OPERATIONAL ANALYSIS OF THE CASCADED WADECHA-BELBELA RESERVOIR SYSTEM

(A case in Ada'a Liben woreda, Oromia region)

by

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CERTIFICATION

I, the undersigned, certify that I have read and hereby recommended for acceptance by the Arba Minch University a dissertation entitled: ***Operational Analysis of the Cascaded Wadecha-Belbela Reservoir System in Ada'a Liben*** in partial fulfillment of the requirements of the degree of Masters of Science in Hydrology and Water Resources Management.

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DECLARATION AND COPYRIGHT

I, WAKENA TOTOBA OLANI, declare that this is my own original work and that it has not been presented and will not be presented to any other University for similar or any degree award.

Signature ____________ 23 Ap, 2006

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First and for most I thank my Almighty God, for through Him I had my well being and passed every hurdle in my study time and in my life at all.

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DEDICATION

This work is dedicated to

My wife

Martha Tafese

And

My daughter

Bethlehem Wakena

ABSTRACT

Wadecha-Belbela reservoir system is located in Oromia Region, East Shoa zone, Adaa Liben woreda serving as a water source of 1600ha irrigation projects. The irrigation system under the reservoir system is increasing progressively during the past decades. The expansion of irrigation development without the knowledge of the water source will have the outcome of agricultural yield reduction and water stress. Inadequate knowledge on operation of the reservoir has been leading to inefficient usage of stored water.

This study focuses mainly on the description and assessment of water resources of the woreda based on climate, land and water information, estimation of irrigation water requirements of the reservoir system irrigation projects, and operational analysis of the reservoir system by the application of reservoir system simulation model (HEC-ResSim).

Nine years of meteorological data were used to simulate the Wadecha-Belbela reservoir system. The main input data to the model were the reservoirs physical characteristics, the irrigation water diversion estimated by CROPWAT 4 windows software, potential evaporation (mm), daily surface inflow (m^3/sec) to the reservoirs system. The outputs of the model were the release (m^3/sec), storage (m^3), reservoir level (m), and inflow-outflow relations of the reservoir system.

From the analysis it can be deduced that the available water sources of the reservoir system has sufficient capacity to irrigate the potential land under the system without water stress, provided that proper release rules are followed. The maximum capacity of the reservoir system estimated is 21.85 Mm^3 and the maximum water demand is 17.22 Mm^3 this will have the surplus water storage

4.63Mm^3 remained in the reservoirs system. Therefore, if the releases of water from the reservoir systems are followed according to the monthly irrigation water requirement, this can sufficiently serve as the operating rule of the reservoirs.

The study also provides an operation rule curve using the application of HEC-ResSim

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ABBREVIATIONS AND ACRONYMS

ACTS	African Centre for Technology Studies
AMC	Antecedent Moisture Condition
Bm^3	Billion meter cube
CARE	Cooperative for Assistance and Relief Everywhere
CN	Curve Number
COSAER	Commission for Sustainable Agricultural and Environmental Rehabilitation
CWR	Crop Water Requirement
DEM	Digital Elevation Model
DSS	Data Storage system
ETo	Reference Evapotranspiration
EWWCA	Ethiopian water works construction Authority
FAO	Food and Agricultural Organization (of UN)
FIA	Flood Impact Area
FWS	Field Water Supply
GDP	Gross Domestic Product
GIS	Geographic Information system
GIWR	Gross Irrigation water Requirements
GUI	Graphical User interface
ha	hectare
HEC	Hydrologic Engineering Centre
HMS	Hydrologic Modeling System
HWL	Highest Water level
Ia	Initial abstraction
IDD	Irrigation Development Department
ILRI	International Live Stock research Institute

IPMS	Improved productivity and market Success
ITCZ	Inter-tropical Convergence zone
km	Kilometers
km^2	Kilometers square
LWL	lowest water level
m	meter
m.a.s.l.	Meters above sea level
m^3	meter cube
m^3/s	meter cube per second
mm	millimeter
Mm^3	Million meter cube
MOA	Ministry of Agriculture
MoWR	Ministry of Water Resources
NIWR	Net Irrigation Water Requirements
NMSA	National Meteorological Service Agency
^oC	degree Centigrade
OIDA	Oromiya Irrigation Development Authority
RAM	Readily Available Moisture
RAS	River Analysis System
ResSim	Reservoir Simulation Model
SCS	Soil Conservation Service
SSI	small Scale Irrigation
TAM	Total Available Moisture
USDA	United States Department of Agriculture
WRDA	Water Resources Development Authority

1. INTRODUCTION AND BACKGROUND

1.1 General

Ethiopian is endowed with estimated amounts of 123 Bm^3 of surface water and 2.6 Bm^3 ground freshwater per annum (MoWR, 2001a). However, its distribution in terms of spatial and temporal does not give adequate opportunity for all parts of the country for development and sustaining livelihoods. In some parts of the country, the intensity of recurrent drought affects the livelihood of the agricultural communities and the whole economy at large. Even in a year of good rain, the occurrence of floods affects the livelihood of riparian residents with little capacity to neither protect from the seasonal flood nor mitigate the impact. Further more, the total irrigated area in Ethiopian river basin amounts to 161,790ha, which is only 4.4% (MoWR, 2001a), progress is slow and by 2004, the total coverage near 250,000ha including traditional schemes (Awulachew et al, 2005).

Agriculture is the principal sector of the Ethiopian economy, which provides a lively hood to 85% of the population which generates about 52% of the GDP and 90% of exchange earning (MOA 1998). But it is still performing too much below the growing demand. A major challenge confronting agriculture is the rapid increase in the size of population. Wide scale poverty among the farming population is another factor linked to agricultural performance. As part of the country, semi-arid agricultural activities are subsistence type of small holder farming. It shares most of the agricultural problems that country faced. Small holder farmers are suffering due to food shortage because of high dependency of back ward agricultural practices. However, small scale irrigation developments are practiced here and there and benefiting Ethiopian farmers who are living at lowest life standards. As population growth increases the land and water uses is becoming scarce and competitive.

The study area is highly endowed by agricultural resources such as land and water, which can economically support the existing population. The existing high potential of land and water resources of the Ada'a Liben woreda could be harnessed to increase productivity, produce high value crops and significantly improve farmer's income. But lack of proper utilization and operational management of these resources is not only failed to meet the required productivity level but also affect the resources sustainability.

Therefore, these externalities which are associated with irrigation agriculture in the woreda are affecting the food self-sufficiency and the sustainability of the water resources schemes. This study will analyze the problem of irrigation water management and lack of effective operational monitoring of the water resources that renders the agricultural products both qualitatively and quantitatively on which the population of the woreda depends.

Rural development is an indispensable prerequisite, not only for any improvement, but even for the maintenance of a minimum basic living standard for a growing population. Irrigation agriculture is to be the main basic strategy that farmers should have to adopt to improve agricultural productivity and increase production to alleviate the existing food shortage problem in the country. Despite its importance in a wide spectrum of purposes, the water resources balance with the highly growing irrigation practice of the district is poorly understood. Proper assessment of the water resources potential in terms of quantity with its irrigation demand is extremely essential for any future water resources development.

1.2 The objectives of the Study

The objectives of the study are:

- Description and assessment of water resources in the woreda and compilation of relevant climatic, water and land information.
- Estimation of irrigation water requirement potentials of Wadecha-Belbela irrigation systems.
- Analyzing the operations of the Belbela-Wadecha reservoir system.
- Establish water release guide rules to the Belbela-Wadecha irrigation schemes.

1.3 Research Problems

The hypothesis is that, as a result of having no reservoir operation rule, the irrigation schemes in the Ada Liben woreda area may be facing water stress situation under expanding irrigation. Hence, developing proper reservoir operation rule curves could help to optimize the water resources availability and development potential.

The expansion of irrigation agricultural development practice in the area without proper management and operation rules, the agricultural productivity is facing problem of water stress and yield reduction. The following sets of problems are observed on the site based on preliminary survey:

- No clear water releases operation rules of the irrigation systems.
- No optimal procedures or guide lines for the agricultural crops and water scheduling of the whole systems.
- No all encompassing institutional setup for management of the water in the reservoir.
- Lack of proper utilization of the existing land and water resources.

1.4 Materials and Methods

***Data Collection*:**

- Collect the suitable map(soil map, topo map and land use map) of the catchments area for identification of the river networks and irrigation schemes;
- Collect relevant secondary data from all sources such as the original design documents of the schemes and assess previous studies conducted on the area (i.e. land use, soil, irrigation potential of the area, water abstraction from the system and relevant studies)
- Collect primary data from the site on the land use, socio economic aspects, and relevant hydro meteorological data (i.e. DEM, Rainfall, Evaporation, Temperature, Wind speed, Relative humidity, Sunshine duration, River discharge) from respective offices;
- Collect the main types of crop produced in the area from the agriculture offices in the woreda.

***Data Processing*:**

- Establishing the river networks by using GIS Arch View software and other relevant models.
- Estimate the surface runoff of the reservoir catchments that can be inflow to the reservoirs by the SCS curve number method.
- Estimating the water demand from the Belbela-Wadecha Rivers catchments based on the climate data and crop data by using CropWat 4 Windows software package (CropWat 4 Windows Version 4.3).

- Data organization, data pre-processing , producing relevant map (i.e. DEM, catchment and sub-catchment area boundaries from DEM and soil map and land cover maps from relevant hardcopy maps);
- Simulate the reservoir system analysis by the Hec-ResSim (Hec-ResSim 2.0) hydrologic model software.
- Estimate the maximum irrigation potential that can be utilized by existing water resources in the future.

1.5 Significance of the study

Though such a complex interaction on the two cascaded dams, no detail and satisfactory investigation or study was undertaken on the highly expanding irrigation activities with the limited existing water resources in the past. So, this study is important in such a way that it asses the reservoir operation problems and the stresses caused by the highly expanding irrigation development under the reservoir system for good and optimum operation of the reservoir water management in this challenging areas and paves for further studies.

The significance of the study is that it is the operation and management of the limited land and water resources by the local community and the country at large. This study will give the idea of application of operational analysis of reservoirs to researchers on the other existing reservoirs in Ethiopia especially those operating for hydropower and irrigation projects for proper operational management.

1.6 Description of the study area

1.6.1 Location and accessibility

The study area under consideration is found in east Showa zone in the area encompassed between Belbela and Wadecha streams at about 15-30km east of Bishoftu (Debre Zeit) town along the road to chafe Donsa (Fig.1.1), and it is located between $38^{0}1'$-$40^{0}04'$ East longitude and $8^{0}47'$-$09^{0}00'$ North latitude. These micro dams are established in Ada'a-Liben district in East Showa zone and it is 55km, 85km and 30 km far from Addis Ababa, Adama and Bishoftu towns respectively. It is found in high land of Ethiopia with average elevation of 2,300m a.m.s.l. In this woreda Agriculture is the major source of employment, revenue, export earnings and more of keeping food security and it is also the country's desperately need to increase the productivity of the agricultural sector.

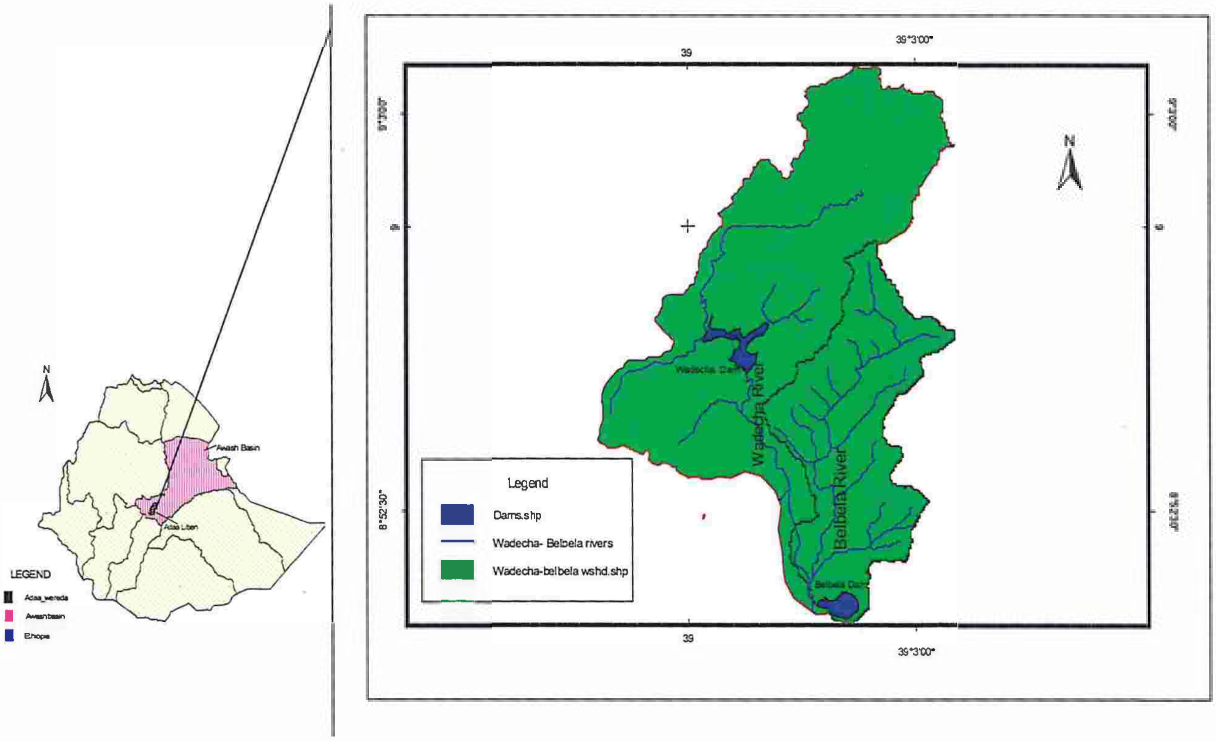


Figure 1.1 The Study area catchment systems

1.6.2 Physical characteristics of the Storage Dams

The two storage dams (Wadecha and Belbela) one supplementing (recharging) the other through hydrological catchments transfers were constructed in 1980 by a Cuban Civil Mission in collaboration with Ethiopian Water Resources Authority (WRDA). The protection works, canals, and on farm structures were later constructed by the Ethiopian Water Works Construction Authority (EWWCA) with an objective of irrigating land area to be used by State Farms. The volume of the reservoir system is 25.5 millions m^3 with dead storage of 1.6million m^3 (OIDA, 2000).The physical characteristics of the reservoirs obtained from the design report of the dams are presented as shown in Table 1.1 and 1.2 and Figure 1.2 and 1.3.

Table 1.1 Physical characteristics of Wadecha micro dam (OIDA, 2000)

PROPERTIES	
Type of the dam	*Inclined earth fill*
Catchment area	*115 Km^2*
Mean Runoff	*29.21Mm^3*
Storing area at HWL	*2.67Km^2*
Storing volume at HWL	*15.16Mm^3*
Dead volume at LWL	*0.94Mm^3*
Useful volume	*14.23Mm^3*
Dam useful life	*30 year*
Bed level	*2399.5 m a.m.s.l.*
Crest level	*2417.5m a.m.s.l.*
Embankment length	*478m*
Free board	*2.5m*
Spill way- length	*110m*
-width at crest	*14m*
Maximum design flood of spillway	*111m^3/se*
Lowest water level (LWL)	*2406m a.m.s.l.*
Highest water level (HWL)	*2415m a.m.s.l.*
Outlet -Pipe Diameter	*0.76m*
-Maximum discharge	*3.76m^3/se*
- Mean discharge	*2.77m^3/se*

Table 1.2. Physical characteristics of Belbela micro dam (OIDA, 2000)

PROPERTIES	
Type of the dam	*Inclined earth fill*
Catchment area	*85Km²*
Mean Runoff	*21.6Mm³*
Storing area at HWL	*2.10Km²*
Storing volume at HWL	*12.10Mm³*
Dead volume at LWL	*0.67Mm³*
Useful volume	*11.5Mm³*
Dam useful life	*30 year*
Bed level	*1919 m a.m.s.l.*
Crest level	*1945.75m a.m.s.l.*
Embankment length	*710m*
Free board	*5.0m*
Spill way- length	*98m*
-width at crest	*15m*
Maximum design flood of spillway	*387m³/se*
Lowest water level (LWL)	*1925m a.m.s.l.*
Highest water level (HWL)	*1940.75m a.m.s.l.*
Outlet -Pipe Diameter	*0.76m*
-Maximum discharge	*3.87m³/se*
- Mean discharge	*2.4m³/se*

Available Balance:

Belbela Micro Dam

- Useful volume to be discharged ....11,500,000 m^3

Wadecha Micro Dam

- Useful volume to be discharged .... 14,000,000 m^3
- **Total** .... **25,500,000m^3**

Source: Oromia Irrigation Development Authority Central Branch office, 2000 Adama.

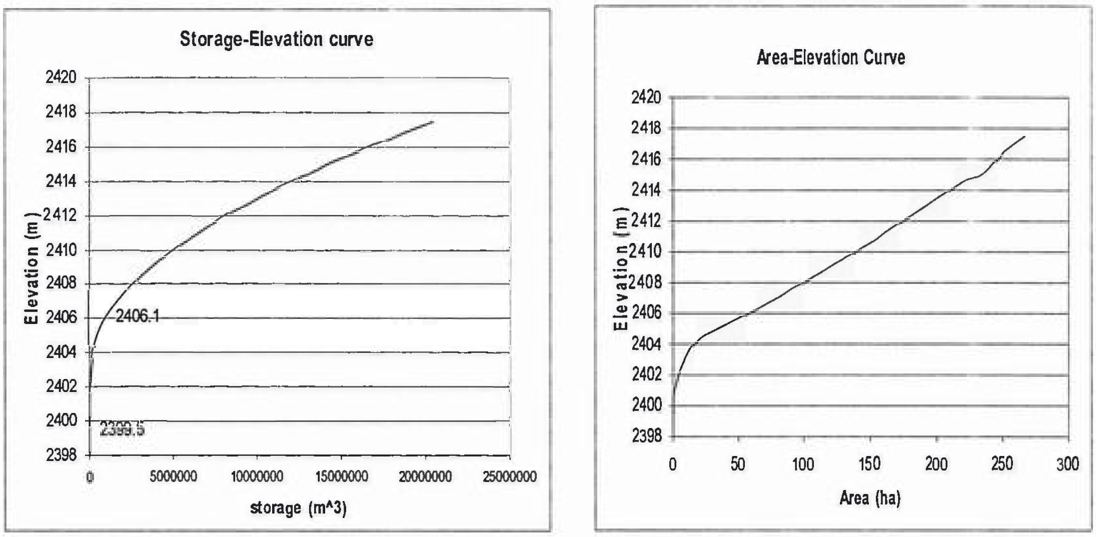


Figure 1.2. Wadecha Reservoir Area-Storage-Elevation curves

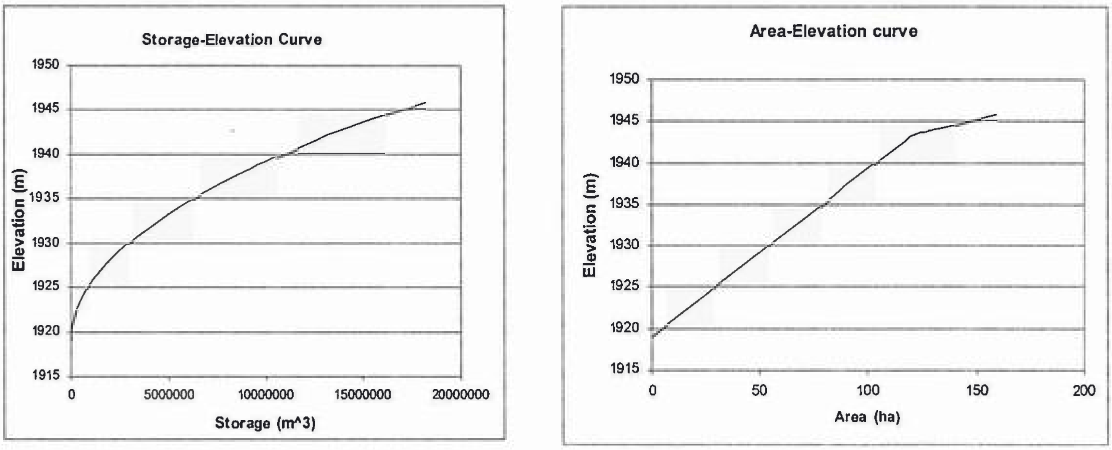


Figure 1.3. Belbela Reservoir Area-Storage-Elevation curves

1.6.3 Geomorphology and soil of the catchment area

The soil of the study area is dominated by clay (black cotton soil) and brown in color which the type of clay mineral that assumed greater importance with respect to soil water storage. The physical assessment of soils of the study area shows dominated by vertisols or black cotton soil Table 1.3. The average soil depth is about 0.65 to 1.05m with medium infiltration rate and medium water holding capacity (OIDA, 2002).

Table 1.3. The textural classification of soil of the woreda.

S.No	Soil type	Woreda (Ada'a) in %
1	Sand and silt	3.0
2	Clay (Black cotton)	88.0
3	Clay Loam	9.0

Source: *- Adaa woreda Bureau of Agriculture (2005)*

The soil map of the study area is obtained from GIS department of International Live Stock research institute (ILRI) in a soft copy form. As it is explained in its attribute the soil classification is based on FAO-UNESCO (1990). Accordingly 9 soil mapping units were identified and soil map has been produced in Arc GIS environment. Some of the soil types described in the map with respect to their position in a different relief intensity and slope are Eutric Cambisols, Vertic Cambisols, Eutric Fluvisols, Leptosols, Luvisols, Phaeozems, and Vertisols Figure 1.4.

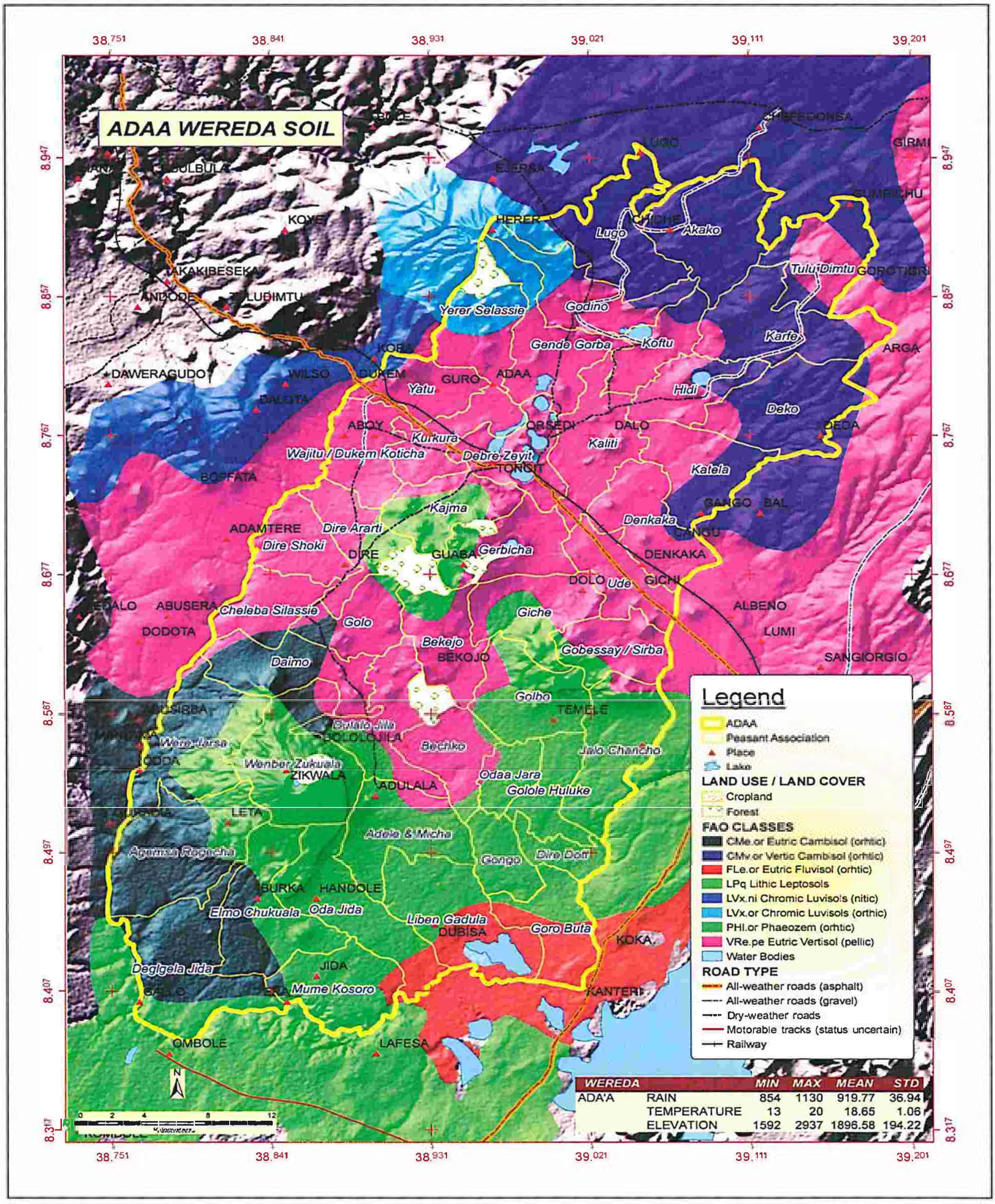


Figure 1.4.Soil map of Adaa Liben woreda (ILRI 2005)

From the analysis of soil map and by comparing it with the previous studies on the project areas the soil of the irrigation projects are almost near to deep clay and the south parts are loams which are good physical properties. The main characteristics of these soils have moderately water holding capacity with medium infiltration rate (Maidment, 1993).This land is highly suitable for most irrigated crop cultivation and by observation of the sites during the field survey in comparison of crop stand and recorded yield generally these soils are fertile, even if extra buildings inputs are suggested by beneficiaries.

The vegetation over the irrigation project area is not satisfactory to protect the land from erosion and degradation, so rill and gully erosion is some times occurred if unless and other wise soil conservation method is applied to the agricultural land degraded and the future soil is tends to be poor in texture as the result of the decreasing soil productivity.

All the cultivable areas are very deep by which almost all crops are able to be benefited with a continuous soil treatment such as fertilizer application, crop rotation system, and good water management with a proper implementation system. Salinity is not expected at all projects at present in its hazardous condition. Series slope ranges are not widely seen in the irrigation command areas .But there are some gullies and water courses within the surface that run down to the big gullies and these have great impact on soil erosion during the rainy season.

1.6.4 Socio-economic information and land use of the study area

The Ada'a Liben woreda is bounded by six neighboring woreda's, which are Berehna Aletu woreda in the north, Akaki in the west, Kersana Kondaltiti in the South west, Lome in east, Dugda Bora in the South, and Gimbichu woreda in the north east . All these woreda's are riparian woreda for the rivers contributing as water resources potential of the Ada'a Liben district.

The total population of Ada'a is 310,059 comprising 149,491 females and 160,565 males according to the data obtained from the woreda agricultural bureau population census. The majority of the people in the woreda are Oromo's with few Amhara's. The woreda has about 161056 hectares total area. Most of the rural populations are depending on the agricultural farming and Livestock raring and farmers mostly depend on communal pastoral lands to graze live stocks but those lands are heavily stocked and overgrazed.

Table 1.4 The land use pattern of the Adaa Liben

Land use Type	**Area in hectare**
Cultivated	106,607.5
Forest land	2,489.00
Grazing land	5,395.38
Bush land	13,834.06
Others	32,730.59
Total	**161,056.53**

Currently, the land use of all the project areas is in dangerous conditions. Almost all of the land of the Adaa Liben woreda is in cultivation and deforestation and cutting bush trees are the common activity in the area. The rate of change forest and bushes areas to agricultural land is alarmingly increasing Figure 1.6.These processes leads to bare land and the soil will be exposed to erosion. The soil characteristics of the project areas suitable for erosion due to traditional cultivation system, the need for conservation measure, slope and nature of soil-water erosion and other present existed conditions in the areas.

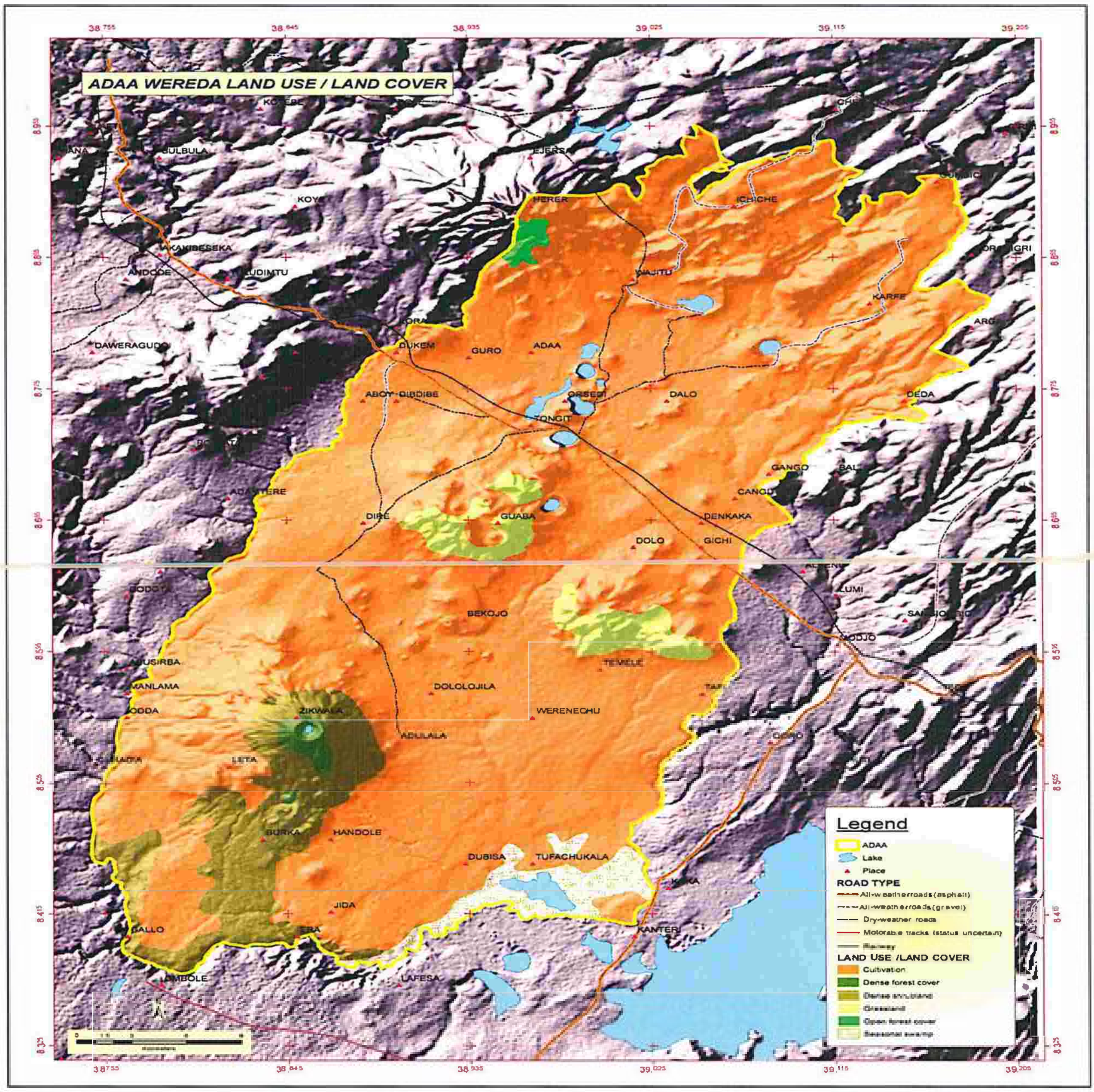


Figure 1.5. Land use/Land cover of Adaa Liben (ILRI 2005)

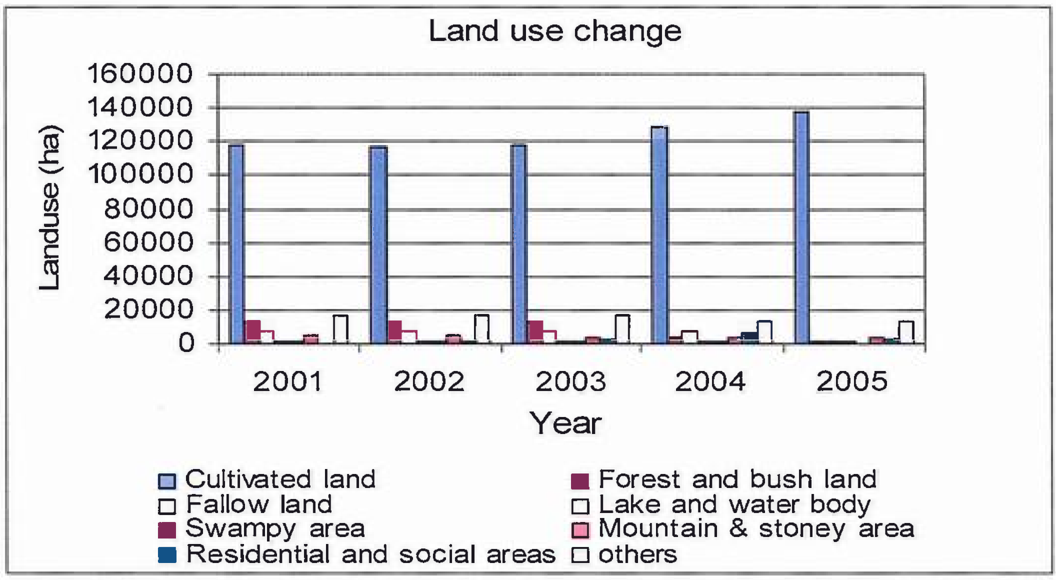


Figure 1.6. The Adaa Liben district land use change

Source: *- Adaa woreda Bureau of Agriculture (2005)*

The dam sites are also not well protected. Their surroundings are not fenced and by now farmers are approaching to the edge of the dam. And this leads to a serious water erosion and improper management. Even though the dam sites are located almost on flat tributary watershed, due to the irregular agricultural activities small gullies (water ways) are expected to disturb its stabilization. Plain and plateau lands are also existed in the surrounding areas, but not disturbed uniformly. There are mountains by near the surroundings of the reservoirs, and have an impact to the natural land appearances in the areas. Since these land features present almost in a circular form, their slopes and heights are also differs. All water ways come from the mountains part passes over or beside these land forms. Some scattered acacia trees and bushes are observed by the side of the water courses.

The soils of the reservoirs system catchments need special treatment because they have restricted drainage condition. Its high water holding capacity and low infiltration rate may bring sophisticated problems in the future. On the other hand, the absence of forest (trees and bushes) also has a direct impact on soil fertility. The demand for irrigation and the dams' capacity will be in question after few years in the future. Thus for these and other related factors like degree of soil degradation, shortage of grazing land, deforestation, un protected sites of the dams, low technology application and the increasing number of population with their vast livestock production system will have an impact on development activity.

1.6.5 Climate of the study area

The moisture for precipitation in the area originates from south-west equatorial air stream, which moves northwards with in tropical convergence zone (ITCZ), (NMSA, 1996). Ethiopia is located in the region where June through September is the main rain season. The Wadecha-Belbela River system catchments however has even extended period of wet season (March-September with mean monthly rainfall varying from 50 to223 mm). June to September rainfall contributes 74% to the mean annual precipitation in the catchment.

The climate in the area is wet to sub-humid according to the Thonthwaite's system of defining climate or moisture regions (NMSA, 1996). The mean annual rainfall obtained from the monthly rainfall on the bases of 53 years of records at Debre Zeit Air Force meteorological station gauge is about 866.6mm. The Rainfall is unimodal with highest amount of rain fall occur between June and September and the lower between February and May Figure 1.7. The effective rainfall calculated by CropWat 4 Windows on the bases of dependable rain is to be 491.0mm. Though there is no other station in the catchment that records temperature to compare with, it can be concluded from Debre Zeit station that the high land part of the catchment annual temperature ranges from 17.2°C to 20.7°C, while the mean annual temperature of 54 years of record at Debre Zeit station is 18.9 °C. The hottest season is March, April, May and June and the maximum temperature is recorded in April and May Figure 1.8.

