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# EFFECTS OF USING LIGNITE MINE DRAINAGE FOR IRRIGATION ON SOILS - A CASE STUDY OF PERUMAL TANK COMMAND AREA IN TAMILNADU STATE

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## ABSTRACT

**The excess groundwater pumped out during mining operation in Neyveli Lignite Corporation Limited (NLC ltd) located at Neyveli township in Tamilnadu State is let through the stream called Paravanar into the irrigation tank namely, Perumal tank. This water is found to carry with it a lot of suspended particles mainly as coal dust and small amounts of fly ash too. This paper presents the effects on the quality of soil as a result of using this water for irrigation in the Perumal tank command area. This paper also suggests suitable measures for the enhancement of soil quality, soil fertility and crop yield in the study area.**

## INTRODUCTION

Whatever may be the source of irrigation water, some soluble salts are always dissolved in it. However, in nature, quantity of dissolved salts and quality of water depend upon the source of water and its course before use. Among the soluble constituents, calcium, magnesium, sodium, chlorides, sulphates, bicarbonates and boron are of prime importance in determining the quality of irrigation water and its suitability for irrigation purpose. Factors like structure of the soil, drainage characteristics, nature of crops grown and climatological conditions are equally important in determining the suitability of water in agriculture. With poor water quality various soil and cropping problems can

be expected to develop.

The soil properties important to the growth of the plant are those attributing to soil fertility.

The magnitude of plant growth reflects the composite of many favorable and unfavorable factors. Favorable growth factors include adequate aeration, adequate water, adequate nutrients, adequate soil depth and proper soil temperature. Unfavorable factors are many – toxic levels of certain elements, diseases, adverse temperature and inadequate or excess sunlight.

Lignite mining operations require often considerable water volumes to be pumped and drained into surface water receivers. It can be linked through suitable streams, canals to the storage receivers. The mine drainage from Neyveli Lignite Corporation Limited, Neyveli, approximately 32,000 gallons per minute from Mines-I and 48,000 gallons per minute from Mines-II are pumped out to surface receivers, one such is Perumal tank, located at a radius of nearly 10 km from Neyveli Lignite Corporation Limited.

Water from mines may contain increased iron, chlorides, manganese, and sulphate in addition to other suspended matter like clay, sand and very micro-sized lignite particles in particular washed out from the open-pit slopes. The suspended matter contained in the water is characterized by variable concentrations between 10 mg/dm$^3$ and 10,000 mg/dm$^3$ with varying sedimentation parameters and makes their treatment very difficult. The size of the suspended particles varies mostly from colloids to 2 mm diameter.

The drainage volume of lignite mining operation varies depending upon the geological and hydrological conditions. The treatment of mining water is mostly limited to reduction in suspended particles. No open cast mining can be put to effective operation without satisfactorily solving the environmental damages. Neyveli Lignite Corporation Limited is not an exception in this regard. The water drained out from the Neyveli lignite mines is the only source of irrigation water in the nearby command areas during non-monsoon periods.

Such water received through the streams/canals reaching the nearby tanks including Perumal tank has been utilized for irrigation in the respective command areas for more than nearly two decades.

In this paper, the current soil status in the command area of the Perumal tank situated in Chidambaram Taluk of Tamilnadu State is presented satisfying the following objectives.

1. Examination of the physical and chemical parameters of the soil in the command area.

2. Assessment of possible effects on the command area in the long run as a result of prolonged use of mine waters for irrigation.

3. Suggesting measures to overcome any possible ill-effects of using mine water for irrigation from the viewpoint of improving crop production.

