CHAPTER 3
SYSTEM DESCRIPTION

3.1 INTRODUCTORY

The interlinking of rivers is aimed at linking surplus river basins with the deficit ones so that the excess water from the surplus areas could be diverted to the deficit areas. This would improve water availability for drinking, irrigation and industrial purposes in the receiving basin. Floods are also often moderated in the diverted basin to a certain extent. Some of the examples of such interlinking in the south of India are: Periyar Project, Parambikulam-Aliyar Project, Kurnool-Cudappah Canal and the Telugu-Ganga Project.

3.2 PARAMBIKULAM-ALIYAR PROJECT

The Parambikulam Aliyar Project (PAP) is an interstate multipurpose project completed in late 1960s and functioning based on an agreement between Tamil Nadu and Kerala States of the Indian Union. The project diverts the water from the basins of three west flowing rivers originating from the western ghats along the Kerala-Tamil Nadu border, namely the Periyar, Chalakkudipuzha and Bharathapuzha. These rivers are mainly fed by the southwest monsoon and northeast monsoon rainfall. The water diverted to the east is mainly used for irrigation purpose. Geographically, most of Tamil Nadu is on the eastern side of western ghats which makes it a rain shadow region. This is considered as the prime justification for the massive diversion scheme under the PAP. Both Kerala and Tamil Nadu share the benefits of the PAP network. The main storage and diversion structures consist of nine dams
and two weirs spread over Kerala and Tamil Nadu. The connectivity of these series of reservoirs is achieved with the aid of natural drainage channels, and also, canals and tunnels constructed in the three river basins; 934.5 Mm³ of water is impounded and utilized and also 639 MW (installed capacity) of hydropower is generated. The details of reservoirs under the PAP and their geographical locations with respect to the sub-basin, basin and state are given in Table 3.1.

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Sub-basin</th>
<th>Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Nirar Weir +</td>
<td>Nirar</td>
<td>Periyar</td>
</tr>
<tr>
<td>Lower Nirar Dam +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tamil Nadu Sholayar Dam +</td>
<td>Sholayar</td>
<td></td>
</tr>
<tr>
<td>Kerala Sholayar Dam *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parambikulam Dam *</td>
<td>Parambikulam</td>
<td>Chalakkudipuzha</td>
</tr>
<tr>
<td>Thunacadavu Dam *</td>
<td>Thunacadavu</td>
<td></td>
</tr>
<tr>
<td>Peruvripallam Dam *</td>
<td>Peruvripallam</td>
<td></td>
</tr>
<tr>
<td>Aliyar Dam +</td>
<td>Aliyar</td>
<td>Bharathapuzha</td>
</tr>
<tr>
<td>Upper Aliyar Dam +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kadamparai Forebay Dam +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thirumoorthy Dam +</td>
<td>Palar</td>
<td></td>
</tr>
<tr>
<td>Manacadavu Weir *</td>
<td>Chitturpuzha</td>
<td></td>
</tr>
</tbody>
</table>

+ Tamil Nadu State; * Kerala State

All the hydrological parameters like storages, inflows and outflows are measured at fixed intervals. For this, 68 gauging points have been established. A Joint Water Regulation Board (JWRB) formed as per the provisions of the PAP agreement, consisting of 2 members each from both the states, scrutinise and finalise annual water account and regulate the water as per the available storage and demand. The Kerala Tamil Nadu Agreement on the PAP was executed on 20 May 1970 with retrospective effect from 9 November 1958. As per the existing agreement, the arrangements embodied are open for review at the expiry of thirty years in the light of experience gained in managing the project.
Figure 3.1: Map of the PAP on the GIS platform

Source: Irrigation department, Government of Kerala
Figure 3.2: Conceptual diagram of the PAP
The layout of the PAP on a GIS platform prepared by Government of Kerala and a conceptual diagram are given in Figures 3.1 and 3.2 respectively. The PAP, when envisaged as a joint venture of Tamil Nadu and Kerala States, was seen as a symbol of interstate cooperation. But recently, a few issues have cropped up mainly because of water shortage for irrigation in the region. Review process of the PAP agreement had been initiated and is under progress. Apart from the physical infrastructure of the PAP, the institutional mechanism is also identified by the Kerala - Tamil Nadu Agreement on the PAP and by the decisions of the Joint Water Regulation Board (JWRB). The features of the PAP including the entitlements are given in Appendix 1.

