CHAPTER-5

GENERAL DISCUSSION

5.1 Inventory of village ponds

An inventory of ponds in India needs to be prepared for which, however, extensive survey is needed (Kumar and Padhy, 2015). There are some national and international studies related to inventory of standing freshwater bodies mainly includes Hughes et al., 2004; Bruck et al., 2010; Panigrahy et al., 2012; Verpoorter et al., 2014. The inventory of village ponds is very important. It can help in management and conservation of small fresh water bodies.

There are very few studies on the inventory of village ponds of the state Haryana were available. In the present study, the villages of the district were surveyed and an inventory of village ponds was prepared. Inventory mainly includes the origin, shape, size, nomenclature and number of village ponds. From the survey, it was reported that there are approximately 982 village ponds in the district at present time. The number was approximately 1024 in the past. Maximum number of village ponds were reported in Chhara village (32) followed by Matanhail (23) and Manthothi (16). From the results, it was observed that there is a decrease in number of village ponds with time. It is mainly due to encroachment and land use change (Figure-5.9). Further, it was also concluded that the main cause of degradation of village ponds is not due to the decrease in the number village ponds but it is due to pollution of village ponds.

The nomenclature of village ponds were based upon the name of person, age of pond, community (Pana), caste, religion, name of the tree, features of ponds and location of ponds (Table-5.1). Most of the village ponds were 1-8 acre in size and 3-8 feet deep. The origin of village ponds was mainly due to depression of land which leads to collection of rainwater and they are converted in to ponds. In some villages, it was also found that the people used to take the clay soil for pot making, Chullha making and many other purposes and that depression ultimately converted in to ponds.
### Table 5.1: Nomenclature of village ponds in district Jhajjar

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Nomenclature of village ponds</th>
<th>Examples and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On the basis of names of deities</td>
<td>Shive mandir johar, Puranmal johar, Bhiyawal johar, Panchpeera johar, Guga johar, Baba Langadiya johar, Baba Haridas etc.</td>
</tr>
<tr>
<td>2</td>
<td>On the basis name of caste or community</td>
<td>Bamanwala, Harijan johar, Balmiki johar etc.</td>
</tr>
<tr>
<td>3</td>
<td>On the basis name of a person</td>
<td>Kalawala, Harjawala, Babluwala, Daswala, Devkadas johar etc.</td>
</tr>
<tr>
<td>4</td>
<td>On the basis of name of tree</td>
<td>Neemwala, Badwala, Peepalwala etc.</td>
</tr>
<tr>
<td>5</td>
<td>On the basis of use of the ponds</td>
<td>Dhobiwala, Kui wala, Machhiwala etc.</td>
</tr>
<tr>
<td>6</td>
<td>On the basis of location of village ponds</td>
<td>Gamwala, Schoolwala, Baniwala, Firniwala etc.</td>
</tr>
<tr>
<td>7</td>
<td>On the basis of their size and origin</td>
<td>Bda johar, Chhota johar, Nya johar, Purana johar etc.</td>
</tr>
<tr>
<td>8</td>
<td>Miscellaneous</td>
<td>Khudana: On the basis of source of clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gandewala: On the basis of poluted water</td>
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<tr>
<td></td>
<td></td>
<td>Piliya johar: Medicinal use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tijawala: Festival</td>
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<tr>
<td></td>
<td></td>
<td>Bhindawas johar: Source of water Bhindawas lake</td>
</tr>
<tr>
<td></td>
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<td>Pakka or Kachha johar: On the basis of their feature</td>
</tr>
</tbody>
</table>
Uses of village ponds

The village ponds are very important for rural society. They are used for various purposes by villagers. In District Jhajjar ponds are used for cattle drinking, fishing, religious, medicinal, irrigation, as a source of clay for making chulhas and pots (Figure 5.1).

Source of water in village ponds

It was also reported that the main source of water in village ponds is rainwater (55.90%) followed by canal (35.45%) and tube well (4.09%) (Figure 5.2).
5.2 Physicochemical analysis of village ponds

**pH analysis:**

The pH of water is the measure of alkalinity and acidity of water. Most of the biological and biochemical process of water bodies are affected by pH (Arya *et al.*, 2011). Accumulation of free carbon dioxide due to little photosynthetic activities of phytoplankton will lower the pH value of the water while intense photosynthetic activities of the phytoplankton will reduce the free carbon dioxide content resulting in increased pH values (Singh and Gupta, 2014). High value of pH during pre-monsoon season may be due to high evaporation rate. Some previous reports by Jakhar and Rawat, (2003); Jene *et al.* (2013); Kumari *et al.*., 2017 and Mishra, 2017 have close conformity with our results. The low pH values during monsoon may be due to dilution caused by the rainwater. In most of the pond samples, pH of water was alkaline in nature. Our results are in agreement with Kahate and Khan (2017) and Dubey (2017).

