## Table 2.1.1 Main States of Agricultural Produciton and Amounts (1993-94)

| Crop | | State | Production (M. tons) | % of Total Production |
|---|---|---|---|---|
| All Foodgains | Food grains | Uttar Pradesh | 37.20 | 20.2 |
| | | Punjab | 21.58 | 11.7 |
| | | Madhya Pradesh | 19.13 | 10.4 |
| | | Maharashtra | 13.58 | 7.4 |
| | | West Bengal | 13.10 | 7.1 |
| | | Bihar | 12.78 | 6.9 |
| | | Andhra Pradesh | 12.25 | 6.6 |
| | | Haryana | 10.25 | 5.6 |
| | | Karnataka | 8.66 | 4.7 |
| | | Tamil Nadu | 8.26 | 4.5 |
| | | Orissa | 7.29 | 4.0 |
| | Rice | Wewt Bengal | 12.11 | 15.1 |
| | | Uttar Pradesh | 10.21 | 12.7 |
| | | Andhra Pradesh | 9.56 | 11.9 |
| | | Punjab | 7.64 | 9.5 |
| | | Tamil Nadu | 6.75 | 8.4 |
| | | Orissa | 6.62 | 8.2 |
| | | Bihar | 6.11 | 7.6 |
| | | Madhya Pradesh | 5.96 | 7.4 |
| | Wheat | Uttar Pradesh | 20.82 | 34.8 |
| | | Punjab | 13.38 | 22.4 |
| | | Haryana | 7.23 | 12.1 |
| | | Madhya Pradesh | 6.77 | 11.3 |
| Others | Groundnut | Andhra Pradesh | 2.55 | 32.6 |
| | | Tamil Nadu | 1.87 | 23.9 |
| | | Karnataka | 1.20 | 15.3 |
| | | Maharashtra | 0.77 | 9.8 |
| | | Gujarat | 0.68 | 8.7 |
| | | Others | 0.76 | 9.7 |
| | | All India | 7.83 | 100.0 |
| | Soybean | Madhya Pradesh | 3.60 | 75.8 |
| | | Maharashtra | 0.67 | 14.1 |
| | | Rajasthan | 0.37 | 7.8 |
| | | Others | 0.11 | 2.3 |
| | | All India | 4.75 | 100.0 |

| Crop | | State | Production (M. tons) | % of Total Production |
|---|---|---|---|---|
| Coarse Cereals | | Maharashtra | 7.84 | 25.4 |
| | | Karnataka | 4.65 | 15.1 |
| | | Uttar Pradesh | 3.65 | 11.9 |
| | | Madhya Pradesh | 3.13 | 10.1 |
| | | Rajasthan | 2.38 | 7.7 |
| | | Andhra Pradesh | 2.01 | 6.5 |
| | | Bihar | 1.58 | 5.1 |
| Total Pulses | | Madhya Pradesh | 3.26 | 24.5 |
| | | Uttar Pradesh | 2.52 | 18.9 |
| | | Maharashtra | 2.21 | 16.6 |
| | | Rajasthan | 1.07 | 8.1 |
| | | Bihar | 0.74 | 5.6 |
| | | Andhra Pradesh | 0.68 | 5.1 |
| | | Orissa | 0.50 | 3.8 |
| Total | | Madhya Pradesh | 4.74 | 22.0 |
| | | Andhra Pradesh | 2.90 | 13.5 |
| | | Rajasthan | 2.41 | 11.2 |
| | | Maharashtra | 2.35 | 10.9 |
| | | Tamil Nadu | 1.97 | 9.2 |
| | | Karnataka | 1.89 | 8.8 |
| | | Gujarat | 1.57 | 7.3 |
| | | Others | 3.67 | 17.1 |
| Rapeseed and Mustard | | Rajasthan | 1.75 | 32.8 |
| | | Uttar Pradesh | 1.12 | 21.0 |
| | | Haryana | 0.80 | 15.0 |
| | | Madhya Pradesh | 0.60 | 11.3 |
| | | Others | 1.06 | 19.9 |
| | | All India | 5.33 | 100.0 |

Source: Agricultural statistics at a glance, Min. of Agriculture

## Table 2.1.2 Irrigated Area Ratios by Major Crops in India, 1992-93

(Unit : %)

| State | Rice | Jowar | Bajra | Maze | Wheat | Barley | Total Cereals | Gram | Total Pulses | Total Food Grains | Groundnut | Rape-seed & Mustard | Total Oil Seeds | Sugar cane | Cotton | Tobacco | Total (Under All Crops) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Andhra Pradesh | 94.5 | 2.1 | 17 | 31.7 | 80 | - | 66.7 | 1.7 | 0.6 | 51.7 | 128.1 | - | 18.1 | 97.2 | 12.8 | 321.2 | 39.9 |
| Arunachal Pradesh | 31.3 | - | - | - | - | - | 20.3 | - | - | 19 | - | - | - | - | - | - | 14.1 |
| Assam (a) | 33.8 | - | - | - | - | - | 33.6 | - | 9.3 | 32.6 | - | - | - | - | - | - | 14.9 # |
| Bihar | 37.5 | 2.1 | 0.1 | 42 | 87.3 | 19.5 | 50.4 | 3.9 | 2 | 44.8 | 0.4 | 32 | 17 | 14.3 | 11.6 | 81.3 | 43.2 |
| Goa | 30.9 | - | - | 100 | - | - | 28.8 | - | 83.3 | 33.8 | 100 | - | 4 | 100 | - | - | 21.7 |
| Gujarat | 52.4 | 5.3 | 13.9 | 8.1 | 82.9 | 86.7 | 29.9 | 30.5 | 9 | 25.8 | 9.4 | 98.3 | 25.4 | 100 | 31.8 | 64.2 | 29.3 |
| Haryana | 99.6 | 60.2 | 17.5 | 21.9 | 97.9 | 84.9 | 81.5 | 22.9 | 320.8 | 75.6 | 50 | 65 | 65.4 | 95.7 | 99.6 | 100 | 73.4 |
| Himachal Pradesh | 62.2 | - | 30.2 | 7.7 | 17.7 | 14.8 | 18.1 | 8.2 | 12.2 | 17.8 | 8.7 | 11.1 | 13.6 | 33.3 | 16.1 | 12.8 | 17.9 |
| Jammu & Kashimir | 91.8 | - | 0.2 | 6 | 24.1 | 12.5 | 39.3 | 9.4 | 11.8 | 38.3 | 0.3 | 80.6 | 70.4 | 47.8 | 10.2 | 16.1 | 40.7 |
| Karnataka | 64.9 | 6.7 | 12.3 | 65.1 | 35.7 | - | 24.9 | 10.5 | 3.3 | 20 | 21.2 | 16.7 | 20.2 | 99.2 | 27.1 | 3.4 | 22.6 |
| Kerala | 39.4 | - | - | - | - | - | 38.7 | - | - | 37.1 | - | - | 11.8 | 33.3 | - | - | 12.3 |
| Madhya Pradesh | 23.3 | 0.1 | - | 1.1 | 59.8 | 32.9 | 27.6 | 26.3 | 14 | 23.8 | 7.4 | 41.8 | 6.9 | 96.8 | 24.9 | 73.9 | 20.7 |
| Maharashtra (b) | 26.1 | 8.9 | 4.1 | 37.4 | 76.8 | - | 15.1 | 36.4 | 6.6 | 13.1 | 19.5 | 23.5 | 13 | 100 | 3.3 | 1.7 | 15.4 # |
| Manipur | 50 | - | - | - | - | - | 49 | - | - | 47.5 | - | - | - | - | - | - | 40.1 |
| Meghalaya | 42.9 | - | - | - | - | - | 34.6 | - | - | 33.8 | - | - | - | - | - | - | 18.8 # |
| Mizoram (e) | 14 | - | - | - | - | - | 13.4 | - | - | 13.4 | - | - | - | - | - | - | 7.8 # |
| Nagaland | 44.4 | - | - | - | 100 | - | 34.9 | - | - | 31.9 | - | - | - | - | - | - | 27.2 |
| Orissa | 34.7 | - | - | 10.6 | 100 | - | 32.4 | - | 6.5 | 25 | 38.1 | 27 | 18.1 | 100 | - | 15.4 | 26.2 |
| Punjab | 99 | 61.7 | 77.8 | 53.7 | 96.4 | 88.4 | 95.8 | 15.4 | 6+2.5 | 95.2 | 63.6 | 87.7 | 58 | 95.5 | 99.4 | - | 94.6 |
| Rajasthan | 35.9 | 0.4 | 1.6 | 8.9 | 91.8 | 84.8 | 26.6 | 17.2 | 8.2 | 21.6 | 29.2 | 61.6 | 45.1 | 100 | 97.7 | 50 | 27.2 |
| Sikkim (c ) | 100 | - | - | - | - | - | 22.2 | - | - | 19.8 | - | - | - | - | - | - | 12.8 # |
| Tamil Nadu | 92.3 | 7.6 | 9.1 | 51.2 | 12.9 | - | 67 | 14.3 | 6 | 55.5 | 31.9 | 5 | 35.9 | 99.5 | 33.3 | 88.9 | 47.9 |
| Tripura (b) | 15.6 | - | - | - | 16 | - | 15.3 | 79.9 | 9.1 | 15.1 | 4 | - | 0.3 | 20 | - | - | 11.3 # |
| Uttar Pradesh (b) | 48.9 | 1.5 | 5.8 | 32.3 | 90.3 | 52.9 | 64.8 | 18.5 | 23.5 | 58.8 | 1.5 | 74.2 | 55.4 | 85.1 | 87.9 | 98.6 | 62.3 # |
| West Bengal (d) | 24.6 | - | - | - | 72.5 | 5.6 | 26.9 | 2.9 | 1.7 | 25.1 | - | 54.1 | 44.1 | 15.4 | - | - | 22.4 # |
| All-India | 46.8 | 6.3 | 5.8 | 21.8 | 84.3 | 60.8 | 43.3 | 21.9 | 10.4 | 37.1 | 19.2 | 57.5 | 23.9 | 87.9 | 33.2 | 41.2 | 35.7 |

Notes : (a) - Based on the figures for the year 1953-54.
(b) - Based on the figures for the year 1991-92
(c) - Based on the figures for the year1984-85
(d) - Based on the figures for the year1985-86.
(e) - Based on the figures for the year 1974-75.
(#) Based on the figures latest available of the gross irrigated area and gross sown area.

Source: Agricultural Statistics at a Glance

## Table 2.2.1 Length of State Government Road in Tamil Nadu

(Unit : km)

| | District | Surfaced Road | | | | | Unsurfaceed Road | | | | | Total Length of Road | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1990-91 | 1991-92 | 1992-93 | 1993-94 | 1994-95 | 1990-91 | 1991-92 | 1992-93 | 1993-94 | 1994-95 | 1990-91 | 1991-92 | 1992-93 | 1993-94 | 1994-95 |
| 1 | Tuticorin | 1,785 | 1,811 | 1,866 | 1,919 | 1,986 | - | - | - | - | - | 1,785 | 1,811 | 1,866 | 1,919 | 1,986 |
| 2 | Tiruvallur & Kanchipuram | 3,353 | 3,466 | 3,564 | 3,671 | 3,731 | 2 | 2 | 2 | 3 | 2 | 3,355 | 3,468 | 3,566 | 3,674 | 3,733 |
| 3 | Coimbatore | 3,264 | 3,310 | 3,352 | 3,471 | 3,614 | 1 | 1 | 2 | - | 5 | 3,265 | 3,311 | 3,354 | 3,471 | 3,619 |
| 4 | Dharmapuri | 2,654 | 2,755 | 2,816 | 2,876 | 2,896 | - | - | - | - | - | 2,654 | 2,755 | 2,816 | 2,876 | 2,896 |
| 5 | Dindigul | 1,970 | 2,039 | 2,095 | 2,196 | 2,235 | 12 | 12 | 12 | - | - | 1,982 | 2,051 | 2,107 | 2,196 | 2,235 |
| 6 | Virudunagar | 1,487 | 1,528 | 1,545 | 1,565 | 1,628 | 4 | 4 | 4 | 4 | 4 | 1,491 | 1,532 | 1,549 | 1,569 | 1,632 |
| 7 | Kanniyakumari | 1,014 | 1,089 | 1,106 | 1,144 | 1,149 | - | - | - | - | - | 1,014 | 1,089 | 1,106 | 1,144 | 1,149 |
| 8 | Chennai (Madras) | 20 | - | - | - | - | - | - | - | - | - | 20 | - | - | - | - |
| 9 | Madurai | 2,012 | 2,023 | 2,073 | 2,109 | 2,166 | - | - | - | - | - | 2,012 | 2,023 | 2,073 | 2,109 | 2,166 |
| 10 | Nilgiris | 972 | 1,014 | 1,018 | 1,044 | 1,052 | - | - | - | - | - | 972 | 1,014 | 1,018 | 1,044 | 1,052 |
| 11 | Nagapattinam | 2,061 | 2,115 | 2,167 | 2,205 | 2,222 | 12 | 9 | 9 | 9 | 9 | 2,073 | 2,124 | 2,176 | 2,214 | 2,231 |
| 12 | Vellore | 1,942 | 2,002 | 4,484 | 2,265 | 2,382 | - | - | - | - | - | 1,942 | 2,002 | 4,484 | 2,265 | 2,382 |
| 13 | Sivagangai | 1,460 | 1,490 | 1,509 | 1,585 | 1,668 | 5 | 4 | 4 | 1 | 1 | 1,465 | 1,494 | 1,513 | 1,586 | 1,669 |
| 14 | Erode | 3,352 | 3,393 | 3,437 | 3,519 | 3,660 | - | - | - | - | - | 3,352 | 3,393 | 3,437 | 3,519 | 3,660 |
| 15 | Pudukkottai | 1,806 | 1,819 | 1,856 | 3,087 | 3,166 | - | - | - | 1 | - | 1,806 | 1,819 | 1,856 | 3,088 | 3,166 |
| 16 | Ramanathapuram | 1,390 | 1,416 | 1,454 | 1,491 | 1,500 | - | - | - | - | - | 1,390 | 1,416 | 1,454 | 1,491 | 1,500 |
| 17 | Salem | 3,644 | 3,757 | 3,808 | 3,903 | 3,952 | - | - | 1 | 2 | 2 | 3,644 | 3,757 | 3,809 | 3,905 | 3,954 |
| 18 | Cuddalore | 4,162 | 4,239 | 4,302 | 1,619 | 1,637 | 39 | 39 | 39 | 1 | 1 | 4,201 | 4,278 | 4,341 | 1,620 | 1,638 |
| 19 | Thanjavur | 2,021 | 2,052 | 2,063 | 2,111 | 2,149 | - | - | - | - | - | 2,021 | 2,052 | 2,063 | 2,111 | 2,149 |
| 20 | Thiruvannamalai | 2,284 | 2,359 | - | 2,436 | 2,525 | - | - | - | - | - | 2,284 | 2,359 | - | 2,436 | 2,525 |
| 21 | Tirchy | 3,779 | 3,836 | 3,986 | 2,877 | 2,908 | 6 | - | 2 | - | - | 3,785 | 3,836 | 3,988 | 2,877 | 2,908 |
| 22 | Tirunelveli | 2,442 | 2,525 | 2,568 | 2,634 | 2,741 | - | - | - | - | - | 2,442 | 2,525 | 2,568 | 2,634 | 2,741 |
| 23 | Villupuram | - | - | - | 2,800 | 2,848 | - | - | - | 37 | 29 | - | - | - | 2,837 | 2,877 |
| | State Toral | 48,874 | 50,038 | 51,069 | 52,527 | 53,815 | 81 | 71 | 75 | 58 | 53 | 48,955 | 50,109 | 51,144 | 52,585 | 53,868 |

Source : Tamil Nadu An Economic Appraisal 1994-95

## Table 2.2.2 Consumption of Fertilizer in India

(Unit : kgs)

| State | 1993-94 (Estimated) | | | | 1994-95 (Estimated) | | | |
|---|---|---|---|---|---|---|---|---|
| | Nitrogen | Phosphate | Potash | Total | Nitrogen | Phosphate | Potash | Total |
| Andhra Pradesh | 82.30 | 28.01 | 6.68 | 116.99 | 84.08 | 28.96 | 8.33 | 121.37 |
| Karanataka | 38.15 | 17.41 | 9.39 | 64.95 | 38.93 | 16.35 | 9.64 | 64.92 |
| Kerala | 25.69 | 10.96 | 21.88 | 58.53 | 27.71 | 14.12 | 24.90 | 66.73 |
| Tamil Nadu | 59.32 | 23.12 | 29.48 | 111.92 | 69.07 | 27.71 | 39.86 | 136.64 |
| Goa | 20.25 | 12.06 | 7.08 | 39.39 | 22.90 | 9.19 | 9.31 | 41.40 |
| Gujarat | 45.03 | 14.95 | 3.73 | 63.71 | 53.56 | 19.14 | 4.78 | 77.48 |
| Madhya Pradesh | 22.57 | 10.22 | 0.73 | 33.52 | 23.71 | 12.40 | 1.29 | 37.40 |
| Maharashtra | 40.05 | 12.90 | 6.52 | 59.47 | 47.22 | 18.88 | 9.31 | 75.41 |
| Rajasthan | 20.23 | 7.39 | 0.15 | 27.77 | 26.18 | 8.18 | 0.44 | 34.80 |
| Haryana | 93.87 | 6.65 | 0.07 | 100.59 | 98.77 | 27.22 | 0.38 | 126.37 |
| Himachal Pradesh | 25.14 | 2.38 | 1.65 | 29.17 | 29.73 | 2.60 | 2.31 | 34.64 |
| Jammu & Kashmir | 32.53 | 6.07 | 0.55 | 39.15 | 38.61 | 8.22 | 1.34 | 48.17 |
| Punjab | 125.90 | 32.65 | 0.99 | 159.54 | 137.29 | 35.27 | 2.19 | 174.75 |
| Uttar Pradesh | 73.32 | 13.93 | 1.50 | 88.75 | 79.98 | 16.45 | 2.83 | 99.26 |
| Assam | 5.37 | 1.29 | 2.00 | 8.66 | 5.69 | 1.25 | 2.54 | 9.48 |
| Manipur | 42.71 | 4.44 | 0.27 | 47.42 | 46.66 | 10.60 | 1.64 | 58.90 |
| Meghalaya | 7.56 | 4.72 | 1.10 | 13.38 | 9.32 | 4.80 | 0.80 | 14.92 |
| Nagaland | 2.31 | 2.11 | 0.64 | 5.06 | 1.19 | 1.32 | 0.51 | 3.02 |
| Sikkim | 4.54 | 2.13 | 0.69 | 7.36 | 5.28 | 1.57 | 0.45 | 7.30 |
| Tripura | 11.68 | 3.82 | 1.99 | 17.49 | 11.54 | 4.91 | 3.03 | 19.48 |
| Arunachal Pradesh | 1.13 | 0.84 | 0.33 | 2.30 | 1.21 | 0.94 | 0.43 | 2.58 |
| Mizoram | 3.62 | 4.46 | 1.62 | 9.70 | 3.19 | 3.10 | 2.28 | 8.57 |
| Bihar | 46.48 | 9.72 | 1.48 | 57.68 | 51.80 | 9.41 | 3.35 | 64.56 |
| Orissa | 15.75 | 3.48 | 1.93 | 21.16 | 16.26 | 3.82 | 2.40 | 22.48 |
| West Bengal | 49.08 | 21.14 | 15.76 | 85.98 | 51.98 | 18.50 | 15.70 | 86.18 |
| All India | 48.10 | 14.61 | 4.97 | 67.68 | 52.76 | 16.45 | 6.47 | 75.68 |

Source: Agricultural Statistics at a Glance

## Table 2.2.3 Production of Principal Crops in Tamil Nadu, 1993-94

| Crop | Area (1,000 ha) | Yield (kg/ha) | Production (1,000 tons) | Percentage to total | |
|---|---|---|---|---|---|
| | | | | Area | Production |
| **Cereals** | | | | | |
| Paddy(in rice) | 2,306 | 2,927 | 6,750 | 32.2 | 15.6 |
| Cholam | 506 | 960 | 486 | 7.1 | 1.1 |
| Cumbu | 213 | 1,121 | 238 | 3.0 | 0.6 |
| Maize | 38 | 1,618 | 61 | 0.5 | 0.1 |
| Ragi | 158 | 2,095 | 331 | 2.2 | 0.8 |
| Korra | 4 | 500 | 2 | 0.1 | 0.0 |
| Varagu | 36 | 1,194 | 43 | 0.5 | 0.1 |
| Samai | 64 | 1,000 | 64 | 0.9 | 0.1 |
| Others | 12 | 500 | 6 | 0.2 | 0.0 |
| Sub-total | 3,337 | 2,392 | 7,981 | 46.6 | 18.4 |
| **Pulses** | | | | | |
| Bengalgram | 10 | 693 | 7 | 0.1 | 0.0 |
| Redgram | 110 | 452 | 50 | 1.5 | 0.1 |
| Greengram | 106 | 391 | 41 | 1.5 | 0.1 |
| Blackgram | 216 | 419 | 91 | 3.0 | 0.2 |
| Horsegram | 128 | 497 | 63 | 1.8 | 0.1 |
| Others | 120 | 200 | 24 | 1.7 | 0.1 |
| Sub-total | 690 | 400 | 276 | 9.6 | 0.6 |
| **Condiments and Spices** | | | | | |
| Betel Nuts | 3 | -- | -- | -- | -- |
| Cardamom | 5 | 90* | 0 | 0.1 | 0.0 |
| Chillies | 73 | 596 | 44 | 1.0 | 0.1 |
| Garlic | 1 | 5,930* | 6 | 0.0 | 0.0 |
| Pepper | 3 | 200* | 1 | 0.0 | 0.0 |
| Coriander | 52 | 212 | 11 | 0.7 | 0.0 |
| Turmeric(Dry) | 22 | 6,193 | 137 | 0.3 | 0.3 |
| Tamarind | 19 | 3,053 | 58 | 0.3 | 0.1 |
| Others | 2 | -- | -- | 0.0 | -- |
| Sub-total | 180 | | 257 | 2.5 | 0.6 |
| **Fruits** | | | | | |
| Banana | 83 | 31,554 | 2,619 | 1.2 | 6.1 |
| Mango | 68 | 6,162 | 419 | 0.9 | 1.0 |
| Jack Fruit | 3 | 1,027* | 3 | 0.0 | 0.0 |
| Guava | 6 | 624* | 4 | 0.1 | 0.0 |
| Grapes | 2 | 1,325* | 3 | 0.0 | 0.0 |
| Citrus | 11 | 2,109* | 23 | 0.2 | 0.1 |
| Cashnuts | 76 | 95* | 7 | 1.1 | 0.0 |
| Others | 6 | -- | -- | 0.1 | -- |
| Sub-total | 255 | | 3,078 | 3.6 | 7.1 |
| **Sugar crops** | | | | | |
| Sugarcane(in cane) | 249 | 104,386 | 25,992 | 3.5 | 60.1 |
| Others | 19 | -- | -- | 0.3 | -- |
| Sub-total | 268 | | 25,992 | 3.7 | 60.1 |
| **Vegetables** | | | | | |
| Potato | 6 | 22,084 | 128 | 0.1 | 0.3 |
| Tapioca | 85 | 37,719 | 3,222 | 1.2 | 7.4 |
| Sweet Potato | 3 | 15,333 | 46 | 0.0 | 0.1 |
| Onion | 25 | 8,044 | 198 | 0.3 | 0.5 |
| Brinjal | 9 | 851* | 8 | 0.1 | 0.0 |
| Tomato | 20 | 975* | 19 | 0.3 | 0.0 |
| Others | 23 | -- | -- | 0.3 | -- |
| Sub-total | 171 | | 3,621 | 2.4 | 8.4 |
| **Fibres** | | | | | |
| Cotton | 229 | 316 | 72 | 3.2 | 0.2 |
| Others | 2 | -- | -- | 0.0 | -- |
| Sub-total | 231 | | 72 | 3.2 | 0.2 |
| **Oilseeds** | | | | | |
| Groundnut(Nuts-in-shell) | 1,158 | 1,611 | 1,866 | 16.2 | 4.3 |
| Gingerly | 129 | 457 | 59 | 1.8 | 0.1 |
| Sunflower | 40 | 830 | 33 | 0.6 | 0.1 |
| Castor | 33 | 311 | 10 | 0.5 | 0.0 |
| Coconut( in nuts) | 208 | 12,139 | -- | 2.9 | -- |
| Others | 18 | -- | -- | 0.3 | -- |
| Sub-total | 1,586 | | 1,968 | 22.2 | 4.5 |
| **Others** | | | | | |
| Coffee | 33 | -- | -- | 0.5 | -- |
| Tea | 62 | -- | -- | 0.9 | -- |
| Tobacco(cured leaf) | 9 | 1,462 | 14 | 0.1 | 0.0 |
| Bamboo | 1 | -- | -- | 0.0 | -- |
| Mulberry | 16 | -- | -- | 0.2 | -- |
| Fodder Crops | 180 | -- | -- | 2.5 | -- |
| Green Manure Crops | 4 | -- | -- | 0.1 | -- |
| Other Non-Food Crops | 135 | -- | -- | 1.9 | -- |
| Sub-total | 440 | -- | 14 | 6.1 | 0.0 |
| **Total** | 7,158 | -- | 43,259 | 100.0 | 100.0 |

Note : * 1992-93

Source: Department of Statistics, Madras-6.

