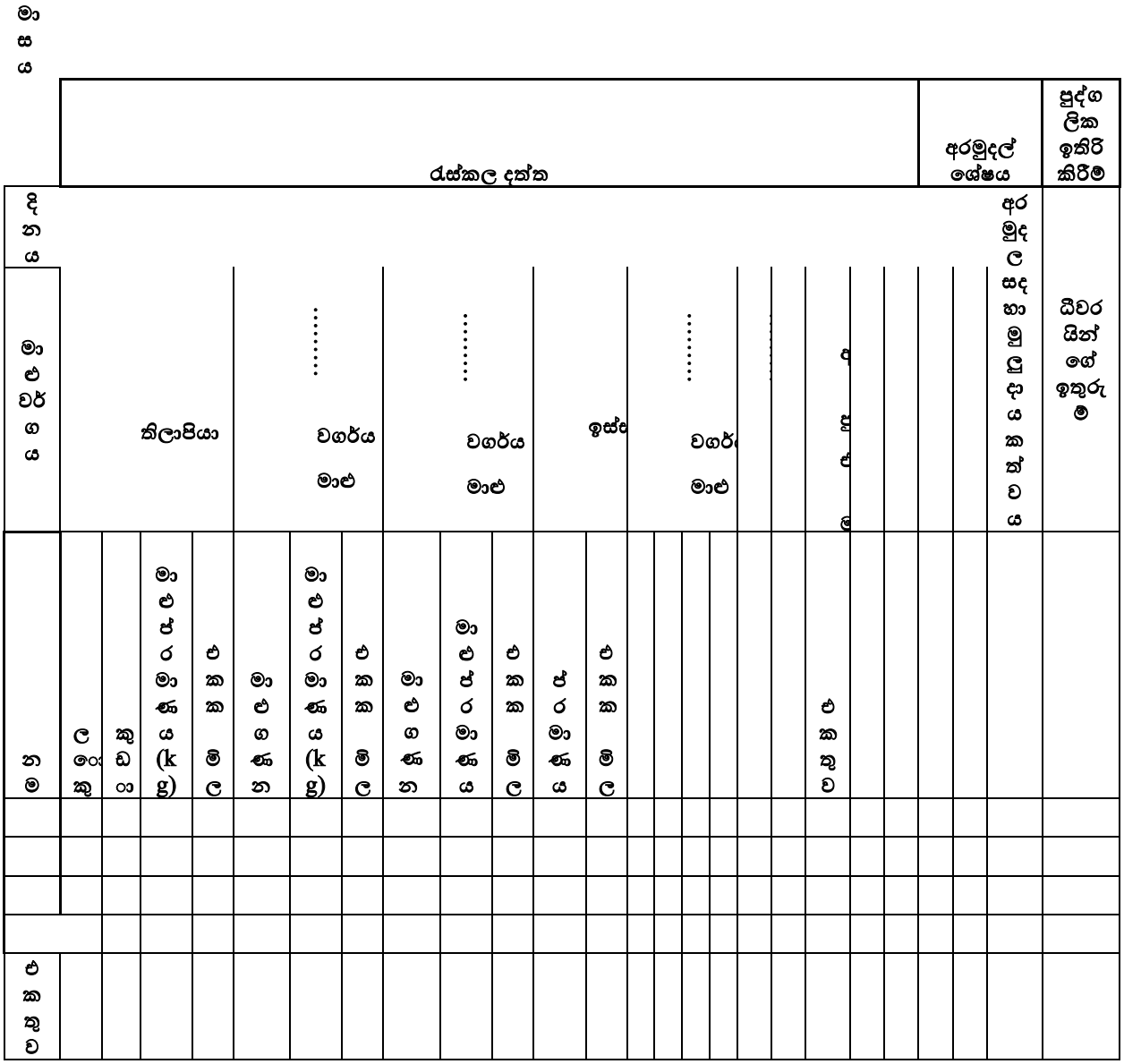
Appendix 12 Improved data recording formal specimen 07