**Temperature analysis**

Temperature plays a very important role in fresh water ecosystems (Singh and Mathur, 2005). The physicochemical and biological behaviour of any aquatic ecosystem largely depends upon temperature (Dwivedi and Pandey, 2002). As the water temperature increases it result in decrease in dissolved oxygen and high respiration rate of aquatic organisms. Our results showed maximum temperature in pre-monsoon, moderate in post-monsoon and minimum in monsoon season. This trend is followed because the water temperature depends upon change in intensity of solar radiation. The similar results were also obtained by Chaurasia and Pandey, (2007); Shrivastva and Kanugo, (2013); Mishra *et al.* (2013); Dhanlakshmi *et al.* (2013); Verma and Khan, (2015); Kumari *et al.* (2017) and Yadav and Singh (2017).

**Colour and odour analysis**

The colour and odour are also important indicators of water quality of any aquatic ecosystem (Dhanlakshmi *et al.*, 2013). Though colour does not affect the aquatic organism directly, but it restricts the light penetration and reduces aquatic plant’s growth (Olopade, 2013). In fresh water resources, the colour of water may be due to the presence of humic acids, fulvic acids, metallic ions, suspended matter, plankton, weeds and different types of industrial effluents. Pure water is colourless and water with colour is the indication of contamination (Dami *et al.*, 2012).
The results show green and light green color of most of the pond water samples in this context, our results are in concordance with Munni et al. (2013); Ramakrishna and Jayanthy, (2015); Chauhan et al. 2017. The green color represents higher planktons, and light green color represents low planktons level (Das, 1997). Some ponds (S12 and S23) have water brown in color this may be due to the high amount of dissolved solid as mud or the presence of dead plant materials. In this context, our results are in concordance with Selvamohan et al., 2014; Parveen et al., 2017. In some ponds, the color water was found turbid in monsoon season. In this context, results are in agreement with Sudani, (2015); Olopade (2013). Some ponds have transparent water that means there is no dissolved particle and detrained plant material.

The odor of the water may be due to the organic and inorganic contaminants in water (Chindo et al., 2013). According to Indian standard, 10500 (2012) the acceptable limit for water odor is agreeable (no odor). Most of the ponds of the study area have dumping of village waste water and therefore bear foul smell.

**TDS analysis**

Total dissolved solids (TDS) gives indication of the salinity behavior of water and it describes all solids particularly mineral salts that are dissolved in water. In the present study maximum value of TDS was recorded in S23, it was mainly because of ongoing construction work around this pond. Most of the ponds showed maximum TDS in pre-monsoon, moderate during post-monsoon and minimum in monsoon season. High value of TDS during pre-monsoon season may be due to high evaporation rate. Some previous reports by Sahni and Yadav (2012); Yadav et al. (2013) also obtained the similar results.

In pond samples number, S22 and S24 (2014) and S1, S6, S7, S9, S16 and S18 (2015), the high value of TDS was reported during monsoon in comparison to pre-monsoon. It may be due to addition of domestic waste water, garbage and sewage etc. during monsoon. Our results in this context show agreement with Chaurasia and Pandey (2007) and Dhanalakshmi et al. (2013). Increased level of TDS is the indication of increase in nutrient level and that result into eutrophication of aquatic bodies (Swarmlata and Narsigharao, 1998; Singh and Mathur, 2005; Verma et al., 2012).
**Conductivity analysis**

Conductivity is the capacity of water to carry electric current. It mainly depends on the presence of relative concentration of ions their mobility, valence and on the temperature of the liquid. In present study, most of the ponds have high value of EC during pre-monsoon season. During pre-monsoon period, the amount of salt accumulates because of comparatively high temperature and therefore high rate of evaporation (Talling and Talling, 1965). During pre-monsoon, high temperature compel the livestock’s to frequently visit these water bodies, their urination and other excretes inside the pond water are also responsible for increase in total ions concentration. Our results are in concordance with the similar studies conducted in different part of India (Chaurasia and Pandey, 2007; Baruah and Kakati, 2012; Mishra et al., 2013; Qureshimatva et al., 2015a) It was interesting to note that some pond samples (S1, S6, S7, S9, S16, S18, S22 and S24) showed high conductivity during monsoon than pre-monsoon. The results are in agreement with Hulyal and Kaliwal (2011), Dhanalakshami et al. (2013), Ramulu and Benarjee, (2013), Choudhary et al. (2014) and Luharia et al. (2016). The fluctuations in EC in different seasons is due to fluctuation in total dissolved solids (TDS) and salinity (Pandey and Pandey, 2003; Olukunle and Oyewumi, 2017)