The long term mean monthly Potential Evapotranspiration estimated using FAO Penman-Montieth for the study area based on climatic variables recorded at Debre Zeit Air Force meteorology station ranges from 105.4 mm in July to the maximum of 153 mm in May. Relative humidity records show the mean monthly value of 61.3% with mean minimum monthly of 53% in February and reaches maximum 76% in August. Generally the wet season in the catchment have mean monthly relative humidity value of more than 65% (figure 1.10). Wind speed has varied value with time according to the records found at Debre Zeit Air Force station. Wind speed records of 12 years show that the highest occurring between February and May and the lowest between Junes to September with mean annual of 1.39 m/sec. The mean annual sunshine hours obtained from the monthly data on the bases of 12 years of records at Debre Zeit Research Center meteorological station gauge are about 8.2 hours, the maximum being 9.8 hours in the month of December and the minimum 5.5 hours in the month of July. Long-term mean monthly values of climatic variables are presented in the following Figures 1.9 and 1.11.

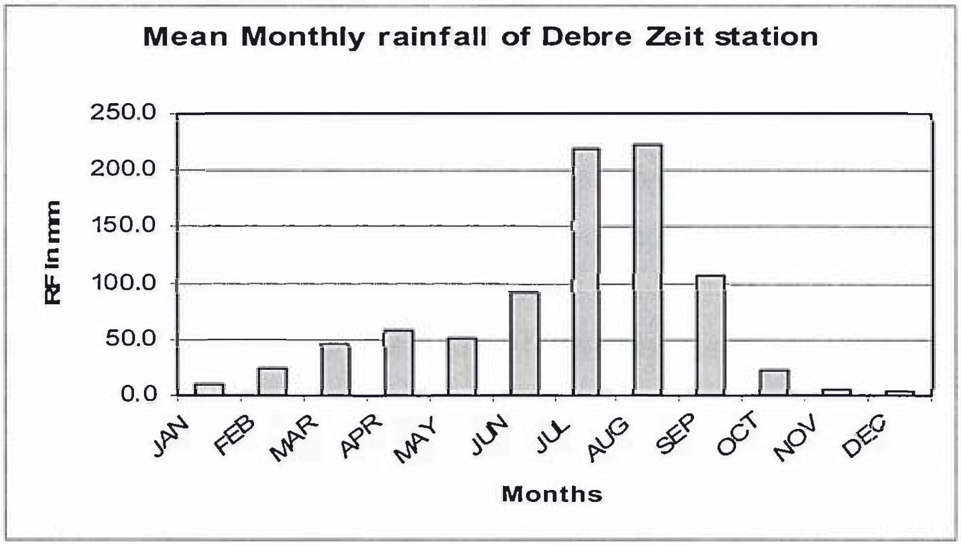


Figure 1.7. Mean Monthly rainfall of Adaa Liben

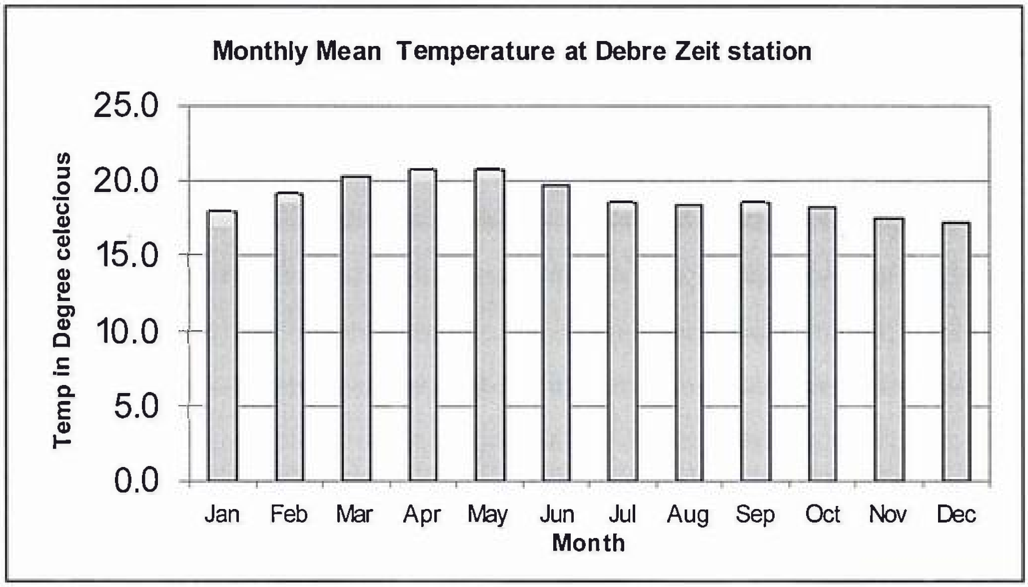


Figure 1.8. Long-term Mean Monthly Temperature of Adaa Liben

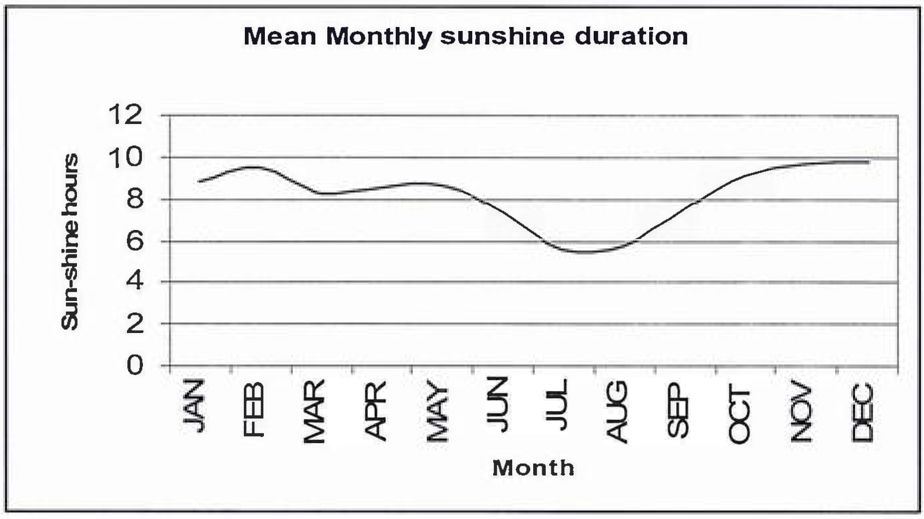


Figure 1.9. Long-term Mean Monthly Sunshine duration of Adaa Liben

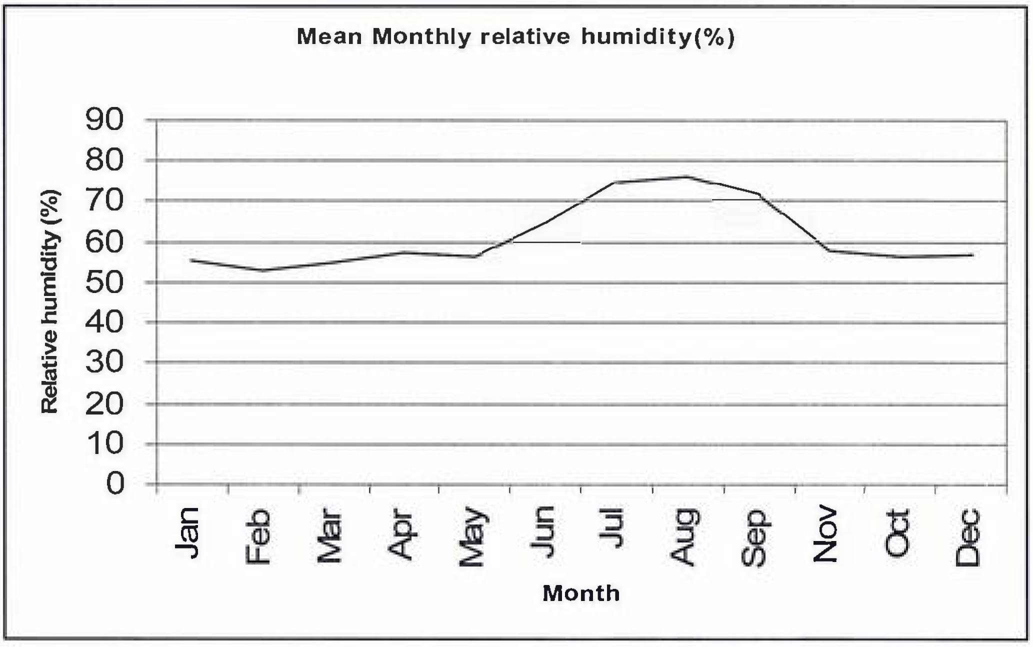


Figure 1.10. Long-term Mean Monthly Relative humidity of Adaa Liben

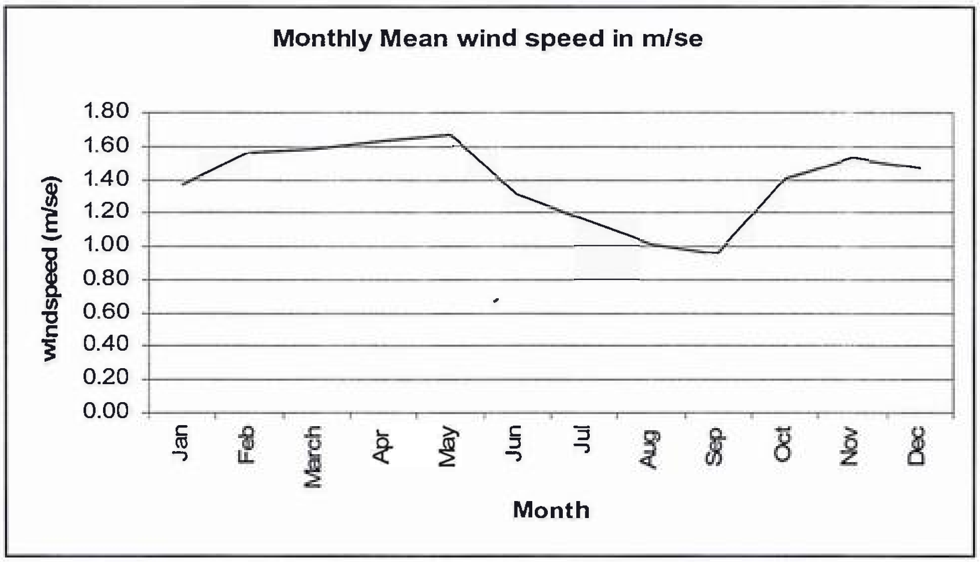


Figure 1.11. Long-term Mean Monthly Wind speed of Adaa Liben

2. LITERATURE REVIEW

2.1 Irrigation Development in Ethiopia

It is difficult to know exactly how much irrigated land exists in Ethiopia, however recent estimates put the total area of land at 160,000–198,000 has. This estimate includes traditional, communal, private and public schemes. Many schemes are concentrated (approximately 48%) in the Awash Valley, where 92% of all large schemes were built prior to 1990 (ACTS, 2002).

Modern irrigation had started at the beginning of the 1960's by private investors and was concentrated in the middle Awash valley, expanded to the Awash Basin and the WabiShebele Basin. At the beginning of the 1970s, about 100 thousand ha of land was estimated to be under modern irrigation in Ethiopia, about 50% of which was located in the Awash Basin (Wetterhall, 1972). With the 1975 rural land proclamation, the large irrigated farms were nationalized and placed under the responsibility of the Ministry of State Farms while small-scale Irrigation schemes were transformed into Producers' Cooperatives. After the major famines of 1984/85, the government began to focus on the potential of small-scale irrigation as food security and started promoting farmer and community-oriented small scale irrigation by providing assistance and support to local communities for rehabilitating and upgrading traditional schemes, (Habtamu G.1990).

The Irrigation Development Department (IDD) of the Ministry of Agriculture (MOA) was established and is responsible for the development of small-scale irrigation starting from 1985 on wards. SSI development was traditionally seen as infrastructure development, and grouped with rural roads and similar construction teams and largely staffed with engineering oriented personnel.

Seventy five percent of the staff of the IDD, as described by Habtamu in 1990, was engineering cadres. The typical Irrigation and Rural Water Supply Team under the IDD was comprised of three brigades: earthen dam construction, diversion weir construction and land development. The department struggled over the years with less than optimal, centralized funding and staffing limitations to meet the challenges and opportunities of SSI development in Ethiopia.

With the change in the government in 1991, the IDD was dissolved and replaced by the Regional Commission for Sustainable Agriculture and Environmental Rehabilitation (COSAER) being promoted under the new federalist structure in a number of regions (Gebremedhin B. and D.Peden, 2002). These new organizations have embraced the promotion of small-scale irrigation as their primary mandate and they are channeling millions of Birr each year into such development and construction activities. The focus within these organizations and the overall approach remains engineering oriented encompassing three phases and a changing of institutional players. At the design phase, a combination of regional bodies, the Regional Bureaus for Agriculture, Energy, Water and Mining, and Health, together with the project proponent participate. Once the basic project document is approved, the CO-SAERs or the Cooperating Sponsors take charge and work with the community and concerned Woreda Council, in the construction of the basic infrastructure, headwork, dam or weir and primary canals. After these civil works are completed, the scheme is handed over to the communities concerned and the Regional Bureaus (Agriculture, Energy, Water and Mining, and Health) for the implementation of the irrigation system. Then the community is expected to complete the secondary and tertiary canals and begin to use the system, with the advice and assistance of the Development Agents provided by the Regional Bureau of Agriculture through a Water Users Association created among the user community. The other two bureaus of Water, Energy and Mining and

Health are expected to ensure that head works are properly maintained and health concerns are addressed, respectively.

2.2 Current status of irrigation in Adaa Liben

Now a days Irrigation development in Adaa Liben district is increasing at highly rate. There are small, medium and large-scale irrigation schemes in the woreda. Small Scale supplies a total command area of under 200 ha as opposed to medium and large scale, which are 200-3000, and above 3000 ha respectively (MWR, 2001b).

Belbela-Wedecha reservoir system serves and irrigating area of 1,340ha (detail shown on Table 2.1) is the focus of this study.

Any future sustainable utilization of the water resources of the study area and proper management of the existing irrigation schemes demands the establishment of a proper conceptual hydrologic model of the reservoir system catchments. In this regard, the water balance simulation for the optimal operation of the two cascaded reservoirs is one of the most important components of such a study. The research basically has focused on the analysis of operational ruling releases and institutional management of the existing cascaded Wadecha-Belbela reservoirs complex serving as water sources of about 1,340ha irrigation project.

Table 2.1. The existing irrigation schemes in the reservoir system catchments

S.N	Farm name	Size in (hectare)	Remark
1)	Keteba Gembi	300	Traditional Scheme
2)	Goa Workie	150	Modern Scheme
3)	Godino	200	Modern Scheme
4)	Harawa	20	Traditional Scheme
5)	Dhanama	40	Traditional Scheme
6)	Belbela	45	Modern Scheme
7)	Ful-Tino	85	Modern Scheme
8)	Densho Agro-Industry enterprise	500	Currently some are transferred to flowering farm
Total		**1,340**	

The present most frequently cited estimate of irrigation potential in the area is about 5,441 ha (Adaa Liben woreda office Agriculture, 2005). The Figure 2.1 below is shown in sharp contrast to the widely cited overall potential for irrigation throughout the district, including small, medium and large-scale irrigation. Table 2.2 provides an overview of the present reference data regarding the scope for irrigation potential in Adaa Liben.

Currently, in the woreda 5,441ha of land has been studied and identified as potential developable (prioritized area) Appendix-2.A. However, the overall potential of the woreda is not clearly known, particularly when the potential of Awash River basin is taken in to consideration .The woreda Agricultural office has in its record a land area of 3,561.9ha already under irrigation by farmers and a total beneficiary of 5,600 house holds. That shows an average land holding size of about 0.5ha irrigated area. However, in the woreda there are certain unaccounted private commercial and state/regional government owned schemes, which are already in place. Particularly, irrigated agriculture through development of ground water for horticulture and flower farming are emerging quite strongly. The exact extent of exploitation of the ground water resources and the developed area is not known, particularly those associated to commercial farming. According to the information gathered from the agricultural bureau of the woreda, a total of 1087 hand dug wells are also available irrigating 55ha of irrigation land (OIDA, 2002).

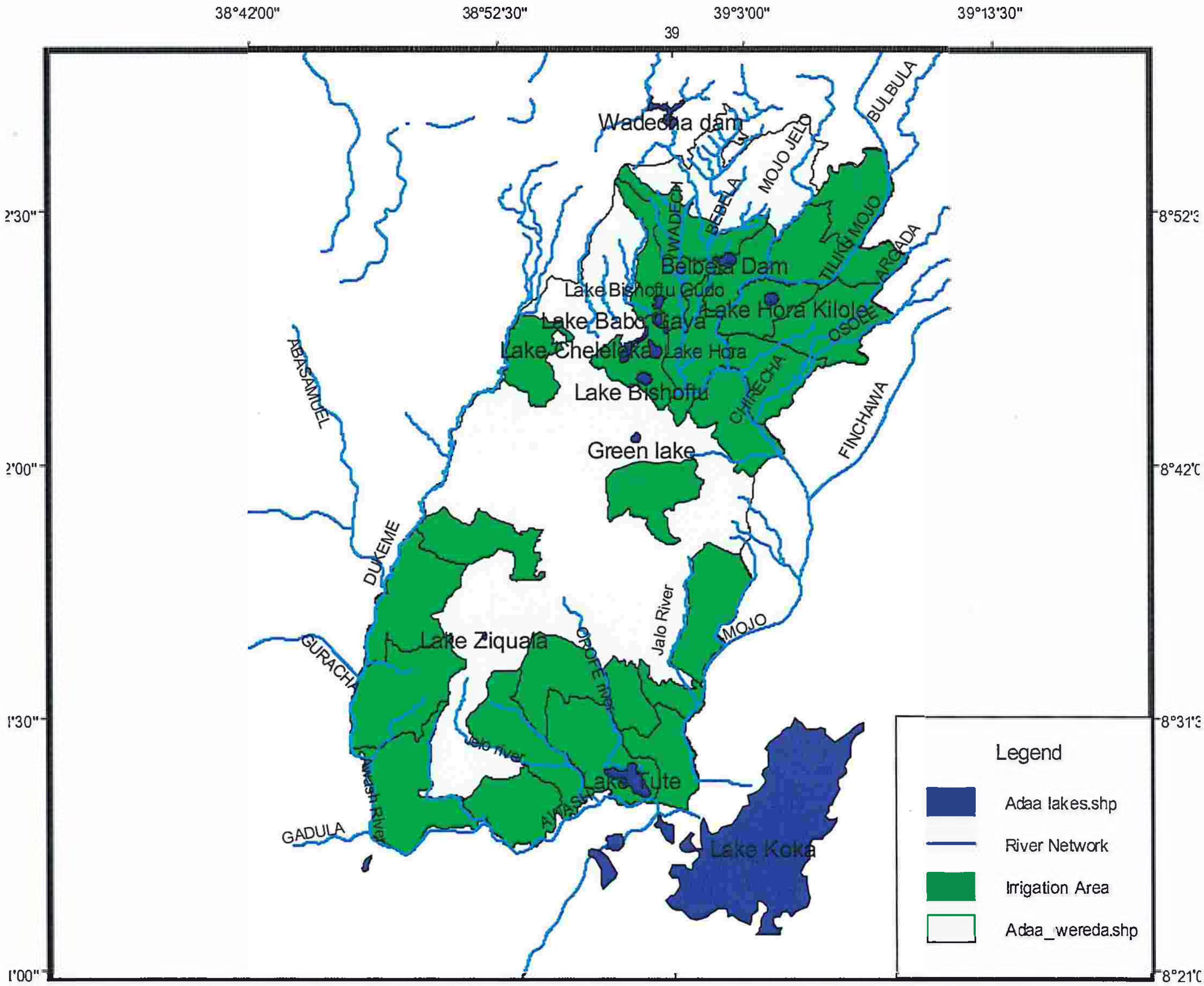


Figure 2.1. Irrigation potential and drainage system map of the Adaa Liben

Table 2.2. Irrigation potential of the Adaa Liben Woreda (Adaa Liben woreda office of Agriculture 2005)

S.No	Type of abstraction	Irrigable area in (ha)
1	Diversion	2,195
2	Pumping	3,231
3	Spring	15
Total		**5441**

The Ada'a Liben woreda has 10 rivers and 7 lakes of water resources bodies. Most of the rivers and lakes are currently under some form of use and some are not used at all. Most of the rivers in the woreda are not gauged.

2.3 History of the Dams

The Wadecha and Belbela dams were constructed for irrigation purpose in 1980 in the 'Derg' regime by the Cuban civil mission in collaboration with Water Resources Development Authority (WRDA) of Ethiopia. The objectives of these two storage dams were to irrigate about 1600 ha of land area to be used by State farms and to render service to the Rehabilitation Center of People's Hero's.

During Belbela-Wadecha project identification, it was the policy of the government to promote and encourage State Farms and force private farmers to become Laborers of the State farms by taking their farmlands, and Belbela-Wadecha hydraulic complex was constructed within this context of the government policy (Oromia irrigation development Authority Central branch, Adama, 1998).

During the first phase of this project (Wadecha-Belbela) implementation 500 ha of net land was developed and distributed in the following way among the different agencies: 365 ha to the ministry of State Farm and 135 ha of land to Rehabilitation Center of people's Hero's. All these 500 ha lands were taken from the peasant around the area, and those on the project area were forced to pull out and settle in the neighboring Peasant associations. Accordingly, from 1980 up to 1991 it was under full control of the mentioned organizations, and using the water from the two reservoirs. However, since 1991 the land (500 ha) was totally transferred to Poultry Enterprise, which doesn't use irrigation and the reservoirs are giving no service at this moment (OIDA, Central Branch, Adama, 1998).

The 1600 ha of land area to be developed was divided in to different zones. The 365 ha and 135 ha of land area was categorized as zone one and two respectively. While part of the Ful-Tino irrigation project was identified as part of zone three in the second phase of Belbela-Wadecha irrigation project implementation. However, the second phase of this project was not implemented due to change of government policy in agriculture.

The reservoirs were under the direct supervision of WRDA. As the result of restructuring of the government policy and institutions, these reservoirs were handed over to the Oromia Bureau of Natural Resources Development & Environmental Protection in early 1993. Since then, the Bureau has been carrying on studies and surveys on how this stored water can be fully utilized. As a part of this reallocation/restructuring Godino, Dhanama, Ful-Tino, Keteba Gembi, Goha Workie, and other irrigation projects getting its irrigation water supply from Wadecha -Belbela reservoirs.

2.4 Initial assessment of environmental impacts of irrigation development in the study area

The relationship between hunger, poverty and environment is essentially based on interplay between social, natural, and economic factors. The irrigation development under the reservoir system will have an expectation of improving the population food sufficiency. Farmers may be profited by producing high value crops which will gain high income.

The environment of the study area is naturally poor in resources except fertile irrigable agricultural land and the water resources used for irrigation which can only be used crop production, no other important resource is existing in the study area. The project area is characterized with different slope variations. The sloped part of the land area is degraded and exposed to high surface runoff. The vegetation coverage of the study area is considerable very low, except that there only very scattered bushy and small shrubs and some acacia species are found with negligible land area coverage. As a result of lack of natural vegetation coverage gullies are formed to affect agricultural areas. The gully formed from the irrigation drainage canals are to be considerable as a negative impact of the irrigation projects of the area in general and the existing irrigation expansion is expanding the existing gully formation (OIDA, 2002).

According to the data obtained from district agricultural office of Adaa Liben the land area affected by runoff due to the land degradation and gully formation amounts 2.2% of the irrigable land. On the other hand, the irrigation expansion in the area is causing the problem of health. Malaria is the series problem to be suspected due to the moisture formation by the irrigation projects with which the favorable condition will be created for the mosquitoes' development under good climatic condition of the project areas for the vectors (Wagnew, A. 2004).

Currently, there are environmental conflicts among upstream and downstream farmers in the system. Conflict is between the upstream Wadecha reservoir where the dam is located and the use of water exists at the downstream beneficiaries. The whole system has also no proper institutionally established management and the most part of the structures such as spillway, outlets pipes, Gates, Canal are damaged at certain locations due to lack of operation and maintenances.

3. DATA AVAILABILITY AND SOURCES

3.1 Climate data

Climate data of the study area are fairly available. The most important climate data used in the study area of monthly rainfall, monthly temperature, monthly relative humidity, monthly sun shine duration and monthly wind speed at three metrological stations located in the catchment of the study area has been obtained from National Meteorological Service of Ethiopia. These climate data are available with different length of records at each three different stations. The three meteorological stations found in the catchment are Debre Zeit, Mojo and Chafe Donsa meteorological stations.

The rainfall data used in the analysis was a 53 years (1951-2003) monthly data and 9 years (1995-2003) daily data at Debre Zeit stations. It was not possible to include the daily rainfall data of more than 9 year of records in the analysis due to lack of continuous records of the data. The other near by stations of chafe Donsa and Mojo monthly rainfall records of 6 and 41 years have been collected for the analysis.

Monthly maximum and minimum temperature data records of 54 years (1952-2005), 9 and 22 years of Debre Zeit, Chafe Donsa and Mojo respectively have been collected for the analysis.

The mean monthly relative humidity of 56 years (1951-2005), Wind velocity of 12 years (1994-2005) and Sun shine duration of 12 years (1994-2005) have been obtained for the analysis.

3.2 The Rivers discharge data

Since the two rivers of Wadecha and Belbela streams on which the two dams have been constructed are unguaged, the discharges of the streams data used as the inflows of the reservoirs was estimated from the 9 years of daily rainfall data obtained from Debre Zeit station records. The stream data were estimated by using curve number method from the daily rainfall obtained from the study area.

3.3 Land use, soil, and crop data

The land use and soil map of the study area was obtained from international live stock research Institute (ILRI) department of GIS in soft copy form. But the land use change of 5 years (2001-2005) of records in tabular form has been collected from Adaa Liben woreda office agriculture. The other soil characteristics laboratorically examined data has been extracted from the original design documents of the irrigation projects under consideration obtained from Oromia Irrigation Authority development central branch.

In addition, the crop data of the study area was also collected from the same office of Agriculture of Adaa Liben and from the design documents of the irrigation projects. The crop data includes the main crops produced in the area, the planting and harvesting date of crops and the cropping pattern. The other crop data such crop coefficients, depletion level, and yield response of the crops are obtained from FAO publications.

3.4 The reservoirs physical characteristics data

The two reservoirs physical characteristics data were the most scanty and important part of the data. Searching these data was also the most difficult work faced in this research work and it was not possible to get the original design documents of the reservoirs due the restructuring of the governmental organization to handle such type of documentation in the past decades. The design and construction of the dams were during the 'Derg' regime and the documents have not been handled by any responsible governmental organization at present time. But the most important parts of the reservoirs physical characteristics data such as data at dead storage, at spillway level and at top level were obtained from the Oromia Irrigation Development Authority (OIDA). On the other hand the area and storage of the reservoirs at spillway level and top level was surveyed at field work by using GPS coordinate system and compared with the obtained data from the office. The other intermediate parts of the data points have been interpolated from the data collected and checked against the observed data at field work.

3.5 Irrigation Land data

Both the existing and potential land under the reservoir system data has been collected from the Adaa Liben woreda office of agriculture that was surveyed in 2005. These data was obtained at kebele level and with respect to the rivers in the woreda.

4. DATA ANALYSIS AND RESULTS

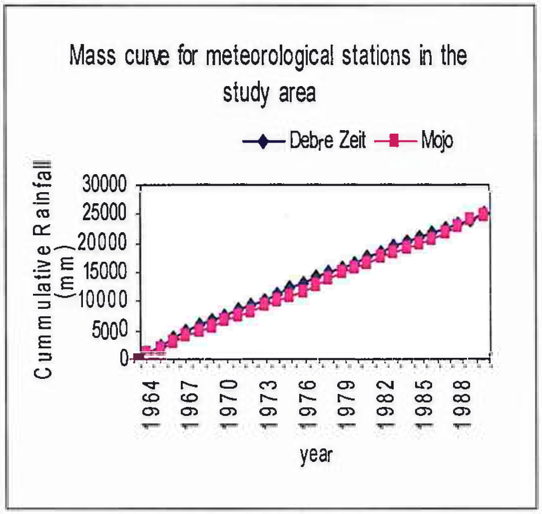
4.1 Rainfall Data

Precipitation of the study area has been investigated for 53 years period, using data of the Debre Zeit Air Force station and two rain gauge stations of which one of them is located in side catchment of the study area and the other one is outside the study area. The location of the stations, distribution, and recording period of each station are shown in Figure 4.3 and Table 4.1. The reliability of the data has been checked using double mass curve method and a few missing data were completed through the weighted average and station-year methods. The accumulated rainfall data of Mojo and Debre Zeit stations have been plotted against the time (year), and the result is shown in Figure 4.1. There is no discontinuity in stations, and the data has been used in the future analysis. Since the number of years of records at Debre Zeit Air Force station is very large that is 53 years and the station itself is in side the study area, it is suitable and used for the crop water requirement calculation. On the other hand, all of the rest nearby stations have similar rainfall pattern, but they have no similar number of records. At the same time, Mojo meteorology station is out side of the study area and covers small parts as well as chafe Donsa station has very short length of records. Therefore, the two stations have been discarded from the analysis.

Table 4.1. Meteorological stations list (recording length and available data).

Station	Location	Altitude(m)	Measured parameters	Recording length	Available data for analysis
Debre Zeit	38°57'E 8°44'N	1850	Rainfall,Temperature,Relative humidity, wind speed & sun shine hours	1951-2003	Daily and monthly
Mojo	39°07'E 8°37'N	1870	Rainfall, Temperature & Relative humidity	1964-2003	monthly
Chafe Donsa	39°08'E 8°58'N	2400	Rainfall	1999-2003	monthly

The average monthly rainfalls of the three meteorological stations and the aerial rainfall have been plotted in figure (4.4). The monthly rainfalls of all stations are almost similar.



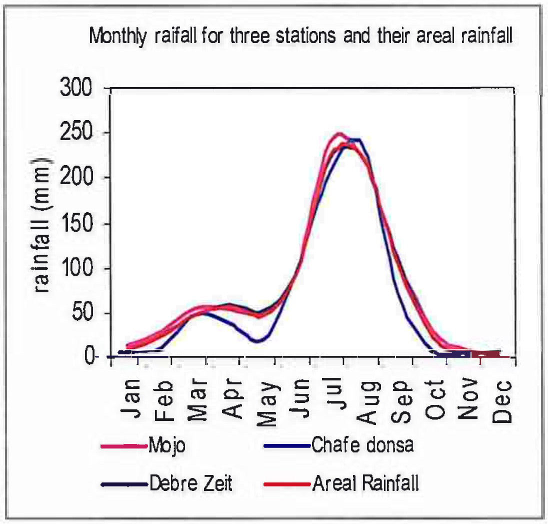


Figure4.1.Mass curve of rainguage stations Figure 4.2.Average monthlyrainfall

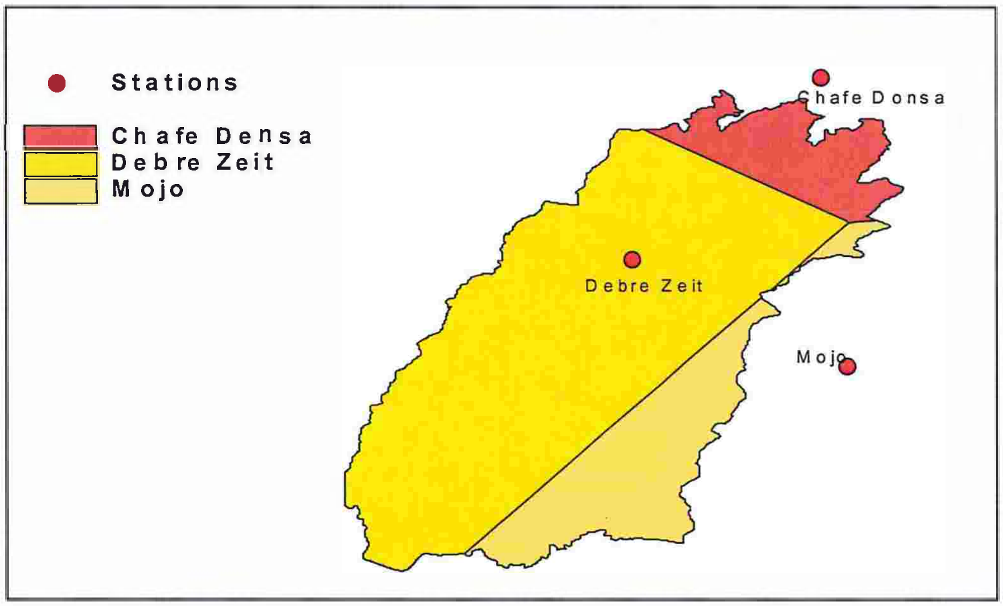


Figure 4.3. Theissen polygon map of the study area of rainguage stations

Table 4.2. Weighting coefficients of the stations in the study area based on Theissen polygon

Station Name	Relative weight of polygon	Area of polygon (Km^2)
Debre Zeit	0.69	1,163.45
Mojo	0.2	327.63
Chafe Donsa	0.11	181.37

To estimate the area rainfall for any area, point rainfall needs to be converted to area depth of rainfall. There are various methods to do this; in the present study Theissen Polygon method has been used. Figure 4.3 shows the Theissen polygon of the study area and location of the meteorological stations. The relative area weight for three polygons enclosing the corresponding stations is presented in Table 4.2.

The monthly mean area rainfall in the study area has been calculated by Theissen Polygon method according to relative weight of polygons using meteorological stations data. This aerial rainfall has not been used in the future steps of the research, because all the meteorological stations data are similar with area rainfall calculated and the reasons mentioned in the previous steps. Only monthly rainfall data of Debre Zeit station has been used in the estimation of irrigation water requirements.

4.2 Temperature

For calculating reference Crop Evapotranspiration (ETo), which will be used to determining of crop water requirement (CWR), monthly climate data (temperature, humidity, wind speed and sun shine duration) are necessary. Investigation of these parameters has been done using Debre Zeit Air Force station data, which is located in the central part of the study area. Mean annual temperature, average of minimum and maximum temperature of the study area are shown in Table 4.3. The warmest month is May; average mean daily in this month is $21^{o}C$, whereas December has the lowest average mean daily temperature (17.2^{o}C). Dry season of the study area has been determined using Ombrothermic curve of the study area. Ombrothermic curve is the curve by which the dry season of any catchments can be determined based on the rainfall and temperature data of the meteorological station in the catchment. The magnitude of rainfall and temperature of the study area will identify the dry season of the area. Based on this curve, there is almost no a dry period, but it can be suggested from the curve that from October to the month of February may be considered as dry period Figure 4.6.

Table 4.3. Temperature in Debre Zeit Air force station

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	17.9	19.2	20.4	20.7	20.7	19.8	18.6	18.4	18.6	18.3	17.6	18.9	17.2
Average Max.	26.2	27.3	28	27.9	28.6	27.2	24.1	23.8	25	26	25.7	25.6	26.3
Average Min.	9.7	11.1	12.7	13.5	12.9	12.3	13.0	12.9	12.3	10.6	9.4	8.8	11.6

4.3 Relative Humidity

Relative humidity is one of the most important factors that directly affect Evapotranspiration. Based on the Debre Zeit Air Force station's data the mean annual relative humidity is about 61%. The most humid month is August (70%) and the least humid month is February (53%). The monthly average relative humidity for the last 47 years (which are necessary for calculating the reference Evapotranspiration used in the estimation of crop Water Requirement (CWR)and other steps of present research). This data is obtained from Ethiopian National meteorological Service Agency (NMSA).