The Kerala - Tamil Nadu Agreement on the PAP which is abbreviated as ‘PAP agreement’, focuses on the terms of sharing of waters of the three rivers and their tributaries between Kerala and Tamil Nadu. The works that can be taken up under the PAP, key benefits of sharing for each state and the financial terms of the project are also covered under this agreement. The JWRB is the executive arm of the PAP agreement. It is a body represented by a four member committee consisting of the Chief Engineers of Water Organisations and Electricity Boards of the respective states. Basically, it is a water regulation body consisting of mainly engineers from both the states.

3.3 ALIYAR SUB-BASIN

The Aliyar river has its origin in the Anamalai hills and flows in a northwesterly direction for about 37 km in Tamil Nadu, enters into Kerala, and finally joins the Bharathapuzha basin. The Uppar and Palar are the major tributaries of the Aliyar river. The area consists of denudation forms such as pediment, pediment with black cotton soil and shallow pediments. The alluvial landforms occur along the foothills of Anamalai ranges in the western ghats. The Aliyar dam located at 10° 28’ 26” N latitude and 76° 58’ 23” E longitude was constructed across the Aliyar river.
during 1959-1969 as a part of the PAP, mainly for irrigation purposes. The dam of 3.2 km length retains a large reservoir. The Aliyar reservoir has a catchment area of 198 km$^2$ and a gross capacity of 110 Mm$^3$. Apart from its own catchments, the Aliyar reservoir receives water from the Upper Aliyar reservoir through the Aliyar feeder canal and from the Parambikulam reservoir through a contour canal. The highest inflow usually occurs during July-August. Salient features of the Aliyar dam are given in Table 3.2.

Table 3.2: Salient features of the Aliyar dam

<table>
<thead>
<tr>
<th>District</th>
<th>Coimbatore</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Tamil Nadu</td>
</tr>
<tr>
<td>Basin</td>
<td>Aliyar</td>
</tr>
<tr>
<td>Catchment area</td>
<td>468.8 km$^2$</td>
</tr>
<tr>
<td>Maximum flood discharge</td>
<td>1159.77 cumecs</td>
</tr>
<tr>
<td>Area of water spread</td>
<td>646 ha</td>
</tr>
<tr>
<td>Crest level</td>
<td>317 m</td>
</tr>
<tr>
<td>Full reservoir level</td>
<td>320.04 m</td>
</tr>
<tr>
<td>Maximum water level</td>
<td>320.04 m</td>
</tr>
<tr>
<td>Top bund level</td>
<td>322.78 m</td>
</tr>
<tr>
<td>Capacity at full reservoir level</td>
<td>109.43 Mm$^3$</td>
</tr>
<tr>
<td>Spillway provided type</td>
<td>Radial</td>
</tr>
<tr>
<td>Vent numbers</td>
<td>11</td>
</tr>
<tr>
<td>Vent size</td>
<td>9.15 x 3.05 m</td>
</tr>
<tr>
<td>River sluice</td>
<td>1 No., Size 1.52 x 1.83 m</td>
</tr>
<tr>
<td>Sill level</td>
<td>283.46 m</td>
</tr>
<tr>
<td>Canal sluices</td>
<td>2 Nos., Size 1.52 x 1.83 m</td>
</tr>
<tr>
<td>Sill level</td>
<td>298.70 m</td>
</tr>
<tr>
<td>Capacity at canal sluice sill level</td>
<td>8.81 Mm$^3$</td>
</tr>
<tr>
<td>Maximum height of dam</td>
<td>44.2 m</td>
</tr>
<tr>
<td>Length of dam</td>
<td>3200 m</td>
</tr>
<tr>
<td>Dead storage</td>
<td>8.81 Mm$^3$</td>
</tr>
</tbody>
</table>

Source: Public Works Department, Tamil Nadu.
The Aliyar sub-basin lies between 10°20' 0" and 10° 45' 0" N latitude and between 76° 40' 0" and 77° 10' 0" E longitude. A drainage map and land use map prepared from the Google Earth using QGIS software are given in Figures 3.3 and 3.4 respectively.

