INVESTIGATION OF SOCIOECONOMIC CHARACTERISTICS OF AGRICULTURAL COMMUNITIES IN RELATION TO THE DEVELOPMENT OF CULTURE-BASED FISHERIES IN NON-PERENNIAL RESERVOIRS OF SRI LANKA.

Mohottala G. Kularatne,University of Kelaniya, Sri Lanka. Kule_econ@kln.ac.lk
Upali S. Amarasinghe,University of Kelaniya, Sri Lanka. zoousa@kln.ac.lk ,Sena S. De Silva,Deakin University, Australia, sena@deakin.edu.au , U. Asanka D. Jayasinghe. University of Kelaniya, Sri Lanka. uadj@yahoo.com

ABSTRACT

Participation of community groups is one of the main requirements for culture-based fisheries (CBF) in non-perennial reservoirs of Sri Lanka. Homogeneity of the group characteristics facilitates to arrive at collective decisions. And as such can be considered as positive feature for development of CBF. In this paper an attention made to identify the most important social and economic characteristics affecting the group decisions for development and management of CBF in non-perennial reservoirs of Sri Lanka. Principal component analysis (PCA) revealed that out of 25 measured parameters only 4 namely, the group size of fishers, participation rate in fisheries activities, caste of community and participation rate for regular meetings, were important in determining socioeconomic heterogeneity of the sample. Average income derived from CBF was appreciably high in communities with small group size and high participatory level in-group activities. Contingent evaluation of willingness to pay also demonstrated that the involvement of more people with fishing attitude would be preferred for the successful CBF activities. This analysis indicates that socioeconomic characteristics of rural communities can be meaningfully used for selecting non-perennial reservoirs suitable for development of CBF in Sri Lanka.

Keywords: Culture-based fisheries, non-perennial reservoirs, group characteristics

INTRODUCTION.

The importance of inland fisheries to the society is increasingly recognized as a means of food security (Coates 1995). Also, there is a growing importance of the human dimension in inland fisheries (Sipponen and Greboval 2001). In Sri Lanka, non-perennial reservoirs known as village tanks which support rural economy in the form of agriculture, animal husbandry, and subsistence fishery. In fisheries development perspective, small reservoirs are more suitable for culture-based fisheries (Mendis 1977; De Silva 1988, 2001).

Management and conservation of these village reservoirs had been practised under informal social and ecological institutions (eco-institution) in the past. Regarding fishery resources, reservoirs are managed by village assembly and only the families within the village have the right to utilize common property resources (Ulluwishewa 1995). The reservoir is considered as a common property of village community (Senaviratne 1989). Siriweera (1994) pointed out that farmers, who had land in the command area of the reservoirs, had been working as groups on various agriculture-related activities (i.e. from ploughing to harvesting). Collective fishing was done under the control of village irrigation leader (Ulluwishewa 1995).

For successful common property resource management, thus human aspects must be considered (Pringle 1985). These include individual motivations, characteristics of individuals, nature of institutional arrangements, interactions among users, the ability of users to create new arrangements, and the

behaviour of regulatory authorities (Feeny et al. 1996). It is obvious that a distinct group of people manage the non-perennial reservoirs in Sri Lanka. Condition of well-delineated group of users is discussed as a key variable out of the seven characteristics in modern common property resources discourse (Stevenson 1991).

Today the Farmer Organizations (FO) manage most of the non-perennial reservoirs. FO has been established under the Agrarian Service Acts No. 58 in 1979, No. 4 in 1991, and No. 46 in 2000. The Act has given authority to the FO to work as a group in agricultural activities (including inland fisheries). Only a few non-perennial reservoirs are utilized by individuals for development of culture-based fisheries (CBF) while many others are utilized by small groups of the FOs. Sustainability of the group depends on a number of social, economical, institutional, and technological factors (Agarwal 2001). Small size of the user group, closeness of user and the resources, homogeneity among group members, effective enforcement mechanisms, past experience of the organization, external support and strong leadership are crucial characteristics in community level institutions. Therefore it is important to investigate factors influencing culture-based fisheries for an effective management of the resources. In the present paper, an attempt is made to investigate socioeconomic characteristics of agricultural communities in relation to the development of CBF in non-perennial reservoirs of Sri Lanka, with particular reference to importance of socioeconomic heterogeneity in this development activity.

