Fishing Gear in the Sondu-Miriu River: Level of Use, Preference and Selectivity

Waswala-Olewe M. Brian, Okot-Okumu James and Abila O. Richard



Waswala- Olewe M. Brian Okumu James Abila o. Richard

Abstract: Artisan fishers of Osodo beach of Sondu-Miriu River (Kenya) use both traditional and modern gear to catch riverine fish species. This study, conducted between August 2006 and July 2007, revealed that fishers most predominantly used gear were the seine nets (42%) and the gill nets (28%). Other used gear include long lines (14%); fish baskets (9%) and weirs (7%). The selectivity of this fishing gear varied with the developmental stages of the fish to be caught. Non-selective gear caught both targeted and non-targeted species irrespective of size and development stages. The ranking of selective to non-selective fishing gear was the long lines, fish baskets, weirs, gill nets and beach nets at 2%, 11%, 16%, 24% and 32%, respectively. The non-selective fishing gear may have negative impacts on the riverine fish by reducing spawning biomass and lacustrine fish recruitment. These findings underscore the need for greater appreciation, research, and adaptation of appropriate fishing gear to ensure sustainable utilization of the riverine fisheries in Sondu-Miriu River.

Key words: Sondu-Miriu River, Osodo beach, riverine fish, lacustrine fish, fishing gear

Introduction

Fish plays an important role in both the aquatic ecosystem and to the human population. They are good indicators of environmental health within rivers and their catchments. They occupy vital ecological roles and are conservation targets. Fishing provides goods and services to the human population as a source of food, as an economic resource, and as recreation to the immediate and adjacent communities (Schofield & Davies 1996). Fishing gear has the ability to harvest targeted fish species and sizes. Selective fishing is the ability of a fishing operation to avoid non-target species or stocks, or when encountered, to capture and release them in a manner that minimizes mortality (Garcia 2003). When gear fails to meet this ability, it is considered non–selective. Use of fish gear is dependent on the fishing ground, the terrain, the target species, and availability of resources. According to National Research Council, (1988), most gear has been developed locally and with local knowledge. Within Sondu-Miriu River, artisan fishers harvest fish using long lines, beach seines, weir traps, gill nets and baskets (Gichuki et al. 2001).

Globally, fish catch is on the decline (Hutching & Reynolds 2004; Larsen 2005). Prior to the 1950s, the Labeo fishery was one of the most important in Lake Victoria, but was destroyed by fishermen using too many gill nets at the mouths of rivers during the breeding migration (Lowe-Mc Connel 1992). At present, current fish stocks and consequent harvest rates in Kenya have fallen, with a reported decline in catch within the Sondu-Miriu River (Ogutu-Ohwayo 1990a; Ogutu-Ohwayo 1990b). The phenomenon of large numbers of large ripe fish crowding rivers on their upstream migrations is now virtually gone, though the butterfish (Schilbe intermedius) and the Lake Victoria squeaker (Synodontis victoriae) are still common in riverine catches (Mugo & Tweddle 1999). The decline in fish on the Sondu-Miriu has been attributed to over-fishing (Van Someren 1959), papyrus encroachment (Balirwa & Bugenyi 1980), habitat degradation (Ochumba 1994), and predation by Nile Perch (Lates nilotica) (Ogutu-Ohwayo & Balirwa 2006).

Rivers are crucial breeding and nursery grounds for the riverine fish species which later repopulate the lakes. Therefore, there is an acute to establish an appropriate level of use, preference, and selectivity of artisan fishing gear within Osodo beach area.

Methods

Fish samples were collected using five different types of artisan gear used by fishers within Osodo beach. The gear was long lines, fish baskets, seine nets, gill nets and weirs. The fish were identified using Witte and Van Densen (1995) keys and weighed immediately on site on a digital Salter Brecknell 7010 SB weighing scale to the nearest gram. A standard surgical blade was used to dissect the caught fish on site to obtain primary data on their sex and stage of maturity (sexual development). Juvenile fish were classified as within developmental stages 1-3, while adult fish were of developmental stages 4-5.

