Buffaloes in favour of culture-based fisheries in Sri Lanka

Posted on 3/9/2007 | 4244 reads | Tags: Inland aquaculture

By Asanka Jayasinghe and Upali Amarasinghe

Department of Zoology, University of Kelaniya, Kelaniya, Sri Lanka, email asankadj@kln.ac.lk

During the reigns of the Sinhalese kings Sri Lanka was popularly known as the "Granary of the East??? because of its high rice production. Throughout thousands of years of this history cattle and buffaloes were reared hand in hand with the agrarian community nourishing the nation. In these civilizations, 60–80 % of the population was involved in some form of agricultural activity. As developing countries, people in this region use cattle and buffaloes rather than machinery in each step of their agricultural activities. Other than this draft power for agricultural operations, cattle/buffaloes are a valuable resource as a source of milk, meat and hides. Also, within the agrarian community cattle/buffaloes have a sociological value as property, possessions and a readily available currency converter[1].

Cattle-borne fertilizers for agriculture and aquaculture

Another major output from the livestock that is seldom taken into account by economists is the faecal matter that can be used as an organic fertilizer. An adult buffalo produces about 4–6 tons of wet manure per year[1]. People in Sri Lanka conventionally use cow dung as a fertilizer for vegetable crops in chena (shifting) cultivation as well as for flower pots in their home gardens. Buffaloes help in each step of the paddy cultivation, so that paddy fields get automatically fertilized during the process. These droppings are rich with nitrogen (N) and phosphorus (P), the two major essential elements for plant growth.

Many countries have tested the applicability of cow dung as an organic fertilizer for fish culture in ponds. Adding cow dung results in an enhanced biological productivity and thereby increased aquaculture production. By now, animal faeces have become a conventional type of fertilizer commonly used in aquaculture systems all over the world. Farmers can add organic fertilizer either manually or through a self nourishing system introduced as "integrated farming???. This usually appears as fish-cum-poultry farming or fish-cum-duck farming, by setting poultry/ duck cages over the fish ponds. Then the bird droppings directly reach water through the bottom lattice of the cages.

It is rather impractical to build a cattle farm over a fish pond. Instead, farmers can add cattle manure manually to their ponds considering the nature of cultured organism, water quality and soil characteristics of that area[2]. In pond fish culture, farmers often use cow dung in combination with poultry manure and/or inorganic inputs. For rearing Indian and Chinese major carps the conventional manure dosage for pond fertilization may vary between 10–50 tons per hectare per year[3,4,5]. This can be an unachievable target with increasing pond size.

Cattle/buffaloes and culture-based fisheries

In culture-based fisheries, juvenile fish are released into a natural or a man-made water body relatively far larger than a fish pond and harvested upon reaching a desirable size. During the growth period fish feed on available natural food in that water body. If there is a possibility to manually fertilize the water body the harvest will be a rewarding one. The large size of the culture system makes manual fertilization impractical. However, if it is a non-perennial (seasonal) water body, which is smaller in size, and if there is a higher density of cattle/buffaloes grazing within the catchment the scenario would appear as an integrated farm setup. For example, an experimental introduction of grazers for a 10 hour period to a small catchment in New Zealand was reported to increase particulate phosphorus in the water 100 times as in the pre-grazing status[6].

Livestock grazing within catchments contribute a large amount of nitrogen and phosphorus through their faecal matter. The amount of phosphorus in cattle urine is low[7] but a remarkable amount of phosphorus is transferred to the soil via faeces[8,9,10]. It has been estimated that approximately 70% of phosphorus in feed concentrates of cattle is exported to land in excreta[11]. Nevertheless, when inundated, the nutrient release rate from dung is normally higher than that of submerged vegetation despite slight differences between that of different animal species[12].

Resources for culture-based fisheries

There are more than 12,000 non-perennial reservoirs in Sri Lanka scattered mainly throughout the dry zone. These rain-fed reservoirs are commonly known as seasonal or village tanks. These non-perennial reservoirs often do not exceed 20 hectares in area at their maximum capacity and dry out almost completely at least once a year. Throughout history, the agrarian society of Sri Lanka has been characterized by a “one tank–one village??? ecological pattern[13]. Each village consisted of a non-perennial reservoir, paddy fields irrigated under that reservoir and the dwellings of the owners of the paddy lands. Many scientists have pointed out the suitability of non-perennial reservoirs for culture-based fisheries[14,15,16,17]. With onset of rain farmers can stock the reservoirs with fingerlings of Indian and Chinese major carps. As water is retained usually for 6–11 months table-size fish can be harvested by the dry season.

