

SUCCESS STORIES OF FISHERIES MANAGEMENT IN SMALL RESERVOIRS



CENTRAL INLAND CAPTURE
FISHERIES RESEARCH INSTITUTE

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ALIYAR RESERVOIR

Aliyar reservoir was created across Aliyar river in Bharathapuzha basin in Tamil Nadu. It is situated between 10°15' and 10°30' N and 76°50' and 77°10'E and covers 646 ha at the FRL of 320.04 m above MSL. Aliyar reservoir was studied by CIFRI for 11 years (1982-92).

The basin soil is acidic (pH 6.42), comprising sand (24.1%) silt (29%) and clay (46.99%) with levels of available phosphate nitrogen and C/N ratio indicating medium level of productivity.

The characteristic feature of the reservoir is the *Microcystis* sp. blooms during low water levels. The blue green algae constitute 84.32% of the total plankton of the reservoir.

The average rate of energy transformation in the reservoir is estimated at 13,580 cal m⁻²day⁻¹. The incident solar energy of visible light at Aliyar reservoir works out at 2150000 cal m⁻²day⁻¹. The peak yield from the reservoir @ 193.58 kg ha⁻¹ in 1989-90 reveals a conversion efficiency of 0.47% of the available energy in the reservoir. The rate of energy conversion at primary producer level as well as fish production level at Aliyar is considered higher than in any other Indian reservoir. The fish fauna of the reservoir consists of 40 species besides seven stocked species.

A direct outcome of the adoption of scientific management practices in Aliyar was a substantial hike in fish yield (193.58 kg ha⁻¹) from 77.75 kg ha⁻¹ with major carps constituting 84.04 to 96.25%. This reservoir acted as testing ground for the field trials of scientific management package developed by CIFRI and the yield optimization achieved thereof is a standing testimony to the validity of the package.

THIRUMOORTHY RESERVOIR

Thirumoorthy reservoir was created across Palar river and Nagappa Naicker Odai in Bharathapuzha basin. It is a small reservoir located at 10°28' N and 77°09' E, in Tamil Nadu. It has a catchment area of 8029 ha. It has a water spread of 388 ha at FRL and 79.88 ha at DSL. CIFRI scientists conducted investigation in this reservoir during 1991 to 1997.

The soil was acidic (6.5) and improved to the alkaline side in subsequent years. The low available phosphorus content of the soil (0.2 - 0.8 mg 100 g⁻¹) suggested poor productivity.

The plankton status showed a dominance of phytoplankton represented by Bacillariophyceae, Chlorophyceae and Myxophyceae. The zooplanktons were dominated by Cladocerans. The benthos were mainly constituted by *Chironomus* sp., *Chaoborus* and oligochaetes.

The average fish production potential at 0.5% of energy conversion works out to 268.1 kg ha⁻¹ yr⁻¹. The fish faunal species were 28 in number and revealed poor species diversity.

Though the ecological investigations indicated low to medium production potentiality of the reservoir, the fish yield could be substantially increased by the scientific techniques adopted by CIFRI in this reservoir since 1991. The fish yield increased steadily from 1991 onward and reached an all time record of 49.9 t (213.4 kg ha⁻¹) in 1996-97. The stocked species formed the major fishery (88.5-96.4%) of the reservoir. *C. catla* and *C. carpio* stocked at a higher rate were the maximum contributors.



Fish seed raised for reservoir stocking



Netting of fishes in reservoir



Stocked species forming the major fishery



Harvesting of stocked fish

MARKONAHALLI RESERVOIR

Markonahalli reservoir (12° 55' N, 76° 56' 15" E) is a minor irrigation project constructed on the river Shimsha in the district of Tumkar, Karnataka. The reservoir has a catchment area of 4103 km³ and a capacity of 68 million m³ at the FRL of 731.57 m above the MSL. The reservoir area at FRL is 1336 ha and at lowest storage level, is reduced to 128 ha. This reservoir was investigated by CIFRI during 1989 to 1995.

