2. REVIEW OF LITERATURE

Water is an indispensible natural resource on earth. All life including human being depends on water. Due to its unique properties, water is of multiple uses for all living organisms. In India 77% of water is used for agricultural sector (Goyal, 1996). Out of the total water reserves of the world, about 97% is salty and only 3% is freshwater. Even this small amount is not available, but locked up in polar ice caps and just 0.003% is readily available to us in the form of ground water and surface water which were found in lakes, ponds, streams, rivers etc. (Kaushik and Kaushik, 2006; Kamble et al., 2008).

The physico – chemical characteristic of a lake or a pond depends on their size, shape, topography or climatic biological community and anthropogenic activity. Pond vary physically in terms of temperature, water current and transparency. Chemically they vary in major ions, nutrients and contaminants (Adeyemi et al., 2008). The quantity of nutrients in the water play a significant role for the survival of all living micro and macrophytes especially the penetration of light, temperature, pH, hardness, phosphates and nitrates function as influencing factors for their existence. (Rajan et al., 2007). The health of aquatic ecosystems and biodiversity are directly related to the health of almost every component in the ecosystem (Kakati, 2010). In most freshwater bodies nutrient enrichment causes eutrophication and excess growth of macrophytic vegetation also an indication of the eutrophication status of water body (Garg et al., 2010). Due to tremendous development of industry and agriculture the water ecosystem has become perceptibly altered in several respects in recent years as such they are exposed to all local disturbances regardless of where they occur. Monitoring of water quality and conservations are very important, as the pond water is used in several ways. Physico-chemical analysis of water is the
prime consideration to assess its quality for best utilization like irrigation, drinking and domestic purpose (Jawale and Patil, 2009). It not only reflects the quality of an aquatic ecosystem but also its biological diversity (Ghavzan and Gunale 2006; Tas and Gonnol, 2007). In fact such abiotic features deliberate on the health status and productivity of an ecological system are interrelated. They play a vital role in the maintenance of ecological balance. Much work has been carried out throughout the world on the ecological status of freshwater ecosystem.

Due to expanding urbanization, intensive agricultural practices and unsustainable exploitation of the wetland resources, all the physico-chemical parameters record a unusual pattern. Most of the freshwater environments are under immense anthropogenic stress like grazing encroachment, drawing of water for irrigation purpose, dumping of agricultural, domestic and municipal waste etc. In fact chemical parameters like pH, conductivity, chloride, nitrate, nitrite, phosphate were increased or decreased showing dramatic seasonal changes (Agarwal et al., 2000). Parray et al. (2010) noted the ecological characteristics of water from Salvalanga tank in Shimoga and the hydrology of Dahikhuta reservoir was reported by Shastri and Pendse (2001). Narayan et al. (2007) reported that pH, temperature, electrical conductivity, dissolved oxygen and nutrients provide the basis for judging the suitability of water for social and political developments. Nair and Rajendran (2000) pointed out the different seasonal variation of parameters and water chemistry of freshwater environment. Kanjiti wetland in Punjab was reported with special reference to physico chemical parameters by Kaur et al. (2000). Impact of sewage waters in freshwater environment with productivity and heavy metals were observed by several researches (Agarwal et al., 2000 and Yadava et al., 2008). Bio-monitoring of water qualities were stressed by Sudhiva and Kumar (2000) and seasonal
observation on different factors were pointed out by Srivastava et al. (2003) in the water bodies of Jaipur city. The effect of pH and related parameters were studied by Wang et al. (2002). Hussain et al. (2004) studied the impact of domestic waste water on Gandhi Sagar lake Bhikwara, Rajasthan, India. Khan and Shah (2004) observed the aquatic plant communities in the lakes and reservoirs of Kashmir. The diurnal variation of water quality parameters in tropical water bodies of freshwater environment was reported by Angadi et al. (2005). Sasmal et al. (2005) reported the tropical status of a lake in Himalayas and macrobenthos of lake Nainital at Uttarapradesh (Bhagat and Gupta, 2005; Gupta and Bhagat, 2005). Mir et al. (2005) noticed the impacts of Skim effluents on the water quality of Anchar lake at Kashmir. The nutrient dynamics, productivity and the potential source of freshwater environment was noticed by several researchers (Chowdhary and Mamun, 2006; Usha and Ramalingam, 2006; Bhagat et al., 2009).