## Table 2.2.4 Yearly Variations of Principal Crops in Tamil Nadu

| Crop | | Unit | 1989-90 | 1990-91 | 1991-92 | 1992-93 | 1993-94 | Average | C.V. (%) |
|---|---|---|---|---|---|---|---|---|---|
| Paddy | Area | (1,000 ha) | 1,963 | 1,856 | 2,118 | 2,184 | 2,306 | 2,085 | 8.5 |
| | | (%) | 94 | 89 | 102 | 105 | 111 | 100 | |
| | Yield(in rice) | (kg/ha) | 3,088 | 3,116 | 3,115 | 3,116 | 2,927 | 3,072 | 2.7 |
| | | (%) | 101 | 101 | 101 | 101 | 95 | 100 | |
| | Production | (1,000 ton) | 6,063 | 5,782 | 6,596 | 6,806 | 6,750 | 6,399 | 7.1 |
| | | (%) | 95 | 90 | 103 | 106 | 105 | 100 | |
| Cholam | Area | (1,000 ha) | 587 | 541 | 512 | 484 | 506 | 526 | 7.5 |
| | | (%) | 112 | 103 | 97 | 92 | 96 | 100 | |
| | Yield | (kg/ha) | 1,184 | 1,014 | 1,080 | 1,004 | 960 | 1,048 | 8.3 |
| | | (%) | 113 | 97 | 103 | 96 | 92 | 100 | |
| | Production | (1,000 ton) | 695 | 549 | 553 | 486 | 486 | 554 | 15.4 |
| | | (%) | 125 | 99 | 100 | 88 | 88 | 100 | |
| Cumbu | Area | (1,000 ha) | 261 | 274 | 246 | 220 | 213 | 243 | 10.7 |
| | | (%) | 107 | 113 | 101 | 91 | 88 | 100 | |
| | Yield | (kg/ha) | 1,112 | 1,081 | 1,104 | 1,144 | 1,121 | 1,112 | 2.1 |
| | | (%) | 100 | 97 | 99 | 103 | 101 | 100 | |
| | Production | (1,000 ton) | 291 | 296 | 272 | 251 | 238 | 270 | 9.3 |
| | | (%) | 108 | 110 | 101 | 93 | 88 | 100 | |
| Ragi | Area | (1,000 ha) | 172 | 170 | 158 | 151 | 158 | 162 | 5.5 |
| | | (%) | 106 | 105 | 98 | 93 | 98 | 100 | |
| | Yield | (kg/ha) | 1,995 | 1,863 | 1,961 | 1,933 | 2,095 | 1,969 | 4.3 |
| | | (%) | 101 | 95 | 100 | 98 | 106 | 100 | |
| | Production | (1,000 ton) | 343 | 316 | 311 | 291 | 331 | 318 | 6.2 |
| | | (%) | 108 | 99 | 98 | 92 | 104 | 100 | |
| Sugarcane | Area | (1,000 ha) | 222 | 233 | 238 | 216 | 249 | 232 | 5.6 |
| | | (%) | 96 | 100 | 103 | 93 | 107 | 100 | |
| | Yield(in cane) | (ton/ha) | 104 | 101 | 105 | 107 | 104 | 104 | 2.1 |
| | | (%) | 100 | 97 | 101 | 103 | 100 | 100 | |
| | Production | (1,000 ton) | 23,086 | 23,480 | 24,887 | 23,064 | 25,992 | 24,102 | 5.4 |
| | | (%) | 96 | 97 | 103 | 96 | 108 | 100 | |
| Cotton | Area | (1,000 ha) | 281 | 239 | 258 | 267 | 229 | 255 | 8.2 |
| | | (%) | 110 | 94 | 101 | 105 | 90 | 100 | |
| | Yield(in lint) | (kg/ha) | 307 | 290 | 270 | 289 | 316 | 294 | 6.1 |
| | | (%) | 104 | 99 | 92 | 98 | 107 | 100 | |
| | Production | (1,000 ton) | 86 | 70 | 70 | 77 | 72 | 75 | 9.4 |
| | | (%) | 115 | 93 | 93 | 103 | 97 | 100 | |
| Groundnut | Area | (1,000 ha) | 1,016 | 963 | 1,099 | 1,188 | 1,158 | 1,085 | 8.7 |
| | | (%) | 94 | 89 | 101 | 109 | 107 | 100 | |
| | Yield(in shell) | (kg/ha) | 1,193 | 1,225 | 1,381 | 1,486 | 1,611 | 1,379 | 12.7 |
| | | (%) | 87 | 89 | 100 | 108 | 117 | 100 | |
| | Production | (1,000 ton) | 1,211 | 1,179 | 1,518 | 1,766 | 1,866 | 1,508 | 20.7 |
| | | (%) | 80 | 78 | 101 | 117 | 124 | 100 | |
| Pulses | Area | (1,000 ha) | 821 | 847 | 776 | 739 | 690 | 775 | 8.1 |
| | | (%) | 106 | 109 | 100 | 95 | 89 | 100 | |
| | Yield | (kg/ha) | 407 | 425 | 452 | 464 | 400 | 430 | 6.5 |
| | | (%) | 95 | 99 | 105 | 108 | 93 | 100 | |
| | Production | (1,000 ton) | 334 | 360 | 351 | 343 | 276 | 333 | 10.0 |
| | | (%) | 100 | 108 | 105 | 103 | 83 | 100 | |

Note : (%) Percentage to average

Data source: Department of Statistics, Madras-6.

## Table 2.2.5 Water Source of Irrigation Area Irrigated in Tamil Nadu

| Water Souces | 1990-91 | 1991-92 | 1992-93 |
|---|---|---|---|
| A. Number of Sources | | | |
| 1. Government canals | 2,281 | 2,218 | 2,220 |
| Length in km | 12,587 | 12,587 | 12,642 |
| 2. Private canals | 9 | 9 | 9 |
| Length in km | 24 | 24 | 24 |
| 3. Number of reservoirs | 64 | 66 | 66 |
| 4. Number of tanks | | | |
| 1) Command area of 40 ha or more | 7,281 | 7,299 | 7,176 |
| 2) Command area of less than 40 ha | 31,202 | 31,453 | 31,687 |
| Total | 38,483 | 38,752 | 38,863 |
| 5. Number of tubewells | | | |
| 1) Government | 3,163 | 3,716 | 3,951 |
| 2) Private | 86,584 | 94,349 | 104,391 |
| Total | 89,747 | 98,065 | 108,342 |
| 6. Number of other government wells used only for irrigation | | | |
| 1) Masonry | 1,967 | 1,973 | 1,855 |
| 2) Non-masonry | 390 | 390 | 405 |
| Total | 2,357 | 2,363 | 2,260 |
| 7. Number of other private wells used only for irrigation | | | |
| 1) Masonry | 1,425,315 | 1,423,249 | 1,855 |
| 2) Non-masonry | 252,590 | 256,841 | 1,417,280 |
| Total | 1,677,905 | 1,680,090 | 1,419,135 |
| 8. Number of wells for domestic purpose only | 578,401 | 583,010 | 586,348 |
| 9. Number of wells not in use | 120,837 | 1,224,397 | 141,054 |
| B. Area Irrigated in ha | | | |
| Net area irrigated by | | | |
| 1) Government canals | 768,827 | 842,892 | 850,901 |
| 2) Private canals | 560 | 560 | 560 |
| 3) Tanks | 530,933 | 577,021 | 628,830 |
| 4) Wells (including tubewells) | 1,058,527 | 1,167,743 | 1,200,579 |
| 5) Other sources | 13,943 | 16,972 | 10,932 |
| Total | 2,372,790 | 2,605,188 | 2,691,802 |

Source : Season and Crop Report of Tamil Nadu for the Agricultural Year 1992-93

## Table 2.2.6 Irrigation Water Sources and Net Irrigation Area in Tamil Nadu , 1992-93

### Number of Irrigation Water Sources

| | District | Canals | | | Tubewells | | | Wells for Irrigation only | | | Tanks | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Government | Private | Total | Government | Private | Total | Government | Private | Total | Area>40ha | Area<40ha | Total | |
| 1 | Tiruvallur & Kanchipuram | 37 | | 37 | 5 | 5,046 | 5,051 | 6 | 101,267 | 101,273 | 1,362 | 2,266 | 3,628 | 109,989 |
| 2 | Cuddalore | 369 | | 369 | 977 | 42,600 | 43,577 | 911 | 139,688 | 140,599 | 1,176 | 1,501 | 2,677 | 187,222 |
| 3 | Vellore | 604 | | 604 | 1 | 2 | 3 | 17 | 153,305 | 153,322 | 420 | 935 | 1,355 | 155,284 |
| 4 | Tiruvannamalai | 144 | | 144 | | | 0 | 86 | 156,963 | 157,049 | 616 | 1,188 | 1,804 | 158,997 |
| 5 | Salem | 116 | 7 | 123 | 241 | 3,458 | 3,699 | 50 | 229,596 | 229,646 | 160 | 669 | 829 | 234,297 |
| 6 | Dharmapuri | 181 | 1 | 182 | 5 | 15 | 20 | 320 | 127,727 | 128,047 | 123 | 2,209 | 2,332 | 130,581 |
| 7 | Coimbatore | 41 | 1 | 42 | | 1,536 | 1,536 | 71 | 92,089 | 92,160 | 41 | 37 | 78 | 93,816 |
| 8 | Erode | 13 | | 13 | | | 0 | 47 | 109,455 | 109,502 | 21 | 31 | 52 | 109,567 |
| 9 | Tiruchy | 163 | | 163 | 25 | 10,911 | 10,936 | 41 | 142,442 | 142,483 | 191 | 2,438 | 2,629 | 156,211 |
| 10 | Pudukkoottai | 27 | | 27 | 67 | 676 | 743 | 229 | 54,053 | 54,282 | 660 | 4,269 | 4,929 | 59,981 |
| 11 | Thanjavur | 27 | | 27 | 630 | 22,945 | 23,575 | 0 | 32,789 | 32,789 | 130 | 298 | 428 | 56,819 |
| 12 | Nagapattinam | 19 | | 19 | 1,909 | 16,381 | 18,290 | 0 | 9,599 | 9,599 | | | 0 | 27,908 |
| 13 | Madurai | 164 | | 164 | 5 | 593 | 598 | 29 | 65,959 | 65,988 | 340 | 2,083 | 2,423 | 69,173 |
| 14 | Dindugal | 41 | | 41 | | 3 | 3 | 40 | 79,183 | 79,223 | 103 | 2,777 | 2,880 | 82,147 |
| 15 | Ramanathapuram | | | 0 | 34 | 118 | 152 | 69 | 12,952 | 13,021 | 453 | 1,377 | 1,830 | 15,003 |
| 16 | Virudunagar | | | 0 | | 4 | 4 | 87 | 42,149 | 42,236 | 286 | 711 | 997 | 43,237 |
| 17 | Sivagangai | 19 | | 19 | 50 | 34 | 84 | 156 | 18,789 | 18,945 | 572 | 4,025 | 4,597 | 23,645 |
| 18 | Tirunelveli | 197 | | 197 | | | 0 | 62 | 85,318 | 85,380 | 373 | 1,797 | 2,170 | 87,747 |
| 19 | Tuticorin | 4 | | 4 | 2 | 67 | 69 | 38 | 29,276 | 29,314 | 107 | 521 | 628 | 30,015 |
| 20 | Nilgiris | 1 | | 1 | | | 0 | 0 | 364 | 364 | 1 | 3 | 4 | 369 |
| 21 | Kanniyakumari | 53 | | 53 | | 2 | 2 | 1 | 1,803 | 1,804 | 41 | 2,552 | 2,593 | 4,452 |
| | State Total | 2,220 | 9 | 2,229 | 3,951 | 104,391 | 108,342 | 2,260 | 1,684,766 | 1,687,026 | 7,176 | 31,687 | 38,863 | 1,836,460 |

### Net Irrigated Area by Water Sources

| | District | Canals | | | Tubewells | | | Wells for Irrigation only | | | Tanks | | | Total | Share of Command Area by Water Source | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Government | Private | Total | Government | Private | Total | Government | Private | Total | Area>40ha | Area<40ha | Total | | Canal | Wells | Tanks |
| 1 | Tiruvallur & Kanchipuram | 6,554 | | 6,554 | 26 | 19,817 | 19,843 | 3 | 102,253 | 102,256 | 113,017 | | 113,017 | 241,670 | 2.71% | 50.52% | 46.77% |
| 2 | Cuddalore | 58,680 | | 58,680 | 48 | 111,518 | 111,566 | 748 | 86,074 | 86,822 | 52,350 | | 52,350 | 309,418 | 18.96% | 64.12% | 16.92% |
| 3 | Vellore | 3,282 | | 3,282 | | | 0 | | 79,322 | 79,322 | 6,604 | | 6,604 | 89,208 | 3.68% | 88.92% | 7.40% |
| 4 | Tiruvannamalai | 2,625 | | 2,625 | | | 0 | | 88,693 | 88,693 | 28,817 | | 28,817 | 120,135 | 2.19% | 73.83% | 23.99% |
| 5 | Salem | 16,614 | | 16,614 | | 4,750 | 4,750 | 26 | 117,041 | 117,067 | 3,722 | | 3,722 | 142,153 | 11.69% | 85.69% | 2.62% |
| 6 | Dharmapuri | 8,712 | | 8,712 | | | 0 | 314 | 82,153 | 82,467 | 16,877 | 55 | 16,932 | 108,111 | 8.06% | 76.28% | 15.66% |
| 7 | Coimbatore | 55,989 | 560 | 56,549 | | 2,201 | 2,201 | 19 | 80,177 | 80,196 | 2,329 | 61 | 2,390 | 141,336 | 40.01% | 58.30% | 1.69% |
| 8 | Erode | 87,470 | | 87,470 | | | 0 | 10 | 53,537 | 53,547 | 317 | | 317 | 141,334 | 61.89% | 37.89% | 0.22% |
| 9 | Tiruchy | 76,927 | | 76,927 | 40 | 14,947 | 14,987 | | 79,396 | 79,396 | 18,183 | | 18,183 | 189,493 | 40.60% | 49.81% | 9.60% |
| 10 | Pudukkoottai | 10,485 | | 10,485 | 148 | 2,263 | 2,411 | 82 | 11,773 | 11,855 | 74,856 | | 74,856 | 99,607 | 10.53% | 14.32% | 75.15% |
| 11 | Thanjavur | 169,720 | | 169,720 | 50 | 9,795 | 9,845 | | 3,560 | 3,560 | 9,137 | | 9,137 | 192,262 | 88.28% | 6.97% | 4.75% |
| 12 | Nagapattinam | 252,482 | | 252,482 | 20 | 4,365 | 4,385 | | 844 | 844 | | | 0 | 257,711 | 97.97% | 2.03% | 0.00% |
| 13 | Madurai | 63,805 | | 63,805 | 11 | 2,253 | 2,264 | 108 | 65,504 | 65,612 | 23,998 | | 23,998 | 155,679 | 40.98% | 43.60% | 15.42% |
| 14 | Dindugal | 4,928 | | 4,928 | | 5 | 5 | | 59,526 | 59,526 | 13,046 | 200 | 13,246 | 77,705 | 6.34% | 76.61% | 17.05% |
| 15 | Ramanathapuram | | | 0 | 60 | 372 | 432 | 42 | 7,960 | 8,002 | 59,519 | | 59,519 | 67,953 | 0.00% | 12.41% | 87.59% |
| 16 | Virudunagar | | | 0 | | 5 | 5 | | 28,447 | 28,447 | 33,123 | | 33,123 | 61,575 | 0.00% | 46.21% | 53.79% |
| 17 | Sivagangai | | | 0 | 164 | 538 | 702 | | 9,335 | 9,335 | 80,957 | | 80,957 | 90,994 | 0.00% | 11.03% | 88.97% |
| 18 | Tirunelveli | 17,622 | | 17,622 | | | 0 | 10 | 50,855 | 50,865 | 53,166 | | 53,166 | 121,653 | 14.49% | 41.81% | 43.70% |
| 19 | Tuticorin | 3,489 | | 3,489 | 2 | 411 | 413 | 86 | 17,602 | 17,688 | 22,702 | | 22,702 | 44,292 | 7.88% | 40.87% | 51.26% |
| 20 | Nilgiris | 403 | | 403 | | | 0 | | 50 | 50 | | | 0 | 453 | 88.96% | 11.04% | 0.00% |
| 21 | Kanniyakumari | 11,114 | | 11,114 | | | 0 | | 1,220 | 1,220 | 15,794 | | 15,794 | 28,128 | 39.51% | 4.34% | 56.15% |
| | State Total | 850,901 | 560 | 851,461 | 569 | 173,240 | 173,809 | 1,448 | 1,025,322 | 1,026,770 | 628,514 | 316 | 628,830 | 2,680,870 | 31.76% | 44.78% | 23.46% |