Soil texture is sandy loam, with slightly alkaline pH. High levels of alkalinity and specific conductivity indicate higher levels of photosynthetic activity. Primary productivity levels ranged from 62.5 to 288.46 mg cm⁻³ hr⁻¹. The standing crop of plankton is modest. Thirty one genera of phytoplankton belonging to Cyanophyceae, Chlorophyceae, Bacillariophyceae and Dinophyceae are recorded from the reservoir. Zooplankton is rich in diversity and abundance. The reservoir has a rich macrophytic community. Only twenty eight species of fishes out of which twenty three are indigenous, four stocked and one exotic species have been recorded.

Investigation conducted by CIFRI has shown the yield potential of Markonahalli reservoir at 160 kg ha⁻¹ for FRL area. The fish yield has touched 75 kg ha⁻¹ in 1993-94 from the earlier level of 5.5 kg ha⁻¹ with stocking support of only catla and rohu in 1991. The potential yield can be achieved with sustained stocking @ 400 ha⁻¹ and utilization of the aquatic vegetation by addition of fishes like *P.pulchellus*.

GULARIYA RESERVOIR

It is a small reservoir of the Gangetic plain situated in Allahabad district, Uttar Pradesh and created over a small rivulet Gulariya. The reservoir covers 300 ha at FRL and 6.7 ha during summer. It dries up completely during extreme summer. The reservoir has a gross storage capacity of 9.3 million m³ at FRL. CIFRI scientists conducted investigation in the reservoir during 1978 to 1980.

The soil of this reservoir is predominantly sandy with some clay and silt. Loss of nutrients in the reservoir through irrigation channel is replenished from allochthonous sources.

Annual average production of carbon, estimated on the basis of primary productivity is 2266 to 2462 t yr⁻¹. The fish food organisms are abundant. Green algae dominate followed by blue greens. Occasional algal blooms and luxuriant growth of periphyton and macrophytes indicate organic environment.

With much of its nutrients derived from allochthonous sources. Gulariya is placed in the category of lotic reservoirs where morphoedaphic approach has limited application.

CIFRI through its investigations calculated the stocking rate at 500 fingerlings ha⁻¹ presuming a yield potential of approx. 200 kg ha⁻¹. In 1977-78, 75800 fingerlings were stocked which resulted in a yield of 15.15 t. This along with the residual stock netted out during the year amounted to 22 t *i.e.*, 150 kg ha⁻¹. Considering that the total catch from the reservoir ranged from 0.076 to 8 t during 1971-72 to 1976-77, there has been a three fold hike in the production rate after introducing the new management package.

BACCHRA RESERVOIR

Bachhra reservoir was created on the small rivulet Bacchra in Allahabad district, Uttar Pradesh. The reservoir covers an area of 140 ha at FRL of 111 m above MSL and a mean depth of 5.22 m. At full storage the reservoir holds 7.42 million m³ of water which comes down to 0.03 million m³ at DSL. During dry season, the water spread becomes 4 ha in area. CIFRI scientists conducted investigation in the reservoir during 1985 to 1988.

The reservoir can be placed in the eutrophic category based on a number of physico-chemical attributes. Due to nutrient enrichment from the rain washings, the reservoir is rich in TDS, nutrients and mineral salts and the water is conducive for primary productivity.

The estimated annual primary production in terms of carbon varies from 1250 t to 1402 t. The plankton community of the reservoir is rich with the total count of 4762 units l⁻¹ during during 1984. The rate of colonization of periphyton and benthic macrofauna on available substrata is good.

The indigenous ichthyofauna of the river consisted mainly of rheophilic species of low population density and after impoundment the lentic body harbours 51 species of fish.

The fish yield potential of the reservoir was calculated as 240 kg ha⁻¹ @ 1.2% of the primary production against which an actual yield of 139 kg ha⁻¹ (10 t) was obtained in 1988. Mrigal and calbasu formed 29.54% and 31.87% of the catch respectively. This higher yield obtained in 1988 is the result of the scientific methods as advocated by CIFRI viz., optimum stocking density and maintenance of rational stocking and harvesting schedule.