The problem of pollution in the freshwater system in our country is mainly due to industrialization and population expansion. In India only 2% of the present population is provided with sewage facilities and only about 25% of the total sewage is produced in cities (Rao et al., 2004). Pollution caused by sewage mixing, municipal waste, urban run off and dense uncleaned macrophytes made the freshwater into polluted nature (Garg et al., 2006 a and b). Mahananda et al. (2005) has explained the physico chemical factors as indicators of pollution. A contribution on the hydro-chemical evaluation of ground water quality and the assessment of lentic water bodies were made by Ramachandra and Solanki et al. (2007) and Kumar et al. (2009). The biogenic element concentrations in the water of a small pond was reported by Szyperek (2010) and the concentrations of phosphate, nitrate and potassium were determined.
Studies on the role of sediment in a natural water body are vital for understanding an aquatic system particularly the process like element cycle, transportation of nutrients and contaminants and the preservation of water quality (Arunkumar and Joseph, 2007). The occurrence of higher level of nutrients and trace metals in the bottom sediments can often be attributed to anthropogenic influences rather than natural enrichment of geological weathering (Davies et al., 1991). As the sediments are rich in minerals, their heterogeneous nature, with inorganic particles provide an important ecological information (Vanguinter et al., 1997). The structural composition remains significant with carbon, nitrogen, phosphate, organic carbon etc. Soil microorganisms play a significant role in the decomposition process in the bottom region of the aquatic ecosystem (Misra and Dhar, 2004). Temporal and spatial variation along with the influence of different seasons affect the status of nutrient level and mineralization process in the sediment. Studies on seasonal variation in the parameters of soil in Naga Panchayat pond in Chitrakott was observed by Garg (2002), Choudhary et al. (2000) assessed the role of submerged macrophyte and sediment accumulation of lake and studied the biochemical properties of *Eichhornia crassipes* under eutrophic condition.

Sediments contain high levels of heavy metal contaminations in the water bodies and they act as indicators of pollution problem (Anand and Sharma, 2000). Different activities of human beings created adverse effects on all living organisms causing pollution. Govindasamy et al. (2000); Sivakumar et al. (2000), Madhusudan et al. (2000) and Mohanraj (2001) have contributed the study of heavy metals in various lentic water bodies of Tamil Nadu. Mishra and Tripathi (2008) reported the removal of heavy metals by three macrophytes. Zhao et al., (1999) and Antunes,
et al. (2001) studied the accumulation and effects of heavy metals by *Azolla filiculoides*.

Anthropogenic activities like mining, ultimate disposal of treated and untreated waste effluents containing toxic metals as well as metal chalets from different industries, (e.g. tannery, steel industries, battery industries, thermal power plants etc.,) indiscriminate use of heavy metal containing fertilizers and pesticides in agriculture also resulted in deterioration of water quality rendering serious environmental problems to human beings (Srivastara et al., 2000; Amman et al., 2002; and Papastergious, 2007). Begum *et al.* (2008) analysed the nutrients and heavy metal profile of Madivala lake in Bangalore.

Toze (2006) studied the bioavailability and accumulation of heavy metals and phosphorus in agricultural soils amended by long term application of sewage sludge. Rai *et al.* (1995) explained the heavy metal pollution in aquatic ecosystem and its phyto remediation using wetland plants. Heavy metals are polluting the air, soil and water (Srivastara and Purnima, 1998). However they play an important role as essential elements (Kunz *et al.*, 2001). The non-essential metals such as Cd$^{2+}$, Hg$^{2+}$ and Pb$^2$ are toxic for plants. From last few years, a great interest has been shown for research on macrophytes as bio indicators for heavy metals in aquatic ecosystems. (Aoi and Hayashi, 1996; Maine *et al.*, 1999). *E. crassipes* has a huge potential for removal of the pollutants from waste water. (Maine *et al.*, 2006; Magabeira *et al.*, 2004).