Structured questionnaires were used to determine the seasonality, location, and preference of fish caught on Osodo Beach of the Sondu-Miriu River between August 2006 and July 2007. The questionnaires were administered to the fishers at four fish landing sites, with each site receiving twenty questionnaires. Random sampling of the respondents was done to reduce bias, and we collected a total of eighty questionnaires in the area. The questionnaires were completed overnight and returned for analysis the following day. The questionnaires requested information regarding gear level of use and preference. Statistical data collected was coded, cleaned, tabulated, analyzed and interpreted using statistical packages (MS-Excel and SPSS) and the resultant information was translated for presentation in graphical forms (below).

Study Area

The study was conducted in the Sondu-Miriu River. The

river basin lies between latitude 0˚17'S - 0˚22'S and longitude 34˚04'E – 34˚49'E (figure 1). It forms the fourth largest river basin in Kenya, and drains into Lake Victoria and adjacent flood plains. It is 110 kilometers long (FAO 1990) and receives an annual mean rainfall of 1,415 millimeters. It flows at an annual average of 41 m3/sec, though instantaneous rates vary from 4 cumecs during the dry season (drought) to 250 m3/sec in the wet season, when it occasionally floods. The river level is at the highest between March and June and lowest between October and February every year. This variation in water flow reflects rainfall on the Mau escarpment (Manyala 1992). The river exhibits an average percentage slope of 2.3 and an average transport capacity index of 0.14 (Odada et al. 2004). Osodo Beach is at the lower end of the river at an altitude of 1,145 m.

The Sondu-Miriu River is characterized by luxuriant wetland refugia dominated by papyrus (Cryperus papyrus), reeds (Phragmites austalis), and hippo grass (Vossia cuspidate). Strands of water hyacinth (Eichhornia crassipes) and water lettuce (Pistia stratiotes) are also present. Hippopotami and a large variety of water birds including yellow-billed stocks, cormorants, and Black Smith's plovers also inhabit the riverbanks. Osodo beach is at the delta where the river joins Lake Victoria. The annual mean temperature of the area is 26˚C, ranging between 24˚C and 36˚C. The soil is fertile with the major types: phaeozem, lithosols, and the cambisols (Odaro 2005).