## STUDY AREA



### Location

Perumal tank is one of the biggest tanks in Tamilnadu State. It is situated in 11°24¢ N latitude and 79° 41¢ E longitude at an altitude of 5.50 m above MSL. It is situated between Cuddalore and Chidambaram towns in Cuddalore district. It is connected to Walajah tank on its upstream through the stream middle Paravanar. Mines drainage from Neyveli Lignite Corporation Limited reaches Walajah tank through the stream Upper Paravanar. A portion of the mine drainage reaching Walajah tank is discharged to Perumal tank through the stream middle Paravanar. For mining one tonne of lignite, about thirteen tones of water has to be pumped out. Mine-I and Mine-II produce over 6.5 million tonnes and 10.5 million tones of lignite per annum respectively. The huge quantity of water from Neyveli mines along with coal wash water and trade effluent is led into the Upper Paravanar stream which finds their way to Walajah tank and Perumal tank.

### Catchments and command area

The tank receives water from a catchments of 74 square miles and combined catchments of 216 square miles. It receives water from Cauvery basin and Vellar river basin from Sethiarthope weir through the stream Paravanar. The total area of the Perumal tank command is 6503 acres. The entire command area is irrigated through 11 canals. Table 1 shows the details of the off-taking irrigation canals of the tank.

### Climate

The climate in the Perumal tank command area is semi-arid. It is characterized by hot summer and generally dryness, except during North-east monsoon period (October - December) which experiences heavy rain followed by winter (January - February) and Hot-weather season (March - May) and South-west monsoon (June - September).

### Rainfall

The average annual rainfall in the Perumal tank command area is 1346.6 mm. About 90% of the annual rainfall is received during North-east monsoon period. The productivity of the monsoon crop in the command area depends mainly on the success of the North-east monsoon.

In the absence of sufficient rainfall during the monsoon period, water availability for irrigation is augmented by the mines drainage reaching the tank almost continuously throughout the year. This continuous receipt of mine drainage by the tank enables irrigating crops grown during the non monsoon period.

### Soil

The soil in the Perumal tank command area is generally clayey and in some regions, it is sand mixed clay alluvium.

**Table 1**
Details of the irrigation canals – Perumal tank command area

| S. No. | Name of Irrigation Canal | Length of Canal (km) | Command area (acres) |
|---|---|---|---|
| 1. | Kundiyamallur | 3.22 | 515 |
| 2. | Manavaikkal | 4.83 | 500 |
| 3. | Kallaiyankuppam | 5.64 | 500 |
| 4. | Sirupalaiyur | 6.44 | 636 |
| 5. | Theerthanagiri | 4.83 | 550 |
| 6. | Thanur New | 8.05 | 600 |
| 7. | Thanur Old | 6.44 | 500 |
| 8. | Sambareddipalayam | 5.83 | 615 |
| 9. | Andarmullipallam | 4.83 | 635 |
| 10. | Alappakkam | 5.64 | 752 |
| 11. | Umaiyan | 4.83 | 800 |
| | | Total | 6503 |

**Quality of irrigation water**

The pH of tank water ranges between 6.5 and 8.0. The electrical conductivity (EC) and sodium absorption ratio (SAR) are found to be well within limits. The water is of bicarbonate category. Micro sized particles mainly in the form of coal dust are found to be present in the mine waters received by the tank. As the tank has a huge storage capacity and sufficient depth, the sedimentation of these particles occur to a good extent. However, the waters released for irrigation from the tank through the off-taking canal located near the entry point of mine drainage to the tank carry these coal dust particles. The Kundiyamallur canal is located very near the entry point of mine water to the tank. Water conveyed by the other canals mostly is devoid of these suspended coal dust particles to a large extent.

**Cropping pattern**

Paddy is the prime crop that is cultivated widely in the command area of the tank. In Perumal tank command the following crop rotation is adopted.
Paddy – Paddy
Paddy – Black gram or Green gram
Paddy – Paddy – Green gram

In uplands where drainage facilities are available, sugarcane, turmeric and banana are cultivated. From the revenue records collected, it is found that paddy – paddy sequence has been adopted to a maximum extent in the command area.

