Relative Yield Indices of Challawa Gorge Dam, Kano State, Nigeria

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ARTICLE INFO

Article No.: 111817167

Type: Research

DOI: 10.15580/GJBS.2017.6.111817167

Submitted: 18/11/2017

Accepted: 22/11/2017

Published: 29/11/2017

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Keywords:

fish potential yield morpho-edaphic index, conductivity, mean depth, dam, Relative Yield index

ABSTRACT

Reservoir morpho-metrics and ionic input of Challawa dam, Kano State (Nigeria) were applied to estimate the potential fish yield using morpho-edaphic index (MEI). Physico-chemical parameters of the reservoir were sampled monthly from three stations (Feginma, Sakarma, and Turawa) for the period of six months (March to August, 2017) using standard methods. Potential fish yield estimates of the three sites were determined using the values of the Physico-chemical characteristics of the reservoir with the relationship $Y = 23.281 \text{ MEI}^{0.447}$, where Y is the potential fish yield in Kg/ha, MEI is Morphoedaphic index (given in $\mu\text{S/cm}$) which was obtained by dividing mean conductivity of the reservoir by mean depth. The potential fish yield estimates of the three sites are 88.05, 98.56 and 111.12 Kg/ha. The relative yield index (RYI) which is the ratio of estimated yield with angler harvest, was determined using the relationship $\text{RYI} = Y_{\text{obs}}/Y_{\text{est}} \times 0.75$, where Y_{est} is estimated potential yield in kg/ha and Y_{obs} is anglers harvest in Kg. The anglers were 53.3, 65.7 and 57.05 Kg respectively, which implied that the relative yield indices were 44.5%, 49.9% and 38.5%. The results of this study showed that, the reservoir's exploitation level was moderate ($\text{RYI} \leq 1$). Good ionic content, good dissolved oxygen levels, good pH, low-levels of pollution, accounted for the high estimates of the fish yield. Therefore effective management system, implementation of good fishing regulations and practices should be implemented.

INTRODUCTION

The natural aquatic systems have witnessed changes in stock diversity and abundance, genetic structure and age composition of stocks resulting from structural changes in habitat, food composition and uncontrolled exploitation (Omowumi, 2013). Fisheries resources are fast reducing in Nigeria due to over exploitation, adequate knowledge of species composition, relative abundance of her water bodies must be understood and actively pursued (Ayamre & Ekelemu, 2016). West Africa is blessed with abundant water confinements with diverse applications and utilization including fish production, besides other primary uses, these practices have become common practice in many countries. Several limnological parameters such as conductivity, total dissolved solids, water quality parameters and reservoir morphometry have been used in estimating potential fish yields from reservoirs (Alhassan, 2011). The morpho-edaphic index (MEI) developed by Ryder (Ryder, 1982) is the most widely accepted method used for estimating fish potential yield.

As a measure of exploitation level; the relative yield index (RYI) defined by Adams and Olver (Baigún *et al.*, 2006) was used to assess the fish stock exploitation level of the dam. The RYI is the ratio between the observed catch and the estimated potential yield. This present study aims at determining the potential fish yield of the Challawa Dam, using morpho-edaphic index and limnological parameters and exploitation level using relative yield index.

The present study is to determine the potential fish yield and exploitation levels of Challawa dam.

MATERIALS AND METHOD

The study was conducted in Challawa gorge dam. The dam is located at 8006'58.04"E latitude 11041'21.95"N longitude (Google Earth, 2016) in Karaye Local Government of Kano State in the Northwest of Nigeria, about 90 km southwest of Kano city.

In this study, electrical conductivity and water depth were considered as Physico chemical parameters. Conductivity was measured using a Hanna portable device (combo pH/EC/TDS/T°C model HI9835), mean values of conductivity were taken and used. Mean depth was determined using a graduated van-vie from a dugout canoe. Fish samples were collected from the

catches of the fishermen using funnel traps, gill nets and cast nets. The sampling was done for the period of six months from March to August, 2017. The samples were taken to the laboratory and each individual identified using keys by Reed *et al.*, (1967). Also, total weight of all catches of fishermen were determined using a weighing balance in the field and readings were recorded.

Estimates of the potential fish yield were obtained using the Physico-chemical characteristics of the reservoir and the relationship

$$Y = 23.281(\text{MEI})^{0.447} \quad (1)$$

Where Y is the potential fish yield in kg/ha, MEI is morpho-edaphic index, which is given in $\mu\text{S/cm}$ and is estimated by dividing the mean conductivity by the mean depth Ryder *et al.*, (1974).