..... මාසික ආදායම් ගිණුම් විස්තර					
විස්තර	එකතුව	දායකත්වය	ඉතිරිකිරීම්		
සමිතියට දායකත්ව මුදල් ආදායම					
සාමාජික ඉතුරුම්					
මාළු පැටවු ආදායම්					
ඉස්සන් ආදායම					
වෙනත් ආදායම්					
එකතුව	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Appendix 13 Improved data recording formal specimen 08

මිරිදිය ධීවර සංවිධානය -			
මාසික මුදල් ගිණුම.....			
විස්තර	එකතුව	විස්තර	එකතුව
මුදල් ශේෂය			
සංගමය සඳහා දායකත්ව ආදායම			
සාමාජික ඉතුරුම්			
මාළු වෙළඳපොළ සඳහා ණය			
ඉස්සන් ආදායම			
වෙනත් ආදායම්			
ණය එකතු කිරීම			
සේවක E.P.F දායකත්වය			
		පිරිවැය	**0.00**
		ඉතිරි මුදල්	**0.00**
එකතුව		අවසාන ශේෂය	**0.00**

Appendix 14 Improved data recording formal specimen 09



Appendix 15 Simple Budget board format

භාණ්ඩය	විස්තරය	ආදායම සතියේ/ මාසයේ	වියදම සතියේ/ මාසයේ	ශේෂය සතියේ/ මාසයේ
මාළු අලවිය				
මාළු තැන්පත් කිරීම				
මාළු කොටු පවත්වාගෙන යාම				
ධීවර ආඥාපන්න				
ගමනාගමන ගාස්තු				
වෙනත් ආදායම්				
ආධාර				
වෙනත් වියදම්				
		එකතුව		
		සතියේ/ මාසයේ ශේෂය		

ධීවර කළමණාකරනය පිලිබඳ උපදේශණ වැඩමුලුව.

මෙහෙයවීම - නාරා ආයතනය

"What is common to the greatest number gets the least amount of care."

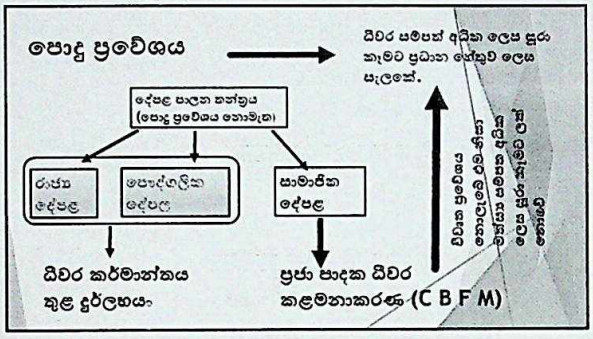
- විවෘත ප්‍රවේශය නිසා ධීවර සම්පත් සුරා කෑමට ලක්වේ.
- ධීවරයා ධීවර සම්පතට හිමිකරුවෙක් නැති බව පිනයි.
- මහු මසුන් ඇල්ලුවේ නැතිනම් වෙනත් කෙනෙකු අල්ලනු ඇති බව පිනයි.
- සියලුම ධීවරයින් මෙසේ සිදු කිරීමෙන් මුහුදේ/ ජලාශයේ මත්ස්‍ය ගහනය අඩුවේවි.