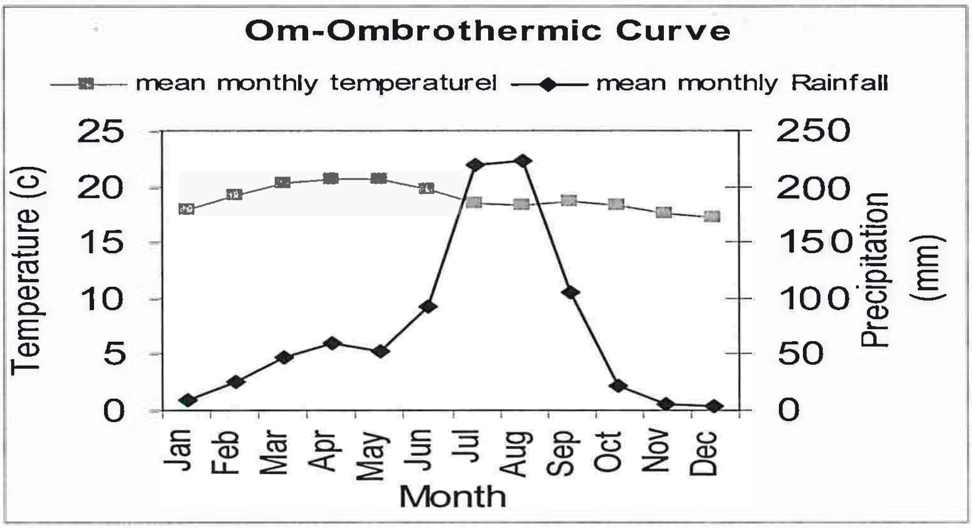


Figure 4.4. Ombrothermic curve of the study area

4.4 Sunshine duration and Wind speed

Sunshine duration and wind speed are the other parameters that are necessary for calculating reference Evapotranspiration (ET_O) and Crop Water requirement (CWR) by Penman-Montieth method in CropWat 4 windows model. For preparing these data, Debre Zeit air force station has been used. For the present research analysis 12 years of records of both parameters were obtained from Ethiopian national Meteorological Service Agency (NMSA).

4.5 Runoff data

Generally most of Ethiopian rivers do not have sufficient hydrological data, because of their being ungauged. The Wadecha and Belbela streams on which the two dams were constructed have no gauging stations recording the rivers discharge. Thus for such case, it is unavoidable to use the rainfall data to estimate the surface runoff flows to the reservoirs from each catchments. Inflows to the reservoirs have been calculated by using the SCS curve number estimation method based on the nine years of daily data of rainfall available at Debre Zeit Air Force meteorology station and Land use cover of the catchments. Surface runoff is predicted for daily rainfall by using SCS curve number equation (USDA-SCS, 1972).

$$Q = \frac{(R-0.2S)^2}{R+0.8S} \quad , \quad R > 0.2S$$

$$Q = 0.0 \quad , \quad R \le 0.2S$$

Where, Q is the daily surface runoff in (mm)

R is the daily rainfall in (mm)

S is the retention parameter in (mm)

The retention parameter, S, varies;

a) Among watersheds because soils, land use, management, and slope all vary, and
b) With time because of changes in soil water content.

The parameter S is related to curve number (CN) by the SCS equation (USDA-SCS, 1972).

4.6 Determination of Curve numbers for the study area

In the SCS method of runoff determination, there provided a curve number for estimation of maximum potential retention S with an empirical formula,

$$S = 254*\left(\frac{100}{CN}-1\right)$$

The constant, 254, in equation (2.3) gives S in mm.

The major factors that determine CN are the hydrologic soil group, cover type, treatment, hydrologic condition, and antecedent runoff condition. The values of CN is obtained from the in the appendix (4.B) for the two catchments represents average antecedent runoff conditions for urban, cultivated agricultural, other agricultural, and arid and semiarid range land uses. The following section will explain how to determine factors affecting the CN.

The curve numbers used in the above formula apply for normal antecedent moisture condition (AMC II) implies average condition of moisture. For dry (AMC I) low runoff potential and wet condition (AMC III) high runoff potential, equivalent curve number has been computed by the following formulas.

$$CN(\mathrm{I}) = \frac{4.2CN(\mathrm{II})}{10-0.058CN(\mathrm{II})}.$$

and

$$CN(\mathrm{III}) = \frac{23CN(\mathrm{II})}{10+0.13CN(\mathrm{II})}$$

The range antecedent moisture condition for each class is shown in (Table 4.4). Curve number has been tabulated by the Soil Conservation Service on the basis of soil type and land use. Four soil groups are defined as follow:

Group A: Deep sand, deep loess, aggregated silts, high infiltration rate,>7.6mm/hr.

Group B: Shallow loess, sandy loam, moderate infiltration rate (3.8 to 7.6 mm/hr).

Group C: Clay loams, shallow sandy loam, soils low in low in organic content, and soils usually high in clay, low infiltration rate (1.3 to 3.8 mm/hr).

Group D: Soils that swell significantly when wet, heavy plastic clays, and certain saline soils, very low infiltration rate (<1.3 mm/hr).

Table 4.4. Classification of antecedent moisture classes (AMC) for the SCS method of rainfall abstractions.

	Total 5-days antecedent rainfall (mm)	
AMC group	*Dormant season*	*Growing season*
I	less than 12.7	less than 35.6
II	12.7 to 28.0	35.6 to 53.3
III	over 28.0	over 53.3

(Source: Applied Hydrology, Ven Te Chow, et.al. 1988)

There should be understanding that the assumptions reflected in the initial abstraction term and ascertain assumption applies to their situation. The initial abstraction term which consists of interception, initial infiltration, surface depression storage, evapotranspiration, and other factors, was generalized as 0.2S based on data from agricultual watersheds (S is the potential maximum retention after runoff begins). This approximation can be especially important in an urban application because the combination of impervious areas with pervious areas can imply a significant initial loss that may not take place. The opposite effect of greater initial loss, can occur if the imervious areas have surface depressions that store some runoff. To use a relationship other than initial bastraction, I_a=0.2S one must use rainfall- runoff data to establish new S or CN relationships for each cover and hydrologic soil group.

The CN procedure is less accurate when runoff is less than 12.7mm(Ven Te Chow 1998). Therefore, another procedure to determine runoff at wadecha-Belbela watershed were estimated based on the guide lines given in Table 4.4.The SCS runoff procedures apply only to direct surface runoff; do not overlook large sources of subsurface flow or high groundwater levels that contribute to runoff. These conditions are often related to hydrologic soil group A soils and forest areas that have been assigned relatively low CN values (Maidment 1993).

Table 4.5.Summary of determination of curve number

Land use	Catchment Area (ha)		Cover condition	Hydrologic soil group	CN for AMC (II)
	Wadecha	Belbela			
Cultivated land	10,266.8	7,186.5	Poor	C	88
Forest & bush	71.02	49.7	Fair	C	77
Fallow land	96.2	67.34	Poor	D	94
Lake & Water body	121.5	85.0	Fair	D	98
Swampy area	37.25	26.1	Fair	C	98
Mountain & Stony area	301.5	211.05	Fair	D	91
Residence area	153.0	107.2	Poor	D	92
Total	**12,000**	**8,400**			

Curve numbers of average antecedent soil moisture condition AMC (II) values of each watershed have been tabulated based on their cover condition; hydrologic soil group and land use Table 4.5.

The weighted CN of each catchment can be calculated by the formula:

$$CN_w = \frac{\sum A*CN}{\sum A}$$

Where, A is the area of each land use classification

Table 4.6. The annual rainfall to annual runoff relationship of Wadecha-Belbela watershed.

Year	Total Rainfall(mm)	Total Runoff(mm)	Annual runoff coefficient
1995	590.60	159.56	0.27
1996	1077.90	395.38	0.37
1997	855.00	265.03	0.31
1998	1022.20	341.22	0.33
1999	953.80	384.00	0.40
2000	843.30	216.28	0.26
2001	882.10	251.95	0.29
2002	662.10	170.77	0.26
2003	1096.30	384.14	0.35
Total	***7983.30***	***2568.33***	***0.32***

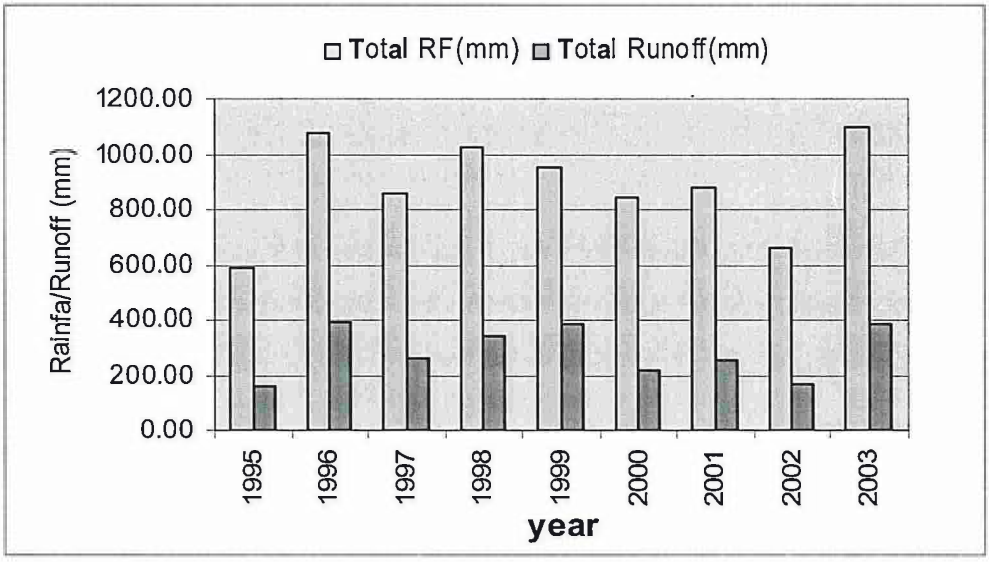


Figure 4.5. The relationship between annual rainfall and annual runoff the Wadecha-Belbela catchment.

Wadecha-Belbela catchment system was assumed to have the same catchment characteristics as well as very small catchment and the point rainfall record of Debre Zeit station has been taken to generate runoff from the catchments. Therefore, it is impossible to produce the rainfall-runoff relationship for both catchments separately.

For this research the daily rainfall data of 9 year has been used for the estimation of surface runoff from the watershed under consideration used as the inflow of the two reservoirs. Apart from the very high rainfall that was recorded for the Wadecha-Belbela reservoirs system catchment that is Debre Zeit Air Force meteorology station in 1996 and 2003, and the driest year of 1995, rainfall in the area was fluctuating around the long-term average rainfall value Figure 4.5. The surface runoff generated from the annual mean rainfall of 887.03mm is 285.4mm with the average annual rainfall-runoff coefficient 0.32 Table 4.6.The daily values of runoff estimated for each watershed has been shown in Appendix-7A.

5. CROPWAT MODEL

5.1 General

CROPWAT is a decision support system developed by the Land and Water Development Division of FAO for planning and management of irrigation. CROPWAT is meant as a practical tool to carry out standard calculation for reference Evapotranspiration, crop water requirements and crop irrigation requirements and more specifically the design and management of irrigation schemes. It allows the development of recommendation for improved irrigation practices, the planning of irrigation schedules under varying water supply conditions, and the assessment of production under rain fed conditions or deficit irrigation (Clarke et al, 1998).

Procedures for calculation of the crop water requirements and irrigation water requirements are based on methodologies presented in FAO irrigation and drainage papers No. 24 "Crop Water Requirements" and No. 33 'Yield response to water". The model uses the FAO (1992) Penman-Montieth method for calculating the Reference Crop Evapotranspiration. These estimates are used in crop water requirements and irrigation scheduling calculations.

5.2 Input data

Calculations of the crop water requirements and irrigation requirements are carried out with inputs of climatic, crop and soil data. For the estimation of crop water requirements (CWR) the model requires:

a) Reference Crop Evapotranspiration (ETo) values measured or calculated using the FAO Penman-Montieth equation based on decade/monthly climatic data; minimum and maximum air temperature, relative humidity, sun shine duration and wind speed;

b) Rainfall data (daily/decade/monthly data); monthly rainfall is divided in to a number of rain storms each month;

c) A cropping pattern consisting of planting date, Crop coefficient data files (including K_c values, stage days, root depth, depletion fraction) and the area planted (0-100% of the total area); a set of typical crop coefficient data are obtained from FAO drainage paper publications (FAO Irrigation and drainage papers No. 24, 33 and 56) and from the program. In addition, for irrigation scheduling the model requires information on:

d) Soil type: total available moisture depletion (% of total available moisture). These informations have been obtained from the interview of farmers at the field level, from the characteristics of soils in the study area, and the FAO papers.

e) Scheduling criteria; several options can be selected regarding the calculations of application timing and application depth (e.g. 50mm every 14 days, or irrigate to return the soil back to field capacity when 50% of the easily available moisture has been used).

5.3 Calculation method

The value of decade or monthly reference Crop Evapotranspiration (ETo) are distributed in to monthly values using four distribution models (the default is a polynomial curve fitting).The four distribution models in the cropwat are Polynomial curve fitting, Three month parabolic curve fitting, linear distribution and Daily average curve fittings.

The model calculates the crop water requirements using the equation CWR = ET_O*K_c*area*depth. This means that the peak CWR in mm/day can be less than the peak ET_O value when less than 100% of the area is planted in the cropping pattern.

The average value of crop coefficients for each time step are estimated by linear interpolation between the K_c values for each crop development stage.

For crop water requirements and scheduling purposes, the monthly total rainfall has to be distributed in to equivalent daily values. CROPWAT for windows does this in two steps. First the rainfall from month to month is smoothed in to a continuous curve (default curve is a polynomial curve, but can be selected other smoothing methods available in the program, e.g. linear interpolation between monthly values). Next the model assumes that the monthly rainfall in six separate rainstorms, one every five days (the number of rainstorms can be changed). The model has available four effective rainfall methods (the USDA SCS method is the default). In the present research the "*Dependable rain* " method is selected due to suitability of the model in practical cases and the other rest methods are not practically applicable in the country like Ethiopia. For the scheduling, calculations can be selected two options, Irrigation Scheduling and/or Daily Soil Moisture Balance. The Irrigation Scheduling option shows the status of the soil moisture every time new water enters the soil, either by rainfall or a calculated irrigation application. Daily Soil Moisture Balance option shows the status of the soil every day through out the cropping pattern, how the soil moisture changes in the growing season. User defined irrigation events and other adjustments to the daily soil moisture balance can be made when the scheduling criteria are set to "User-defined".

Total available moisture (TAM) in the soil for the crop during the growing season is calculated as Field capacity minus the Wilting point times the current rooting depth of the crop. Readily available moisture (RAM) is calculated as

TAM*P, where P is the depletion fraction as defined in the crop coefficient (K_c) file. To avoid crop stress, the calculated soil moisture deficit should not fall below the readily available moisture.

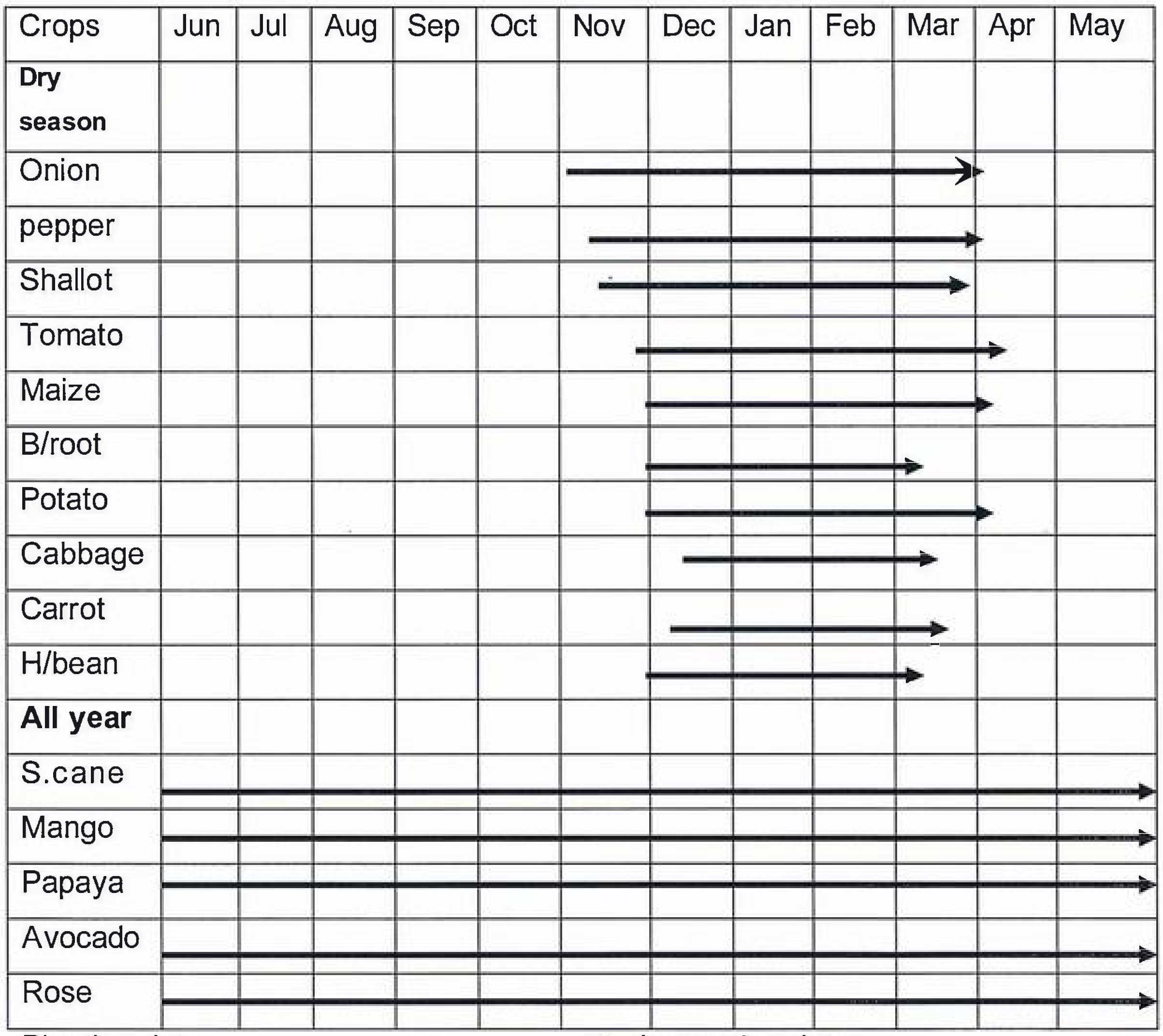
5.4 Irrigation efficiency

Irrigation efficiency is normally expressed in terms of the amount water stored in the root zone as a percentage of the total water released at the project head works. It is separated in to three components: the conveyance efficiency (E_c), the field canal efficiency (E_b) and the field application efficiency (E_a) or project efficiency $E_p=E_c*E_b*E_a$ (FAO Irrigation and drainage papers No. 24).

Irrigation efficiency (E_p) is expressed in terms of water loss (m_3/m^3).For practical purposes; it is normally considered as constant over the growing season. However, in most cases efficiencies will vary over the season. For the present research, taking in to consideration of the length of main canals and the nature of both main canal and field canal whether they are lined or unlined as well as the soil nature that is medium soil, the efficiency of irrigation has been taken as conveyance efficiency (E_c) 80%, field canal efficiency (E_b) 80% and field application efficiency (E_a) 60% these all will yield the over all irrigation efficiency (E_p) of 38.4%.But for the Densho Modern Flowering Farm project taking in to consideration of the controlled application of water and the distribution system of drip irrigation with very precise control the irrigation efficiencies have been taken as 90, 80 and 70 percent for conveyance efficiency, field canal efficiency and field application efficiency has been taken respectively. This leads to overall Irrigation efficiency of 50 percent.

5.5 Crop Calendar

Both dry season and wet season crops are cultivated in the study area. Onion, pepper, tomato, maize and potato are the major dry season crops widely grown in the irrigated lands. Allocated area for these crops is about 60%. Planting time for the dry season crops are within one-month from November-01 depending on wet season crops harvest and soil preparation.



Planting date ⟶ harvesting date

Figure 5.1. Typical Crop calendar of the study area.

The other small vegetables crops are also grown in the same season that will have about 30% allocated area. The rest are all year or perennial crops that comprise 10% allocated area and they can be grown starting from June-01 figure (5.1).

5.6 Irrigation potential under the reservoir system

The maximum irrigation potential data that can be irrigated under the reservoir system has been collected from Agricultural office, Irrigation Department of Adaa Liben as shown in table (5.1).

Table 5.1. Maximum Irrigation potential of the reservoir system.

S.No	Project name	Size in hectare
1.	**Under Wadecha reservoir**	**783**
1.1	Keteba Gembi	300
1.2	Goa Workie	200
1.3	Godino	200
1.4	Harawa	83
2.	**Under the Belbela reservoir**	**817**
2.1	Dhanama	100
2.2	Belbela	100
2.3	Ful-Tino	85
2.4	Densho Modern Flower Farm	532
Total		**1600**

5.7 Model Outputs

After entering all the data, CROPWAT for windows automatically calculates the results as tables or plotted in graphs. The time step of the results can be any convenient time step: daily, weekly, decade or monthly. The out put parameters for each schemes and crops in the cropping pattern are:

- Reference Crop Evapotranspiration - ET_o (mm/period)
- Crop Coefficient K_c - average value of crop coefficient for each time step;
- Effective Rain (mm/period) – the amount of water that enters the soil;
- Crop Water Requirements – CWR or ET_m (mm/period);
- Irrigation Water Requirements – IWR (mm/period);
- Field Water Supply – FWS (l/se/ha);
- Total Available Moisture – TAM (mm);
- Readily Available Moisture – RAM (mm);
- Actual Crop Evapotranspiration – Etc (mm);
- Ratio of actual crop Evapotranspiration to the maximum crop Evapotranspiration – Et_c/ET_m (%);
- Daily Soil Moisture deficit (mm);
- Irrigation interval (days) and irrigation depth applied (mm);
- Lost irrigation (mm) – irrigation water that is not stored in the soil , (i.e. either surface runoff or percolation);
- Estimated yield reduction due to crop stress (when Et_c/ET_m fall below 100 percent).

5.8 Irrigation Water Requirements Calculation

Crop water requirements (CWR) are calculated on the basis of monthly effective rainfall (P_{eff}) and reference Evapotranspiration (ETo), the first being calculated from average rainfall following the dependable rain method and the later being calculated following the Penman-Montieth approach (FAO,1992). Dependable rain method of effective rainfall estimation has been proceeded as the following procedure.

$$\text{Effective rainfall} = 0.6 * \text{Totalrainfall} - 10 \text{..................(Totalrainfall} < 70\text{mm/month)}$$

$$\text{Effectiverainfall} = 0.8 * \text{Totalrainfall} - 24 \text{...................(Totalrainfall} > 70\text{mm/month)}$$

For a given crop, i, and a given cropping period, j:

$$CWR_j = \sum_{i=1}^{N} \left(K_{cit} * ET_o - P_{eff} \right) \text{ ....Unit mm/period}$$

Where K_{cit} is the crop coefficient of a given crop, i, during the stage, t, and N is the total number of crops in that period. Each period has its own water requirement for the total number of crops in that period. Net irrigation water requirements (NIWR) in a specific scheme for a given period is thus the product of individual crops water requirements and irrigation area in a specific scheme for a given period are the product of individual crop water requirements (CWR_j) calculated for each period and the percentage of area cropped in the same period.

$$NIWR_j = CWR_j * S_j \text{ ....Unit m}^3\text{/se}$$

Where S_j is the total area in period, j, for a specific scheme. To account for losses of water incurred during conveyance and application to the field, an efficiency factor that were mentioned in section 5.4 should be included when calculating the irrigation water requirements for a scheme. The efficiency (E_p) of water distribution covers the efficiency of water conveyance, the field canal efficiency and field application efficiency as described earlier. It results in the gross irrigation water requirements (GIWR) per period.

$$GIWR_j = \frac{NIWR_j}{E_p} \text{..............................} \text{ Unit in } m^3/se$$

The calculated reference crop evapotranspiration (ETO), crop water requirements (CWR) and irrigation water requirements (IWR) of the projects under the reservoirs system by the CROPWAT model have been shown as in the figure 5.2

5.9 Obtained results for research

The values of Irrigation water requirements for each scheme which can be served from each reservoir has been determined by using the data prepared in the previous section (crop types obtained from the design reports of the irrigation projects and from the field survey collected by asking farmers of the projects area) and CROPWAT software. The irrigation water requirements of each irrigation projects are calculated on the monthly base that can be used in the reservoir simulation of the next research steps. The results of monthly gross irrigation water requirements (GIWR) are shown in the Tables 5.4 below.

Cropping patterns of the irrigation projects under each reservoir has been as shown in Table 5.2 and 5.3.

Table 5.2 Cropping pattern of the Wadecha Reservoir irrigation projects

	Keteba Gembie SSIP				
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Onion	75	25	1-Nov	26-Mar
2	Shallot	90	30	5-Nov	30-Mar
3	Vegetables	45	15	10-Nov	13-Feb
4	Tomato	30	10	15-Nov	14-Apr
5	Maize	15	5	1-Dec	31-Mar
6	Avocado	15	5	1-Jun	1-Jun
7	Papaya	30	10	1-Jun	1-Jun
	Total	300	100		
	Goa Workie SSIP				
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Onion	80	40	1-Nov	26-Mar
2	Shallot	13	6.5	5-Nov	30-Mar
3	Vegetables	5	2.5	10-Nov	13-Feb
4	Tomato	10	5	15-Nov	14-Apr
5	Maize	20	10	1-Dec	31-Mar
6	Sugar cane	40	20	1-Jun	1-Jun
7	Papaya	5	2.5	1-Jun	1-Jun
8	Potato	15	7.5	1-Dec	20-Apr
9	Cabbage	7	3.5	5-Dec	15-Mar
10	Mango	5	2.5	1-Jun	1-Jun
	Total	200	100		
	Godino SSIP				
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Onion	52	26	1-Nov	26-Mar
2	Pepper	19	9.5	5-Nov	30-Mar
3	Vegetables	5	2.5	10-Nov	13-Feb
4	Tomato	8	4	15-Nov	14-Apr
5	Maize	30	15	20-Nov	31-Mar
6	Beet root	14	20	1-Dec	1-Mar
7	Cabbage	7	3.5	5-Dec	15-Mar
8	Potato	40	20	1-Dec	20-Apr
9	Shallot	25	12.5	5-Nov	30-Mar
	Total	200	100		
	Harawa SSIP				
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Onion	12.5	27.3	1-Nov	26-Mar
2	Pepper	7.6	9.1	5-Nov	30-Mar
3	Vegetables	3	3.6	10-Nov	13-Feb
4	Tomato	4.6	5.5	15-Nov	14-Apr
5	Maize	12	14.5	20-Nov	31-Mar
6	Beet root	6.1	7.3	1-Dec	1-Mar
7	Cabbage	3	3.6	15-Dec	15-Mar
8	Potato	16.6	20	1-Dec	20-Apr
9	Shallot	4.5	9.1	5-Nov	30-Mar
	Total	83	100		

Table 5.3 Cropping pattern of the Belbela Reservoir irrigation projects

		Dhanama SSIP			
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Shallot	30	30	5-Nov	30-Mar
2	Tomato	20	20	15-Nov	14-Apr
3	Potato	9	9	1-Dec	20-Apr
4	Beet root	7	7	10-Dec	1-Mar
5	Carrot	7	7	5-Dec	5-Mar
6	Pepper	7	7	5-Nov	30-Mar
7	Maize	4	4	20-Nov	31-Mar
8	Cabbage	4	4	15-Dec	15-Mar
9	H.been	4	4	1-Dec	24-Feb
10	Sugar cane	5	5	1-Jun	1-Jun
11	Mango	3	3	1-Jun	1-Jun
	Total	100	100		
		Belbela SSIP			
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Shallot	30	30	25-Nov	30-Mar
2	Tomato	20	20	15-Nov	14-Apr
3	Potato	9	9	1-Dec	20-Apr
4	Beet root	7	7	10-Dec	1-Mar
5	Carrot	7	7	5-Dec	5-Mar
6	Pepper	7	7	5-Nov	30-Mar
7	Maize	4	4	20-Nov	31-Mar
8	Cabbage	4	4	15-Dec	15-Mar
9	H.been	4	4	1-Dec	24-Feb
10	Sugarcane	5	5	1-Jun	1-Jun
11	Mango	3	3	1-Jun	1-Jun
	Total	100	100		
		Fultino SSIP			
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Onion	25.5	30	25-Nov	26-Mar
2	Tomato	17	20	15-Nov	14-Apr
3	Potato	7.7	9	1-Dec	20-Apr
4	Beet root	6	7	10-Dec	1-Mar
5	Carrot	6	7	5-Dec	5-Mar
6	Pepper	6	7	5-Nov	30-Mar
7	Maize	3.4	4	20-Nov	31-Mar
8	Cabbage	3.4	4	15-Dec	15-Mar
9	H.been	3.4	4	1-Dec	24-Feb
10	Sugarcane	4.2	5	1-Jun	1-Jun
11	Mango	2.4	3	1-Jun	1-Jun
	Total	85	100		
		Densho Modern Flower Farm			
S.No	Crop Type	Area (ha)	Area of percentage (%)	Planting date	Harvesting date
1	Rose Flowers	532	100	1-Jun	1-Jun

Table 5.4. Monthly Gross irrigation water requirements of each irrigation projects based on long-term climate data

Month	Harawa	Keteba Gembi	Godino	Goawork	Ful-Tino	Densho Flower Farm	Dhanama	Belbela
	m^3	m^3	m^3	m^3	m^3	m^3	m^3	m^3
E_p %	*38.4*	*38.4*	*38.4*	*38.4*	*38.4*	*50*	*38.4*	*38.4*
Jan	118,803	1181183	236811	621918	207782	528595.2	245088	353952
Feb	160,569	1462050	341649	773388	295596	556174.1	347328	354240
Mar	111,738	1105346	288760	627141.6	253397.3	482630.4	297607.5	251204
Apr	29,727	602842.5	100324	287251.2	134842.9	468841	159042.6	96701
May	1,974	42808.5	5156	28755	6832.98	2037.56	8038.8	1224
Jun	392	20250	945	2592	214.2	147087.4	288	72
Jul	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0
Sep	980	8505	3591	20736	856.8	344736	1080	1886
Oct	2,353	26730	10017	41904	3100.545	450455	3650.4	4320
Nov	1,471	28552	10773	44496	4417.875	464244.5	5184	14117
Dec	85,993	1023638	193057	568530	137226.6	478033.9	161995.5	151443
Total	**521,039**	**3,568,878**	**1,150,340**	**2,946,837**	**876,499**	**6,031,624.2**	**1,031,175**	**1,095,123**

NB: Ep is the irrigation efficiency in percent.

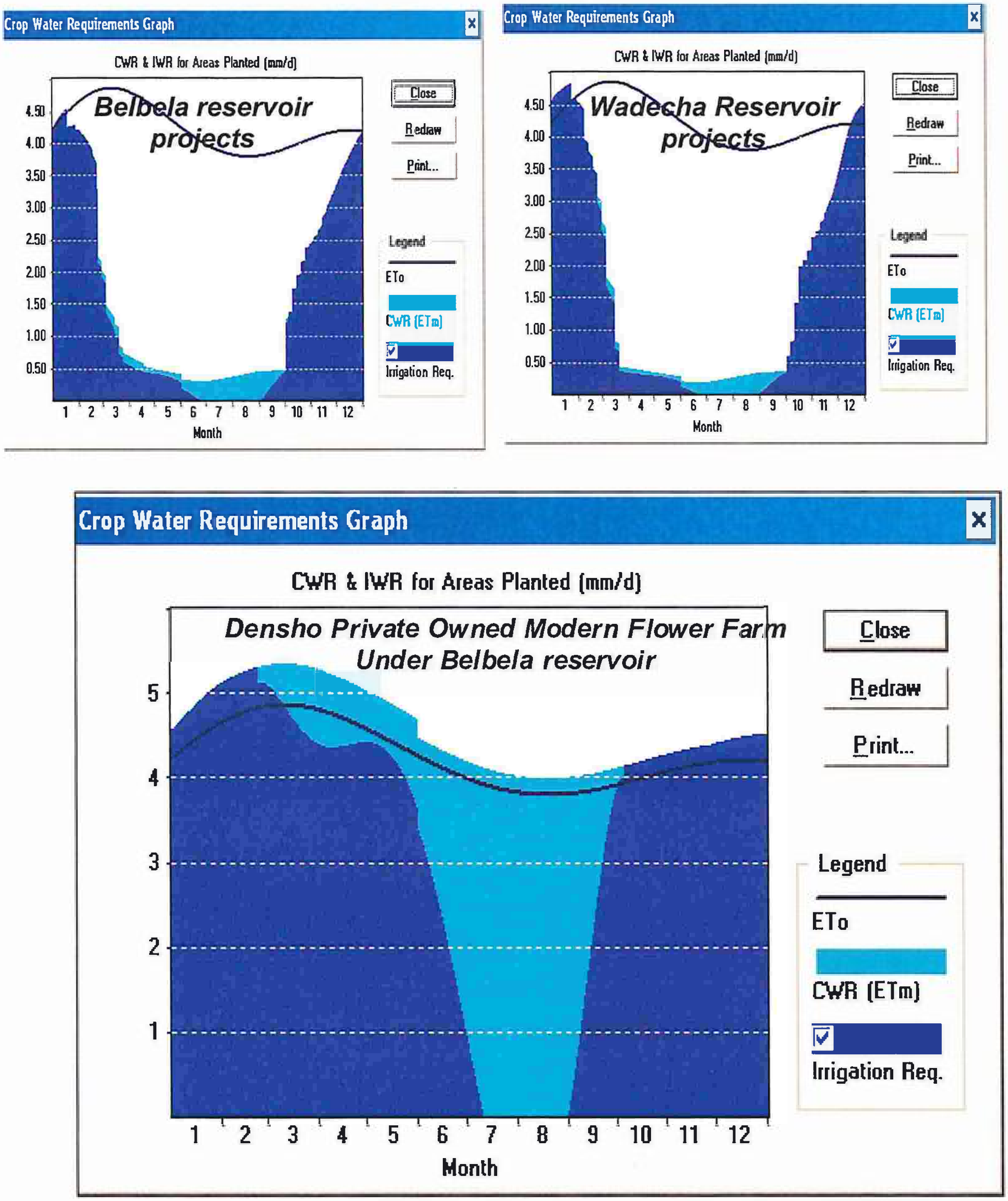


Figure 5.2 Reference crops Evapotranspiration, (ET0) Crops water requirement (CWR) and irrigation water requirement of the irrigation projects under the two reservoir system.

6. RESERVOIR SYSTEM SIMULATION MODEL (HEC-ResSim)

6.1 General

Water resources management is a complex and varied topic that requires consideration of a broad range of social, economic and environmental interests. As the world's water resources become increasingly stressed, effective tools for management become more important. One tool often used in water resources management is decision support systems. McKinney and Watkins (1995) define a decision support system as "an integrated, interactive computer system, consisting of analytical tools and information management capabilities, designed to aid decision makers in solving relatively large, unstructured problems."

HEC-ResSim is a computer program applicable in hydrologic and hydraulics of reservoir system simulation model used for research in water resources management being conducted to explore the link between decisions support system and GIS. ResSim is comprised of a graphical user interface (GUI), a computational program to simulate reservoir operation, data storage and management capabilities, and graphics and reporting facilities. The Data Storage system, HEC-DSS is used for storage and retrieval of input and output time series data (Joan D. Klipsch, 2003).

ResSim offers three separate sets of functions called *modules* that provide access to specific types of data within a watershed. These modules are Watershed Setup, Reservoir Network, and Simulation. Each module has a unique purposes and an associated set of functions accessible through menus, toolbars, and schematic (Joan D. Klipsch, 2003).