Figure 3.3: Drainage map of the Aliyar sub-basin

Figure 3.4: Land use map of the Aliyar sub-basin
The annual average rainfall of the sub-basin is 635 mm. The Vettaikaran-
pudur (VP) and Pollachi canals take off from this reservoir and irrigate a command
area of 14030 ha. This reservoir is also planned to meet the requirements of the
command area in Tamil Nadu and Kerala states on the downstream side. The wa-
ter released to the Aliyar river from the reservoir, after meeting the requirements of
2580 ha command area in Tamil Nadu by diversion through 5 anicuts or regulators -
Pallivilangal, Ariyapuram, Karapetty, Periyanai and Vadakkallur - flows to the Chit-
turpuzha Project (CPP) to meet the irrigation requirements of 21500 ha of command
area in the Chittur taluk of Kerala state.

3.4 CHITTURPUZHA PROJECT

The Chitturpuzha sub-basin of Bharathapuzha basin in Palakkad district
of Kerala State is situated at the tail-end of the PAP system. It is situated on the
eastern side of Palakkad district and is close to the boundary of Kerala and Tamil
Nadu. Chittur is a border taluk of Kerala State located between 10°35′ and 10°45′ N
latitude and 76°40′ and 76°52′ E longitude, where the climate is different from sur-
rounding areas due to its geographical and topographical disposition. The western
ghat hill range, which plays a vital role in the climatic condition of Kerala, has a gap
here of 37 km width and Chittur taluk is located almost at the middle of this gap,
termed as ‘Palakkad Gap’. This natural formation contributes to the agroclimatic
condition of this area, which resembles that of the semi-arid zone. The habitation of
the area comprises mostly of farmers and agricultural labourers.

The northeast monsoon is the main rainy season in Chittur taluk, making
the climate and soil characteristics similar to that of Tamil Nadu, unlike that of the
rest of wet humid tropic zone of Kerala. During the summer season, the hot winds
from Tamil Nadu enter into Palakkad through the Gap and thus make the Chittur
area hotter and drier. The temperature increases steadily from the month of March
till the onset of southwest monsoon in June. Mean daily maximum temperature is
reported to be 37.4° C. During the summer months, the soil moisture depletes and the evapotranspiration accelerates; cracks are observed on the top clayey soil layer. During the monsoons, heavy rainfall causes excessive run off and soil erosion.

The Chittur area has various types of farming activities. About 86% of the area is currently under cultivation and rice is the main crop. Even before 50 years, villagers on the border were involved in cultivating wheat, pulses and groundnut which require comparatively less water. Cotton was also a major crop in the region. With the advent of the Tamil Nadu Agricultural University in Coimbatore, new and hybrid varieties of seeds became popular. For survival, farmers often switched over to hybrid varieties from traditional varieties and to crops other than wheat and groundnut. Positive advancements and researches in the farming sector were observed in the eastern parts of Chittur. The conversion of farm lands for other uses has been comparatively less in Chittur area.

When the Aliyar river enters Kerala, it is known as Chitturpuzha. The CPP of Palakkad district in Kerala is dependent on the water obtained from the Aliyar reservoir under the PAP. The average annual rainfall in the area is only around 700 mm whereas Kerala State as a whole receives an average annual rainfall of 3000 mm. The people of the area mainly depend on the water let into the Chitturpuzha from the Aliyar reservoir for their farming activities.