MATERIALS AND METHODS

Selection of the non-perennial reservoirs

This study was carried out in five administrative districts where a high number of seasonal reservoirs are found (i.e., Anuradhapura, Kurunegala, Hambantota, Monaragala, and Ratnapura) and are with different social and economic setup. Detailed description on site selection procedure has been given in Jayasinghe et al. (2005), Wijenayake et al. (2005) and Kularatne et al. (in press). Depending on reservoir size (<20 ha), water retention time (6 – 11 months), accessibility, available infrastructure, market status, willingness for CBF etc., 47 non-perennial reservoirs were randomly selected. These reservoirs were within 46 villages which are situated in 29 Divisional Secretariat Divisions.

Fisheries data collection

Of the selected reservoirs, only 36 reservoirs could be stocked with fingerlings of exotic Chinese and Indian major carps during 2002 – 2003 culture period due to various reasons such as very low water level as a result of extended drought periods, community conflicts and poor organization setup, fingerling availability, etc. After 6 – 10 months of culture period, when the water levels receded, reservoirs were completely harvested. Due to poaching and false reporting of harvest data in 13 reservoirs, reliable yield data were available only from 23 reservoirs. Total fish yield, and wholesale and retail prices per kg at each village were recorded.

Sociological data collection

The study was conducted by sample surveys in selected farmer communities. Primary and secondary data were used in the study. Participatory rapid appraisal (PRA) and rapid rural appraisal (RRA) research techniques such as interviews with individuals, group discussions, interviews with representatives of institutions and community organizations, observations and case studies were used for primary data collection. Secondary information was extracted from previous research reports, Grama Niladhari (village authority) reports and resource profiles published by the Divisional Secretariat Divisions.

In each of the 46 villages, a sample of households associated with the reservoir was selected. Logistic reasons such as time allocation for the field survey, financial restrictions, and location of the reservoirs

influenced the determination of sample size. Representing the village population, 15-20 individuals from each community were interviewed. In addition, 46 group discussions were performed at each reservoir (village) to get an overall idea about their view on CBF.

CBF activities in seasonal reservoirs are usually organized by one of the following three groups.

By the FO

By the aquaculture management committee (i.e., sub group of the FO); or

By individuals or community based organizations other than the above

Most fisheries in seasonal reservoirs are organized under the first two categories. Therefore, only the reservoirs implementing first 2 strategies were selected for this survey. An aquaculture management committee (AMC) normally consists of around 10 members. A maximum of 20 households were selected from each village consisting almost all of the members of AMC. The rest of the sample was the non-members from the same village. In addition, officials of the FO and AMC were interviewed as groups.

Interviewing was done by using two sets of structured, pre-tested questionnaires, one for the officials of FOs and AMCs and the other for general members. There were questions on characteristics of resource system, community, institutions (formal and informal), market, and the state intervention on the fish production.

Data Analysis

Principal Component Analysis (PCA), an ordination method to identify the underlying structure of a multivariate dataset, was used to analyse socioeconomic data in the present study. Twenty-five socioeconomic characteristics (Table 1) were used to ordinate 46 communities through PCA using Primer Version 5.2.2 computer software package (Clarke & Warwick 1994; Clarke & Gorley 2001). At first, parameters selected for PCA analysis were Ln (x+1) transformed and standardized in order to reduce non-normality of the data and to minimize the variations in sampling units. For further clarification, bubble scale plots of individual socioeconomic characteristics were superimposed on the PCA plot to identify the characteristics with less variability and negligible gradient across the data set. The relationship between economic output of CBF, expressed as market value of yield per ha, and PC scores of first principal component was determined.

Table 1. Explanatory variables, expected signs and descriptions.