Source : Season and Crop Report of Tamil Nadu for the Agricultural Year 1992-93

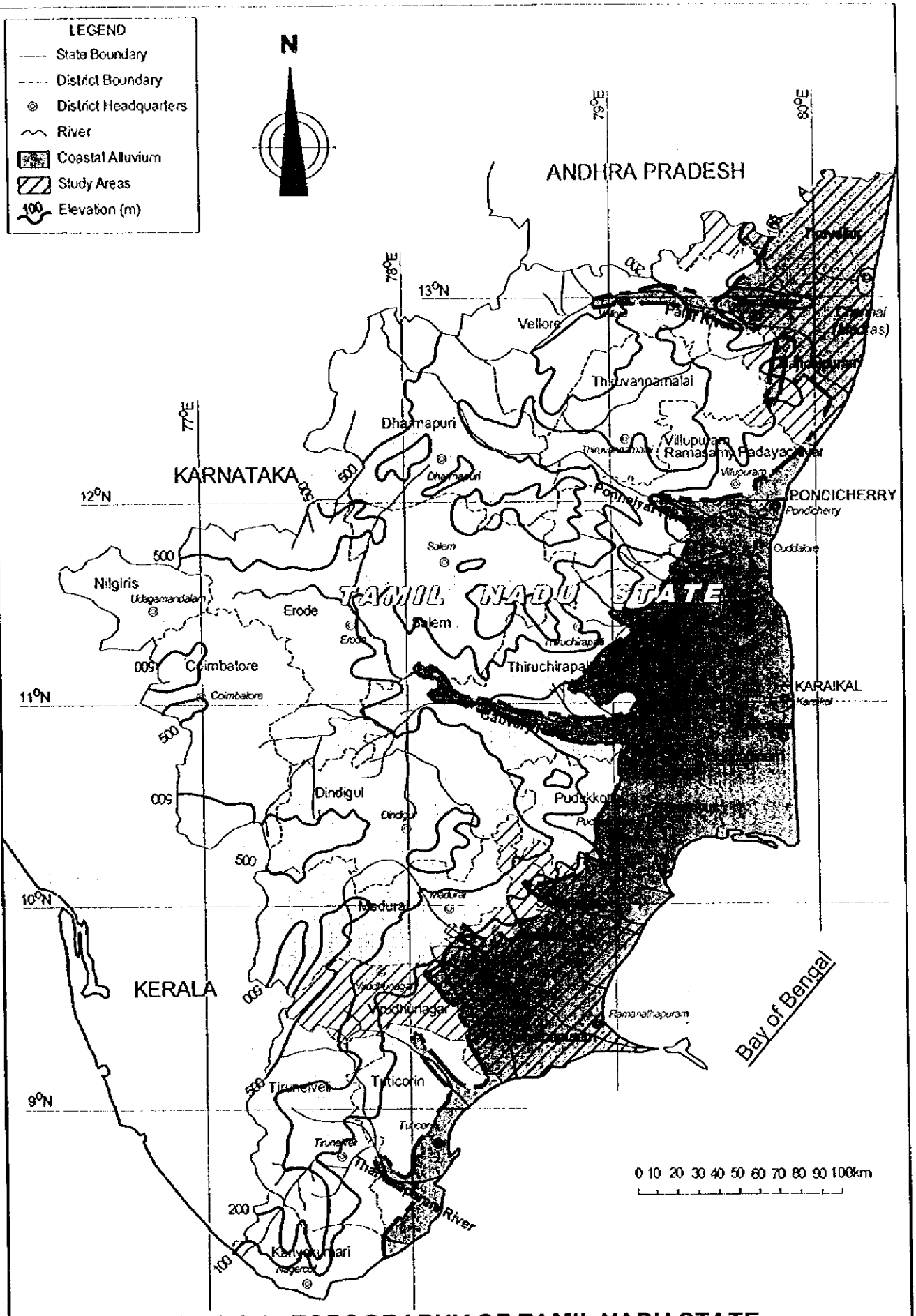



**Fig. 2.2.1 TOPOGRAPHY OF TAMIL NADU STATE**

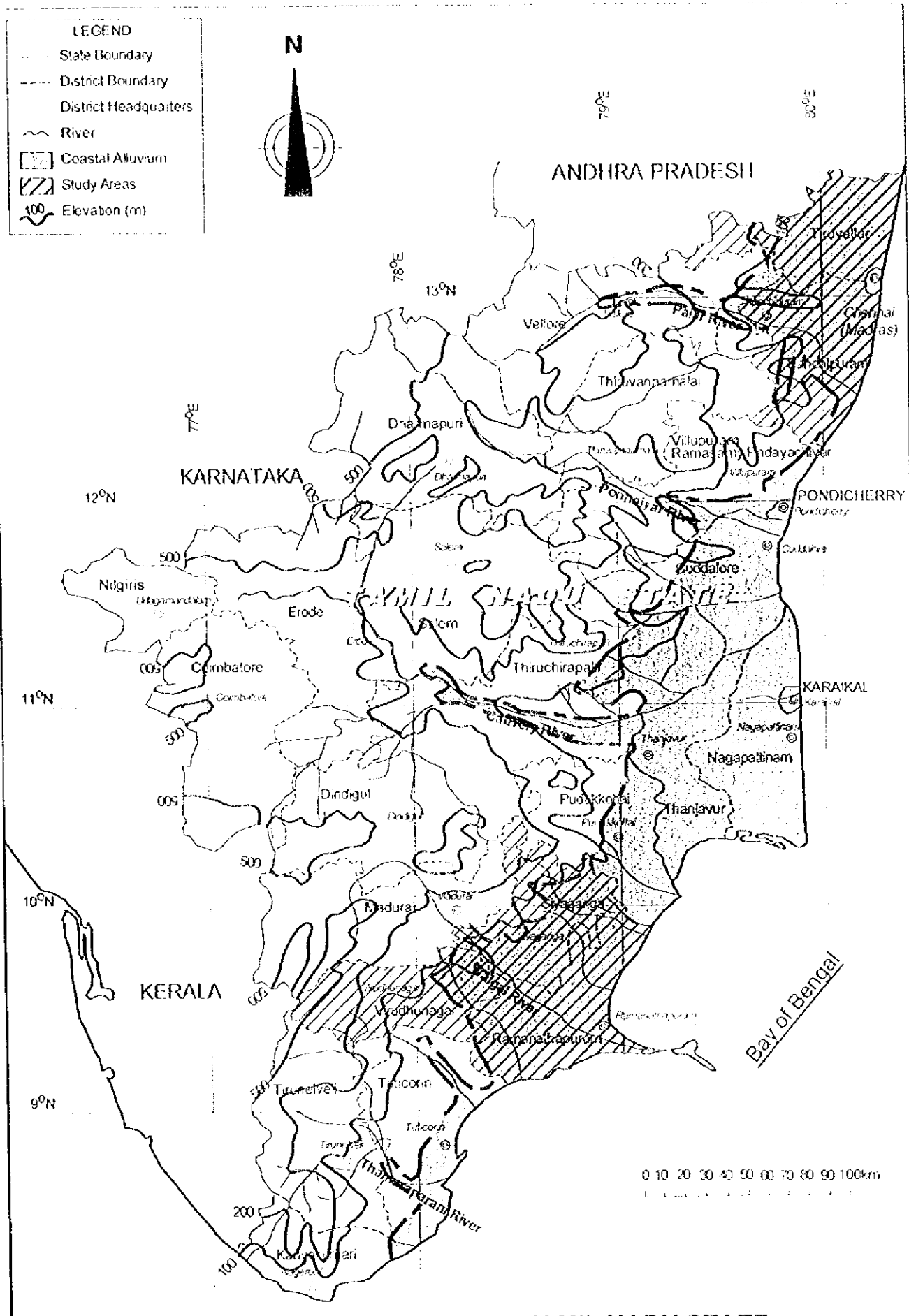



**Fig. 2.2.1 TOPOGRAPHY OF TAMIL NADU STATE**

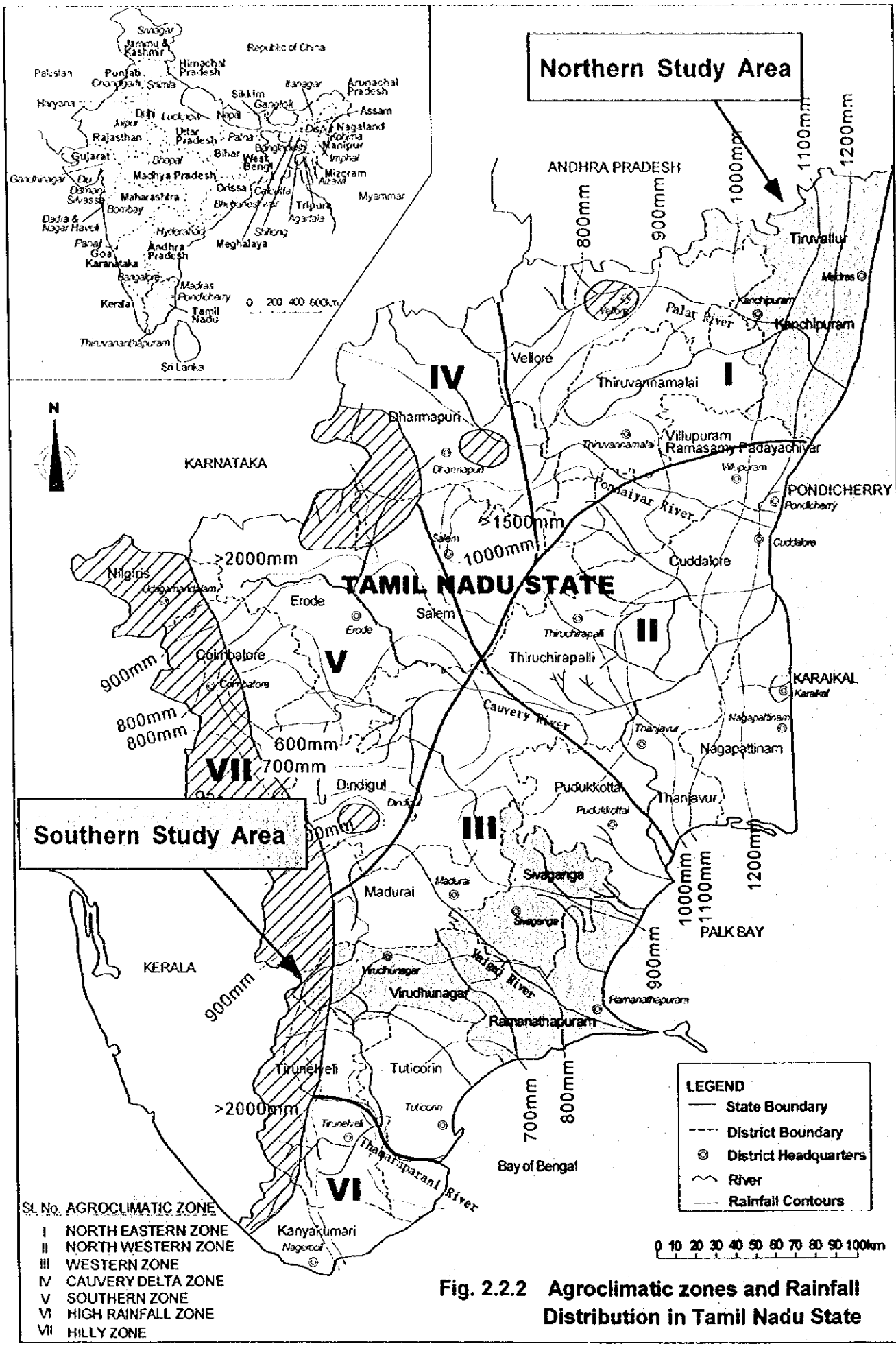



**Fig. 2.2.2 Agroclimatic zones and Rainfall Distribution in Tamil Nadu State**

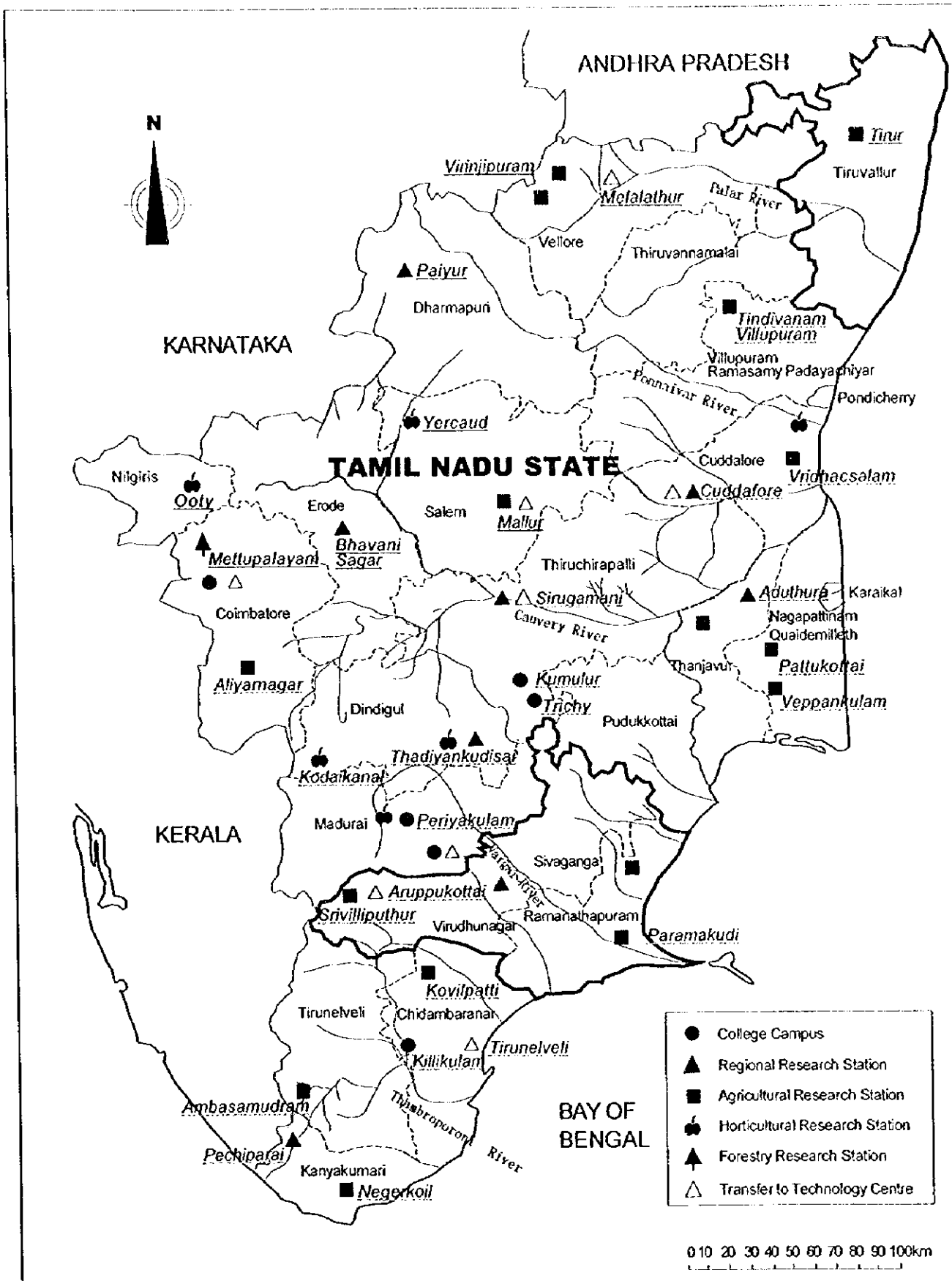
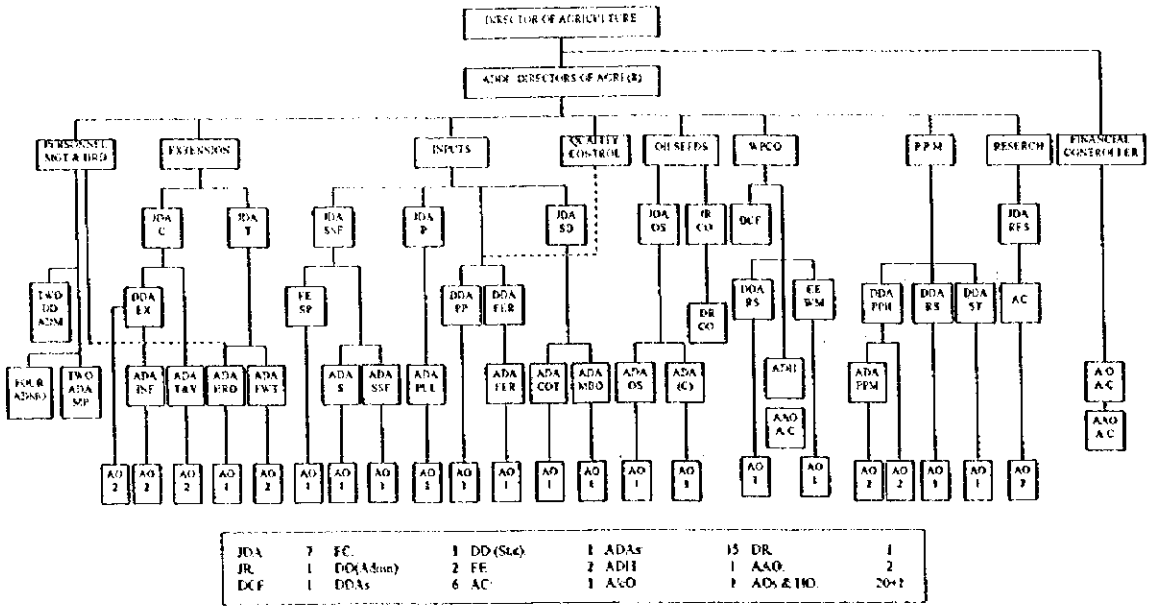
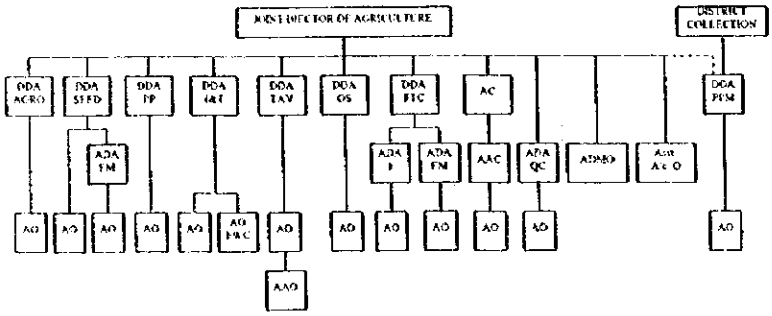


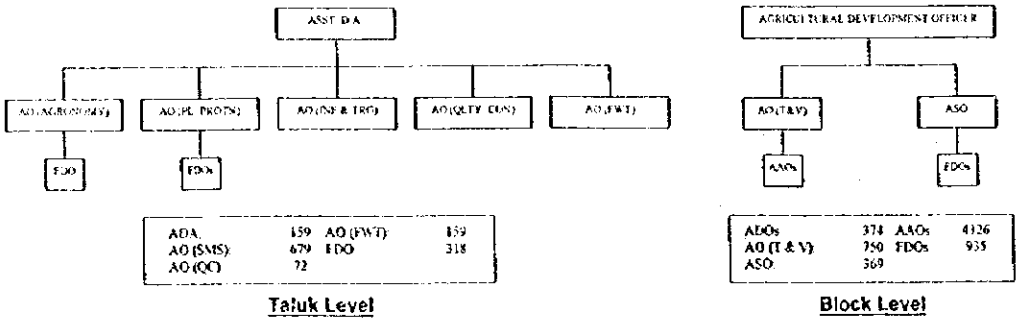

**Fig. 2.2.3 TAMIL NADU AGRICULTURAL UNIVERSITY RESEARCH AND EXTENSION CAMPUSES**




State Level




District Level




Taluk Level

Block Level

**Fig. 2.2.4 Organization for Agricultural Extension Services in Tamil Nadu**

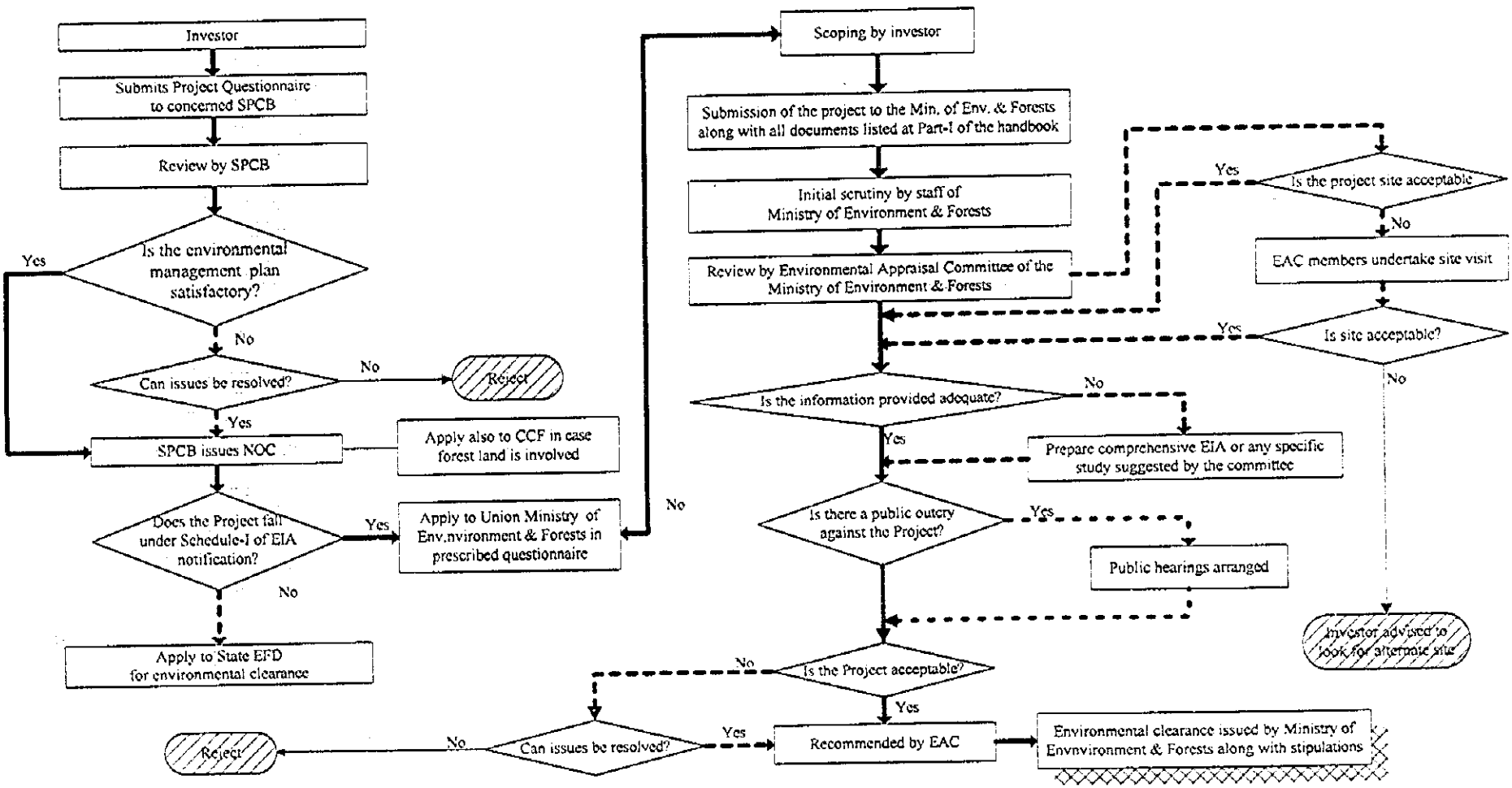



**Fig. 2.2.5 Flow Chart of Obtaining Environmental Clearance**

# CHAPTER 3 : THE STUDY AREA

# CHAPTER 3 THE STUDY AREA

## 3.1 General Features

### 3.1.1 Location

The Study Area consisting of the Northern and the Southern Study Areas is located in Tamil Nadu State as shown in the Location Map; the Northern Study Area (NSA) is located at the northern part of the State and the Southern Study Area (SSA) in the southern part of the State. The areas are measured to be about 7,857 $km^2$ and 12,606 $km^2$ for the Northern and the Southern Study Areas, respectively. About 2,600 units of minor irrigation tanks requested for the Study are scattered in these areas.

### 3.1.2 Administration

The Northern and the Southern Study Areas comprise of two (2) and three (3) administrative districts, respectively; the Tiruvallur and the Kanchipuram districts in the Northern Study Area and the Virudunagar, the Sivaganga districts in the Southern Study Area. Tiruvallur and the Kanchipuram districts in the Northern Study Area were divided from the former Chengalpattu-MGR District in May 1996 and renamed in July 1997.

**Districts in the Study Area**

| Northern Study Area | | | Southern Study Area | | |
|---|---|---|---|---|---|
| Districts* | Area ($km^2$) | Population** ($10^3$ person) | Districts* | Area ($km^2$) | Population** ($10^3$ person) |
| 1. Tiruvallur<br>2. Kanchipuram | 7,857 | 4,654 | 1. Ramanathapuram | 4,232 | 1,144 |
| | | | 2. Virudunagar | 4,288 | 1,565 |
| | | | 3. Sivaganga | 4,086 | 1,078 |
| Northern Study Area Total | 7,857 | 4,654 | Southern Study Area Total | 12,606 | 3,787 |
| Study Area Total | | | | 20,463 | 8,441 |
| Share in the State | | | | 15.7% | 15.1% |

Notes: *: As of July 1997
**: Population Census 1991

Each district consists of 6 to 8 taluks as shown in Table 3.1.1. At present, there are 16 and 18 taluks in the Northern and the Southern Study Areas, respectively.

### 3.1.3 Population

The population in the Study Area is calculated to be about 4,654 x $10^3$ persons and about 3,787 x $10^3$ persons for the Northern and the Southern Study Areas, respectively, as shown in 3.1.2.

The urban and the rural populations are also calculated to be about 2,088 x $10^3$ persons and about 2,566 x $10^3$ persons in the Northern Study Area, and to be about 1,126 x $10^3$ persons and about 2,661 x $10^3$ persons in the Southern Study Area, The population of each taluk in the Study areas is tabulated in Table 3.1.2.