**Turbidity analysis**

Turbidity of water is due to the amount of particulate matter that is suspended in water. It measures the scattering effect of light that suspended solids have after facing light. Therefore, higher the turbidity, higher will be the intensity of scattering light. The fresh water bodies may get contamination from soil runoff that increase the turbidity and is the measure of cloudiness of water (EPA, 2000; Schwartz et al., 2000). The acceptable limit of turbidity for drinking water is 1NTU and permissible limit 5 NTU (Indian standard, 10500, 2012). In the present study all the water samples have higher turbidity when compared with the Indian standard acceptable limits of drinking water. The results are in agreement with Gopi et al., 2017. In most of the samples the turbidity was higher in pre-monsoon in comparison to monsoon and post monsoon seasons. Our results are in concordance with Qureshimatva and Solanki, 2015b. The high value of turbidity during pre-monsoon may be due to growth of aquatic vegetation and low volume of water (Kumar and Ravindernath, 1998). In some ponds water samples including S1, S9, S11, S14 and S15 (2014) and S1, S8, S14 and S16 (2015), the high value of turbidity was reported during monsoon in comparison to pre-monsoon. It may be due to addition of domestic waste water, garbage and sewage etc. during monsoon season. Our results are in agreement with Mohammed et al. (2017) in this context.
CHEMICAL PARAMETERS

Chloride analysis

Chloride anions are naturally occurring ions in potable and industrial water. It has no adverse effect on health, but imparts bad taste to drinking water. Its higher concentration in freshwater bodies is an indication of pollution by domestic sewage. Their high concentration in natural freshwater bodies is mainly due to anthropogenic impacts. In the present study maximum concentration of chloride in pond sample S23 was recorded because of construction work around the pond. Most of the ponds showed maximum chloride concentrations in pre-monsoon, moderate in post-monsoon and minimum in monsoon season. Our results were supported by Khabrade and Mule (2005); Mirza et al. (2006); Misra et al. (2013). The high concentration of chloride during pre-monsoon and low during monsoon season may be due to shrinkage of area of water during pre-monsoon and dilution effect during monsoon season. It may also be due to frequent visit of livestock’s during pre-monsoon due to high temperature, therefore direct mixing of cattle dung during this season. The higher concentration of chloride is considered to be an indicator of pollution due to higher organic waste of animals and human origin (Misra et al., 2013; Mahobe and Mishra, 2013; Dubey, 2017).

In some pond samples S6, S11, S15 and S21 (2014); S13 (2015) the concentration of chloride were high during monsoon in comparison to pre-monsoon season. This may be due to dumping of organic matter from catchment area with rainwater during monsoon season. In this context our results were supported by some previous studies including Tidame and Shinde (2012), Shiddamallayya and Pratima (2008) and Yadav et al. (2013).

Sulphate analysis

Sulphate is also a naturally occurring ion in freshwater bodies. As the previous trend of chloride, the sulphate concentrations were also high during pre-monsoon, moderate during post monsoon and lower during monsoon season. The high value of sulphate during pre-monsoon may be due to low water level during pre-monsoon. The results were supported by Agarkar and Garode (2000), Shinde et al. (2010), Tidame and Shinde, 2012, Mahobe and Mishra, 2013.
The samples $S_4$ and $S_{23}$ have higher concentration of sulphate in monsoon in comparison to pre-monsoon season during 2014 and 2015 respectively. The similar results were also obtained by Brahmbhatt et al. (2012) and Akintoye et al. (2014). The higher concentration of sulphate during wet season may be due to run-off water from the land to the water body. It may also be due to water-hyacinth mat during rainy season (Aneja and Singh, 1992).

**Bicarbonate**

Alkalinity is the measure of water capacity to neutralize the acid. Total alkalinity is the sum of carbonate, bicarbonate and hydroxide ions. The release or uptake of carbon dioxide by living organism may change the proportion of bicarbonates and carbonates in water (Boyd, 1982) Bicarbonates are the major anions responsible for alkalinity in pond water samples. Most of the ponds showed maximum bicarbonate concentrations in pre-monsoon, moderate in post-monsoon and minimum in monsoon season. The results are in concordance with Mansoori et al. (1992) and Chaurasia and Pandey, (2007); Mahobe, (2013).

In some pond samples including $S_2$, $S_{12}$, $S_{15}$ and $S_{17}$ (2014), $S_{19}$ and $S_{25}$ (2015) the concentration of bicarbonate was high during monsoon in comparison to pre-monsoon season. Pandey and Shukla (2005) reported that in highly productive water the alkalinity will also be high. The similar results were also obtained by Olopade (2013).