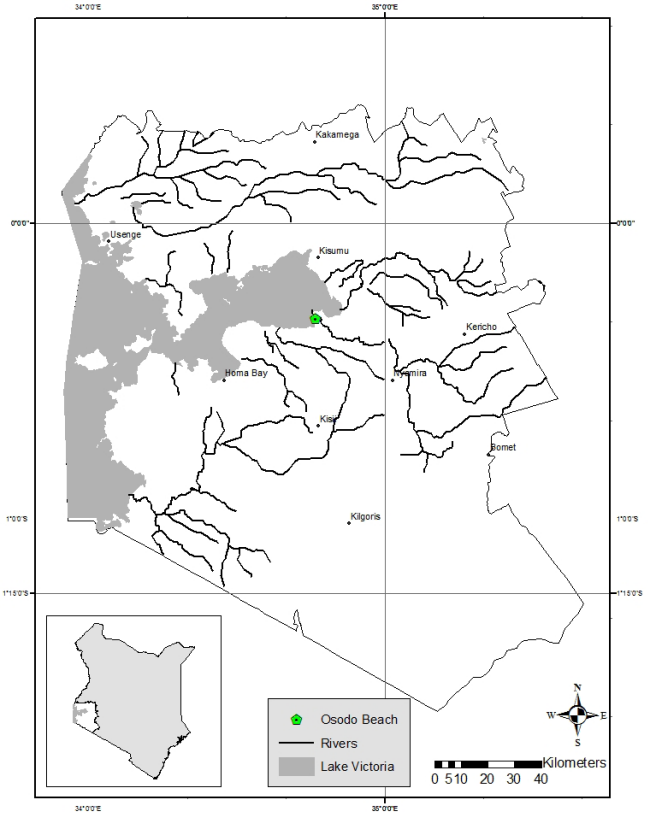

Figure 1: Map of Study Area

Result and Discussion

Fishing Gear and Levels of Use from August 2006 – July 2007

The study revealed that artisan fishers around Sondu-Miriu River caught fish using long lines, beach seines, weirs, gill nets and baskets, as reported by Gichuki *et al.* (2001). The use of this primitive gear was attributed to the fact that the artisan fishers did not have adequate monetary sources to modernize and mechanize their fishing gear. The fishers used dugout boats to fish within the river. Credit facilities and services were absent in the study area during the study period. This was also a setback to artisan fishers in their bid to ensure mechanization of gear and methods and also to ensure efficient fish catching. The degree of gear preference as noted in Figure 2 (below) was in the order of beach >gillnets>long lines>basket>weirs.

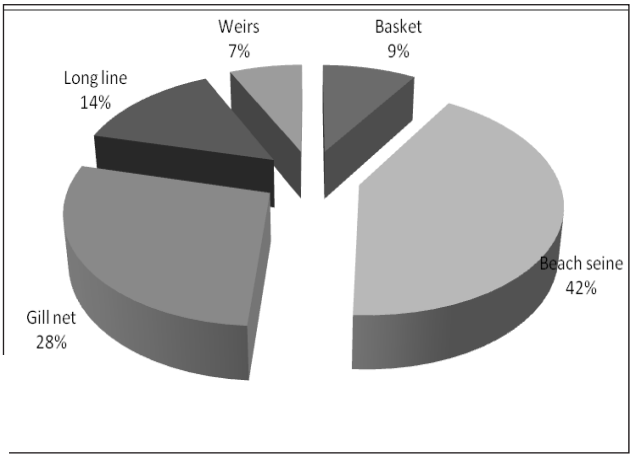

Figure 2: Level of Fish Gear Use in Sondu-Miriu River from August 2006 – July 2007

The beach seines were highly used during the rainy season due for their ability to catch mature gravid (*S. intermedius)*. Fish from beach seines were utilized both for subsistence and economic purposes. Fish of large sizes (above 10 centimeters total length) were sent to the market while smaller ones, those less than 10 centimeters (especially *B. altianalis* and *B. jacksonii*) were for personal consumption.

Gill nets were second most commonly used at 28%. The fishers used the lower sized mesh sizes (less than 4 inches) to catch mature *S. intermedius*, *L. victorianus,* and *Barbus* species. Gill nets of mesh sizes 4 inches and above set at a hanging ratio below 0.5, snagged target fish species. This was practice attributed to poor law enforcement.

Long lines, baskets, and weirs were used at levels of 14%, 9% and 7%, respectively. These locally assembled gear mostly targeted fish for subsistence use within the households. This was because they catch fewer fish compared to beach seines and gill nets. Only large fish of sizes of 10 centimeters and above were destined to the markets.

Fishing Gear Preference from August 2006 – July 2007

The fishers preferred gill nets at 44.4% while the least preferred means was the fish basket at 9.7% as indicated in Figure 3. The choice of fish gear depended on cost, approval from local authorities, and amount of fishing effort needed. The major reasons for gear preference choice were lack of detection by law enforcement authorities and the amount of fish caught by the gear.

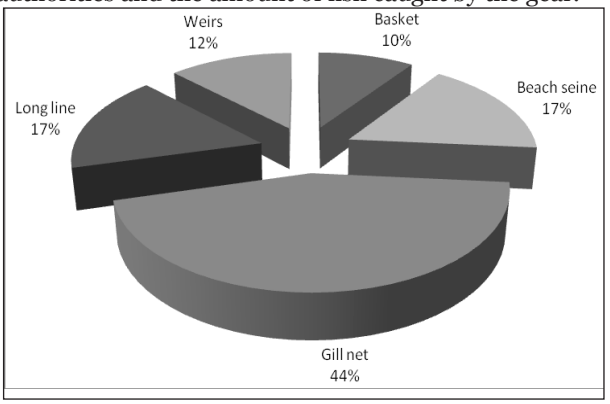

Figure 3: Gear Preference by Fishers of Sondu-Miriu River from August 2006 – July 2007

Fishing Gear Selectivity from August 2006 – July 2007 (Proportion of Juvenile and Mature Fish)

The proportion of juvenile fish caught decreased in the order of beach seines, gill nets, weirs and long lines (figure 3). The least used fish gear was the mosquito beach seine. This was due to the fact that it caught both targeted and the non-targeted fish species, irrespective of their developmental stages in large numbers.