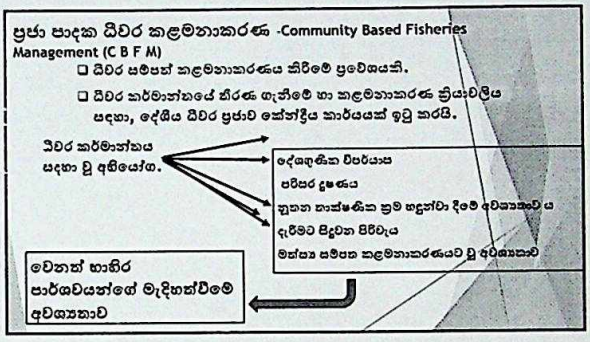
Tradegy of Commons

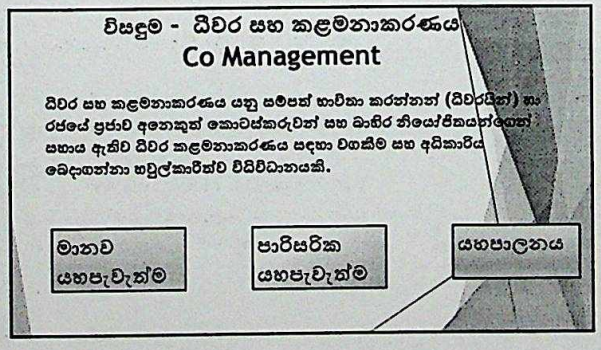
විසඳුම

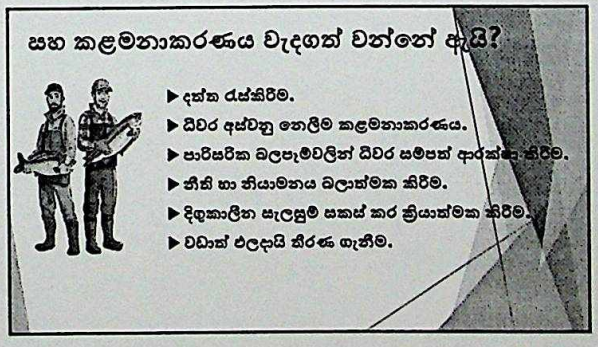
ස්භාවික සම්පත් අධි භාවිතය හා අනවශ්‍ය සුරාකෑම

පොදු සම්පත් පෞද්ගලීකරණය කිරීම හෝ රජයේ රෙගුලාසි හරහා විවෘත ප්‍රවේශය පාලනය කිරීම

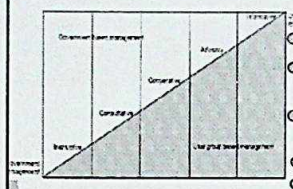

පොදු ප්‍රවේශය
ධීවර සම්පත් අධික ලෙස සූරා කෑමට ප්‍රධාන හේතුව ලෙස සැලකේ.
දේපළ පාලන තන්ත්‍රය (පොදු ප්‍රවේශය නොමැත)
රාජ්‍ය දේපළ
පෞද්ගලික දේපළ
සාමාජික දේපළ
ධීවර කර්මාන්තය තුළ දුර්ලභයා
ප්‍රජා පාදක ධීවර කළමනාකරණ (C B F M)
ධීවර ප්‍රවේශය නොලබීම නිසා ධීවර සම්පත් අධික ලෙස සූරා කෑමට පෙලඹීම


ප්‍රජා පාදක ධීවර කළමනාකරණ -Community Based Fisheries Management (C B F M)
❑ ධීවර සම්පත් කළමනාකරණය කිරීමේ ප්‍රවේශයකි.
❑ ධීවර කර්මාන්තයේ නිරත වැනීමේ හා කළමනාකරණ ක්‍රියාවලිය පදනම, දේශීය ධීවර ප්‍රජාව කේන්ද්‍රීය භාර්යයක් ඉටු කරයි.
ධීවර කර්මාන්තය සඳහා වූ අභියෝග.
දේශගුණික විපර්යාස
පරිසර දූෂණය
නූතන තාක්ෂණික ක්‍රම භාවිතා දීමේ අවශ්‍යතාවය
දැරීමට සිදුවන පිරිවැය
මත්ස්‍ය සම්පත කළමනාකරණයට වූ අවශ්‍යතාව
වෙනත් භාහිර පාර්ශවයන්ගේ මැදිහත්වීමේ අවශ්‍යතාව


විසඳුම - ධීවර සහ කළමනාකරණය
Co Management
ධීවර සහ කළමනාකරණය යනු සම්පත් භාවිතා කරන්නන් (ධීවරයින්) හා රජයේ ප්‍රජාව අතෙකුත් කොටස්කරුවන් සහ බාහිර නියෝජිකයන්ගෙන් සහාය ඇතිව ධීවර කළමනාකරණය සඳහා වගකීම සහ අධිකාරිය බෙදාගන්නා හවුල්කාරිත්ව විධිවිධානයකි.
මානව යහපැවැත්ම
පාරිසරික යහපැවැත්ම
යහපාලනය


