CHAPTER - VII

WATER BALANCE AND IT'S APPLICATION TO VARIOUS PHYSICAL ELEMENTS OF THE KURNOOL DISTRICT
Water balance as the comparative study of rainfall and evapotranspiration plays an important role in many earth science fields especially in agriculture and water resources development (Subrahmanyam 1980). In this chapter an attempt is made to bring out the relationship between the elements of water balance with various physical elements like land capability, surface and sub-surface water resources, irrigation and cropping pattern of the district. Similar studies have been carried out by Subrahmanyam and Subramaniam, (1965), Subrahmanyam and Murthy (1968), Subramaniam and Sastry (1969), Ram Mohan, (1980), Subramaniam and Umadevi (1983) and Sambasiva Rao (1983).
The various 9 classes of land which includes fluvial plains, irrigated plains other than fluvial, valley fills and bajadas, piedmont plains, creap built plains, pediments and pediplains, black soil plains, residual hills and hilly-terrain with slope less than 20° and hilly-terrain with slope more than 20° show different physical characteristics in terms of relief, slope, soils, mode of irrigation, crop cultivation, erosion and ground water level variations. Similarly these different classes of land show a group of elements of water balance uniformly in some zones. Ex:- In hilly-terrain which possess moderate to thick vegetal cover, soil formation, variations in slope, drainage etc., more or less show similarities in distribution of potential evapotranspiration, actual evapotranspiration, moisture adequacy, water surplus and moisture index. The potential evapotranspiration over the hilly-terrain ranges from 1200mm to 1400mm per annum. There are 3 stations in the hilly-terrain where recorded data on rainfall and temperature are available. They are Srisailam, Gundla Brahmeswaram and Ahobilam. The water surplus is high in these 3 stations. The moisture adequacy is high and Aridity Index is low. There is low water shortage and high moisture available in the hilly-terrain. The water surplus is
noticed from July to December months. The water availability calendar shows that over the hilly-terrain there is high moisture availability from July to December. During January to June there is water deficit. But over plain regions water deficit is noticed from January to August and water surplus is found in the month of October, November and December. Therefore, the Nallamallai hills located on the eastern parts of the district possess rich biotic species. However, due to water deficit over the plain regions the water availability period is low and only one crop is cultivated in the months of July, August, September, October, November and December. The second crop over plain regions would be cultivated by supplementing with irrigation water either by canal or tank or well. Therefore, there is inadequate water resources available over the plain regions covering pediplains, creep built plains, wash plains, valley fills etc., A careful management of water resources has to be urged for suitable crop cultivation over the plain regions.

WATER BALANCE AND SURFACE AND SUB-SURFACE WATER RESOURCES

An analysis of distribution of surface and sub-surface water resources reveal that due to high water shortage over the plain regions a careful management of
water resources is essential. However, the recharge in the
district varies from 70.29 mm in Aluru station to a maximum
of 107.76 mm in Atmakur station. The total surface water
resources of the district has been estimated to be 13,273,
165,000 m$^3$. Out of this about 10% (1,327,316,500 m$^3$) is
stored in the ponds, tanks, reservoirs etc. About
1,849,226,780 m$^3$ (13.93%) is recharged to ground water
resources. It has been estimated that about 10,096,700,280
m$^3$ of water is lost in the form of evaporation and
evapotranspiration which accounts for 76.07% of the total
surface water resources. The ground water level variations
range from 2.1 meters in Pamulapadu to a maximum of 11.2
meters in Kosgi. The spatial distribution shows that the
ground water level ranges from 3 to 6 meters in northern
mandals of the district and 6 to 9 meters in southern
mandals of the district. The ground water level
fluctuations range from 2 to 4 meters. The rise and fall in
ground water level shows that in about 34 mandals there is
fall in ground water level. The fall ranges from 0.2 to 5.6
meters. The fall in ground water level is presumed to be
due to low recharge, high water deficit and high water
extraction in southern mandals of the district. However,
due to return flow of water from canal irrigation in K.C.
Canal ayacut area rise in ground water level is noticed. In
other words water balance elements have greater influence on distribution of surface and sub-surface water resources.

WATER BALANCE AND OCCURRENCE OF DROUGHTS

The study of drought occurrence on monthly basis over a period of 90 years reveal that during the months of January, February, March, April and December the occurrence of droughts are high and exceeds more than 50 years in all the stations. During May and November the number of years range from 30 to 50 years. However, in June, August, September and October months the number of occurrence of drought years vary from 15 to 30 years. The seasonal analysis of drought occurrence reveals that during winter period the occurrence of droughts exceeded 60 years during this period of study. In summer and northeast monsoon period the occurrence of droughts vary from 20 to 30 years. The drought occurrence is low in southwest monsoon period. The study of water balance elements reveal that during winter and summer periods there is high water shortage in the district, moderate to low in southwest monsoon and northeast monsoon periods. The drought intensity is very high during January, February, March, April and December months. It is moderate in May, October and November months. It is low in June, July, August, and September months.
During winter period it is high, moderate in summer and northeast monsoon periods and low in southwest monsoon period. The occurrence of disastrous droughts show that during January, February, March and December months their occurrence is very high and exceed 60 years. The disastrous droughts are moderate in May, October and November months. They are low in June, July, August and September months. During winter period, the occurrence of disastrous droughts are high, moderate to low in summer and northeast monsoon periods and low in southwest monsoon periods. The study on drought intensity and occurrence has been correlated with the water deficit months in the district. They confirm with occurrence of high water deficit during the months of January, February, March, April, May, October, November and December and low water deficit in the months of June, July, August and September. Thus, water balance elements have a greater influence on the occurrence of drought intensity in the district.

