SUMMARY AND CONCLUSION

The present investigation on the effects of solid waste disposal in water and soil in and around Imphal City during April, 2006 and March, 2007 came out with valuable results which will give vital informations regarding the water and soil quality of the city. Moreover, this will also provide information relating to physical composition of the solid waste generated in the city.

Imphal City is one of the most populated city in Manipur State having an area of 29.57 sq. km. and is located at 24° 33' N and 24° 55' N latitudes and 93° 42' E and 94° 7' E longitudes covering some parts of Imphal West and East District, Manipur. It lies at an elevation of 790 metresa above the mean sea level.

During investigation it was observed that the municipal solid waste was dumped without any treatment and environmental considerations. The unauthorized dumping of the wastes by the local people near available water bodies and vacant places causes lots of problems. Wastes in this city mostly consist of putrescible organic matter which decomposes rapidly under general environmental conditions producing faul and unpleasant odour. This poses serious problems to the general public. The problem becomes more acute in rainy season since the wastes pollute the rain water and then subsequently flows into nearby river or water bodies. Open dumping of the wastes in the Permanent Disposal Site at Lamphelpat area might promote breeding of micro-organisms and other disease producing vectors. This problem might cause serious hazards to the people inhabiting near the dumping site. The disposal practice might cause frequent malaria, hepatitis, dysentery, diarrhea and skin infections in the surrounding area of the disposal site.

For the study of effects of solid waste disposal in water and soil of the city, 7 sampling sites were selected out of which 3 were non-disposal sites and 4 were disposal sites. The non-disposal sites were those where solid wastes were not
disposed off while the disposal sites were those where dumping of solid wastes take place. Two groups of sites were selected in order to have a comparision between them.

From the ombrothermic diagram based on 10 years data of temperature, humidity and rainfall, it was observed that the climate was moderate and monsoonic with three distinct seasons viz. Summer (March to May), Rainy (June to October) and Winter (Nov. to Feb).

Identification of the physical composition of solid waste generated in the City has been taken up. It was observed that the municipal solid wastes of Imphal city were highly heterogenous with a high percentage of biodegradable fractions. It was also observed that paper, kitchen wastes and vegetable wastes contribute mainly among the biodegradable wastes and plastic and glass contribute as main components among non-biodegradable wastes. Some amount of earth and ash were also found in the solid waste. The percentages (dry weight) of various fractions of the solid wastes of the city were:

(i) Biodegradable – 70%  
(ii) Non-biodegradable – 27%  
(iii) Miscellaneous – 3%

Various physico-chemical parameters of water samples collected from both the non-disposal sites and the disposal sites were studied. During the period of study, the water temperature ranged from 14°C to 29°C at the non-disposal sites while at the disposal sites, it was fluctuated between 14°C to 30°C. At the non-disposal sites, the lowest value of the water temperature was observed in January, 2007 (NDS-2) while the highest value was also observed at NDS-2 in August, 2006. At the disposal sites, the lowest values were recorded in December, 2006 (DS-4) and January, 2007 (DS-1) while the highest value was observed in April, 2006 (DS-1 and DS-4).
pH values of the non-disposal sites ranged between 6.7 to 10.4. Highest value was observed in April, 2006 at NDS-3 while the lowest value was found in the month of May, 2006 at the site NDS-1. At the disposal site, pH values varied from 6.5 to 8.6. Maximum value of pH was found in July, 2006 at DS-3 and minimum value in April, 2006 at the site DS-4.

The electrical conductivity of water of the non-disposal sites were in the range from 84.50 $\mu$ mho/cm to 318.63 $\mu$ mho/cm. The highest value was at the site NDS-3 (March, 2007) and the lowest value was at the site NDS-2 (July, 2006). The values of the electrical conductivity at the disposal sites were between 71.50 $\mu$ mho/cm to 1082.90 $\mu$ mho/cm. The maximum value was observed in the month of June, 2006 at DS-3 and the minimum value was in the month of October, 2006 at DS-2.