As a measure of exploitation level the relative yield index (RYI) defined by Adams and Olver (Baigún *et al.*, 2006) was used. The RYI is the ratio between the observed catch and the estimated potential yield and thus,

$$\text{RYI} = Y_{\text{obs}}/Y_{\text{est}} \times 0.75 \quad (2)$$

Where; Y_{obs} = observed yield (which was obtained from the total weighted fish samples obtained in the field), Y_{est} = estimated potential fish yield (obtained using MEI).

RESULTS AND DISCUSSION

The data obtained from the readings of conductivity shows that site 2 (Sakarma) recorded the highest conductivity value with $90\mu\text{SCm}^{-1}$, least value was recorded in site 3 (Turawa) having $85.2\mu\text{SCm}^{-1}$ (Table 1). The table also, revealed that site 3 has the highest MEI value with 4.8, this was followed by site 2, site 3 recorded the least MEI value with 3.8. The potential fish yield is also presented on table 1, this estimates show that site 3 recorded 111.12 Kg which is the highest, least potential yield estimate is 88.05 Kg as recorded in site 1. Anglers harvest shows that site 2 has the highest harvest, followed by site 3, the least harvest was recorded in in site 1 (Table 1). Relative Yield Index (RYI) and RYI (%) revealed that site 2 has the highest values with 0.499 and 49.9%, site 3 recorded the least with 38.5% respectfully (Table 1).

Table 1: The characteristics of the study sites and the potential yield indices

Characteristics	Study sites		
	Feginma	Sakarma	Turawa
Geographical Coordinates	N 11° 39' 28.1" E 007° 58' 18.9"	N 11° 39' 54.3" E 008° 00' 61.1"	N 11° 40' 52.4" E 008° 02' 31.9"
Elevation (M)	518	527	518
Mean Depth (M)	4.53 ± 0.5	3.45 ± 0.8	2.52 ± 0.5
Conductivity (μS/cm)	87.5	90.2	85.2
Morpho Edaphic Index (MEI)	3.8	4.2	4.8
Potential Fish Yield (Kg)	88.05	98.56	111.12
Anglers Harvest (Kg)	53.3	65.7	57.05
Relative Yield Index (RYI)	0.445	0.499	0.385
Relative Yield Index (%)	44.5	49.9	38.5

DISCUSSION

Field yield

The fish potential of the three sites of the Challawa dam ranged between 88.05 to 111.12 Kg, the mean of this distribution stand at 99.25 Kg. This agrees with the statement of (Mustapha, 2009) who stated that shallow tropical reservoirs are more productive than deeper lakes, hence the fish yield from Challawa dam obtained is similar to the ones found from the works of other researchers such as Oyun reservoir (Mustapha, 2008) in Nigeria, Botanga (86.98 kg/ha) and Libga (97.19 kg/ha) reservoir (Quarcoopome & Amevenku, 2008) in Ghana. The fish potential yield of the Challawa dam is however, higher than the yield of the other tropical reservoirs such as Kubani (38 kg/ha) (Balogun & Aduku, 2004), Kainja dam (Ibrahim, Auta, & Balogun, 2009).

The high potential yield may be as a result of high conductivity with low depth, hence according to (Edward, 2013) shallow reservoirs in the tropics are said to be more productive than those in the temperate regions.

Relative Yield Index

The relation yield index of the three study sites fall within a range of 0.385 to 0.499 which yielded a percentage range of 38.5% to 49.9%, this upper limit coincides with the findings of Jenkins (1982) in Baigún *et al.*, (2006) but however, it is lower than the result obtained by Mosa and Regidor (2003) with 80% as cited by (Baigún *et al.*, 2006). Attributable to the dynamics of Relative Yield Index includes the differences in salinity of water, conductivity, species biomass and biomass accumulation, food conversion efficiencies, biomass composition of estimated species, and potential fish yield estimates. The Relative Yield Index of the Challawa dam cannot be expressed as being overexploited (RYI<1). And, indicated that the dam is rich. According to Adams and Olver (1977) RYI value less than 1 indicates moderate exploitation of fish stock.

CONCLUSION

The mean fish potential yield of the three study sites was estimated to be 99.25Kg/ha with relative yield intensity of 0.358, 0.45 and 0.49 that account for 38.5%, 45.0% and 49.9% exploitation indices. This implies that the reservoir has a good fish stock potential with a moderate level of exploitation. Also, all the Physico-chemical parameters of the reservoir studied during the sampling period fall within the acceptable range.

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