Brankovic *et al.* (2010) reported the concentration of some heavy metals by aquatic macrophytes in the reservoir near the city of Kragujevac (Serbia). Kumar *et al.* (2011) viewed the assessment of heavy metal pollution caused by macrophytes, water and sediment of a tropical wetland system using hierarchical cluster analysis.
technique. Hg, Cu, Pb, Cd and Zn accumulation in macrophytes growing in tropical wetland was studied by Nunez et al. (2011).

Macrophytes are considered as important components of the aquatic ecosystem not only as food source to aquatic organisms but also they act as an efficient accumulator of heavy metal (Chung and Jeng, 1974). Most of the aquatic weeds were used for waste water treatment as they have fast growth, high biomass production, and have the ability to accumulate nutrients and heavy metals. Ganjo and Khwakaram (2010) has observed that the aquatic macrophytes were function as biological purifiers. They also play an important role in metal accumulation via absorption, cation exchange and through plant induced chemical changes in the rhizosphere. All over the world, the accumulation of metals in sediment and macrophytes of contaminated water was reported by several workers (Cardwell et al., 2002; Bini et al., 2005; Ratushnyak and Trushin, 2007; and Dar et al., 2011).

From contaminated water Narain et al. (2011) has reported that the aquatic plant water hyacinth has the ability to remove chromium and cadmium. As copper is not only a essential element for plant but it is highly phytotoxic at high concentration. (Brankovic et al., 2010). In different countries copper level of different aquatic plants in unpolluted region was reported by Prasad et al. (2001). Jafari and Akhavan (2011) showed that dead biomars of *Lemna minor* accumulated higher levels of Zinc. Most of the roots of aquatic plants accumulate Pb and higher metal concentration in the roots of *Typha latifolia* was pointed out by Ellis et al. (1994). Shrestha et al. (2010) reported the effect of copper on the growth of *Elodea canadensis*. Zurayk et al. (2002) made a study on phyto accumulation of Nickal in *Mentha aquatica* and *M. sylverstris*. 

In freshwater habitats especially in shallow lakes and wetlands macrophytes play a vital role in determining the structure and function of ecosystems by virtue of acting both as “nutrient sinks” and “nutrient pumps”. The nutrient enrichment of water bodies not only create changes in the biomass of aquatic plants but also alter their species composition and community features (Kamal et al., 2004). Rolli et al. (2006) explained that a good number of hydrophytic plant commonly with a wide range of habitats depending on the available source of moisture and minerals in the soil.

Wetland plants vary greatly in their degree of metal uptake (Hadad et al., 2006 and Maine et al., 2006). Several factors were involved in the metal accumulation (Yu and Gu, 2007a, b and 2008). Accumulation of Hg, Cu, Pb, Cd and Zn by the macrophytes growing in wetlands occur in the decreasing order as Zn>Cu>Hg>Pb>Cd (Nunez et al., 2001). Moreover aquatic plants play a key role in balancing water bodies. They are capable of acquiring large quantities of trace elements and heavy metals. The uptake of trace metals often increased when plants were grown in effluent water containing high levels of micronutrients (Zhang et al.,
The accumulation of heavy metals like cadmium, copper, zinc, lead and nickel from soils and aquatic weeds like *Typha latifolia*, *Polygonum microcephalum* and *Pistia stratiotus* were observed by several researches. Taylor *et al.*, 1983; Satyakala and Kaiser, 1997; Tang and Dang 2001; Stoltz and George, 2002; Sune *et al.*, 2007).