**Carbonate**

The main contributors to alkalinity in natural waters bodies are carbonates, bicarbonate and hydroxide. The carbonate concentration in any aquatic ecosystem depends upon free carbon dioxide in the water (Munawar, 1970). The carbonate was found nil in most of the water samples, our results are in concordance with Sahni et al., 2012; Anjali and Tank, 2013. The water tends to be more alkaline if it contains more carbonate and less alkaline if it contains large quantity of bicarbonates, carbon dioxide and calcium (Kumar et al., 2008)

**Calcium analysis**

Calcium is an essential nutrient for aquatic organisms being a cell wall constituent and regulatory factor for many physiological functions. It is commonly found in all natural water bodies (Chourasia and Adoni, 1985; Ansari and Prakash, 2000). Calcium is responsible
for hardness of water. The general trend of calcium concentration was similar to chloride and sulphate as high during pre-monsoon, moderate during post-monsoon and low during monsoon. It may be due to high evaporation rate during pre-monsoon and dilution effect during monsoon. The results were supported by Hulyal and Kaliwal (2011), Brahmbhatt et al. (2012), Tidame and Shinde (2012). The low level of calcium reported during winter season may be due to calcium absorbed by aquatic organisms during this period for shell construction (Qureshimatva, 2015). Higher calcium content in drinking water cause incrustation in water supply and adversely affected domestic use of water (Raghvendra, 1992).

However, in some pond samples (S1, S17 and S25) the concentration of calcium was found high during monsoon. Increase in calcium hardness during rainy season may be due to addition of calcium through runoff water. The results were supported by some previous studies including Aneja and Singh (1992), Verma et al. (2012).

**Magnesium analysis**

In most of the ponds the magnesium concentration was found high during pre-monsoon and moderate during post-monsoon and lowest during monsoon season. High value of magnesium during summer may be attributed to decrease in water volume and increase of rate of evaporation. The similar reports were also obtained by Arya et al. (2011), Tidame and Shinde (2012) and Brahmbhatt (2012).

It was interesting to note that there was only single pond (S3) where magnesium concentration was found high during monsoon in comparison to pre-monsoon season. The results in this context were supported by Narayan et al., (2005); Akintoye et al. (2014) and Misra, 2017. It may be due to the washing away of nutrients into the ponds with rainwater, from a widespread agricultural area and thus resulting in the increase in level of certain chemical elements.

**Sodium analysis**

Sodium is a natural component of fresh water. The high concentration of sodium in natural freshwater bodies is mainly due to pollution such as soapy solution, detergent, human and animal waste disposal, precipitation runoff, sewage disposal, mineral deposits and water treatment chemicals such as sodium fluoride, sodium bicarbonate and sodium hypochlorite
etc. In most of the ponds the values of sodium was higher in pre-monsoon season when compared with monsoon and post-monsoon seasons. High sodium content during pre-monsoon season may be due to increased rate of water evaporation and high atmospheric temperature during this period (Sahai and Sinha, 1969). The results were supported by Bordoloi and Baruah (2014) in one of the study conducted on historical pond of Upper Assam.

In some pond samples, including S4, S6, S11 (2014) and S4, S9, S21 (2015) the value of sodium was high in monsoon in comparison to pre-monsoon season. The high level of sodium during monsoon season may be due to the rainwater as it carries the salt dissolved from the surrounding area (Sahai and Sinha, 1969). The similar results were also obtained by Kumar et al. (2014) in one of the study conducted on Lahru pond located in Himachal Pradesh.

**Potassium analysis**

In most of the pond samples, the value of potassium was high in pre-monsoon season. The higher value of potassium may also be due to high rate of evaporation during pre-monsoon. The results were supported by Bordoloi and Baruah (2014) in one of the study conducted on historical pond of Assam.

In some pond samples S6, S8, S10, S14, S18 (2014) and S8, S16, S23 (2015), the value of potassium was high during monsoon in comparison to pre-monsoon. The probable cause of high potassium during monsoon may be due to dumping of surface runoff water containing soaps, detergents, cow dung cakes etc. Our results in this context are in concordance with the reports of Mohamed (2005) from pond water samples of Abu za'baal ponds, Egypt.

### 5.3 Floristic inventory of village ponds

Floristic information reflects the structural and functional complexities of freshwater ecosystems (Sharma, 2008). A large number of studies have been conducted throughout the country about the flora of freshwater bodies. But very few studies were conducted for documentation of flora of small freshwater bodies particularly of village ponds of Haryana. Therefore, present study has been conducted to inventories the floral diversity in wet periphery of village ponds of district Jhajjar, Haryana.