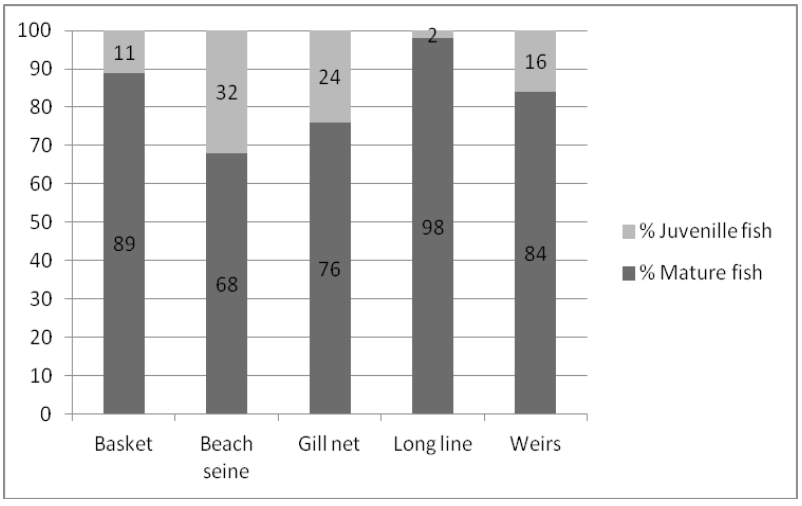

Figure 4: Artisan Gear Selectivity in the Sondu-Miriu River from August 2006 - July 2007

Long Line Selectivity

Long lines were the most selective artisan fishing gear used in the Sondu-Miriu River, meaning this gear was most effective at catching a specifically sized fish. The catch from long lines comprised of 98% adults and only 2% juveniles like the *O. niloticus, C. gariepinus* and *L. niloticus* fish species. This was attributed to the use of varied bait sizes, bait types, and hooks. Long lines are therefore highly encouraged on the basis of this study. The only major demerit of the long lines was that it required many hooks and lures to successfully provide fish to sustain local and urban population market demands.

Fish Baskets Selectivity

Fish baskets were the second best fishing gear in terms of selectivity as the catch from the gear was made up of 89% adults and 11% juveniles. The baskets were used to catch *Haplochromine cichlids*, *S. intermedius* and *O. niloticus*. Baskets selectivity was dependant on twine spacing. With an increase in reed spacing, the small and juvenile fish were able to swim in and out freely.

The study established that there was no recommended twine spacing for constructing fish baskets. Neither the Government of Kenya nor the Ministry of Livestock and Fisheries has issued such recommendations. This has led to some unscrupulous fishers reducing twine spacing to maximize catch due to increased fishing pressure to meet market demand. This practice was more rampant during the rainy seasons when the *S. victoriae* spawned. This practice, if not checked, would have a negative effect on the sustainability of the riverine fisheries. The study also established that fishing baskets were rarely checked and that most were abandoned yet continued to "ghost fish," meaning this gear continues to trap fish even after its use.

Weir Selectivity

Sixteen percent of the total catch obtained from the weirs was comprised of juvenile fish while the remaining 84% were adult. Weirs were used by artisan fishers primarily to catch *S. victoriae*, *Haplochromine cichlids* and *O. niloticus*. Selectivity was also dependant on spacing between the *Phragmites* wall spacing. With an increase in spacing, the small and juvenile fish were able to swim in and out freely.

