03. REVIEW OF LITERATURE

A reservoir is an impoundment hindering the surface progression waterway of a river, stream or any other water course (Sugunan, 1997 a). Whole country consists with 19,370 numbers of reservoirs total areas covering upto 3,153,366 ha. (Sugunan,1995). Numbers of artificial freshwater closed waterbodies have come into subsistence throughout last 50 years to inclusive a range of adaptable river valley projects, addition of rich water potential specific to the improvement of Indian freshwater aquatic resources. Such human made freshwater water areas are classifed as reservoirs, which may produce sufficient extent besides classtype of important fish specis, if the appropriate conservation and management performances are engaged in a dynamic manners (Lu, 1986 and Natarajan, 1976).

Rivers connected waterbodis, ponds, tanks, lakes, channels and reservoirs have been extensively studied by numbers of reserchers (Ganapati, 1940; Biswas, 1949 b; Singh, 1955; Rao, 1955; Das and Srivastava, 1959 a, b; Misra, 1960; Abraham, 1962; George, 1962; Zafar, 1966, 1967; Ganapati and Sreenivasan, 1968; Kant and Kachroo, 1973; Vyas, 1968; Vyas and Kumar, 1968; Jana, 1973; Jana et al., 1980; Rao, 1975, 1977; Jayangoudar, 1980; Sharma et al., 1982; Unni, 1982; Zutshi, 1989; Sugunan, 1995). Reservoirs of south Indian part are the most methodically examined water reservoirs (Ganapati and Chacko, 1951; Ganapati and Pathak, 1972; Ganapati and Sreenivasan, 1966). Considering numbers of facts freshwater reservoir also looks as physical object, in view of hydrogeological and hydro-constructional feature, subsequent to the geographical position and eco-biological features are overlooked (Gecheva et al., 2013). Numbers of reservoirs are being categorized according to their real morphometry conditions (Jenkins, 1967), topographic configuration, watershed composition according to Bulley et al., 2007, trophic status, water abode time, types of use, and location specific geographical distribution.

Previous few years, investigations on list of water bodies, confined to a variety of geographic zones have been properly figure out and also summarised in diverse research articles. Along with the all types of Indian water bodies, point out may be river Ganga (Krishnamurti et al., 1991), river Narmada (Unni,1997) and several other rivers (Trivedy, 1988, 1990), Lake Dal, Srinagar (Kundangar and Sarwar, 1997), Lake Loktak (Tombi Singh and Singh, 1994), Lake Sambhar

(Gopal and Sharma, 1994), Lake Harike (Ladhar et al.,1994), Lake Wular (Trisal et al., 1994), Keoladeo Ghana National Park (Vijayan, 1994), Kawar lake (Sharma and Dattamunshi, 1995), Upper Lake, Bhopal (Agarker et al., 1994), lakes near Udaipur (Vyas et al., 1989), Kashmir lakes (Zutshi, 1989; Kaul and Handoo, 1989, 1993), high altitude lakes (Zutshi et al., 1972; Zutshi, 1991), lakes of Himalayan area (Zutshi, 1985) and many reservoirs (Sugunan,1995). These research publications showing all facets of water chemistry and biology along with the better plan for lead for conservation and management practices (Ando, 1996).

The entire Indian landscape is spotted with over 4290 big (> 15 m highest depth or > 1 million cubic meter storage space) and countless minor manmade water bodies (Sugunan, 1995; Suryanarayanan, 1996). Natural condition such fluvial environments are among the most dynamic, diverse, and complex ecosystems (Humphries et al., 2014). Water Dams are build and operated for a extensive purposes including flood manage (Angelidis et al., 2010; Miranda and Meals, 2013), hydroelectric energy production (Kankal et al., 2014 and Xiao et al., 2015), irrigations (Cobaner et al., 2008 and Sattari et al., 2012), watering of livestock, fish farming, specific navigation, and supply of domestic water (Beutel, 2003 and Altin et al., 2010).