From the results, it was reported that Poaceae is the most dominant family with 30 plant species followed by Fabaceae, Asteraceae Amaranthaceae and Solanaceae with 17, 15, 12 and 9 plant species respectively (Figure- 5.3). One of the similar study conducted by
Olubode (2011) on floral diversity of freshwater ecosystems including Apete river, Eleyele lake and Oba dam reported the dominance of Poaceae family. Other similar study conducted by Mishra and Narain (2010) on Bakhira wetland in Uttar Pardesh reported dominance of Cyperaceae followed by Poaceae family. Monocot families include Araceae, Cyperaceae, Poaceae, Pontederiaceae, Typhaceae and Xanthorrhoeaceae. There is a dominance of herbs (67.4%) followed by trees (17.7%) and shrub (14.9%) were reported (Figure-5.4).

The genus Cypress contributed (5 species); Cenchus (4 species); Acasia, Alternanthera, Casia, Euphorbia and Phylanthus (3 species each); Amaranthus, Blumea, Boerhavia, Calotropis, Capparis, Chenopodium, Convolvulus, Dactyloctenium, Datura, Ficus, Melilotus, Panicum, Polygonum, Rumex, Saccharum, Salvedora, Setaria, Solanum, Vicia and Ziziphus (2 species each) and other genus contributed only single species. There is a dominance of Prosopis juliflora in the wet periphery of most of the village ponds.

Such floristic inventory may act as a positive force for biodiversity (Heywood, 1999; Webb et al., 2010 and Jaykumar et al., 2011). The role of taxonomy as a integral component of biodiversity protection has been highlighted and discussed at scientific level by Nair, 2004; Mace, 2004; Narendran, 2006; Raczkowski and Wenzel, 2007 and Mayo et al., 2008.

The results of this comprehensive inventory are important because in the absence, it will be difficult to set up conservation priorities. The baseline information in the form of floristic inventory may be highly useful for future ecological work such as rehabilitation and conservation of the flora of these aquatic ecosystems. Therefore, it is recommended that a long term comprehensive study should be undertaken to document the ecological status of aquatic biodiversity of the study area. There is a sturdy need to promote conservation of ponds in rural areas to reduce the loss of these freshwater bodies and depletion of native plant species for the benefit of the present as well as future generations.
Figure 5.3: Dominant families of plants found within wet periphery of village ponds

Figure 5.4: Percentage (%) showing habitat wise distribution of village pond flora
5.4 Ethnobotanical potential of village pond flora

The present study revealed the ethnobotanical information of local people of Jhajjar district of Haryana. The ethnobotanical information obtained mainly includes local name, plant part used, ailments treated, methods of preparation and mode of application. Plants enumerated during survey were reported to be used against many diseases including leucorrhoea, urinary problems, constipation, diarrhoea, jaundice, joint pain, allergy, skin burn, kidney stone, pneumonia, bronchitis, asthma, fever, headache etc. All the parts of plant viz. leaves, stem, fruit, root, seed, flower and whole plant are used for medicinal purpose (Figure-5.5). Fabaceae is the dominant family among the ethnomedicinal plants following by Solanaceae and Asteraceae (Figure 5.6). Our results are in concordance with similar study conducted in district Jhajjar by Punghal et al. (2010).

Many of these plants have been used for similar purposes in other parts of Haryana also as by some authors (Yadav et al., 2006; Yadav et al., 2010; Vashishta and Kaur, 2013; Yadav and Bhandoria, 2013; Singh and Singh, 2015; Singh, 2016). However, there were difference in their recipes, drug preparation methods and mode of their use.

Analysis of the data showed that in most of the cases the remedies prescribed for wound healing, skin burn and other skin problems include external application of drugs. Remedies from internal problems mainly include oral administration of drugs. This is in concordance with similar studies conducted in other parts of the country (Qureshi et al., 2007; Vashishtha and Kaur, 2013; Parul and Vashistha, 2015). It was also reported that most of the plants enlisted were used for treatment of more than one ailment.