The study established that there is no recommended standard weir wall spacing (between the *Phragmites*) set by the Government of Kenya nor the Ministry of Livestock and Fisheries. The lack of clearly defined policy to address this has led to the abuse of the wall spacing by the fishers to increase their catch, especially the *S. victoriae* during their spawning seasons. By spacing the *Phragmites* closely together, fishers indiscriminately trapped the small sized and juvenile fish. Juvenile fish caught by weirs comprised of *Barbus* sp., *S. victoriae*, *L. victorianus* and *L. niloticus*. The un-attended and lost/ abandoned weirs ghost fished. Dead fish in the weirs increased the chances of predation especially by crabs and cormorants.

Unchecked weirs that trap juvenile fish will cause a reduction in the target fish population and eventually diminish their recruitment potential. The study found out that the fishers erected weirs during the spawning seasons to target large gravid fish. This practice violated *Part II Section 5 [1][b]* and *Gazette Notice No. 7565* of the Kenya Fisheries Act 378 and subsequent amendments which state that: "*Specific fish breeding grounds in Lake Victoria have been gazetted as non-fishing areas. They are mostly river mouths and bays*". However, weak law enforcement means that violators are unlikely to face consequences.

Gill Net Selectivity

The gill nets used during the study ranged from 1 to 10 inches. Gill nets of mesh sizes 6 to 10 inches did not catch fish. Seventy-six percent of the total catch was comprised of adult fish while the rest were juvenile fish (figure 4). Gill net selectivity was dependant on the mesh size used by the artisan fishers. Adult *S. intermedius* and *S. victoriae* within the river had a maximum body size of 35 and 20 cm, respectively. The low sized nets (1-3) caught both juvenile and adult *S. intermedius, Barbus* sp., *B. sadleri, C. gariepinus* and *S. victoriae* comprising of 31% adults and 68% juveniles. *S. intermedius, Barbus* sp. and *B. sadleri* were the most affected fish species caught in undersized gill-nets due to their shoaling behaviour. Seventy-five percent of the Haplochromine cichlids caught by these undersized nets were brooding females with developing fry and eggs in their buccal cavities. Fishing effort exerted by the nets was usually increased during the spawning periods when the fishers wanted to maximize their take. This continued catching of juvenile fish will result in the decline of traditionally cherished fish species like the *S. intermedius* and L. *victorianus*. The juvenile and small-sized fish were for local consumption and not intended for the urban markets while the adult fish were sold in the urban fish markets. The only adult fish caught by mesh sizes below 4 inches were of the *Brycinus* and *Barbus* sp. as confirmed with their stages of sexual development (4 and 5).

Although the laws and policies prohibit the use of these net sizes, fishers continued to use this gear, due to lax enforcement by law authorities. Use of illegal net sizes violates *Part II Section 5 [1][b]* and *Gazette Notice No. 7565* of the Kenya Fisheries Act 378 and subsequent amendments that state that " *Fishing gear like beach seines, trawls, nets, monofilament and mosquito nets of less than 10 mm mesh size and gill nets of less than 127 mm have been outlawed. Professional/trading in these nets in all fishing beaches in Kenya is also illegal*".

Use of recommended gill nets hang at a recommended 0.5 – 0.7 hanging ratio mainly caught mature *S. intermedius*, *C. gariepinus* and immature *L. niloticus*. All *S. intermedius* caught were in breeding stages comprising of gravid females and milting males. However, when hanging below the 0.5 hanging ratio, the gill net had a higher probability of entangling riverine fish. This practice increased chances of fish being caught and snarled in the nets. Gill nets of mesh sizes above 5 inches did not have any catch in them. This was because all the fish within the river were small enough to pass through.