HEC-ResSim allows users to import an ArcGIS Shape files as a background layer. The shape files act as a guide for laying out the model representation of the physical system. Example inputs for HEC-ResSim include stream flow, municipal/Industrial withdrawals and returns, reservoir operations and power generation. The reservoir operations can include reservoir capacity, area-elevation-capacity curves, controlled and uncontrolled spillway capacity, diversions and evaporation. Figure 6.1 illustrates the basic modeling features available in each module.

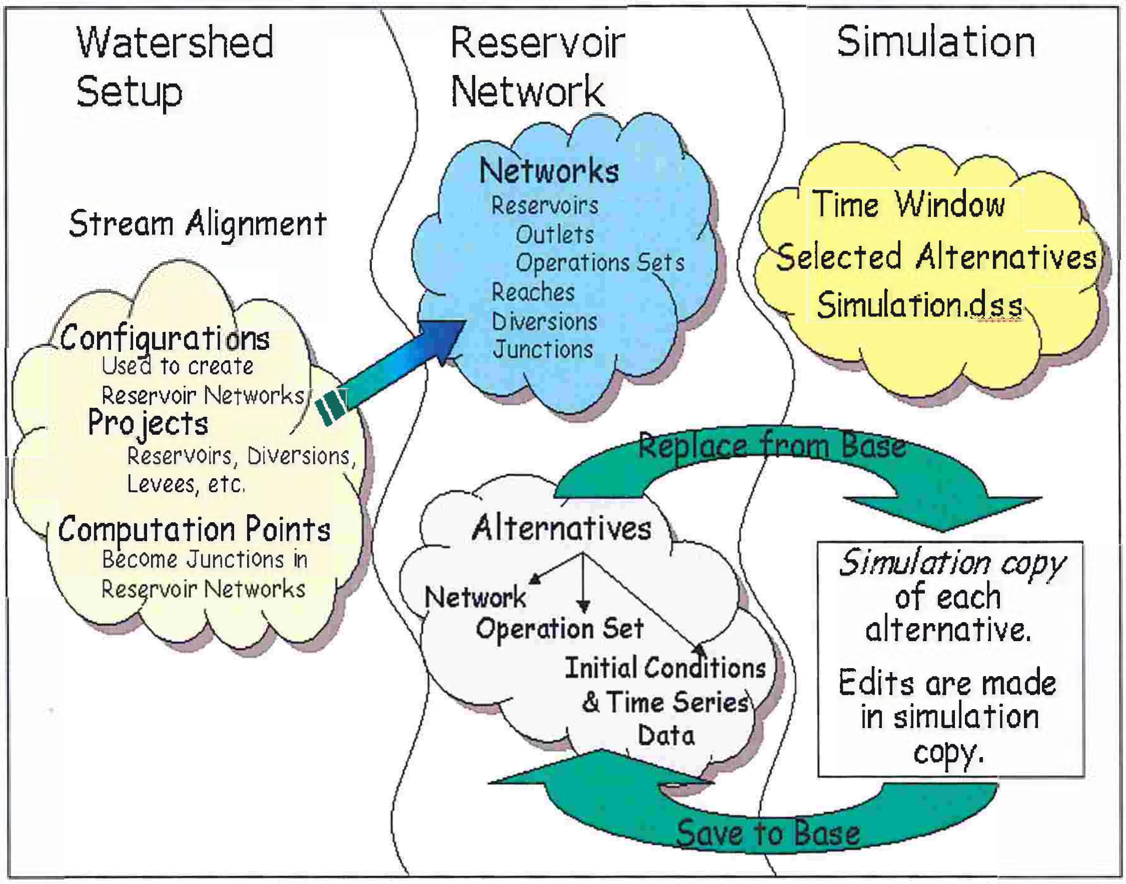


Figure 6.1 ResSim Modules concepts(Joan D. Klipsch, 2003)

6.2 Wadecha-Belbela reservoirs Watershed Setup

The purpose of the Watershed Setup module is to provide a common framework for watershed creation and definition among different modeling applications. This module is currently common to Hec-ResSim, HEC-FIA, HEC-HMS and HEC-RAS.

Wadecha-Belbela watershed is associated with a geographic region for which multiple models and area coverage's can be configured. The watershed may include all of the streams, projects (e.g., reservoirs, irrigation diversions), Computation points, impact areas, time-series locations, and hydrologic and hydraulic data points for a specific area. All of these details together, once configured, form a watershed framework of the system.

In the Wadecha-Belbela watershed Setup there are assembled items that describe a watershed's physical arrangement. Once the new watershed has been created , it is easy to import maps from external sources of Arc view GIS, by specifying the units of measure for *viewing* the watershed, adding layers containing additional information about the watershed, create a common stream alignment, and configure elements. The watershed setup of the Wadecha-Belbela reservoir system is shown as in Figure 6.2.

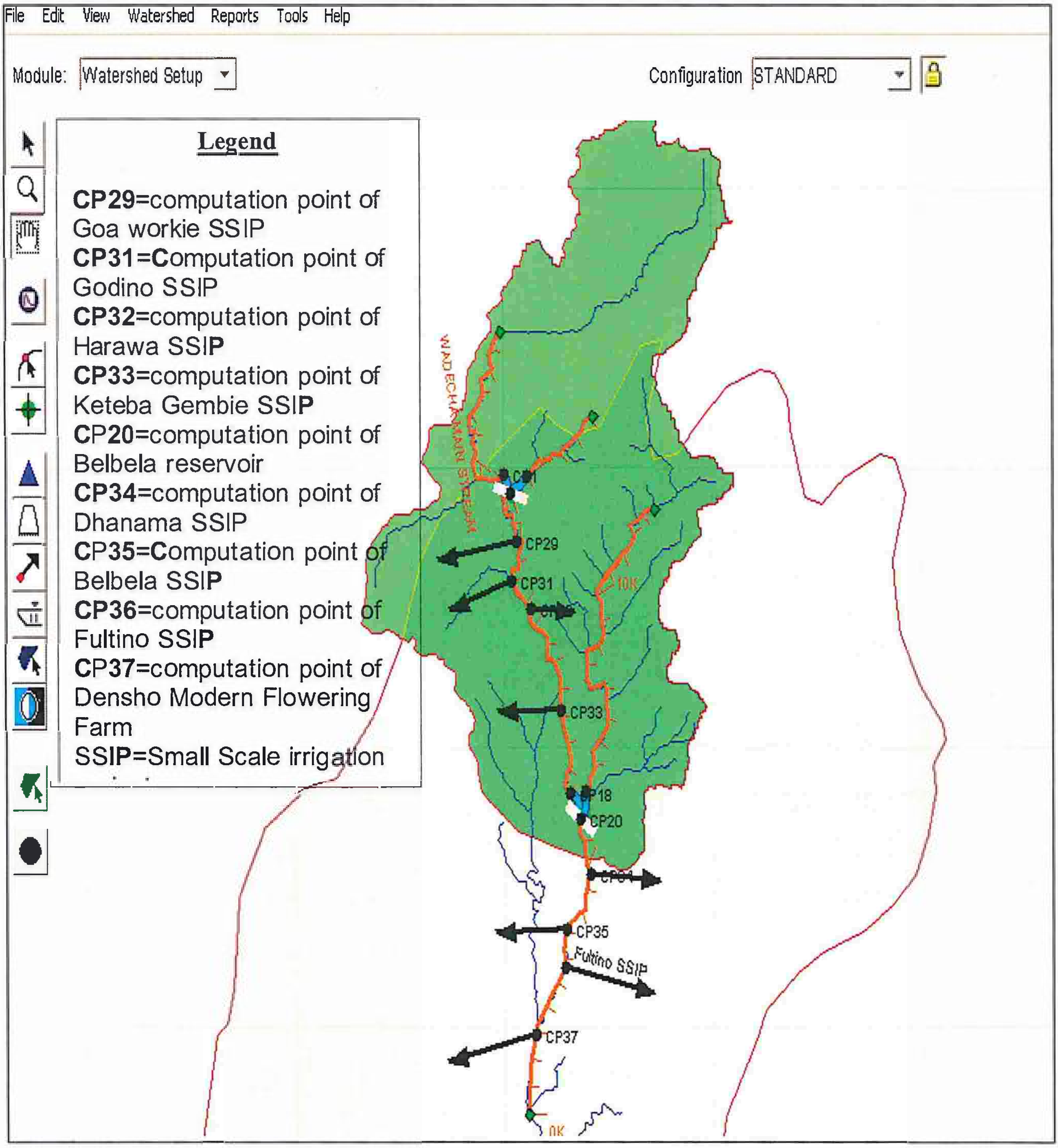


Figure 6.2. Watershed Setup of the Wadecha-Belbela reservoir system

6.3 Wadecha-Belbela Reservoir Network

The purpose of the Reservoir Network module is to isolate the development of the reservoir model from the output analysis. In the Reservoir Network module, one will build the river system schematic, describe the physical and operational elements of the reservoir model, and develop the alternatives that to be analyzed. Using configurations that are created in the Watershed Setup module as a template, the basis of a reservoir network has been created. Then the routing reaches have been added and other network elements to complete the connectivity of the network schematic as well. Once the schematic is complete, physical and operational data for each network element were defined. Also, alternatives were created that specify the reservoir network, operation set(s), initial conditions, and assignment of Dss pathnames (time-series mapping).

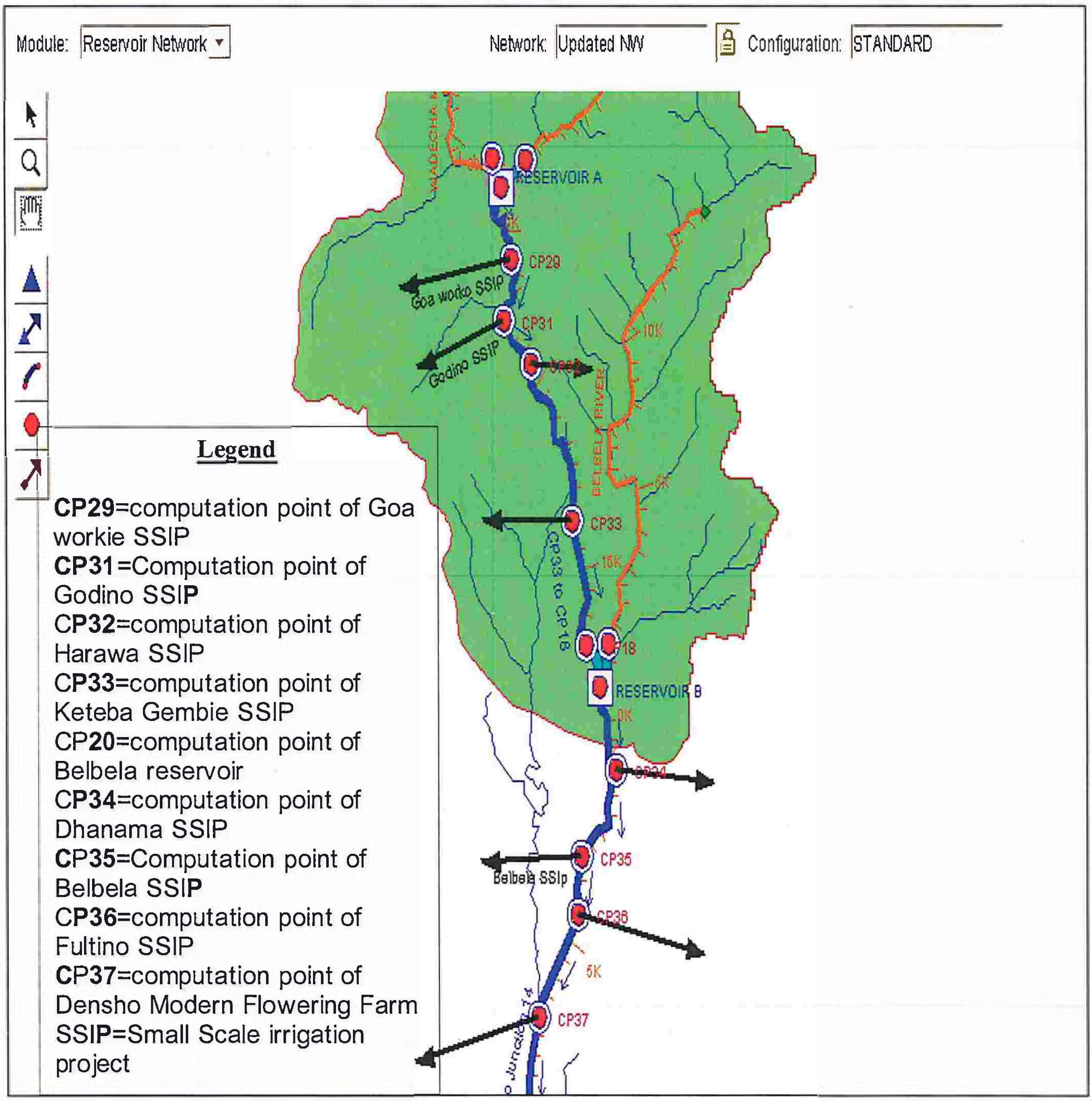


Figure 6.3. Schematic representation of the Wadecha-Belbela reservoir system

6.4 Simulation procedure and results

The purpose of the Simulation module is to separate output analysis from the model development process. Once the reservoir model is complete and the alternatives have been defined, the Simulation module is used to configure the simulation. The computations are performed and results are viewed within the Simulation module. Due to the difficulty of showing 3827 data points in tabular form, the out puts of the model have been shown graphically in the next chapter Figures 7.1 and 7.2.

During the creation of the simulation model it was a must to specify a simulation time window, a computation interval, and the alternatives to be analyzed. The time widows given for present case was starting, lock back, and end time of the simulation. Then, ResSim creates a directory structure within the *rss* folder of the watershed that represents the “simulation”. Within this “simulation” tree will be a copy of the watershed, including only those files needed by the selected alternatives. Also created in the simulation is a DSS file called simulation.dss, which will ultimately contain all the DSS records that represent the input and output for the selected alternatives. Additionally, elements can be edited and saved for subsequent simulations.

6.5 Reservoir System Operation Rules

Reservoir systems were created by defining system operation rules for the two reservoirs. ResSim provides for Tandem operation to manage the storage distribution between the upstream and downstream reservoirs on the same stream. Tandem operations were created by applying a Tandem rule at an upstream Wadecha reservoir operating for a down stream Belbela reservoir.

When a Tandem or parallel reservoir system is defined, the model determines the priority and the amount of release to make from each reservoir in order to operate to wards a storage balance. For every decision interval an end-of-period storage is first estimated for each reservoir based on the sum of beginning –of-period storage and period average inflow volume, minus all potential out flow volume. The estimated end-of-period storage for each reservoir was compared to a desired storage that is determined by using a system storage balance scheme.

There are two methods by which the desired storage balance is determined: Implicit and explicit. Implicit method is used when the reservoir system is established-either by adding a Tandem operation rule to an upstream reservoir operating for downstream. But explicit method is a user defined method used for determining the desired storage balance in the reservoir system. The Wadecha-Belbela reservoir is a two-reservoir Tandem system. Wadecha reservoir is the upstream reservoir where a Tandem operation rule has been applied in its operation set. This establishes an implicit system operation with the downstream reservoir, Belbela reservoir. As the two reservoirs have different amount of storage capacity (Wadecha 15 Mm3 and Belbela 12 Mm^3), the guide curve has been set to be the top of conservation zone (i.e. spillway level) for each reservoirs.

In the implicit system operation, a release decision is made for a particular time period may not necessarily achieved the desired balance. The reservoirs in the system are considered “in balance “when both reservoirs have reached their guide curves, or they are operating at equivalent storage levels in terms of percentage of their counter part system storage zones.

6.6 Input data

The main input data of the Wadecha-Belbela reservoir system was the runoff flows estimated by SCS curve method in the previous section from the daily rainfall data and the watershed map created and exporting from the Arc View GIS 3.3 that was already developed by delineating the map of the watershed area fro the DEM data. These databases contain both spatial and temporal informations about the entire system, including the reservoirs location, diversions and informations about the reservoirs. The other data were collected from many governmental agencies like Oromia irrigation development authority Central Branch, Adaa woreda Agricultural office and Ministry of water resources Development of Ethiopian.

The two reservoirs are found 15 Km far apart from each other and the Wadecha reservoir is the upper most one which traps more runoff from its catchment. Water released from Wadecha reservoir is irrigating the Godino, Goa Workie, Keteba Cembi, and Harawa irrigation projects and at last the water emptied to the Belbela dam, which is also a flood harvesting dam and is not fed by Perennial River. It is cascaded with Wadecha dam to supply irrigation water to Belbela, Ful-Tino, Dhanama, and Densho private owned modern flower farm schemes (Figure 6.3).

The object classes related to these two reservoirs were created containing reservoir operations information that can be integrated in to HEC-ResSim. These object classes include monthly average evaporation appendix-6A, figure 6-A1, 6-A2, 6-A3 and 6-A4 and reservoir area-elevation curves, and monthly average irrigation diversions (table 5.2). The dam capacity table the elevation related to the top of the flood storage, the total height of the dam and the total capacity of the reservoirs appendix-6A figure (6-A5 and 6-A6). Reservoirs data was obtained from the Oromia Irrigation development authority Central branch that was reported during the design of the reservoirs. The reservoir area-elevation-capacity curves data at a short interval has been interpolated in the model by using conic interpolation method based on the data in section 1.6.2.

6.7 Transferring data to HEC-Dss tools

HEC-DssVue is a tool for transferring time series data from HEC-DSS database storage to a working space or it allows to access data stored in HEC-DSS database. The tool is comprised of two visual basic executable that utilize an object library and object classes within the database structure (DSS catalogs) and contains all relevant records and descriptors to automatically transfer the time series data during simulation process. The time series data of the reservoirs have been stored in HEC-DssVue file. This data is the runoff flows to the reservoirs estimated in chapter 3 from the year 1995 to 2003.

The irrigation requirements of the system have been entered for each irrigation projects in the diversion editor appendix 6-A, Figure (6-A7and 6-A8). These values are obtained from CROPWAT model processed in the previous section. These values are based on the monthly irrigation requirements of the schemes.

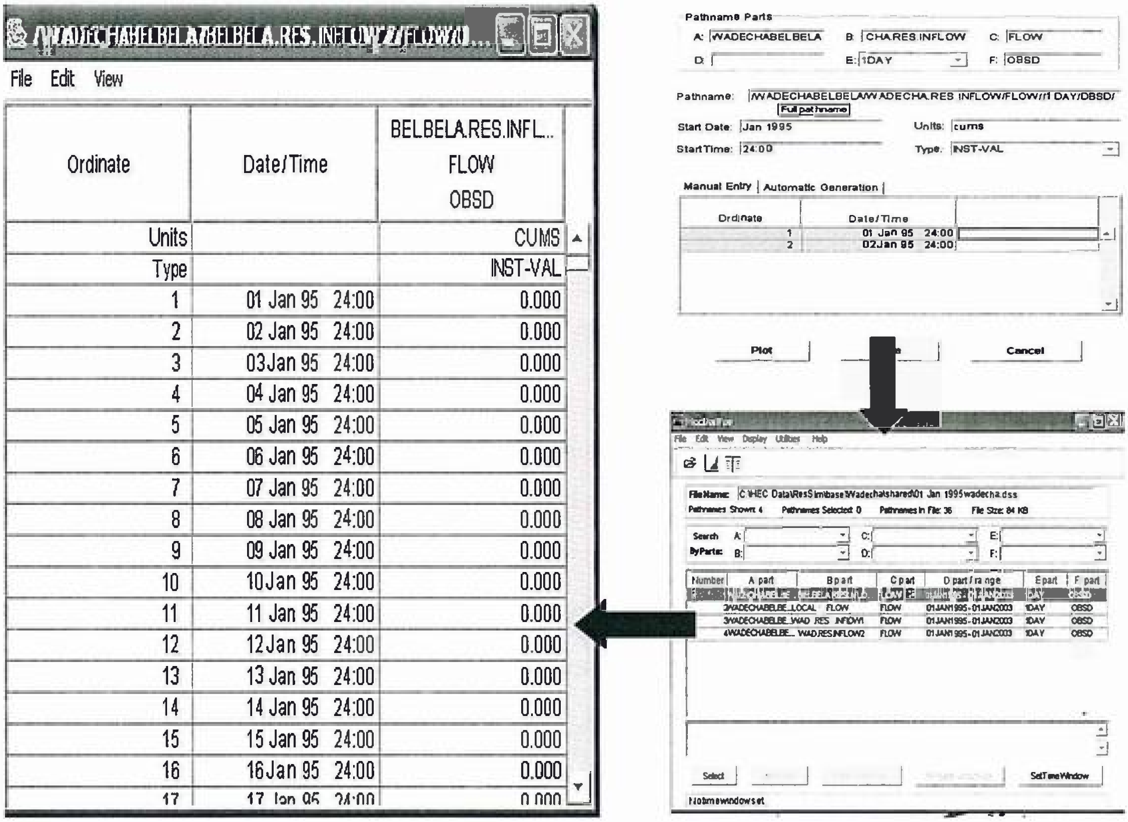


Figure 6.4. Time series transfer database and HEC-DSS

A key step in transferring a time series data from the database storage in to the DSS format is the creation of DSS catalog in side the database. DSS catalog is the object class table within the database that contains the information related to the DSS data and its pathname. The DSS pathname consists of six parts in the following format.

A/B/C/D/E/F

Where:

- A - Group name for the data such as a watershed name, study name, or any identifier which allows the records to be recognized as belonging to a group.

- B - The location identifier for the data. The location identifier may be a site name or organization ID such as NMSA gage name.
- C – The parameter of the data such as flow, precipitation, storage or evaporation.
- D – The start date of the time series.
- E – The time interval for regular data or the block length for irregular interval data.
- F – An optional descriptor that can be used for additional information about the data.

6.8 Modeling activities

The activities include building the modules, the time series conservation, entering the reservoirs network data and performing the HEC-ResSim simulation. The model consisting of the stream alignments that defines the flow coming in to the system and a representation of Wadecha-Belbela Reservoir system (figure 6.3). A simple operational simulation was done for the year 1995 to 2003 based on the daily time series data. The time series is only the runoff flows to the reservoirs. The reservoirs characteristics data such as reservoir area –elevation-capacity and irrigation diversion data's were entered through the editors.
The DSS catalog created for the reservoir system contains seven fields including the data number (Figure 6.4).

When converting time series data in to HEC-DSS format it is important that the time series be continuous, without gaps in the dates. After converting the time series data in the HEC-DSS file format it can be used in the simulation by setting the path to DSS-path for each inflow points to the reservoirs in the alternative editors. The final DSS time series files are shown in the Figure 6.4.

In addition to the time series data, reservoir data had to be entered in to the HEC-ResSim model. This information includes reservoir operations, elevation-area-capacity curves and average monthly evaporation. All of this data is entered in to HEC-ResSim Reservoir editor. For this data, copy and paste process was utilized to transfer it from EXCEL Spreadsheets in to the reservoir editor.

Appendix-6.A show the data used in the project with screen captures of the data entry screens in HEC-ResSim and Table 6.1 and 6.2 show the two reservoirs characteristics.Appendix-7.A show the all the daily data generated from each catchments of the reservoirs by using SCS curve method.

Table 6.1. Wadecha Reservoir Characteristics

Elevation(m)	Storage(m^3)	Area (ha)	Remark
2399.5	0	0	Bed level
2400.5	1333.33	0.2	
2401.43	10113.95	2	
2402.37	45225.69	5.8	
2403.3	120372.54	10.6	
2404.23	261636.49	20.3	
2405.17	540287.62	40.1	
2406.1	1006581.89	60.9	Dead storage Level
2407.03	1662865.6	80.7	
2407.97	2512805.7	100.5	
2408.9	3529871.36	118.47	
2409.83	4714265.31	136.45	
2410.77	6080483.83	154.42	
2411.7	7590934.25	170.54	
2412.63	9251370.01	186.66	
2413.57	11081248.59	202.78	
2414.5	13041629.26	218.91	
2415	14176222.76	235.03	Conservation level
2416.5	17821872.21	251.15	
2417.5	20413547.19	267.27	Top level

Table 6.2 Belbela Reservoir characteristics

Elevation (m)	Storage (m^3)	Area (ha)	Remark
1919	0	0	Bed level
1919.84	25576	4.17	
1920.67	76502.78	8.34	
1921.51	163522.45	12.52	
1922.34	284330.08	16.69	
1923.18	441714.91	20.86	
1924.02	634187.12	25.03	
1924.85	859059.98	29.21	
1925.69	1121743.28	33.38	Dead storage level
1926.53	1419477.53	37.55	
1927.36	1748296.2	41.72	
1928.2	2116160.53	45.9	
1929.03	2514310.65	50.07	
1929.87	2952295.91	54.24	
1930.71	3425317.82	58.41	
1931.54	3927367.91	62.59	
1932.38	4470543.78	66.76	
1933.22	5048753.36	70.93	
1934.05	5654695.48	75.1	
1934.89	6303012.24	79.28	
1935.72	6978267.82	83.45	
1936.56	7696690.65	87.62	
1937.4	8450144.8	91.79	
1938.23	9229284.43	95.97	
1939.07	1.01E+07	100.14	
1939.91	1.09E+07	104.31	
1940.74	1.18E+07	108.48	Conservation level
1941.58	1.27E+07	112.66	
1942.41	1.37E+07	116.83	
1943.25	1.47E+07	121	
1944.08	1.57E+07	133.62	
1944.92	1.69E+07	146.24	
1945.75	1.82E+07	158.86	Top level

7. RESULTS AND DISCUSSIONS

7.1 Results of the irrigation water requirements

The irrigation water requirements of the projects under the reservoir system have been estimated from climatic variables of the area and crop data by using the CROPWAT model. The area of irrigation projects under the Wadecha and Belbela reservoirs annually are about 783ha and 817ha respectively. The details of areas of irrigation projects under each reservoir are in section 5.6 Table 5.1. The time step used in the model was 10 days and it has been changed to monthly time step after the model output. These irrigation water requirements values have been changed to volumetric parameter and compared to the reservoirs useful capacity so that it can not be greater than the reservoirs capacity.

The irrigation water requirements results obtained in the pervious section 5 from CROPWAT can be summarized as Table 7.1 and Table 7.2 below with respective to each reservoir. These summarized irrigation water requirements of the projects under each reservoirs are the values used in the reservoir simulation system. The total sum column of the table is the release required for each reservoir to meet the irrigation water demand of the projects under the reservoir system.

The irrigation water requirements of the projects have been estimated by taking in to consideration of the maximum area coverage of the crops during the whole dry season's period Figure 5.2. Therefore, the summarized irrigation water requirements can be used in the establishment of operational release polices of the reservoirs.

Table 7.1. The gross irrigation water requirements diverted at the dam outlets (estimated by CROPWAT)

Month	Wadecha Reservoir projects					Belbela reservoir projects				
	Harawa	Keteba	Godino	Goawork	Total	Fultino	Densho	Dhanama	Belbela	Total
	m^3/s	*m^3/s*	*m^3/s*	*m^3/s*	***m^3/s***	*m^3/s*	*m^3/s*	*m^3/s*	*m^3/s*	***m^3/s***
Jan	*0.11*	*0.72*	*0.22*	*0.57*	***1.62***	*0.17*	*1.23*	*0.20*	*0.26*	***1.86***
Feb	*0.15*	*0.88*	*0.31*	*0.71*	***2.04***	*0.24*	*1.31*	*0.28*	*0.14*	***1.96***
Mar	*0.09*	*0.63*	*0.25*	*0.54*	***1.51***	*0.20*	*1.16*	*0.23*	*0.01*	***1.58***
Apr	*0.02*	*0.29*	*0.06*	*0.20*	***0.56***	*0.10*	*1.11*	*0.11*	*0.01*	***1.30***
May	*0.00*	*0.02*	*0.00*	*0.02*	***0.05***	*0.01*	*1.03*	*0.01*	*0.01*	***1.04***
Jun	*0.00*	*0.01*	*0.00*	*0.00*	***0.01***	*0.00*	0.56	*0.00*	*0.00*	***0.56***
Jul	*0.00*	*0.00*	*0.00*	*0.00*	***0.00***	*0.00*	0.00	*0.00*	*0.00*	***0.00***
Aug	*0.00*	*0.00*	*0.00*	*0.00*	***0.00***	*0.00*	0.00	*0.00*	*0.00*	***0.00***
Sep	*0.01*	*0.01*	*0.01*	*0.03*	***0.06***	*0.01*	0.59	*0.01*	*0.01*	***0.60***
Oct	*0.01*	*0.02*	*0.01*	*0.04*	***0.07***	*0.01*	1.05	*0.01*	*0.11*	***1.16***
Nov	*0.01*	*0.06*	*0.02*	*0.09*	***0.17***	*0.01*	1.09	*0.01*	*0.21*	***1.32***
Dec	*0.07*	*0.56*	*0.16*	*0.45*	***1.24***	*0.100*	1.12	*0.12*	*0.27*	***1.61***

Table 7.2 Irrigation water requirement for different projects according to CROPWAT results based on long-term climate data.

Project name	Area (ha)	GIWR (m^3/ha)	GIWR (m^3)
Wadecha Reservoir projects			
Harawa	83	6,277.6	521,039.45
Goa Workie	200	14,734.2	2,946,837.1
Godino	200	5,751.7	1,150,340.3
Keteba Gembi	300	11,896.3	3,568,878.2
Total	783	-	8,187,095
Belbela Reservoir projects			
Dhanama	100	10,311.75	1,031,174.9
Belbela	100	10,951.23	1,095,123.2
Ful-Tino	85	10,311.75	876,498.7
Densho Flower Farm	532	11,337.64	6,031,624.2
Total	817	-	9,034,421

7.2 The inflow-out flow of the reservoirs

The results obtained from the simulation of model for nine years of time series data show that the reservoirs are full once every year figures 7.1 & 7.2. Since the reservoirs are full once every year, they can store useful amount of water volume that can be used for the irrigation requirements. Therefore; climatically the reservoirs can fulfill the required demand and they would not be dry in any year or the required capacity of the reservoirs will be obtained every year. This means that 85% useful storage capacity of the reservoirs can be obtained. The simulation has been carried out assuming that there is continuous flow through the controlled outlet and throughout the simulation period. Even though, there is controlled outflow throughout the year the reservoir is at full condition once a year.

Since the reservoirs are at full level once every year, then there is a possibility of obtaining the useful capacity of the reservoirs once a year. In this way; it is important to estimate the irrigation supply from each reservoir. A simple water balance can be done on the system. The total useful volume of each reservoir is necessary to be checked in balance of the total irrigation water requirements of the projects under each reservoir..

The inflow data series to the reservoirs are mainly from the respective streams Wadecha and Belbela Rivers. These two rivers are unguaged. The inflow data was estimated from the rainfall data of the available station in their catchments. The outputs of the reservoirs are obtained from the calibration of the model. The annual volumetric distributions of the input-output of the reservoirs are also presented in Figures 7.3 and 7.4.

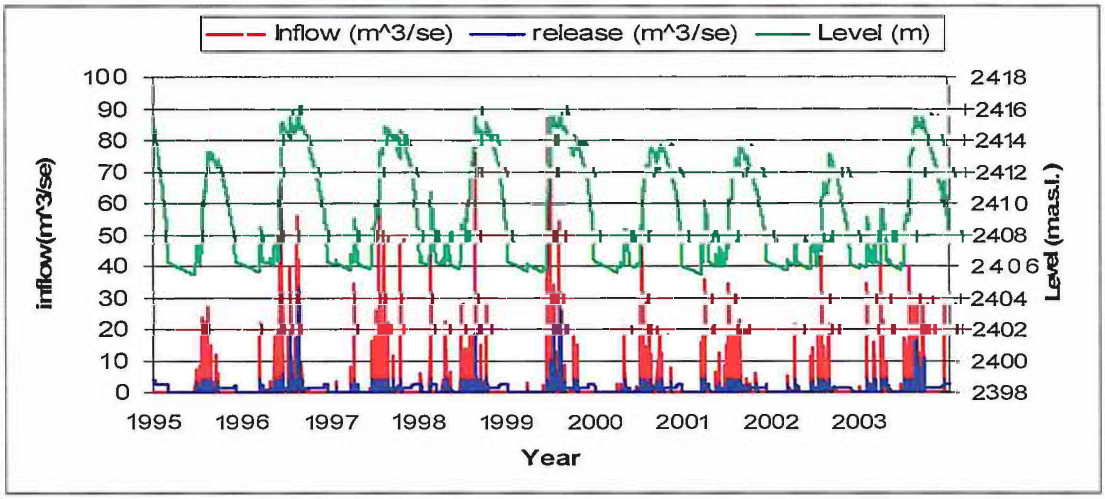


Figure 7.1. Wadecha reservoir water level and inflow-outflow rate

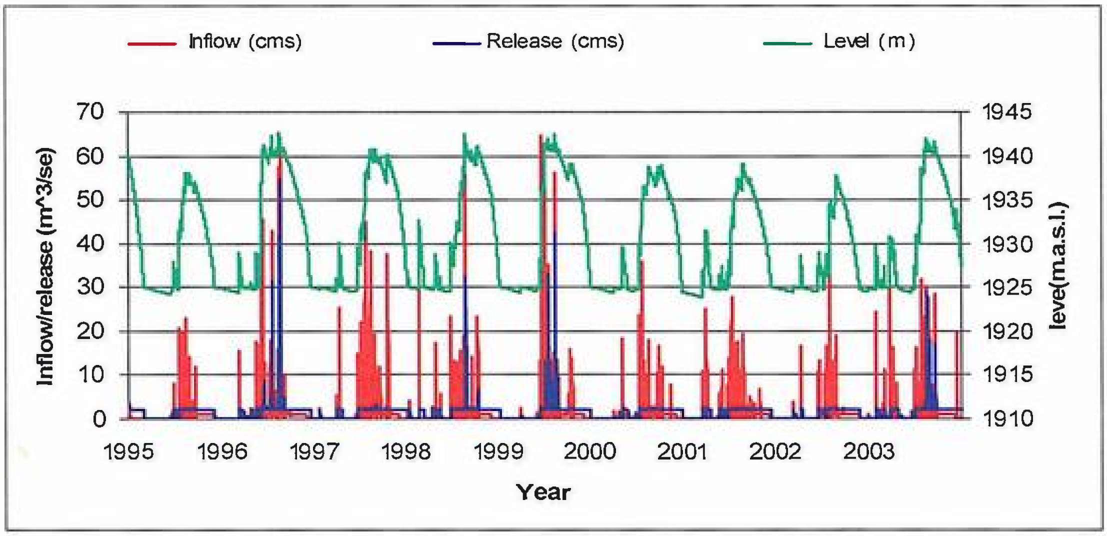
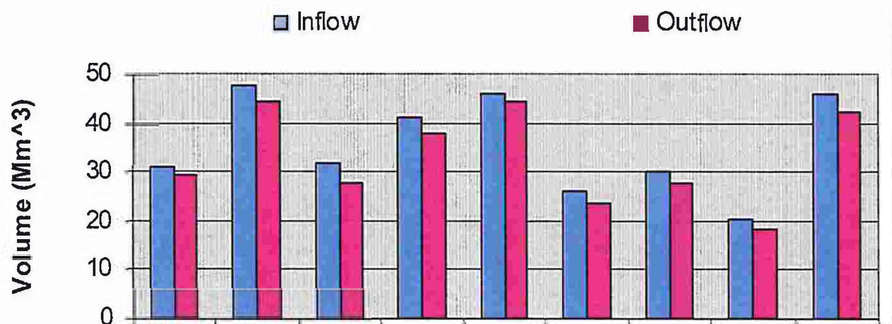


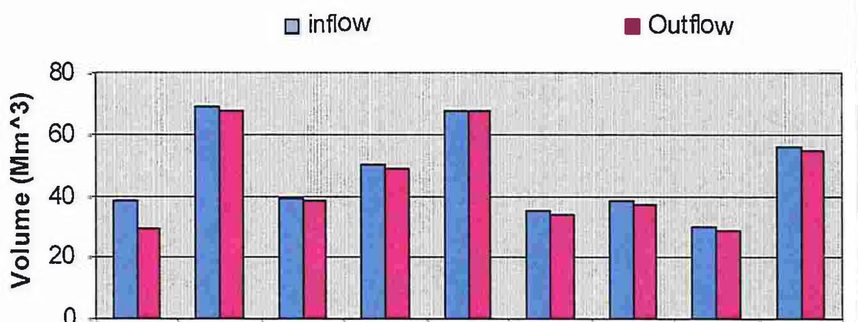
Figure 7.2. Belbela reservoir water level and inflow-outflow rate



	1995	1996	1997	1998	1999	2000	2001	2002	2003
Inflow	30.8	47.45	31.81	40.95	46.1	25.96	30.24	20.5	46.1
Outflow	29.15	44.16	27.51	37.76	44.3	23.47	27.6	18.4	42.23

Year

Figure 7.3 Annual input and output volumes of Wadecha reservoir



	1995	1996	1997	1998	1999	2000	2001	2002	2003
inflow	38.4	68.85	38.8	50.28	67.92	35.16	38.63	29.65	56.2
Outflow	29.46	67.34	38.27	48.76	67.58	34.1	37.3	28.66	54.4

Year

Figure 7.4. Annual input and output volumes of Belbela reservoir

7.3 Comparison of Useful storage and Irrigation requirement

The storage capacity of the reservoirs can be estimated by subtracting the storage value at dead storage elevation from the storage value of spill level simulated by the model every year. For each reservoir the useful storage is shown in the Tables 7.3 and 7.4. These values are greater than the demand of irrigation water requirements. As it can be seen from the Tables the difference between the useful storage and irrigation requirements in all years are positive and there is no deficit occurred at all for the Wadecha dam.