Documentation of this information is very important. It will provide the raw material to pharmacologist for discovery of new drugs (Johnsy et al., 2012). During the survey, it was found that younger generation was not aware about the local names of plants that were used by their elders since longer time. Therefore, the knowledge has diminished with time if not documented. Habitat modification and loss of natural vegetation is also the major cause for loss of medicinally important plant species. Need of the hour is to create awareness among people for sustainable use of natural resources.
Figure 5.5: Percentage of plant parts used for ethanobotanical purposes

Figure 5.6: Dominant families of ethanobotanical plants
5.5 Factors for degradation of village ponds

The village ponds are the most important source of water. In India, about 68.84% of population lives in rural areas (Census, 2011). There are very few freshwater resources available in rural areas. Therefore, the village ponds are most important for the rural regions of the country. Each village has one to many ponds. The rural communities depend upon ponds to fulfil their daily requirement of freshwater. But due to many anthropogenic effects their existence is in danger (Kranthi et al., 2014; Kumari et al., 2017 and Gujjar and Kiran, 2017). According to Shrivastava and Kanugo (2013) nearly about 70% of all the available water in our country is polluted mainly due to domestic waste, industrial waste and land and agricultural drainage.

From the literature survey, it was reported that most of the ponds in different states of the country are unfit for use (Rajive et al., 2012; Mahobe and Mishra, 2013; Sabiha Naj, 2014; Mishra et al., 2014; Harney et al., 2013; Chauhan et al., 2017; Bharti et al., 2017). The situation of village ponds in Haryana is also miserable (Gupta and Kaushik, 2012). The serious threat in the state is associated with change in societal behavioural pattern, ethics, values and life style. It was also reported that high rates of exploration than its recharging, inappropriate dumping of waste material, lack of strict enforcement by law and loose governance are the cause of deterioration of water quality in the state (Gupta et al., 2009). The various causes responsible for degradation of village ponds are summarized in (Figure-5.8).

Pollution

The water pollution is usually caused by anthropogenic effect. From the present study, it was observed that, dumping of village waste in the village ponds is the leading factor for degradation of ponds. Our result are in concordance with Dhanlakshmi et al. (2013) as they have also reported that establishment of human colonies at the bank of ponds and dumping of domestic waste are the main cause of eutrophication of village ponds. Most of the villages have very poor drainage system and there is no separate disposals of village waste, therefore the waste water of most of villages thrown in to ponds. There is also an absence of lit-toilets in most of the houses in villages and there is dumping of human excreta directly in the ponds. Due to lack of sanitation facilities most of the people in villages uses pond catchment areas for defection (Adhikary, 2016). From the information gathered from informers and by
personnel observations, it was found that 74.5% villages of district have dumping of village waste water in ponds. The village waste water contains detergents, human excreta, cow dung, rotten vegetable waste and many other organic compounds which make the water rich in organic material. Some religious ponds are used by villager for dumping of pujasamagri and garlands in the ponds. Yadav et al. (2013) also reported that the ponds surrounded by temple receiving the number of organic and inorganic waste from temples. The pond peripheries are used by villagers for sun drying of cow dung cakes. There are 27.72% of villages have ponds which were covered with cow dung cakes. Gupta and Kaushik, (2012) conducted study on village ponds of Haryana and also reported the ill impact of cow dung cakes on village ponds.

The cow dung cakes fall with rain water inside the ponds. It increases the organic materials in the pond water and was the major source of pollution and turns the water blackish. The Pasumela in Jhajgarh village is also responsible for decrease in the quality of water of Tala Johar of the village as it is overexploited during the mela period. Some time death of fishes also leads to foul smell of pond water. In some villages, ponds are used by villagers for washing of clothes (5.90%) and agricultural tools and tractors (8.63%). Chauhan et al., 2017 also reported that the washing of clothes is the major cause of degradation of village ponds. Further, in some ponds of the district especially of Bahadurgarh block have dumping of factory waste that ultimately leads to eutrophication of village ponds.

**Encroachment**

Pollution is not only the threat that village ponds are facing in the state. Encroachment and filling up of ponds is also the serious problem both in urban as well as in rural areas of the district (Gupta and Kaushik, 2012). The expansion of agricultural land by filling the ponds with soil, settlements and urbanisation are the major factor for encroachment. According to the present study 24.99% of the villages have encroachment of ponds land for different purposes.

Village panchayats and governmental agencies utilised the pond land for different purposes such as construction of Diggi, Panchayat bhawan, Dharmsala, Water pump houses, Playground, Construction of park and Educational institution i.e. Schools and colleges. The ponds of the Jassor kheri, Badsa and Jharli villages have been lost because the pond land was acquired by governmental agencies for Atomic Research Institute, AIIMS-2 (All India Institute for Medical Sciences) and Jharli power plant respectively. Village panchayats have
also allotted plots to the BPL (Below poverty line) (2.27% of villages) families after filling of pond land with soil. Accelerated land price is also led to encroachment of village ponds (Kumar and Padhy, 2015). Digging of ponds in some villages were also responsible for loss of the ponds as due to digging there is a change in the soil type (i.e. clay to sandy soil) which cannot hold water for long time.