**Population in the Study Area**

(Unit: $10^3$)

| Northern Study Area | | | | | Southern Study Area | | | | |
|---|---|---|---|---|---|---|---|---|---|
| District | House-hold | Total Pop. | Male Pop. | Female Pop. | District | House-hold | Total Pop. | Male Pop. | Female Pop. |
| Tiruvallur | 1,008 | 4,654 | 2,375 | 2,279 | Sivagangai | 242 | 1,078 | 530 | 548 |
| Kanchipuram | | | | | Virudunagar | 376 | 1,565 | 785 | 780 |
| | | | | | Ramanathapuram | 244 | 1,144 | 569 | 575 |
| Total | 1,008 | 4,654 | 2,375 | 2,279 | Total | 862 | 3,787 | 1,884 | 1,903 |

Source: Population Census 1991

The following table shows the population of scheduled caste and tribes in the rural areas of the Study Area. The taluk-wise population of the scheduled castes and tribes in rural areas in the Study Area is summarized in the Table 3.1.3.

**Population of Scheduled Castes and Tribes in Rural Areas of the Study Area**

(Unit: $10^3$)

| Northern Study Area | | | | Southern Study Area | | | |
|---|---|---|---|---|---|---|---|
| District | Pop. in Rural Area | Scheduled Caste and Tribe | (%) | District | Pop. in Rural Area | Scheduled aste and Tribe | (%) |
| Thiruvallur | 2,566 | 941 | 36.7 | Sivaganga | 788 | 150 | 19.1 |
| Kanchipuram | | | | Virudunagar | 979 | 237 | 24.2 |
| | | | | Ramanathapuram | 894 | 187 | 20.9 |
| Total | 2,566 | 941 | 36.7 | Total | 2,662 | 574 | 21.6 |

Source: Population Census 1991

The literacy rate of the Study Area indicates rather constant values ranging from between 47.2 to 49.0 % as shown in the table. Considering that the rate of the state's average is 62.66 % including the urban areas, those indicated values are considered rather low. Table 3.1.4 presents the taluk-wise literacy rates in rural areas of the Study Area.

**Literate Population in Rural Areas of Study Area**

(Unit: $10^3$)

| District | Literate Pop. | (%) |
|---|---|---|
| Northern Study Area | | |
| Tiruvallur<br>Kanchipuram | 1,210 | 47.2 |
| Total | 1,210 | 47.2 |
| Southern Study Area | | |
| Sivaganga. | 386 | 49.0 |
| Virudunagar | 467 | 47.6 |
| Ramanathapuram | 434 | 48.5 |
| Total | 1,286 | 48.3 |

Source: Population Census 1991

As for the gender-wise literacy rate in the Study Area, it is also obvious that the literacy rates of female are quite lower than those of male as shown in Table 3.1.4.

Population of Workers in Rural Areas of the Study Area

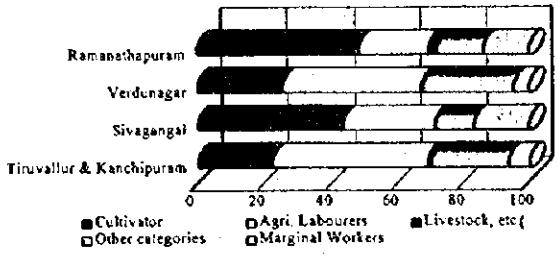
(Unit: $10^3$)

| District | Male | Female | Total |
|---|---|---|---|
| Northern Study Area | | | |
| Tiruvallur | 729 | 397 | 1,126 |
| Kanchipuram | | | |
| Total | 729 | 397 | 1,126 |
| Southern Study Area | | | |
| Sivaganga | 219 | 189 | 408 |
| Virudhunagar | 286 | 250 | 536 |
| Ramanathapuram | 252 | 194 | 446 |
| Total | 757 | 633 | 1,390 |

Source: Population Census 1991

The district-wise population of workers in rural areas of the Study Area is summarized in the table. The workers population accounts for 43.9 % and 52.2 % to the whole of rural population in the Northern and the Southern Study Areas. Table 3.1.5 shows the taluk-wise population of total workers in rural areas in the Study Area.

The graph indicates category-wise population of workers in rural areas of the Study Area. In the Southern Study Area, the share of marginal farmers of the Sivaganga district is found to be as large as 17 %. The taluk-wise population of workers is summarized in Table 3.1.6.




CATEGORY-WISE POPULATION OF WORKERS IN RURAL AREAS

### 3.1.4 Social Infrastructure

In general, the conditions of social infrastructures in the Study Area are observed in a rather proper situation, especially on the aspects of communications, water supply, electrification and education. This situation implies the recent efforts for social development in rural areas of the State. The expects of housing and sewerage, however, are considered still inferior, particularly in areas for agricultural laborers. Health care system also requires some improvements on nutrition and health-check for landless marginal and small farmers in order to improve their living conditions.

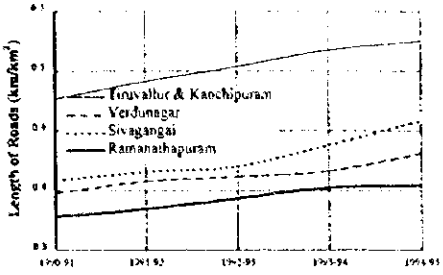
The rural road networks in the Study Area are considered sufficient to connect to their neighboring villages and urban areas. Most of rural roads are intermittently unpaved with surface-damages. The railway system passes through all districts of the State.

(1) Rural Electrification

On the aspect of rural electrification, the Government has made this implementation carried out in all villages and hamlets in the Study Area.

(2) Transportation Network

The situation of road networks in the Study Area as on March 31, 1994 is illustrated in the figure. Railway network in the Study Area is shown in Fig. 3.1.1 and Fig. 3.1.2. These transportation networks imply the existence of rather proper transportation facilities for rural life and economic activities.




LENGTH OF STATE GOVERNMENT ROADS IN THE STUDY AREA

On the aspect of transportation, based on the development of rural road network and railway, the transportation by bus and train in the Study Area is observed in good operation at the moment. For large quantities of produces and materials, transportation means by tractors and animal draught carts are often used.

(3) Rural Water Supply and Sewerage

As a result of government effort, rural villages in the Study Area are basically supplied with domestic water supply which system has been simply carried out by filtration through gravel and sand layers in the upper tank with, sometimes, chlorination prior to its discharge. The operation and maintenance of related facilities is assigned to the corresponding village(s).

(4) Education System and Literacy Profile

The literacy profile of the Study Area is presented in the following table.

**Literacy Profile in the Study Areas**

| District | Literacy Rate | (Rank) | Male Literacy Rate | (Rank) | Female Literacy Rate | (Rank) |
|---|---|---|---|---|---|---|
| Tiruvallur & Kanchipuram | 66.38 | (6) | 77.07 | (8) | 55.22 | - |
| Sivaganga | 63.04 | (10) | 76.92 | - | 49.74 | - |
| Virudunagar | 62.91 | (11) | 75.57 | (11) | 50.17 | (10) |
| Ramanathapuram | 61.59 | - | 74.76 | - | 48.70 | (13) |

(5) Health Care System

Government hospitals in the Study Area are summarized as follows:

**District Government Hospitals in the Study Area**

| Districts | Existing bed strength | |
|---|---|---|
| | Taluk Headquarters hospitals | Non-Taluk hospitals |
| Tiruvallur & Kanchipuram | 400 | - |
| Sivaganga | 208 | 144 |
| Virudunagar | 402 | 78 |
| Ramanathapuram | 198 | - |

Source: 8th. Five Year Plan, 1992 - 97, Tamil Nadu

**Bed-population Ratio in the Study Area**

| Districts | Total Government Hospital Beds | Ratio |
|---|---|---|
| Tiruvallur & Kanchipuram | 2,410 | 1,917 |
| Sivaganga | 590 | 1,822 |
| Virudunagar | 658 | 2,362 |
| Ramanathapuram | 670 | 1,695 |

Source: 8th Five Year Plan, Tamil Nadu

(6) Other Social Infrastructures

In the Study Area, particularly in rural regions, the social infrastructures including village offices, guest-houses, cemeteries, sports grounds, recreation-facilities etc. are observed to be in a modest scale and condition.

For daily goods, villagers in the Study Area should depend on some small shops with limited items. Central village markets open daily, and all goods are found very scarce in the Study Area. A large number of low-income people depend on the ration - provision scheme provided by the Government.

## 3.2 Natural Features

### 3.2.1 Topography

Generally the land may be grouped into three (3) physiographic divisions: (a) coastal plains with elevation below 150 metres contour, (b) central plateau with elevation ranging between 150 m and 300 m contour, and (c) hilly areas with elevation above 300 m.

Based on the drainage pattern of the rivers, 34 river basins have been demarcated which are grouped into 17 river basins. Araniar, Koratalaiyar, Palar flow in the Northern Study Area and Pambar, Kottakaraiyar, Vaigai, Gundar, Vaippar flow in the Southern Study Area.

(1) Northern Study Area

Most of the Northern Study Area is located in the coastal alluvium extending along the Coromandel coast except the western and the southern ends of the Study Area as shown in Fig. 2.2.1. The area is generally considered to be flat with a little undulation of which elevation varies less than 100 m above see level except some hilly areas in western end of the area. In the flat plain areas, vast paddy fields extend and thousands of large and small irrigation tanks are scattered.

The hilly areas are mainly located at the western end of the area reaching the edge of the Eastern Ghats, and in those areas the elevation varies from 100 m to 500 m above sea level.

The Palar River which originates in Karnataka State is the largest river in the Northern

Study Area and flows eastward into Bay of Bengal.

(2) Southern Study Area

In the Southern Study Area, the Sivaganga and the Ramanathapuram districts are located in the coastal alluvium, while the Virudunagar district is in the hard rock area. The western end of the Virudunagar district reaches the hilly areas extending from the Western Ghats in Kerala State. The elevations vary less than 100 m in the Sivaganga and the Ramanathapuram districts, those in the Virudunagar district exceed 100 m at the western end of the district.

The Vaigai River is the largest one in the Southern Study Area, which flows west to east toward the Rameswaram Island. The river forms an alluvial plain along it, and vast agricultural land is created.

The land surface is flat along the river with mild slopes toward Bay of Bengal; in north of the river westward while southward in south of the river. The irrigation tanks are constructed on these plains cascading from rather high areas to low areas resulting crescent-shape of tanks. There are many canals connecting the irrigation tanks to perennial or seasonal rivers and to upstream tanks, forming vast canal networks in the area. In the Virudunagar district, the drainage is mainly made by the Vaippar river flowing southeastward.

Generally, the vegetation in the Southern Study Area seems to be poor than that in the Northern Study Area because of the poor rainfall in the Southern Study Area comparing with the Northern Study Area as described in the next section.

### 3.2.2 Meteorology and Hydrology

(1) General

Monthly data were collected and analyzed to grasp the meteorological characteristics in the Study areas as well as to estimate the irrigation water requirements. Computerized data were collected from IWS, while printed data are collected from PWD (Groundwater).

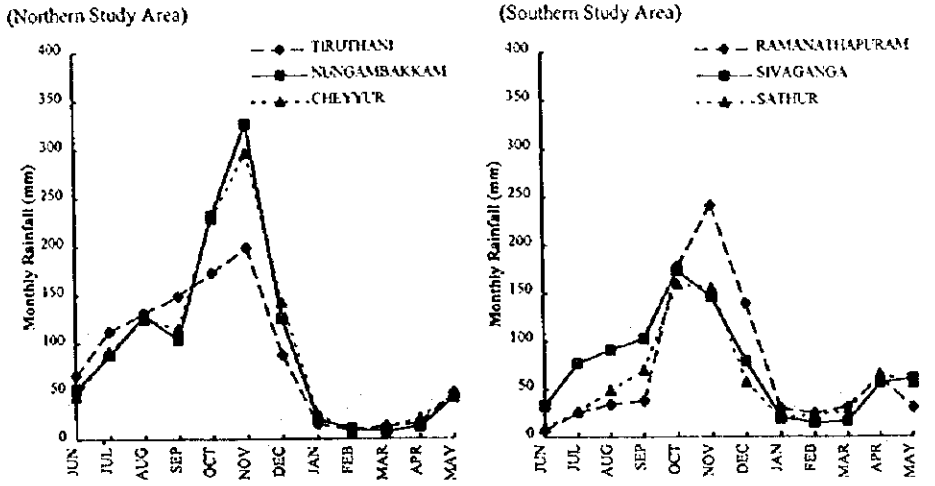
(2) Rainfall and Climate

Table 3.2.1 and Fig. 3.2.1 present the general characteristics of climate and rainfall in the State and the Study Area.

The Northern Study Area of Tiruvallur & Kanchipuram districts comes under the fourth range namely areas having rainfall more than 1,000 mm. Part of the Ramanathapuram and the Sivaganga districts of the Southern Study Area come under third range namely rainfall between 800 and 1,000 mm. Part of the Ramanathapuram

and the Virudunagar districts of the Southern Study Area come under the range of 600 to 800 mm. The Northern Study Area has high rainfall and part of the southern study area has high/medium rainfall and the other part low/medium rainfall.

In the Northern Study Area, the rainfall is observed generally more than 1,000 mm with the variation from 1,000 mm to 1,200 mm, while it decreases below 1,000 mm in the Southern Study Area. In the Southern Study Area, the rainfall varies from 700 mm to 900 mm. It decreases from north to south in the Southern Study Area, while it increases west to east.




(Northern Study Area)

| Station | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TIRUTHANI | 67.0 | 111.9 | 131.1 | 148.7 | 172.8 | 199.1 | 87.8 | 15.5 | 9.2 | 13.0 | 15.7 | 47.9 | 1,019.7 |
| NUNGAMBAKKAM | 51.7 | 87.4 | 129.0 | 103.4 | 232.1 | 326.7 | 125.0 | 20.2 | 10.8 | 7.5 | 12.4 | 43.0 | 1,102.1 |
| CHEYYUR | 45.0 | 91.0 | 124.9 | 115.5 | 229.3 | 297.0 | 142.2 | 26.3 | 7.6 | 11.4 | 20.8 | 47.0 | 1,158.0 |

(Southern Study Area)

| Station | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAMANATHAPURAM | 6.6 | 26.0 | 33.6 | 38.0 | 177.7 | 241.0 | 139.2 | 29.6 | 24.4 | 31.0 | 61.4 | 30.5 | 839.0 |
| SIVAGANGA | 32.7 | 77.0 | 90.6 | 102.4 | 173.5 | 145.6 | 79.0 | 20.2 | 14.3 | 16.5 | 55.5 | 60.5 | 867.9 |
| SATHUR | 9.5 | 26.7 | 48.7 | 70.0 | 159.6 | 155.3 | 57.1 | 19.1 | 23.4 | 27.1 | 65.1 | 56.1 | 717.8 |

**MEAN MONTHLY RAINFALL IN THE STUDY AREAS**

The figure shows the seasonal variation of monthly rainfall in some selected stations of the Study Area. The hydrological year of the Study areas starts in June, which is considered as a beginning of the SW monsoon. The SW monsoon lasts in September, and the NE monsoon starts in October. The NE monsoon continues till December, and most of rainfall occurs during these two (2) monsoon periods.

As shown in the table, dependability on the NE Monsoon from October to

**Distribution of Seasonal Rainfalls**

| Rainfall Station | Share of Rainfall (%) | | |
|---|---|---|---|
| | SW Monsoon | NE Monsoon | Transitional Season |
| Northern Study Area | | | |
| Tiruthani | 45 | 45 | 10 |
| Nungambakkam | 34 | 62 | 4 |
| Cheyyur | 33 | 58 | 9 |
| Average | 37 | 55 | 8 |
| Southern Study Area | | | |
| Ramanathapuram | 12 | 66 | 22 |
| Sivananga | 35 | 46 | 19 |
| Sathur | 22 | 52 | 26 |
| Average | 23 | 55 | 22 |

December is considered higher than that on the SW Monsoon from June to September. 55 % of rainfall occurs during the NE Monsoon in general. In the Southern Study Area, the rainfall during the SW Monsoon is not considered remarkable but almost same as that during the other season. In Ramanathapuram, only 12 % of rainfall occurs during the SW Monsoon.

(2) Other Meteorological Parameters

The average temperature reaches a maximum of 32 or 33 °C in May and a minimum of 24 or 25 °C in January in both Study areas. The range of annual variation is not considered wide but within a range between 7 and 9 °C. Generally, the temperature observed in the Southern Study Area indicates higher values than in Northern Study Area.

Difference in relative humidity is not found between the Northern and the Southern Study Area, but the values in Nungambakkam Station are considered higher than the others throughout a year because it is located in Chennai where the local climate is influenced by nearby ocean.

(3) Drought Prone Areas in Southern Study Area

The following blocks in the districts of the Southern Study Area are declared as drought prone areas by the Ministry of Rural Development of GOI.

**Drought Prone Areas**

| District | Number | Blocks |
|---|---|---|
| Virudunagar | 7 | Kariapatti, Narikudi, Sathur, Sivakasi, Vembakottai, Virudhunagar, Aruppukottai |
| Ramanathapuram | 7 | Bogalur, Kadaladi, Kamuthi, Mandapam, Mudukulathur, Paramakudi, Thirupullani |
| Sivaganga | 7 | Devakottai, Ilayangudi, Kalayar Koil, Kallal, Kunnangudi, Sungampuneri, S. Pudur |

(4) Long Term Variation of Rainfall

Fig. 3.2.2 shows the long-term variation of annual rainfall in the selected stations. It clearly indicates that there occurred twice of drought periods in the Study areas; the first drought period in the beginning of 1950s and the second in the middle of 1970s. If the frequency of such drought is 20 - 25 years, the rainfall in the area may be decreasing at present although any recent records are not collected in the Study.

As seen in the figure, serious drought has been occurred with an interval of about five (5) years, and this is considered to be more frequent when compared to the results of interview survey made to the farmers during the field survey.

(5) Probable Drought Rainfall

2-year and 5-year probable drought rainfalls are calculated for the selected gauging stations as summarized in the following table.

**Calculated Probable Annual Rainfall**

(Unit: mm)

| Northern Study Area | | | Southern Study Area | | |
|---|---|---|---|---|---|
| Station | Probable Rainfall | | Station | Probable Rainfall | |
| | 2 year | 5 year | | 2 year | 5 year |
| Thiruthani | 1,020 | 765 | Ramanathapuram | 839 | 624 |
| Nungambakkam | 1,253 | 954 | Sivaganga | 868 | 669 |
| Cheyyur | 1,158 | 835 | Sathur | 718 | 549 |

(6) River Basins in the Study Area

The following five (5) and 10 river basins are located in and around the Northern and the Southern Study Areas, respectively.

1) Northern Study Area

- Araniyaru basin
- Palar basin
- Coum basin
- Ongur basin
- Adayar basin

2) Southern Study Area

- Vellar basin
- Manimuthar basin
- Uttarkosamangaiaru basin
- Vaipparu basin
- Koluvanaru basin
- Kottakaraiaru basin
- Gundar basin
- Pambar basin
- Vaigai basin
- Vembaru basin

### 3.2.3 Geology and Hydrogeology

(1) Geology of the Study Area

The block-wise geology formations of the Study Area are given in Table 3.2.3 and 3.2.4.

a) Northern Study Area

The Tiruvallur & Kanchipuram districts are principally made up of archean, upper Gondwana and Tertiary formation. These are overlaid by laterite and alluvium. The oldest rocks are the crystalline rock of archean age, mainly comprising of biotite and hornblende gneiss charnockites and granites. These are intruded by amphibolite dykes of dolorites and occasionally with veins of quartz and pegmatites. These Archean formations are noticed in Saidapet, Tiruttani,

Chengleput, and Madurantakam taluks. Crystalline formations also occur in part of Kancheepuram and Sriperumbadur Taluks. Granites and genesisses of Archean age occur mainly in Tiruttani taluk. These crystaline rocks have undergone weathering to a variable extent.

Upper Gondwana

The Gondwana series represent a massive pile of lacustrine and fluvial deposits laid down on the old crystalline rock topography. The upper Gondwana consists of clays (Sriperumbudur Shales in Araniar and Kortalayar basins), shales, sanctuaries and conglomerates.

The clays and Sriperumbudur shales of Upper Gondwana period is exposed in Sriperumbudur, Kancheepuram and Tiruvallur taluks.

The Satyavedu Stage consisting of beds of conglomerate mixed with a few beds of coarse medium sand stone, beds of clayey sand stone and sandy shale is found in Tiruvallur and Ponneri taluks.

Tertiary Formations

The rocks belonging to this period have been assigned to the Miocene-Pliocene (Cuddalore) series, but no fossil evidence of age has been found. It is only on stratigraphical and lithological evidence that they are separated from the upper Gondwana series.

Alluvium

The worn down and eroded surface of tertiary and Gondwana rock is covered by an extensive stretch of alluvial deposits. The alluvial plain spans the lower reaches of the three main rivers, namely the Arani, Kortaliyar and Cooum and branches off into two separate plains further west. One plain follows the Arani in a west-north westerly direction and the Koratalayar where, it is joined by another alluvial plain extending towards the north-west from the Palar River at a point five miles east of the Palar anicut. Alluvium deposits consist of sand and clays. The alluvial deposits owe their origin chiefly to the Kortalayar, Cooum and Palar rivers.

b) Southern Study Area

The geological formations met with in this study area, namely, Virudhunagar, Ramanathapuram and Sivaganga comprises Archean Metamorphic complex represented by granites, granitic gneiss, felspalthic gneiss and charnockites. These archean formations are overlaid unconfirmally at place by Gondwana formations of upper Jurassic in age comprising shales, sand stones, clay and grits. These are overlaid by tertiaries, granites and clays.

In west part of the southern study area namely in the taluks of Srivilliputhur, Sathur and Parts of Aruppukottai Taluks of Virudhunagar District the Archean metamorphic complex namely charnockites, Felspathic genesis, calcgneiss and pink granites occur. The remaining portion of Aruppukottai Taluk is occupied by strip of alluvium and tertiary formations.

The eastern and the southeastern portion of the southern study area namely Ramnad, Paramakudi, Muthukulathur and Tiruvadanai Taluks of Ramnad District are covered by alluvium.

The northern part of the Southern Study Area, namely, Tirupathur and Sivagangai taluks of the Sivaganga District comprise of Archean rocks, Tertiary sand stone, Gondwana formations and river alluvium.