No:	Characteristic	Expected sign	Description
1	GROUP_S	(-)	Group Size; Small number is favored to CBF
2	AV_EDU_Off _Bearers	(+)	Average education level of office bearers of FO and AMC
3	AV_EDU_C	(+)	Average education level of group members
4	AV_AGE Off _Bearers	(+)	Average age of office bearers
5	AV_SER_Off Bearers	(+)	Average years of service to the FO/AMC of office bearers
6	AV_FISH_EX_ Off _Bears	(+)	Average years of experiences in fishery activity of the office bearers of FO/AMC
7	LEADSHI_Off_Bearers (Max Av:4)	(+)	Leadership of office bearers (Ranks; 1- very weak, 2- somewhat good, 3 – Good, 4- very good)
8	AGE_G	(+)	Average age of the group
9	PER_YM_G	(+)	Equality percentage of young members of the group
10	PER_AM_G	(+)	Equality percentage of active members of the group
11	INCOME_G	(+)	Equality percentage of income of the group (Highest percentage of low income)
12	WEALTH_G	(+)	Equality percentage of wealth of the group (Highest percentage of low wealth)
13	KINSHI_G	(+)	Equality percentage of kinship of the group
14	CASTE_G	(+)	Equality percentage of caste of the group
15	MIGRAMem_G	(-)	Equality percentage of migrant members of the group
16	COM_IN_G	(+)	Equality percentage of common interest of the group
17	PART_F_G	(+)	Equality percentage of participation to the fishery activity
18	POL_P_G	(+)	Equality percentage of political party representation.
19	PAR_RA_G	(+)	Participation rate at the meetings
20	AV_AGE_C	(+)	Average age of community (years)
21	AV_FAMILYSIZE_C	(+)	Average family size of the community
22	AV_ECONacti_C	(-)	Average number of income generating activities of the households
23	AV_UNEMPO_C	(+)	Average number of unemployed members of households
24	AV_DEPEN_RA_C	(+)	Average dependency ratio of the households
25	BASICS living _C (Max 22)	(+)	Basic living condition of community (Housing, water, sanitary, electricity, roads, transport, communication, getting information (Ranks: 1- Weak, 2- Good, 3-very good)

Parameters important to describe the heterogeneity of the data set were then used to calculate disparity among the 23 farmer communities who had successfully harvested and other 23 communities who had not successfully harvested or not performed CBF activities during the culture cycle. Average income and willingness to pay for CBF were calculated for each community. using contingent evaluation techniques (CET). Here, the dichotomous-choice method (Gunathilaka 2003) was used to examine “willingness to pay” for CBF in farmer communities. In this approach, the respondents were asked to state whether they would be willing to pay some amount of money as a capital for stocking fish fingerlings. The answer would be “Yes” or “No”. With this “take it or leave it” offer each respondent received, a hypothetical cost of stocking for one culture cycle was assumed to be Rs. 100,000. A value of willingness to pay was determined on the basis of this amount which ranged from 0% to 100% of total stocking cost.

RESULTS.

Results of initial PCA using twenty-five socio economic characteristics explained only 35.4% of cumulative variance of the data set. It was evident from this analysis that group size, caste of the community, participation rate of fisheries activities and participation rate of regular meetings were the most influential characteristics while the other parameters have low variability and gradient across the dataset. Two examples of bubble scale plots having low and high variability across the data set are shown in Figure 1

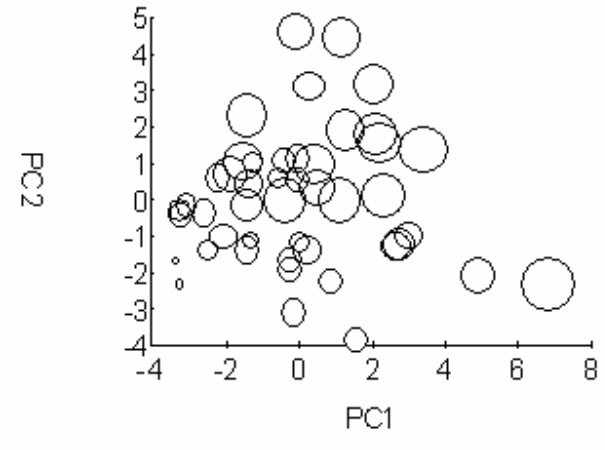

Figure 1. A

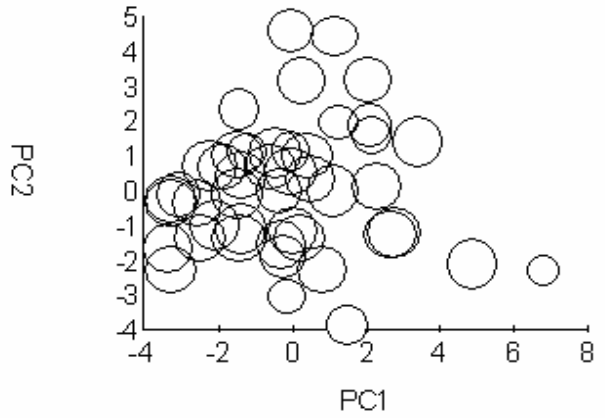

Figure1. B

Figure 1. (A) Group size showing high variability and (B) percentage of active members on fishing activities in the groups showing less variability.