The minimum volume difference was occurred in the year 2002. This is due the less rain fall in that year and it can be referred to the rainfall-runoff simulated in the previous section 4.6.

Table 7.3. The simulated storage and irrigation requirement relationship of Wadecha reservoir.

Year	Maximum Water level (m)	Maximum water stored (m^3)	Useful volume stored (m3)	Irrigation demand (m^3)	Difference (m^3)
1995	2413.3	1.06E+07	9,770,672	8,187,095	1,583,577
1996	2416.2	1.43E+07	13,477,205	8,187,095	5,290,110
1997	2414.9	1.42E+07	13,442,235	8,187,095	5,255,140
1998	2416	1.43E+07	13,477,205	8,187,095	5,290,110
1999	2416.1	1.43E+07	13,477,205	8,187,095	5,290,110
2000	2413.8	1.17E+07	10,894,113	8,187,095	2,707,018
2001	2413.4	1.16E+07	10,794,311	8,187,095	2,607,216
2002	2413.1	1.03E+07	9,507,406	8,187,095	1,320,311
2003	2415.7	1.43E+07	13,477,205	8,187,095	5,290,110
Average		**1.28E+07**	**12,035,284**	**8,187,095**	**3,848,189**

Table 7.4. The simulated storage and irrigation requirement relationship of Belbela reservoir.

Year	Maximum Water level (m)	Maximum water stored (m^3)	Useful* volume stored (m^3)	Irrigation demand (m^3)	Difference (m^3)
1995	1938.1	9,147,123	8,477,123	9,034,421	-557,298
1996	1942.6	1.17E+07	10,809,805	9,034,421	1,775,384
1997	1940.8	1.17E+07	10,809,805	9,034,421	1,775,384
1998	1942.2	1.17E+07	10,809,805	9,034,421	1,775,384
1999	1942.5	1.17E+07	10,809,805	9,034,421	1,775,384
2000	1938.9	9,884,895	8,994,700	9,034,421	-39,721
2001	1939.1	1.01E+07	9,209,805	9,034,421	175,384
2002	1937.7	8,725,941	8,055,941	9,034,421	-978,480
2003	1941.9	1.17E+07	10,809,805	9,034,421	1,775,384
	Average	**1.07E+07**	**9,865,177**	**9,034,421**	**830,756**

As the rainfall of the catchments has been decreasing starting from the year 1999 to 2003, the useful storages of the reservoirs are also decreasing in the same range of time. But the irrigation projects have not been affected by drought. This condition was checked from the field survey during the interview of farmers in the project areas.

The same procedure has been proceeded for the Belbela dam and the results are tabulate as shown in table 7.4. In this case, the useful storage of the reservoir is less than the irrigation water requirements of the projects under the reservoir in some years. For example; in 1995, 2000, and 2002 the difference shows deficit of supply. These deficits of supply can be compensated by building number of ponds along the reservoir system to store more water or the upstream Wadecha reservoir can supply in the same years. Wadecha dam can supply water required at any time to compensate the deficit of Belbela dam,

* The useful volume of each reservoir at every year was calculated by subtracting the dead storage from the storage of reservoirs below the spillway level, the maximum of spillway level storage at the year of maximum storage.

because as it can be observed from the Table there is a surplus of water that can be released to compensate the deficiency occurred.

In general it can be considered to estimate that the whole system can serve the existing potential demand without failure. The average surplus of water in the two reservoirs will be estimated as 4.68Mm^3 for the simulation period.

7.4 Operation of the reservoirs

The maximum abstraction scenario was considered for the analysis of the reservoirs operation and the condition of reservoirs water supply with the balanced demand has been satisfied.

The results of monthly irrigation requirements release and the monthly inflow of the reservoirs have been displayed in the Figures 7.5 and 7.6 as shown below. From the Figures it can visualize that the total amount of runoff over the catchments of each reservoirs are much greater than the irrigation requirements of the projects under the reservoir system. This is caused mainly due to the total amount of rainfall over the system catchment is very high.

The results of the analysis of the release policies of each reservoir are revealed as shown in the Table 7.5 below. The releases of each reservoir indicated are estimated for 10 hours per day. Accordingly, the level of each reservoir to be maintained at each month is indicated in the Table. It is important, scientific and method of efficient use of limited water resources to release the water stored in the wet season in each reservoir according to the requirement of irrigation water by the crops during the dry season.

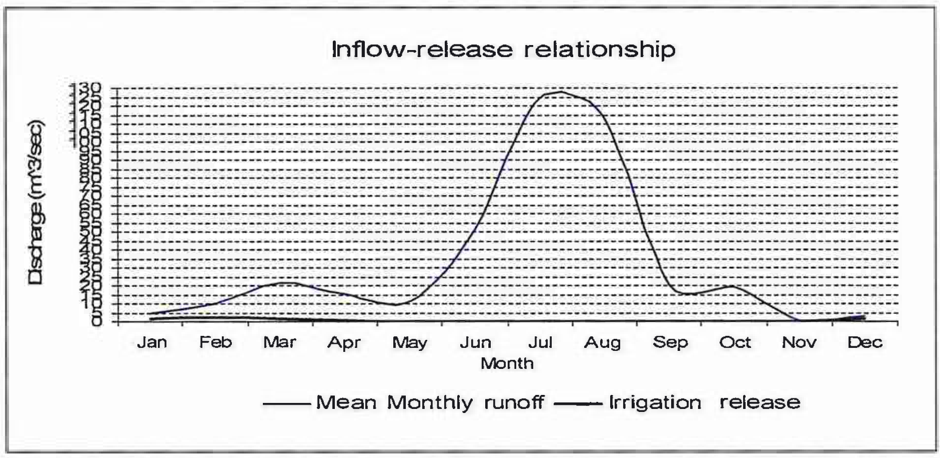


Figure 7.5. Wadecha reservoir monthly inflow-release graph

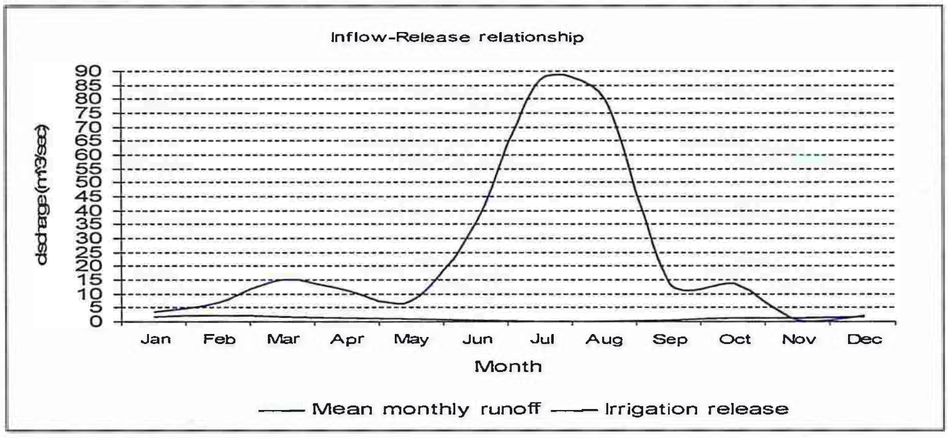


Figure 7.6. Belbela reservoir monthly inflow-release graph

- ***Wadecha Reservoir operation***

As it is already mentioned, the rainfall pattern in the Wadecha reservoir catchment is very high. In the rainy season the dam will be at full level in a very short time. Therefore, in order to store the rainy season runoff, the water existing in the reservoir should be flushed out in the winter season (i.e. in May and June) by opening the gates of controlled out let of the dam such that the water level will be reduced to about 2406m a.m.s.l.

At the end of the summer season (i.e. in August) the gates have to be closed to store the runoff flow, then the water level developed should not be above 2415m a.m.s.l. When the water stored in the dam is needed to be released in the Belbela canal for the purpose of irrigating the farms under the dam and Belbela dam also, it is important to follow the operational policy given by the operator as shown in the Table 7.5. The release rules given in the Table 7.5 is for 10 hours per day every month.

Table 7.5. The estimated irrigation water release policy of the Wadecha-Belbela reservoirs at the beginning of each month

Month	Release to meet irrigation water requirement at the dam outlets			
	Wadecha Reservoir		**Belbela Reservoir**	
	Release(m^3/day)	Level (m)	Release (m^3/day)	Level (m)
Jan	72,000*	2411.7	72,000	1932.5
Feb	72,000	2410.7	72,000	1930.0
Mar	54,000	2408.8	57,600	1929.4
Apr	20,160	2407.9	46,800	1928.6
May	2,100	2407.0	36,000	1927.8
Jun	360	2406.7	18,000	1926.0
Jul	0.0	2415.0	0.0	1940.0
Aug	0.0	2415.0	0.0	1940.25
Sep	2,160	2414.4	2,160	1939.8
Oct	2,520	2413.5	43,200	1939.5
Nov	6,120	2412.8	46,800	1937.5
Dec	46,800	2412.0	57,000	1935.6

* The above values of irrigation water release requirement are rounded to the nearest '10, '100, '1000 numbers by taking in to consideration the water loss between outlet of the dams and the farms diversion inlets.

- ***Belbela reservoir operation***

Belbela dam is located 15 Km far away down stream of the Wadecha reservoir. It takes two hours to travel the water released from Wadecha dam to reach the Belbela reservoir diversion canal head work. The dam bed level is 480m below the Wadecha dam bed level. The reservoir will be at full level when the water level stored in dam reaches 1940.25m a.m.s.l. The storage above this level can always be drawn out by the spillway channel.

As explained in the case of Wadecha reservoir the water stored in the rainy season should be drawn out through the controlled out let to protect the properties and lives below the down stream of the reservoir.

At the end of the summer season the gates should be closed to store the water required by the irrigation projects under the reservoir. When the farms under the reservoir need irrigation water the gate valves of the controlled outlets have to be opened depending on the operational policy given in Table 7.5 to release the required amount of water in each month. By this procedure if the Belbela dam water level approaches 1927m a.m.s.l. the water from the Wadecha dam should be released to restore the reservoir.

8. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary and Conclusions

Irrigation development aims to bring about increased agricultural production and consequently to improve the economic social and environmental well being of the rural population. Despite of these importances, assessment of water resources in relation to the expanding irrigation potential and analysis of irrigation water operations and management will bring about the sustainability of agricultural resources.

For this study assessment of water resources of irrigation system based on climate, water and land informations and analysis of the reservoir operation has been utilized to analyze the water availability of the Wadecha- Belbela reservoirs used as water sources of the maximum irrigation potential under the reservoirs based on runoff data estimated from 9 years of rainfall data in the reservoir catchments used as an input in the selected reservoir operation simulation model HEC-ResSim. HEC-ResSim model was the full model extensively used in the reservoir operation simulation, which has tested for the system under consideration. As explained before the SCS method was used to estimate the runoff flows as inflow to the reservoirs. In the absence of stream flow records, estimates of stream flow may be made from records of precipitation in the same catchments.

The reservoir- area-volume curves have been estimated from the reservoirs characteristics obtained from the design reports of the dam. This data is also used in the reservoir operation simulation. The estimated elevation-volume-area curves of the reservoirs have been computed at the intermediate parts only.

The required quantities at the bottom level, spillway level, and top level are already obtained from Oromia Irrigation Development Authority (OIDA).

The irrigation water requirements of the irrigation projects under each reservoir have been estimated based on climatic data in the catchments for the main crops produced in the area by CROPWAT 4 windows version 4.3. By making these analyzed data mentioned above as an input the HEC-ResSim model automatically revealed the results of reservoir operation simulation.

Based on these data's as an input of the model the simulated reservoir operation shows that the reservoirs are under safe condition without water stress confronting the irrigation projects under the system. The Wadecha reservoir which has the useful capacity of 14 Mm^3 will serve as water sources of a total of 783 hectare maximum irrigation potential and release the surplus water stored for the downstream Belbela reservoir which has the useful capacity of 12 Mm^3 serving the maximum irrigation potential of 817 hectare. The two reservoirs in collaboration will have a surplus water of about 4.68 Mm^3 which can irrigate about 230 to 242.5 hectare of land in addition to the existing potential of irrigable land.

From the characterization of the reservoir system catchments it can be concluded that the existing useful storage potentials of the reservoirs are sufficient for the existing irrigation potential under the system without any deficiency in demand.

Based on the simulated reservoir parameters the useful storage balance of each reservoir and the irrigation requirements of the projects under the reservoirs have been estimated as the summary. The useful storage balance of Wadecha and Belbela reservoirs are 12.035Mm^3 and 9.86Mm^3 respectively.

Similarly, the irrigation demands balancing the storage of the reservoirs are 8.2Mm^3 and 9.03Mm^3 for Wadecha and Belbela projects respectively. Accordingly, the total useful supply of the reservoirs band the total irrigation demands are 21.9Mm^3 and 17.22Mm^3 respectively.

Therefore, it can be concluded that the total monthly irrigation water requirement can serve as a simple reservoir release rule due to the surplus nature of the available water for the maximum irrigation potential under the reservoir system. Accordingly, the optimal reservoir operating rules are fixed as monthly irrigation water requirement of each reservoir system.

8.2 Recommendations

It should be recommended that some research work have to be done on the land use of the catchment. Measurements of the inflow of the reservoirs and sedimentation assessment on the reservoir system catchment are the crucial research works have to done in the future. Due to catchment area cultivation system, erosion is expected to be a sever problem in the study area. The soil in the area needs special treatment because it has restricted drainage condition due to the clayey soils domination. The absence of vegetation cover has also a direct impact on soil fertility. The demand for irrigation and the dam capacity will be in question after few years in the future due to the climate change in the area. Thus for these and other related factor like degree of soil degradation, shortage of grazing land and the increasing number of population with their vast livestock production system will have an important impact on development activity. So, as to get earlier solution research priorities are the best to get there.

The planting dates of dry season crops in the area should be started from October-01 in order to maintain the irrigation water supply sufficiently and the whole dry season will be covered by the irrigation crops.

The surplus water maintained in the reservoirs can be used in the trans boundary or riparian districts down stream of the catchment after the Adaa Liben woreda if possible. Storage ponds have to be established to store the surplus water that should not be stored in the reservoirs, because they can hold more water from the next rainy season.Afforestation and soil conservation of the dam sites area are the main important task has to be performed in order to keep the reservoirs with their safe use full storage.

REFERENCES

1. Adaa Liben woreda Office of agriculture (2005) Annual report of the woreda activities, Adaa Liben.
2. African Centre for Technology Studies (ACTS) (2002) Scarcity and Surfeit: The Ecology of Africans Conflicts Institute for Security Studies (ISS), Chapter 6, Nairobi, Kenya.
3. CARE. (1998) Initial Environmental Examination – CARE Ethiopia DAP Food and Livestock Security Program. Addis Ababa: CARE-Ethiopia, March 1998.
4. Chow V. T., Maidment D.R., and Mays L.W. (1988) Applied Hydrology. McGraw-Hill, New York.
5. Chow V.T (1964) Hand book of Applied Hydrology. McGraw-Hill, New York.
6. Derek Clarke DR. (1998) CROPWAT 4 windows user guide. FAO, Rome
7. Doorebes J. (1984) FAO Irrigation and Drainage paper 24. Italy, Rome
8. East Showa Water Mineral and Energy resources Development Bureau (1998) Goa Workie Small Scale Irrigation Project final design draft, Adama.
9. East Showa Water, Mineral and Energy resources Development Bureau. Godino Small Scale Irrigation Project final design draft, Adama.Unpublished.
10. Gebremedhin B.and D.Peden .D (2002) Policies and institutions to enhance the impact of irrigation development in mixed crop-livestock systems, In: *Integrated water and land management research and capacity building priorities for Ethiopia*, Proceedings of MoWR/EARO/IMWI/ILRI international workshop held at ILRI, Addis Ababa, Ethiopia. 2-4 December.
11. Habtamu Gessese. (1990) Problems and Constraints in the Study, Construction and Management of Small-Scale Irrigation Projects,

Paper No. S2-6. Presented at the National Irrigation Policy and Strategy Workshop, Addis Ababa.

12. Joan D. Klipsch (2003) USACE, HEC-ResSim Reservoir System Simulation – User's Manual. Version 2.0, U.S. Army Corps of Engineers Hydrologic Engineering Center, USA.
13. Maidment, D.R. (1993) Hand Book of Hydrology. McGraw-Hill, New York.
14. MICHAEL A.M. (2003), Irrigation Theory and Practice, Indian Agricultural Institute, New Delhi.
15. Ministry of Water Resources (2001a) Data collected from different river basin development master plan studies. Planning and Projects Department, Ministry of Water Resources, Addis Ababa, Ethiopia.
16. MOA (Ministry of Agriculture) (1998) *Information regarding activities of small-scale irrigation (in Amharic).* Irrigation Development Department, MOA, Addis Ababa, Ethiopia.
17. MOGES, S.A. (2003) Development and application of Hydrological Decision Support tools for Pangani River Basin in Tanzania. PH.D. Thesis, University of Dar es Salaam.
18. MoWR (1990) Preliminary Water Resources Development Master plan of multipurpose and major irrigation Projects, Addis Ababa.
19. MoWR (Ministry of Water Resources) (2001b) Water Sector Development Program Methodological Framework. MoWR, Addis Ababa, Ethiopia.
20. NMSA (National Meteorological Services Agency) (1996) Assessment of drought in Ethiopia. NMSA, Addis Ababa, Ethiopia.
21. OIDA (1993) Dhanama Small Scale Irrigation project final design draft, Adama.
22. OIDA (2000) Keteba-Gembi Small Scale Irrigation Project final design draft, Adama.

23. OIDA (2002) Ful-Tino Small Scale Irrigation Project final design draft, Adama.
24. Richard G. Allen, Luis S. Pereira, Dirk Raes and Martin Smith (1192) FAO Irrigation and Drainage Paper 33. Italy, Rome.
25. Richard G. Allen, Luis S. Pereira, Dirk Raes and Martin Smith (1998) FAO Irrigation and Drainage Paper 56. Italy, Rome.
26. SCS National Engineering Hand Book (1985), Section 4 Hydrology. Soil Conservation Service, USAD, Washington D.C.
27. Vincent J Zipparro, Hasen (1993) DAVIS' Hand book of Applied Hydraulics. McGraw-Hill, Chicago.
28. Wagnew A. (2004) Socio-Economic and Environmental impact Assessment of community based Small-scale Irrigation in upper Awash Basin, M.Sc. Thesis, Addis Ababa University, Ethiopia.
29. Watkins, D. Jr., and D. McKinney (1995) "Recent Developments in Decision Support Systems for Water Resources, U.S. National Contributions in Hydrology 1991-1994" Reviews of Geophysics, Supplement,941-948. ftp://ftp.crwr.utexas.edu/pub/outgoing/PATINOC/Conferences/TransWMngmt2004_Paper1-Final.pdf
30. Wetterhall H. (1972) Government and land in Ethiopia. Ministry of Land Reform and Administration, Addis Ababa, Ethiopia (unpublished report).

APPENDICES

Appendix-1.A Summary of morphological characteristics for the major soil of Adaa Liben

S.N	Soil group	Depth	Color	Texture	Drainage	Proportion in percent
1	Fluvisols	Deep to very deep	variable	Clay/silty clay	well	3
2	Leptosols	shallow	Brown to yellowish	Loam/clay loam/clay	well	13
3	vertisols	Deep to very deep	Dark grey /black	clay	Imperfect to poor	39
4	Cambisols	Moderately deep	Brown /dark brown	Silty clay	well	25
5	Phaeozem	Deep	Dark grey	Clay loam/clay	Moderatel ywell	18
6	Luvisols	Deep to very deep	Brown/radi sh brown	Clay/silty clay	well	2

Appendix-2.A Irrigation potential of Adaa Liben woreda

Potential Rivers, Lakes and Irrigable area in Ada Liben Woreda					
S.No	Name of River	Peasant Association	Irrigable area(ha)	Current status	Type Diversion
1	Jello River	OdaJida	25	Not Operational	Pumping
2	Adelle River	Liben Gadula	20	Operational	pumping
	"	Dire Doti	10	Operational	pumping
3	Ashufe River	Agamsa Rogicha	15	Not Operational	Spring traditional
4	Orofe River	Gongo	15	Operational	Diversion
5	Wadecha River	Godino	120	Operational	Diversion
	"	Gende Gorba	166	Operational	Diversion
	"	Goa Worko	100	Operational	diversion
6	Chancho River	Jello Chancho	10	Not Operational	Diversion
7	Kolbe River	Kolbe Koticha	28	Operational	Diversion
8	Awash River	Liben Gadula	160	Not Operational	Pumping
	"	Gogiti Goro	260	Not Operational	Pumping
	"	OdaJida	170	Not Operational	Pumping
	"	MumeKosoru	190	Not Operational	Pumping
	"	Daglagala Jida	170	Not Operational	Pumping
	"	Warrajarsa	160	Not Operational	Pumping
	"	Agamsa Rogicha	90	Not Operational	Pumping
9	Mojo River	TuluDimtu	7	Not Operational	Pumping
	"	Kerfe	30	Operational	Pumping
	"	Hidi	85	Operational	Pumping
	"	Katila	20	Operational	Pumping
	"	Koftu	15	Not Operational	Pumping
	"	Kaliti	15	Operational	Pumping
	"	Denkaka	15	Operational	Pumping
	"	Jello Chancho	25	Not Operational	Pumping
	"	Gogiti Goro	1500	Operational	Pumping
10	WadechaDam	Ketaba Gimbi	300	Not Operational	Diversion
	"	Godino	80	Operational	Diversion
	"	Harawa	83	Operational	Diversion
11	Hora Kirole (lake)	Hidi	65	Semi-Operational	Pumping
12	Adekore (lake)	Gechi Da'imo	20	Semi-Operational	Pumping
13	Tute (lake)	Liben Gadula & G.goro	85	Semi-Operational	Pumping
14	BelbelaDam	Koftu	45	Operational	Diversion
	"	Dinsho Flowering Farm	532	Operational	Diversion
	"	Fultino	85	Operational	Diversion
	"	Dhanama	40	Operational	Diversion
15	Chaleleka lake	Bishoftu	14	Semi-Operational	Pumping
	"	Gende Gorba	80	Not Operational	Pumping
	Total		**5441**		

Appendix-4A Climatic data

Table 4. A1 Mean monthly rainfall at Debre Zeit station

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1951	0.0	0.0	50.0	36.5	25.9	15.2	110.5	80.4	40.0	25.9	2.0	0.0
1952	0.0	0.0	0.0	42.6	17.2	59.5	134.2	191.1	127.4	8.2	0.0	0.0
1953	0.0	24.4	11.0	88.0	17.0	77.8	96.6	165.2	45.2	0.0	0.0	24.7
1954	0.0	0.0	57.0	30.5	6.6	70.5	160.0	160.7	114.2	28.9	0.0	0.0
1955	11.1	0.0	23.0	36.4	0.0	80.1	353.9	208.4	142.9	0.0	0.0	0.0
1956	1.5	1.4	8.9	48.0	7.1	84.3	134.4	78.0	0.0	48.6	8.5	0.4
1957	0.0	25.6	64.4	91.8	48.1	123.1	209.5	305.4	24.8	5.0	1.0	0.0
1958	65.5	52.3	23.8	49.4	7.0	175.9	273.8	243.2	172.2	16.3	0.8	0.0
1959	18.0	34.0	38.4	43.9	42.1	108.3	244.3	215.4	125.4	14.5	0.0	16.0
1960	0.8	5.0	43.3	11.2	99.5	56.5	167.9	301.9	161.6	0.0	5.2	0.0
1961	0.0	3.2	111.2	41.9	28.2	107.2	153.8	191.2	89.9	39.3	16.7	0.0
1962	0.0	1.0	62.0	24.7	3.7	0.0	201.1	237.3	181.8	46.5	0.9	21.6
1963	0.0	1.6	0.0	61.9	103.5	76.0	281.2	448.0	105.2	0.0	2.7	27.5
1964	0.0	0.0	0.0	184.0	42.3	56.0	434.5	365.3	187.1	22.6	0.0	11.0
1965	37.8	0.0	58.5	29.5	0.0	38.2	408.5	240.5	125.6	76.9	6.7	0.0
1966	0.0	256.2	27.5	135.2	25.1	122.5	251.4	409.6	168.5	40.0	0.0	0.0
1967	0.0	0.0	100.0	73.9	164.8	62.1	314.2	259.6	136.0	16.0	79.1	0.0
1968	0.0	190.1	12.6	102.0	5.0	60.1	272.3	140.2	203.0	0.0	17.8	0.0
1969	11.0	0.0	56.7	104.0	24.9	137.1	125.1	278.6	64.6	7.5	3.2	0.0
1970	44.1	31.1	7.5	71.4	45.3	46.0	250.7	290.1	112.0	5.9	0.0	0.0
1971	0.7	0.0	16.5	63.0	107.6	121.3	215.8	281.0	123.1	2.9	0.3	14.4
1972	0.0	95.2	53.7	136.0	47.7	102.1	214.4	124.6	66.0	2.6	0.0	0.0
1973	0.0	0.0	0.0	2.7	28.0	108.3	138.5	241.9	133.7	42.1	0.0	2.0
1974	0.0	12.5	104.2	7.6	98.1	114.4	307.3	199.0	136.0	3.0	0.0	0.0
1975	0.0	6.3	19.5	72.1	54.5	149.7	382.1	223.4	154.4	7.0	0.0	0.0
1976	0.0	0.0	71.1	106.0	80.7	102.9	230.9	232.2	42.2	3.8	35.2	0.8
1977	43.1	1.0	87.7	90.2	57.6	101.6	272.8	202.7	82.2	112.7	3.4	0.0
1978	1.4	69.0	34.5	47.4	28.5	133.7	132.3	191.1	122.3	24.6	1.7	0.1
1979	77.7	0.0	54.7	13.5	76.0	110.9	224.9	187.6	83.8	12.6	0.0	0.0
1980	20.0	10.1	32.3	24.2	69.4	75.1	242.4	215.5	58.1	40.7	0.0	0.0
1981	0.0	20.5	164.2	62.1	7.1	35.8	294.6	151.8	162.8	4.2	0.0	1.2
1982	20.8	75.4	34.5	47.3	57.7	91.0	123.9	233.6	46.1	25.5	9.4	0.0
1983	0.0	10.2	62.8	105.2	209.5	149.4	128.8	344.8	88.6	23.4	0.0	0.0
1984	0.0	0.0	19.3	0.0	108.7	80.7	220.5	217.3	85.0	0.0	0.0	3.6
1985	3.5	0.0	14.5	63.7	111.4	74.1	307.3	292.7	130.0	1.1	0.0	0.0
1986	1.8	30.7	76.4	76.9	132.7	69.5	81.8	116.9	120.6	11.3	0.0	0.0
1987	0.0	61.4	138.2	90.1	154.0	65.0	83.3	155.9	80.9	4.6	0.0	0.0
1988	8.0	15.9	6.0	44.7	36.8	100.7	146.0	236.8	121.4	16.7	0.0	0.0
1989	0.6	12.2	35.1	47.0	0.4	59.1	183.7	171.5	135.2	21.2	0.0	3.3

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	0.0	123.3	58.2	86.4	36.6	76.0	224.0	173.2	102.4	0.0	0.0	0.0
1994	0.0	0.0	29.2	19.5	19.6	74.5	232.8	187.3	108.6	0.0	10.2	0.0
1995	0.0	2.4	7.8	34.0	5.5	92.5	188.4	169.6	75.1	0.0	0.0	11.9
1996	16.4	0.0	103.1	55.3	105.4	261.5	164.1	275.6	90.0	0.1	5.9	0.0
1997	27.8	0.0	26.7	74.8	13.6	121.7	235.8	171.8	71.4	99.9	10.9	0.0
1998	32.0	51.4	13.9	77.2	41.8	77.7	206.3	293.5	97.6	93.3	0.0	0.0
1999	0.5	0.0	36.6	0.0	10.0	176.9	298.7	258.6	48.7	90.9	0.0	0.0
2000	0.0	0.0	8.6	50.4	65.4	77.4	244.3	181.4	139.4	40.0	23.4	3.4
2001	0.0	4.6	166.4	21.8	104.0	79.5	242.3	143.4	64.3	38.2	0.0	0.0
2002	8.6	0.0	48.0	34.6	11.0	109.1	179.3	178.0	58.4	0.0	0.0	21.3
2003	38.3	55.4	64.4	100.3	21.1	81.4	277.9	285.5	120.0	6.0	3.6	35.4
Mean	**9.8**	**25.7**	**46.9**	**59.2**	**52.3**	**92.6**	**220.1**	**223.0**	**105.5**	**22.6**	**5.0**	**4.0**
S.Dev	**18.0**	**49.8**	**40.7**	**38.2**	**48.6**	**43.5**	**81.6**	**75.4**	**45.0**	**28.6**	**12.7**	**8.5**

Table 4.A2 Mean monthly Maximum temperature at Debre Zeit station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1952	26.2	26.8	29.2	27.2	28.4	28.6	23.7	25.3	24.7	25.3	25.3	25.3
1953	26.6	27.7	28.2	27.1	29.2	27.7	23.3	23.8	24.8	26.6	26.5	24.9
1954	26.4	28.0	28.0	28.6	29.5	26.8	22.9	22.8	23.5	24.4	25.5	25.6
1955	25.8	26.8	28.7	28.2	29.1	27.0	24.5	23.6	24.3	25.9	26.6	26.5
1956	25.8	27.9	29.3	28.1	28.9	27.2	23.1	24.1	24.4	24.1	23.7	24.4
1957	26.2	26.1	25.9	26.6	27.5	27.3	24.5	23.6	26.4	27.2	27.0	25.2
1958	25.7	24.9	28.5	28.7	30.4	26.5	22.9	23.3	24.8	25.8	25.7	26.2
1959	27.4	27.8	28.4	29.5	29.4	28.4	23.5	23.2	24.5	26.0	25.5	25.4
1960	25.2	27.5	27.4	28.5	27.7	27.6	24.0	24.0	24.9	26.3	25.7	25.5
1961	26.4	26.9	27.2	27.0	29.3	26.4	22.7	23.0	24.7	24.9	24.1	25.2
1962	26.0	27.0	27.3	29.4	29.2	27.6	25.1	24.1	24.5	24.8	25.2	26.0
1963	25.2	27.5	28.0	26.5	27.2	27.7	25.2	23.6	25.3	26.6	25.5	25.0
1964	25.8	28.1	29.7	27.2	28.0	26.3	23.3	23.6	23.9	24.7	25.2	24.1
1965	26.0	27.1	28.0	27.7	29.6	29.1	24.8	23.8	25.7	25.4	25.0	25.8
1966	27.1	26.0	27.4	27.1	29.3	27.5	25.0	24.2	25.1	26.2	25.5	26.7
1967	25.7	27.3	27.5	27.1	27.5	27.3	22.9	24.0	24.4	24.8	24.1	24.1
1968	26.0	23.8	26.5	26.4	28.2	27.0	24.7	24.3	25.7	25.9	25.6	25.8
1969	26.1	25.4	26.4	28.5	28.2	26.4	24.2	23.9	25.8	27.1	26.2	26.1
1970	25.3	27.7	26.8	28.5	29.4	28.4	24.8	23.1	25.0	26.4	25.3	25.2
1971	25.5	27.7	27.9	28.4	27.1	25.8	23.7	23.8	24.8	26.2	24.6	23.7
1972	26.1	25.5	27.0	26.1	27.9	27.1	24.2	24.2	25.4	27.3	26.8	27.5
1973	27.7	29.3	30.3	30.7	28.6	26.6	24.7	23.6	24.6	25.5	25.6	24.5
1974	26.6	26.9	26.5	28.1	27.4	26.1	23.4	23.6	24.2	27.1	24.9	25.5
1975	26.2	27.1	28.9	27.7	28.4	25.7	22.9	22.2	23.7	25.1	24.6	25.0
1976	25.7	27.3	28.0	28.0	26.8	26.9	23.8	23.3	25.2	26.7	24.7	25.5
1977	24.6	25.9	27.4	27.5	27.2	26.3	23.6	23.8	24.7	26.2	24.5	25.1

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	25.8	26.3	27.1	28.2	28.4	26.9	22.9	24.2	24.7	25.6	25.4	25.2
1979	24.5	26.8	27.2	28.3	27.9	27.0	24.0	24.1	25.0	26.2	26.2	26.1
1980	26.2	28.2	29.1	28.6	29.2	27.2	24.0	23.9	25.0	25.7	25.9	26.0
1981	27.1	27.3	25.9	25.7	28.8	29.1	24.4	23.9	23.2	25.4	25.5	25.6
1982	25.9	26.1	27.9	26.8	27.6	27.5	24.6	23.0	25.0	24.6	25.3	25.3
1983	25.9	27.1	28.2	26.9	27.6	26.8	25.5	23.5	24.8	25.6	26.4	26.0
1984	26.3	27.4	29.1	30.1	28.0	26.0	24.1	23.2	25.0	26.6	26.5	25.4
1985	26.5	26.8	28.5	26.7	27.0	27.3	23.2	22.9	24.4	25.9	26.2	25.7
1986	26.1	27.0	27.6	26.8	27.0	26.8	24.2	24.6	25.0	26.5	26.6	25.9
1987	25.7	27.1	26.7	26.9	27.0	26.3	26.3	25.3	26.8	27.5	26.8	26.4
1988	26.5	28.0	29.8	28.9	29.4	27.3	23.1	23.7	24.3	25.2	25.6	25.8
1989	24.5	26.5	28.0	26.5	28.9	27.7	23.3	22.4	24.6	25.2	26.1	25.2
1990	26.5	26.3	26.7	26.5	29.0	27.6	24.6	23.9	24.8	26.8	26.8	26.2
1991	26.2	27.3	28.0	27.9	28.6	27.2	24.1	23.8	25.0	26.0	25.7	25.6
1992	26.2	27.3	28.0	27.9	28.6	27.2	24.1	23.8	25.0	26.0	25.7	25.6
1993	26.2	27.3	28.0	27.9	28.6	27.2	24.1	23.8	25.0	26.0	25.7	25.6
1994	27.1	27.8	28.4	28.9	29.6	26.9	23.8	23.1	24.4	26.0	25.0	25.5
1995	26.4	28.7	28.5	27.8	29.9	29.2	24.4	23.7	25.0	26.2	26.1	26.4
1996	26.0	28.7	28.0	27.8	27.2	24.2	24.0	24.2	25.5	26.5	25.7	25.7
1997	26.1	27.4	29.0	27.2	29.7	27.7	24.9	25.2	26.9	25.9	25.3	25.9
1998	26.6	27.8	28.6	30.1	29.6	28.9	24.6	23.6	25.3	25.8	25.7	25.4
1999	26.9	28.8	27.8	29.7	30.0	28.0	23.7	24.3	25.1	25.5	25.1	25.4
2000	26.7	28.2	29.7	29.4	29.1	27.5	24.8	23.7	24.9	25.1	25.5	25.8
2001	26.5	29.2	27.7	29.1	28.4	26.7	24.6	24.1	26.9	27.6	26.9	27.6
2002	27.0	29.9	29.3	30.4	31.4	29.1	26.8	25.3	26.4	27.9	27.3	26.2
2003	26.9	28.9	28.6	27.8	29.3	27.6	23.6	23.9	25.0	26.6	26.3	24.7
2004	26.6	29.0	27.5	26.5	28.6	26.7	24.0	24.1	25.3	25.5	25.5	25.4
2005	26.1	27.2	28.0	28.0	28.5	27.2	24.1	23.8	25.0	26.0	25.6	25.6
Mean	26.2	27.3	28.0	27.9	28.6	27.2	24.1	23.8	25.0	26.0	25.7	25.6
S.Dev	0.66	1.132	0.999	1.169	1.009	0.95	0.848	0.64	0.755	0.84	0.779	0.728