(2) Hydrogeology

1) Groundwater Potential

The district-wise groundwater potential and utilisation of groundwater reserves for irrigation for the Study Area were estimated. Out of the total groundwater recharge about 15 percent is kept reserved to meet the domestic and industrial uses. The details of groundwater recharge, draft and balance available as on January, 1992 are given below:

**Groundwater Recharge, Draft and Balance in Study Areas**

| Study Areas | Groundwater Recharge (ha./m) | Utilisable Quantity (ha./m) | Draft Ground Water Utilised Quantity (ha m) | Balance for Develop ment (ha.m) | Stage | | Probable Number of Wells |
|---|---|---|---|---|---|---|---|
| | | | | | 1992 (%) | 1997 (%) | |
| Tamil Nadu | 2,639,125 | 2,243,256 | 1,355,773 | 887,483 | 60 | 63 | 478,789 |
| Northern Study Area | | | | | | | |
| Kanchipuram & Tiruvallur | 215,216 | 182,934 | 111,706 | 71,228 | 61 | 64 | 38,582 |
| Southern Study Area | | | | | | | |
| Sivaganga | 75,356 | 64,052 | 8,036 | 56,016 | 12 | 15 | 30,342 |
| Ramanathapuram | 22,604 | 19,217 | 1,402 | 17,815 | 7 | 10 | 9,649 |
| Virudhunagar | 80,593 | 68,504 | 32,776 | 35,728 | 47 | 50 | 19,352 |

The details of dark, grey and white blocks of the Study Area are given in Table 3.2.4.

2) Regulatory instruments and procedures in force

The notes prepared by the Central Ground Water Board for Development and Management Strategy for the districts of the Study Area are furnished below:

a) Northern Study Area - Kanchipuram & Tiruvallur Districts

Groundwater development has been on moderate scale with some scope for further development. In the coastal area due to extensive pumping of groundwater sea water interface moved more than 10 km. Management strategies to protect the existing well fields have to be adopted. Hard rock areas have saturated thickness of 6 to 8 m in monsoon and 1 to 2 m in summer. Suitable cropping pattern and horticulture shall be planned.

In Minjur area there is quality problem. Minjur, Tiruvallur and Madhavaram are over developed areas.

b) Southern Study Area

Virudunagar District

Virudhunagar, Kariapatti and Thiruchuli areas are scarcity areas. Sathur and parts of Vaipar river belt have quality problem. Watrap and Rajapalayam areas are having problem of over development.

Sivaganga District

Scarcity area in the district is Manamadurai, Sivaganga and Tirupattur taluks. In hard rock areas and Gondwana Sediments the potential zones are limited. Surface water reserves are also limited. The groundwater development is limited to selected pockets in hard rocks and Kannangudi blocks in sedimentary tract.

Ramanathapuram District

Groundwater problem areas are as follows:

| | |
|---|---|
| i) Scarcity: | Rameswaram Island |
| ii) Quality: | Ramanathapuram taluk, R.S. Magnalam Union, Kadaladi Union and Mudukulathur Union. |
| iii) Over Development: | Parts of Dune aquifers of Mandapam area, Vaigai riverbed, Tiruvadanai aquifer in southern and western sides. |

### 3.2.4 Soils and Vegetation

(1) Soils

Soils in the Study Area are divided into five (5) orders; Entisol (Redloam), Inceptisols (Lateritic), Vertisols (Black), Alfisols (Sandy Coastal Alluvium) and Ultisols (Red Sandy). Their distributions are shown in Fig. 3.2.3 and 3.2.4.

Nitrogen content seems to be low in both Northern and Southern Study Areas as well as in whole Tamil Nadu state, and the content of Phosphorous is low in the Southern Study Area comparing with the Northern Study Area. Potassium content is judged to be enough to grow crops in both Study areas.

(2) Natural Vegetation

The Study Area is located at around 10°00' to 13°38' N.L. with below 200 meters above sea level and belongs to tropical savanna climate (Aw). The natural vegetation is somewhat differed by the northern part and the southern part of the Study Area. In the northern part, the vegetation consists of teak, sal, rosewood, pine, bamboo, redwood, anjan, garjan, paduk, mulberry, sisu, myrabolans and a large number of valuable trees. On the other hand, in the southern part, the vegetation becomes sparse and consists of shorea robusta, acacia, catechu kikar, acacia arabica, prosopis, tamarix albizzias, date palm, ber, pipal and other bushes.

### 3.2.5 Environmental Conservation in the Study Area

(1) Endangered Plant Series

123 plant species have been declared as endangered in the State. Three (3) plants present in the Study Area. Two (2) Plants, *Cupparis Shevaroyensis* and *Cleoxme burmanni* are in the Southern Study Area and one (1) *Decaschistiarufa* is in the Northern Study Area.

(2) National Parks and Protected Areas

National parks and sanctuaries in the Study Area are shown in previous section 2.2.6 and details are described in Table 3.2.5.

As a coral and coral reefs, the Gulf of Mannar lies in the Southern Study Area.

The following is the list of wild life sanctuaries in the Study Area.

**Wild Life Sanctuaries in the Study Area**

| Sr. | Name | Area (ha) | District |
|---|---|---|---|
| 9. | Pulicat Lake Bird Sanctuary | 15,367 | Tiruvallur |
| 4. | Srivilliputhur Grizzled Giant Squirrel Wild Life Sanctuary | 48,520 | Virudhunagar |
| 7. | Vedanthagal Birds Sanctuary | 30 | Kanchipuram |
| 8. | Karikili Birds Sanctuary | 61.21 | Kanchipuram |
| 10. | Vettangudi Birds Sanctuary | 38 | Ramanathapuram |
| 11. | Kanjiramkulam Birds Sanctuary | 104 | Ramanathapuram |
| 12. | Chitrangudi Birds Sanctuary | 47 | Ramanathapuram |

Note : location of these area are shown in the figure of section 2.2.6 by number of name

No protected mangrove area falls in the Study Area. No national park falls in the Study Area.

## 3.3 Agriculture in the Study Area

### 3.3.1 Land Tenure and Holding

(1) Land Use

As shown in the Table 3.3.1, about 41 % of the Study Area are cultivated and more than 55 % are cultivated area are irrigated.

(2) Number of Operational Holdings and Area Operated

The number of operational holdings, the area operated and the average size of holdings in the Study Area are shown in the table.

**Number of Operational Holdings, Area Operated and Average Size of Holdings in the Study Areas in 1990-92**

| District | No. of holdings | | Area operated | | Average size | |
|---|---|---|---|---|---|---|
| | No. | (%) | (ha) | (%) | (ha) | (%) |
| Kanchipuram & Tiruvallur | 560,463 | 7.0 | 389,385 | 5.2 | 0.69 | 74.4 |
| Ramanathapuram | 342,262 | 4.3 | 279,706 | 3.7 | 0.82 | 87.5 |
| Kamarajar | 283,699 | 3.5 | 280,824 | 3.8 | 0.99 | 105.9 |
| Sivaganga | 290,083 | 3.6 | 200,331 | 2.7 | 0.69 | 73.9 |
| Sub-total | 1,476,507 | 18.5 | 1,150,246 | 15.4 | 0.78 | 83.4 |
| STATE | 7,998,932 | 100.0 | 7,473,677 | 100.0 | 0.93 | 100.0 |

Source Department of Statistics, Madras-6

(3) Average Size of Operational Holders

The average size of operational holdings in the Study Area is 0.78 ha in 1990-91 ranging from 0.69 ha in the Districts of Kanchipuram & Tiruvallur and Sivaganga to 0.99 ha in the District of Virudhunagar as shown in the above table. The average size is smaller than that of the State (0.93 ha) and about 78 % of the operational holdings are below 1.0 ha as shown in the next table.

Number of Operational Holdings by Size in the Study Area in 1990 - 91

| Study area (District) | Marginal Below 1.0 ha | Small 1.0 - 2.0 ha | Semi-medium 2.0 - 4.0 ha | Medium 4.0 - 10 ha | Large > 10 ha | Total |
|---|---|---|---|---|---|---|
| Kanchipuram & Tiruvallur | 457,917 | 63,436 | 27,348 | 10,237 | 1,525 | 560,463 |
| | 81.7% | 11.3% | 4.9% | 1.8% | 0.3% | 100.0% |
| Ramanathapuram | 263,473 | 50,166 | 21,111 | 6,729 | 783 | 342,262 |
| | 77.0% | 14.7% | 6.2% | 2.0% | 0.2% | 100.0% |
| Virudunagar | 199,371 | 51,151 | 23,768 | 8,435 | 964 | 283,699 |
| | 70.3% | 18.0% | 8.4% | 3.0% | 0.3% | 100.0% |
| Sivaganga | 235,057 | 36,338 | 14,062 | 4,131 | 495 | 290,083 |
| | 81.0% | 12.5% | 4.8% | 1.4% | 0.2% | 100.0% |
| Sub-total | 1,155,818 | 201,091 | 86,289 | 29,532 | 3,767 | 1,476,507 |
| | 78.3% | 13.6% | 5.8% | 2.0% | 0.3% | 100.0% |
| STATE | 5,848,096 | 1,274,515 | 617,605 | 227,594 | 31,122 | 7,998,932 |
| | 73.1% | 15.9% | 7.7% | 2.8% | 0.4% | 100.0% |

Source: Department of Statistics, Madras-6

### 3.3.2 Agricultural Production

(1) Principal Crops

The major crops cultivated in the Study Area are largely differed by the location of the area. In the districts of Kanchipuram & Tiruvallur and Sivaganga where the percentage of irrigated area to the total cropped area is above 60 % (Table 3.3.2), the major crops cultivated are paddy, groundnut and sugarcane (Table 3.3.3). In these areas paddy, groundnut and sugarcane share more than 60%, 10 to 20 % and 3 to 4 % to the total cropped area, respectively (Table 3.3.3).

On the other hand in the Ramanathapuram and Virudhunagar Districts where the percentage of irrigated area to the total cropped area is 32 % and 33 % (Table 3.3.2), the major crops are diversified as paddy, chili, groundnut and ragi in the Ramanathapuram District, and Cotton, paddy, cumbu (Pennisetm typhoideum), groundnut, blackgram, Cholam, greengram, gingelly, chili, sugarcane, ragi (Eleusine cora cana), varagu (Paspalum Scrobiculatum) and redgram in the Virudunagar District (Table 3.3.3).

(2) Average Yield

Average yields of main agricultural crops are given in the table 3.3.2. and as described below:

1) Paddy

The average yield of paddy rice is highest in Virudhunagar District with 3,172kg/ha in 1992-93, followed by Tiruvallur & Kanchipuram (3,079kg/ha), Sivaganga (2,651kg/ha) and Ramanathapuram (1,537kg/ha). These yields are lower than that of the State, except average in Virudunagar district.

2) Groundnut

The average yields of groundnut in the Study Area is largely differed by district, that is, the highest is 1,786 kg/ha in the combined Tiruvallur and Kanchipuram District and the lowest is 973 kg/ha in Sivaganga District in 1992-93. The differences in yield among the districts also probably be caused by the irrigation ratio because the irrigated yields are about 2.5 times of the non-irrigated yields on the average of the four (4) districts.

3) Sugarcane

Sugarcane is cultivated under irrigated condition. The average yields are about 107 tones/ha in cane in the 3 Districts in 1992-93 except Sivaganga District whose yield is 95 tons/ha.

4) Ragi

The average yield of ragi in the Study Area is 1,519 kg/ha in 1992-93 ranging from 2,495 kg/ha in Virudunagar District to 929 kg/ha in Ramanathapuram Districts. The yield is largely differed by irrigation ratio, that is, the irrigated yields are 2.03 times of the non-irrigated yields on average of the 4 Districts.

5) Cotton

The average yield of cotton in the Study Areas is 1,072 kg/ha in lint in 1992-93 with the maximum of 2,270 kg/ha in Sivaganga District and the minimum of 1,014 kg/ha in Virudhunagar District. The irrigated yield is 2 times of the non-irrigated yield on average of the 4 Districts.

6) Cholam, Cumbu, Gingelly

The average yields of cholam, cumbu and gingelly in the Study Area are 1,512kg, 1,369 kg and 377 kg per ha.

(3) Gross Income

For the introduction of profitable crops in the Study Areas, gross income per hectare by crop was estimated based on the available data in the Study Area as shown in Table 3.3.3.

Regarding the gross income by crops, the maximum gross income was obtained by banana with the average gross income of Rs. 158,267 in the Study Area followed by mango (Rs. 157,432), turmeric (Rs. 101,097), sugarcane (Rs. 78,175), tamarind (Rs. 41,659), tapioca (Rs.31,674), onion (Rs. 18,183), chillies (Rs. 16,727), paddy (Rs.13,673) and groundnut (Rs.8,999).

Gross Income per hectare by Crop in the Study Area

(Rs/ha)

| Crop | Tiruvallur & Kanchipuram | Ramnath | Virudunagar | Sivaganga | Average |
|---|---|---|---|---|---|
| Banana | 166,232 | 154,224 | 155,300 | 156,312 | 158,267 |
| Mango | 167,237 | 152,500 | 154,922 | 155,067 | 157,432 |
| Turmeric | 145,052 | 105,492 | - | 52,746 | 101,097 |
| Sugarcane(in gur) | 79,300 | 77,071 | 81,415 | 75,016 | 78,175 |
| Tamarind | 47,831 | 39,548 | 39,707 | 39,548 | 41,659 |
| Tapioca | 33,292 | 26,520 | 33,223 | 33,660 | 31,674 |
| Onion | 18,292 | 19,914 | 14,710 | 19,817 | 18,183 |
| Chillies | 25,314 | 10,782 | 15,025 | 15,789 | 16,727 |
| Paddy(in paddy) | 18,789 | 6,463 | 17,307 | 12,133 | 13,673 |
| Groundnut(in pods) | 14,127 | 7,910 | 7,760 | 6,199 | 8,999 |
| Bengal gram | 7,142 | | 5,155 | | 6,149 |
| Red gram | 6,086 | 6,096 | 6,100 | 6,116 | 6,100 |
| Ragi | 6,156 | 3,385 | 8,519 | 4,831 | 5,731 |
| Green gram | 4,536 | 4,565 | 5,953 | 4,998 | 5,011 |
| Cardamom | - | 4,817 | - | - | 4,817 |
| Cholam(Sorghum) | 4,454 | 3,590 | 5,211 | 4,191 | 4,361 |
| Coriander | 3,220 | 4,817 | 4,519 | 4,530 | 4,271 |
| Cumbu(Bulrush Millet) | 6,528 | 1,917 | 4,161 | 3,837 | 4,112 |
| Gingelly | 5,399 | 2,862 | 2,916 | 4,197 | 3,843 |
| Black gram | 3,847 | 3,648 | 3,980 | 3,813 | 3,822 |
| Cotton(in lint) | 3,758 | 2,298 | 2,497 | 3,856 | 3,102 |
| Horse gram | 2,145 | 2,242 | 2,034 | 2,100 | 2,130 |
| Varagu(Kodo Millet) | 2,032 | 2,030 | 2,253 | 2,008 | 2,096 |
| Samai(Panicum Miliare) | - | 1,647 | - | 2,117 | 1,882 |
| Kuru | 2,240 | 1,206 | 1,244 | 1,191 | 1,470 |

### 3.3.3 Farming Practices

In the southern part of the Study Area, where the normal annual rainfall ranges from 700 to 1,000 mm with the unsecured yearly distribution, the timely receipt of rain has a decided influence on the land use and cropping patterns. The farmers in the area require suitable farming technology in order to meet challenges of the insecure rainfall. The representative technologies for the insecure rainfall are as below:

i) Use of rice seedlings purchased from outside areas.
ii) Change over cultivation method from transplanting to direct sowing.
iii) Change over the cultivation crop from rice to cholam/ groundnut/ cotton.
iv) Introduction of mixed cultivation such as cholam, cumbu and cotton.

Other farming practices such as land preparation method, application of fertilizer, crop protection and in-field water management are discussed in detail in Volume III of the Report.

### 3.3.4 Cropping Pattern

Cropping patterns in the Study Area are prepared based on the data of the Season and Crop Report of Tamil Nadu as mentioned in Fig. 3.3.1. Generally, paddy is cultivated under irrigated condition in Rabi season. However, in Ramanathapuram District, rainfed paddy prevails in large areas in summer season (Jan. to June). Sugarcane is cultivated only under irrigated condition. However, the area remains only 2 to 3% of the total planted areas due to the long growing duration extending nearly for one year. In some water available areas, paddy in kharif season and irrigated ragi, cotton, groundnut and chillies are also cultivated. For most of the crops, irrigated yields are obtained 2 to 2.5 times more than that of non-irrigated (Table 3.3.2).

### 3.3.5 Livestock

As described in the section 2.2.4 (12), the main livestock in the Study Areas are cattle (1.359 million heads), sheep (1.138 million heads), goats (0.787 million heads), buffaloes (0.479 million heads) and pigs (46,000 heads). Nearly half of the heads of livestock in the Study Areas has been spread in the Tiruvallur & Kanchipuram Districts. Especially, buffaloes and cattle concentrate in the District. Poultry is raised 12 % of the State in the Study Areas, and 42.1 % of the total heads of ducks and drakes in the State is raised in the Study Area, almost concentrating in the Tiruvallur & Kanchipuram districts. Milk production in the Study Area amounted to 564,200 tones on average of the years from 1990 to 95, which correspond to 16.2 % of those in the State. Egg production in the Study Areas amounts to 1,489 $X10^5$ pieces per year, which is equivalent to 5.3 % of those of the State. The egg production in the recent 5 years in the Study Areas shows a constant upward trend.

### 3.3.6 Farm Household Economy

In general, the characteristics of farm household economy in the Study Area are observed as follows:

(1) Large Scale Farmers

For big farmers of land holding more than 10 ha, their farm holding economy is considered very stable for making a good profit. Their cropping systems are based on the high profitable marketability with basic crops such as paddy, gingelly, and cotton to high-valued cash crops such as sugarcane, vegetables and fruit trees. Recently, big farmers have a tendency of cropping fruit trees and sugarcane which can make an average annual profit of Rs.30,000 per ha. Generally, big farmers have sufficient supplies of irrigation water, operation capital and inputs, and farming knowledge to efficiently manage their farms. Supporting assistance, therefore, are considered basically unnecessary.

(2) Medium Scale Farmers

For medium farmers land holding of more than 2 ha up to 10 ha, the characteristics of their farm household economy have been observed similar to big farmers, based on high marketable produces, except for a lower annual financial surplus after family expenditure due to a rather smaller farm-size. However, they can obtain an annual financial surplus after all expenses, calculated in the range from Rs.40,000 - 200,000 upon their farm sizes. Like big farmers, most medium farmers have supplies of irrigation water, operation capital and inputs, and farming knowledge to manage their farms. Supporting assistance, therefore, would be basically negligible, especially for farmers of more than 4 ha in this category.

(3) Small Scale Farmers

For small farmers land holding of 1 - 2 ha, their farm household economy is basically based on family consumption at first with surplus to be sold in the market. Their cropping system, therefore, is mostly based on staple crops for self-consumption, mainly paddy with a minor part for other cash crops. The revenue from selling the surplus farm produces will be used for paying loans, family expenditure and inputs for the next cropping operations. For cash crops seasonal or annual crops such as vegetables, sugarcane, etc. are often appraisal but no perennial crops like fruit trees due to needs for quick revenues. In case of assured irrigation water supply, they can enlarge the cropping areas of these high-valued cash crops for more revenues. Therefore, there are 2 basic cases; if they could perform 2 crops, they would have a financial surplus after all operation expenses and basic family expenditure and, in case of only one crop, their produces are basically for family consumption and a minimum revenue for family expenditure. Small farmers, therefore, need supplies of irrigation water, operation capital and inputs, and also farming knowledge for improving their farm revenues.

(4) Marginal Farmers

For marginal farmers, land holding of less than 1 ha, their production is mainly for family consumption. Their farming is substantially based on traditional farming style to crop mainly paddy combined with millet for assuring their staple food in any cases of rainfall precipitation. Generally their farms are not assured with irrigation water supply for cropping wholly paddy. In dry season, they try to cultivate groundnut for making some farm revenue. They essentially need stable supplies of irrigation water, capital, inputs and knowledge for a stable farming operation, especially in the drought-prone region in the Southern Study Area.

Regarding differences on farm incomes between the Northern and the Southern Study Area, farm holders in the Northern Study Area are basically gaining higher farm revenues than farmers in the Southern Study Area of a same farmland area due to better farming conditions, especially on irrigation water and soil, for assuring 2 crops in a year. Particularly, for marginal farmers of less than half ha (0.6 acre) their farm revenues could not support the whole family expenditure in a year. The situation of these farmers is more severe in the Southern Study Area. Generally, marginal farmers have to do other labour works like coolies for earning some revenue for supporting their family expenditure.

The estimates on crop budgets and family expenditures in the Study Area are shown in Table 3.3.4, and average family expenditures by farmer category are shown as follows:

**Average Monthly Family Expenditures by Farm Category**

(Rs/Family/Month)

| Expense-Item | Landless | Marginal | Small | Medium | Big | Remarks |
|---|---|---|---|---|---|---|
| 1. Staple Food | 300 | 300 | 400 | 800 | 1000 | If purchase |
| 2. Other Foods | 100 | 150 | 200 | 700 | 800 | -id- |
| 3. Ingredients | 20 | 50 | 100 | 200 | 700 | |
| 4. Clothes | 80 | 150 | 200 | 400 | 700 | |
| 5. Transports | 50 | 150 | 200 | 400 | 600 | |
| 6. Education | 0 | 100 | 100 | 250 | 400 | |
| 7. Medicines | 50 | 50 | 100 | 250 | 300 | |
| 8. Electric | 0 | 50 | 80 | 150 | 250 | |
| 9. Fuel | 0 | 50 | 70 | 150 | 250 | |
| 10. Ceremony | 0 | 50 | 80 | 200 | 250 | |
| 11. Recreation | 0 | 50 | 70 | 200 | 250 | |
| 12. Miscellaneous | 100 | 150 | 200 | 300 | 500 | |
| TOTAL : | 700 | 1300 | 1800 | 4000 | 6000 | Monthly Average |

### 3.3.7 Agricultural Marketing

The marketing system of agricultural produces in the Study Area is basically similar to the whole marketing system in Tamil Nadu but mostly limited to 5 produces: (1) paddy and foodgrains, (2) sugarcane, (3) cotton, (4) groundnut and (5) vegetables.

For general marketing routes, farmers can sell on the field their produces to traders providing their cropping loans and traders coming to their fields on harvest time, or bringing their produces to sell in regulated markets, village or district markets or city-dealers.