Final PCA performed with selected 4 parameters explained 74.3% of cumulative variation by first two principle components (Table 2 and Fig. 2). The first principal component (PC1) was positively loaded by group size of the community and negatively loaded by participatory group characteristics (i.e. participation rate for fisheries activities and participation rate at regular meetings) and the caste of the community.

Table 2. Results of the PCA of socioeconomic characteristics in the 46 communities studied.

	PC1	PC2
Eigen values	2.13	0.84
Percentage of Variation	53.4	20.9
Cumulative percentage of Variation	53.4	74.3
Socioeconomic characteristics		
Group size	0.501	-0.302
Participation rate of fisheries activities	-0.547	-0.061
Participation rate at regular meetings	-0.543	-0.405
Caste of community	-0.393	-0.861

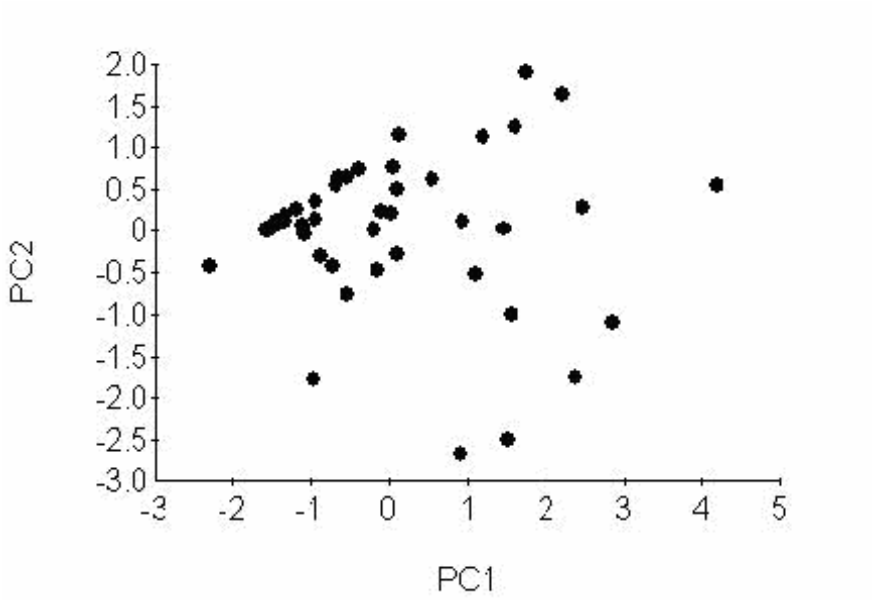

Figure 2. Ordination of socioeconomic characteristics of communities in 46 villages using PCA.

The market value of fish yield (kg/ha) in fully harvested 23 reservoirs was significantly correlated ($P < 0.01$) to the PC 1 scores (Fig. 3). This indicates that community groups characterized by smaller size, high participation rate for fisheries activity and regular meetings and high percentage of individuals with same caste, had better income from CBF. Table 3 compares the average values of the 4 socioeconomic characteristics in 2 community groups namely, the group of 23 communities who stocked and

successfully harvested their reservoirs and the group of 13 communities who stocked but not successfully harvested their reservoirs.