Dissolved oxygen (D.O.) values of the non-disposal sites ranged from 2.03 mg/l (Dec., 2006 at NDS-1) to 10.13 mg/l (Dec., 2006 at NDS-3) while at the disposal sites, the values were ranged between 0.02 mg/l (March, 2007 at DS-1) to 8.91 mg/l (June, 2006 at DS-2).

Hardness values of the non-disposal sites fluctuated between 28 mg/l to 80 mg/l. The highest value was observed in the month of December, 2006 at NDS-3 and lowest value was recorded in July, 2006 at NDS-1. At the disposal sites, the values of hardness were varied between 26 mg/l to 244 mg/l. The lowest value was at the site DS-2 in July, 2006 while the highest value was at DS-3 in the month of April, 2006.

The alkalinity values of the non-disposal sites ranged between 10 mg/l to 70 mg/l. The highest alkalinity was recorded in May, 2006 at the site NDS-3 while the lowest value was recorded in November, 2006 at the site DS-1 during the study period. At the disposal sites, its values were ranging from 20 mg/l (June and Nov. 2006 at DS-1 and June and October, 2006 at DS-2) to 220 mg/l (April, 2006 at DS-3).
Free carbon dioxide values of the non-disposal sites varied from 0 mg/l (March, 2007 at NDS-3) to 35.2 mg/l (August, 2006 at NDS-1) while at the disposal sites its values were from 6.6 mg/l (Dec., 2006 at DS-2) to 211.2 mg/l (July, 2006 at DS-4).

Chloride values of the non-disposal sites varied from 19.88 mg/l to 85.20 mg/l. Maximum value of chloride was recorded in May, 2006 at the site NDS-3 while minimum value was recorded in November, 2006 at the site NDS-2. At the disposal sites chloride values were ranged between 18.43 mg/l (Nov., 2006 at DS-2) to 241.4 mg/l (June, 2006 at DS-3).

Phosphate values of the non-disposal sites varied from 0.09 mg/l (March, 2007 at NDS-3) to 0.44 mg/l (June, 2006 at NDS-1) while at the disposal sites, its values were from 0.045 mg/l (April, 2006 at DS-3) to 0.95 mg/l (March, 2007 at DS-1).

Calcium exhibited a range of 6.41 mg/l to 20.04 mg/l in the non-disposal sites while at the disposal sites, the values were varied from 7.21 mg/l to 110 mg/l. The maximum value was observed in June, 2006 at both the non-disposal sites and the disposal sites while the minimum values were recorded in the months of December, 2006 at NDS-1 and July, 2006 at DS-2 at the non-disposal site and disposal site respectively.

Concentrations of magnesium of the non-disposal sites varied from 0 mg/l (July, 2006 at NDS-1) to 12.6 mg/l (April, 2006 also at NDS-1) while at the disposal sites, its values varied between 0.48 mg/l (June, 2006 at DS-1) to 35.95 mg/l (April, 2006 at DS-3).

Potassium concentrations ranged from 0 mg/l to 13 mg/l at the non-disposal sites. The highest values were found in June, 2006 at NDS-1 and November, 2006 at NDS-3 while the lowest values were found in August, 2006 at NDS-1 and June, 2006.
at NDS-2. At the disposal sites, its concentrations were from 0 mg/l (July, 2006 at DS-2) to 79 mg/l (June, 2006 at DS-3).

Sodium concentrations varied from 1 mg/l (February, 2007 at NDS-2) to 56 mg/l (June, 2006 at NDS-3) at the non-disposal sites while its values were between 4 mg/l (February, 2007 at DS-2) to 139 mg/l (June, 2006 at DS-3) at the disposal sites.

The correlation among various physico-chemical parameters suggests strong positive correlation between electrical conductivity and total hardness; electrical conductivity and magnesium; total hardness and magnesium; water temperature and free carbon dioxide; total alkalinity and potassium; water temperature and chloride; electrical conductivity and chloride; electrical conductivity and sodium; total alkalinity and chloride; free carbon dioxide and chloride; pH and electrical conductivity; pH and total hardness; pH and magnesium; potassium and sodium; water temperature and total alkalinity; electrical conductivity and total alkalinity; total hardness and chloride; total hardness and calcium; total alkalinity and magnesium; calcium and potassium; calcium and sodium; and pH and dissolved oxygen.