Submerged plants with small leaves provide ample structure, whereas floating plants provide little submerged surface, but support animals such as amphibians and water birds (Shamel *et al.*, 2011). The role of aquatic plants in phytoremediation technology is also a well established fact (Skimmer *et al.*, 2007). Aquatic ferns in particular exhibit exorbitant potential to remove various contaminants, including organic compounds, radio nuclides, heavy metals from the environment (Benaroya *et al.*, 2004; Stepniewska *et al.*, 2005; Sune *et al.*, 2007). The potential use of *Salvinia* in heavy metal removal has been studied extensively (Olguin *et al.*, 2005 and Molisani *et al.*, 2006). Among various *Salvinia* species *S. minuta* is considered as a hyperaccumulator of lead and cadmium (Olguin *et al.*, 2002). Its potential use in phytoremediation was also reported by Dhir (2009).

Aquatic weeds have been reported to be a good source of organic fertilizer or bio-fertilizer. Most of them contain nitrogen, potassium and phosphate. They are important in water holding capacity and helps in improving soil texture (Majid *et al.*, 1984). Developing countries like India, Bangladesh, Pakistan, Thailand etc., have utilized aquatic weeds in the production of bio-gas and the liquid sludge is an organic fertilizer and soil conditioner equivalent to compost (Watanabe and Lin., 1984).

Most of the weeds are good source of protein may be incorporated into the diet of herbivorous live stock. Water hyacinth is consumed by buffaloes and cattles. Several species of fishes and birds were also fed on aquatic weeds, as they provide
moisture, protein, nitrogen, phosphorus and potassium. Macrophytes were used to indicate the trophic status of freshwater environment and Kopeck et al. (2010) has reported 22 species of aquatic weeds as bio-indicators. Several reporters have pointed out the genus like *Utricularia, Elodea, Lemna, Potamogeton, Carex, Typha* and *Ceratophyllum* were the major indicator plants. (Azaïzeh et al. (2006)). In many countries tests are performed to choose indicatory plants and based on their occurance surface water eutrophication was assessed (Szoszkiewiez et al., 2006) and collected macrophytes with the Mean Trophic Rank (MTR) method with reference to physico-chemical parameters of water. *Utricularia intermedia* and *Glyceria fluitans* were added in addition as indicator plants. *Eichhornia crassipes, Ludwigia helminthorrhiza* and *Polygonum punctatum* were prepared as Cu and Zn phytoremediators (Nunez, 2011). Eventhough macrophytes are important metal accumulators in wetlands sediment is the main metal compartment due to the fact that its total mass is greater than the corresponding plant biomass in a green area (Yu and Gu, 2008 a and b). Genus like *Aphanocapsa, Anabaena, Merismopedia Chrococcus* and *Oscillatoria* were grown over *Ceratophyllum, Elodea, Myriophyllum* and *Pistia* species (Bhattacharya et al., 2011).

**Vermicomposting**

Fertilizers play a major role in agricultural out put. The excess use of chemical fertilizers and pesticides have made depletion of soil microorganisms and create environmental hazards which affect human health and environment (Nath et al., 2009). Several tons of animal waste, agro and kitchen wastes were produced annually with unpleasant odour and causes pollution problems (Gupta, 2006 and Garg et al., 2006). Much attention has been paid in recent years to
manage different organic waste in an eco-friendly basis as resources of low input value. Vermicomposting, through earthworm, is an ecobiotechnological process that transforms energy rich complex organic substances into stabilized vermicompost (Bentize et al., 2000), in providing organic fertilizer for plants and discouraging the use of synthetic chemical fertilizers.

In India, most of the metropolitan cities are dumping enormous quantities of municipal solid wastes (MSW), market perishable wastes, animal and other composite wastes. The degradable waste such as organic, household, market, coir pith, industrial waste from hotels and hostels are being dumped on the roadsides and in other common localities, causing serious environmental problems transmitting diseases to human beings as well as to the livestock. Recycling and reuse of the degradable wastes by appropriate technology would minimize the problems caused by these wastes. Vermicomposting does not need sophisticated instruments and involves less work and time. It creates job opportunities in rural, urban and coastal areas providing additional income to the rural women and unemployed youth by giving an alternate source of monthly income by this process.