## MATERIALS AND METHODS

Undisturbed and disturbed soil samples were taken from different locations of the tank command area. Both undisturbed and disturbed soil samples were taken from locations of the command namely Kundiyamallur and Ayamathur served by the Kundiyamallur canal, T. Kallaiynakuppam, Sirupalaiyur and K. Kalliyankuppam served by the Kalliyankuppam canal,



Adhinarayanapuram and Theerthanagiri served by the Theerthanagiri canal and Palliodai and Poondiyankuppam served by the Umaiyan canal. Also soil samples were drawn from the locations namely, Sambareddipalayam, Adhinarayanapuram and Mettupalayam which are irrigated exclusively by groundwater. The samples collected in the commands of the canals mentioned were representative of the entire command in the sense that they were drawn in the head, middle and tail reaches of the canals. The soil samples collected were dried and sieved as per the procedure adopted for sampling purposes and were labeled properly for investigation. The undisturbed soil samples were tested for physical and mechanical properties while the disturbed soil samples were tested for physico-chemical properties and macronutrient and micronutrient characteristics.

The physico-chemical properties namely, soil pH and Electrical Conductivity (EC) were determined as per Jackson (1973). Organic Carbon was determined as per Jackson (1973). Exchangeable cations namely, sodium (Na), Potassium (K), Calcium (Ca) and Magnesium (Mg) were determined as per Richards (1954). Available nitrogen (N) was determined as per the procedure recommended by Subbiah and Asija (1956). The available phosphorous (P) was estimated after Olsen's procedure. The available micronutrients namely, Zinc (Zn), Copper (Cu), Manganese (Mn) and Iron (Fe) were determined as per the procedure given by Gaines and Mitchell (1979).

The various physical properties that were determined of disturbed soil samples include porosity, bulk density and particle density. The different physical properties estimated of undisturbed soil samples include bulk density, dry density, specific gravity, porosity, void ratio and permeability. The permeability was determined by the constant head permeameter. The mechanical analysis of soil consisted of the determination of the percentage of various sized particles as they existed in soil. The grain size distribution n was determined by sieve analysis.

## RESULTS AND DISCUSSION

Table 2 shows physical properties of the undisturbed soil samples collected from the tank command. The average bulk density of the undisturbed soil samples collected from different locations in the commands of the Kundiyamallur canal, Kallaiyankuppam canal, Theerthanagiri canal, Umaiyan canal and in the Samabareddipalayam village was found to vary in a very narrow range between 2.00 gm/cc and 2.10 gm/cc. The average porosity of the soil samples collected in the canal irrigated commands varied between 26% and 31.4%. Based on porosity, the soil type was categorized as sandy clay loam. The permeability of these soils was found to be moderate in the range 1.17 x $10^{-2}$ mm/s to 1.22 x $10^{-2}$ mm/s.

Table 3 shows the physical and physico-chemical properties of the disturbed soil samples collected from different locations in the study area. It is found from Table 3 that all the soil samples drawn from different locations in the various irrigated commands have pH in the range 6.0 – 7.2. This is found

**Table 2**
Physical properties of undisturbed soil samples

| Location of porosity (%) | Nature soil samples | Average permeability ($\times 10^{-2}$) (m/s) | Average collected of irrigation | Average bulk density | Average density dry (gm/cc) | Average specific gravity (gm/cc) |
|---|---|---|---|---|---|---|
| Kundiyamallur canal command | Canal | 2.10 | 1.91 | 2.30 | 27.0 | 1.22 |
| Kallaiyankuppam canal command | Canal | 2.00 | 1.82 | 1.60 | 31.4 | 1.17 |
| Theerthanagiri canal command | Canal | 2.10 | 2.02 | 2.30 | 27.0 | 1.20 |
| Umaiyan canal command | Canal | 2.10 | 1.97 | 1.80 | 26.0 | 1.18 |
| Sambareddipa-layam village | Ground water | 2.10 | 2.01 | 2.20 | 23.0 | 0.98 |

