UTILIZATION OF RESERVOIR DAMS FOR FISH PRODUCTION IN MARAGWA AND THIKA DISTRICTS

J. Jumbe[1], B. M. Mwangi[2] and L. Maina[3]

INTRODUCTION

Maragwa and Thika districts have a large number of water reservoirs, constructed during the colonial times, for purposes of storing irrigation water. The reservoirs range in size from less than a hectare to several hectares and have a storage capacity ranging from 25,000 to 80,000 cubic meters. The reservoirs are found on coffee, tea, pineapple and sisal estates. They are used mainly for supplying water for irrigation during dry season and also for domestic and livestock watering. In a review on the utilization of dams and reservoirs in Africa, Bernaccek (1986) observed that they have a high potential for fisheries production. Achieng (1994) and Coche *et al.* (1994), in a review of Aquaculture Development and Research in Kenya, recommended the making of an inventory of the dams and reservoirs. They also recommended that research be conducted to facilitate their utilization for fish production. Most of the dams and reservoirs in the two districts have stocks of fish but the status of these fish stocks has not been investigated hence their production potential remains largely unknown and un-utilized.

Fish species composition and the water quality and condition are the most important factors influencing fisheries productivity in aquatic systems (Ryder, 1965). Little is known about the fish species composition of these dams neither has their water quality and condition been assesed. Ekpenyong (1991) listed conductivity, pH, calcium, magnesium, sodium, potassium, bicarbonates, sulphate, chloride, iron, silicate, nitrate and phosphate as some of the most important chemical parameters influencing fisheries productivity in small water reservoirs. High nutrient levels promote the growth of phytoplankton, which in turn enhance zooplankton growth, which both form food base for the fish (Bowen, 1982). Oglesby (1977) found a close relationship between fish yields with lake phytoplankton standing crop production and morphoedaphic factors (TDS, conductivity and pH). Nutrients (phosphates and nitrates) enter these reservoirs through surface runoff from the agricultural farmlands thus increasing primary productivity, and consequently zooplankton, which in turn increases benthic invertebrate biomass and fish (Boyd, 1982).

When suitable combinations of fish species are stocked in the dams and reservoirs based on their diet, it is possible to utilize all the food niches. Fryer and Iles (1972) reviewed the feeding ecology of cichlid fishes of Africa and noted that there are over 15 types of feeding behaviour, including phytoplankton, zooplankton, benthic and macrophyte feeders. The fish stocks of these dams and reservoirs currently consist of "Tilapiine" fishes, Catfishes and some predator species. One of the objectives of the current study is to examine the faunal and floral species composition and abundance in order to find the most appropriate combinations and to identify any stocking needs.

The local communities in the study area have not actively participated in the exploitation of the fisheries resources of the dams and reservoirs largely due the lack of knowledge and cultural factors. They will be mobilized, enlightened and organized into groups, which will be trained in fishing techniques, fish preservation and marketing. The fish, which will be sold locally, will improve their income base and protein intake in their diet.

Necessity and relevance of the research

Fish production in Kenya is mainly from inland fresh water lakes, the sea and aquaculture production in kitchen ponds. Most of the inland lake fisheries are currently overexploited and there is a need to find alternative sources of fish. The current marketing system and prices do not favour the poor rural populations as they cannot afford the cost and the distribution outlet channels do not cover many rural centres. Most of the rural residents of Thika and Maragwa Districts, where the research project will be conducted, live below the poverty line and do not have easy access to fish nor can they afford to buy the fish from the lakes to supplement their protein intake.

[1] *Department of Biological Sciences, Kenyatta University*
[2] *Department of Biological Sciences, Kenyatta University*
[3] *Department of Sociology, Kenyatta University*

The presence of a large number of water reservoirs and dams in the two districts, when stocked with suitable fish species and exploited by the communities, will provide an invaluable source of fish for the benefit of all. The current state, where reservoirs and dams, which are currently under utilized for fish production will be reversed and they will provide a reliable source of fish and income for the residents as has been done in other countries, such as Zimbabwe, Zambia and South Africa. In those countries dams are now extensively used both for irrigation, recreation and fisheries production (Marshall and Maes, 1994).

METHODOLOGY

Field studies will be conducted in Thika and Maragwa Districts of Central Province, Kenya. Preliminary surveys will be carried out on their limnological (waters' physical and chemical conditions, faunal and floral) status, fish species composition and diets, their biology and stock densities. A baseline study will be conducted to assess the status of fish availability and consumption and the determining factors. Later, the community will be mobilized and trained in fisheries exploitation and utilization techniques. The work will be carried out in collaboration with the Fisheries Department (GOK).

Reservoir Inventory

A comprehensive inventory of all the dams and reservoirs in the two Districts will be compiled from data collected in the field, the Water Dept., Fisheries Dept.(GOK) and any other documented sources. Data will include: Location, Size and Morphometry, Catchment area activities, Limnological data, Uses and conservation status, Species records of flora and fauna.