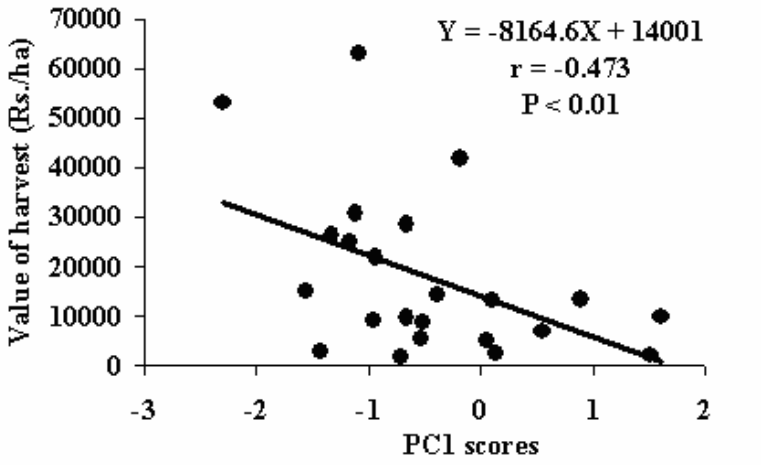

Figure 3. Relationship between PC1 scores and market valve of yield/ha in 23 fully harvested non-perennial reservoirs.

Table 3. Average values of selected socioeconomic characteristics of two types of communities engaged in culture-based fisheries

Characteristics	Stocked /harvested community in culture cycle 2003-04	Stocked /non-harvested Community in culture cycle 2003-04
Group size	21	31
Participation rate for fisheries activity	72%	55%
Participation rate for regular meetings	74%	57%
Percentage of same caste	81%	71%

Results of the willingness to pay (WTP) for culture-based fisheries development are shown in Table 4. The farmer communities, who succeeded in CBF, recorded the highest percentage of members (80%) who were willing to contribute to the cost of CBF activities. Fourteen percent of them were willing to pay the total cost. Thirteen communities who were not successful had a similar attitude for contribution, but about 77% of them were willing to pay only less than 25% of total cost.

Table 4. Willingness to pay (WTP) in farmer communities (%) for culture-based fisheries in non-perennial reservoirs.

Nature of contribution	WTP of 23 Communities of fully harvested	WTP of 13 Communities who stocked fingerlings but not harvested	WTP of 10 Communities who did not perform culture-based fisheries activities
Said “Yes”	80	78	70
< 25%	52	77	69
25%	24	10	5
50%	8	5	5
75%	1	0	1
100%	14	8	20

The rest of 10 communities cannot be directly compared with other 2 groups, because the major reason for not performing CBF activities was not sociological but due to very low water level during the stocking period. However, they had shown a lesser contribution (70%) in WTP than the other 2 groups, although 20% were willing to bear the total cost.

Fishing in non-perennial reservoirs is not the main source of income of the farmer communities. For a village, only a small number of people (usually less than five) are involved in fishing activities for subsistence purposes. Therefore, to investigate whether WTP was influenced by fishing attitude, individuals of 23 communities which were unsuccessful in CBF were divided into 2 groups; persons who were actively involved in fisheries activities (fishers) and those who were not actively involved in fisheries activities (non- fishers). Results are given in Table 5.

Table.5. Average WTP for culture based fisheries of fishers and non-fishers in 13 reservoirs that were stocked but failed and 10 reservoirs that were not stocked.

Nature of contribution	Reservoirs stocked but not harvested		Reservoirs not stocked	
	WTP in Fishers	WTP in Non-Fishers	WTP in Fishers	WTP in Non-Fishers
Yes (%)	95	70	95	56
Less than 25	51	70	62	77
25	20	22	7	2
50	9	2	5	5
75	9	0	2	0
100	11	6	24	16

In both groups 95% of fishers were willing to pay for CBF. Also, 70% of non-fishers who were even unsuccessful in CBF were willing to contribute to the cost of culture-based fisheries. Nevertheless, WTP for total cost was also higher in fishers of both groups.

DISCUSSION

Non-perennial reservoirs of Sri Lanka are multiple use resources with the major use of irrigation and usually the village activities are organized in a reservoir-centered manner. Historically, reservoirs belong to the state or to the temple and also, there may be private ownerships (Seneviratne 1989). Berkes and Farvar (1989) mentioned that common property regimes in general may be held within open access, communal property, state property or private property. Only families lived within the village had right to utilize all common-property resources in a reservoir-based village (Ulluwishewa 1995). Therefore, non-perennial reservoirs in Sri Lanka do not seem to have open access property rights as in the case of tragedy of the commons (Hardin 1968).