to be well within the normal pH range of 6.0 – 8.5 permissiblefor irrigation water. However, the soil samples collected from groundwater irrigated locations in the villages namely, Sambareddipalayam, Adhinarayanapuram abd Mettupalayam were found to have pH slightly below 6.0 in the range 5.5 – 5.9. Suitable soil amelioration has to be made in order to adjust for the slightly acidic nature of soil pH and hence to bring it to the normal range, particularly when crops which are sensitive to the acidic pH are grown. Hence, it could be said that because of the organic carbon content in the coal dust particles and the micronutrients in fly-ash which might find its way to the tank irrigated lands, the soil pH tended to become normal from slightly acidic. This, in fact, was a good effect of the mine drainage water component in irrigation in the Perumal tank command area.

The Electrical conductivity (EC), which is a measure of the Total dissolved solids (TDS) present in soil, was also found to be well within the normal range (below 1.0) prescribed. From Table 3, it is evident that all soil samples drawn from both canal irrigated commands and groundwater irrigated areas have EC below 1.0 dS/m in the range 0.478 dS/m to 0.870 dS/m. Comparatively speaking, the EC of soil samples drawn from the canal irrigated areas were found to be in a higher range with those of soil samples drawn from the groundwater irrigated areas. This may be attributed to the presence of nutrients in coal dust and fly-ash finding its way through the tank water into the irrigated commands. As per Khan (1996), mobilization of nutrients from fly-ash into soil could raise the EC of soil.

Therefore, the areas irrigated by the tank water through different canals were found to have soil pH and soil EC well within the prescribed normal ranges suitable for the growth of crops/plants.

The bulk density of soil is always smaller than the particle density. Bulk density decreases with finer texture. It varies indirectly with the pore space in the soil. Soils with low bulk densities have favorable physical conditions



**Table 3**
Physical and Physico-chemical Properties of disturbed soil Samples

| Name of canal command | Reach of canal command | Nature of irrigation | pH | EC (dS/m) | Bulk density (gm/cc) | Particledensity (gm/cc) |
|---|---|---|---|---|---|---|
| Kundiyamallur | Head | Canal | 6.6 – 6.9 | 0.478 – 0.598 | 1.1 – 1.2 | 1.9 – 2.0 |
| | Middle | Canal | 6.9 – 7.2 | 0.648 – 0.777 | 1.1 – 1.2 | 1.9 – 2.0 |
| | Tail | Canal | 6.8 – 7.1 | 0.748 – 0.758 | 1.1 – 1.2 | 1.9 – 2.0 |
| Kallaiyankuppam | Head | Canal | 6.8 – 7.3 | 0.623 – 0.658 | 1.2 – 1.3 | 2.2 -2 .3 |
| | Middle | Canal | 6.3 – 6.6 | 0.724 – 0.795 | 1.3 – 1.5 | 2.1 – 2.5 |
| | Tail | Canal | 7.1 – 7.2 | 0.798 – 0.870 | 1.1 – 1.2 | 2.0 – 2.1 |
| Theerthanagiri | Head | Canal | 7.2 – 7.3 | 0.824 – 0.838 | 1.2 – 1.3 | 1.5 – 1.6 |
| | Middle | Canal | 6.8 – 7.4 | 0.720 – 0.748 | 1.2 – 1.5 | 1.5 – 2.2 |
| | Tail | Canal | 6.0 – 7.2 | 0.600 – 0.798 | 1.3 – 1.5 | 2.0 – 2.1 |
| Umaiyan | Head | Canal | 6.7 – 7.0 | 0.735 – 0.754 | 1.2 – 1.3 | 2.2 – 2.3 |
| | Middle | Canal | 6.8 – 7.2 | 0.710 – 0.810 | 1.1 – 1.3 | 2.1 – 2.3 |
| | Tail | Canal | 7.0 – 7.1 | 0.540 – 0.610 | 1.1 – 1.2 | 2.1 – 2.2 |
| Sambareddipalayam village | - | Groundwater | 5.5 – 5.8 | 0.439 – 0.450 | 1.1 – 2.0 | 2.1 – 2.7 |
| Adhinarayanapuram village | - | Groundwater | 5.7 – 5.9 | 0.446 – 0.460 | 1.1 – 2.0 | 2.1 – 2.7 |
| Mettupalayam village | - | Groundwater | 5.5 – 5.6 | 0.478 – 0.489 | 1.1 – 1.2 | 2.1 – 2.2 |