BAGHLA RESERVOIR

Bhaghla reservoir has been created across the rivulet Barica in Allahabad district, Uttar Pradesh. The reservoir covers 250 ha at the FRL. The water retention capacity is 9.58 million m^3 at FRL and 0.141 million m^3 at DSL. CIFRI scientist conducted investigations here from 1988 to 1991.

The soil is alkaline with high specific conductivity of 322.5 μmhos . Nutrients as well as the total ionic concentration indicate eutrophic conditions. The mean gross primary productivity was estimated at 98.58 $\text{mgCm}^{-3}\text{hr}^{-1}$ in 1998-90 and 110.47 $\text{mgCm}^{-3}\text{hr}^{-1}$ in 1990-91.

The rich nutrients in water and soil enable luxuriant growth of plankton, benthos, periphyton and aquatic macrophytes. Average plankton density varied from 1484 to 4363 unit l^{-1} for the three years under investigation. Cyanophyceae dominated the phytoplankton population. The density of benthic organisms ranged from 976 to 2132 $\text{individuals m}^{-2}$, and periphyton density was estimated at 144 to 545415 $\text{individuals cm}^{-2}$ during the period.

The fish yield potential of the reservoir has been estimated to range from 184 to 210 kg ha^{-1} . The fish yield obtained during the period of investigation by CIFRI ranged from 102 to 106 kg ha^{-1} .

YERRAKALVA RESERVOIR

Yerrakalva reservoir has been formed across the rivulet Yerrakalva in Khammam district of Andhra Pradesh. It is situated between the geographical ordinates $81^{\circ}15'22''$ E and $17^{\circ}5'44''$ N. The reservoir has a catchment of 1073 km^2 and the water spread area at FRL is 8100 ha and the mean area is 1139 ha . CIFRI scientists conducted investigation in this reservoir during 1993 to 1995 and 1998-1999.

Though the reservoir is medium productive, it has tendency to be high productive in view of the soil pH reaching over 7.5, available nitrogen over $60 \text{ mg } 100 \text{ g}^{-1}$, alkalinity above 90 to 110 mg l^{-1} and specific conductivity $> 200 \text{ mmhos/cm}$. The rate of carbon fixation was high with values recorded at the surface and in sub surface between $41.66 \text{ mgCm}^{-3}\text{hr}^{-1}$ and $104.16 \text{ mgCm}^{-3}\text{hr}^{-1}$. Thirteen species of fish have been recorded from the reservoir along with freshwater prawn *M.malcolmsonii*.

The productive potential of the reservoir was estimated at 87 kg ha^{-1} . As a result of the management policy of CIFRI which advocated stocking of major carps, catla and rohu the impact has been felt on the productivity of the reservoir. The fish yield during 1998-99 has been estimated at 89.5 kg ha^{-1} as against 56 kg ha^{-1} during 1993-94 and 51 kg ha^{-1} during 1994-95. The impact of stocking about 4 lakhs of catla and 2.7 lakhs of rohu is clearly seen in the enhanced yield of these species which were not represented earlier in the catch.

BHATGHAR RESERVOIR

Bhatghar reservoir is mainly rainfed with a catchment area of 336 km. It is situated across the river Yelwandi at 18°10' N and 73°52'E in Pune district of Maharashtra. The dam covers upto 2800ha at FRL and shrinks to 1500 ha at the lowest level. This reservoir was studied by CIFRI during 1987-1992.

The soil and water quality do not indicate a high productivity. The average gross primary productivity varied from 20.83 to 145.80 ($71.20 \text{ mg Cm}^{-3-1} \text{ day}^{-1}$).

No aquatic vegetation and benthic organisms were present. The plankton community of the reservoir confirms the oligotrophic nature of the water body. The phytoplankton was represented by Chlorophyceae, Myxophyceae, Bacillariophyceae, Desmidaceae and Dinophyceae while zooplanktons were represented by Rotifera, Cladocera, Copepods and Protozoa.