**Scarcity of water**

Scarcity of water play important role in loss of village ponds. Those ponds of the district that are connected with canals or any other source contain water throughout the year. There are some village ponds (12.7%) which only have rainwater as a source of water. These ponds remain dry during the summer and contain water only during the monsoon season. The villagers in these villages mainly depend upon water supply and hand pump water for their cattle drinking and bathing.

**Invasive plants**

The national invasive species council of US government defines exotic species as the non-native species whose introduction does or likely to cause economic or environmental harm or affecting human health. It is invasion by alien species which has been resulted in loss of biodiversity and changes in community structure and ecosystem functioning (Mooney and Hobbs, 2000). In the present study, the most important invasive plant was *Eichhornia crassipes* (water hyacinth). In some villages the plant completely covers the surface of water by forming a mat on the upper surface of water. Water hyacinth makes the village ponds unfit for use for cattle drinking, bathing or any other purposes. Exotic plant species pose a threat to the native biodiversity in different ecosystems (Wilcove et al. 1998). Along with biodiversity loss, exotic plants can also hamper economic development, decreases aesthetic value of the natural ecosystems and pose serious challenges for conservation and management of fresh water ecosystem.
Figure: 5.7: Percentage of Factors for village pond degradation in Jhajjar district
Photo No. 26. Dumping of sewage waste in the pond in village Salhawas in District Jhajjar

Photo No. 27. Encroachment in the pond area in village Salhawas in District Jhajjar
Photo No. 28. Change in Land use of village pond (replacement with Herbal Park in Beri)

Photo No. 29. Dumping of cattle dung on the pond periphery
Photo No. 30. Scarcity of water in pond in a village M.P. Majra in district Jhajjar

Photo No. 31. Washing of tractor in the pond in village Jahajgarh Majra in district Jhajjar
Photo No. 32. Washing of clothes in pond water in village Wazirpur in district Jhajjar

Photo No. 33. Washing of clothes in pond water in village Mundsa in district Jhajjar
Photo No. 34. Eutrophication in the pond in village Chhuchhakwas in district Jhajjar

Photo No. 35. Water hyacinth (*Eichhornia crassipes*) in the pond of village Matanhail
5.6 Suggestion for conservation and management

A rich and healthy freshwater ecosystem always brings benefits for everyone. Ponds are vital and threatened habitats without their proper conservation and management, we will continuously lose, critical biodiversity, cultural and economic recourses offered by them. Village ponds are small in size and therefore very susceptible to destroy (Elton, 1966; Macan, 1977). We know that small freshwater bodies are under threat everywhere, therefore we need to protect it through strong practical action by using good information till available. There are some suggestions given by villager to conserve these small freshwater ecosystems (Figure-5.8)

Separate disposal of village waste

Dumping of village waste is the major cause of degradation of village ponds. Kumar et al., 2017 strongly recommended prevention of domestic waste water in fresh water bodies. From the present study, it was found that the villages of the district have very poor drainage system and there were no separate sites for disposal of waste water. In most of the villages, it was suggested that there should be separate site for disposal of village waste water. In Beri block (83.33%), Jhajjar (72.88%), Bahadurgarh (68.85%), Matanhail (64.28%), Salhawas (48.66%) of villages suggested separate disposal of village waste to protect the ponds from further degradation.

Free from cow dung cakes

Sun drying of cow dung cakes is a very common practice in villages. The villager use to load the periphery of village ponds from cow dung cakes. It is also the major cause of degradation of village ponds. Therefore, villagers of the district suggested that the ponds periphery should be clean and free from cow dung cakes. In Beri block maximum (33.33%), Jhajjar (16.94%), Matanhail (16.66%), Salhawas (16.66%) and Bahadurgarh (9.83%) of villages suggested to make the ponds free from cow dung cakes.

Permanent boundaries

There were very few ponds in the district which are surrounded by permanent boundaries. The boundary lines around the pond play very important role in conservation of village ponds (Kumar and Padhy, 2015). In Beri block maximum (27.77%), Salhawas
(21.62%), Bahadurgarh (14.75%), Jhajjar (13.55%) and Matanhail (9.52%) of villages suggested that there should be permanent boundaries around pond. Agricultural runoff also deteriorates pond water quality due to accumulation of toxic chemicals including insecticides and pesticides (Mishra et al., 2014). The boundaries can prevent the dumping of runoff water from field in to village ponds. There is a requirement of fencing of village ponds to prevent them from becoming dumping site of solid and liquid wastes. As dumping of wastes materials provide the breeding sites to mosquitoes and spreading many diseases. To prevent the spread of diseases like dengue, the Honourable Gujrat High Court strictly directed the municipal cooperation to fence all the ponds of the state to check waste dumping activities around ponds (TOI, 2015). The permanent boundaries also help to prevent encroachment by villagers for the purpose of agriculture and settlements.