for plant growth. In the canal irrigated soils, the bulk density varied between 1.1 gm/cc to 1.5 gm/cc while in the groundwater irrigated soils, it varied from 1.1 gm/cc to 2.0 gm/cc. For good plant growth, it is recommended that the bulk density of soil be below 1.6 gm/cc. The soils

Table 4 shows the organic carbon content and exchangeable cations present in soils in the irrigated commands of Perumal tank.

The contents of organic carbon in the soils of tank irrigated areas were found to vary from a low of 0.10% in the head reach of Umaiyan canal command (Umaiyan canal is the last off-taking canal of Perumal tank with regard to the nearness to the location of the point of inflow of mine drainage through middle Paravanar stream to the tank) to a high of 0.89% in the tail reach of the Kallaiyankuppam canal command (the third off-taking canal with regard to the nearness to the location of the point of inflow of mine drainage to the tank). In general, it is found

**Table 4**
Average values of organic carbon content and exchangeable cations in soils of Perumal tank command area

| Name of canal command | Reach of canal command | Nature of irrigation | Organic Carbon (%) | Exchangeable Cations (cmol / kg) Calcium | Magnesium | Sodium |
|---|---|---|---|---|---|---|
| Kundiyamallur | Head | Canal | 0.86 | 20.0 | 5.57 | 0.57 |
| | Middle | Canal | 0.79 | 20.0 | 9.88 | 0.60 |
| | Tail | Canal | 1.41 | 36.0 | 3.80 | 0.82 |
| Kallaiyankuppam | Head | Canal | 0.27 | 14.0 | 8.12 | 0.13 |
| | Middle | Canal | 0.27 | 14.0 | 3.80 | 0.04 |
| | Tail | Canal | 0.89 | 17.5 | 23.75 | 0.15 |
| Theerthanagiri | Head | Canal | 0.31 | 30.5 | 9.60 | 0.53 |
| | Middle | Canal | 0.31 | 24.0 | 10.10 | 0.40 |
| | Tail | Canal | 0.20 | 15.5 | 5.80 | 0.20 |
| Umaiyan | Head | Canal | 0.10 | 28.5 | 4.81 | 0.02 |
| | Middle | Canal | 0.15 | 19.5 | 5.90 | 0.05 |
| | Tail | Canal | 0.11 | 15.5 | 4.05 | 0.09 |
| Sambareddipalayam village | - | Groundwater | 0.11 | 14.0 | 4.56 | 0.95 |
| Adhinarayanapuram village | - | Groundwater | 0.08 | 16.0 | 4.81 | 0.05 |
| Mettupalayam village | - | Groundwater | 0.04 | 18.0 | 3.80 | 0.05 |

from Table 4 that the organic carbon content of soils are found to be higher in the Kundiyamallur canal command (the nearest off-taking canal with regard to the location of the inflow point of mine drainage to the tank) in the range 0.79% to 1.41% and lower in the Umaiyan canal command in the range 0.10% to 0.15%. It could also be noted from Table 4 that the organic carbon content in the soils progressively decreased from the irrigated commands of the Kundiyamallur canal (first off-taking canal) to that of the Umaiyan canal last off-taking canal). This is a clear indication of the fact that because of the progressive sedimentation of the suspended coal dust particles and fly-ash mine drainage water in the tank as it traverses through the length of the tank, the content of organic carbon is found to be lower in the soils of the command of the last off-taking canal namely, Umaiyan canal. As the first off-taking canal namely, Kundiyamallur canal is located nearest to the inflow point of the mine drainage, the sedimentation of the suspended particles in mine drainage was found be very less allowing most of the particles to be carried with the tank water let out for irrigation. Table 5 show the standards adopted for rating of organic carbon content present in agricultural soils by the Soil Testing Laboratory, Agricultural Department, Tamilnadu State.