There was one masonry regulator at Moolathara from very early times. Since it was not safe to remodel this existing structure, it was proposed to build a new regulator. The Moolathara regulator is now serving the purpose of a diversion system. The four earlier diversion schemes at Kunnammattupathy, Thembararamadakku, Nurnee and Alankadavu regulators situated across the Chitturpuzha were later acquired from private owners and interlinked by the Government of Kerala to form parts of the CPP. From these independent systems, irrigation is provided in the Chittur taluk during the past 100 years by diversion canals.
Figure 3.5: Layout of the CPP canal network
Figure 3.5 shows the layout of the CPP canal network (Source: Water Resources Department, Kerala). During the early 1960s, as a part of the PAP, Aliyar dam was constructed in the upper reaches of the Chitturpuzha in the area falling within Tamil Nadu State, which brought down the flow of water to the downstream reaches causing water shortage in the area. As part of the interstate agreement between Governments of Kerala and Tamil Nadu under the PAP, a total quantity of 205.30 Mm$^3$ (7250 Mcft) of water shall be released annually to the CPP through the Manacadavu weir, monitored on a fortnightly basis. The Manacadavu weir is the downstream gauging point under the PAP. The command area of the CPP consists of 24080 ha located in Palakkad, Chittur and Alathur taluks in Palakkad district. The water is let into the canal network through the Moolathara regulator (Figure 3.6), being the chief controlling mechanism of this irrigation scheme.

![Figure 3.6: Moolathara regulator in Kerala](image)

This regulator is located 40 km downstream of the Aliyar dam. There are two main canals starting from the Moolathara regulator namely the Moolathara
Left Bank Canal (LBC) including 2 lift irrigation schemes and the Moolathara Right Bank Canal (RBC). The length of the LBC is 118.40 km and the length of the RBC is 26.60 km. Recently, the RBC has been extended upto Korayar adding 4560 ha to the original command area. The schematic representation of the system considered for the study is shown in Figure 3.7.

![Figure 3.7: Schematic diagram of the study area](Image)
3.5 METEOROLOGICAL DATA BASE

For computation of irrigation requirements, the meteorological data were collected from the Regional Agricultural Research Institute, Pattambi, Kerala. The meteorological data collected for the study area include rainfall, maximum and minimum temperature, maximum and minimum relative humidity, sunshine hours and wind speed. The mean monthly temperature varies from $25^0$ to $30^0$ C. Rainfall details of the Moolathara raingauge station was considered for computation of effective rainfall of the CPP command area and rainfall details of the Aliyar raingauge station was considered for computation of effective rainfall of the command areas in Tamil Nadu.

3.6 STORAGE AND WITHDRAWALS FROM ALIYAR RESERVOIR

Fortnightly historic inflow, storage and release from the Aliyar reservoir for 31 years, i.e., for the period 1980 – 2011 were collected. From these records, corresponding monthly figures were computed. The elevation-area curve and elevation-storage curve for the Aliyar reservoir are shown in Figures 3.8 and 3.9 respectively. The release data include release to Pollachi canal, VP canal and to the river downstream.

The releases through the five individual anicuts or regulators were collected and the total release through the regulators computed. The quantity of flow received at the Manacadavu weir was collected for the same period of 31 years. From these data, the intermediate natural flow joining the river and that reaching the Manacadavu weir are computed considering the water balance criterion.
Figure 3.8: Elevation-area curve for the Aliyar reservoir

Figure 3.9: Elevation-capacity curve for the Aliyar reservoir
3.7 COMMAND AREA AND CROPPING PATTERN

The cultivable command areas under the Pollachi canal, VP canal, regulators and the CPP are 9505 ha, 4525 ha, 2580 ha, 21500 ha respectively. Rice is the major crop grown in the command areas of the Pollachi and VP canals, and in the command areas of regulators. The cropping pattern in the CPP command area is given in Table 3.3.

Table 3.3: Cropping pattern in the CPP command area

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area, ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBC Rice</td>
<td>15700</td>
</tr>
<tr>
<td>RBC Rice</td>
<td>470</td>
</tr>
<tr>
<td>RBC Coconut</td>
<td>432</td>
</tr>
<tr>
<td>RBC Vegetables</td>
<td>338</td>
</tr>
<tr>
<td>RBC extension</td>
<td></td>
</tr>
<tr>
<td>Groundnut</td>
<td>912</td>
</tr>
<tr>
<td>Coconut</td>
<td>2280</td>
</tr>
<tr>
<td>Vegetables</td>
<td>490</td>
</tr>
<tr>
<td>Cotton</td>
<td>878</td>
</tr>
</tbody>
</table>

Source: Irrigation Department, Government of Kerala.