In the Study Area, a number of regulated markets with official prices were established to handle major items of paddy, foodgrain, cotton and groundnut. Sugarcane farmers sell the harvested cane to nearby sugar factories or dealers with minimum prices fixed by the Government. For vegetables, farmers depend only on dealers and markets in villages or districts with a fluctuated pricing system.

| Region with Market Committee | Regulated Market | Commercial Grading Centre |
|---|---|---|
| Northern Region (Tiruvallur and Kanchipuram Committee) | 1. Kancheepuram<br>2. Titutani<br>3. Tiruvallur<br>4. Red Hills<br>5. Madurantagam<br>6. Uthirametur<br>7. Poneri<br>8. Tirukalu Kundram<br>9. Sunguvar Satram<br>10. Pallipattu<br>11. Uthukottai<br>12. Achara Pakkam<br>13. Gummudi poondi<br>14. Nasarath pattai | 1. Kancheepuram<br>2. Uthitametur<br>3. Madutan tagam<br>4. Tirukalu Kundram<br>5. Tirutani<br>6. Tiruvallur<br>7. Red Hills |
| Southern Region (Ramanathapuram Committee) | 1. Vitudhu nagar<br>2. Raja Palayam<br>3. Sattur<br>4. Aruppukattai<br>5. Sirvilliputhur<br>6. Weltrap<br>7. Vamba kattai<br>8. Sivaganga<br>9. Thiruppuvanam<br>10. Mana Madurai<br>11. Singam Puneti<br>12. Karai kudi<br>13. Narikudi<br>14. Deva Kottai<br>15. Ramnad<br>16. Paramakudi<br>17. Kamuthi<br>18. Thiruvadani<br>19. Rajasinga<br>20. Mudukalathur | 1. Vitudhu nagar<br>2. Singam Puneri<br>3. Ramnad<br>4. Paramakudi<br>5. Sattur<br>6. Aruppu Kattai<br>7. Rajapalayam<br>(Kapas Grading Centre) |

In general the marketing system of agricultural produces in the Study Area is not well organized, especially for agricultural produces and the lack of related facilities for supporting marketing such as multipurpose storage, cold storage, transport means, central retailing markets of all goods to facilitate all kinds of marketing activities.

The number of regulated markets with related godown facilities in the Study Area, therefore, is considered sufficient at this moment. Only the items to be handled are limited and the supporting facilities should be reinforced for better activities on agri-business.

In general the advantages of the present marketing system are the ready presence of traders in the field at harvesting times to buy and to collect the produces at once. Farmers have no needs of measures to handle the post-harvest treatments, which require facilities and techniques along with their costs.

However, the disadvantages of the present system are farmers should sell the produces at almost lowest prices on the field and on-season due to no other choices for a quick revenue to pay loans, to collect capital for the next crop and because of lack of post-harvest treatment facilities to assure a safe handling for better off-season prices afterwards. Besides for minor products such as perishable vegetables etc. farmers are not sure on the marketability and handling techniques for producing in a profitable way, resulted in the present situation of a limited production scale.

### 3.3.8 Agricultural Supporting System

(1) Agricultural Research and Technology Development

There are 37 agricultural research stations in the 7 different agro-climatic zones in the State. Four research stations out of 37 are located in the Study Area. The activities at these stations are as follows:

| Name of Station | Location | Main Activities |
|---|---|---|
| Paddy Experimental Station | Tirur | Crop improvement work in rice under wet dry and semi-dry conditions |
| Cotton Research Station | Srivilliputhur | Improvement of medium staple cotton for assured irrigated areas |
| Regional Research Station | Aruppukottai | Dry farming for red and black soils |
| Agricultural Research Station | Paramakudi | Verification of findings on rice improvement |

(2) Technology Transfer Activities

60 out of 384 main centers and 43 out of 396 sub-centers of the technology extension system in the Department of Agriculture are located in the Study Area.

### 3.3.9 Aquaculture

(1) General

Irrigation is the means by which man increased the agriculture production. River diversion and small storage reservoirs like tanks are the earliest forms of irrigation methods. Water sorted in tank is used not only for irrigation but also for other community purposes like drinking, bathing, and washing clothes. Tank water is also used for fish farming.

(2) Aquaculture in Tamil Nadu

1) Potential Water Spread in Tamil Nadu

Tamil Nadu state has an inland water spread of about 371,000 ha with 28 reservoirs of 52,000 ha and about 5,400 major and 30,000 minor irrigation tanks offering a good scope for developing inland fisheries. Besides there are about 3,000 small ponds in villages. The details are summarized in the table.

Among the inland water bodies the seasonal tanks and other ponds contribute to the maximum for the annual inland fish production (49 %) major irrigation tanks (both perennial and long seasonal tanks) stands next in importance (32.6 %). This is followed by rivers and canals (14.8 %), estuaries and backwaters (3.7 %), FFDA tanks (3.5 %), major reservoirs (3.2 %) and miscellaneous rice field, swamps, etc. (2.1 %).

**Inland Fisheries in Tamil Nadu**

| Waterspread Classification | Max. Cultivable Area (ha) |
|---|---|
| 1. Reservoir | |
| i) Large and Medium | 35,000 |
| ii) Small | 17,000 |
| Sub-total | 52,000 |
| 2. Major irrigation & long seasonal tanks | |
| i) Area under Intensive Culture | 32,000 |
| ii) Others | 65,690 |
| Sub-total | 97,690 |
| 3. Short seasonal tank/ponds | |
| i) FFD Tank | 4,100 |
| ii) Others | 154,000 |
| Sub-total | 158,100 |
| 5. Estuaries and Backwaters | 56,000 |
| 6. Derelict Waters Swamps, etc. | 7,000 |
| Total | 307,790 |

2) Fish Farmers Development Agencies

During 1960, there was a simultaneous development of induced crop spawning technique and composite fish culture. In the improved fish culture technology, the commonly cultivated six species - Catla (*Catla-catle*), Rohu (*Cabeo Rohita*), Mrigal (*Cirhinus Mrigala*), Silver Carp (*Hypothalimichthys Molitrix*), Grass Carp (*Ctenopharyngodon Carpio*) and common carp (*Cyprinus Capio*) are considered to be the best culturable species of fish in the inland water system. These species are proportionately cultured to exploit the water body to the maximum with

approximate socking ratio - Catla at 40 %, Rohu and Mrigal at 25 % each and Grass Carp at 10 %. The fish production was improved from 1.5 t/ha to 5.0 t/ha in this period.

The Technical Advisory Committee of Government of India recommended the introduction of Fish Farmers Development Agencies (FFDA). FFDA has been established in the coastal farming areas. Now there are 542 FFDAs in all over India. An area of 386,000 ha has been brought under scientific fish culture and 404,000 farmers have been trained in improved practices upto 1995 - 96 through the active support provided under FFDA. There are 13 FFDAs functioning and active in introducing scientific and modern practices of pisciculture and training to the entrepreneurs.

(3) Possibility to Introduce Aquaculture in the Study Area

In the Study Area, there are two (2) FFDAs, one (1) at Kanchepuram with jurisdiction over Tiruvallur and Kanchipuram districts and another at Ramanathapuram. In the Southern Study Area, intensive activities are in progress only in 179 Panchayat Union tanks under 10 Panchayat Unions in the Virudunagar district at present.

Since the annual rainfall is limited in the Southern Study Area, most of the rainfed tanks in these areas are considered to be the short seasonal tanks, which are dried up during most period of a year. Therefore, it seems to be difficult to introduce such pisciculture that needs the water for feeding fish long period.

On the contrary, the rainfed tanks in the Northern Study Area have water even during the dry season though the water level varies widely and lowered. It is, therefore, considered possible to introduce pisciculture to the pilot tanks in the Northern Study Areas if such water is available as a result of water balance study. During the field surveys, it was found that in some villages such as the Vadakkupattu tank, etc. fishing was conducted.

## 3.4 Tank Irrigation

### 3.4.1 General

(1) Necessity of Irrigation

In areas below EL 200m, annual rainfall varies from 600mm to 1,200 mm in the State. The Southern Study Area receives 600 to 700 mm of annual rainfall and it is a drought prone area.

Major crop cultivated in the Study Area is paddy in the NE monsoon season. According to the estimation of EC project by CROPWAT (FAO46), Crop water requirement for paddy in the Southern Study Area is 550mm and rainfall in NE

monsoon season is 500mm. Considering the irrigation efficiency and effective rainfall, it is apparent that for most crops especially paddy, it is not possible to carry out secure agricultural operation under rainfed conditions and the irrigation is inevitable in the area (Table 3.4.1). Based on the results of the tank baseline survey in Virudunagar District, less than 70% of command area could be irrigated in average, and tanks stored up to the normal water level 1.4 year during past five (5) years (Table 3.4.2).

(2) Minor Irrigation Tanks in the Study Area

As shown in table in the section 2.3.1 (2), the total command area of tanks in the Study Area account for more than 49% of the total command area in the State. As stated in Chapter 2, about 50% of minor rainfed PWD irrigation tanks in the State are in the Study Area. The Southern and Northern Study Areas are in different agro-climatic zones. Number of marginal and small farmers form a high percentage in the Study Area (table in the section 3.3.6 (4)). Therefore, the Study Area can be adjudged as the most suitable area for minor irrigation tank study for the rural development.

### 3.4.2 PWD Rainfed Tanks in the Study Area

(1) PWD Rainfed Tanks

The Study focuses on the minor irrigation tanks maintained by PWD except system tanks. PWD irrigation tanks are with command area more than 40ha. Some of them were constructed under the planning and design by PWD, but most of them are constructed before the Independence and therefore detailed tank dimensions are not clear. Bast on the Tank Long List submitted to the JICA preparatory mission by PWD in August 1996, scale of command area of tank and its distribution is shown in Table 3.4.2.

The Study focuses on the 2,093 of PWD tanks commanding areas more than 40 ha except for system tanks. According to the draft tank inventory list prepared by PWD in May 1997, number of tanks and command areas area summarized in the table below:

| Districts | Tank Inventory List | | Data Not Available | Number of EC Tanks | Study Tanks (estimated) | |
|---|---|---|---|---|---|---|
| | Number of Tanks | Average Command Area (ha)** | | | Number of Tanks | Command Area (ha) |
| Northern Study Area | 1,214 | 116.36 | 85 | 107 | 1,022 | 127,488 |
| Southern Study Area | 1,214 | 97.85 | 12 | 131 | 1,071 | 86,258 |
| Study Area Total | 2,428 | 106.30 | 97 | 238 | 2,093 | 213,746 |

Source: * prepared by PWD in May 1997

Most of rainfed tanks are chained each other with surplus/supply channels to store the water during flood period.

(2) Conjunctive Use of Water (surface water and groundwater) for Irrigation

In general, it is possible that the rainfed tanks function as a recharge dam, which store the rainfall in the sub-surface for long period comparing the surface run-off. Because of deterioration of tanks, including the non-reliable rainfall and drought, most of command area in the Study Area is extracting groundwater as a supplemental irrigation water. Tank command area is reduced from 0.94 million ha in 1961 at peak to 0.63 million ha in 1993 in the State. While the groundwater command area increased from 0.5 million ha in 1951 to 1.2 million ha in 1993 in the State.

| District | Share of Net Irrigated Area by Sources (%) | | |
|---|---|---|---|
| | Canal | Tank | Groundwater |
| Tiruvallur & Kanchipuram | 2.71 | 46.77 | 50.52 |
| Ramanathapuram | 0.00 | 87.59 | 12.41 |
| Sivaganga | 0.00 | 88.97 | 11.03 |
| Virudhunagar | 0.00 | 53.79 | 46.21 |
| Southern Study Area | 0.00 | 78.72 | 21.28 |
| Study Area | 1.42 | 62.01 | 36.57 |

Source : Season and Crop Report 1992-93, DOA

There is no data available on the conjunctive use of surface water and groundwater in the tank command area of the Study tanks. But it is clear that farmers who are rich enough to dug wells use groundwater at free of electricity charge. Net irrigated area in the Study Area by water sources-wise are summarized in the table.

Above table shows that 1) agriculture in Virudhunagar district which is the most drought prone area, mostly depended on water from wells, and 2) wet area of Tiruvallur & Kanchipuram districts also depend on groundwater, possibly for the second paddy crop after NE monsoon.

Usage of groundwater for irrigation in the Study Area is observed as follows:

- Generally wells are located in the head and middle reaches of command area
- the initial investment cost for a well with pump house and pumping installation ranges from Rs. 35,000 to Rs. 90,000 per well
- in spite of the flat rate electricity charges, and now free electricity for agricultural pump set, the farmers do not use their well water for irrigation whenever the tank has storage, since the tank water is perceived as more nutritious and well water is used only to meet the crisis.
- the selling of surplus water from wells is not commercialized generally, although its opportunity cost is very high sometimes. Well owing farmers do consider the acute withering condition of crops raised by relatives and friends who stock their help in saving the crops in critical stages. Normally Rs.5 to Rs.10 per hour is charged for 5 HP electric pump set and Rs.15 to Rs.20 for 5 HP diesel pumpset
- Farmers who own wells are able to commence their cultivation in the apt season without waiting for the monsoon and they are able to save the crop at the later stage

when the tank water gets exhausted completely.
- The well owing farmers prefer to raise annual cash crops such as sugarcane and banana during normal and good years to get more profit

The water balance of tank command area shall be analyzed not only surface water, but groundwater in the chain tank basin. Up to now, there is no data available for the total water balance in their basins. Under the EC Tank Modernization project, water balance studies in the chain tank basin including groundwater is going on.

(3) Reduction of Storage Capacity of Tank and Irrigable Area

Most farmers in the tank command area cited the reduction of tank storage capacity and inflow water through supply channel is caused by the sedimentation. Until now no measurement data on the siltation in the tank pond and supply channel is made. Also no annual run-off in the small-scale rainfed tanks are measured. They are only estimated by the method described in Design Manual of PWD. Even the tank capacity is not measured recently.

### 3.4.3 Irrigation in Tank Command Area

(1) Irrigation Method

Most of the command areas in the Study Area paddy is cultivated during NE monsoon, only in the Northern Study Area the second paddy is cultivated after NE monsoon. In Southern Study Area, when the groundwater is available, upland crops/vegetables are cultivated after paddy in NE monsoon.

Mostly flood irrigation for paddy and sugarcane is applied through earth channels after taking off water by sluices from the tank pond. After receiving water from irrigation channel, water is taken by plot to plot method. There area no diversion nor discharge measurement devices. Temporary earth banks are usually used for changing flow from the irrigation channel to other irrigation channel or to increase the water level in the channel.

Recently, the channel linings are introduced by the modernization project under PWD to reduce the conveyance losses in the channel. Major construction costs for the EC tank modernization project are provided in channel lining.

(2) Operation of Tank Irrigation

Rainfed irrigation tanks have long history, the traditional irrigation operated under the strong leadership and community. When the tank received adequate storage to start cultivation, the village headman would decide the date for sluice opening in consultation with the farmers' committee. Under the traditional system *Neerkattis* are employed by the village, under control of the headman, to manage water distribution

and sluice operation also maintaining flows in the distribution system. Water is supplied by rotation following a set pattern. The leadership at local level declined as political interference in village life creates groupism leading to difficulties in organizing collective efforts.

Most of tanks in the Study Area have formal or informal water users association (WUA). The timing and water distribution of irrigation water is by the WUA under the advice of agricultural extension workers, and most farmers in the tank command area explained no conflicts among the farmers. Most cases, the large-scale farmers have the priority to get water from tanks specially in drought year. No scientific water distribution are practiced and mostly irrigated based on the traditional method. Basically upstream farmers get high priority in the water distribution. Sometimes water from tank sluice continuously flow in to field even during the heavy rain. Recently, EC Tank Modernization Project introduced the community organizer system to formulate formal WUA and motivating the farmers for their tank modernization works.

Irrigation Management Training Institute (IMTI), PWD, provide water management training to the farmers organization especially for WUA.

(3) Maintenance of Tank Irrigation Facilities

Following takeover of tanks by PWD, farmers looked to the State for maintenance and traditional *Kudimarmath*, which farmers contributed an amount of labour in accordance with their cultivation areas, declined.

PWD's maintenance cost of tank without supply channel was Rs.220/ha/year and farmers' charge is Rs.60/ha/year. For the tank with supply channel, it raises to about Rs.280/ha/year but farmers' charges remain unchanged.

### 3.4.4 Present Conditions of Irrigation System and Facilities

With deterioration of catchment, reduced the tank water supply, the command area contracts in response to lower reliability for cultivation. This nature is most pronounced at the tail of the command area, and has led to the rapid proliferation of dug wells in these areas, utilizing the seepage from the tank bed and paddy field.

(1) Field Survey of Representative Tanks

To grasp the existing condition of tanks, the field survey was conducted on 15 (minimum 2 tanks in one category) representing tanks selected among the social environmental sample tanks. Characteristics and problems of the tanks were surveyed, and constraints and present conditions of the farmers' organizations were also observed by the Study Team. Availability of 1:5,000 topographic maps of each village was also confirmed. The field survey was carried out for the following items.

- Meteorology and hydrology
- Present water use (irrigation, domestic and other water uses)
- Socio-economical conditions
- Agricultural production and farming practice
- Agricultural supporting services and project implementation organization
- Farmers' association
- Agriculture and rural infrastructure

(2) Present Conditions of Tank Irrigation Facilities

Through the field inspection of the Study Team, the tank facilities are observed as follows:

1) Catchment Area

Because of deterioration of catchment by cultivation with high bunded paddy fields and cut forest for fuel, almost total interception and retention of normal rainfall, spilling occurs only during intense storms following antecedent high rainfall. Thus the tank water supply is reduced, consequently the command area contracts in response to lower reliability of cultivation.

2) Supply Channel

Several tanks have feeder channels, which take off from rivers and supply water during short periods of peak flow. By siltation of feeder channel bed as well as by degradation and aggradation of riverbed, the carrying capacity of the feeder channel has been reduced. Encroachment of channel area and urbanization are also the attributes for this deterioration.

3) Waterspread Area (Pond)

Because of siltation from catchment area and no desilting works done for many years, the storage capacity of tank capacity is reduced. Siltation would be increased by the destruction of catchment.

Some of the waterspread areas are also used as fish pond and community forest.

4) Tank Bunds

Most of tank bunds are age old and no proper maintenance were practiced. The poor condition of tank bunds threatens the whole tank system and weak bunds may break due to excessive seepage, inadequate weirs, insufficient freeboard, etc.

The tank bunds constructed based on the following PWD standard:

crest width: 2.0 m
side slope: 1.5 : 1.0 for front and 2.0 : 1.0 for rear slopes
stone revetment on the front slope up to maximum water level

Rather steep embankment slope, poor embankment material, and inadequate compaction causes sliding. In the case of relatively high embankments, seepage line appears on the rear slope, and causes the sliding of embankment.

The narrow bund crest, improper treatment of crest surface, and farmers and animal passing on the crest cause the easy brake of top shape by erosion.

5) Surplus Arrangement (Spillway)

Surplus water in the water spread area during heavy floods pass through the surplus arrangements, such as weirs, surplus channels, to prevent the overtopping the tank bunds. In Northern Study Area, almost every year surplus water discharged through surplus arrangements, but in Southern Study Area surplus years occur once in five to ten-years. Many tanks posses surplus arrangements which do not function satisfactorily. The surplus weirs have been designed based on the empirical discharge formulae. The design discharge is often insufficient to the actual flood occurring. Furthermore, the masonry weirs are deteriorated leading to breaches during heavy floods or surplus channels have encroached upon the land preventing controlled flow of water.

In some tanks, farmers constructed and living at just downstream of surplus arrangement because of no surplus condition occurred many years. No discharge measurement devices such as staff gauge on the weir crest are installed.

6) Sluices (Intakes)

Sluice is an intake structure of stored water in a tank pond. Well functioning sluices are the hearts of the tank system. Traditionally, tower-head structures with plug rod and conical wooden plugs to close the plug hole in the horizontal stone slab with its round sluice operating have been working satisfactorily. Vent opening sizes are standardized (6", 8", 10") and design allows drawing normal supplies of water when the tank has a low water level. During the peak demand period (land preparation), the sluice opening may sometimes not be sufficient, however, the regulation of flow and also closing are advantageous. For the final release of the tank, there is a second rectangular opening at the sill level of the sluice barrel which is normally closed by wooden plug or solid stone. Most cases, wooden conical pugs and logs are not seen and the lower openings are under the siltation.

The operation of the sluice is one of the major concern. Sometimes the handles for

screwing are not solid enough, then the sluice is continuously open, no proper locks are available or locks are broken and operation can be done by any farmer at his wills.

Initially, the EC tank modernization project, the regulating arrangements were proposed by installing vertical lift type rectangular metal sheets paddle shutters in front of the vents or sluice barrel with screw gearing arrangement to replace the conical plug.

After monitoring performance of the vertical lift type rectangular metal sheets and paddle shutters in front of the vents or sluice barrel with screw gearing arrangement, the following points are noticed in some EC tanks:

- since shutters were large, even a small lift has caused much variations in the sluice discharges
- it was found very difficult to arrest the leakage through groove cut in the masonry for guiding the shutter

The leakage of several sluice regulating facilities are observed as shown below:

**Leakage through Sluices in Aralikottai Tank**

| Date | Water Level in the Tank (m) | Leakage in cusec | | |
|---|---|---|---|---|
| | | Rectangular Shutters | Plug-hole | Rectangular Shutters |
| Oct.22,'89 | 1.18 | 0.440 | 0.215 | 0.412 |
| Nov.18,'89 | 1.54 | 0.412 | 0.240 | 0.610 |
| Nov.11,'90 | 1.79 | 0.440 | 0.240 | 0.610 |
| Dec. 5,'90 | 1.47 | 0.215 | negligible | 0.350 |

Source: CWR-Anna University

By these results, the conical plug-hole type with the new screw-gearing arrangement is adopted for EC tank modernization project. It might be depended on the shutter fitting techniques of local contractor or skills of the technician as these problems are not found in other countries.

7) Water Distribution Facilities (Irrigation Channels)

The water distribution system, in most cases, consists of unlined earthen channel with outlets leading directly to the field or long irregular shaped uncontrolled field channels. No discharge measurement devices, check structures, regulators or diversion boxes are installed.

8) Drainage Channels

No drainage channel including surplus channels is installed in most cases. During the high water stage of tanks, cultivation filed near to the toe of tank bund show the poor drainage conditions and causes the difficulty of cultivation and poor

productivity.

9) On-farm Facilities

Field channels are usually absent as the conventional irrigation practice is to irrigate from field to filed (plot to plot). This results in over-irrigation of some parts and under-irrigation of others. Most farmers do not want to install on-farm facilities because of the fear of possible reduction of their cultivation area.

10) Water Management

Traditional water management within a command area is vested with village committee on the basis of an informal restoring arrangement that subordinates equity to influence of vested interests. A rotational supply with equity is not regularly practiced also it is hardly achieved to supply the right quantity at the right time. Because of leakage of sluices, and poor maintenance of plug of sluices, meaningless water always flowing in the irrigation channels even during long period of heavy rains. These result the insufficient water storage in the tanks.

For easy comprehension, the present constraints and the countermeasures proposed are summarized and shown in Table 3.4.3.