Table 4.A3 Mean monthly Minimum temperature at Debre Zeit station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1952	8.7	10.2	12.2	13.6	11.8	11.4	12.5	8.9	11.3	9.8	8.1	8.9
1953	9	10.6	12.5	13.7	12.4	12.3	13.3	13.1	11.4	10.2	10	9.1
1954	8.1	11.1	12.7	13.4	12.2	12	10.9	12.3	12.1	9.4	9.2	8.1
1955	10.6	9.3	11.4	13	11.5	11.2	11.9	12	11.8	9.9	9.6	10
1956	9.8	8.7	12	13.1	12.3	12.1	12.6	14.8	11.8	11	7.8	8.7
1957	9.1	10.4	12.3	13	12.8	10.2	12.6	12.6	11	10.4	9.8	8.7
1958	11.1	12.5	12.5	14.1	12.9	12.9	13.6	12.9	12.8	10.2	8.5	10.3
1959	11.3	12	12.4	13.6	13.6	12.4	13.5	12.8	12.4	11.5	8.7	8.6
1960	8.7	10.1	13.2	13.1	13.5	12.2	13	12.9	12.4	10.4	9	10.2
1961	9.6	11.3	12.7	13.5	12.8	12.5	13.4	12.9	13	11.1	12	8.3

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1962	7.6	9	12	12.5	12.6	12.1	12.9	13.1	13.3	9.8	10.6	10.2
1963	10	12	13	13.9	13.2	12.2	13.2	13.2	12.2	10.6	10.7	10.2
1964	11.3	12.8	13.8	13.7	12	11.2	12.9	12.4	12.1	11	9.1	8.4
1965	10.1	10	11.8	13.9	12.8	12.7	12.6	13	12.2	10.9	10.9	9.4
1966	10.5	13	12.8	13.9	13.2	12.1	12.4	13.3	11.2	11.3	10.5	7.9
1967	8	11.8	13.6	13.4	12.7	12.1	12.8	12.5	12.6	10.6	11.1	6.3
1968	7.3	12.4	10.7	13.4	12.7	12.6	11.5	12.4	12.4	10.8	9.7	9.1
1969	11.9	11.1	12.6	12.7	12.7	11.3	12.9	13	12.2	10.5	10.5	7.8
1970	12	11.8	13.7	13.7	13.3	12.6	13.6	13.2	12.5	11	7.2	7
1971	9.8	9.4	12	12.2	12.4	12.1	12.8	11.6	11.2	9.6	8.6	7.9
1972	8.3	10.1	10	11.7	11	10.6	11.7	11.2	10.2	9.1	8	8.1
1973	8.6	9.4	12.1	14.2	12.8	11.35	12.2	11.6	11.5	8.8	7.9	5.8
1974	8.9	10.2	12.7	12.3	12.6	12.1	12.4	11.9	11.8	9.7	6.8	7.5
1975	8	11.1	12.7	12.8	12.7	12.1	12.3	12.9	12.1	9.6	8.6	7.6
1976	8	12	12.5	12.75	12.5	11.9	12.6	12.7	12	11.6	10.5	9
1977	9.7	10	12.5	12.7	12.8	12.2	12.9	12.2	11.1	11.1	9.2	8.3
1978	7.9	11.3	12.8	13.8	12.1	11.7	13.7	13.1	12.1	10.6	8.65	9.4
1979	11.5	10.9	12.2	12.9	13	12.4	12.1	12.7	12.3	10.5	8.1	9.2
1980	9	10.3	12.9	13	12.2	12.3	13.3	12.3	11.9	10.8	9.8	7.6
1981	9.8	11.2	13.6	13.3	12.5	11.7	12.9	12.6	12.2	9.5	8.4	6
1982	9.7	11.3	10.8	11.6	13.1	11.8	12.3	13.1	12.3	10.8	10.8	10.6
1983	9.8	12.7	13.8	13.6	14.3	12.4	13.3	13.9	12.6	10.7	9.1	8.2
1984	7.8	7.8	12.1	13.9	13.4	13	12.8	12.9	12	9.6	9.5	8.1
1985	8.5	9.8	12.4	12.8	12.3	11.6	11.8	11.9	11.3	9.2	9.2	8.9
1986	9.15	10.55	13.05	13	13.45	12.25	13	13.4	12.3	10.8	10	10
1987	9.8	11.3	13.7	13.2	14.6	12.9	13.9	13.7	12.8	12.3	9.9	10.3
1988	11.6	13.9	14.1	15.3	13.6	13.5	14.6	13.6	13	11.1	7.6	8.3
1989	8.6	14.6	13.1	17.2	11.9	12.7	13.5	12.4	12.7	10.1	9.7	12
1990	10	13.8	12.9	13.2	12.6	11.2	13.5	13.6	13.2	10.4	9.8	8.6
1992	9.67	11.09	12.74	13.50	12.91	12.34	13.02	12.94	12.27	10.58	9.39	8.81
1993	9.67	11.09	12.74	13.50	12.91	12.34	13.02	12.94	12.27	10.58	9.39	8.81
1994	9.44	10.8	13.5	14.5	13.9	13.2	13.7	13.3	12.4	10.4	9.8	9.1
1995	9.2	12.2	13.9	14.7	14	12.6	13.6	13.9	12.1	11.6	9.8	11.5
1996	11.8	11.4	14.3	13.7	13.7	13.9	13.3	13.7	12.6	10.7	9.8	9
1997	11.9	10.3	13.9	13.8	14.1	13.8	13.8	13.8	13.3	13.3	12.6	9.8
1998	12.8	14.2	14.7	15.2	14.5	13.8	14.5	14.3	13.5	12.2	8.4	7.6
1999	9.8	10.2	13.5	14.3	13.7	13.2	13.4	13.5	13.4	11.85	8.1	8.5
2000	9	10.3	12.5	14.3	13.3	12.9	13.6	13.2	13.3	11.5	10.5	9.9
2001	10.2	11.1	13.7	13.8	14.1	13.3	13.9	14.5	12.6	11.8	9.8	11.1
2002	11.4	11.8	14.3	14.4	13.7	14.2	14.3	14.1	13.3	12.2	10.8	12.6
2003	11.2	13	14	15.1	14.1	14.5	14.2	14.4	13.7	11.2	11.4	10
2004	9.65	10.5	9.5	11.9	9.6	12	13.1	13	11.9	8.4	7.3	8.2
2005	8.1	8	12.1	12.3	13.1	12.2	13	13.6	12.6	8.2	7.4	3.5
Mean	9.68	11.09	12.74	13.50	12.91	12.34	13.02	12.94	12.27	10.58	9.39	8.81

Table 4.A4 Mean monthly Average temperature at Debre Zeit station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total
1952	17.5	18.5	20.7	20.4	20.1	20.0	18.1	17.1	18.0	17.6	16.7	17.1	221.7
1953	17.8	19.2	20.4	20.4	20.8	20.0	18.3	18.5	18.1	18.4	18.3	17.0	227.0
1954	17.3	19.6	20.4	21.0	20.9	19.4	16.9	17.6	17.8	16.9	17.4	16.9	221.8
1955	18.2	18.1	20.1	20.6	20.3	19.1	18.2	17.8	18.1	17.9	18.1	18.3	224.6
1956	17.8	18.3	20.7	20.6	20.6	19.7	17.9	19.5	18.1	17.6	15.8	16.6	222.9
1957	17.7	18.3	19.1	19.8	20.2	18.8	18.6	18.1	18.7	18.8	18.4	17.0	223.2
1958	18.4	18.7	20.5	21.4	21.7	19.7	18.3	18.1	18.8	18.0	17.1	18.3	228.9
1959	19.4	19.9	20.4	21.6	21.5	20.4	18.5	18.0	18.5	18.8	17.1	17.0	230.9
1960	17.0	18.8	20.3	20.8	20.6	19.9	18.5	18.5	18.7	18.4	17.4	17.9	226.5
1961	18.0	19.1	20.0	20.3	21.1	19.5	18.1	18.0	18.9	18.0	18.1	16.8	225.5
1962	16.8	18.0	19.7	21.0	20.9	19.9	19.0	18.6	18.9	17.3	17.9	18.1	226.0
1963	17.6	19.8	20.5	20.2	20.2	20.0	19.2	18.4	18.8	18.6	18.1	17.6	228.9
1964	18.6	20.5	21.8	20.5	20.0	18.8	18.1	18.0	18.0	17.9	17.2	16.3	225.3
1965	18.1	18.6	19.9	20.8	21.2	20.9	18.7	18.4	19.0	18.2	18.0	17.6	229.2
1966	18.8	19.5	20.1	20.5	21.3	19.8	18.7	18.8	18.2	18.8	18.0	17.3	229.6
1967	16.9	19.6	20.6	20.3	20.1	19.7	17.9	18.3	18.5	17.7	17.6	15.2	222.1
1968	16.7	18.1	18.6	19.9	20.5	19.8	18.1	18.4	19.1	18.4	17.7	17.5	222.5
1969	19.0	18.3	19.5	20.6	20.5	18.9	18.6	18.5	19.0	18.8	18.4	17.0	226.8
1970	18.7	19.8	20.3	21.1	21.4	20.5	19.2	18.2	18.8	18.7	16.3	16.1	228.8
1971	17.7	18.6	20.0	20.3	19.8	19.0	18.3	17.7	18.0	17.9	16.6	15.8	219.4
1972	17.2	17.8	18.5	18.9	19.5	18.9	18.0	17.7	17.8	18.2	17.4	17.8	217.6
1973	18.2	19.4	21.2	22.5	20.7	19.0	18.5	17.6	18.1	17.2	16.8	15.2	224.0
1974	17.8	18.6	19.6	20.2	20.0	19.1	17.9	17.8	18.0	18.4	15.9	16.5	219.6
1975	17.1	19.1	20.8	20.3	20.6	18.9	17.6	17.6	17.9	17.4	16.6	16.3	220.0
1976	16.9	19.7	20.3	20.4	19.7	19.4	18.2	18.0	18.6	19.2	17.6	17.3	225.0
1977	17.2	18.0	20.0	20.1	20.0	19.3	18.3	18.0	17.9	18.6	16.9	16.7	220.7
1978	16.9	18.8	20.0	21.0	20.3	19.3	18.3	18.7	18.4	18.1	17.0	17.3	223.9
1979	18.0	18.9	19.7	20.6	20.5	19.7	18.1	18.4	18.7	18.4	17.2	17.7	225.6
1980	17.6	19.3	21.0	20.8	20.7	19.8	18.7	18.1	18.5	18.3	17.9	16.8	227.2
1981	18.5	19.3	19.8	19.5	20.7	20.4	18.7	18.3	17.7	17.5	17.0	15.8	222.8
1982	17.8	18.7	19.4	19.2	20.4	19.7	18.5	18.1	18.7	17.7	18.1	18.0	223.9
1983	17.9	19.9	21.0	20.3	21.0	19.6	19.4	18.7	18.7	18.2	17.8	17.1	229.4
1984	17.1	17.6	20.6	22.0	20.7	19.5	18.5	18.1	18.5	18.1	18.0	16.8	225.3
1985	17.5	18.3	20.5	19.8	19.7	19.5	17.5	17.4	17.9	17.6	17.7	17.3	220.4
1986	17.6	18.8	20.3	19.9	20.2	19.5	18.6	19.0	18.7	18.7	18.3	18.0	227.5

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Year Total
1987	17.8	19.2	20.2	20.1	20.8	19.6	20.1	19.5	19.8	19.9	18.4	18.4	233.6
1988	19.1	21.0	22.0	22.1	21.5	20.4	18.9	18.7	18.7	18.2	16.6	17.1	233.9
1989	16.6	20.6	20.6	21.9	20.4	20.2	18.4	17.4	18.7	17.7	17.9	18.6	228.7
1990	18.3	20.1	19.8	19.9	20.8	19.4	19.1	18.8	19.0	18.6	18.3	17.4	229.3
1991	17.9	19.2	20.4	20.7	20.7	19.8	18.6	18.4	18.6	18.3	17.5	17.2	227.2
1992	17.9	19.2	20.4	20.7	20.7	19.8	18.6	18.4	18.6	18.3	17.5	17.2	227.2
1993	17.9	19.2	20.4	20.7	20.7	19.8	18.6	18.4	18.6	18.3	17.5	17.2	227.2
1994	18.3	19.3	21.0	21.7	21.8	20.1	18.8	18.2	18.4	18.2	17.4	17.3	230.3
1995	17.8	20.5	21.2	21.3	22.0	20.9	19.0	18.8	18.6	18.9	18.0	19.0	235.7
1996	18.9	20.1	21.2	20.8	20.5	19.1	18.7	19.0	19.1	18.6	17.8	17.4	230.7
1997	19.0	18.9	21.5	20.5	21.9	20.8	19.4	19.5	20.1	19.6	19.0	17.9	237.8
1998	19.7	21.0	21.7	22.7	22.1	21.4	19.6	19.0	19.4	19.0	17.1	16.5	238.9
1999	18.4	19.5	20.7	22.0	21.9	20.6	18.6	18.9	19.3	18.7	16.6	17.0	231.9
2000	17.9	19.3	21.1	21.9	21.2	20.2	19.2	18.5	19.1	18.3	18.0	17.9	232.4
2001	18.4	20.2	20.7	21.5	21.3	20.0	19.3	19.3	19.8	19.7	18.4	19.4	237.6
2002	19.2	20.9	21.8	22.4	22.6	21.7	20.6	19.7	19.9	20.1	19.1	19.4	247.1
2003	19.1	21.0	21.3	21.5	21.7	21.1	18.9	19.2	19.4	18.9	18.9	17.4	238.0
2004	18.1	19.8	18.5	19.2	19.1	19.4	18.6	18.6	18.6	17.0	16.4	16.8	219.9
2005	17.1	17.6	20.0	20.1	20.8	19.7	18.6	18.7	18.8	17.1	16.5	14.5	219.6
Mean	***17.9***	***19.2***	***20.4***	***20.7***	***20.7***	***19.8***	***18.6***	***18.4***	***18.6***	***18.3***	***17.5***	***17.2***	***227.2***
STDV	***0.75***	***0.88***	***0.77***	***0.84***	***0.71***	***0.66***	***0.61***	***0.58***	***0.55***	***0.70***	***0.75***	***0.94***	***5.86***

Table 4.A5 Mean monthly Average Relative humidity at Debre Zeit station

Year	Jan	Feb	March	Apr	May	Jun	July	August	Sept	Nov	Oct	Dec
1951	41	35	51	65	59	52	72	73	63	54	49	53
1952	46	42	48	58	59	71	79	50	59	48	39	42
1953	42	41	43	55	42	57	70	74	70	49	48	54
1954	43	46	46	37	36	54	69	70	71	47	43	43
1955	52	29	31	40	38	51	63	70	64	42	37	42
1956	48	38	34	44	34	47	67	70	64	55	41	41
1957	42	49	56	57	45	53	68	73	61	54	59	56
1958	56	62	52	47	48	70	83	80	77	52	50	55
1959	57	57	54	54	76	78	82	83	81	73	67	71
1960	65	52	63	57	64	65	78	79	76	55	55	57
1961	53	58	59	69	59	70	81	81	77	69	72	69
1962	60	54	68	57	55	61	76	80	82	74	65	57
1963	58	57	48	66	64	56	74	77	66	41	63	67
1964	68	61	55	72	73	74	80	79	77	67	59	69
1965	62	50	56	66	55	60	75	78	71	66	64	60
1966	51	67	65	67	58	70	76	78	72	58	52	49

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1967	47	46	52	62	65	65	81	79	74	67	71	63
1968	55	76	57	68	62	66	78	77	75	61	67	65
1969	69	75	70	60	61	73	80	81	72	55	61	64
1970	66	60	64	55	58	66	59	76	72	57	57	59
1971	60	51	55	55	65	71	54	77	71	60	61	65
1972	61	69	61	67	58	63	75	78	70	54	54	54
1973	53	44	40	40	55	64	75	81	76	59	52	53
1974	57	59	64	53	60	65	77	77	77	56	50	49
1975	49	62	52	63	59	73	80	83	78	64	65	63
1976	62	65	64	65	70	71	81	81	71	63	69	65
1977	75	69	65	67	70	74	81	81	78	69	73	66
1978	59	64	66	66	67	73	83	80	80	75	71	71
1979	79	71	72	69	72	76	84	82	78	71	68	69
1980	69	67	62	65	63	75	83	83	78	70	66	66
1981	64	68	78	77	66	71	83	83	82	68	66	67
1982	72	72	66	73	70	73	82	83	76	71	76	75
1983	73	73	71	76	74	77	79	85	81	74	67	70
1984	68	63	60	56	71	79	80	78	76	59	62	66
1994	48	45	49	51	57	66	74	74	68	49	60	56
1995	38	42	47	51	41	51	69	71	64	41	47	47
1996	45	37	50	49	47	62	72	72	66	40	43	43
1997	50	35	45	49	42	60	69	71	62	49	51	45
1998	52	46	46	46	42	51	69	74	63	55	44	36
1999	42	36	47	36	42	53	71	70	69	59	46	45
2000	42	33	40	44	51	59	72	71	70	61	51	50
2001	49	42	57	46	60	65	71	73	63	53	44	47
2002	53	37	49	46	49	61	68	72	63	40	39	56
2003	49	44	45	54	38	57	73	76	75	45	46	50
2004	54	44	48	58	42	62	69	72	66	53	49	52
2005	56	44	56	52	58	66	75	74	70	51	48	44
Mean	**56**	**53**	**55**	**57**	**56**	**65**	**75**	**76**	**72**	**58**	**56**	**57**
S.Dev	**10.09**	**13.12**	**10.26**	**10.51**	**11.43**	**8.45**	**6.65**	**5.91**	**6.28**	**10.00**	**10.69**	**10.1**

Table 4.A6 Mean monthly Average Wind speed at Debre Zeit station

Year	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994	1.5	1.6	1.6	1.9	2	1.4	1.3	1	1.1	2	1.6	1.6
1995	1.4	1.5	1.8	1.5	2.4	1.4	1.1	1	0.9	1.7	1.4	1.5
1996	1.4	1.6	1.5	1.6	1.4	1	1	1	0.9	1.5	1.5	1.4
1997	1.3	1.9	1.7	1.5	2	1.5	1.1	0.9	1.1	1.5	1.5	1.5
1998	1.5	1.3	1.7	1.6	1.4	1.2	1.2	1	0.8	0.9	1.3	1.4
1999	1.4	1.7	1.5	2	1.7	1.3	1.1	1	0.8	1.1	1.6	1.4
2000	1.5	1.7	1.8	1.8	1.4	1.3	1.1	1	0.8	1.2	1.3	1.3
2001	1.1	1.3	1	1.3	1	1.1	1	0.9	0.9	1.2	1.4	1.3
2002	1.2	1.3	1.2	1.6	1.3	1.2	1.1	1	1	1.3	1.5	1.4
2003	1.3	1.3	1.6	1.3	2	1.5	1.3	1	0.9	1.4	1.5	1.4
2004	1.4	1.6	1.75	1.6	1.7	1.6	1.3	1.1	1.2	1.6	1.9	1.7
2005	1.5	1.9	1.9	1.9	1.7	1.3	1.3	1.2	1	1.6	1.9	1.7
Mean	**1.38**	**1.56**	1.59	**1.63**	1.67	1.32	1.16	1.01	**0.95**	**1.41**	**1.53**	1.46
S.Dev	0.13	0.22	0.26	0.23	0.39	0.17	0.12	0.08	0.13	0.30	0.20	0.14

Table 4. A7 Mean monthly Average Sunshine duration at Debre Zeit station

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1990	8.55	6.7	8.8	7.3	7.9	7	5.4	6.4	7	10	10	10.1
1994	10.4	10.1	8.8	8.7	9.6	6.3	4.9	5.5	7.4	10.2	9	10.2
1997	7.5	10.6	8.9	7.2	9.9	8.1	5.8	6.3	8.9	7.8	7.6	9.8
1998	8	7.9	7.8	8.9	8.2	7.8	5.5	4.6	6.3	7.6	10	10.4
1999	9.5	10.6	7.4	10	8.9	8	4.5	6.4	5.9	7.85	10	10.6
2000	10.1	10.3	7	9.95	8.4	6.9	6.2	5.2	5.5	8.1	9.1	9.5
2001	9.1	10	6.6	9.9	7.9	6.5	6.1	4.7	8.7	9.8	10	10
2002	8.2	10.1	8.1	9.2	8.5	9.9	7	6.4	8.2	9.9	10	7.1
2003	8.8	8.9	9.8	7.3	9.5	7.1	5	4.9	10.4	10.4	9.9	9.3
2004	8.65	9.5	8.4	7.6	9.3	6.6	5.8	5.9	7.4	8.4	10	9.5
2005	8.5	10.1	9	8.1	7	6.5	4.8	7.1	6.9	9.9	9.7	10.8
Mean	8.8	9.5	8.2	8.6	8.6	7.3	5.5	5.8	7.5	9.1	9.7	9.8
S.Dev	0.88	1.23	0.96	1.12	0.88	1.06	0.73	0.83	1.45	1.12	0.84	1.00

Appendix-4. B. Curve Numbers Selection

Table 4.B1. SCS Runoff Curve Numbers

A. *Urban areas*

Cover description

Cover type and hydrologic condition	Averagef % Impervious Area*	Curve number for hydrologic soil group A	B	C	D
Fully developed urban areas (vegetatin established):					
Open space (lawns, parks, golf courses, cemeteries, Etc.)+					
Poor condition (grass cover < 50%)		68	79	86	89
Fair conditon (grass cover 50 to 75%)		49	69	79	84
Good conditon (grass cover> 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding Right-of-way		98	98	98	98
Paved; open ditches (including right-of way)		83	89	92	93
Gravel (including right-of –way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western deser urban areas:					
Natural desert landscaping (pervious areas only)		63	77	85	88
Artificial desert landscaping (impervious weed Barrier, desert shrub with 1-to 2-in sand Or gravel mulch and basin borders					

* The average percent impervious area shown was used to develop the composite CNs. Other assumption are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in food hydrologic condition. CNs for other combinations of conditons may be computed.

CNs shown are euivalent to those of pasture. Composite CNs may be computed for other combination of open space cover type.

Composite CNs for natural desert landscaping should be computed based on the impervious are percentage (CN=98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic conditon.

Composite CNs to use for the design of temporary measures during grading and construction should be based on the degree of development (impervious area percentage) and the CNs for the newly graded pervious areas.

Urban districts:		96	96	96	96
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas:					
Newly graded areas (previous areas only, No vegetatio		77	86	91	94
Idle lands (CNs are determinedusing cover types Similar to those in Table B.1c)					

Table 4.B1. SCS Runoff Curve Numbers (Continued)

B. ***Cultivated agrcultural areas***

Cover description			Curve numbers for Hydrologic soil group			
Cover type	Treatment*	Hydrologic Condition	A	B	C	D
Fallow	Bare soil	-	77	86	91	94
	Crop residue cover(CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	poor	72	81	88	91
		Good	67	78	85	89
	SR+CR	poor	71	80	87	90

* Crop residue cover applies only if residue is on at lesst 5 percent of the surface throughout the year. Hydrologic conditin is based on combination of factors that affect infiltration and runoff, including (i) density and canopy of vegetative areas, (2) amount of year-round cover, (3) amount of grass or close-seeded legumes inrotations, (4) percent of residue cover on the land surface (good$\geq 20\%$), *and* (5) degree of surface roughness.

Poor; Factors impair infiltratin and tend to increase runoff.
Good: Factors encourage average and better thanaverage infiltration and tend to decrease runoff.

		Good	64	75	82	86
	Contoured©	Poor	70	79	84	88
		Good	65	75	82	86
	C+CR	poor	69	78	83	87
		Good	64	74	81	85
	Contoured and terraced(C&T)	poor	66	74	80	82
		Good	62	71	78	81
	C&T+CR	poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	poor	65	76	84	88
		Good	63	75	83	87
	SR+CR	poor	64	75	83	86
		Good	60	72	80	84
	C	poor	63	74	82	85
		Good	61	73	81	84
	C+CR	poor	62	73	81	84
		Good	60	72	80	83
	C&T	poor	61	72	79	82
		Good	59	70	78	81
	C&T+CR	poor	60	71	78	81
		Good	58	69	77	80
Close seeded	SR	poor	66	77	85	89
Or broadcast		Good	58	72	81	85
Legumes or	C	poor	64	75	83	85
Rotation		Good	55	69	78	83
Meadow	C&T	poor	63	73	80	83
		Good	51	67	76	80

Table 4. B1. SCS Runoff Curve Numbers (Continued)

C. Other agricultural areas

Cover description	Hydrologic Condition	Curve numbers for hydrologic soil group A	B	C	D
Pasture, grassland, or range- continuous forage	poor	68	79	86	89
For grazing*	Fair	49	69	79	84
	Good	39	61	74	80
Meadow – continuous grass, protected from Grazing and generally mowed for hay	_	30	58	71	78
Brush__ brush-weed-grass mixture with brush	poor	48	67	77	83
The major element	Fair	35	56	70	77
	Good	30	48	65	73
Woods-grass combination (orchard or tree farm)	poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
	Poor	45	66	77	83
Wood	Fair	36	60	73	79
	Good	30	55	70	77
Farmsteads__ buildings, lanes, driveways, and Surrounding lots	__	59	74	82	86

*poor :< 50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good :> 75% ground cover and lightly or only occasionally grazed.
Poor :< 50% ground cover.
Fair: 50 to 75% ground cover.
Good :> 75% ground cover.

CNs shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CNs for woods and pasture.
Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 4. B1. SCS Runoff Curve Numbers (Continued)

D Arid and semiarid range areas

Cover description: Cover type	Hydrologic Condition*	Curve numbers for Hydrologic soil group: A	B	C	D
Herbaceous __ mixture of grass, weeds, and	poor	80	87	93	
Low-growing brush, with brush the min	Fair	71	81	89	
element	Good	62	74	83	
Oak-aspen – mountain brush mixture of oak	poor		66	74	79
Brush, aspen, mountain mahogany, bitter brush,	Fair		48	57	63
maple, and other brush	Good		30	41	48
Pinion-juniper __pinion, juniper, or both: grass	poor		75	85	89
understory	Fair		58	73	80
	Good		41	61	71
	Poor		67	80	83
Sagebrush with grass understory	Fair		51	63	70
	Good		35	47	55
Desert shrub__major plants include saltbush,	Poor	63	77	85	88
Greasewood, creosotebush, blackbrush, bursage,	Fair	55	72	81	86
Paid verde, mesquite, and cactus	Good	49	68	79	84

* poor:< 30% ground cover(litter, grass, and brush overstory).
Fair 30 to 70% ground cover.
Good:> 70% ground cover.
Curve numbers for group A have been developed only for desert shrub.

Appendix-4. B2. Procedures for calculating daily runoff flows to the reservoirs

1	2	3	4	5				
				CN (II) values for each land use				
Days	Daily Rainfall (mm),R	5 days AM	AMC Condition	cultivated	Forest	Fallow	water body	Swampy
				88	**77**	**94**	**98**	**98**
1995, Jan-01	0.0	0	1	75.5	58.4	86.8	95.4	95.4
2	0.0	0	1	75.5	58.4	86.8	95.4	95.4
3	0.0	0	1	75.5	58.4	86.8	95.4	95.4
4	0.0	0	1	75.5	58.4	86.8	95.4	95.4
5	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
6	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
7	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
8	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
9	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
10	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
11	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
12	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
13	0.0	0.0	1	75.5	58.4	86.8	95.4	95.4
167	0.1	7.0	1	75.5	58.4	86.8	95.4	95.4
168	0	1.9	1	75.5	58.4	86.8	95.4	95.4
169	13.9	15.8	2	88	77	94	98	98
170	2.6	16.7	2	88	77	94	98	98
171	0.7	17.3	2	88	77	94	98	98
172	0.00	17.2	2	88	77	94	98	98
173	0.0	17.2	2	88	77	94	98	98
174	2.5	5.8	1	75.5	58.4	86.8	95.4	95.4
175	19	22.2	2	88	77	94	98	98
176	9.0	30.5	3	94	89	97	99	99
177	0.0	30.5	3	97	95	99	100	100
178	14.1	44.6	3	94	89	97	99	99
179	14.7	56.8	3	94	89	97	99	99
180	0	37.8	3	94	89	97	99	99
181	0.0	28.8	3	94	89	97	99	99
182	7.5	36.3	3	94	89	97	99	99

Table continued........

5			6	7	8	9
CN (II) values for each land use						
Mountain & Stoney	Residential	Small grains	**CN**avg	S (mm)	Q (mm)	Qin (m^3/s)
91	**92**	**88**				
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
91	92	88	88.2	33.85	1.24	1.724
91	92	88	88.2	33.85	0.00	0.000
91	92	88	88.2	33.85	0.00	0.000
91	92	88	88.2	33.85	0.00	0.000
91	92	88	88.2	33.85	0.00	0.000
80.9	82.8	75.5	76.0	80.33	0.00	0.000
91	92	88	88.2	33.85	3.25	4.510
96	96	94	94.5	14.74	1.76	2.447
98	98	97	97.5	6.41	0.00	0.000
96	96	94	94.5	14.74	4.80	6.672
96	96	94	94.5	14.74	5.21	7.242
96	96	94	94.5	14.74	0.00	0.000
96	96	94	94.5	14.74	0.00	0.000
96	96	94	94.5	14.74	1.07	1.492
91	92	88	88.2	33.85	0.00	0.000
81	83	75	76.0	80.33	0.00	0.000

Procedures involved in calculating runoff

1. Column-1 Year of record and daily calendar in ascending order (1995, Jan-01 to 2003,Dec-31)
2. Column-2 Daily rainfall in (mm).
3. Column-3 the sum total of the previous five days consecutive rainfall values.
4. Column-4 Antecedent moisture condition according to the definition of SCS for the growing season referring the values in column 3 of the same day.
5. Column-5 Estimation curve number for each land use for each antecedent moisture condition based on curve number CN(II) by the formula applied to each conditions stated by SCS ($CN(I) = \frac{4.2CN(II)}{10 - 0.058CN(II)}$, $CN(III) = \frac{23CN(II)}{10 + 0.13CN(II)}$)
6. Column-6 The weighted curve number values for each antecedent moisture condition in column 5 ($CN(I)_{avg} = \frac{CN(I)_1 * A_1 + CN(I)_2 * A_2 + ...CN(I)_n * A_n}{A_T}$)

Where, $CN(I)_n$ is the curve number value estimated for each land use in column 5 for each antecedent moisture condition I,

A_n is the area of particular land use coverage in hectare

A_T is the total catchment area of each reservoir.

7. Column-7 Values of S computed using the formula $S(mm) = \frac{25400}{CN_{avg}} - 254$
8. Column-8 Values of runoff, $Q(mm)$ computed by using the formula $Q(mm) = \frac{(R-0.2S)^2}{R+0.8S}, R > 0.2S;\ Q(mm) = 0.0, R \leq 0.2S$
9. Column-9 Runoff values $Q(m^3/se)$ computed by using the formula;

$$Q_i(m^3/se) = \left(\frac{Q(mm) * A_i(m^2)}{1000 * day(\text{sec})} \right)$$

Where; Q_i are the daily runoff values for each reservoir catchment

A_i Is the catchment area of each reservoir.

Appendix-5A Long-term mean monthly values of climate variables at Debre Zeit station

Country:	Ethiopia			Station	: Debre Zeit		
Altitude:	1850 meters above M.S.L						
Latitude:	8.71 Deg. (North)			Longitude	: 38.95 Deg. (East)		
Month Units	MaxTemp (deg.C)	MiniTemp (deg.C)	Humidity (%)	Wind Speed. (Km/d)	Sunshine (Hours)	Solar Rad. (MJ/m2/d)	ETo (mm/d)
January	26.2	9.7	56	119.2	8.8	20.5	4.03
February	27.3	11.1	53	134.8	9.5	22.8	4.68
March	28	12.7	55	137.4	8.2	22	4.79
April	27.9	13.5	57	140.8	8.6	22.8	4.93
May	28.6	12.9	56	144.3	8.6	22.2	4.93
June	27.2	12.3	65	114	7.3	19.8	4.15
July	24.1	13	75	100.2	5.5	17.3	3.4
August	23.8	12.9	76	87.3	5.8	18.2	3.46
September	25	12.3	72	. 82.1	7.5	20.8	3.89
October	26	10.6	58	121.8	9.1	22.5	4.4
November	25.7	9.4	56	129.6	9.7	22	4.24
December	25.7	9.4	57	126.1	9.8	21.4	4.05
Average	**26.3**	**11.7**	**61.3**	**119.8**	**8.2**	**21**	**4.25**
Pen-Montieth equation was used in ETo with the following values							
For Angstrom's coefficients :							
	a = 0.25		b = 0.5				

Appendix-5B. ETO and Effective rainfall calculation based on dependable method

Month	ETo (mm/d)	Total Rainfall (mm/month)	Effective Rain (mm/month)
January	4.03	9.8	0
February	4.68	25.7	5.4
March	4.79	46.9	18.1
April	4.93	59.2	25.5
May	4.93	52.3	21.4
June	4.15	92.6	50.1
July	3.4	220.1	152.1
August	3.46	223	154.4
September	3.89	105.5	60.4
October	4.4	22.6	3.6
November	4.24	5	0
December	4.05	4	0
Total (mm/year)	1548.2	866.7	491

N.B.

Effective rainfall calculated using the following formulas:

Effective R. = 0.6 *Total R-10...... (Total R. <70mm/month),

Effective R. = 0.8 *Total R.-24 .... (Total R. >70mm/month).

Appendix-5C Soil data

Soil description	Medium
Total available soil moisture	210.0 mm/m depth.
Initial soil moisture depletion	50%
Initial available soil moisture	105.0 mm/m depth.
Maximum infiltration rate	300 mm/d.
Depth of root-restricting layer	1.05 m.

Appendix-6A HEC-ResSim Reservoir Inputs

Selecting Pool under the Physical Tab in the Reservoir Editor (Figure 6.A1) allows for the input of the Elevation-Area-Storage curve. This information was obtained from the Oromia Irrigation Development Authority. These informations are values at Dead storage level, Spillway level and Top level and the intermediate values are computed by the software using the cone interpolation method.