The total fish landings from the reservoir during 1987 were estimated at 24.7 t which declined to 12.7 t in 1988.9 t in 1989 and 1990 and increased to 12.1 during 1991. The mean fish production was 13.5 t and the yield 4.8 kg ha^{-1} .

Based on the rate of primary energy fixation, a fish yield potential of 65 kg ha^{-1} has been estimated for this reservoir. As such a stocking rate of 250 fingerlings ha^{-1} has been proposed. Sustained stocking of adequate number of fingerlings holds the key for efficient management of the reservoir.

GOVINDGARH RESERVOIR

Govindgarh is a small irrigation reservoir across the river Bichia in district Rewa, Madhya Pradesh. The 307 ha reservoir has a small catchment of 25.12 km². It has a live storage capacity of 8.69 million m³. CIFRI scientists conducted investigation in this reservoir during 1967 to 1972.

Physico-chemical profile of the reservoir present a rather enigmatic picture with certain parameters indicating an oligotrophic regime while others pointing towards eutrophy. The rate of primary productivity, though not very high, does not portray a picture as bad as reflected by some of the chemical indicators. Annual average gross production of carbon for the years 1968 & 69 was estimated at 1.104 & 1.482 g Cm⁻³ day⁻¹ respectively. This is equal to 404 & 541 g Cm⁻³ for two years respectively. Mean density of plankton was good ranging from 1030-1185 units l⁻¹ during 1968,69, the share of phytoplankton being 898 and 1048 unit l⁻¹ respectively.

According to various estimates the fish production potential of the reservoir is estimated at 220.5 kg ha⁻¹ and the actual yield obtained is 59.64 kg ha⁻¹. There is need to increase the stocking rate from the present level to enhance productivity. Moreover the stocking and harvesting schedule needs to be evolved, allowing the stocked fish to grow for a maximum period of time during non-overflow months.

KULGARHI RESERVOIR

This reservoir of 193 ha is situated across the seasonal stream Durha nalla of the Ganga basin in Satna district, Madhya Pradesh. The catchment covers only 27.69 km². CIFRI scientists investigated this reservoir during 1968 to 1972.

Despite its small size and low mean depth (4.5 m) the water has a low productivity. The catchment with acidic soil, low calcium carbonate (2.28%) and organic carbon (0.61%) is very poor in nutrients P and N. The water quality is categorised as medium productive.

The reservoir has a fairly good plankton production with 75% (by number) of phytoplankton and a high rate of primary productivity. Both plankton and carbon fixation rate go up substantially during summer months.

The fish yield potential of the reservoir is estimated at 45.1 kg ha⁻¹. The reservoir fish production ranged from 363 kg to 812 kg with an average yield of 7.4 kg ha⁻¹.

Kulgarhi is the first reservoir in India where *H.molitor* was first introduced on experimental basis. The growth rate registered by recovered silver carp was remarkable. The fastest being 404 mm in 293 days, though on evaluation of growth performance of catla and silver carp it showed silver carp negatively affected growth of catla in the reservoir.

LONI RESERVOIR

This reservoir is 350 ha located in district Sankargarh, Madhya Pradesh and has a medium soft nutrient poor water with moderate primary productivity and plankton count.

Macrophytes, weeds associated fauna and the benthic invertebrates form the mainstay of biotic communities through which energy transformation takes place. *Hydrilla*, *Vallisneria*, *Najas* and *Potamogeton* are particularly abundant among the aquatic plants which colonize the littoral region upto 31.5 m depth during post-monsoon months. The nutrients brought in along with the monsoon inflow are better utilized by the aquatic plants, than the plankton. There is an equally rich community of benthic macrofauna; chiefly represented by molluscs, annelids and insect larvae. CIFRI scientists investigated the reservoir during the period 1967 to 1972.

Commercially important fishes of the reservoir comprise small clupeids, detritophagous and predatory catfishes. The fish yield potential of the reservoir is estimated as 35.74 kg ha⁻¹. The per hectare yield from the reservoir was estimated to be 26.76 kg ha⁻¹ which is a definite improvement over that estimated during 1967 to 1970 (14.73 kg ha⁻¹).