### 3.4.5 Necessity of Rehabilitation of Tank Irrigation System and Facilities

(1) Necessity of Tank Rehabilitation

Though the farmers have taken up the high yielding varieties and other modern techniques of farming, in respect of water use and water regulation they are still poorly informed and have not paid their attention. This is perhaps because this requires joint management, part of this system being under the care of governmental agencies and part under their own or local government. This task is generally by two government agencies viz. PWD for major tanks (more than 40 ha) and, a local civil administrative body (Panchyat Union) for other small tanks. Upkeep of these tanks to impart their fullest benefits to users is lower priority consideration for these bodies as they are entrusted with multiple responsibilities.

Lack of data on tanks has been a major constraint in planning of tank rehabilitation and modernization. Vital statistics like the capacities of tanks at various period of time, the number of fillings, figures on the receipt and supply of water, surplus amount of water are lacking. Such lack of essential information leads to believe that the farmers by themselves have just not been able to administer the minor irrigation tanks on sound lines.

The maintenance and repairs of many of tanks are poor. Almost all tanks require repairs either in tank itself or in their components. Since the tank irrigation forms one

third of total tank irrigated area, more attention should be paid for utilizing these storage structures for the benefit of country. To attain maximum productivity from a farm land, water must be supplied and regulated in such a way that maximum production could be obtained from the available water. This is not happening at present juncture. In fact, the lowest yield per unit area in irrigated land is only from the tank irrigated lands.

(2) Necessity of Improvement of Tank Irrigation System

Because of scarcity of water resources and limitation of development potential of surface water in the Study Area, the most effective work to maximize the available water resource for the irrigation is canal lining.

Irrigation efficiency is estimated as follows:

Ei = Ed X Ec X Ea

where Ei : irrigation efficiency
Ed : distribution efficency or operational efficiency
Ec : conveyance efficiency
Ea : application efficiency

According to the CWR-Anna University, each efficiency was measured as presented in the table below:

| Name of Tank | EC Tank Modernization | Conveyance Ec (%) | Distribution Ed (%) | Application Ea (%) | Irrigation Ei (%) | Improvement (%) |
|---|---|---|---|---|---|---|
| Arafikottai | before | | | 75.00 | 63.69 | |
| | after | | | | 96.60 | 32.91 |
| Kohamangalam | before | | | | 65.83 | |
| | after | | | | 92.70 | 26.87 |
| Keelarajakuramam | before | | | | 80.14 | |
| | after | | | | | |
| Arunbavur | before | 51.61 | 60.00 | 70.36 | 21.78 | |
| | after | | 89.00 | | | |
| Puliankulam | before | 66.10 | 86.68 | 79.81 | 45.73 | |
| | after | 93.02 | 98.00 | | 72.75 | 27.02 |
| Karaikanmoi | before | 79.19 | 50.00 | 69.82 | 27.65 | |
| | after | 95.70 | 90.00 | | 60.14 | 32.49 |
| Vengal | before | 20.53 | 65.8 | 70.91 | 9.58 | |
| | Drum Cultivation | | | 64.70 | | |
| Average (except Vengal) | before | 65.63 | 65.56 | 73.33 | 31.55 | |
| | after | 94.36 | 92.33 | 73.33 | 63.89 | 29.82 |

Source: Tank Modernization Monitoring and Evaluation (Phase I) Final Report, June 1992 and (Phase II) Interim Report, Oct. 1994
Note: before conditions are earth canal and no OFD, after conditions are with canal lining, and OFD by EC Tank Modernization

The irrigation efficiency can be improved by more than 25%. This means, by canal lining only, more than 25% of irrigable area can be extended.

(3) The Government Efforts for Tank Rehabilitation

In parallel with EC Tank Modernisation Programme, the following actions for tank rehabilitation or improvement works are implemented since 8th Five Year Plan:

Special Minor Irrigation Programme and Desilting Cum Reclamation Scheme: Special Minor Irrigation Programme contemplates formation of tanks, construction *anicuts*, excavation of link channels, restoration of abandoned tanks, river pumping schemes, etc. These are original works leading to assure irrigation and creating additional irrigation potential and resulting in additional food production. Desilting-cum-reclamation schemes contemplates desilting of tanks to restore the lost capacity due to siltation and reclamation of the lands.

Strengthening and improvement of Irrigation tanks having ayacut less than 100 acres vested with Panchayat Unions: There are 20,400 Panchayat Union tanks in the State. These tanks are to be standardised initially for maximum efficiency. Under the A'M.I.P. works, standardisation of bunds, reconstruction of sluices and repairs to the existing sluices are done. Repairs and reconstruction of surplus arrangements are also executed.

Standardisation of Ex-Zamin Tanks: The scheme contemplates standardisation and improvements of Minor Irrigation sources in the State. Under the Accelerated Repair Programme, permanent improvements to irrigation tanks to make them fully beneficial by standardising the bunds, providing sluices and surplus arrangements, excavating supply channel etc. wherever necessary are executed.

Standardisation of Tanks with Supply Channel: Under this programme, complete standardisation of tanks such as strengthening of bunds, repairs to sluices and weir, improving to supply channel right from offtakes, etc.

### 3.4.6 Categorization of PWD Rainfed Tanks

(1) Categorization of Rainfed Tanks

Since the Study for rehabilitation of PWD rainfed tank amounts over 2,600, it is necessary to categorize into several types, and to conduct the feasibility study for each representing category to facilitate the establishment of tank rehabilitation plans.

Tank categorization was planed at the inception stage of the Study that 1) the inventory list will be first of all translated into a computer database to facilitate the above categorization, and 2) the lack and shortage of data will be checked and supplemented, then 3) the tank categorization will be made. The tanks which are located in sanctuaries, national parks, etc. will be deleted if considered as those not suitable for rehabilitation in view of environmental protection. The tanks included in those for EC assisted schemes will also be removed form the list. The categories will be set considering the following items.

(1) Agro-climatic areas: the Study Areas are divided into two (2) major climatic zones as shown in Fig. 2.2.2; Agro-climatic Zone I and III.

(2) Capacity of tank and size of command area.
(3) Ratio of command and catchment areas (potential of water resources development)
(4) Existence and operation condition of agriculture organizations such as water users' association (number of Hamlet, conflict and arbitration)
(5) Extent of damage on the irrigation facilities (tanks, intake facilities, irrigation canals), and urgency of rehabilitation
(6) Present conditions of farming practice and scales (ratio of marginal farmers)
(7) Extent of dependence to tanks (extent of groundwater development)

Without considering their accuracy, the following data are used as a source of tank categorization:

1. Tank Long List : prepared by PWD and handed over to JICA preparatory study team in August 1996, which contains the name of tank and location, command area and tank capacity.
2. Tank Inventory List : prepared by PWD in 1996 and handed over to the Study Team in May 1997, which is revised in May 1997.
3. Rainfed Tank Baseline Survey : prepared by Statistics Department in 1995 containing name of tank and village, registered command area, average cultivated area, annual rainfall at nearest rainfall station, surplus or dry years in last 5 years, number of land holding farmers at scale at sampled tanks.
4. Social Environmental Survey conducted on 240 tank areas under supervision of the Study Team in 1996

(2) Main Factors for Tank Categorization for Rehabilitation Project

The Study aims to formulate the PWD rainfed tank rehabilitation plan. In order to evaluate the total project, priority of rehabilitation implementation, the tank categorization shall be conducted. For these purposes, the tank shall be categorized based on 1) factor of water availability (hydrological feasibility) which can identify the possibility and degree of difficulty of water storage or needs of groundwater development, 2) factor of cost for rehabilitation which can be determined by the physical dimensions of tanks, 3) factor of benefit which can be determined by the efficiency of operation maintenance of rehabilitated tank facilities and increased agricultural production by tank rehabilitation.

1) Water Availability (Hydrological)
2) Physical Dimensions of Tank Facilities (Cost Factor)
3) Agricultural Production (Benefit Factor-1)
4) Efficient O& M (Benefit Factor-2)

(3) Agro-climatic Zone

Mostly the agro-climatic zone is categorized based on the annual rainfall and its

pattern. The rainfall volume and pattern is a major factor for the water availability and agricultural production. Through the field inspection, an annual rainfall difference of 200mm is identified between the Northern and Southern Study Area resulting in perfectly different agricultural conditions, such as cropping intensity. Also shape of storage area is round in the Northern Study Area and crescent in Southern Study Area. It caused the different ratio of tank bund length storage capacity ratio.

According to the surplus conditions of tank in the Baseline Survey, both Study Area shows about 86% and 50% for the Northern and Southern Study areas, respectively (Table 3.4.2). Therefore, both Study Areas shall be divided in to 2 categories; tanks in wet zone with annual rainfall of more than 1,000mm and in dry zone with annual rainfall between 700mm and 900mm.

(4) Tank Dimensions

Based on the available database, the correlation among tank dimensions, such as catchment area (free and equivalent), length of bund, scale of waterspread area, scale of command area (registered and average cultivated), tank storage capacity, farm household in the command area (total numbers, share of marginal farmers) were examined, and summarized in Table 3.4.4. Results showed the relatively high correlation between 1) the catchment area and tank capacity, 2) number of farm household in the command area and average cultivated area.

1) Catchment Area and Tank Capacity

Correlation between free catchment area and tank capacity in both Study Areas is relatively high (correlation coefficient 0.4 to 0.6).

At the stage of tank planning, tank capacity is determined by the estimated possible runoff from catchment area and irrigation schedule. Therefore they shall be correlated. Also this results show that intercepted catchment area can not be accounted for the inflow area of tanks in the Southern Study Areas.

2) Ratio between Catchment Area and Command Area

No clear correlation between the catchment area (Ao) / average cultivation area (Ac) ratio and surplus water year within last 5 years is obtained at this stage. In Southern Study Area, low occurrence of surplus condition shows higher average Ao/Ac ratio as shown in the table:

| Surplus Occurrence | 0% | 20% | 40% | 60% | 80% | 100% |
|---|---|---|---|---|---|---|
| Average Ao/Ac ratio | 2.61 | 5.39 | 6.99 | 4.12 | 3.25 | 4.85 |

Source : Combined data of Baseline Survey and Tank Inventory List

As shown in Table 3.4.1, the required catchment area under the improvement of irrigation efficiency (Ef=60%) requires more than 5 times of irrigation area,

assuming the runoff ratio at 30% and 80% of rainfall probability in the Southern Study Area in this stage (Refer to Table 3.4.2). It shows the higher Ao/Ac ratio can be cultivated under the surplus water conditions.

3) Ratio between Command Area and Tank Storage Capacity

The correlation between tank command area and storage capacity shows the average depth of tank water in the command area. As same as correlation between the catchment area and tank capacity, command area shall be correlated with storage capacity for the tank planning stage. In case of ample water available, it is one of design factor for determination of required tank capacity against the crop water requirement in the command area.

4) Scale of Command Area

Total number of tanks in Northern and Southern Study Area is almost equal, therefore each Study Area is divided into 3 groups with almost equal number of tanks. Their distribution and cumulative curve of tank numbers are shown in Table 3.4.5. As a result, tanks in the Northern Study Area are divided into tank command area less than 60 ha, 60 to 110 ha and more than 110 ha. Southern Study Area also divided by the tank command area less than 55 ha, 55 - 90 ha and more than 90ha.

| Category | Agro-climatic Condition | Scale of Command Area |
|---|---|---|
| N-1 | Wet Zone (more than 1,000mm) Northern Study Area | less than 60 ha |
| N-2 | | 60 to 110 ha |
| N-3 | | more than110 ha |
| S-1 | Dry Zone (700-900mm) Southern Study Area | less than 55 ha |
| S-2 | | 55 - 90 ha |
| S-3 | | more than 90 ha |

5) Cultivation Density

According to the baseline survey results, actual cultivated area ratio against registered command area varies from 70% to 95% (Table 3.4.2). Actual cultivation ratio varies not only the tank conditions but also usage of groundwater in the command area or dependence of surface water.

As stated in 3.4.5 of this Chapter, the lining of irrigation canal can save the irrigation water about 25%. In other words, 25% of average cultivated area can be extended by irrigation lining. Therefore, it is possible to say that command area cultivated less than 75% at present can increase up to 100% of command area by canal lining works only. And tank command area cultivated more than 75% of total area can cultivate more than once.

(5) Social Factor (Efficient O&M)

Based on the results of social environmental survey conducted by local consultants at 240 sample tank areas under the supervision of JICA Study Team, no formal organization of farmers was found in the tank command areas. Most of command area operated the irrigation under the informal organization, which is active during flood fighting or acute scarcity period. When minor social conflicts occurred in the command area, senior persons in the tank command area take a lead and try to settle. For the major conflicts involving different caste groups are normally settled through police or courts. The heterogeneity in the farm size, varying income levels, political and caste groups contribute mainly for the inefficiency in tank related improvement works by the informal organization in the tank based villages.

(6) Tank Categories in the Study

Based on the above-mentioned analysis, the following tank categorization is made by 1) agro-climatic zones from the water availability factor, 2) cultivated area ratio in the command area from the project benefit factor, 3) ratio between free catchment area and command area from the water availability factor, and 4) scale of command area from the efficient O&M and social factors.

| Category | Agro Climatic Zone | Ratio of Cultivated Area | Ratio of Free Catchment Area / Command Area | Scale of Command Area | Estimated Tank No. |
|---|---|---|---|---|---|
| NR-1 | Northern | more than 75% | ---- | Small, | 262 |
| NR-2 | | | | Medium, | 289 |
| NR-3 | | | | Large | 248 |
| NR-4 | | less than 75% | | --- | 223 |
| SP-4 | Southern | less than 75% | ---- | --- | 220 |
| SR-1 | | more than 75% | more than 5 | --- | 216 |
| SP-1 | | | less than 5 | Small, | 240 |
| SP-2 | | | | Medium, | 238 |
| SP-3 | | | | Large | 157 |
| NR | Rehabilitation non-effective tanks : cultivation area less than 10% to registered command area or share of marginal farmer in command area less than 10% and no tank information available | | | | 97 |

## 3.5 Social Environment

### 3.5.1 Present Sociological Condition

(1) Religion and Caste System

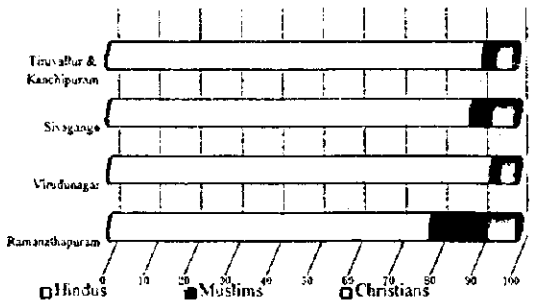
In India, religion can be changed but one's caste can not be changed. The caste in which one is born is immutable. The caste system stratifies into four (4) hierarchical and pyramidical segments; the Brahmins, the Kshatriyas, the Vaisyas and the Sudras. The Indian society considered only those within this hierarchy as 'free' people and others outside it as the scheduled caste considered 'out-castes', 'untouchables', etc. The caste system is also called the '*Varna*' system. There are more than 3,000 castes as against the four (4) *Varnas* presented by the Hindu scriptures (*Vedas*).

With the acquisition of land ownership and the exclusive rights in decision making, the *Varna* system gradually threw-up a 'class system' - the upper caste became easily the powerful dominant class. The middle class also acquired a bargaining power through their skills and credit worthiness. The scheduled castes were the ones deprived, denied and exploited since they were the last in the stratification of society.

Under Article 341 and 342 of the Constitution of India certain castes and tribes are declared, and in the State, 76 castes and 36 tribes have been declared as the scheduled ones. As described in Section 3.1.3, the population of scheduled castes and tribes share 36.7 %, 19.1 %, 24.2 % and 20.9 % of the whole rural population in Tiruvallur & Kanchipuram, Sivaganga, Virudhunagar and Ramanathapuram districts, respectively, and most of them are facing difficulties by poverty. To solve the situation of low economic and social status of the scheduled castes, some reservations in the government jobs and in education institutions has been guaranteed for them. In all the rural poverty alleviation programs a 50 % is for the scheduled castes.

In India, religion has a profound influence on a person's thinking, attitude and values, but there are some difficulties when religion and caste both act and interact on people. India is told to be the cradle of major religions and today it is on the basis of religions that the country is facing disintegration. All religions – Christianity, Islam, Buddhism do practice casteism but not so blatantly and visibly as the Hindus. For the former religions do not give scared sanctions but the people continue to discriminate as scheduled caste be he/she in any religion.

The figure shows the main religious communities in the Study Area. In all districts, Hindus are predominant sharing from 78 % to 94 %. In Ramanathapuram District, Muslims' population is found to be rather larger than in the other districts accounting to about 14 %.




PERCENTAGE OF POPULATION BY RELIGION

Religion indicator to the type of occupation is sometimes considered as a great extent. For example, one will hardly find a Muslims ploughing the field. They may own the land especially now due to the flow of foreign money from the Gulf countries, but they take more to trade and commerce - Christians due to education take to services and are also economically very backward. This is because more than religion caste binds people in a greater solidarity especially when it comes to gain power and to counter the domination of other castes. The politicians have politicized religious communities and so today in India and in Tamil Nadu we do experience riots of one religious community against another and one caste against another caste. A religious fundamentalism has made inroads into communities.

(1) Culture

It would perhaps be no exaggeration to say that Brahmins, on the one hand, and non-Brahmins and Adi-Dravidas, on the other represent two cultures. In speech Sanskrit has a major influence on the Brahmins, while non-Brahmins how specialized in Tamil studies. The Tamil spoken by the Brahmins and non-Brahmins has some vocabulary and phraseology distinctions.

The kind of food one eats and the way it is cooked and served also has its distinctions between these three castes. In the villages the Brahmins do not dine at non-Brahmin weddings and the non-Brahmins do not dine with the scheduled castes.

Technology in its turn brings in industrialization and this in turns fastens the pace of urbanization and these have profound effects on beliefs, ideas and orientation of people.

Culture has thus two aspects namely material and non-material. With the advancement of science and technology people have adapted different tools, utensils, machines, means of transport and communication in their daily lives. This is the material aspect of culture. The non-material aspects of culture are beliefs, customs, traditions, practices, moral and values. The material aspect of culture moves upward at a great speed but the non-material aspects do not, hence, the 'cultural lag', denoting a crippling movement.

In 'the modernization of tanks' the material aspects can bring in improved storage of water, better techniques of management, etc. However, if the small and marginal farmers refuse to change their practices of cultivation, utilization an stick to 'what was good for our forefathers is good for us' (reverence for the past) and refuse to break habits, then the whole project may not give the results that are expected. The non-material aspects must be taken care of and changed to keep up with the speed and rate of the material aspects in the 'modernization of tanks'. It is, therefore, necessary to educate, create awareness and make the users cooperate and be involved from the initial stages as copartners rather than so beneficiaries of a project.

(2) Gender Issue

The Committee on the Status of Women reviewed women's role and status in the most of the areas continue to be far from satisfactory - be it in the economic, social and political dimensions of their lives - India in a nation with 407 million women - that to make development real it was realized that the principles of gender equality and gender equity must be aimed at. It was with this basic concern that the Government of India appointed in 1971 a Committee on the Status of Women in India. It raised basic questions about the socialization process, about the patriarchal and hierarchical systems, about the resource/asset ownership, and distribution patterns etc. these led to a recognizable shift in the governmental policies and for the

first time in India's planning history a Chapter on Women and Development was included in the Sixth Five Year Plan (1980 - 85). This envisaged a myth-pronged strategy for women's development in the following areas.

- Employment and economic independence
- Education
- Access to health care and family planning
- Support services to meet piocentical gender needs
- Creation of an enabling policy institutional and legal environment

Several initiatives were taken by the government and supplemented by the non-governmental organizations. In spite of all these efforts women in India are discriminated, exploited and backward. This is reflected in the Human Resource Report published by the United Nations Development program (UNDP) in 1995. The report has ranked India 134$^{th}$ among 174 countries in the Human Development Index (HDI) which takes life expectancy, literacy, combined enrollment and adjusted real Gross National Product (GDP) per capita. In Gender-related Development Index (GRI) which takes note of inequality in achievement between men and women, India has been placed 99th among 130 countries. The greater the gender disparity in a country, the lower its ranking. This as well as the Gender Employment Measure (GEM) are two additional indices prepared by UNDP. In its GEM, which measures the participation of women in economic and political decision making, India has been ranked 101$^{st}$ out of 116 countries. Whatever may be the political explanations and the debate on how wrong or right these indices, measurements and ranking are fact remains that the majority of the women in India are powerless, assetless and hence voiceless.

1) Constitutional and Legal Rights of Women

The Constitution of India not only affirms equality to women but urges and empowers the state to take such measures of positive discrimination on off-set the cumulative discrimination that had forgotten during centuries against women.

Articles 14, 15, 15(3) and 16 are all directed towards prohibiting discrimination and ensuring equality of opportunity. The state has exacted various legislative measures to counter social discrimination, and provide support services for women.

The 7$^{th}$ Five Year Plan (1992 - 97) made special note that women must not be bypassed in any development program and special program were implemented to augment the general programs

There have been various interventions in the form of policies as instruments to support and protect women as follows:

- National Policy on Education (1986)
- National Health Policy (1983)

- National Population Policy (1993)
- National Nutrition Policy (1993)

All these took a closer look at the reality position of India and consciously addressed itself to women's concern.

Poverty Eradication Programs have been launched in rural areas - here again stipulation has been made by which at least 40 % of the beneficiaries to be reserved for families below the poverty line. The Integrated Rural Development Program (IRDP) has been designed to raise the income of the small and marginal farmers, rural artisans and agricultural labouers. Here too women's promotion of beneficiaries steadily increased from 10 % to 34 % in 1993 - 1994.

In addition, the following programs have been carried out in the State.

- Training of Rural Youth in Self-employment (TRYSEM) for poverty eradication
- Jawahar Rozgar Yojana (JRY) for employment
- Indira Awas Yojana Program for providing houses to the women in poorest situation
- Development of Women and Children in Rural Areas (DWCRA) for providing women and children in rural areas with skill training, credit and support for self-employment as well as for improving basic services in health, child-care, nutrition and drinking water

2) Women in Rural Areas

Women's population in rural area of the Study Area is summarized in the table of next page for each taluk and district.