සහ කළමනාකරණය වැදගත් වන්නේ ඇයි?
▶ දන්න රැස්කිරීම.
▶ ධීවර අස්වනු නෙලීම කළමනාකරණය.
▶ පාරිසරික බලපෑමවලින් ධීවර සම්පත් ආරක්ෂා කිරීම.
▶ නීති හා නියාමනය බලාත්මක කිරීම.
▶ දිගුකාලීන සැලසුම් සකස් කර ක්‍රියාත්මක කිරීම.
▶ වඩාත් ඵලදායී තීරණ ගැනීම.

රජයේ කාර්යභාරය සහ සම්පත් භාවිතා කරන්නන්ගේ කාර්යභාරය අනුව ධිවර සහ කළමනාකරණය විධිවිධාන වර්ගීකරණය කිරීම.

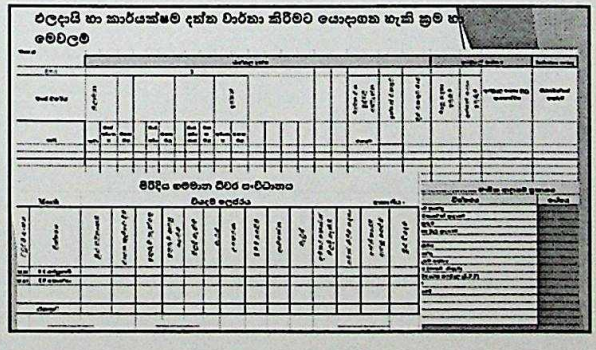


සහ කළමනාකරණය .....

01. දක්ෂ සටහන් කිරීම සහ පවත්වාගෙන යාම.
- දක්ෂ වල ආරක්ෂිතභාවය.
- යාවත්කාලීන වීම.
- දක්ෂ හුවමාරුව.

දක්ෂ නිවැරදිව පැහැදිලිව සහ පහසුවෙන් පරිශීලනය කිරීමට හැකිවීමේ ප්‍රයෝජන.

- මත්ස්‍ය නිෂ්පාදනය පිළිබඳව තත්ත්වය දැනගැනීම.
- මත්ස්‍ය නිෂ්පාදනයේ වෙනස්කම් හඳුනා ගැනීමට.
- මත්ස්‍ය මිල ගණන්වල සහ ඒවායේ කාලීනව සිදුවන වෙනස්කම් අවබෝධ කරගැනීමට.
- මත්ස්‍ය කළමනාකරණයට අවශ්‍ය නිර්ණායක නීති රීති කාලීන සහ අවශ්‍යතානුකූලව යාවත්කාලීන කිරීමට.
- පර්යේෂණ, අධ්‍යාපනික නීති රෙගුලාසි ප්‍රතිපත්ති සංවිධානය කරන ආයතනවලට අවශ්‍ය යෙදවුම් ලෙස ප්‍රයෝජනවත් වීම.



වැඩිදියුණු කළ දත්ත ඇතුළත් කිරීමේ ක්‍රමවේදයක් අනුගමනය කිරීමට ඔබගේ ධීවර සමීතියට ඇති අපහසුතා.

එම අපහසුතා මගහැර ගැනීමට ගත හැකි උපායමාර්ග සහ සම්බන්ධ විය යුතු ආයතන.

සහ කළමනාකරණයේ ඇති පොදු ගැටලු

02. විනිවිද භාවය පිළිබඳ ගැටලු.

සාමාජිකයන්ට, අනෙකුත් කොටස්කරුවන්ට, දත්ත හුවමාරු කර ගැනීමේදී ඇතිවන ගැටලු.