A significant positive correlations were also observed between free carbon dioxide and water temperature; chloride and calcium; chloride and sodium; phosphate and sodium; water temperature and chloride; free carbon dioxide and chloride; water temperature and total alkalinity; dissolved oxygen and total hardness; water temperature and dissolved oxygen; total hardness and total alkalinity; total alkalinity and calcium; pH and total alkalinity; total hardness and potassium; and chloride and calcium.

While strong negative correlations were observed between water temperature and dissolved oxygen; water temperature and total hardness; water temperature and magnesium; dissolved oxygen and chloride; total hardness and total alkalinity; water temperature and potassium; electrical conductivity and dissolved oxygen; chloride and magnesium; and dissolved oxygen and potassium.
A significant negative correlations were also observed between pH and free carbon dioxide; pH and chloride; water temperature and electrical conductivity; pH and potassium; dissolved oxygen and calcium; pH and sodium; electrical conductivity and sodium; dissolved oxygen and free carbon dioxide; dissolved oxygen and chloride; magnesium and sodium; pH and phosphate; dissolved oxygen and magnesium; water temperature and calcium; total alkalinity and potassium; free carbon dioxide and magnesium; and chloride and magnesium.

Various physico-chemical parameters of the soil samples collected from both the non-disposal and the disposal sites were also analysed seasonally. The soil temperature values for the non-disposal sites ranged from 19.5°C (winter season) to 27.5°C (summer season). Maximum value was observed at the site NDS-3 and minimum value was recorded at the site NDS-2. At the disposal sites, its values were from 21°C (winter season) 27.5°C (summer season). Highest value was recorded at DS-4 and the lowest value was found at DS-1.

The seasonal values of soil pH of the non-disposal sites ranged from 4.6 to 8.1. The highest and the lowest values were observed in summer and rainy season respectively at NDS-3. At the disposal sites, the values of the soil pH were fluctuated from 6.2 (summer season) to 8.3 (winter season). Here also, both the maximum and minimum values were observed at the site DS-3.

The electrical conductivity of soil of the non-disposal sites ranged from 130.91 μhm/cm (winter season) to 785.85 μhm/cm (summer season). The highest value of conductivity was recorded at the site NDS-3 while the lowest value was observed at the site NDS-1. At the disposal sites, the values soil conductivity ranged from 149.5 μhm/cm (rainy season) to 1614.60 μhm/cm (summer season). The highest and the lowest values were recorded at the sites DS-3 and DS-2 respectively.
Bulk density of soil of the non-disposal sites varied between 0.95 g/cm$^3$ (rainy season at NDS-3) to 1.22 g/cm$^3$ (winter season at NDS-1) while at the disposal sites, its values were from 1.02 g/cm$^3$ (summer season at DS-4) to 1.31 g/cm$^3$ (summer season at DS-2).

The seasonal moisture content of soil of the non-disposal sites fluctuated from 2.47 % (summer season) to 24.30 % (rainy season). The lowest value of the percentage moisture content was recorded at the site NDS-1 and the highest value was recorded at the site NDS-2. For disposal sites, the values ranged from 2.5 % (summer season) to 25.04 % (rainy season). The maximum value was recorded at the site DS-1 and the minimum value was recorded at the site DS-3.

Chloride concentrations for the non-disposal sites ranged from 10.65 mg/100g (summer season at NDS-1) to 56.80 mg/100g (summer season at NDS-3) while for the disposal sites, its values were fluctuated in between 12.78 mg/100g (summer season at DS-2) to 173.24 mg/100g (summer season at DS-3).

The seasonal soil alkalinity values of the non-disposal sites varied from 0.15 meq/100g (summer season at NDS-2) to 0.65 meq/100g (summer season at NDS-3) while at the disposal sites, the values were from 0.2 meq/100g (rainy season at DS-2) to 0.6 meq/100g (winter season at DS-3).