WATER BALANCE AND IRRIGATION

The gross irrigated area in the district during 1993-94 was 1,78,610 hectares which accounts for 10.11 percent of the total geographical area. Out of the 1,78,610 hectares about 83,863 hectares is the area under canal
irrigation and accounts to 46.95 percent of the total gross area irrigated. About 11,677 hectares was under tank irrigation and accounts to 6.53 percent of the gross area irrigated. Under well irrigation about 45,009 hectares was found and it accounts to 25.19 percent of the gross area irrigated. The area under tube well irrigation during 1993-94 was 28,379 hectares and accounts to 15.88 percent of the gross area irrigated. The area under other sources of irrigation was 9,682 hectares and accounts to 5.40 percent.

From the study of area irrigated source wise it is found that the area irrigated under canal irrigation accounts to nearly 47 percent of the gross area irrigated followed by well irrigation (25.19 percent), tube well irrigation (15.88 percent), tank irrigation (6.53 percent) and other sources of irrigation (5.42 percent). The area irrigated more than once during 1993-94 was 26,797 hectares and accounts to 15 percent of the gross area irrigated. There are about 1,03,257 hectares of ayacut area irrigated under K.C. Canal, Thungabhadra Project low level canal and Thungabhadra Project high level canal during 1993-94. Under medium irrigation about 6,232 hectares was noticed in Gajuladinne project. Under minor irrigation there are about 609 tanks with an ayacut area of 31,462 hectares. The analysis of area irrigated source wise shows that only 11,677 hectares of land was under tank irrigation during 1993-94. In other
The annual water losses in the form of evaporation and evapotranspiration is about 1,660 mm. during 1993-94. The actual water available for evaporation and evapotranspiration is 949 mm. The water deficit is 711 mm. on plain regions in the district during 1993-94. The moisture adequacy is 57.16 percent and Aridity Index is 42.84 percent. Climatologically the year 1993-94 is a favourable year for cultivation practices because of high moisture adequacy and low aridity index. Therefore, about 1,78,610 hectares of land could be brought under various source of irrigation. The ground water level during 1993-94 varied from 2.8 mts. in C.Belagal to a maximum of 11.4 mts. in Panyam. The ground water level distribution during 1993-94 varied from 6 to 9 mts. in majority of the wells of the district. The annual recharge during 1993-94 was 104
mm. Which accounts for 15.04 percent of the total annual rainfall. The correlation of moisture adequacy with area irrigated source wise over a period of 10 years from 1983-84 to 1993-94 show positive correlation of about +0.64. Similarly the correlation between the recharge and area irrigated source wise also showed positive correlation of +0.57, Therefore, there is a clear correlation between water balance elements and area irrigate source wise in the district. Thus, water balance elements play a significant role in irrigation development in the district.

WATER BALANCE AND CROPPING PATTERN

The major crops cultivated in the district are paddy, groundnut, chillies, onion, sunflower, cotton, jowar, bajra, korra, redgram, fruits and vegetables and other crops. During 1993-94 about 73,153 hectares of land has been cultivated under paddy which accounts for 7.31 percent of the total cropped area. Under jowar cultivation about 1,41,870 hectares of land has been cultivated and accounts to 14.18 percent. Under bajra cultivation the total cultivated area was 19,363 hectares and accounts to 1.93 percent. The area under korra cultivation during 1993-94 was 41,414 hectares of land and accounts for 4.14 percent of the cropped area. The area under sunflower cultivation was
about 1,60,777 hectares and accounts to 16.67 percent. Under redgram cultivation the total land was 20,397 hectares and accounts for 2.03 percent. The total area under cotton cultivation was about 77,323 hectares and accounts to 7.73 percent. The groundnut area cultivated during 1993-94 was 3,29,994 hectares and accounts to 32.99 percent. The area under chillies was about 8,904 hectares and accounts for 0.89 percent. The total area under fruits and vegetables was 31,726 hectares and accounts to 3.17 percent. The area under other crops was 89,430 hectares and accounts to 8.94 percent. In the analysis of cropping pattern it has been found that the groundnut ranks the highest cropped area (32.99 percent) followed by sunflower (16.07 percent), jowar (14.18 percent), other food crops (8.94 percent) cotton (7.73 percent), rice (7.31 percent), redgram (2.03 percent), bajra (1.93 percent), tobacco (1.53 percent) and chillies (0.89 percent). All the above said crops are cultivated in the district are on the plains, valleys and pediplains. Out of 10,000,065 hectares of total cropped area during 1993-94 about 7,25,636 hectares of land was cultivated during kharif season and accounts to 72.55 percent. During rabi season the total cropped area was about 2,74,429 hectares of land and accounts to 27.44 percent. The analysis of water balance elements reveal that the months of June, July, August and September receives high rainfall in the district.
and accounts to 485.2 mm. The karif season ranges from June to September. The potential evapotranspiration is about 612 mm. The actual evapotranspiration is about 443 mm. The water deficit during this period is 169 mm. The moisture adequacy is about 72 percent and aridity index is 28 percent. Therefore, the karif is highly favourable for crop cultivation in the district. Due to favourable climatic conditions in karif season about 72.55 percent of the total cropped area is noticed. The correlation between moisture adequacy and selected crops yield and production show positive in rice, groundnut, korra, redgram and cotton. The correlation values are +0.40, +0.35, +0.30, +0.32 and +0.25 respectively. However, the correlation values for tobacco, jowar and bajra are low. The values are +0.16, +0.3, +0.2 respectively. Thus there is a clear relationship between the elements of water balance, cropped area, crop yield and crop production.