Seine Selectivity

Seine nets caught every fish species and size irrespective of the developmental stage within its purse. Seine nets are ideally used to catch *R. argentea* but due to its tensile strength; some fishers used it to catch the lacustrine fish during the spawning period (*S. intermedius*, *Barbus* sp. and *S. victoriae*). This resulted from laxity in law enforcement. The caught fish were hauled in, snagged, gilled, wedged or entangled. Some fishers used seines during the dry season to catch other fish in order to sustain their subsistence and economic need. Beach seines caught even non-target species, especially *A. frenatus*. The juvenile fish caught by the beach seines were the *L. niloticus*, *O. niloticus* and *Haplochromine* cichlids. This gear is banned in Kenya between 1st April and 31st July of every year when trade or transportation of *R. argentea* is forbidden (Part II Section 5[1][a] and Gazette Notice No. 7565 of 9th November 2001, and Legal Notice No. 214 of 23rd December 2003 – Fisheries Act 378). This ban was imposed to allow for *R. argentea* recruitment.

Recommendation

1 There is need to check fishing work through the establishment of defined landing sides, checking the increasing number of artisan fishers who fish in the river, and limiting gear use through type or nature. This has been enforced in the management of 'dagaa', the silver cyprinid, *R. argentea*, through closed seasons. The river fish should not be caught during the spawning season (February – July) to enable recruitment. If the fish should be caught during this season, there is a need to monitor and regulate the fishing gear.

2 There is need for thorough scientific research on riverine fish ecology, populations, and regenerative capacity for the better management of the fishing industry in Sondu-Miriu River.

3 The study recommends the revision of fishing laws and regulations, through a consultative process with the fishers (major stakeholders). The laws and regulations should define spacing of weirs and fishing baskets, to reduce by-catch and harvesting of juvenile fish.

4 There is need to educate fishers on selective and non-selective gear, and proper gear disposing methods (incinerating or recycling) for the sustainability of the fish. Set weirs and baskets should also be marked to avoid loss.

5 The study finally recommends the There is need to provide credit facilities to the local communities to establish other income generation activities

to improve their livelihoods. This will create job opportunities and reduce the fishing pressures already experienced. Fish storage and processing facilities should also be developed in the area.

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Acknowledgements

We would also like to thank the following organisations and individuals: Mr. and Mrs. Olewe Owiti for funding the study; all Kenya Marine Fisheries Research Institute – Kisumu staff especially Mr. Andrew Asila, Mr. Zablon Awounda, Dr. Ojwang' W. Oweke, and Mr. Ken Onyango; the Beach Management Unit (BMU) and fishing village of Osodo beach. We also value the contribution of Dr. George Paul Omondi, Dr. Fredrick Oliang'a, and Ms. Azenath Kadienge for their critique and diligent work in grammar and spell-checking the text.

Brian M. WASWALA-OLEWE *is currently an Environmental Education and Training Specialist (EETU) at the United Nations Environment Programme (UNEP). His work is focuses on promoting environmental education and training for sustainable development with higher education institutions (HEIs) globally. Brian has over 7 years' experience in the fields of natural resource management and environmental education from various government agencies and non-profit organizations in Kenya. In addition to his environmental education work, he has made significant contributions to ecosystem management in Kenya such as the mapping of Kenyan wetlands (The Kenya Wetland Atlas), the gazzettement of Tana River Delta as a Ramsar site, and on issues of savanna and wetland ecosystems during his tenure at Kenya Wildlife Service as an ecologist. Brian has mentored a number of environmental science students and communities at Technical University of Kenya, the University of Nairobi, Maasai Wilderness Conservation Trust, Friends of Nairobi National Park, and the National Museums of Kenya (Kisumu) among others. He holds a Master of Science degree in Environment and Natural Resource Management and a Bachelor of Science degree in Wildlife Conservation and Management from Makerere University (Uganda) and University of Nairobi (Kenya) respectively.*
Corresponding address: brianmarv@gmail.com