The crop seasons of rice in the command areas of Kerala and Tamil Nadu are given in Table 3.4.

Table 3.4: Crop seasons of rice

<table>
<thead>
<tr>
<th>Rice</th>
<th>Kerala</th>
<th>Tamil Nadu</th>
</tr>
</thead>
<tbody>
<tr>
<td>I crop</td>
<td>May 20th to Oct 15th</td>
<td>June 1st to Oct 15th</td>
</tr>
<tr>
<td>II crop</td>
<td>Oct 20th to Mar 30th</td>
<td>Oct 16th to Mar 31st</td>
</tr>
</tbody>
</table>

The duration of various crops grown in the command area is given in Figure 3.10.
### CROPPING PATTERN - KERALA

<table>
<thead>
<tr>
<th>Month</th>
<th>Crop</th>
<th>Month</th>
<th>Crop</th>
<th>Month</th>
<th>Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul</td>
<td>Rice</td>
<td>Aug</td>
<td>Rice</td>
<td>Sep</td>
<td>Rice</td>
</tr>
<tr>
<td>Oct</td>
<td>Coconut (Perennial)</td>
<td>Nov</td>
<td>Vegetables</td>
<td>Dec</td>
<td>Vegetables</td>
</tr>
<tr>
<td>Jan</td>
<td>Groundnut</td>
<td>Feb</td>
<td>Groundnut</td>
<td>Mar</td>
<td>Groundnut</td>
</tr>
<tr>
<td>Apr</td>
<td>Cotton</td>
<td>May</td>
<td></td>
<td>June</td>
<td></td>
</tr>
</tbody>
</table>

### CROPPING PATTERN - TAMILNADU

<table>
<thead>
<tr>
<th>Month</th>
<th>Crop</th>
<th>Month</th>
<th>Crop</th>
<th>Month</th>
<th>Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul</td>
<td>Rice</td>
<td>Aug</td>
<td>Rice</td>
<td>Sep</td>
<td>Rice</td>
</tr>
<tr>
<td>Oct</td>
<td></td>
<td>Nov</td>
<td></td>
<td>Dec</td>
<td></td>
</tr>
<tr>
<td>Jan</td>
<td></td>
<td>Feb</td>
<td></td>
<td>Mar</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td></td>
<td>May</td>
<td></td>
<td>June</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.10: Calendar for different crops
3.8 IRRIGATION REQUIREMENTS

Irrigation water requirement may be defined as the quantity of water that must be supplied through irrigation for meeting the crop demands. The irrigation requirements of the different command areas were computed following the steps given below:

- Arriving at the reference crop evapotranspiration ($ETo$) based on climatic data.
- Estimation of the crop evapotranspiration ($ETc$).
- Finding out the net monthly irrigation requirement for the crop.
- Estimation of the total irrigation requirement for the command area.

Estimation of crop water and irrigation requirements for a proposed cropping pattern is an important component of the planning and design of an irrigation system. Whereas Crop Water Requirement (CWR) refers to the water consumed by the crops for cell construction and transpiration, the Irrigation Requirement (IR) is the water that must be supplied through the irrigation system to ensure that the crop receives its full crop water requirement. The FAO (1984) defined CWR as the depth of water needed to meet the water loss through evapotranspiration of a crop, being disease-free, growing in large fields under non-restricting soil conditions, including soil water and fertility, and achieving full production potential under the given growing environment. The CWR is equal to crop evapotranspiration ($ETc$), which refers to the amount of water lost through evapotranspiration. The $ETc$ can be arrived at from climatic data by directly integrating the effect of crop characteristics into reference crop evapotranspiration ($ETo$). The reference crop evapotranspiration ($ETo$) is the evapotranspiration from a reference surface not short of water. Modified Penman method (FAO, 1974; Michael, 2011), which is earlier recommended and widely used in the region, has been used in the present study for computing the $ETo$ and subsequently the $ETc$ values. Crop evapotranspiration is given by:

$$ETc = ETo \times Kc$$  \hspace{1cm} (3.1)
where,

\[ ETc = \text{crop evapotranspiration (mm/day)} \]

\[ ETo = \text{reference crop evapotranspiration (mm/day)} \]

\[ Kc = \text{crop coefficient.} \]