Agro-industries account for the production of large quantities of wastes from coir, paper, dairy, biscuit, fruit pulp wastes from stems, leaves and flowers used in aromatic oil extraction units. Apart from sugar and alcohol as primary products, sugar industries and fermentation units also produced many by-products such as pressmud, bagasse, distillery waste, boiler ash and fermentation yeast sludge. All these waste serve as excellent source of nutrients to earthworms (Bhawalkar and Bhawalkar, 1992). Bio-conversion of biogas slurry and municipal wastes was converted into eco-friendly manures by vermicomposting techniques.
All living plants decayed and produced rich humus with high organic matters. They are used for the growth of cereals, pulses, vegetables and horticultural plants. Several microorganism were involved in the degradation process. Vermicompost are produced by the fragmentation of organic waste by earthworms, have a fine particulate structure with nutrients, readily available for plant growth (Atiyeh et al., 2000).

Earthworms accelerate the decomposition of organic matter directly by consumption and indirectly by incorporating organic matter into soil and stimulating microbial activity in cast and burrows (Edwards and Steele, 1997). Edwards and Lofty (1977) reported that earthworms can consume 10 – 30% of their own biomass per day. The action of earthworm Eisenia fetida with beneficial microorganisms worked upon the substrates and brings the nutrient value more.

The vermicompost which is the granular aggregate of vermicasting is reported to be rich in plant nutrients (Edwards and Burrows, 1988). The quality of organic matter in the soil is the key to optimum plant nutrition. Among the available source of organic manures vermicompost is a potential source due to growth enhancing substances and number of beneficial microorganisms like N₂ fixing, P – solubilizing and cellulose decomposing organisms Bansal and Kappor (1997). Ndewga and Thompson (2001) reported the bioconversion methods in solid waste and Sundberg et al. (2004) explained the increase of composting may be due to the direct action of microbes and the addition of environmental factors helps to increase the decomposition rate and to conserve nitrogen. Vermicompost is known to contain all the essential plant nutrients and gives steady supply of these nutrients during entire crop period, leading to better growth and development on yield attributes. Garg and Gashik (2005). Baran et al. (1996) reported clay and red soil amended with vermicompost showed that the root weight was increased in red soils whereas the clay
soil with vermicompost has no change in root weight. Shanthi and Kurian (2010) showed the importance of vermicompost and its nutritive efficiency for better plant growth, enhanced yield, and biochemical aspects in *Arachis hypogea*. The effect of vermicompost on soil bacterial and fungal population in rice crop was reported by Swetha *et al.* (2011). Sannigrahi (2009) has used *Eichhornia crassipes*, *Pistia stratiotes*, and *Typha angustata* in vermicomposting using *Perionyx excavates* earthworms. These compost recorded 0.71 to 1.36% of total nitrogen, 0.38% to 0.75% of total phosphorus, and 0.86 to 1.44% of total potassium indicating its good quality as organic fertilizer. The successful vermicompost of water hyacinth was studied (Saini *et al.*, 2008; Ansari, 2009 and Chauhan *et al.*, 2010) with or without combining with other substrate while the application of vermicompost of water hyacinth was studied on various species of plants and fishes. (Rakshit *et al.*, 2008; and Chakrabarty *et al.*, 2009).

In general vermicompost improves soil structure, increasing water holding capacity and porosity which facilitate the root respiration and growth (Lee, 1992; Parthasarathi *et al.*, 2008). The beneficial effect of vermicompost on crops like Sorghum (Sheeba *et al.*, 2011), wheat (Sharma and Madan, 1988), Strawberry (Singh *et al.*, 2008), Petunia (Araneon *et al.*, 2004), marigold, pepper, cornflower, and tomato and black gram (Parthasarathi *et al.*, 2008) have been reported.