The available phosphorous values of soil of the non-disposal sites ranged between 2.5 mg/100g (winter season at NDS-3) to 8.1 mg/100g (rainy season at NDS-1 and winter season at NDS-2) while its values varied from 4.0 mg/100g (summer season at DS-3) to 19.6 mg/100g (winter season at DS-1) at the disposal sites.

Total Nitrogen concentrations of the non-disposal sites were in between 4.62 mg/100g (summer season) to 7.42 mg/100g (rainy season and summer season). The lowest value was recorded at the site NDS-2 while the highest values were recorded at the sites NDS-1 (summer season) and NDS-3 (rainy season). At the disposal sites, the
concentrations of total nitrogen were from 4.16 mg/100g to 10.32 mg/100g. The highest value was recorded in winter season at the site DS-4 and the lowest value was observed in rainy season at the site DS-2.

The seasonal soil potassium values of the non-disposal sites were ranged from 15 mg/100g (winter season at NDS-3) to 36 mg/100g (rainy season at NDS-1) while at the disposal sites, its seasonal concentrations were varied from 15 mg/100g (summer season at DS-2) to 88 mg/100g (summer season at DS-4).

The values of sodium of soil of the non-disposal sites varied from 9mg/100g (winter season) to 94 mg/100g (summer season). The highest value was recorded at the site NDS-3 and the lowest value was observed at the site NDS-2. At the disposal sites, its values ranged from 10 mg/100g (rainy season at DS-2) to 45mg/100g (rainy season at DS-4).

Among the various parameters of soil quality, a strong positive correlations were observed between bulk density and electrical conductivity; moisture content and chloride; moisture content and potassium; bulk density and sodium; electrical conductivity and pH; available phosphorus and pH; available phosphorus and electrical conductivity; sodium and potassium; pH and soil temperature; potassium and electrical conductivity; sodium and chloride; moisture content and sodium; and sodium and available phosphorous.

The significant negative correlations were also observed between chloride and electrical conductivity; potassium and soil temperature; nitrogen and bulk density; and moisture content and total alkalinity.

Seasonal variations of some environmentally significant heavy metals and inorganic elements in water were also analysed. Manganese concentrations in water samples collected from the non-disposal sites were from 0 ppb to 3 ppb. The highest value of manganese was observed in winter season and the lowest value was observed
in summer season. The highest and lowest values were recorded at both the sites NDS-1 and NDS-3 studied. At the disposal sites, the values of manganese ranged between 0 ppb to 94 ppb. The highest value was recorded in summer season at the site DS-1 and the lowest value was observed in rainy season at two sites DS-1 and DS-4.

The copper concentrations of the non-disposal sites ranged from <1 ppb to 4 ppb. The maximum value of copper was recorded in winter season at NDS-1 and the minimum value was recorded in summer season at the site NDS-3. At the disposal sites, its values varied from 0 ppb to 8 ppb. The highest value was recorded in summer season at DS-3 and the lowest value in rainy season at DS-4.

The values of zinc of the non-disposal sites fluctuated from 0 ppb (summer season at NDS-1 and NDS-3) to 280 ppb (rainy season at NDS-1) while at the disposal sites, its values were from 0 ppb (rainy season at DS-1 and DS-4) to 24 ppb (summer season at DS-1).

The cadmium was absent throughout the study period at all the sites studied except in winter seasons in very small concentrations.

Iron concentrations of the non-disposal sites varied between 33 ppb (summer season) to 405 ppb (rainy season). Both maximum and minimum values were recorded at NDS-1. At the disposal sites, the values were from 40 ppb to 126 ppb. The lowest value was observed in winter season at DS-1 and the highest was recorded in rainy season at the site DS-4.

Cobalt was found to be present in small amount in rainy season only at the non-disposal sites studied while it was found to be present in small amount in all seasons at the disposal sites.