Numbers of researcher also take chance to characterize the reservoirs (Jenkins, 1967), but few of the natural and most available is according to reservoir use type (i.e. main cause used for construction), surface area, highest age and deapth. Based on of such data/scores from existing databases (NID 2008; NRRP 1989) has been support to clear out the study. Another varied parameter showing big effects to the reservoir habitat also consist of morphometry features e.g., drainage area, growth index of shoreline (Jenkins, 1967), water maintenance (Jenkins, 1967), trophic grade (Forsberg and Ryding, 1980), location of the reservoir into a river bed (Miranda et al., 2008), and watershed features (Jones et al., 2004). Although, such score/data are unavailable for several reservoirs in present senario. Habitat science linked with the reservoir about its infancy still not developed like sufficient theoretical organization for recognizing input data requrements and systematizes these data to functioning about the external problems (Miranda, 2008).

3.1 Ecological Parameters

Several works relating to estimation on quality of water and tropic status index were carried out in varied reservoir systems (Jiang et al., 2012). Resercher also find out about a few reservoirs within India and studies were mainly focused on identifying the nutrient supply to the reservoir cause as eutrophication (Namdev et al., 2011; Mullar et al., 2010; Agarwal and Rajwar, 2010).

Consequently, the features of quality of water influence the species ability to stay in a known lotic habitat. Data of water paramenters are collect to validate the acid and base condition, trophic state (nutrient fortification) and others chemical stressors. Physical parameters consists of the light dispersion, ionic strength, water temperature whereas associated chemical parameters contain dissolved air gases, main ionic elements and nutrients viz. N, K, P and added minor and major nutrients (USEPA, 2005). Reservoirs receive significant amount of organic and inorganic substance from the upstream river (Karadzic et al., 2010) and it is modified as time passes during storage.

Temperature

Temperature is the most critical factor in the aquatic system. Oxygen quality of water in general, decreases with rise in temperature indicating diurnal as well as seasonal variations (Jhingran, 1991). The temperature of natural inland waters in temperate regions generally varies between 0^oC to 30^o C but this variation is less in tropical inland waters (Litynski, 1952 and Mikulski, 1963). Tarasenko (1977) observed an inhibition of photosynthesis by phytoplankton in heated water of Ivankovske reservoir, in the central part of the Mid Russian Upland, mainly within the Tverskaya district. Konar reservoir, situated above the Tropic of Cancer line, Jharkhand has separate hypolimnion and epilimnion during summer seasons (Natarajan, 1976). Similarly, a well-defined thermocline is reported from Gobindsagar, Himachal Pradesh (Sarkar et al., 1977; Anon., 1989).

Transparency

In general, reservoir water transparency is highest during the winter months following gradual decrease during summer due to low volume of water reaching lowest level in rainy months due to flood (Tripathi, 1982). Unni (1982) recorded low transparency during the rainy season due to

heavy inflow in Sampna reservoir. Jhingran (1991) correlated the elevated levels of DO with increased transparency of water bodies. Readings of water bodies actual depth by using of Secchi disk also showed as quantitative data and qualatitively, that is the most boardly used and oldest techniques for the transparency measurements as one of limnological parameters (LaBounty, 2008 and Naumenko, 2008).

The light penetration in water practically depends on the suspended granular matter at any water bodies (Odum, 1971). Variation in light penetration may cause more radical change in plankton production. Hart (1988) correlated changes in zooplankton composition ariation in transparency of water in turbid subtropical reservoirs. High-particulate solids indirectly affect fish production also by reducing the food availability to fish, but the extent of reduction would vary from fish to fish and based on the nature of suspended solid particles (Alabaster and Loyd, 1980). Oxidization of organic solids by micro-organisms can reduce the concentration of DO to levels at which the fish community gets asphyxiated (Rolley and Owens, 1967).

pH

pH range in normal waters determines the chemical nature and solubility of most substances. The carbonate buffer system is the chief important buffer system in the water and is primarily responsible for the maintenance of pH in aquatic ecosystems. Drastic diurnal varitions in pH may result, due to imbalances in buffer system, having potentially lethal effects on aquatic animals (Schmittou et al., 1998 and Sugunan, 1995).

Unlike Andhra Pradesh reservoirs (Das, 2000) having pH range 7.9- 9.9, reservoirs like Bergi, Gandhisagar, Sampna and Tawa (Unni, 1993) have lower pH (7.0 to 8.5) and Doyang showed still lower values than these.