Sugar factory waste (Lakshmi and Vijayalakshmi, 2000), pig solids (Dominguez 1997) and sludge (Parvaresh *et al.*, 2004) were converted into good quality vermicompost by the different species of earthworms.

Earthworms voraciously feed on organic wastes and while utilizing only a small portion for their body synthesis they excrete a large part of these consumed waste materials in a half digested form. Since the intestines of earthworms harbour
wide ranges of microorganisms, enzymes, hormones, etc., these half digested material decompose rapidly and is transformed into a form of vermicompost within a short time (Edwards, 1972 and Kale et al., 1982).

Earthworms are one of the major soil macro invertebrates and are known for their contributions to soil formation and turnover with their widespread global distribution (Norbu, 2002). It plays a significant role in decomposition due to their symbiotic relationship with bacteria. As earthworms ingest and digest organic matter, they also take in microorganisms and metabolize them. When the organic material passes through the gut of the earthworm it again increases the surface area of the material so that the microorganisms can break it down further. The undigested materials, or castings are fertile and rich in nutrients (Hansen, 2007). Earthworms were successfully employed in the decomposition of sugar factory residuals which turned them into soil nutrients that helped farmers to reduce chemical fertilizers by 50 percent (Logsdon, 1995).

There are about 3,000 species of earthworms distributed all over the world and about 384 species are reported in India (Julka, 1986). Most earthworms are terrestrial organisms, which live in the soil; and is lead a comfortable life in estuarine water also. In India some peregrine species like *Microscotex phosphoreus* are even 20 mm long while some endemic geophagous worms such as *Drawida grandus* reach up to 1 metre in length (Sharma et al., 2005).

Based on their feeding habits they are classified into detrivores and geophagous (Lee, 1985). These worms are called humus farmers and comprises epigenic and anecic forms. *Perionyx excavatus, Eisenia fetida, Eudrilla euginae, Lampito mauritii* and *Polypheretina elongata* are few types of detrivores.
Geophagous types of worms are feeding beneath the surface ingest large rich soil. *Metaphire posthuma* and *Octochaetona thurstomi* are the two common examples.

The vermicomposting through different species of earthworm has been studied (Kale *et al.*, 1982 and Edward *et al.*, 1998). The epigeic earthworm, *Eisenia fetida* (Savigny) is a suitable species for management of wastes which are utilized successfully in vermicomposting (Chaudhari and Battacharjee, 2002; Gunadi and Edwards, 2003). The suitability and potential use of *E. fetida* to manage animal, agro and kitchen wastes with the production of vermicompost and vermiwash has already been established.

The use of industrial waste for the process of vermicomposting has increased tremendously (Collier, 1978; Giraddi, 2000 and Giraddi *et al.*, 2002). Earthworms occur diverse habitats, organic materials like manures litter, compost etc. are highly attractive for earthworms but they are also found in very hydrophilic environment close to both fresh and brackish water, some species can survive under snow. Most of the earthworms are omnivorous. (Levelle, 1983).

Being rich in microflora vermicompost has been found an ideal organic manure enhancing biomass production of a number of crops, in agriculture, horticulture, soil conservation and waste management (Edwards, 1995; Hidalgo, 1999; Kaviraj and Sharma, 2003).