The seasonal values of barium of the non-disposal sites were ranged from 6 ppb (summer season at NDS-1) to 17 ppb (winter season at NDS-3) while its values were from 3 ppb (summer season at DS-1) to 21 ppb (summer season at DS-3).
The strontium values of the non-disposal sites were ranged from 36 ppb to 79 ppb. The minimum value was observed in rainy season at NDS-1 and the maximum value was recorded in winter season at NDS-3. At the disposal sites, its values fluctuated from 40 ppb to 158 ppb. The highest was observed in summer season at the site DS-4 and the lowest was recorded in rainy season at the site DS-1.

Nickel concentrations exhibited a variation of 0 ppb to 3 ppb at the non-disposal sites. The minimum and the maximum values were recorded in rainy season at the sites NDS-3 and NDS-1 respectively. At the disposal sites, nickel values fluctuated between 1 ppb to 5 ppb. The minimum values were recorded at sites DS-1 and DS-4 in rainy season only while the maximum values were recorded at sites DS-1 and DS-3 in winter season only.

Chromium concentrations of the non-disposal sites were ranged between 3 ppb (rainy season at NDS-1) to 10 ppb (winter season at NDS-3) while at the disposal sites, the values ranged from 1 ppb (rainy season at DS-1) to 7 ppb (rainy season at DS-4).

At both the non-disposal sites and the disposal sites, small quantities of arsenic were detected during rainy season only.

The metal lead was absent throughout the study period at the non-disposal sites while it was found to be present in small concentration at DS-3 only (summer and winter seasons) in case of the disposal sites.

Seasonal variations for some selected environmentally significant heavy metals and inorganic elements in soil have been studied. Arsenic was found to content at the non-disposal sites and the disposal sites studied throughout the year but their concentrations in soil samples were negligible.
Cadmium concentrations of the non-disposal sites varied from 94 ppm (rainy season) to 104 ppm (summer season). The minimum and maximum values of cadmium were recorded at the sites NDS-3 and NDS-1 respectively. At the disposal sites, its values were fluctuated from 100 ppm (winter season) to 109 ppm (rainy season). The minimum value was recorded at DS-1 while the maximum value was observed at DS-4.

The seasonal values of cobalt of the non-disposal sites ranged from 2 ppm to 32.8 ppm. The minimum value was observed in winter season at both the sites studied i.e. NDS-1 and NDS-3 while the maximum value was recorded in rainy season at the site NDS-3. The disposal sites values of cobalt were ranging from 2 ppm to 27.53 ppm. The maximum value was recorded in summer season at DS-4 while the minimum value was observed at all the disposal sites studied i.e. DS-1, DS-3 and DS-4 in winter, rainy and winter seasons respectively.

The chromium values of the non-disposal sites ranged from 3 ppm (winter season at both NDS-1 and NDS-3) to 231 ppm (rainy season at NDS-3) while at the disposal sites, its values were from 3 ppm (winter season at DS-1) to 247 ppm (summer season at DS-4).

Copper concentrations of the non-disposal sites varied between 2 ppm (winter season) to 178 ppm (rainy season). The highest value was recorded at the site NDS-1 and the lowest value was recorded at the site NDS-3. At the disposal sites, the values fluctuated between 2 ppm (rainy and winter seasons at DS-3) to 100 ppm (winter season at DS-4).

The values of nickel of the non-disposal sites were varied between 2 ppm (winter and rainy seasons at NDS-1) to 584 ppm (winter season at NDS-3) while at the disposal sites, the values ranged from 2 ppm (winter season at DS-1, winter and rainy season at DS-3 and winter season at DS-4) to 85.11 ppm (rainy season at DS-4).
Lead concentrations varied from 199 ppm (rainy season at NDS-3) to 220 ppm (summer season at NDS-1) at the non-disposal sites while the ranged values for the disposal sites were 228 ppm (summer season) to 296 ppm (winter season). Both the maximum and the minimum values were recorded at the site DS-3.

At non-disposal sites strontium values were ranged from 44.5 ppm (rainy season) to 166 ppm (winter season). Both the maximum and minimum values of strontium were recorded at the site NDS-3 only. At the disposal sites, its values were fluctuated between 69.8 ppm (rainy season at DS-4) to 189.5 ppm (rainy season at DS-1).