වැඩිදියුණු කළ දත්ත සටහන් කිරීමේ ක්‍රමය

<u>මූල්‍ය විනිවිදභාවය.</u>

- මුදල් කළමනාකරණය.
- මුදල් සංචිකය.
- ඒක පුද්ගල අරමුදල්වල ඇති මුදල්.
- මෙම දත්ත වලට අනෙකුත් සාමාජිකයන්ගේ ඇති ප්‍රවේශය.
- මෙම දත්ත යාවත්කාලීන වීමේ කාර්යක්ෂමතාවය.
- විගණනය.

මූල්‍ය විනිවිදභාවය ධීවර සමිතියකට වැදගත් වන්නේ ඇයි ?

- මූල්‍ය ක්‍රියාවලිය කෙරෙහි විශ්වාසය ගොඩනගා ගැනීමට.
- මූල්‍ය දූෂණය වැළැක්වීමට.
- සම්පත් සඳහා සාමූහික වගකීම සඳහා.
- සම්පත් භාවිතය ප්‍රශස්ත කිරීම අරමුණු හා ප්‍රමුඛතා සමග වියදම් සමපාත කිරීමට.
- මූල්‍ය සැලසුම් කිරීම පහසුවීම.
- මූල්‍ය විනය පවත්වා ගැනීම.

ඵලදායී මූල්‍ය කළමනාකරන පද්ධති.

- මූල්‍ය මෘදුකාංග භාවිතය.
- පරිගණක මෙවලම් භාවිතය.

මූල්‍ය කාර්ය සාධනය නිරීක්ෂණය කිරීමට සහ වාර්තා කිරීමට ඔබේ ධීවර සමිතියේ ඇති ක්‍රමවේදය.

නව ක්‍රමවේද -

- ✓මාළු අලවියෙන් පසු ලැබෙන ආදායම්.
- ✓ මාළු තැන්පත් කිරීම වැඩසටහන් සහ පොදු කටයුතු සඳහා සහ වියදම්.
- ✓රජයෙන් හා රාජ්‍ය නොවන ආයතන වලින් ලැබෙන අරමුදල්.
- ✓සමිතියේ ගිණුමෙහි ඇති මුදල්.
- ✓තනි පුද්ගල ගිණුම් පවත්වාගෙන යාම පිළිබඳව වාර්තා.
- ✓ වෙනත් අදාළ මූල්‍ය ගනුදෙනු

මෙවලම්-

- Excel හා Google Sheet.
- මෘදුකාංග (Software)

දත්ත හුවමාරුව-

- මාසික රැස්වීමවලදී නිතර සාමාජිකයන් සමිතියේ මූල්‍ය තත්ත්වය පිළිබඳ දැනුවත් කිරීම.
- ආදායම ව්‍යදම පෙන්වන සරල ලේඛනයක් භාවිතා කිරීම රූප ඔක ප්‍රස්ථාර.
- Sample beget board (සරල අයවැය පුවරුව) එකක් පවත්වා ගැනීම.

සරල අයවැය පුවරුව (Sample beget board)

භාණ්ඩය	විස්තරය	ආදායම්	වියදම්	ශේෂය
		එකතුව		
		ආරම්භක ශේෂය		
		වසුන් මාසයේ ශේෂය		

- මෙම පුවරුව සෑම දිනක සභියකට වරක් අවම යාවත්කාලීන කරන්න.
- සෑම ආදායම් ලැබීමකදීම වියදමක් දැරීමකදීම මෙය යාවත්කාලීන කිරීම.
- විළඹ ආයෝජනය කිරීම සඳහා අවබෝධය ගැනීමට හා අභිරේක මුදල් අවශ්‍යතාවයක් ඇතිද යන්න සියලුම සාමාජිකයන්ට අවබෝධ කරගත හැක.

සහ කළමනාකරණයේ පොදු ගැටලු-

03. ධාරිතාව හා ශාක්‍යතාවය පිළිබඳ ගැටලු

දැනුම | තාක්ෂණය | කළමනාකරණය

- මක්ස්‍ය නිෂ්පාදනය.
- මක්ස්‍ය පැටව තැන්පත් කිරීම.
- අස්වනු කළමනාකරණය.
- නව නීති රීති පිළිබඳ අවබෝධය.
- අඟය එකතු කිරීම නව නිෂ්පාදන ව්‍යවසායකත්වය.
- මූල්‍ය කළමනාකරණය

වගා පාදක ධිවර කර්මාන්තය සඳහා අලෙවි කරන දැනුම.