**Permanent source of water**

In most of the villages the ponds are connected with permanent source of water. But in some villages there is a no source of permanent water or they are not connected with the source of water and they only depend upon rainwater. These ponds contain water only during the rainy season and most of the time they remain empty. In Beri block Maximum (33.33%), Jhajjar (28.81%), Salhawas (18.19%), Matanhail (9.52%) and Bahadurgarh (9.83%) of villages suggested that there should be a source of water other than rainwater.

**Preventing Encroachment**

Encroachment is the major problem for loss of village ponds (Kumar and Padhy, 2015). In the past time, ponds were the important sources of freshwater for people but due to modern life style and supply of freshwater in every village of the district, they are ignored. Therefore in present scenario, they were the dumping site of waste water. People were not aware about the importance of village ponds. Therefore they were exploited excessively and filled by soil to use the land for any other purpose. In Bahadurgarh block maximum (24.59%), Beri (22.22%) Jhajjar (20.33%), Salhawas (16.21%) Matanhail (14.28%) of villages it was suggested that we can conserve the ponds by preventing the use of land for any other purposes.
Figure: 5.8: Percentage of strategies suggested by villages for conservation of village ponds of district Jhajjar
Photo No. 36. Triple pond filtration system at village Hasanpur in district Jhajjar

Photo No. 37. Pond filtration system at village Dhakla in district Jhajjar
Photo No. 38. Construction of boundary wall around the pond in village Badli in Jhajjar

Photo No. 39. Construction of boundary wall around the pond in village Subana in Jhajjar
Preventing washing

Washing of the clothes is also a reason for the degradation of the village ponds. The problem was severe in the past but at present, due to the “supply water” in every village and in each house of the district, this problem has less contribution in degradation of ponds. There are still some villages, where the practices of washing of clothes in village ponds were reported. Further, there are also few villages in the district, where washing of tractors and other agricultural tools in the ponds were reported. Washing of tractors and other tools releases grease and other oily substances and make the pond water unfit for use. In Salhawas block of district Jhajjar maximum (27.02%), Beri (22.22%), Jhajjar (10.16%), Matanhail (9.52%) and Bahadurgarh (8.19%) of villages it was suggested that by preventing washing of clothes, agricultural tools and tractors we can preserve the ponds for future generations.

Desiltation

Siltation plays an important role in degradation of village ponds. Rainwater and village waste water contain dissolved soil and other organic particles and carry them to the ponds. It leads to continuous filling of the ponds with mud and ultimately ponds move towards eutropic condition. Villagers were aware about the siltation of ponds therefore in Salhawas block maximum (21.62%), Bahadurgarh (19.67%), Beri (16.66%), Jhajjar (15.25%) and Matanhail (11.90%) of villages suggested regular desiltation of ponds.

Preventing dumping of worship waste due to religious faith

There is a significance of water in all the world religions. Ponds are associated as being the residence of God and often admired as holy forces. In some villages, ponds are sacred and there is a prohibition for washing of clothes, bathing of cattle’s etc. But people used to dump flower garlands, food articles and many other worship wastes in to ponds due to religious faith. It is not only the wastage but also makes the pond water unfit for use. Pond water exhibited low water quality in religious ponds mainly due to immersion of worship waste material produced during religious occasions (Adhikary, 2016). In all the five block of the district viz. Beri block (5.55%), Bahadurgarh (4.91%), Jhajjar (3.38%), Salhawas (2.70%) and Matanhail (2.38%) of villages suggested prohibition of dumping of worship waste in to village ponds to make the water usable.
Control of Invasive species

Local people do not know the effect of invasive species, therefore during survey in a very few villages invasive species management was suggested. In Beri block maximum (11.11%), Jhajjar (8.47%), Salhawas (5.40%), Bahadurgarh (4.91%) and Matanhail (2.38%) of villages especially suggested removal of Water Hyacinth (*Eichhornia crassipes*) plants to make the ponds usable.

Awareness creation

To aware the people about the importance of village ponds, its conservation and sustainable use, effects of invasive plants at global, national, regional and local levels. Tyagi *et al.*, 2017 strongly recommended the awareness programmes about the decreasing quality of freshwater resources. In the survey, maximum in Beri Block (16.66%) followed by Jhajjar (13.55%), Salhawas (10.81%), Bahadurgarh (9.83%), Matanhail (4.76%) of villages suggested that there should be awareness programme about the importance of village ponds. In this regards not only the governmental agencies but general public should participate to make it successful.