AQUACULTURE BUSINESS DEVELOPMENT PROGRAMME

An Endline Survey of Selected Small Water Bodies (SWBs) Stocked with Nile tilapia (Oreochromis niloticus) Fingerlings

FACT SHEET | KMFRI-KEFS-SDFA & BE-ABDP- 2022

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Supported by:

Small Water Bodies (SWBs) provide a variety of livelihood possibilities globally, contributing highly to economic growth, food security, and national development. Tilapia introductions, being most successful in SWBs, were studied for the purpose of evaluating their biological, ecological, and socioeconomic status in terms of fisheries development.

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RESTOCKING SMALL WATER BODIES (SWBS)

- SWBs are the most abundant freshwater ecosystems on the planet, are crucial for freshwater biodiversity, and are increasingly recognized for their role in ecosystem service delivery (KMFRI-ABDP-SWBs, 2020; Aura et al., 2022a). SWBs also help to ensure an adequate supply of water by storing it in times of surplus and releasing it in times of scarcity, preventing or mitigating floods and contributing significantly to the efficient management of finite water resources that are unevenly distributed and subject to large seasonal fluctuations (Kenya National Assembly, 2019).
- Small Water Bodies (SWBs), including dams, were erected in ancient times for the sole purpose of water supply or irrigation.
- SWBs provide a variety of livelihood options in Kenya, contributing considerably to economic growth, food security, and national development (Aura et al., 2022b).
- They also assist societies in dealing with climate change by storing water, safeguarding people and properties from flooding, and producing cleaner electricity. As a result, they are essential components of the Big 4 Agenda and the fulfilment of Kenya's Vision 2030 Economic Blueprint (GoK, 2007).
- Fish stocking in lakes and SWBs is one of the oldest management strategies, and when done correctly and at the proper area, stocking can play an important part in SWB's supplementing capture fisheries management.
- Several tilapia species, including Nile tilapia (Oreochromis niloticus) have been successfully introduced into reservoirs in Africa, Asia, and South America (Paiva et al., 1994; Sugunan, 1997).
- The endline survey results were compared to comparable data from the baseline survey to assess the impact of the stocked fish on the water body and riparian populations.

STUDY AREA

- This study was undertaken in 15 counties where ABDP is being implemented in Western and Central regions, i.e., Homa Bay, Migori, Kakamega, Kisii, Kisumu, Siaya, Busia, Kirinyaga, Nyeri, Meru, Tharaka Nithi, Embu, Kiambu, Machakos and Kajiado.
- The SWBs which were considered for this survey included the restocked ones that had initially been assessed in the study on Carrying Capacity Assessment of SWBs for Aquaculture Production as well as others that had also been identified and restocked albeit without the initial baseline assessment.

- Under this restocking programme, forty-seven (47) SWBs were each stocked with fingerlings (in respect to their carrying capacities) in 2021. Baseline information was collected from 22 SWBs while 25 were not initially surveyed.

SPECIES RESTOCKED IN SWBs

- Tilapia introductions, being most successful in SWBs, were studied for the purpose of evaluating their biological, ecological, and socioeconomic status in terms of fisheries development. Their adoption typically results in massive increases in fishery productivity in SWBs that retain lacustrine conditions with long water retention durations.

HOW WAS THE STUDY CONDUCTED?

- The study had 3 main components: socioeconomics, water quality and environmental integrity, and fish biology. The endline study was conducted 6 months after the SWBs were stocked with tilapia based on this concept.
- The GPS coordinates of the SWBs were obtained for each site and mapped using ArcGIS 10.0. Observations on the basin/catchment's general environmental conditions, including land use patterns, substrate types, basin vegetation cover, and climatic variables, were made.
- A cross-sectional survey was undertaken in all of the selected dams, utilizing standardized semi-structured questionnaires to collect data from community/dam group leaders, group members, and managers via one-on-one interviews.
- Water quality and environment parameters, were assessed using published standard procedures and methods. Fish samples were collected to assess the aquaculture and fisheries production potential in selected SWBs (Plate 1 & 2).

Plate 1: Fieldwork sampling of the SWBs in Western and Central Kenya regions

KEY FINDINGS

- There was no restocked dam with low socio-economic index indicative of the potential of restocking of SWBs. Hitherto, majority (n = 27; 79%) of the restocked SWBs had moderate impact attributed to the inception limitations of such an activity in natural environments. However, those with high impact (n = 7; 21%) had favourable socio-economic and environmental conditions.
- Notable challenges for moderate performance of the surveyed SWBs were varied environmental challenges, moderate fish growth performances as well as the lack of skills in fishing or unavailability of fishing gear.

Plate 2: Aerial view of Twiga 1 dam, Kiambu County, Kenya. (Source: Google Earth Image)

- Table 1 shows SWBs production characteristics of Western and Central regions, Kenya, which may be attributed to variations in altitude, topography and climatic conditions.