From the above observations and findings, the following conclusions can be drawn.

i) Imphal city has been experiencing the problems of solid waste pollution since after it became a Class-I city in 1971.

ii) The municipal solid wastes of the Imphal city are highly heterogenous with a high percentage of biodegradable fractions. High percentage of decomposable fraction indicates solid waste of the study area can decompose rapidly producing faul and unpleasant odours. Moreover, such wastes can promote breeding of micro-organisms and other disease causing vectors. In rainy season, the runoff from these wastes can pollute nearby surface water bodies and can cause many water borne diseases. Furthermore, pollution of surface soil can also occur through addition of pollutant from these wastes.

iii) From the observations of physico-chemical parameters of water, there exist a wide difference between solid waste disposal sites and non-disposal sites. So it may be concluded that disposal of solid wastes pollute water bodies in and around the city.

iv) In the present investigation, the values of physico-chemical parameters of soil indicates that the soils are comparatively less healthy in the
disposal sites than the non-disposal sites. So, a good soil management is of urgent concern in the study area.

v) The seasonal physico-chemical values of soil vary from one sampling point to another and there is no fixed trend of variation in all the sites studied. Even in the non-disposal sites, there was no fixed seasonal trend. So, the environmental aspects of soil quality of this area need serious attention for a better and clean environment of the city.

vi) From the observations of heavy metals and inorganic elements in water, seasonal variations are evident in almost all the metals examined. But no specific seasonal trend is recorded. Except for zinc, cadmium, iron and arsenic, other metals showed higher values in the disposal sites than the non-disposal sites. So it may be concluded that the solid waste disposal contribute metals in the water bodies.

vii) From the examination of soil toxic metals, it is observed that except for cadmium, lead and strontium, there are no significant differences in concentrations between the non-disposal sites and disposal sites. Both the non-disposal sites studied are at the side of roads which may be the reason for high values of metals in these sides. Here also, there was no specific seasonal trend for almost all the metals studied indicating anthropogenic influences in the distribution of toxic metals in the soil.

The overall picture that emerges out of the present study warrants certain remedial measures to check the increasing pollution of the water and the soil due to unauthorized and unscientific disposal of solid wastes in Imphal City.
SUGGESTIONS AND RECOMMENDATIONS

Imphal, the capital city of Manipur, is one of the most important units in the organization of the urban settlement system in the state. The major establishments of the state like administrative, economic, educational, cultural, political and judicial are situated in this city.

After it became a Class-I city in 1971, the city has been experiencing various problems regarding environmental pollution. Among the environmental problems arises, solid waste pollution is also one of the important problem. As a consequence of solid waste pollution, a significant amount of solid waste piles up near or around various residential areas. Solid waste is currently being disposed of at dumps that are inappropriately sited throughout the city, in backyards or by illegally dumping along roadsides, empty lots, river banks and other environmentally sensitive areas. Abandoned garbage is not only an eyesore, but the sites that are not cleaned up can lead to number of health and safety concerns, which fosters a negative image to any community. Not only do these illegal dump sites cause a heightened risk of physical injury from contact with broken glass, sharp metal and other waste trash but garbage brings with a host of diseases and dangers. Decaying garbage not only creates unpleasant odours but many of the materials that are dumped contain toxic or hazardous substances that could threaten water supplies.

Thus, from the corrective measures point of view, certain suggestive measures and recommendations are listed for consideration.

1. **Stop dumping of solid wastes into major water bodies and unauthorized places** – As the generation of solid wastes increases day by day in the city, dumping the wastes at any vacant places exploits the esthetic values of the city. Besides, haphazard dumping of urban solid wastes along the banks of water bodies like ponds, lakes, rivers has severely deteriorated surface water quality of the area. Moreover, there is possibility to cause soil deterioration and vector borne diseases to the people
residing nearby. So, it is suggested that the waste materials should be dumped only at proper places designated for the purpose.