Dissolved oxygen (DO)

Dissolved oxygen is crucial in many cases, serving as the limiting factor for maintaining aquatic life. DO come from the atmosphere mainly through wind action on the surface layer of water and photosynthesis in euphotic zone of the reservoirs. Research also sustained by several limnologists (Jhingran, 1991) expressed that due to higher water temperature, a marked oxygen deficiency is observed in most of the water bodies. Cornett (1989) has described the patterns of

change in oxygen concentrations of hypolimnion in twenty nine lakes. Effects of oxygen deficiency on freshwater fish species have been broadly studied by Odum (1971) and according to him a daily net production of 8 g O_2/m^2 indicate a balanced nature of an ecosystem. Other notable limnologists worked in the field of DO dynamics in aquatic systems including Hutchinson (1967), Purohit and Singh (1981), Mackie et al., (1983) besides Anumilius and Starast (1990). Das and Shrivastava (2003) observed that DO, the prime important critical factor of natural waters was relatively moderate at the surface (6.9 to 7.0 mg/l) in Doyang Reservoir, Nagaland.

Alkalinity and CO_2

Alkalinity is ability to neutralize acid, shifting the pH value towards the alkaline side. The main contributors to alkalinity in natural waters are HCO_3^-, CO_3^{--} and OH^-. The bicarbonate ions provide CO_2 to autotrophs for photosynthesis (Morton et al., 1972). Alikunhi (1957) has classified the waters having alkalinity over 100 ppm as highly productive systems. Higher values of alkalinity (>300 mg/l) also accounted to cause eutrophication (Pant et al., 1979; Singh and Swarup, 1980).

Total dissolved solids (TDS)

In freshwater ecosystem, the TDS value consists mostly of sulphates, bicarbonates, chlorides, carbonates, nitrates and phosphates of Mn, Mg, Na, K, Fe and Ca. The combined ionic strength of bicarbonate and carbonate ions create the alkalinity in water while total concentration of divalent metallic cations like calcium and magnesium is known as water hardness (Jhingran, 1991).

3.2 Fish and fishery

Fishes are most intensively investigated and Jhingran (1992) who has also included an extensive bibliography has summarized a great deal of the published information. Fish assemblages in reservoirs and lakes are mainly regulated by the water quality parameters (Carol et al., 2006). Freshwater fish assemblages around the world have been irreversibly altered in the last 100 years (Rahel, 2000, 2002; Moyle, 2002), and as we enter a new century, it is imperative to think deeply regarding the fate of our remaining aquatic heritage.

Reservoir is main threats to aquatic ecosystems showing alteration of the water quality, flow regime, habitat status and aquatic biota of river networks (Nilsson et al., 2005; Dudgeon, 2000). Considerable interest was emphasized on the impact of fish grouping on lower stream reaches (Quinn and Kwak, 2003; De Jalon et al., 1994; Merona et al., 2005) and upstream areas (Guenther and Spacie, 2006). Significant variation in fish grouping has been found after the impoundment of reservoirs. Less consideration was also given to fish aggregation in the middle zones of the reservoirs. Studies on the fish assemblages in reservoirs suggest that midway zone, which is a transitional zone in between the upstream river and lacustrine zone of the specific reservoir also significant for the better monitoring of reservoirs (Oliveira et al., 2004, 2005). The cross-sectional area has comparatively high fish density and diversity than others possibly by reason of its higher light penetration and primary productivity (Carvalho et al., 1998; Santos et al., 2010; Terra et al., 2010). However, one of the characteristics of the transition zone is its dynamic nature (Thornton et al., 1990). This zone may consist of static water, gently flowing water and running water and may be at the highest risk of experiencing water quality problems within the three zones (Scott et al., 2009), and the fish assemblages could be most seriously influenced by frequent flow regulation. Unfortunately, only fewer studies have dealt with the problems of reservoir construction on the fish assemblages (Wu et al., 2007; Gao et al., 2010), which found the immediate change of fish grouping after the confinement. It is widely recognized that the shift in fish assemblage is an inevitable impact of the impoundment (Agostinho et al., 2008).