Every cattle / buffalo in the village grazes in the reservoir catchment and at least once a day wade in the shallow water. According to statistics of the Food and Agricultural Organization (FAO) in 2005 there were estimated to be 280,000 buffaloes and 1,150,000 cattle[18] predominantly in the same agricultural areas of the country. Therefore, village tanks get direct or indirect inputs of allochthonous nutrients (externally sourced nutrients) via cattle / buffalo urine and faecal matter. The resulting high nutrient levels favour algal growth, which is the main food item for culturing carps.

Survey

We carried out a research with a view to find out if there was any existing correlation between culture-based fisheries yield and associated cattle/buffalo densities in non-perennial reservoirs. As non-perennial reservoirs are most abundant in administrative districts of Anuradhapura, Hambantota, Kurunegala, Monaragala and Ratnapura we randomly selected 37 non-perennial reservoirs from those. We could record data on number of cattle/buffaloes associated with each reservoir from resource profiles in village authorities and Divisional Secretariat Division offices. To know the exact reservoir area we had to map the reservoirs by marking the geographic position with a GPS while walking along the shoreline at full supply level. Cattle/buffalo density (BD) was calculated by dividing their number by reservoir area.

With the help of farmer communities we conducted one fish culture cycle (of 6–10 months) during 2002-2003. The reservoirs were stocked with fingerlings of exotic species rohu (*Labeo rohita* Hamilton), catla (*Catla catla* Hamilton), common carp (*Cyprinus carpio* L.), bighead carp (*Aristichthys nobilis* Richardson), mrigal (*Cirrhinus mrigala* Hamilton), the GIFT strain of Nile tilapia (*Oreochromis niloticus* L.) and the indigenous species, giant freshwater prawn (*Macrobrachium rosenbergii* De Man). Stocking densities ranged from 218 to 4,372 fingerlings ha[-1] and four species combinations were used.

When the water level of reservoirs fell to 0.5 – 1.0 m in the dry season, all surviving fish were caught using a 5 cm mesh 62 m x 8.5 m seine net. The total fish yield was estimated for each reservoir. Since culture-based fisheries are a relatively a new phenomenon for the farmer communities of Sri Lanka we faced some socio-economic problems during the process. Poor organization in some farmer communities led to incomplete harvesting, poaching and false reporting of data on harvest. Therefore, we could make reliable estimates on total harvest only for 23 reservoirs.

The limnological condition of selected non-perennial reservoirs was closely monitored from November 2001 to January 2004 period. By sampling at the surface 0.3 – 0.6 m above the deepest point of each reservoir we measured about 13 major limnological parameters.

Those were water temperature, Secchi disk depth, conductivity, pH, dissolved oxygen, phenolphthalein alkalinity, total alkalinity, nitrate, dissolved phosphorus, total phosphorus, chlorophyll-a, and organic and inorganic fraction of seston weight.

Research findings

Five key limnological parameters best describe the variations in trophic condition of non-perennial reservoirs of Sri Lanka[19]. Those are Secchi disc depth, total phosphorous, chlorophyll-a, inorganic turbidity and organic turbidity. All five parameters showed significant correlations ($P < 0.05$) to cattle/buffalo density in the initially selected 37 reservoirs. Total phosphorous, chlorophyll-a content, inorganic turbidity and organic turbidity increased against cattle/buffalo while Secchi disc depth decreased showing the effect of cattle/buffalo density on reservoir productivity.

For the 23 reservoirs with a successful culture-based fisheries harvest, cattle/buffalo density showed a significant positive correlation ($P < 0.02$) to the fish yield. In harvested reservoirs fish yield varied from 53 to 1801 kg ha[-1]. And cattle/buffalo density varied from 1 to 216 animals per hectare. The reservoir called Dozer Wewa in Hambantota administrative district possessed the highest fish yield as well as the highest cattle/ buffalo density. The derived equations through these relationships can be utilized to predict culture-based fisheries yield by associated cattle/ buffalo density. Therefore, for fisheries management it is not necessary to measure chlorophyll content or other limnological parameters in which technical skills are essential.

Towards sustainable development

In comparison with other developing countries, Sri Lanka has attained living standard criteria such as maternal deaths at childbirth, literacy rates, basic education levels, longevity, etc. comparable to industrialized countries[20]. Nevertheless, still one fourth of the pre-school children suffer from malnutrition. Around 72% of the total population inhabit rural areas, with around 36% of the labour force engaged in agriculture, forestry and fishing. According to the Department of Census and Statistics, by 2002, 24.7% of the rural community was found to be poor and the Dry Zone districts had a high percentage of population below the district level poverty line[21]. On the other hand, a majority of the reservoirs that have fishery potential as a source of cheap protein and additional income, are scattered in these rural areas of the country. Therefore, among so many other benefits from the cattle/buffaloes, their importance to increase fisheries potential is worth consideration in our management strategies.