The crop coefficient \( Kc \) varies mainly with the specific crop characteristics and combines differences in soil evaporation and crop transpiration rate between the crop and the grass reference surface. The \( Kc \) for a particular crop changes over the growing period as, the groundcover, crop height and leaf area changes. The FAO (1998) provides typical values for \( Kc_{ini} \), \( Kc_{mid} \) and \( Kc_{end} \) for various agricultural crops. Once the \( Kc \) values are obtained, the crop evapotranspiration \( (ETc) \) can be calculated by multiplying the \( Kc \) values by the corresponding \( ETo \) values. The \( Kc \) values for various crops are given in Table 3.5.

<table>
<thead>
<tr>
<th>Crop</th>
<th>( Kc_{ini} )</th>
<th>( Kc_{mid} )</th>
<th>( Kc_{end} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>1.05</td>
<td>1.20</td>
<td>0.8</td>
</tr>
<tr>
<td>Cotton</td>
<td>0.35</td>
<td>1.20</td>
<td>0.60</td>
</tr>
<tr>
<td>Groundnut</td>
<td>0.40</td>
<td>1.15</td>
<td>0.60</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.60</td>
<td>1.05</td>
<td>0.90</td>
</tr>
<tr>
<td>Cocomut</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Source: FAO, 1998

Based on the climatic data, monthly \( ETo \) values were computed using the Modified Penman method. This method was earlier recommended and widely used in the region. Waikar and Dhoot (2005), based on their studies in the Marathwada region of Maharashtra State, has recommended Modified Penman method instead of Penman-Monteith method in areas for which adequate climatic data are not available. The estimates obtained from Modified Penman method were found to match better with the estimates obtained from Penman-Monteith method than those obtained from
other empirical methods. Monthly ET_{0} is given by:

\[ ET_{0} = C[W.Rn + (1 - w)f(u)(es - ea)] \]  (3.2)

where

W - temperature related weighing factor function
Rn - net radiation in equivalent evaporation (mm/day)
\[ Rn = Rns - Rnl \]
Rns - net incoming short wave radiation
\[ Rns = 0.75 \times Rs \]
\[ Rs = [(0.25 + 0.5\times n/N) \times Ra \]
(Ra - extra terrestrial radiation (mm/ day), n - actual bright sunshine hours (measured value), N - maximum possible bright sunshine hours)
Rnl - net long wave radiation which is a function of temperature, actual vapour pressure and n/N ratio
\[ Rnl = f(t)\times f(ea)\times f(n/N) \]
(f(t) - correction for temperature on long wave radiation Rnl, f(ea) - correction for vapour pressure on long wave radiation Rnl, f(n/N) - correction for ratio of actual to maximum bright sunshine hours on long wave radiation Rnl)
es - saturation vapour pressure at the mean air temperature in C
ea - mean actual vapour pressure of the air determined from dry and wet bulb temperature or dew point temperature
f(u) - wind related function
(l-w) - temperature and elevation related weighting factor for the effect of wind and humidity on ET_{0}
(es - ea) - difference between saturated vapor pressure at mean air temperature and mean actual vapor pressure in millibar
C - adjustment factor to compensate for day and night effects

The computed ET_{0} values are given in Table 3.6.
Table 3.6: Computation of monthly $ET_0$ values

