APPROACHES TO SELECT SUITABLE VILLAGE RESERVOIRS FOR THE DEVELOPMENT OF CULTURE - BASED FISHERIES IN SRI LANKA

BY

W.M.H.K. WIJENAYAKE

THESIS SUBMITED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

OF THE

UNIVERSITY OF KELANIYA, SRI LANKA

JULY 2009

DEPARTMENT OF ZOOLOGY

UNIVERSITY OF KELANIYA

KELANIYA 11600

SRI LANKA

Abstract

As world marine fisheries are in crisis, recent emphasis is for the development of inland fisheries. Inland waters contain major portion of one of the world's limited freshwater resources. As such, non-consumptive strategies for the development of fisheries in inland waters are imperative in view of conservation of the limited resources. In Sri Lanka, extensive availability of ancient reservoirs in good operational conditions, a symbolic feature of historical hydrologic civilization is an asset for the development of inland fisheries. Although the primary use of reservoirs in the dry zone of the country is irrigation, their role in maintaining environmental balance and providing daily requirements of rural people has made them a category of resources with multi-dimensional utility values. Most of the reservoirs in the dry zone of Sri Lanka are non-perennial in nature.

Culture-based fisheries (CBF) is a non conventional use of village reservoirs in Sri Lanka providing direct benefits to rural communities as affordable protein source, substantial income generation process, secondary use of water body and creating job opportunities. These reservoirs are highly productive in nature. Although village reservoirs are productive and potentially utilized for CBF, high degree of variation of fish production was observed. Success of the CBF in village reservoirs could be influenced by the biological parameters, environmental settings and socio-economic factors of the riparian communities. The high variability of fish production in village reservoirs possibly due to influence of such factors, demands for the need of selection of suitable reservoirs for the development of CBF for its sustainability. In the present study, an

attempt was made to develop a method for selection of village reservoirs for development of CBF in Sri Lanka.

Forty seven reservoirs, located in five administrative districts (Anuradapura, Hambantota, Kurunegala, Monaragala and Ratnapura) were randomly selected for the present study. Pre-tested questionnaire was distributed among the farmer organizations in the five districts and selection was done by evaluating the questionnaire. Basic information about the communities and the past experience of CBF was collected through rapid rural appraisal techniques. Two parallel studies on limnological aspects and socio-economic aspects of the selected reservoirs were conducted and outcomes of those studies were also used for the present study.

Of the selected reservoirs 32 reservoirs were stocked with hatchery reared fingerlings of major Indian carps, Chinese carps, Common carp, Nile tilapia and freshwater prawn in four different combinations during 2002/2003 culture period. Among 32 reservoirs stocked with fingerlings, 23 reservoirs were successfully harvested. The harvesting data from 9 reservoirs were disregarded due to false reporting and poaching. Lack of knowledge about aquaculture, poor coordination among respective government organizations, poor management of farmer organizations and illegal fishing were observed as main constraints in the CBF management. Lack of reliable information about reservoir area was a constraint for the CBF management. This was particularly so because stocking density (SD) and CBF yield are determined for effective area of reservoir (i.e., 50% of the reservoir extent at the full supply level). SD was significantly related to fish yield according to a second order polynomial model ($p<0.05$). According to a parallel study, chlorophyll-a content of reservoirs was significantly related to fish

yield ($p<0.05$). Reservoir area and aquatic plant cover showed negative relationship with the total fish yield ($p<0.05$). Negative influence of aquatic plant cover on the chlorophyll-a concentration ($p<0.1$) was observed in village reservoirs.

Potential use of satellite remote sensing (SRS) for demarcating reservoir area was observed and the relationship between actual reservoir areas demarcated with Geographical Positioning System (GPS) was significantly related ($P< 0.001$) to the reservoir area demarcated with SRS. Also the SRS techniques were successfully used to quantify the extent of aquatic plant cover in village reservoirs which had negative influence on CBF. Geographical information system (GIS) was used to demarcate the catchment area and catchment land uses of the reservoirs from 1:50000 land use maps published by the Survey General Department of Sri Lanka. Land use patterns of micro-catchments; forest area and scrub land area were significantly related to fish yield ($p<0.05$) providing evidence of importance of the catchment for successful CBF production.

Water availability of reservoirs was predicted by the hydrological simulation model, HCE-HMS 3.0.1. Percentage reservoir volume was positively related to fish yield and the relationship being, Ln Yield = 0.0438 (% volume) + 2.209 ($r = 0.5478$, $p<0.05$). This has a potential to use for CBF planning as reservoir water availability can be predicted before stocking. The percentage volume of the reservoir was calculated from the cumulative rainfall, this has potential value for development of CBF without impacting paddy cultivation.

Classification of reservoirs was done through analytic hierarchy process (AHP) based on weighted linear combination. Relative importance of different factors