2. **Development of proper sanitation system** – It is observed that many city dwellers are using kacha latrine and from where the wastes are directly discharged in the nearby water bodies like rivers, ponds and drains etc. These wastes may contain many types of micro-organisms and pollutants causing many ecological changes in the city like extinction of species, degradation of habitat of fishes etc. So to avoid further contamination of water bodies, a proper sanitation system should be developed in the city.

3. **Development of scientifically approved sanitary landfill** – Although municipal authorities have maintained that the present disposal practice of municipal solid waste of the city is sanitary landfilling, the actual practice seems to be open dumping. Survey of the disposal sites reveals that the scientific dumping method is not adopted which may cause many diseases to general public. Water may be seep through these wastes and may contaminate the groundwater. So, there is an urgent need to develop a scientifically approved sanitary landfill for disposing the city wastes.

4. **Development of resource recovery and recycling units** – Solid waste contains both biodegradable and non-biodegradable substances. So, productive use of waste material represents means of alleviating some of the problems of solid waste management. Composting unit may be developed by using compostable organic material present in solid wastes. Much of the paper, glass, plastic, wood etc. can be recovered from processable municipal solid waste and can be recycled. Refuse-derived fuel is the combustible portion of solid waste that has been separated from the non-combustible portion through processes such as shredding, screening and air classifying. Methane gas can also be recovered from landfill sites scientifically. So, if resource recovery and recycling units are developed, we can conserve natural resources as well as reduce the problems of solid waste.
5. **Regular assessment of water and soil quality**: Periodical monitoring of water and soil quality of the affected areas and also controlled area is required to access the condition of surface water and soil. This will help in understanding the level of water and soil pollution in the city. Besides, it will also help the government in making adequate decision regarding management strategies of the water and soil in the city. By ascertaining the quality of water and soil, immediate steps should be taken up to check the anthropogenic activities around the affected water bodies and soil.

6. **Organising environmental awareness programme**: A large section of the population inhabiting in and around the city does not have the proper knowledge of the need to protect the environment. It is highly recommended that the environmental awareness programmes be organized regularly to give an idea to the city dwellers to properly manage the wastes generated in the city in general and domestic wastes in particular. If such kinds of awareness programmes are conducted regularly, it will definitely help in safeguarding our precious natural wealths like water; soil etc. from further deterioration.

7. **Establishment of water and soil conservation authorities**: Establishment of water and soil conservation authorities of the State in general and city in particular is the need of the hour. By establishing such type of authorities, much of the problems related to water and soil pollutions may be solved. Such authorities will help in conserving water and soil which are regarded as the most important resources for sustaining life on the earth.

8. **Greater involvement of the government in the problem**: At present, waste collection and disposal in the city is being taken care of by the Imphal Municipal Council which is ill-equipped to tackle the huge amount of waste generated. The lack of suitable landfill sites, dedicated manpower and acute fund crunch has made it difficult for the Council to go in for a strong and safe management system. In this
regard, a good and greater support from the State Government is needed to cope with the problem.

9. **Encouragement of Works and Persons related in the field** – A sound waste management involves segregating wastes into biodegradable and non-biodegradable categories at source and disposing it in an environment-friendly way. Dedicated NGOs, local bodies and persons in the field of solid waste management can help achieve it. So, it is felt that the government should initiate projects related to waste management by consulting with such parties in order to have a fair control from solid waste related problems in the city.

10. **Strict enforcement of related laws and regulations** – To protect and improve the environment is a constitutional mandate. The Indian constitution contains specific provisions for environment protection under the chapter of directive Principles of State Policy and Fundamental Duties. The Hon’ble S.C. in several cases interpreted the right to life and personal liberty to include the right to a wholesome environment. There are several legislations, laws, notifications and rules for the protection of natural wealth and environmental pollutions like water pollution, soil pollution and solid waste pollution. Govt. of India enacted the special legislation on environmental problems reflecting fuller effect to the resolutions of the Stockholm Conference of 1972. Some of them are:

   v) Municipal Solid Wastes (Management and Handling), Rules, 2000 etc.

So, the strict enforcement of such rules and regulations are needed to protect the environmental condition of the city.
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