Aguero and Lockwood (1986) argued that the development of scientific knowledge is much slower on motivation and behaviour of fishermen and fish consumers and the socio economic organizations and interrelationship between main actors in the fishery. The fundamentals of the dynamic bio-techno-economic relationships and the socio-cultural conditions must be well understood and accepted by management decision makers (Aguero and Lockwood, 1986). This is of particular importance in the process of transformation of wild fishery into a culture-based fishery in village reservoirs. Poor people are more dependent on village reservoirs for various livelihood needs and contributing more to the management and conservation of those reservoirs through collective actions, which would increase their productivity and income (Balasubramanian and Selvaraj 2003). Nevertheless, as suggested by Cruz and

Cruz (1984), compared to the large irrigation systems, communally managed small irrigation systems are socially, economically and technically efficient.

This study reveals that the group size, caste of the community, participation rate of fisheries activities and participation rate of regular meetings are characteristics influencing a successful CBF program. The extent of cultivatable land represents the number of active farmers associated with each reservoir. According to the Agrarian Development Act of 2000, there should be at least 25 members in a Farmer Organization. In these Farmer Organizations, Aquaculture Management Committees are organized to perform CBF. In 53% of selected communities CBF activities were organized by AMCs. Group size of the AMC varied from 5 to 15. Obviously, when the group size is small, individual economic benefits were higher than in AMCs with large group sizes. The harmony between Farmer Organizations and AMCs are usually achieved due to the reason that there are agreements between the two groups to pay some percentage of total CBF income (mostly about 5%) to the Farmer Organization.

Larger groups are less likely to contribute to collective action than smaller ones (Oliver 1988). Higher percentage of participatory behaviour depends on the group size and the size of the user group has a negative impact on cooperation (Balasubramanian and Selvaraj 2003). Also, when CBF was introduced to Farmer Organizations (FO), many of the members of FOs did not have previous fishery experience or genuine interest in fishing. These communities tended to show poor participatory rate in fisheries activities. In “Kanna” meetings (first meeting of FO in each culture season), farmers and government officials take the decisions on paddy farming as well as aquaculture practices in reservoir. All farmers who own agricultural land under the reservoir are expected to be present at the meeting. Since ownership of land comes by descent, majority of the decision making in the meeting is well supported by kinship and caste. Present analysis also indicates that the communities with homogeneous characteristics with regard to participation in meetings, and caste are important for performing CBF activities. This was also proven by higher percentage of WTP. Variations in total fish yield due to ecological parameters as shown by Jayasinghe et al. (2005) and Wijenayake et al. (2005) may be overcome by a good sociological setup leading to marketing strategies.

ACKNOWLEDGMENT

The financial support from the Australian Centre for International Agricultural Research (ACIAR Project No.FIS/2001/030) is gratefully acknowledged.

REFERENCES

Anon. 2000. Data book for village irrigation schemes of Sri Lanka, Hambantota District Ministry of Agriculture, and Land. Department of Agrarian Services.

Agarawal A. 2001.Common Property Institution and Sustainable Governance of Resources. World Development 29 (10): 1649-1672.

Agrarian Developmment Act. No 46, 2000. Department of Government Printing, Sri Lanka.

Aguero N. and Lockwood B.A. 1986. Resources management is People Managemnt, pp. 345-347. In: J.L, Maclean, L.B. Dizon and L.V. Hosillos (eds.) The First Asian Fisheries Fourm. Asian Fisheries Society, Manila, Philippines.

Amarasinghe U.S. 1994. A synthesis on the management of the capture fisheries of Sri Lankan perennial reservoirs. Vidyodaya Journal of Science 5: 23-40.

Amarasinghe U.S. and S.S. De Silva 1999. Sri Lankan reservoir fishery: A case for introduction of a co-management strategy. Fisheries Management and Ecology 6: 387-399.

Balasubramnian R. and K.N. Selvaraj 2003. Poverty, Private Property and Common Pool Resource Management: The Case of Irrigation Tanks in South India. Working Paper No.2-03, South Asian Network for Development and Environmental Economics (SANDEE), Kathmandu, Nepal.

Berkes, F. and F. Taghi 1989. Common property resources, Ecology and community based sustainable development. Belhaven Press, London. 17 p.