**Sex Ratio in Rural Areas of the Study Area**

| Nothen Study Area | | Rural Population | | | Southern Study Area | | Rural Population | | |
|---|---|---|---|---|---|---|---|---|---|
| District | Name of Taluk | Male | Female | Sex Ratio | District | Name of Taluk | Male | Female | Sex Ratio |
| Tiruvallur & Kanchipuram | Gummidipundi | 70,683 | 68,428 | 968 | Sivaganga | Tiruppattur | 91,942 | 98,960 | 1,076 |
| | Ponneri | 119,926 | 117,407 | 979 | | Karaikudi | 48,663 | 51,194 | 1,052 |
| | Uthukottai | 64,422 | 63,641 | 988 | | Devaikkottai | 36,320 | 38,770 | 1,067 |
| | Tiruvallur | 124,411 | 122,777 | 987 | | Sivaganga | 99,251 | 103,807 | 1,046 |
| | Tiruttani | 69,265 | 67,889 | 980 | | Manamadurai | 69,358 | 69,033 | 995 |
| | Pallipattu | 68,410 | 66,845 | 977 | | Ilayankudi | 39,576 | 41,125 | 1,039 |
| | Kancheepuram | 99,670 | 99,406 | 997 | | Total | 385,110 | 402,889 | 1,046 |
| | Sriperumbudur | 126,884 | 123,561 | 974 | Virudunagar | Srivilliputtur | 91,470 | 90,266 | 987 |
| | Saidapet | 91,029 | 86,723 | 953 | | Virudhunagar | 71,431 | 70,768 | 991 |
| | Chengalpattu | 208,123 | 200,114 | 962 | | Tiruchuli | 46,876 | 47,166 | 1,006 |
| | Uttiramerur | 56,315 | 54,904 | 975 | | Aruppukottai | 101,337 | 102,410 | 1,011 |
| | Madurantakam | 111,308 | 108,827 | 978 | | Sattur | 107,520 | 109,298 | 1,017 |
| | Cheyyur | 87,908 | 86,707 | 986 | | Rajapalayam | 70,481 | 70,310 | 998 |
| | | | | | | Total | 489,115 | 490,218 | 1,002 |
| | | | | | Ramanathapuram | Tiruvadanai | 96,031 | 98,181 | 1,022 |
| | | | | | | Paramakudi | 74,566 | 76,558 | 1,027 |
| | | | | | | Kamudi | 50,915 | 51,000 | 1,002 |
| | | | | | | Mudukalathur | 104,909 | 106,694 | 1,017 |
| | | | | | | Ramanathapuram | 104,619 | 106,978 | 1,023 |
| | | | | | | Rameswaram | 12,180 | 11,621 | 954 |
| | Total | 1,298,354 | 1,267,229 | 976 | | Total | 443,220 | 451,032 | 1,018 |
| Total | | 1,298,354 | 1,267,229 | 976 | Total | | 1,317,445 | 1,344,139 | 1,020 |

In the Study Area, the district-wise urban populations share 55.6 %, 73.5 %, 62.8 % and 78.4 % in the Kanchipuram & Tiruvallur, the Sivaganga, the Virudhunagar and the Ramanathapuram districts, respectively. The rural population is, therefore, considered to depend on agriculture and allied occupations in the Study Area, and the land ownership pattern is believed to be an important indicator to assess economic power. Historically, land ownership has been with the male and continues to be so.

According to the Department of Women and Child Development, the percentage of adult women below poverty line exceeds that of adult men both in rural and urban areas. In spite of a change in the inheritance law that both sons and daughters get an equal share, the age-old custom that sons alone are inheriting has made women landless. The following three (3) groups of rural women are identified in general.

- Landless agricultural households who have to hire themselves to work on the field of others
- Small and marginal farm holdings who work on their piece of family holding and also supplement their meagre income by performing other small tasks
- Women in large farms who do not have to do manual work but have to supervise the farm lands

The third category is of a very small fraction and in all the case the land belongs to the male member.

3) Employment of Women

The table in the next page shows the women's contribution as work forces in rural areas of the Study Area. It is significant that the women's share in the marginal workers are quite large followed by the agricultural laborers. The share of women in the marginal workers exceeds 90 %, while that of agricultural laborers follows with a range from 45 % to 55 %. It means that the employment opportunity for women is quite less than that for men and only temporary opportunity is available for them. Furthermore, in agricultural activities, mainly the common works such as weeding, harvesting, etc. are available for women. In the rural areas, the popular myth that men do heavy work like ploughing and operating tools so they should be given larger and better diet still holds good.

Men resist doing any 'drudgery' works and have identified the type of work which women can and should do in cultivation. Women as a result engage in sowing, transplanting, weeding, winnowing and hauling water, and these types of work are not only the lowest paid but is on a daily casual system.

There is no security that the same woman will be engaged throughout the season. In addition, the wages for women are within a range from Rs. 25 to 30 /day, while those for men within a range from Rs. 40 to 50 /day, according to the field interview.

| Nothern Study Area | | Total | | Agri | Livestock | Other | Marginal |
|---|---|---|---|---|---|---|---|
| District | Name of Taluk | Worker | Cultivator | Labourer | etc | Cat | Worker |
| Tiruvallur & Kanchipuram | Gummidipundi | 29.6 | 22.2 | 42.2 | 10.9 | 15.2 | 93.0 |
| | Ponneri | 28.3 | 11.7 | 41.2 | 5.3 | 15.5 | 94.5 |
| | Uthukottai | 37.9 | 21.8 | 48.0 | 15.7 | 18.8 | 95.7 |
| | Tiruvallur | 33.0 | 19.2 | 42.9 | 8.3 | 16.7 | 89.0 |
| | Tiruttani | 32.7 | 18.6 | 46.9 | 37.2 | 18.2 | 97.5 |
| | Pallipattu | 32.9 | 23.8 | 47.8 | 47.0 | 16.4 | 98.7 |
| | Kancheepuram | 37.6 | 28.3 | 53.2 | 30.9 | 14.7 | 88.1 |
| | Sriperumbudur | 29.1 | 15.8 | 49.7 | 18.4 | 19.8 | 93.5 |
| | Saidapet | 16.9 | 9.3 | 31.5 | 4.7 | 12.6 | 80.1 |
| | Chengalpattu | 28.3 | 18.9 | 45.1 | 8.3 | 15.3 | 90.6 |
| | Uttiramerur | 34.5 | 21.7 | 44.2 | 22.0 | 16.7 | 96.1 |
| | Madurantakam | 36.4 | 24.0 | 48.9 | 29.2 | 17.4 | 93.6 |
| | Cheyyur | 34.5 | 18.2 | 46.1 | 5.1 | 23.7 | 90.1 |
| | Total | 31.4 | 20.4 | 45.1 | 10.5 | 16.1 | 92.6 |

| Southern Study Area | | Total | | Agri | Livestock | Other | Marginal |
|---|---|---|---|---|---|---|---|
| District | Name of Talu | Worker | Cultivator | Labourer | etc | Cat | Worker |
| Sivagangai | Tiruppattur | 33.4 | 28.1 | 47.8 | 23.5 | 23.5 | 95.2 |
| | Karaikudi | 37.1 | 33.4 | 50.8 | 32.8 | 16.9 | 93.9 |
| | Devakkottai | 38.1 | 35.3 | 54.0 | 26.8 | 18.3 | 93.2 |
| | Sivaganga | 38.9 | 33.0 | 54.8 | 26.9 | 20.9 | 94.4 |
| | Manamadurai | 31.5 | 21.8 | 48.1 | 30.5 | 22.8 | 99.0 |
| | Ilayankudi | 36.2 | 31.8 | 56.8 | 9.3 | 23.1 | 96.1 |
| | Total | 36.2 | 30.6 | 51.2 | 27.2 | 21.3 | 95.8 |
| Virudunagar | Srivilliputtur | 43.8 | 32.8 | 52.7 | 12.5 | 30.9 | 89.2 |
| | Virudhunagar | 44.9 | 37.2 | 53.6 | 12.1 | 40.6 | 95.4 |
| | Tiruchuli | 41.2 | 37.4 | 56.8 | 20.0 | 28.3 | 96.3 |
| | Aruppukottai | 44.5 | 41.3 | 57.5 | 9.6 | 22.7 | 94.2 |
| | Sattur | 48.1 | 35.4 | 54.7 | 10.5 | 47.4 | 90.8 |
| | Rajapalayam | 40.5 | 31.2 | 53.1 | 30.7 | 26.1 | 93.9 |
| | Total | 44.4 | 37.2 | 54.4 | 15.7 | 37.0 | 93.7 |
| Ramanathapuram | Tiruvadanai | 31.4 | 29.5 | 57.1 | 1.4 | 14.3 | 98.2 |
| | Paramakudi | 40.0 | 33.3 | 61.7 | 8.7 | 21.4 | 97.8 |
| | Kamudi | 43.2 | 36.0 | 62.7 | 16.8 | 22.7 | 96.4 |
| | Mudukalathur | 39.2 | 37.8 | 53.6 | 3.3 | 29.1 | 96.4 |
| | Ramanathapura | 24.8 | 21.3 | 39.9 | 1.6 | 20.6 | 94.8 |
| | Rameswaram | 8.4 | 9.3 | 30.2 | 0.9 | 14.2 | 92.6 |
| | Total | 34.9 | 32.2 | 54.7 | 2.1 | 24.1 | 96.6 |

### 3.5.2 Social Environment Survey

(1) General

To grasp the present conditions of the marginal and small scale farmers whose intentions are often ignored during project implementation, a social environment survey was carried out during the field survey consisting of:

- rural community survey, and
- farmers' organization survey.

These surveys were carried out for the 240 villages in the Study Area selected in the inventory list at random. About 40 villages were selected in each category.

1) Rural Community Survey

The survey was carried for the pre-selected villages sampled at random for the categories. 240 villages consisting of 119 villages in the Northern Study Area and 121 villages in the Southern Study Area were selected in all so as to select 40 villages in each category.

Interview surveys were made with a Village Administrative Officer (VAO) or a village or Panchayat President of each village. Furthermore, five marginal farmers (landholder less than one ha of farmland) were selected in each particular village, and interview surveys were carried out for them also to grasp their intentions, living conditions, etc.

2) Farmers' Organization Survey

Tank irrigation system is operated by farmers' organization, but operation system is different from tank to tank because the community structure of each irrigation unit might be different from each other. It is important to confirm the possibility of activities by farmers' organizations and human resources as well as to grasp the present operation and management system. The surveys were conducted with agricultural cooperatives, water users' association covering agricultural extension cooperatives, farmers' associations, organization for farming practice and institutions for agricultural finance as well as informal organizations such as charity organizations. Interview surveys were carried out with a Village Administrative Officer (VAO) or a village or Panchayat President of each village.

The questionnaire forms for the above surveys are presented in Volume V of the Report. Since both surveys were carried out at the same time, the questionnaire forms are combined to facilitate the interview to VAO. The questionnaire for VAO consists of Part I: General, Part II: Rural Community and Part III: Farmers' Organization. Various discussions were made among the Study Team, the PWD and the survey company to make the forms suitable for the expected survey as much as possible considering local conditions, etc. Prior to the commencement of actual survey work, its suitability was confirmed at site carrying out test surveys.

The survey works were conducted by the selected survey company and completed as scheduled, and the results obtained through such interview were analyzed. The findings on the survey are summarized below.

(2) Results of Social Environment Survey

The general survey was undertaken during December 1996 to January 1997 covering 240 tanks with 119 tanks in Tiruvallur & Kanchipuram districts representing the northern region and 121 tanks in Ramanathapuram, Sivaganaga and Virudhunagar districts representing the southern region of the State. Total farmer sample was 1,200 with a farm size of less than 1 ha. Further, the socio-economic study included survey of 240 tanks/villages and the farmers' organizations.

Data collection was done by interviewing the respondents using the pre-tested questionnaire. Tools of analysis included, percentage and tabular analyses, Garret Ranking technique and factor shares.

1) General Characteristics of the Tanks

It is observed that in Kanchipuram and Tiruvallur districts, about 61 % of the tanks are falling under 100 ha category, about 23 % under 100 to 200 ha category and about 16 % are having 200 ha command area. In the case of Ramanathapuram

district about 65 % are falling under 40 - 100 ha; about 25.6 % under 100 - 200 ha category and about 9 % are having more than 200 ha command area. In the case of Sivaganga district also, same trend is seen. But in the case of Virudhunagar districts about 81 % are under 40 - 100 ha category followed by 11.5 % having more than 200 ha command area.

2) Socio-environmental Survey for Farmers: Village/Community

It is observed that the average forest area in the villages has ranged from 2 - 7 %. Net area sown also varies from 54 % in northern district to 34 % in the southern districts. Current fallow, which indirectly reflects the water scarcity, is comparatively high in Ramanathapuram district (13 %). Higher percentage of after fallow and current fallow are also the indications of the uncertain water supplies from the tanks for crop cultivation both in the tank and non-tank seasons.

Average land below 1.0 ha is possessed by 41 to 66 % of farmers. Land between 1 - 2 ha is accounted from 25 to 38 %. Percentage of tenants is varying from 8-15 % in different villages. Average population of the villages ranges from 772 - 2,734. Number of households with a size of 2 - 4 is comparatively higher, whereas in the case of farm households, the 5 - 10 size category higher which indicates the possibility of more family labourer engaged in the crop production as well as the subsistence nature of irrigated agriculture under the tank irrigation systems.

In the case of caste distribution, about 50 % belongs to backward community (BC). About 78 to 99 % of the households are engaged in agriculture. Among the population, about 29 to 62 % are full time farming.

About 40 % of the farmers own their buildings. Wells and pump sets are owned by 5 - 26 % of the farmers in different districts. Ownership of farm machinery such as tractors and power tillers is much limited.

Paddy is the main crop in the tank season and transplanting is done by most of the farmers. Mostly the IR20, ADT36 are grown by the farmers extensively. In the non-tank season, mostly farmers who own wells only cultivate about 70 - 75 % of their lands. Average area cultivated by the marginal farmers is about 0.72 ha . Various scarcity management strategies include groundwater supplementation, increased irrigation interval between irrigation from 4 days to 7 days, partial following and change in crop pattern.

There was no water supply in five (5) % of the tanks, about 65 % of the tanks had less than three (3) months water supply; about 30 % of the tanks had more than three (3) months water supply.

Average number of tank irrigation varied from 17-25 and the supplemental well irrigation varied from 4-6 in the tank season. Most of the marginal farmers used to

buy the well water from the nearby well owners who sell the water at the rate of Rs.10-16/hour and each supplemental well irrigation costs about Rs.120 /ha/irrigation.

As regards the inputs other than water, there were not significant differences among the districts. Except human labor, all the other inputs have shown a higher variation among farms with coefficient of variation ranging from 50 to 135 %.

The total quantum of water applied for rice crop was about 125 cm. However, the total quantum of tank water applied had ranged from 87 to 93 cm and the rest was from well supplementation.

The major resources that are being mobilized are from social forestry and fishery, as these are the common property resources generating benefits. The foreshore and catchment lands even though form major component of common property resource in the tanks, they are mismanaged and the resource mobilization is almost zero.

Only about 30 % of the tanks in the 4 districts had reported the existence of fishery benefits and most of the income from fish auction was spent for temple repairs and/or celebrating the village festivals. Only less than two (2) % tanks the income was also spent for tank repairs including the payment of wages for *neerkattis*.

The extent of revenue mobilization was found to be positively correlated with the presence of informal water users' organization. This could signal the importance of improving resource mobilization through farmers' cooperation. The labor contribution by tank beneficiaries for various tank maintenance works was also observed in about 65 - 75% tanks particularly during scarcity periods. Average labor mobilization was about 210 man-days/tank/year.

In the informal organizational process which prevails in almost all the tanks, as such there is no leadership available; but during scarcity periods as well as during periods of conflicts in water distribution, senior persons in the tank command take a lead and try to settle the matters. Most of the minor conflicts are however solved with in the village itself and major conflicts involving different caste groups are normally settled through police or courts. The heterogeneity in the farm size varying income levels, political and caste groups contribute mainly for the inefficiency in tank related improvement works by the informal organizations in the tank based villages.

About 70 - 75 % of the people in the village get seasonal employment particularly in the tank season; and in the non-tank season (March-August) only about 20 - 25% get the employment.

The state-level operation and maintenance expenditure for tanks indicates that

though the nominal (at current prices) outlay per ha. of command area has increased by more than six folds from Rs. 26 to Rs. 161, the real (at constant prices) outlay has not shown significant increase which has hovered around Rs. 33 to Rs. 43 per ha.

About 96 % of villages in the northern districts and about 87 % of the villages in the southern districts have roads. Only 17 - 22 % of the villages have the processing facilities. More than 88 % of the villages have the postal facilities and in all the villages surveyed, 94 - 97 % of the villages have the electric supply. The electricity is supplied free of cost to farmers for irrigation purposes only.

The piped supply system covers from 40-70 % and the rest is from deep (community) wells (20 %) and shallow wells (5 %). The water quality is good to medium. Supply capacity varies from 25 - 40 litters/head/day in the piped systems.

About 30 - 35 % of the households only have the tiled houses. About six (6) to eight (8) % of the farmers avail the institutional finance facilities and the rest depend on the local money lenders.

About 67 % of the population has education up to primary level and about 30 % has no education in the northern district; in the case of southern districts, 57 % to 65 % of the population the primary education and 25 % to 36 % has no education.

Percentage of food and drink expenses is varying from 52 % in northern districts to even 67 % in southern districts. Most people have radios (49 % to 58 %) and TVs (6 % to 9 %). Percentage of farm households having farming successors is ranging from 36 % in northern district to as high as 65 % in the southern districts.

3) Socio-environmental Survey for Farmers

The land use at farm level is dominated by area under paddy crops (about 90 %) followed by upland crops. Marginal and small farmers account for about 87 % of the total farmers in the tank command.

Average family size is about five (5) in all sample tanks in each district. Main job is agriculture for more than 80 % of the population, which lost about six (6) months. Over years, the level of urbanization as well as encroachment by the farmers as well as government allotment of land titles (*pattas*) to landless poor families also to some extent reduced the availability of these lands. Community halls and library facilities are comparatively not much developed.

Average annual income during 1995 - 96 year was ranging from Rs.14,970 to Rs.17,899. The farming expenses was ranging from Rs.8,673 to 10,140 per farm with an average paddy area of 0.72 ha in the tank season and about one (1) ha

under cotton, groundnut and pulse crops in the non-tank season. The living expenses was ranging from Rs.6,530 to Rs.6,980.

Most of the farmers have the intentions to change their livelihood, once the condition of the tanks are improved, which are evident from the facts that 34 to 46 % of the farmers have intended to generate assets by investing in land and animals. Investment in wells is an another attractive activity for 20 % of the farmers. Investment in improved food and living conditions are also indicated by several farmers.

Among the different health hazards, most farmers reported the fever as the most commonly occurring health problem and 68 % to 85 % have preferred private doctors for treatment.

Farmers feel the services of the agricultural extension officers are either not reachable by the small and marginal farmers nor applicable for their small farm holdings Only 7 - 17 % of the sample farmers could only visit the block extension offices either for seed or other inputs like pesticides.

The major constraint in the production is the water scarcity in the tank. Lack of money, higher wage rate and high input cost are the other major constraints faced by the small and marginal farmers. Among the constraints in living, viz., indebtedness unemployment and high food material cost are ranked 1st 2nd and 3rd by the farmers.

Role of women in paddy transplanting is reported by 73 to 84 % farmers and more than 91 % of the farmers have reported women's role in weeding operations. Involvement of women in harvesting operations is reported by 62 - 85 % farmers. Marketing is being attended to mostly by the men. The average wage rate has ranged from Rs.20 to 35/day in the tank season to Rs.15 to 20/day in the non-tank season.

Tank rehabilitation and provision of community wells and increased water storage are the major expectations of the farmers for the government.

Behavioral expectations of the farmers for the project ranked first the catchment treatment, followed by community wells and canal lining. OFD works and sluice restructuring are not shown much interest by the farmers.

Other expectations include provision of regular O&M budgets and making the non-system tanks as system tanks through additional investment for water acquisition.

Factor share analysis indicates that that the factor shares are high towards current inputs i.e., 0.39 compared to the operator (farmer's) share of 0.30.

### 4) Farmers' Organization

According to the results of the social environment survey conducted during the field survey, none of the villages covered by the survey has formal organization but has informal ones. 65 %, 76 %, 79 % and 82 % of the villages have informal organizations in Kanchipuram & Tiruvallur, Ramanathapuram, Sivaganga and Virudhunagar districts, respectively. Those organizations have been maintained as a part of the traditional village system for years, and are considered active only the period when the scarcity of tank water takes place or some conflict occurs in distribution of water among villagers.

## 3.6 Database and Geographical Information System (GIS)

### 3.6.1 Objective of the Database and GIS

(1) Objectives

In 1990/91, there are about 39,200 tanks in the State with a total command area about 530,000 ha, and about 35 % of Minor Irrigation Tanks, including PWD, Panchayat, Ex-Zamin, in the State are concentrated in the Study Area.

Inventory list provided by PWD consists of both engineering and social aspects such as characteristics of Ayacut (command area), catchment area, capacity of tank and farmers' organization, agricultural status.

Purpose of the master plan for minor irrigation tank in the Study takes priority for rehabilitation to targeted tanks with a view of carrying out rehabilitation. So the database system of each tank is formulated for categorization basis on the inventory list and it is supposed to list up and select the tank based on the rehabilitation plan.

Due to the high density of tanks in the Study Area and existence of administrative boundaries, the database should be formulated together with GIS.

These tank database system and GIS can be utilized to monitor the progress of rehabilitation of the tanks and the condition of social environment not only in this Study but also for other administrative purposes.

(2) Design Concept of the Tank Database System

Tank database system must be formulated considering utilization and extension of the data.

In the EC Tank Modernization, several database systems are formulated such as Tank Information System (TIS), Management Information System (MIS), Geographic

Information System (GIS) and Feasibility Report Generator (FRG) for extension of the program.

Considering the future unification of database between the EC's and JICA, the tank database system based on the inventory list is formulated as follows.

- In order to utilize of the database with adjustability with other data, number of basic item such as district, taluk, development block, etc. are made with each code on the basis of the Census of India, Series - 23.
- Since it is easy to add the category and modify the data, data of each tank from PWD inventory list are classified on aspect such as administration, tank characteristic and social aspect of the tank.
- Data can be compared with the database system of EC programme.

Design concept of the Tank Database System is shown in Fig. 3.6.1.

### 3.6.2 Database in the Study

(1) Source of Database in the Study

As stated in the M/M of S/W, the Tank Inventory List was expected to be completed by PWD before commencement of the JICA Study, by early December 1995. The Tank Inventory prepared by PWD in May 1977 is the latest database for the Study.

There are some problems in the inventory list such as discrepancies in engineering dimensions between the original and final inventory list, both metric and feet-pound systems are mixed and remarkably confused on item, catchment area, ayacut and tank capacity.

(2) Tank Database System

The database of the PWD rainfed tanks in the Study Area is formulated using ACCESS of Micro Soft.

### 3.6.3 Geographical Information System (GIS)

Geographical Information System (GIS) formulated in the Study provides tank information on the topographical map based on criteria such as tank location, engineering and social aspects. As mentioned in Section 3.6.1, irrigation tanks including other tanks (Panchyat, ex-Zamin) are distributed closely, and some tanks are rehabilitated under EC programme. So that geophysical information becomes necessity considering other programmes.

GIS corresponds with Tank Database System on the basis of inventory list and both systems offer the followings:

- Utilization of location map for each tank
- Distribution of the tanks based on by administrative information such as district, taluk, development block.
- Selection of the tank data depending on engineering and social aspects
- Selecting and clarifying the command areas depending on well irrigation