Table 1: Socio-economics, biological and physico-chemical considerations of the dams

County	SWB/Dam	Socio-Economic index	Condition Factor (k)	Primary productivity (μgL^{-1})	D.O (mgL^{-1})	Remarks
K–isii	Ibeno	2.12	1.10	31.58 (Moderate)	7.46	Restocking of the dam had Moderate impact to community, ecological factors were optimal
	Rianyanchabera	2.20	1.09	34.57 (Moderate)	6.2	
Migori	Silanga	2.08	3.09	18.88 (Low)	6.25	
	Nyamome	2.33	1.06	-	7.28	
	Nyagesese	1.86	1.02	78.67 (High)	6.04	
Homabay	Pap Orage	2.28	1.07	105.93 (High)	5.94	
	Yongo	2.17	1.66	-	6.78	
	B1	2.24	-	-	4.45	Dam restocking had moderate impact to community, the DO levels were low but within tolerable ranges
Kisumu	Buoye	2.12	1.11	72.75 (High)	6.7	Restocking of the dam had Moderate impact to community, ecological factors were optimal
	Huma	2.10	0.99	-	5.83	Restocking had moderate impact to the community, the dam supports aquaculture; ecological parameter values are within optimal ranges.
	Kere women Group	1.88	1.15	-	5.83	
Kakamega	Lugulu dam	2.33	1.26	25.26 (Moderate)	5.61	
	Mwamba dam	2.16	-	152.76 (High)	3.53	Dam restocking had moderate impact to community, the DO levels were low but within tolerable ranges
Siaya	Uranga	1.92	-	29.04 (Moderate)	5.59	Restocking had moderate impact to the community, the dam supports aquaculture; ecological parameter values are within optimal ranges.
	Adhiri water pan	2.50	1.00	35.75 (Moderate)	3.11	Dam restocking had high impact to community, the DO levels were low but within tolerable ranges
	Nyandorera dam	2.58	1.08	84.92 (High)	3.99	

Busia	Munana	2.12	1.07	16.69 (Low)	3.81	Dam restocking had moderate impact to community, the DO levels were low but within tolerable ranges
	Bumala B dam	2.28	1.15	33.22 (Moderate)	5.88	Restocking of the dam had Moderate impact to community, ecological factors were optimal
Nyeri	Kamangura	2.18	1.30	36.04 (Moderate)	-	
	Lusoi dam	2.48	1.30	24.73 (Low)	-	
Kirinyaga	Kangai	2.88	1.28	-	6.7	Dam restocking had high impact to community, the ecological parameters were within optimal levels
	Karura	2.28	0.92	8.97 (Low)	6.4	Restocking had moderate impact to the community, the dam supports aquaculture; ecological parameter values are within optimal ranges.
Meru	Kiambogo	2.23	1.11	16.03 (Low)	-	
	Nguthiru elain'go	2.33	2.21	55.47 (Moderate)	7.2	
Embu	Ithatha dam	2.28	0.02	8.31 (Low)	4.1	Dam restocking had moderate impact to community, the DO levels were low but within tolerable ranges
	Masinga dam	2.37	-	20.88 (Low)	5.65	Restocking had high impact to the community, the dam supports aquaculture; ecological parameter values were within optimal ranges.
Tharaka Nithi	Kaiboche	2.13	1.22	5.97 (Low)	-	Restocking of the dam had Moderate impact to community, ecological factors were optimal
	Ndetha	2.30	2.13	95.47 (High)	5.2	
Kiambu	Rungiri	2.33	1.35	25.17 (Moderate)	7.82	
	Twiga 1 dam	2.73	1.13	-	5.54	Restocking had high impact to the community, the dam supports aquaculture; ecological parameter values were within optimal ranges.

Kajiado		2.27	1.36	79.52 (High)	9.60	Restocking of the dam had Moderate impact to community, ecological factors were optimal
	Jerusalem	2.50	-	96.58 (High)	3.53	Restocking had high impact to the community, the dam supports aquaculture; ecological parameter values were within optimal ranges.
Machakos	Kikambuani	2.28	0.85	15.59 (Low)	5.85	Restocking had moderate impact to the community, the dam supports aquaculture; ecological parameter values are within optimal ranges.
	Kwa mutia	2.05	1.01	50.60 (Moderate)	6.52	

CONCLUSIONS

- The average relative condition factor (Kn) of tilapia in restocked SWBs was 1.24 ± 0.53 SD, suggesting that the fish were in excellent growth condition. Water conditions also revealed that the studied SWBs had good primary and secondary production necessitating the need to invest in such systems through fish restocking.
- These findings indicate that (re)stocking the SWBs with tilapia was beneficial to the riparian communities, since the species rapidly established itself and is currently fished for household and commercial purposes at varying scales.
- Given the limited exploitation of fish in some SWBs, additional community awareness and capacity building interventions are needed to realize the enormous potential identified during the baseline study and in this survey. Riparian communities will benefit from improved livelihoods as well as food and nutrition security.

RECOMMENDATIONS

- It is recommended that the county governments, including the communities whose jurisdictions the SWBs fall under, adopt the recommendation listed for each SWB. Overall, it is recommended that additional SWBs be (re)stocked with tilapia in order to broaden the geographic scope and community coverage of aquaculture business enterprises. The suggested actions to respond to the unfavorable elements noted for each dam vary from:

- Provision of fishing equipment (crafts and gear) to SWB communities in order to encourage them to explore fishing as a form of income diversification.
- Dam fencing to prevent encroachment and possible pollution from dispersed sources.
- Desilting and reengineering dam structures and nearby ecosystems to reduce sediment and pollutant loading
- Future (re)stocking to be undertaken after considering environmental and social characteristics of each SWB and its locality.
- Further capacity building of the communities around the SWBs on integrated management and conservation of SWBs resources and fish husbandry; livelihood diversification for increased cohesiveness.
- There is need for upscaling the lessons learnt to other potential SWBs that have yet to be identified and established.

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