James OKOT-OKUKU *is currently an Associate Professor and the Head of Department at the Environmentail Management at the College of Agricultural and Environmental Sciences (Makerere University), where he mentors and supervises environmental science students (graduate and undergraduates). James holds a PhD Environmental Science (Makerere University); MSc. Environmental Science and Technology (IHE- DELFT, The Netherlands); BSc. (Hons) Biochemistry/Chemistry; BSc. (Hons) University of Ghana LEGON; and a Grad. Diploma Environmental Science and Technology (IHE- DELFT, The Netherlands). He is a specialised Environmental Scientist (Water and Waste Management) and Environmental Impact Assessment (EIA) expert. Prior to joining Makerere University, James served as a Senior Environment Officer at the Ministry of Environment (Uganda).*

Richard Kennedy Oginga ABILA *has a Doctorate degree in Fisheries (Socioeconomics) from University of Hull, UK and Masters in Agricultural Economics. He has worked as Senior Researcher in the Kenya Marine and Fisheries Research Institute, Kisumu, Kenya for a decade, and has over 20 years' experience working with small-scale fisheries in Africa. Currently Dr. Abila is working as a long-term Fisheries Advisor in Zambia where he is assisting in developing a fisheries co-management system, value chain development and sustainable fish farming. He has previously worked with the Kenya Marine and Fisheries Research Institute (and currently on leave) with projects extending to Uganda and Tanzania. He specializes on Fisheries Socio-economics, including co-management, economics and trade, value chain analysis and market information systems. Richard has played a leading role in international fisheries projects funded by several international agencies such as the EU, The World Bank, NORAD and IUCN. He has also undertaken consultancy work for a number of international and local organisations. He has numerous research publications to his credit that have appeared in international journals and as technical reports.*

Rererence

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words, the best sites are to be reserved for self-finance, self-construction, and self-use/consumption. For example, the present approach of the government to handover the most attractive simple run-of-the-river projects like Upper Karnali and Arun-3 through provision of various incentives, in his view, is a suicidal attempt.

Aspiration

He expressed his aspiration that the use of Nepal's water resources must be based on the facts and figures through continued analytical study, investigation and research by water resources related experts, professional and intelligentsia of Nepal towards the optimum benefit of Nepal and its people. He is very much worried that Nepal's only known major resources, the hydropower, is going in the outsiders' hand in spite of its use for its own development.

Unforgettable Moments

Dr. Shrestha considers his meeting with Ho Chi Minh, the then president of North Vietnam, as a member of international students' community studying inMoscow Power Institute, then USSR, as an unforgettable moment of his life.

Travel

Dr. Shrestha has travelled widely. The countries he has visited include India, Bangladesh, Sri Lanka, Pakistan, Thailand, Malaysia, Singapore, South Korea, Philippines, Australia, New Zealand, Japan, Hong Kong, China, Egypt, Sudan, Kenya, Denmark, then USSR, UK, Hungary, Yugoslavia, Luxemburg, Belgium, USA, Brazil, Paraguay, Holland, Germany, Switzerland, Canada, France, Austria.

Present Activities

Dr. Shrestha, at present, is in close association with only one consulting firm 'The Hydro Engineering Services' (HES). The HES, however, receives limited jobs even with Joint Venture association, and his effort is to improve the quality of work performed by this company.

Besides, a number of assignments were offered to him after his retirement and some of them which he accepted and got engaged in are: advisory support for renewable energy to ESAP; preparation of implementation plan for the Word Bank supported micro hydropower development to REDP; technical review of inventory of glaciers and glacial lakes and their outburst floods (Nepal and Bhutan); and advising the preparation of Hydrologic and Climatic Atlas of Nepal for ICIMOD; preparation of AquaStatNepal for Irrigation in Asia in Figures for FAO.

Past and Present Affiliation/Association

Dr. Shrestha's affiliation and association with the professional societies in the past and presentinclude:

- Member, Nepal National Committee, International Hydrologic Decade, 1969
- Member, Advisory Committee, Nepal Water, 1986
- Member Secretary, Nepal National Committee for ICOLD, 1988
- Member Secretary, Nepal National Committee for World Energy Council, 1992
- Member, National Water Resources Development Council, 1993
- Life Member of Nepal Engineering Association
- Member, Nepal Engineering Council (Regd. No. 664 Civil 'A')

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