However, species evolving in a large river ecosystem and experiencing extreme environment seem to be adjusted to the highly variable river environment (Gido et al., 2004). Findings about the contributions of several abiotic and biotic features in configuration of fish grouping have an important implication for better preservation and managing of habitats under the consequence of anthropogenic performances (Bhat and Magurran, 2007). While globally, there is a rapid decrease of bio-components causing species extinction at the regional scale and introduction of species often cause increase in species diversity (Sax and Gaines, 2003). Freshwater environments along with the prime intensively threatened by human activities, having at the equal time important proportions of range-restricted organisms and big figures of outsider individuals (Darwall et al., 2008). Among human-related alterations of freshwater environment,

dam creation is the main cause for alterations of the normal flowing system, destruction of fluvial networks, and wider distraction of sediment transportation system (Nilsson et al., 2005). Additionally, reservoirs support to the the founding of omnipresent species and assist their extend through natural habitats (Johnson et al., 2008). Scientist also recommended that, such environmental changes would lean to normalize the water reservoir along the biological communities' of riversystem, even these issues have been lightly quantified (Marchetti et al., 2004). The discussion on the role of habitat alterations and omnipresent species in biodiversity loss has gained importance in the severel few years back.

Additionally, the inland fisheries are exposing by short of research support perceptive likely additional human actions influence the production potential of reserviour and lakes (Cowx et al., 2012). Due to partial appreciative about the inland waters task, policy makers frequently not succeed to interfere during the downgrading of fisheries, awaiting the whole ecosystem has almost distorted. Focus to the special drive to an inclusive, scientific foundation for supervisory mechanism concerning the accurate management of inland freshwater aquatic ecosystems for numerous kinds of services, includes to the poverty creation, pasting of inland aquatic biodiversity and lowering of significant freshwater ecosystem services. Appropriate assessment of fisheries resources (Cowx et al., 2002), along with the supplementary services provide through inland aquatic environment, might be vital for creation best managing decision (Brummett et al., 2010).

Habitat decline mostly from severel anthropogenic actions, counting the negative fishing practices, undesirable pollution, careless water bodies' management and natural instability are cause of the fish resource degaradations with fall down in ahead of resurgence (Cabral et al., 2013). The primary ecosystem advances are significant in outsized catchment region for big freshwater lakes and river systems (Bartley et al., 2012). Regural changes and peculiar leaning in fish stocks is complex to appraise. Morevover, to assist the fisheries management practices the stock assessment procedure having for the collection of fishery production inference including the multispecies and multi gear fishery is most imperative (Asha et al., 2014).

3.3 Biodiversity of reservoirs

Numbers of issues, including the species interactions, productivity, habitat category and colonization, category and total species occuring in a specific environment and diversity are closely consistent (Dodds, 2002), therefore the decisive resource of biological diversity is in continous evolution mode. According to Cohen (1995) the ancient lakes contain with a large proportion of freshwater biodiversity. Leveque et al., (2003) worked on freshwater ecology and biodiversity within the tropics. According to Jaarsveld et al., (1998) the resourceful account of all fish species in conservation planning is challenging. O'Reilly (2006) explained about the seasonal prototype in to Hydrodynamics that influences the nutrient accessibility. Geographical remoteness and variation of environment evidently affects the global patterns of animal diversity (Qian and Ricklefs, 2012). Lehman (2000) documented the straight role of climate difference on living community to its bio-volume.

Welcomme (1998) explain the progression of planning and managing status of inland fishery system. While Sugunan (1995) and Sharma et al., (2005) recommended the protection and management actions to enhance fish production from the Indian reservoirs. As like, Linke and Norris (2003) shaped a two ways assessment merged with restoration and conservation aspect, both needed for the proper biodiversity management. Dudgeons (2003) evaluate the accurate involvement of scientific information lead to management and conservation of freshwater biodiversity in tropical Asia. Vass (2000) illisturred the biological monitoring tools designed for freshwater inland fisheries resources. As stated, the aquatic environment of India reprersent the symbolic of them undesirable of man's activities and our freshwater fisheries has not runaway the effects of the focal problem - discharge of pollutants (chemicals and wastes). Odyuo and Srinivasan (2012) figured out fisheries and its management status relates with the ornamental and food values of the Doyang reservoir.

The CBD (Convention on Biological Diversity) has abstracted the consideration to biodiversity linked issues in aquatic systems (Dehadrai and Ponniah, 1997; Gopal, 1997) though the standard knowledge on climatic change is yet to influence the country's hydrobiologists.