4 Ps සංකල්පය

නිෂ්පාදනය(Product)	→	මත්ස්‍යයන් /මත්ස්‍ය නිෂ්පාදන
මිල (Price)	→	මත්ස්‍ය මිල
ස්ථානය(Place)	→	විකුණන ස්ථානය
ප්‍රවර්ධනය (Promotion)	→	ලේබල් කිරීම වෙළඳ නාමය

නිෂ්පාදනය (Product.)

මාළු විශේෂ
- වැඩි ඉල්ලුමක් සහිත මාළු
- මිල අඩු මාළු

වැඩි ඉල්ලුම ඇති මිල වැඩි → මාළු ලෙස

අඩු ඉල්ලුමක් ඇති
- මිල අඩු මාළු → විවිධ මාළු නිෂ්පාදන සඳහා උදාහරණ - දුම් ගැසූ කරවල

මිල (Price)

- මිල ගණන් සාධාරණ විය යුතු වන අතර ඔබට මුල්‍ය වාසියක් /ලාභයක් ලැබීමට හැකිවිය යුතුය.
- මිල නිර්ණය සඳහා ඔබ අනුගමනය කරන ක්‍රම...?
- විශේෂ මිල වෙනස් කිරීම් -
  - අස්වනු වැඩි කාල
  - උත්සවකාල
  - මිල කරන උපායමාර්ග (Pricing Strategies)

විකුණන ස්ථානය (Place)

- සාමාන්‍ය වෙළඳපොළවල්
- විශේෂ නව වෙළඳපොළවල් උත්සාහ කිරීම
  - -සංචාරකයින් ගැවසෙන ස්ථාන
  - -හෝටල් හා අවන්හල් ජාල
  - -සුභසාධන සාප්පු හා ආපනශාලා
  - -වීදි ආහාර උත්සව. -Street food-
- මත්ස්‍යයන් විකුණන ස්වභාවය මේ සඳහා බලපායි
  - -අමු මාළු
  - -මාළු නිෂ්පාදන

ප්‍රවර්ධනය (Promotion)

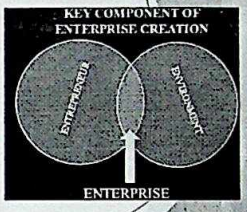
වෙළඳ නාමයක් සහස් කර ප්‍රවර්ධනය කිරීම
අනන්‍ය ලේබලයක් භාවිතය.
හුරුබුහුටි ආහාර ඇසුරුම් යොදා ගැනීම. (Handy Packs)
අභිරුචිකරණය(ඒ ඒ පුද්ගලයාගේ කැමැත්ත ඉලක්ක වූ) කළ නිෂ්පාදන (customized Products)
සමාජ මාධ්‍ය භාවිතයෙන් ප්‍රවර්ධනය.
කැම සම්බන්ධ උත්සව වෙළඳ ප්‍රදර්ශනවලට සම්බන්ධ වීම
Seasonal Offers

ව්‍යවසායකත්වය.....

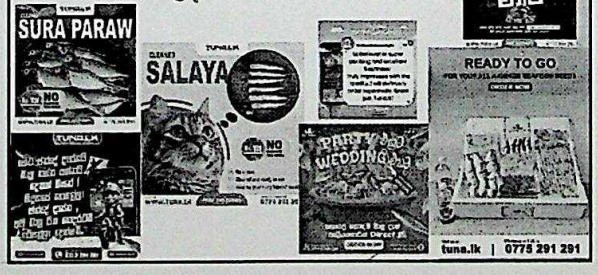
ව්‍යවසායකයෙකුගේ ලෙස හඳුන්වන්නේ කවුද?

ව්‍යවසායකයෙකුගේ ගුණාංග මොනවාද?

ව්‍යවසායකයෙකු වීමේ වැදගත්කම් කුමක්ද?