<table>
<thead>
<tr>
<th>Month</th>
<th>Ra (mm/day)</th>
<th>Mean Temp (°C)</th>
<th>RH (%)</th>
<th>n</th>
<th>N</th>
<th>n/N</th>
<th>Wind velocity (km/hr)</th>
<th>Wind velocity (mbar)</th>
<th>es (mbar)</th>
<th>ea (mbar)</th>
<th>es-ea</th>
<th>F(u)</th>
<th>I-W</th>
<th>Aero dynamic term</th>
<th>Rns</th>
<th>F(t)</th>
<th>F(ea)</th>
<th>F (n/N)</th>
<th>Rnl</th>
<th>Rn</th>
<th>W</th>
<th>W*</th>
<th>$ET_0$ (mm/day)</th>
<th>$ET_0$ (mm/day) adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>12.85</td>
<td>28.00</td>
<td>57.96</td>
<td>9.28</td>
<td>11.56</td>
<td>0.80</td>
<td>5.13</td>
<td>123.1</td>
<td>37.80</td>
<td>21.91</td>
<td>15.89</td>
<td>0.58</td>
<td>0.23</td>
<td>2.09</td>
<td>6.45</td>
<td>16.30</td>
<td>0.13</td>
<td>0.82</td>
<td>1.74</td>
<td>4.70</td>
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From the ETo values, crop evapotranspiration (ETc) is calculated by multiplying it with the corresponding Kc value. The net monthly irrigation requirement for the crop is computed by deducting the effective rainfall from the monthly crop water requirement.

Crop water requirement is partially or fully covered by rainfall. The rainfall contribution is not uniform in all the years. Therefore, in planning and designing irrigation projects, a probability analysis may be carried out for selecting dependable level of rainfall instead of using mean values, if data for more than ten years are available. The dependable rainfall is the rain that can be accounted for with a certain statistical probability, determined from a range of historical rainfall records. It can be, for example, the depth of rainfall that can be expected in 3 out of 4 years (75% probability of exceedance) or, better still, 4 out of 5 years (80% probability of exceedance) (FAO, 1978).

Not all dependable rainfall is effective and some may be lost through surface runoff, deep percolation or evaporation. Only a part of the rainfall can be effectively used by the crop, depending on its root zone depth and the soil storage capacity. Several methods are available for estimating effective rainfall for irrigation scheduling in different countries. They are based on long experience and have been found to work quite satisfactorily in the specific conditions under which they were developed. In India, for crops other than rice, effective rainfall is considered to be equal to 70 percent of the average seasonal rainfall. In another method, effective rainfall is taken as the mean value of rain; the excess over 3 in (75 mm) in one day and 5 in (125 mm) in 10 days being omitted. Effective rainfall has also been assumed to be equal to the lowest monsoon rainfall occurring in three out of four years. With regard to rice, it thrives under conditions of abundant water supply. Depth of flooding is governed by the variety grown and its height, the height of field barriers and availability of water. The water requirements of rice include evapotranspiration and percolation. Assessing effective rainfall is thus more complicated in the case of rice.
Different empirical methods are used in different countries. In India, one method is to assume a percentage of total rainfall varying from 50 to 80 percent as effective. In another method, rainfall less than 0.25 in (6.25 mm) on any day is considered as ineffective. Similarly any amount over 3 in (75 mm) per day, and rainfall in excess of 5 in (125 mm) in 10 days is treated as ineffective (FAO, 1978).

For the analysis, rainfall with 75% probability of exceedance is taken as the dependable rainfall. Rainfall details of the Moolathara raingauge station for the past 15 years were considered for computation of effective rainfall of the command area of the CPP and rainfall details of the Aliyar raingauge station for the past 21 years were considered for computation of effective rainfall of Tamil Nadu command areas; 70% dependable rainfall is taken as the effective rainfall for computation of crop water requirement. After obtaining the net irrigation requirement in the field, the gross monthly irrigation requirement at the source is computed by accounting for the conveyance losses. An irrigation efficiency of 80% is taken for the Pollachi and VP canals, and also for the regulators and 60% efficiency for the CPP; this is based on the feedback from the officials. The monthly irrigation demands obtained are given in Table 3.7.

Table 3.7: Monthly irrigation demand for the sub-systems under the Aliyar (Mm³)

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