Limnological Survey

The limnological survey will encompass the following activities:
a) Water Quality Measurements

i) Morphometric characteristics

A survey will be carried out to measure the areas, maximum lengths and widths, depths and water capacity of representative reservoirs as detailed in Wetzel and Likens (1990). The data will be useful in estimating fisheries productivity in the dams using the Morpho Edaphic Index (Ryder 1965).

ii) Physical characteristics

Turbidity which is one of the most important physical characteristics used, as an indicator of pond productivity, will be measured indirectly using a secchi disc as detailed in APHA (1992). The secchi disc will be slowly immersed in water and the depth at which it disappears and reappears noted. The average of the depths will be taken as the transparency depth. Water temperature will be measured using an mercury thermometer.

iii) Chemical characteristics

The chemical characteristics that will be measured will include dissolved oxygen, nutrients (nitrates and phosphates), major cations (Na^+, Ca^{2+}, K^+ and Mg^{2+}), anions (HCO_3^-, SO_4^{2-} and Cl^-) and selected heavy metals (Pb^{2+}, CU^{2+} and Fe^{2+}). Dissolved oxygen will be measured using the Winkler method (APHA 1992).
Total phosphorous will determined using the ammonium molybdate method, while nitrogen will be determined through sodium-salycilate method (APHA 1992). Major cations and the selected heavy metals will be measured spectrophometrically using atomic absorption spectrum (AAS). Other chemical parameters to be measured will include pH, conductivity and TDS using appropriate probes.

iv) Faunal and flora

Phytoplankton and zooplankton composition and abundance in reservoirs will be analyzed by filtering a sample of water taken from the surface with a bucket of 5 litres through a sieve of 0.063 mm mesh. The filtrate

will be preserved to lugol's iodine prior to observation. Benthic invertebrate composition and abundance will be assessed from 5 bottom sediment samples from each reservoir collected at random using an Ekman grab sampler. Sediment samples will be washed through sieves of 100 mm mesh. Invertebrates will be sorted to genus and species level where possible. The information obtained will form a very strong basis for the choice of the appropriate fish species for stocking.

Fish Studies

i) Fish species composition

A survey to determine the fish species presently existing in the water reservoirs will be carried out through experimental gill net fishing using fleets of mono and multi filament nylon gill nets (100 m long) which will be randomly set over a 24hr period. Fish specimens obtained will be identified to species level, where possible and un identified fish will be taken to the Nairobi Museum, Ichthyology department, for identification.

ii) Reservoir Production, Fish stock abundance and Biomass estimates

Reservoir production will be estimated based on the Morpho Edaphic Index M E I of Henderson and Welcome (1974) as modified for reservoirs (Marshall, 1984)
Fish stock abundance will be assessed using a fleets of monofilament and multi-filament gillnets of mesh size 40, 50, 75, 100, & 125 mm. Gill net selectivity curves will be determined from the fish catch data. Fish biomass will be calculated based on the Catch Per Unit Effort CPUE as an index of abundance Hamley (1975) where:
CPUE = Cachability x Biomass

iii) Fish feeding and reproduction:

To study fish dietary intakes, gut contents of fish representative samples ($n > 20$) will be examined from each site. Gut contents will be examined according to size, habitat and time. Where more than one species of fish is present in the reservoir, possible biotic interactions will be studied to assess levels of niche overlap among the species.
Fish feeding will assessed by examining the stomach contents and the fullness index will be determined according to Blegvad, 1917 where:

$$\text{Fullness Index} = \frac{\text{Wet weight of stomach contents (g)}}{\text{Wet weight of fish (g)}} \times 100$$

Frequency of occurrence (Hynes, 1950) will be determined by accessing the number of stomachs in which a food item occurred and expressed as a percentage of the total number of stomachs examined.
Fish reproduction will be assessed by examination of the ovaries based on size, shape, texture and colour and placed in the various maturity stages according to Dadzie (1969).
The frequency of the maturity stages and monthly variations in the Gonado Somatic Index (GSI = weight of the ovary/total weight of the fish x 100) will be used to determine the breeding seasons.
* Samples collected will be preserved using appropriate methodology and taken back to Kenyatta university for examination and analysis

v) Fish Stocking

Reservoirs and dams found to have low stocks of fish will be stocked with selected fish fingerlings breed at Sagana fish farm in collaboration with the Fisheries Department. Small sized dams and reservoirs, which cannot be exploited on a continuous basis will be stocked and managed as fishponds.

Socio- Economic factors, Community Mobilization and Training

An investigation of the roles of socio-economic factors, attitudes, cultural factors, relating to fish consumption, and fish marketing will be carried out. The community will be mobilized, enlightened and trained to participate in project activities.

i) An investigative survey of the main socio-economic factors, attitudes and cultural factors relating to fish access, consumption, marketing will be done by collecting both primary and secondary data. Data will be collected by use of structured interviews and random observations.

ii) The community will be mobilized and trained in respect to fishing methods, seamanship and safety, aquaculture and fish farming, fish processing and marketing. This will be done by conducting forums with the communities living within the vicinity of the dams with participatory emphasis for target groups.

iii) Sensitization of the communities on the importance of fish consumption, and training in fish preparation, will be done by visual aids, cooking demonstrations and focus group discussions.

iv) Communities will be mobilized to form local management committees to manage and regulate the exploitation of the fisheries resources. This will be done in collaboration with the Fisheries Department Officers and the extension staff.

Data Analysis

The data collected in the field will be log transformed and subjected to ANOVA while data collected using questionnaires will be quantitatively analysed using appropriate tools such as SPSS.

EXPECTED RESULTS AND IMPACTS

The study is expected to:

- Produce a comprehensive inventory of all water reservoirs and dams in Maragwa and Thika Districts including their faunal, floral and morphometric characteristics.
- Establish fish exploitation on all dams with adequate stocks of fish and fish farming on the small dams
- Increase fish availability and consumption by the local communities living within these resource areas.
- Increased income to alleviate poverty among the local communities
- Availability of data/information on the ecology and biology of the fishes and fish stocks of the reservoirs and dams in Thika and Maragwa districts.

Socio-economic Impacts

The project will have the following socio-economic impacts.

- Improve the local community's knowledge about fish ecology and rearing in reservoirs, harvesting and marketing in order to reverse their poverty trends and improve their dietary intakes.
- Encourage better utilization of the water reservoirs by the local communities through sustainable utilization and management for the benefit of the present and future generations.

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