EMPIRICAL MODELS FOR FISH YIELD PREDICTION IN SELECTED RESERVOIRS IN THE DRY ZONE OF SRI LANKA

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ABSTRACT

Sri Lanka (6-10° N, 80-82° E; Area 65,621 km^2) has no natural lakes, except for flood plains (villus) in some rivers. It has more than 10,000 ancient and newly built reservoirs with a total extent of about 170,000 ha. Almost all the reservoirs are situated in the dry zone of the country, which receives less than 200 cm of annual rainfall, and the primary use of them is irrigation.

The inland fishery of the country at present is almost entirely dependent on the exotic cichlids (*Oreochromis mossambicus* and *O. niloticus*) in the multitude of reservoirs, and it accounts for about 11% of the country's total annual fish production of 292,000 tonnes. Some evidence is found that the fish stocks of some perennial reservoirs are overexploited. After discontinuation of state patronage for inland fisheries development in 1990, annual inland fish production has declined from 39,000 tonnes to 12,000 tonnes within a span of four years. This indicates that the existing management strategies are inadequate for sustainable development of the inland fisheries. However due to scattered nature of the perennial reservoirs throughout the dry zone in the country, investigation of fisheries of individual reservoirs with a view to developing management plans is practically difficult. The present study was conducted to develop suitable yield predictive models for the reservoir fishery of Sri Lanka. Basic limnological parameters of 11 major reservoirs were determined and, hydrological and meteorological data were obtained from the Irrigation Department and Meteorological Department respectively. From land-use maps published by the Survey Department, different land-use types of the catchment area (CA) of individual reservoirs were quantified using Geographical Information Systems (GIS).

Based on the data on fish catch and effort collected at least for 20 days a month, mean annual fish yield (FY) in kg/ha and total fishing intensity (FI) in boat-days/ha were estimated using reservoir area at FSL (RA_{FSL}). Due to the fluctuations in water level, reservoir surface area changes considerably. As such FY and FI were also estimated for mean reservoir area (RA_{MEAN}) in each reservoir. The annual mean FY and FI estimated on the basis of RA_{FSL} were 138.3 kg, ha^{-1} and 10.3 boat-days, ha^{-1} respectively. FY and FI estimated on the basis of RA_{MEAN} were 249.0 kg, ha^{-1} and 16.1 boat-days, ha^{-1} respectively. FY is found to be linearly related to FI (estimated using RA_{MEAN}) according to the equations, FY = 12.539 FI + 46.746 ($r = 0.78$; $p<0.01$).

Of the several edaphic factors influencing FY in Sri Lankan reservoirs, draw-down area and flushing rate were strongly correlated with FY. As reservoir productivity is found to be influenced by the ratio of catchment area to reservoir capacity, this ratio can be used as a predictor variable of FY. Of the different land-use types of the catchment area, which were quantified using GIS, only forest cover (FC) and shrub land (SL) either singly or in combination (FC+SL), as ratios to RA (km^2) or RC (km^3) were significantly correlated with FY. The statistical relationships are given below,

$FY_{MEAN} = -529.46 + 111.53 \ln (FC/RC)$ ($r = 0.905$; $p < 0.005$)

$FY_{MEAN} = -333.53 + 82.965 \ln (SL/RC)$ ($r = 0.858$; $p < 0.02$)

$FY_{MEAN} = -544.05 + 102.17 \ln [(FC+SL)/RC]$ ($r = 0.920$; $p < 0.005$)

These models can be used to estimate fish production potential in irrigation reservoirs of the dry-zone of Sri Lanka based on the data on catchment characteristics as quantified by GIS. The statistical relationship between FY and FI can then be used to determine optimal fishing intensity in Sri Lankan reservoirs.

Principal component analysis also indicated that the ratios of FC and SL to RC were the most important variables influencing fish yield in reservoirs. These empirical models are shown to predict FY in five reservoirs in the dry zone of Sri Lanka close to the actual yields. As land-use types can be quantified using GIS, its application is a promising means for deriving yield predictive models in reservoirs. Findings of the present analysis will therefore be useful for developing yield predictive models for reservoir fisheries in other part of the world.

The present study indicates that the total environment including reservoir ecosystem and its catchment should be managed in order to realize the potential yield. As such it appears that through strong co-ordination between all the authorities responsible for the control of irrigation, wildlife conservation, land-use management and fisheries development, fish yield can be augmented in shallow, irrigational reservoirs of Sri Lanka.