All, over the world aquatic weeds are considered as big menace, for reducing fish production, for deteriorating potable water quality, for binding free flow of water navigation as well as water sports, for increasing loss of water through “evapotranspiration” and for spreading mosquito and snail borne human and animal diseases (Gupta, 1987). About 40% of cultivated fishery waters in India are rendered
unproductive because of aquatic weeds. Singh (2000) has used different technologies for controlling the weeds. Several workers (Sluyters, 1976 Gaur et al., 1984; Mukhapadhyay and Hossain, 1990; Gajalakshmi et al., 2001, and Sannigrahi et al., 2002) have reported that good quality compost can be prepared from the aquatic weeds like water hyacinth. Gajalakshmi and Abbasi (2002) recorded the beneficial impact of water hyacinth in vermicomposting. Among the several weeds Salvinia exhibit great capacity for removing contaminants such as inorganic nutrients, heavy metals, high productivity, explosives from waste waters and high metal removal potential and hence different species of Salvinia was utilized in phytoremediation technology. Salvinia natans accumulate copper (Mukkerjee and Kumar, 2005) S.auriculata suck mercury (Molisani et al., 2006) and Sune et al. (2007) reported cadmium and chromium metals were deposited in S.herzogii. Hoffmann et al. (2004) reported the accumulation of arsenic and lead by Salvinia minima. The aquatic weed Azolla function as a potential source in removing lead and cadmium (Stepniewska et al., 2005). The heavy metal cadmium and chromium was removed using two aquatic weeds were studied (Sune et al., 2007). Salvinia natens accumulate large amount of cadmium from the aquatic environment was high lighted by Xu et al. (2009). It has been discovered that water hyacinth’s quest for nutrients can be turned in a more useful direction in cleaning up municipal and agriculture waste water (Begam and Harikrishna, 2010). Vermicomposting technique may be one of the solution for management and the prepared vermicompost from water hyacinth remained satisfactory (Shrestha and Tomrakar, 2010). Several researchers reported the nutrient composition of vermicompost which varies depending upon the waste materials used during the feeding process of earthworms (Ismail, 1997). Gajalakshmi et al., (2005) Mazur et al. (2000) studied the chemical composition of
vermicompost and its effects on crop plants. Bansal and Kapoor (2000) reported the micro and macronutrients of vermicompost and Aira et al. (2002) observed high levels of NPK in vermicompost which increased the growth and yield in several crop plants. Large scale utilization is the only way to control noxious aquatic weeds which require no tillage, fertilizer, seeds or nourishment for their proliferation. Information on nutritional status of vermicomposts prepared from different aquatic weeds will be more helpful to motivate farmers to utilize these vast resources for better crop production (Sannigrahi, 2009). Several crop plants especially pulses have been utilized by the application of vermicompost which improves the quality, quantity and nutritional values. *Vigna mungo*, an economically important crop was applied with bio-fertilizers and their responses were reported by Selvakumar et al. (2009) and Hussain et al. (2011). The effect of rhizobium on *Vigna mungo* was reported by Vijila and Jebaraj (2008) and Delic et al. (2009). The earthworm *Eisenia fetida* is commonly used in vermiculture farm and the farmers used to the growth of plants like *Vigna mungo, Vigna radiata* and *Sesamum indicum* to increase the yield (Hatti et al., 2010). *Vigna mungo* is a common pulse crop of this district and keeping these in view the present study was conducted to prepare vermicompost from the eight common aquatic weeds of Kanyakumari District and tried to find out the yield responses.
Fig. 1.2 Experimental Design

Eight Freshwater ponds of Kanyakumari District

- Vilavancode
  - P<sub>1</sub> and P<sub>2</sub>
- Kalkulam
  - P<sub>3</sub> and P<sub>4</sub>
- Thovalai
  - P<sub>5</sub> and P<sub>6</sub>

**Physico-chemical parameters**

- Water
  - Temperature
  - pH
  - EC
  - DO
  - BOD
  - Nitrite
  - Nitrate
  - Phosphate
  - CO<sub>2</sub>
  - Calcium
  - Magnesium
  - Total Alkalinity
  - Chloride
  - Sodium

- Sediment
  - pH
  - EC
  - Organic carbon
  - Nitrogen
  - Phosphorus
  - Potassium

**Heavy metal Analysis**

- Sediment
  - Zinc
  - Copper
  - Chromium
  - Lead
  - Cadmium

- Water
  - Aquatic weeds
    - *Trapa natans*
    - *Hygrophila auriculata*
    - *Utricularia gibba*
    - *Jussiaea repens*
    - *Azolla pinnata*
    - *Salvinia molesta*
    - *Ceratopteris thalictroides*
    - *Marsilea minuta*