මත්ස්‍ය නිෂ්පාදන සම්බන්ධව ව්‍යවසායකයෙකු වීම සම්බන්ධව උදාහරණ.....

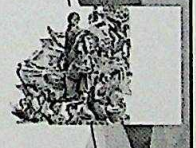


කාන්තාවන් බල ගැන්වීම.....

කාන්තා සවිබල ගැන්වීම යනු කුමක්ද?

කාන්තා සවිබල ගැන්වීම වැදගත් වන්නේ ඇයි

ඊට ප්‍රාර්ථනීය කාන්තාවන් සවිබල ගැන්වීම සඳහා කළ හැකි දේවල් මෙහෙයි.



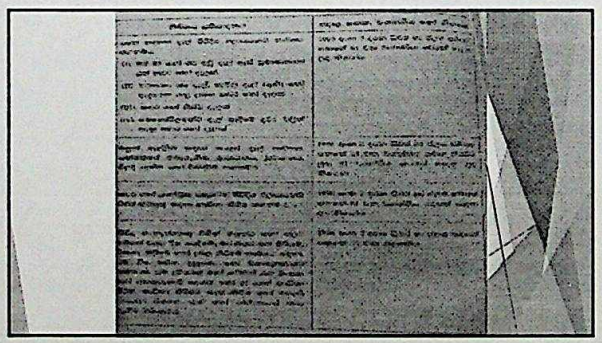
❖මුදල් කටයුතු ලේඛන පවත්වා ගැනීම සඳහා කාන්තාවන් සහභාගි කරවා ගැනීම වඩාත් යෝග්‍ය වේ.

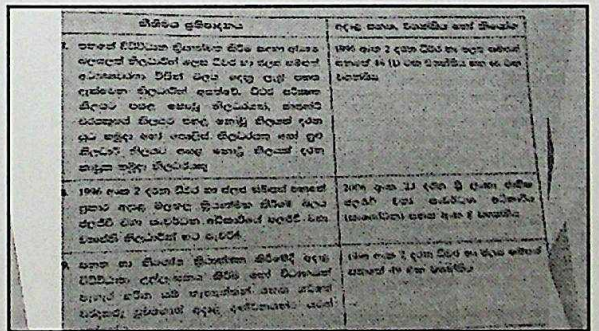
- ලේකම් සහ භාණ්ඩාගාරික තනතුරු සඳහා

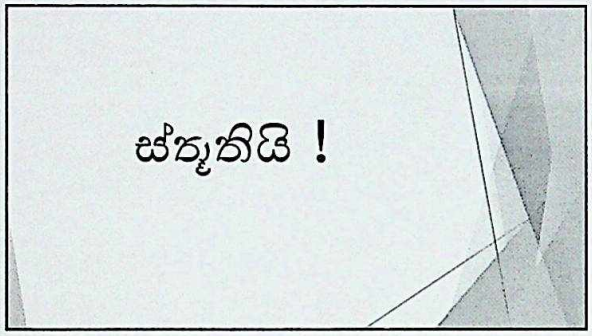
❖සමිතිය තුළ කාන්තා නියෝජනය වැඩි කිරීම සඳහා ක්‍රමවේද සකස් කිරීම

වගා පාදක ධීවර කළමනාකරණය සඳහා වන රෙගුලාසි

නිසිමිය ප්‍රතිපාදනය	අදාළ පනත, විගතිය හෝ නියෝග
1. ධීවර මෙහෙයුම් සඳහා බලපත්‍රයක් නොමැතිව ධීවර කටයුතු වල නිරතවීම තහනම්ය.	1996 අංක 2 දරන ධීවර හා ජලජ සම්පත් පනතේ 61 වගන්තිය යටතේ සඳහන් උද්ඝෝෂන
2. ධීවර කටයුතු සඳහා භාවිතා කරන දැල් යානා ලියාපදිංචි කළ යුතුයි.	1996 අංක 2 දරන ධීවර හා ජලජ සම්පත් පනතේ 15 වන වගන්තිය






ස්තූතියි !