Comparing with the standards presented in Table 5, it was found that the Organic carbon content was found to be low in almost all the soil samples drawn from the irrigated commands of Kallaiyankuppam, Theerthanagiri and Umaiyan canals. Also, the organic carbon content was found to be very low in the range 0.04% to 0.11% in the soil samples drawn from the villages namely, Samabareddipalayam, Adhinarayanapuram and Mettupalayam irrigated by groundwater.



**Table 6**
Average concentration of available major nutrients in the Perumal tank command area

| Name of canal command | Reach of canal command | Nature of irrigation | Available Major Nutrients (kg/ha) Nitrogen | Phosphorous | Potassium |
|---|---|---|---|---|---|
| Kundiyamallur | Head | Canal | 51.0 | 13.15 | 68.0 |
| | Middle | Canal | 54.5 | 13.60 | 66.5 |
| | Tail | Canal | 52.5 | 13.45 | 69.0 |
| Kallaiyankuppam | Head | Canal | 62.5 | 14.65 | 80.5 |
| | Middle | Canal | 70.5 | 12.40 | 86.5 |
| | Tail | Canal | 57.0 | 10.85 | 87.5 |
| Theerthanagiri | Head | Canal | 53.0 | 13.45 | 69.0 |
| | Middle | Canal | 62.0 | 14.00 | 66.5 |
| | Tail | Canal | 54.5 | 13.75 | 68.0 |
| Umaiyan | Head | Canal | 52.7 | 13.40 | 76.0 |
| | Middle | Canal | 56.0 | 9.55 | 97.5 |
| | Tail | Canal | 56.5 | 7.15 | 112.5 |
| Sambareddipalayam village | - | Ground water | 66.5 | 8.55 | 72.0 |
| Adhinarayanapuram village | - | Ground water | 73.5 | 7.75 | 68.0 |
| Mettupalayam village | - | Ground water | 71.0 | 5.75 | 55.0 |

**Table 7**
Standards for rating of available macronutrients in agricultural soils

| Major Nutrient | Low | Medium | High |
|---|---|---|---|
| Nitrogen (N) | Less than 280 kg/ha | 280 kg/ha–560 kg/ha- | More than 560 kg/ha |
| Phosphorous | Less than 10 kg/ha | 10 kg/ha-25 kg/ha- | More than 25 kg/ha |
| Potassium | Less than 110 kg/ha | 110 kg/ha–280 kg/ha | More than 280 kg/ha |

**Table 8**
Average micronutrient status of soils in Perumal tank command area

| Micronutrient | Normal Standard (ppm) | Locations of Soil Samples Collected | | | | |
|---|---|---|---|---|---|---|
| | | Kundiyamallur Canal Command (ppm) | Kallaiyankuppam Canal Command (ppm) | Theerthanagiri CanalCommand (ppm) | Umaiyan Canal Command (ppm) | Groundwater irrigated areas |
| (ppm) | | | | | | |
| Zinc | 1.20 | 1.06 | 1.22 | 0.75 | 0.83 | 1.09 |
| Copper | 1.20 | 1.35 | 0.90 | 0.54 | 0.71 | 0.62 |
| Iron | 3.20 | 5.58 | 3.73 | 9.05 | 8.57 | 9.49 |
| Manganese | 2.00 | 1.22 | 1.34 | 1.13 | 1.20 | 1.32 |