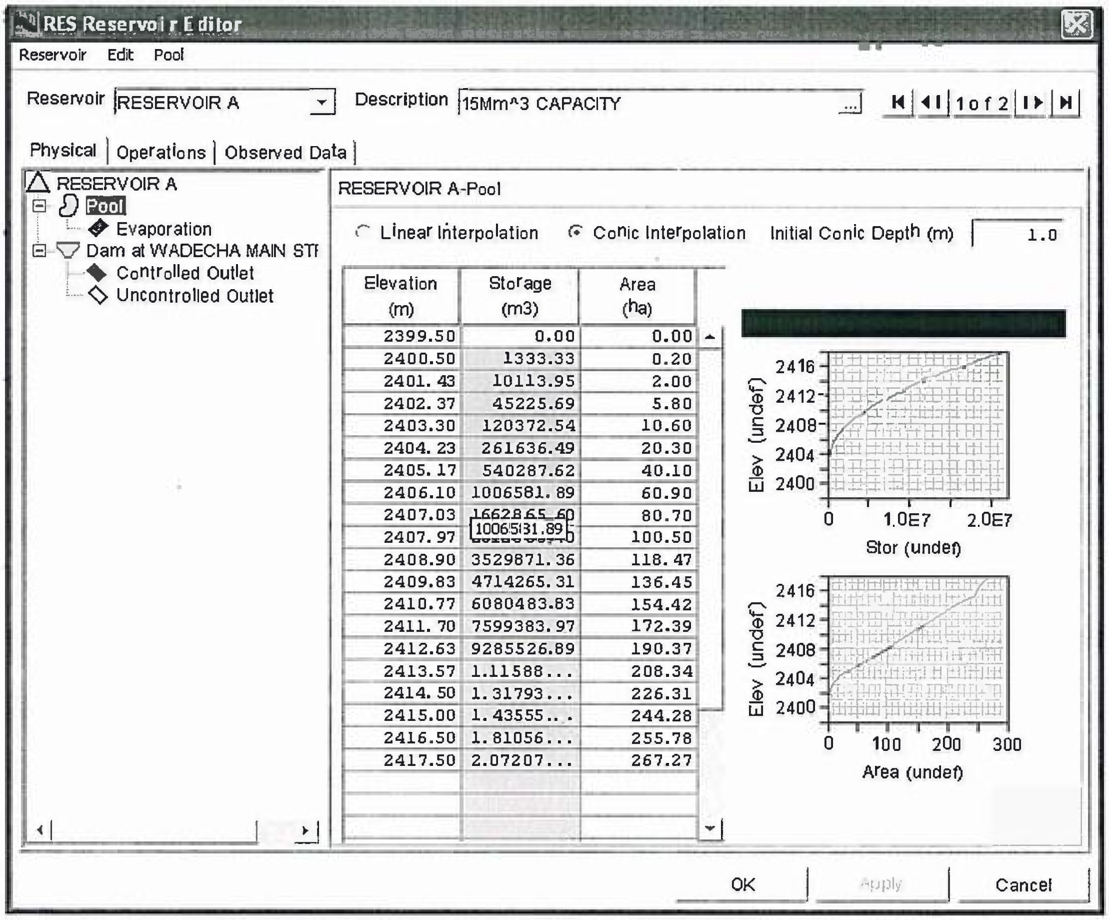


Figure 6.A1. Reservoir Editor in HEC-ResSim – Physical Information of Wadecha Reservoir

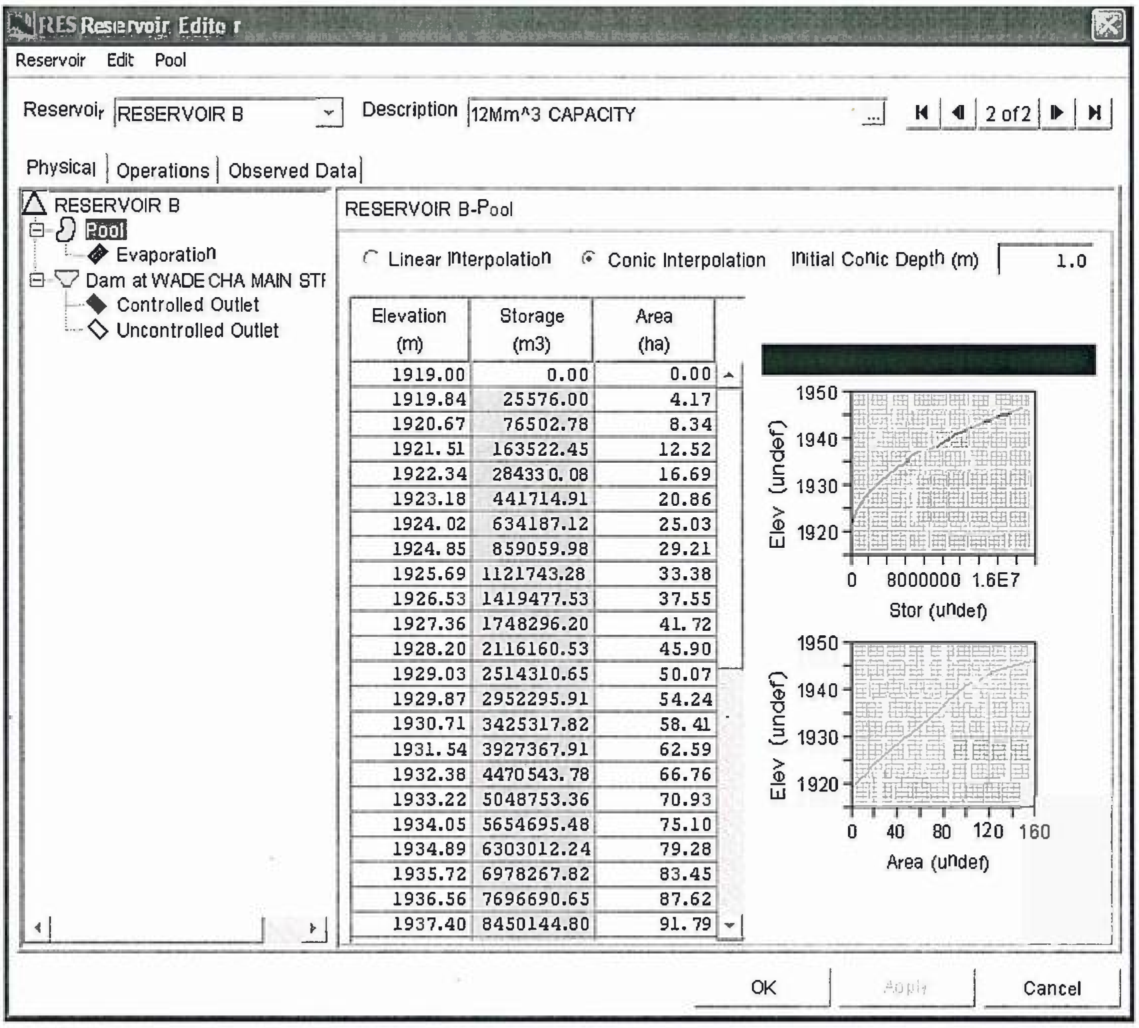


Figure 6.A2. Reservoir Editor in HEC-ResSim – Physical Information of Belbela Reservoir

N.B: Conic Interpolation: The pool definition detailed in the regulation for the two reservoirs was originally developed using the assumption that the volume of water between two elevations can be described by the same equation as that used to compute the volume of a section of a cone. The area of the pool surface at each elevation can be computed based on the topography of the land and the change in elevation. Using this information ResSim can compute the storage between the two elevations. This method of computing storage is available with the conic interpolation option. This option requires us to input an elevation vs. area relationship and a starting storage value at the lowest elevation in the table. ResSim will then compute the storage values using the conic assumption. Conic interpolation will also be used to obtain intermediate storage values for elevations between those explicitly entered in the table.

Selecting Evaporation under the Physical Tab in the Reservoir Editor (Figure 5.A3) allows for the input of the monthly average evaporation information.

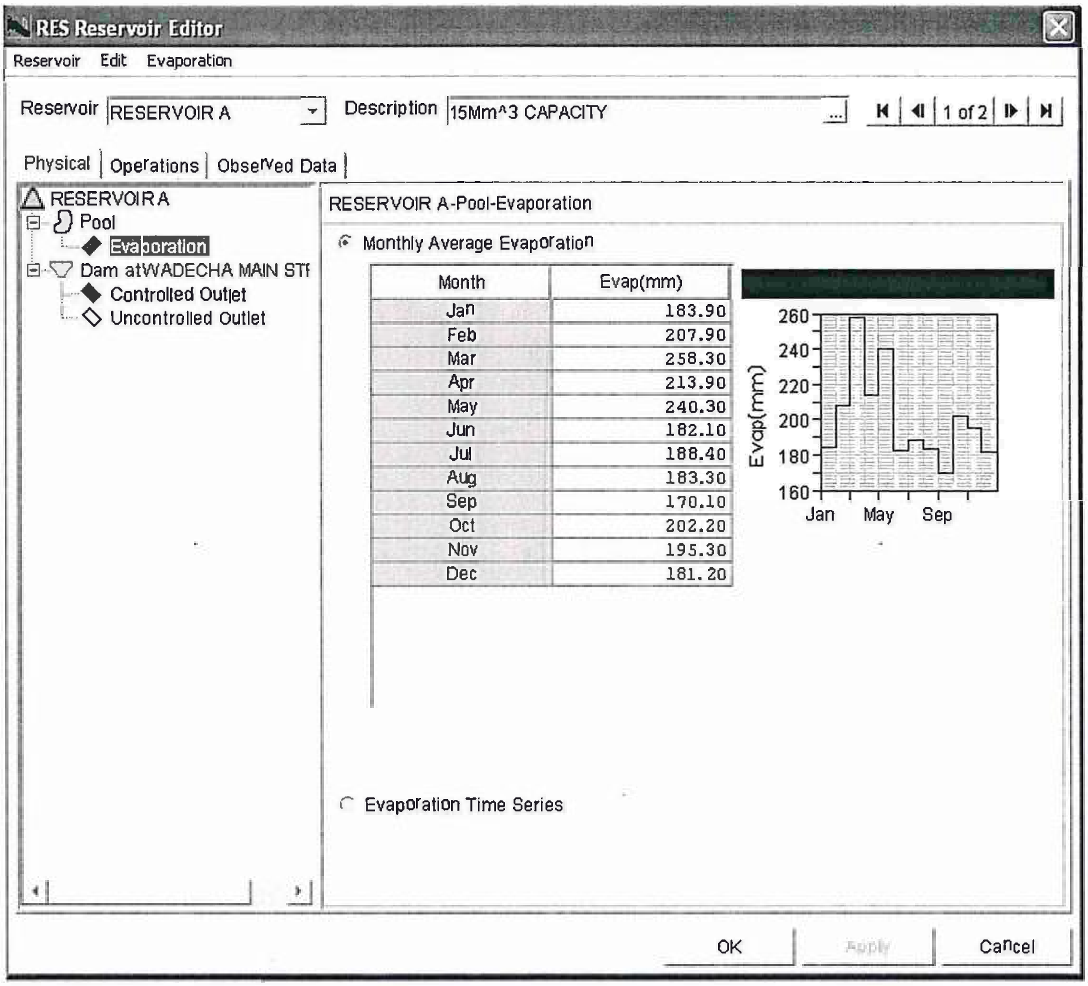


Figure 6.A3 Reservoir Editor in HEC-ResSim – Operations Information on evaporation of Wadecha Reservoir

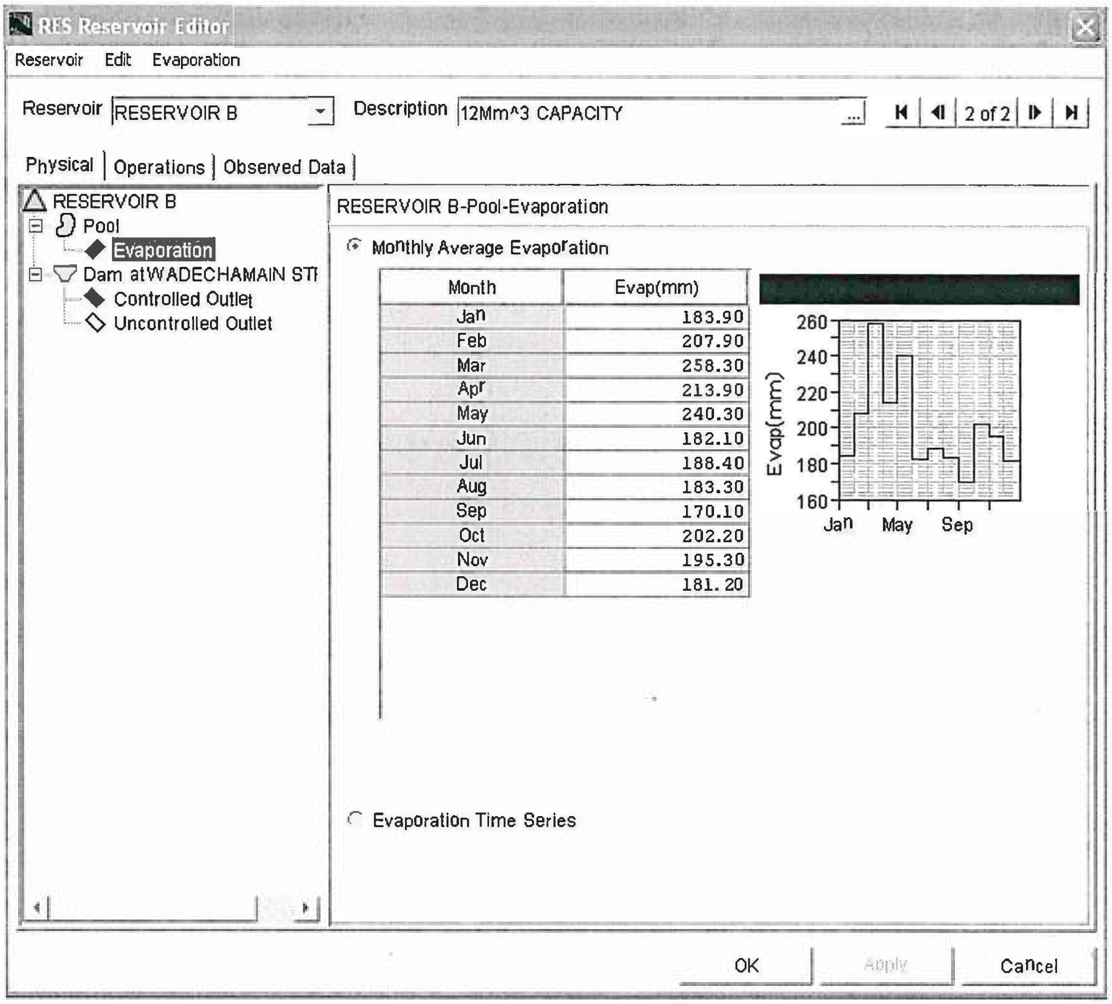
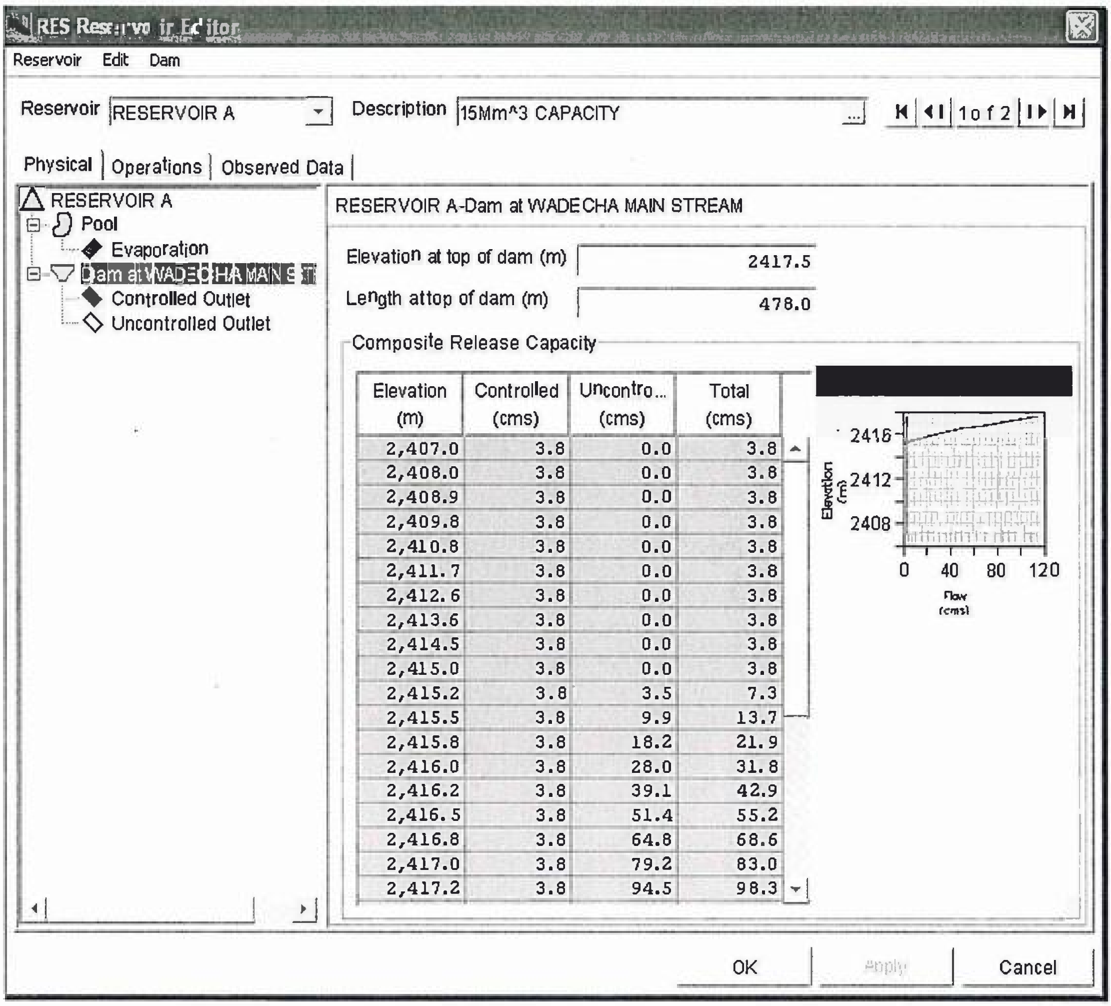


Figure 6.A4. Reservoir Editor in HEC-ResSim – Operations Information on evaporation of Belbela Reservoir

Selecting Controlled outlet and uncontrolled outlet under the Physical Tab in the Reservoir Editor (Figure 5.A5 and 5.A6) allows for the input of the outlet information.



Elevation (m)	Controlled (cms)	Uncontro... (cms)	Total (cms)
2,407.0	3.8	0.0	3.8
2,408.0	3.8	0.0	3.8
2,408.9	3.8	0.0	3.8
2,409.8	3.8	0.0	3.8
2,410.8	3.8	0.0	3.8
2,411.7	3.8	0.0	3.8
2,412.6	3.8	0.0	3.8
2,413.6	3.8	0.0	3.8
2,414.5	3.8	0.0	3.8
2,415.0	3.8	0.0	3.8
2,415.2	3.8	3.5	7.3
2,415.5	3.8	9.9	13.7
2,415.8	3.8	18.2	21.9
2,416.0	3.8	28.0	31.8
2,416.2	3.8	39.1	42.9
2,416.5	3.8	51.4	55.2
2,416.8	3.8	64.8	68.6
2,417.0	3.8	79.2	83.0
2,417.2	3.8	94.5	98.3

Figure 6.A5 Reservoir Editor in HEC-ResSim – Outlet Information Wadecha Reservoir

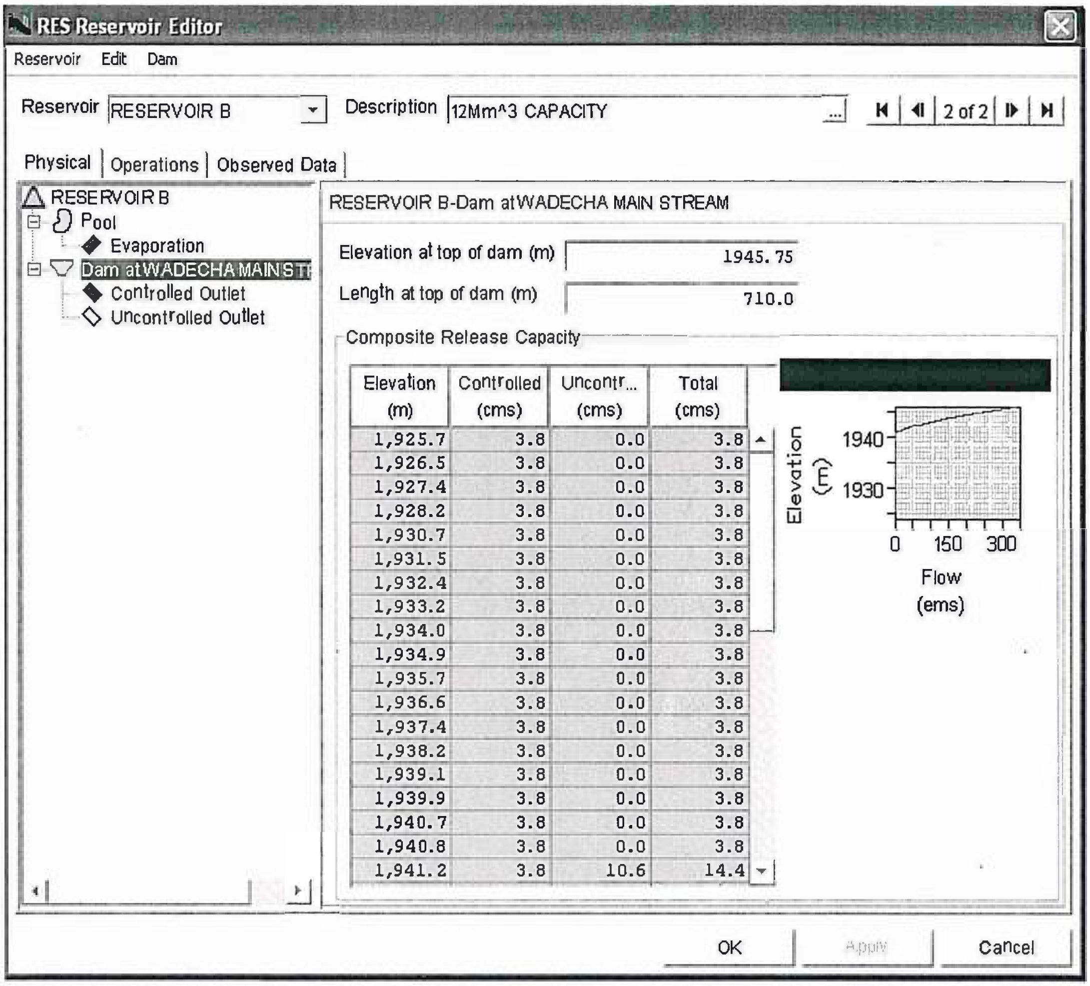
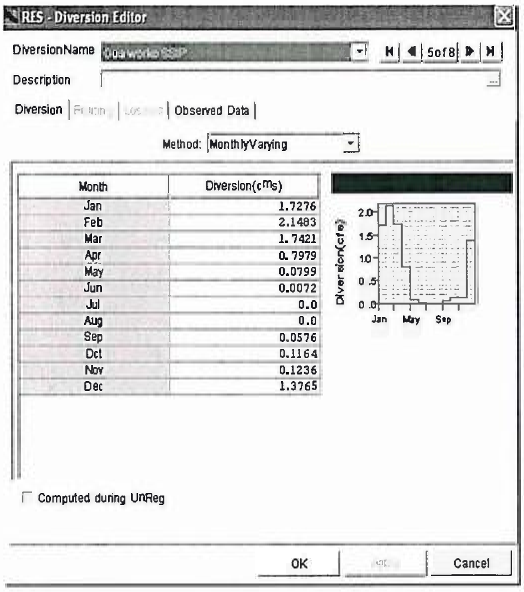


Figure 6.A6 Reservoir Editor in HEC-ResSim – Outlet Information Belbela Reservoir



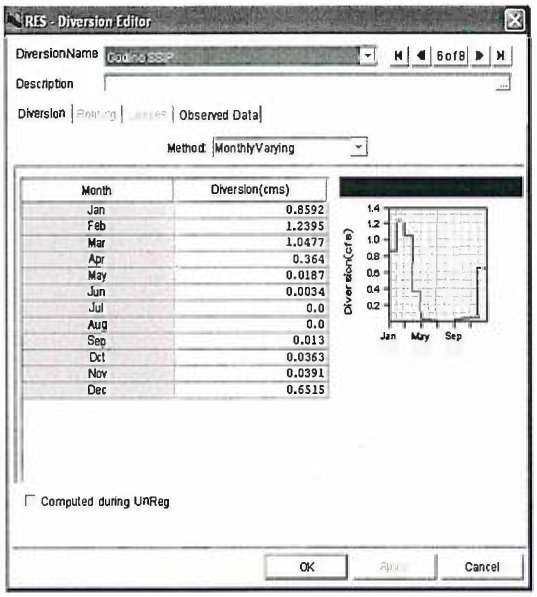
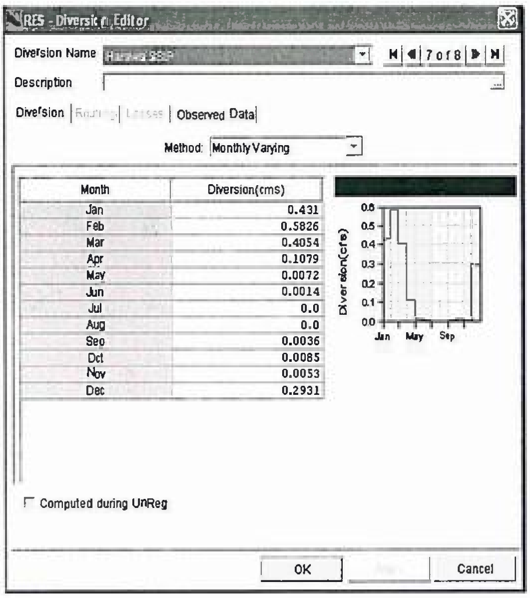


Figure 6.A7.1 Goa Workie diversion

Figure 6.A7.2 Godino SSIP diversion



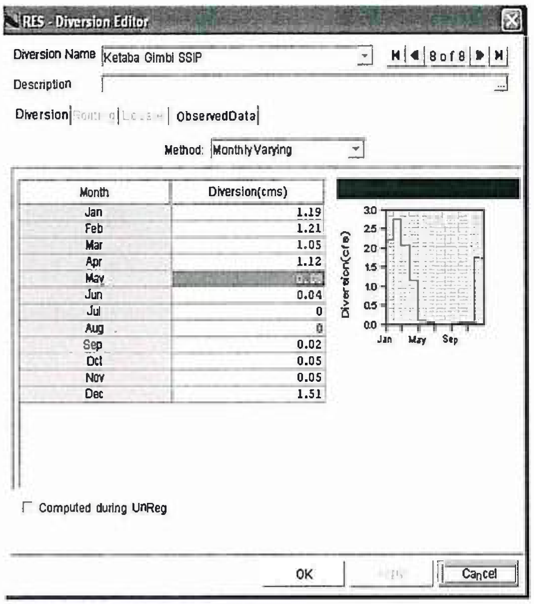


Figure 6.A7.3 Harawa SSIP diversion

Figure 6.A7.4 Ketaba Gembi SSIP diversion

Figure 6.A7. Diversion Editor in HEC-ResSim – diversion Information of Wadecha Reservoir

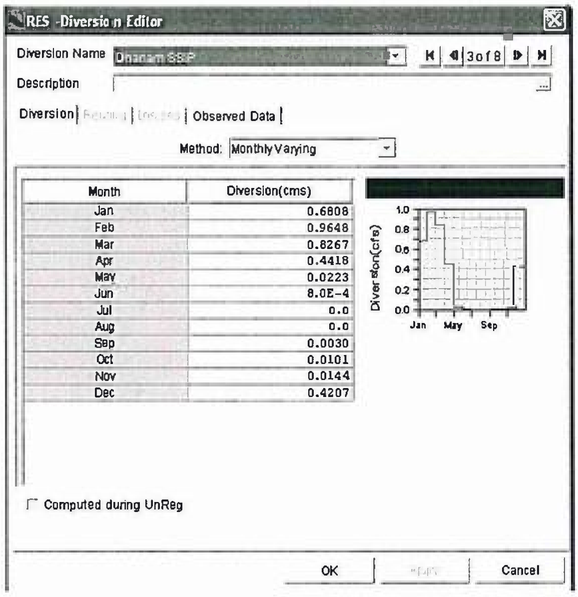


Figure 6.A8.1 Dhanama SSIP diversion

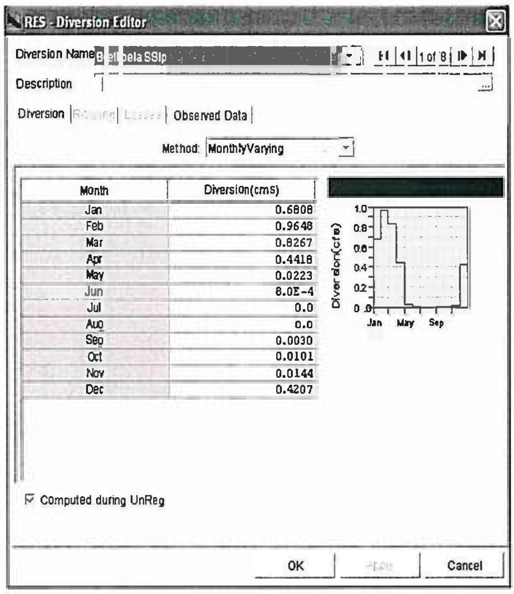


Figure 6.A8.2 Belbela SSIP diversion

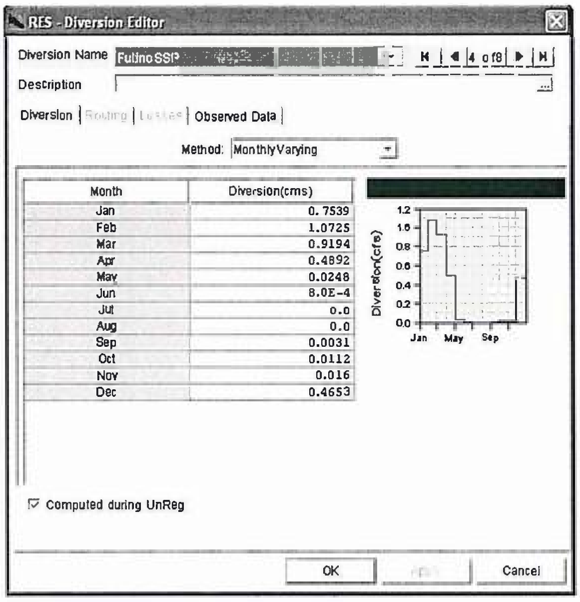


Figure 6.A8.3. Ful-Tino SSIP diversion

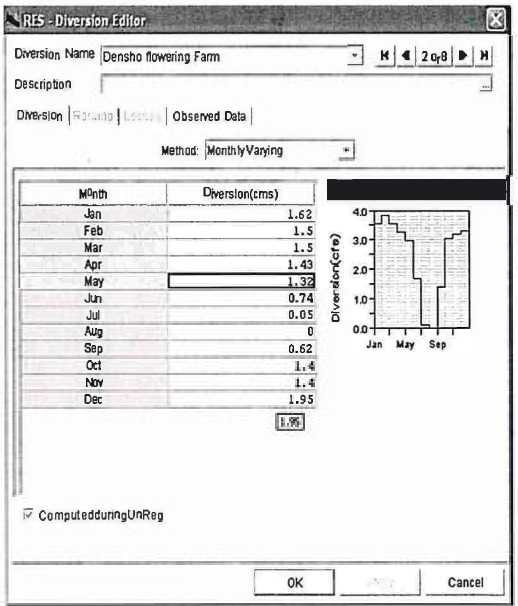


Figure 6.A8.4 Densho Flower Farm

Figure 6.A8 Diversion Editor in HEC-ResSim – diversion Information of Belbela Reservoir

Appendix-7A. Daily runoff data generated for Wadecha-Belbela reservoir system

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
1	0.0	0.0	0.0	0.0	103	0.0	0.0	0.0	0.0	205	1.2	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	104	0.0	0.0	0.0	0.0	206	5.8	0.5	0.6	0.4
3	0.0	0.0	0.0	0.0	105	11.0	0.0	0.0	0.0	207	3.3	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	106	0.0	0.0	0.0	0.0	208	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	107	0.6	0.0	0.0	0.0	209	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	108	2.5	0.0	0.0	0.0	210	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	109	0.0	0.0	0.0	0.0	211	28.5	16.2	22.5	15.8
8	0.0	0.0	0.0	0.0	110	0.0	0.0	0.0	0.0	212	1.5	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	111	0.0	0.0	0.0	0.0	213	21.0	9.9	13.8	9.7
10	0.0	0.0	0.0	0.0	112	0.0	0.0	0.0	0.0	214	2.5	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	113	0.3	0.0	0.0	0.0	215	0.1	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	114	0.0	0.0	0.0	0.0	216	15.0	5.4	7.5	5.3
13	0.0	0.0	0.0	0.0	115	6.2	0.0	0.0	0.0	217	1.8	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	116	0.0	0.0	0.0	0.0	218	1.1	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	117	3.7	0.0	0.0	0.0	219	20.5	9.5	13.3	9.3
16	0.0	0.0	0.0	0.0	118	3.7	0.0	0.0	0.0	220	13.5	4.4	6.1	4.3
17	0.0	0.0	0.0	0.0	119	0.2	0.0	0.0	0.0	221	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	120	0.0	0.0	0.0	0.0	222	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	121	0.0	0.0	0.0	0.0	223	1.5	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	122	0.0	0.0	0.0	0.0	224	32.4	19.6	27.3	19.1
21	0.0	0.0	0.0	0.0	123	0.0	0.0	0.0	0.0	225	1.9	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	124	0.0	0.0	0.0	0.0	226	12.7	3.9	5.4	3.6
23	0.0	0.0	0.0	0.0	125	0.0	0.0	0.0	0.0	227	0.5	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	126	0.0	0.0	0.0	0.0	228	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	127	0.0	0.0	0.0	0.0	229	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	128	0.0	0.0	0.0	0.0	230	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	129	0.0	0.0	0.0	0.0	231	4.8	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	130	0.0	0.0	0.0	0.0	232	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	131	0.0	0.0	0.0	0.0	233	0.2	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	132	0.0	0.0	0.0	0.0	234	6.9	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	133	0.0	0.0	0.0	0.0	235	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	134	0.0	0.0	0.0	0.0	236	9.5	0.2	0.3	0.2
33	0.0	0.0	0.0	0.0	135	0.0	0.0	0.0	0.0	237	1.6	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	136	1.5	0.0	0.0	0.0	238	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	137	0.0	0.0	0.0	0.0	239	22.0	10.7	14.9	10.4
36	0.0	0.0	0.0	0.0	138	0.0	0.0	0.0	0.0	240	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	139	0.0	0.0	0.0	0.0	241	0.1	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	140	2.3	0.0	0.0	0.0	242	0.2	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	141	0.0	0.0	0.0	0.0	243	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	142	0.3	0.0	0.0	0.0	244	1.2	0.0	0.0	0.0
41	0.6	0.0	0.0	0.0	143	0.0	0.0	0.0	0.0	245	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	144	0.0	0.0	0.0	0.0	246	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	145	0.0	0.0	0.0	0.0	247	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	146	0.0	0.0	0.0	0.0	248	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	147	0.0	0.0	0.0	0.0	249	0.1	0.0	0.0	0.0
46	0.5	0.0	0.0	0.0	148	0.0	0.0	0.0	0.0	250	1.9	0.0	0.0	0.0
47	1.1	0.0	0.0	0.0	149	0.0	0.0	0.0	0.0	251	17.0	2.4	3.3	2.3
48	0.0	0.0	0.0	0.0	150	0.8	0.0	0.0	0.0	252	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	151	0.6	0.0	0.0	0.0	253	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	152	0.0	0.0	0.0	0.0	254	0.1	0.0	0.0	0.0
51	2.4	0.0	0.0	0.0	153	9.2	0.0	0.0	0.0	255	0.1	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	154	0.0	0.0	0.0	0.0	256	3.2	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	155	0.0	0.0	0.0	0.0	257	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	156	0.0	0.0	0.0	0.0	258	3.2	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	157	0.0	0.0	0.0	0.0	259	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	158	0.0	0.0	0.0	0.0	260	11.7	0.6	0.9	0.8
57	0.0	0.0	0.0	0.0	159	0.0	0.0	0.0	0.0	261	2.9	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	160	0.0	0.0	0.0	0.0	262	19.1	8.4	11.7	8.2
59	0.0	0.0	0.0	0.0	161	0.0	0.0	0.0	0.0	263	0.1	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	162	0.0	0.0	0.0	0.0	264	13.2	4.2	5.8	4.1
61	0.0	0.0	0.0	0.0	163	5.1	0.0	0.0	0.0	265	1.5	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	164	0.0	0.0	0.0	0.0	266	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	165	1.7	0.0	0.0	0.0	267	0.1	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	166	0.1	0.0	0.0	0.0	268	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	167	0.1	0.0	0.0	0.0	269	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	168	0.0	0.0	0.0	0.0	270	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	169	13.9	1.2	1.7	1.2	271	0.0	0.0	0.0	0.0
68	0.0	0.0	0.0	0.0	170	2.6	0.0	0.0	0.0	272	0.0	0.0	0.0	0.0
69	0.5	0.0	0.0	0.0	171	0.7	0.0	0.0	0.0	273	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	172	0.0	0.0	0.0	0.0	274	0.0	0.0	0.0	0.0
71	5.0	0.0	0.0	0.0	173	0.0	0.0	0.0	0.0	275	0.0	0.0	0.0	0.0
72	0.5	0.0	0.0	0.0	174	2.5	0.0	0.0	0.0	276	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	175	19.0	3.2	4.5	3.2	277	0.0	0.0	0.0	0.0
74	0.3	0.0	0.0	0.0	176	9.0	1.6	2.4	1.7	278	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.0	177	0.0	0.0	0.0	0.0	279	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	0.0	178	14.1	4.6	6.7	4.7	280	0.0	0.0	0.0	0.0
77	0.0	0.0	0.0	0.0	179	14.7	5.2	7.2	5.1	281	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	180	0.0	0.0	0.0	0.0	282	0.0	0.0	0.0	0.0
79	0.0	0.0	0.0	0.0	181	0.0	0.0	0.0	0.0	283	0.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	182	7.5	1.1	1.5	1.0	284	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	183	0.0	0.0	0.0	0.0	285	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	184	0.5	0.0	0.0	0.0	286	0.0	0.0	0.0	0.0
83	1.5	0.0	0.0	0.0	185	0.0	0.0	0.0	0.0	287	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	186	0.0	0.0	0.0	0.0	288	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	187	0.4	0.0	0.0	0.0	289	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	188	8.0	0.0	0.0	0.0	290	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	189	0.0	0.0	0.0	0.0	291	0.0	0.0	0.0	0.0
88	0.0	0.0	0.0	0.0	190	5.0	0.0	0.0	0.0	292	0.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	191	0.1	0.0	0.0	0.0	293	0.0	0.0	0.0	0.0
90	0.0	0.0	0.0	0.0	192	8.2	0.0	0.0	0.0	294	0.0	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	193	9.0	0.1	0.2	0.1	295	0.0	0.0	0.0	0.0
92	0.0	0.0	0.0	0.0	194	2.5	0.0	0.0	0.0	296	0.0	0.0	0.0	0.0
93	0.0	0.0	0.0	0.0	195	6.5	0.0	0.0	0.0	297	0.0	0.0	0.0	0.0
94	0.0	0.0	0.0	0.0	196	16.0	6.1	8.5	6.0	298	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0	197	7.3	1.0	1.4	1.0	299	0.0	0.0	0.0	0.0
96	0.0	0.0	0.0	0.0	198	4.3	0.1	0.2	0.1	300	0.0	0.0	0.0	0.0
97	1.4	0.0	0.0	0.0	199	29.5	17.1	23.7	16.6	301	0.0	0.0	0.0	0.0
98	2.5	0.0	0.0	0.0	200	20.4	9.5	13.1	9.2	302	0.0	0.0	0.0	0.0
99	1.7	0.0	0.0	0.0	201	0.1	0.0	0.0	0.0	303	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	0.0	202	0.1	0.0	0.0	0.0	304	0.0	0.0	0.0	0.0
101	0.0	0.0	0.0	0.0	203	1.2	0.0	0.0	0.0	305	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	204	23.8	12.2	17.0	11.9	306	0.0	0.0	0.0	0.0
										307	0.0	0.0	0.0	0.0
										308	0.0	0.0	0.0	0.0

Table continued……………….