Berkes, F. and M.T. Farvar. (eds) 1989. Common property resources: ecology and community-based sustainable development. Belhaven Press, London.

Clarke K.R. and R.N. Gorley 2001. PRIMER v5: User manual/tutorial. PRIMER-E, Plymouth, UK, 91 pp.

Clarke, K.R. and R.M. Warwick 1994. Similarity-based testing for community pattern: the 2-way layout with no replication. Marine Biology 118: 167-176.

Coates, D. 1995. Inland capture fisheries and enhancement: status, constraints and prospects for food security. Paper presented at the International Conference on Sustainable Contribution of Fisheries to Food Security, Kyoto, Japan, 4-9 December 1995. FAO and Government of Japan, KC/FI/95/TECH/3. 82pp.

Cruz W. and M. C. Cruz 1984. Non-separable Externality, Collective Action, and Irrigation Institutions, The Philippine Economic Journal 56:Vol xxiii Nos. 2&3

Feeny, D., S. Hanna, and A.F. McEvoy. 1996. Questioning the Assumptions of the "Tragedy of the Commons" Model of Fisheries. Land Economics 72(2): 87-205.

De Silva, S.S. 1988. Reservoirs of Sri Lanka and their fisheries. FAO Fisheries Technical Paper No, 298: 127 p.

De Silva S.S. 2001. Reservoir Fisheries: Broad Strategies for Enhancing Yields. In: De Silva , S.S. (ed.) Reservoir and Culture-based fisheries: Biology and Management. ACIAR Proceedings No 98, pp. 7-15. ACIAR, Canberra.

Gunatilaka H.M. 2003. Environmental Valuation: Theory and Application. Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.

Hardin G. 1968. The Tragedy of the commons. Science 162: 1243-1248.

Jayasinghe, U.A.D., U.S. Amarasinghe and S.S. De Silva 2005. Trophic classification of non-perennial reservoirs utilized for the development of culture-based fisheries, Sri Lanka. International Review of Hydrobiology 90: 209-222.

Kularatne M.G., U.S. Amarasinghe and S.S. De Silva, in press. Influence of Socioeconomic heterogeneity on culture-based fisheries in non-perennial reservoirs of Sri Lanka. In: Participatory approach to reservoir fisheries management: Issues, challenges, and policies (M.J.S. Wijayaratne & U.S Amarasinghe eds). Pp. 000-000. German Technical Co-operation (GTZ), Colombo and Sri Lanka Association for Fisheries and Aquatic Resources.

Mendis, A.S. 1977. The role of man-made lakes in the development of fisheries in Sri Lanka. Proc. IPFC 17: 247-257.

Oliver P.E., Marwell G. 1988. The paradox of group size in collective action: A theory of the critical mass II., American Sociological Review, 53: 1-8.

Pringle J.D. 1985.The human factor in fishery resource management. Canadian Journal of Fisheries and Aquatic Sciences, 42(2): 389-392.

Radheyshyam. 2001. Community-Based Aquaculture in India-Strengths, Weaknesses, Opportunitis and Threats. Naga, The ICLARM Quarterly 24: 9-12

Senaviratne A. 1989. The Springs of Sinhala Civilization, Navrang, 7 Inderpuri- New Delhi, 110012 Diamond Printers.

Sipponen M. and D. Greboval 2001. Social ,economic and cultural perspectives of European inland fisheries: review of the EIFC symposium on fisheries and society. Fisheries Management and Ecology 8: 283-293.

Siriweera W.I. 1994. A Ssudy of the economic history of pre-modern Sri Lanka. Vikas Publishing House Pvt Ltd., New Delhi.

Stevenson G.G., 1991, Common Property Economics, *What is common property?* (Chapter one) Cambridge university press, Canada

Ulluwishewa R. 1995. Traditional practices for inland fishery resources management in the dry zone of Sri Lanka: Implication for sustainability. Environmental Conservation 22(2) 127-133

Wijenayake, W.M.H.K., U.A.D. Jayasinghe, U.S. Amarasinghe, J.A. Athula, K.B.C. Pushpalatha and S.S. De Silva 2005. Culture-based fisheries in non-perennial reservoirs in Sri Lanka: production and relative performance of stocked species. Fisheries Management and Ecology 12: 249-258.

12 July 2006 Portsmouth. U.K.