Table 6 shows the major nutrients status of the agricultural soils in Perumal tank command area. Table 7 shows the standards for rating of available macronutrients in agricultural soils. In the canal irrigated areas, the average available nitrogen in soils were found to be low in the range 51.0 kg / ha to 70.5 kg / ha, but mostly in the range 51.0 kg / ha to 62.5 kg / ha. In the groundwater irrigated areas too, the average available nitrogen status of all soil samples were found to be low varying between 66.5 kg /ha to 73.5 kg/ ha. Hence, the fertility status of soils in both canal irrigated and groundwater irrigated areas with respect to available nitrogen were found to be low. A similar range of values for available nitrogen was reported earlier by Raghupathy (1990). The available phosphorous status was found to be medium in all canal irrigated areas except in the middle and tail reaches of the Umaiyan canal command. While in the groundwater irrigated areas, the status of available phosphorous was found to be low as shown in Table 6. The available potassium was found to be low in most of the soil samples drawn from both canal irrigated and groundwater irrigated areas.

Table 8 shows the average micronutrients status of soil samples drawn from both canal irrigated and groundwater irrigated areas.

From Table 8, it is observed that the average status of zinc ranged between 0.75 ppm in Theerthangiri canal command to 1.22 ppm in Kallaiyankuppam canal command. There are slight deficiencies in available zinc in the soils of the tank command compared to the normal requirement of 1.20 ppm. Deficiencies were found in available copper particularly in the canal commands of Theerthanagiri and Umaiyan and in the groundwater irrigated locations. The contents of iron in all the soil samples drawn from different locations in the entire



command area of the tank were found to higher, in the range 3.73 ppm to 9.49 ppm, than the normal requirement of 3.20 ppm. The average deficiencies in Manganese in the various canal commands were found to vary between 33% and 40% compared to the normal requirement of 2 ppm.

A deficient soil can be corrected by modifying soil pH, which enhances the availability of nutrients. The most favorable pH for most nutrients is in the narrow zone of 6.5 to 7.5. The pH of soils in the canal irrigated commands is mostly in the favorable zone with regard to the availability of nutrients, while the pH of soils in the groundwater irrigated locations need to be raised in order to enhance the availability of nutrients. Proper amelioration need to be carried out in order to enhance the levels of both available macronutrients and micronutrients in soils for good crop growth.

## SUMMARY AND CONCLUSIONS

The results obtained from various laboratory tests conducted to ascertain the quality status of soils in Perumal tank command area indicated that the mine drainage water used for irrigation in the tank command has no adverse effect on the soils to hamper the crop growth. In fact, it was observed that the mine drainage component of irrigation water helped to increase the soil pH and kept it in the favorable zone of 6.5 to 7.5 so that the macronutrients and micronutrients are made available to crop growth. The soil status in groundwater irrigated locations was found to slightly acidic and need suitable treatment for raising the pH. This is very imperative for improving crop growth. The higher organic carbon content reported in the soils of the Kundiyamallur canal command could be attributed to the entry of coal dust particles present in suspension in the mine drainage along with the irrigation water discharged from the tank. The content of organic carbon in soils of other canal commands were reported to be comparatively lower due to the fact most of the suspended coal dust particles and fly-ash settled down to the tank bottom and relatively clear water was discharged for irrigation through the remaining off-taking canals of the tank.

The texture of the soil tended to be loamy in the canal irrigated areas. This might be attributed to the presence of suspended micro-sized particles in mine waters used for irrigation. The bulk density of soil samples in both canal irrigated and groundwater irrigated locations were found to be in the optimum range favorable for improving soil porosity, workability of soil, root penetration and moisture retention capacity of soil. There were huge deficiencies in the available nitrogen status of most soils. Proper amendment in natural and artificial fertilizers needs to be done in order to improve the nitrogen status of soils. Suitable amelioration need to be done in order to improve the availability of micronutrients namely, zinc, copper and manganese.

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