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
309	0.0	0.0	0.0	0.0	413	0.0	0.0	0.0	0.0	517	25.5	13.6	18.9	13.3
310	0.0	0.0	0.0	0.0	414	0.0	0.0	0.0	0.0	518	0.4	0.0	0.0	0.0
311	0.0	0.0	0.0	0.0	415	0.0	0.0	0.0	0.0	519	29.2	16.8	23.4	16.3
312	0.0	0.0	0.0	0.0	416	0.0	0.0	0.0	0.0	520	0.1	0.0	0.0	0.0
313	0.0	0.0	0.0	0.0	417	0.0	0.0	0.0	0.0	521	0.1	0.0	0.0	0.0
314	0.0	0.0	0.0	0.0	418	0.0	0.0	0.0	0.0	522	11.1	2.9	4.0	2.8
315	0.0	0.0	0.0	0.0	419	0.0	0.0	0.0	0.0	523	62.0	47.3	65.6	45.9
316	0.0	0.0	0.0	0.0	420	0.0	0.0	0.0	0.0	524	8.3	1.4	2.0	1.4
317	0.0	0.0	0.0	0.0	421	0.0	0.0	0.0	0.0	525	0.2	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0	422	0.0	0.0	0.0	0.0	526	12.2	3.6	5.0	3.5
319	0.0	0.0	0.0	0.0	423	0.0	0.0	0.0	0.0	527	6.0	0.5	0.7	0.5
320	0.0	0.0	0.0	0.0	424	0.0	0.0	0.0	0.0	528	10.1	2.3	3.2	2.3
321	0.0	0.0	0.0	0.0	425	0.0	0.0	0.0	0.0	529	57.8	43.2	60.1	42.0
322	0.0	0.0	0.0	0.0	426	0.0	0.0	0.0	0.0	530	0.7	0.0	0.0	0.0
323	0.0	0.0	0.0	0.0	427	0.0	0.0	0.0	0.0	531	0.4	0.0	0.0	0.0
324	0.0	0.0	0.0	0.0	428	0.0	0.0	0.0	0.0	532	19.3	8.6	11.9	8.4
325	0.0	0.0	0.0	0.0	429	0.0	0.0	0.0	0.0	533	12.3	3.6	5.0	3.5
326	0.0	0.0	0.0	0.0	430	0.0	0.0	0.0	0.0	534	2.5	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0	431	0.0	0.0	0.0	0.0	535	10.3	2.4	3.4	2.4
328	0.0	0.0	0.0	0.0	432	0.0	0.0	0.0	0.0	536	2.7	0.0	0.0	0.0
329	0.0	0.0	0.0	0.0	433	0.0	0.0	0.0	0.0	537	5.1	0.3	0.4	0.3
330	0.0	0.0	0.0	0.0	434	0.0	0.0	0.0	0.0	538	0.0	0.0	0.0	0.0
331	0.0	0.0	0.0	0.0	435	28.3	18.0	22.3	15.6	539	0.0	0.0	0.0	0.0
332	0.0	0.0	0.0	0.0	436	11.0	2.8	4.0	2.8	540	6.6	0.0	0.0	0.0
333	0.0	0.0	0.0	0.0	437	16.2	6.3	6.7	6.1	541	0.0	0.0	0.0	0.0
334	0.0	0.0	0.0	0.0	438	0.0	0.0	0.0	0.0	542	1.7	0.0	0.0	0.0
335	0.0	0.0	0.0	0.0	439	0.0	0.0	0.0	0.0	543	0.1	0.0	0.0	0.0
336	0.0	0.0	0.0	0.0	440	9.5	2.0	2.8	2.0	544	2.5	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0	441	0.0	0.0	0.0	0.0	545	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0	442	0.0	0.0	0.0	0.0	546	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0	443	0.0	0.0	0.0	0.0	547	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	444	6.8	0.0	0.0	0.0	548	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0	445	0.0	0.0	0.0	0.0	549	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0	446	0.1	0.0	0.0	0.0	550	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0	447	0.0	0.0	0.0	0.0	551	0.5	0.0	0.0	0.0
344	0.0	0.0	0.0	0.0	448	0.0	0.0	0.0	0.0	552	3.6	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0	449	0.0	0.0	0.0	0.0	553	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0	450	0.0	0.0	0.0	0.0	554	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0	451	12.5	0.0	0.0	0.0	555	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0	452	15.1	1.8	2.3	1.6	556	4.5	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0	453	1.4	0.0	0.0	0.0	557	26.5	14.5	20.1	14.1
350	0.0	0.0	0.0	0.0	454	2.3	0.0	0.0	0.0	558	2.4	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0	455	0.2	0.0	0.0	0.0	559	6.6	0.7	1.0	0.7
352	0.0	0.0	0.0	0.0	456	0.0	0.0	0.0	0.0	560	0.4	0.0	0.0	0.0
353	11.9	0.0	0.0	0.0	457	0.0	0.0	0.0	0.0	561	0.2	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0	458	0.0	0.0	0.0	0.0	562	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0	459	0.0	0.0	0.0	0.0	563	25.2	13.4	18.6	13.0
356	0.0	0.0	0.0	0.0	460	0.0	0.0	0.0	0.0	564	13.0	4.1	5.7	4.0
357	0.0	0.0	0.0	0.0	461	0.0	0.0	0.0	0.0	565	42.0	26.4	39.4	27.6
358	0.0	0.0	0.0	0.0	462	1.4	0.0	0.0	0.0	566	2.7	0.0	0.0	0.0
359	0.0	0.0	0.0	0.0	463	0.0	0.0	0.0	0.0	567	3.0	0.0	0.0	0.0
360	0.0	0.0	0.0	0.0	464	11.7	0.8	0.9	0.6	568	2.7	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0	465	0.1	0.0	0.0	0.0	569	0.5	0.0	0.0	0.0
362	0.0	0.0	0.0	0.0	466	0.0	0.0	0.0	0.0	570	2.3	0.0	0.0	0.0
363	0.0	0.0	0.0	0.0	467	0.0	0.0	0.0	0.0	571	12.7	0.9	1.2	0.9
364	0.0	0.0	0.0	0.0	468	0.0	0.0	0.0	0.0	572	0.1	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0	469	0.0	0.0	0.0	0.0	573	1.1	0.0	0.0	0.0
366	0.8	0.0	0.0	0.0	470	0.0	0.0	0.0	0.0	574	6.5	0.0	0.0	0.0
367	0.2	0.0	0.0	0.0	471	0.0	0.0	0.0	0.0	575	0.4	0.0	0.0	0.0
368	0.3	0.0	0.0	0.0	472	1.3	0.0	0.0	0.0	576	1.4	0.0	0.0	0.0
369	8.2	0.0	0.0	0.0	473	1.5	0.0	0.0	0.0	577	0.8	0.0	0.0	0.0
370	0.0	0.0	0.0	0.0	474	3.6	0.0	0.0	0.0	578	4.9	0.0	0.0	0.0
371	0.0	0.0	0.0	0.0	475	11.8	0.7	0.9	0.6	579	10.5	0.4	0.5	0.4
372	0.0	0.0	0.0	0.0	476	0.0	0.0	0.0	0.0	580	1.6	0.0	0.0	0.0
373	0.0	0.0	0.0	0.0	477	0.0	0.0	0.0	0.0	581	13.4	4.3	6.0	4.2
374	0.0	0.0	0.0	0.0	478	2.1	0.0	0.0	0.0	582	3.1	0.0	0.0	0.0
375	0.0	0.0	0.0	0.0	479	1.0	0.0	0.0	0.0	583	0.5	0.0	0.0	0.0
376	0.0	0.0	0.0	0.0	480	0.0	0.0	0.0	0.0	584	1.7	0.0	0.0	0.0
377	0.0	0.0	0.0	0.0	481	0.0	0.0	0.0	0.0	585	23.9	12.3	17.1	12.0
378	0.0	0.0	0.0	0.0	482	0.0	0.0	0.0	0.0	586	0.0	0.0	0.0	0.0
379	0.0	0.0	0.0	0.0	483	0.0	0.0	0.0	0.0	587	0.0	0.0	0.0	0.0
380	0.0	0.0	0.0	0.0	484	17.4	2.5	3.5	2.5	588	0.5	0.0	0.0	0.0
381	0.0	0.0	0.0	0.0	485	3.4	0.0	0.0	0.0	589	2.6	0.0	0.0	0.0
382	0.5	0.0	0.0	0.0	486	0.0	0.0	0.0	0.0	590	11.6	0.6	0.8	0.6
383	6.4	0.0	0.0	0.0	487	0.0	0.0	0.0	0.0	591	0.0	0.0	0.0	0.0
384	0.0	0.0	0.0	0.0	488	0.0	0.0	0.0	0.0	592	0.0	0.0	0.0	0.0
385	0.0	0.0	0.0	0.0	489	0.0	0.0	0.0	0.0	593	15.4	5.7	7.9	5.5
386	0.0	0.0	0.0	0.0	490	0.0	0.0	0.0	0.0	594	54.8	40.4	56.1	39.2
387	0.0	0.0	0.0	0.0	491	0.0	0.0	0.0	0.0	595	7.2	1.0	1.3	0.9
388	0.0	0.0	0.0	0.0	492	0.0	0.0	0.0	0.0	596	3.6	0.0	0.1	0.0
389	0.0	0.0	0.0	0.0	493	0.0	0.0	0.0	0.0	597	5.4	0.3	0.5	0.3
390	0.0	0.0	0.0	0.0	494	0.0	0.0	0.0	0.0	598	40.1	26.6	36.9	25.9
391	0.0	0.0	0.0	0.0	495	0.3	0.0	0.0	0.0	599	44.2	30.4	42.2	29.5
392	0.0	0.0	0.0	0.0	496	12.9	0.9	1.3	0.9	600	0.5	0.0	0.0	0.0
393	0.0	0.0	0.0	0.0	497	8.5	0.1	0.1	0.1	601	1.8	0.0	0.0	0.0
394	0.0	0.0	0.0	0.0	498	7.5	1.1	1.5	1.0	602	2.2	0.0	0.0	0.0
395	0.0	0.0	0.0	0.0	499	6.0	1.3	1.8	1.3	603	10.4	2.5	3.5	2.4
396	0.0	0.0	0.0	0.0	500	0.0	0.0	0.0	0.0	604	0.2	0.0	0.0	0.0
397	0.0	0.0	0.0	0.0	501	26.5	14.5	20.1	14.1	605	0.2	0.0	0.0	0.0
398	0.0	0.0	0.0	0.0	502	0.0	0.0	0.0	0.0	606	3.4	0.0	0.0	0.0
399	0.0	0.0	0.0	0.0	503	1.1	0.0	0.0	0.0	607	0.0	0.0	0.0	0.0
400	0.0	0.0	0.0	0.0	504	1.8	0.0	0.0	0.0	608	8.2	0.0	0.0	0.0
401	0.0	0.0	0.0	0.0	505	4.1	0.1	0.1	0.1	609	8.4	0.1	0.1	0.1
402	0.0	0.0	0.0	0.0	506	0.0	0.0	0.0	0.0	610	8.0	1.3	1.8	1.3
403	0.0	0.0	0.0	0.0	507	2.1	0.0	0.0	0.0	611	16.9	6.6	9.4	6.6
404	0.0	0.0	0.0	0.0	508	2.8	0.0	0.0	0.0	612	8.9	1.7	2.4	1.7
405	0.0	0.0	0.0	0.0	509	0.0	0.0	0.0	0.0	613	0.0	0.0	0.0	0.0
406	0.0	0.0	0.0	0.0	510	0.0	0.0	0.0	0.0	614	4.0	0.1	0.1	0.1
407	0.0	0.0	0.0	0.0	511	0.0	0.0	0.0	0.0	615	0.4	0.0	0.0	0.0
408	0.0	0.0	0.0	0.0	512	0.0	0.0	0.0	0.0	616	6.8	0.0	0.0	0.0
409	0.0	0.0	0.0	0.0	513	4.0	0.0	0.0	0.0	617	2.8	0.0	0.0	0.0
410	0.0	0.0	0.0	0.0	514	0.0	0.0	0.0	0.0	618	10.1	0.3	0.4	0.3
411	0.0	0.0	0.0	0.0	515	0.0	0.0	0.0	0.0	619	3.9	0.0	0.0	0.0
412	0.0	0.0	0.0	0.0	516	0.3	0.0	0.0	0.0	620	1.6	0.0	0.0	0.0

Table continued..............

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
621	0.0	0.0	0.0	0.0	725	0.0	0.0	0.0	0.0	831	0.0	0.0	0.0	0.0
622	0.7	0.0	0.0	0.0	726	0.0	0.0	0.0	0.0	832	0.0	0.0	0.0	0.0
623	0.5	0.0	0.0	0.0	727	0.0	0.0	0.0	0.0	833	0.0	0.0	0.0	0.0
624	0.0	0.0	0.0	0.0	728	0.0	0.0	0.0	0.0	834	0.0	0.0	0.0	0.0
625	0.0	0.0	0.0	0.0	729	0.0	0.0	0.0	0.0	835	0.0	0.0	0.0	0.0
626	0.0	0.0	0.0	0.0	730	0.0	0.0	0.0	0.0	836	0.0	0.0	0.0	0.0
627	0.0	0.0	0.0	0.0	731	0.0	0.0	0.0	0.0	837	0.0	0.0	0.0	0.0
628	0.0	0.0	0.0	0.0	732	0.0	0.0	0.0	0.0	836	0.0	0.0	0.0	0.0
629	0.0	0.0	0.0	0.0	733	0.0	0.0	0.0	0.0	839	0.0	0.0	0.0	0.0
630	0.0	0.0	0.0	0.0	734	0.0	0.0	0.0	0.0	840	0.0	0.0	0.0	0.0
631	1.2	0.0	0.0	0.0	735	0.0	0.0	0.0	0.0	841	0.0	0.0	0.0	0.0
632	0.1	0.0	0.0	0.0	738	0.0	0.0	0.0	0.0	842	2.2	0.0	0.0	0.0
633	12.0	0.7	1.0	0.7	737	0.0	0.0	0.0	0.0	843	3.0	0.0	0.0	0.0
634	12.2	0.8	1.0	0.7	738	0.0	0.0	0.0	0.0	844	0.3	0.0	0.0	0.0
635	0.0	0.0	0.0	0.0	739	0.0	0.0	0.0	0.0	845	5.5	0.0	0.0	0.0
636	0.0	0.0	0.0	0.0	740	0.0	0.0	0.0	0.0	846	0.0	0.0	0.0	0.0
637	0.0	0.0	0.0	0.0	741	0.0	0.0	0.0	0.0	847	0.0	0.0	0.0	0.0
638	0.0	0.0	0.0	0.0	742	0.0	0.0	0.0	0.0	848	3.7	0.0	0.0	0.0
639	0.0	0.0	0.0	0.0	743	0.0	0.0	0.0	0.0	849	0.0	0.0	0.0	0.0
640	0.1	0.0	0.0	0.0	744	0.0	0.0	0.0	0.0	850	0.0	0.0	0.0	0.0
641	0.0	0.0	0.0	0.0	745	0.0	0.0	0.0	0.0	851	0.0	0.0	0.0	0.0
642	0.0	0.0	0.0	0.0	748	0.0	0.0	0.0	0.0	852	0.0	0.0	0.0	0.0
643	0.0	0.0	0.0	0.0	747	0.0	0.0	0.0	0.0	853	0.0	0.0	0.0	0.0
644	0.0	0.0	0.0	0.0	748	0.0	0.0	0.0	0.0	854	0.0	0.0	0.0	0.0
645	0.0	0.0	0.0	0.0	749	0.0	0.0	0.0	0.0	855	0.0	0.0	0.0	0.0
646	0.0	0.0	0.0	0.0	750	0.0	0.0	0.0	0.0	856	0.0	0.0	0.0	0.0
647	0.0	0.0	0.0	0.0	751	2.9	0.0	0.0	0.0	857	0.0	0.0	0.0	0.0
648	0.0	0.0	0.0	0.0	752	0.0	0.0	0.0	0.0	858	0.0	0.0	0.0	0.0
649	0.0	0.0	0.0	0.0	753	7.9	0.0	0.0	0.0	859	0.0	0.0	0.0	0.0
650	0.0	0.0	0.0	0.0	754	17.0	2.4	3.3	2.3	860	0.0	0.0	0.0	0.0
651	0.0	0.0	0.0	0.0	755	0.0	0.0	0.0	0.0	861	0.0	0.0	0.0	0.0
652	0.0	0.0	0.0	0.0	756	0.0	0.0	0.0	0.0	862	0.0	0.0	0.0	0.0
653	0.0	0.0	0.0	0.0	757	0.0	0.0	0.0	0.0	863	0.0	0.0	0.0	0.0
654	0.0	0.0	0.0	0.0	758	0.0	0.0	0.0	0.0	864	0.0	0.0	0.0	0.0
655	0.0	0.0	0.0	0.0	759	0.0	0.0	0.0	0.0	865	0.0	0.0	0.0	0.0
656	0.0	0.0	0.0	0.0	760	0.0	0.0	0.0	0.0	866	0.0	0.0	0.0	0.0
657	0.0	0.0	0.0	0.0	761	0.0	0.0	0.0	0.0	867	0.0	0.0	0.0	0.0
858	0.0	0.0	0.0	0.0	762	0.0	0.0	0.0	0.0	868	0.0	0.0	0.0	0.0
659	0.0	0.0	0.0	0.0	763	0.0	0.0	0.0	0.0	869	6.8	0.0	0.0	0.0
660	0.0	0.0	0.0	0.0	764	0.0	0.0	0.0	0.0	870	0.0	0.0	0.0	0.0
661	0.0	0.0	0.0	0.0	765	0.0	0.0	0.0	0.0	871	0.0	0.0	0.0	0.0
662	0.0	0.0	0.0	0.0	766	0.0	0.0	0.0	0.0	872	0.0	0.0	0.0	0.0
883	0.0	0.0	0.0	0.0	787	0.0	0.0	0.0	0.0	873	0.0	0.0	0.0	0.0
664	0.0	0.0	0.0	0.0	768	0.0	0.0	0.0	0.0	874	0.0	0.0	0.0	0.0
665	0.0	0.0	0.0	0.0	789	0.0	0.0	0.0	0.0	875	0.0	0.0	0.0	0.0
666	0.0	0.0	0.0	0.0	770	0.0	0.0	0.0	0.0	876	0.0	0.0	0.0	0.0
667	0.0	0.0	0.0	0.0	771	0.0	0.0	0.0	0.0	877	0.0	0.0	0.0	0.0
668	0.0	0.0	0.0	0.0	772	0.0	0.0	0.0	0.0	878	0.0	0.0	0.0	0.0.
669	0.0	0.0	0.0	0.0	773	0.0	0.0	0.0	0.0	879	0.0	0.0	0.0	0.0
870	0.0	0.0	0.0	0.0	774	0.0	0.0	0.0	0.0	880	0.0	0.0	0.0	0.0
671	0.0	0.0	0.0	0.0	775	0.0	0.0	0.0	0.0	881	0.0	0.0	0.0	0.0
872	0.0	0.0	0.0	0.0	778	0.0	0.0	0.0	0.0	882	6.8	0.0	0.0	0.0
673	0.0	0.0	0.0	0.0	777	0.0	0.0	0.0	0.0	883	8.1	0.1	0.1	0.0
874	0.0	0.0	0.0	0.0	778	0.0	0.0	0.0	0.0	884	5.2	0.0	0.0	0.0
675	0.0	0.0	0.0	0.0	779	0.0	0.0	0.0	0.0	885	1.3	0.0	0.0	0.0
676	0.0	0.0	0.0	0.0	780	0.0	0.0	0.0	0.0	886	0.0	0.0	0.0	0.0
877	0.0	0.0	0.0	0.0	781	0.0	0.0	0.0	0.0	887	0.0	0.0	0.0	0.0
678	0.0	0.0	0.0	0.0	782	0.0	0.0	0.0	0.0	888	5.0	0.0	0.0	0.0
879	0.0	0.0	0.0	0.0	783	0.0	0.0	0.0	0.0	669	0.0	0.0	0.0	0.0
680	0.0	0.0	0.0	0.0	784	0.0	0.0	0.0	0.0	890	0.5	0.0	0.0	0.0
681	0.0	0.0	0.0	0.0	785	0.0	0.0	0.0	0.0	891	2.2	0.0	0.0	0.0
882	0.0	0.0	0.0	0.0	788	0.0	0.0	0.0	0.0	892	0.0	0.0	0.0	0.0
683	0.0	0.0	0.0	0.0	787	0.0	0.0	0.0	0.0	693	0.0	0.0	0.0	0.0
684	0.0	0.0	0.0	0.0	788	0.0	0.0	0.0	0.0	894	0.0	0.0	0.0	0.0
685	0.0	0.0	0.0	0.0	789	0.0	0.0	0.0	0.0	895	·0.0	0.0	0.0	0.0
686	0.0	0.0	0.0	0.0	790	0.0	0.0	0.0	0.0	896	5.6	0.0	0.0	0.0
887	0.0	0.0	0.0	0.0	791	0.0	0.0	0.0	0.0	897	13.0	1.0	1.3	0.9
688	0.0	0.0	0.0	0.0	792	0.0	0.0	0.0	0.0	898	0.0	0.0	0.0	0.0
669	1.5	0.0	0.0	0.0	793	0.0	0.0	0.0	0.0	899	0.0	0.0	0.0	0.0
690	0.0	0.0	0.0	0.0	794	0.0	0.0	0.0	0.0	900	7.5	0.0	0.0	0.0
691	0.0	0.0	0.0	0.0	795	0.0	0.0	0.0	0.0	901	5.4	0.0	0.0	0.0
892	0.0	0.0	0.0	0.0	796	0.0	0.0	0.0	0.0	902	0.5	0.0	0.0	0.0
693	0.0	0.0	0.0	0.0	797	0.0	0.0	0.0	0.0	903	19.4	8.7	12.1	8.4
894	4.4	0.0	0.0	0.0	798	0.0	0.0	0.0	0.0	904	23.0	11.6	16.1	11.2
695	0.0	0.0	0.0	0.0	799	0.0	0.0	0.0	0.0	905	0.0	0.0	0.0	0.0
696	0.0	0.0	0.0	0.0	800	0.0	0.0	0.0	0.0	906	1.2	0.0	0.0	0.0
897	0.0	0.0	0.0	0.0	801	0.0	0.0	0.0	0.0	907	0.0	0.0	0.0	0.0
698	0.0	0.0	0.0	0.0	802	0.0	0.0	0.0	0.0	908	6.7	0.8	1.1	0.7
899	0.0	0.0	0.0	0.0	803	0.0	0.0	0.0	0.0	909	4.0	0.0	0.0	0.0
700	0.0	0.0	0.0	0.0	804	0.0	0.0	0.0	0.0	910	8.0	0.0	0.1	0.0
701	0.0	0.0	0.0	0.0	805	0.0	0.0	0.0	0.0	911	0.5	0.0	0.0	0.0
702	0.0	0.0	0.0	0.0	806	0.0	0.0	0.0	0.0	912	4.6	0.0	0.0	0.0
703	0.0	0.0	0.0	0.0	807	0.0	0.0	0.0	0.0	913	9.9	0.3	0.4	0.3
704	0.0	0.0	0.0	0.0	808	0.1	0.0	0.0	0.0	914	3.2	0.0	0.0	0.0
705	0.0	0.0	0.0	0.0	809	0.0	0.0	0.0	0.0	915	31.5	18.8	26.2	18.3
706	0.0	0.0	0.0	0.0	810	0.0	0.0	0.0	0.0	916	5.6	0.4	0.8	0.4
707	0.0	0.0	0.0	0.0	611	0.0	0.0	0.0	0.0	917	0.7	0.0	0.0	0.0
708	0.0	0.0	0.0	0.0	612	0.0	0.0	0.0	0.0	916	8.9	1.7	2.4	1.7
709	0.0	0.0	0.0	0.0	813	0.0	0.0	0.0	0.0	919	20.6	9.6	13.4	9.4
710	0.0	0.0	0.0	0.0	814	0.0	0.0	0.0	0.0	920	4.2	0.1	0.1	0.1
711	0.0	0.0	0.0	0.0	815	2.5	0.0	0.0	0.0	921	6.5	0.7	1.0	0.7
712	0.0	0.0	0.0	0.0	816	23.8	5.7	7.9	5.5	922	4.4	0.1	0.2	0.1
713	0.0	0.0	0.0	0.0	817	0.0	0.0	0.0	0.0	923	0.0	0.0	0.0	0.0
714	0.0	0.0	0.0	0.0	818	0.0	0.0	0.0	0.0	924	0.1	0.0	0.0	0.0
715	0.0	0.0	0.0	0.0	619	0.0	0.0	0.0	0.0	925	4.0	0.0	0.0	0.0
716	0.0	0.0	0.0	0.0	820	0.0	0.0	0.0	0.0	926	0.8	0.0	0.0	0.0
717	0.0	0.0	0.0	0.0	821	0.4	0.0	0.0	0.0	927	0.9	0.0	0.0	0.0
716	0.0	0.0	0.0	0.0	822	20.1	3.8	5.2	3.7	928	3.9	0.0	0.0	0.0
719	0.0	0.0	0.0	0.0	823	1.8	0.0	0.0	0.0	929	2.8	0.0	0.0	0.0
720	0.0	0.0	0.0	0.0	824	0.0	0.0	0.0	0.0	930	0.0	0.0	0.0	0.0
721	0.0	0.0	0.0	0.0	825	0.0	0.0	0.0	0.0	931	3.2	0.0	0.0	0.0
722	0.0	0.0	0.0	0.0	826	0.0	0.0	0.0	0.0	932	57.0	42.5	59.0	41.3
723	0.0	0.0	0.0	0.0	827	0.2	0.0	0.0	0.0	933	0.0	0.0	0.0	0.0
724	0.0	0.0	0.0	0.0	828	0.1	0.0	0.0	0.0	934	0.0	0.0	0.0	0.0

Table continued.....

Days	Rainfall	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/	Days	Rainfall(r	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
935	6.5	0.7	1.0	0.7	1039	0.0	0.0	0.0	0.0	1143	0.0	0.0	0.0	0.0
936	34.2	21.2	29.5	20.6	1040	0.0	0.0	0.0	0.0	1144	0.0	0.0	0.0	0.0
937	1.5	0.0	0.0	0.0	1041	0.0	0.0	0.0	0.0	1145	21.8	10.8	14.7	10.3
938	0.4	0.0	0.0	0.0	1042	0.0	0.0	0.0	0.0	1146	51.1	38.9	51.2	35.8
939	0.0	0.0	0.0	0.0	1043	0.0	0.0	0.0	0.0	1147	5.9	0.5	0.7	0.5
940	18.4	7.9	11.0	7.7	1044	0.0	0.0	0.0	0.0	1148	1.0	0.0	0.0	0.0
941	0.0	0.0	0.0	0.0	1045	0.0	0.0	0.0	0.0	1149	0.0	0.0	0.0	0.0
942	0.0	0.0	0.0	0.0	1046	0.0	0.0	0.0	0.0	1150	0.0	0.0	0.0	0.0
943	8.7	0.0	0.0	0.0	1047	0.0	0.0	0.0	0.0	1151	0.0	0.0	0.0	0.0
944	0.0	0.0	0.0	0.0	1048	0.0	0.0	0.0	0.0	1152	0.0	0.0	0.0	0.0
945	17.2	2.5	3.4	2.4	1049	0.0	0.0	0.0	0.0	1153	0.0	0.0	0.0	0.0
946	1.3	0.0	0.0	0.0	1050	0.3	0.0	0.0	0.0	1154	0.0	0.0	0.0	0.0
947	3.6	0.0	0.0	0.0	1051	0.0	0.0	0.0	0.0	1155	1.1	0.0	0.0	0.0
948	0.1	0.0	0.0	0.0	1052	0.0	0.0	0.0	0.0	1156	0.0	0.0	0.0	0.0
949	0.5	0.0	0.0	0.0	1053	0.0	0.0	0.0	0.0	1157	0.0	0.0	0.0	0.0
950	0.0	0.0	0.0	0.0	1054	0.0	0.0	0.0	0.0	1158	0.1	0.0	0.0	0.0
951	0.1	0.0	0.0	0.0	1055	0.0	0.0	0.0	0.0	1159	7.7	0.0	0.0	0.0
952	49.6	35.5	49.2	34.5	1056	0.0	0.0	0.0	0.0	1160	0.0	0.0	0.0	0.0
953	0.0	0.0	0.0	0.0	1057	0.5	0.0	0.0	0.0	1161	0.4	0.0	0.0	0.0
954	0.9	0.0	0.0	0.0	1058	0.0	0.0	0.0	0.0	1162	0.5	0.0	0.0	0.0
955	4.5	0.1	0.2	0.1	1059	0.0	0.0	0.0	0.0	1163	1.1	0.0	0.0	0.0
956	8.0	1.3	1.6	1.3	1060	0.0	0.0	0.0	0.0	1164	2.0	0.0	0.0	0.0
957	2.3	0.0	0.0	0.0	1061	5.5	0.0	0.0	0.0	1165	0.0	0.0	0.0	0.0
958	5.6	0.0	0.0	0.0	1062	0.2	0.0	0.0	0.0	1166	0.0	0.0	0.0	0.0
959	6.0	0.0	0.0	0.0	1063	3.2	0.0	0.0	0.0	1167	0.0	0.0	0.0	0.0
960	1.6	0.0	0.0	0.0	1064	0.0	0.0	0.0	0.0	1168	0.3	0.0	0.0	0.0
961	2.7	0.0	0.0	0.0	1065	0.0	0.0	0.0	0.0	1169	0.0	0.0	0.0	0.0
962	1.6	0.0	0.0	0.0	1066	0.0	0.0	0.0	0.0	1170	0.0	0.0	0.0	0.0
963	5.5	0.0	0.0	0.0	1067	0.0	0.0	0.0	0.0	1171	0.0	0.0	0.0	0.0
964	10.6	0.4	0.5	0.4	1068	0.0	0.0	0.0	0.0	1172	0.0	0.0	0.0	0.0
965	0.0	0.0	0.0	0.0	1069	0.0	0.0	0.0	0.0	1173	0.0	0.0	0.0	0.0
966	0.0	0.0	0.0	0.0	1070	0.0	0.0	0.0	0.0	1174	0.0	0.0	0.0	0.0
967	5.4	0.0	0.0	0.0	1071	0.0	0.0	0.0	0.0	1175	0.1	0.0	0.0	0.0
968	5.8	0.0	0.0	0.0	1072	0.0	0.0	0.0	0.0	1176	0.3	0.0	0.0	0.0
969	1.5	0.0	0.0	0.0	1073	0.0	0.0	0.0	0.0	1177	1.5	0.0	0.0	0.0
970	6.0	0.0	0.0	0.0	1074	0.0	0.0	0.0	0.0	1178	0.0	0.0	0.0	0.0
971	28.2	15.9	22.1	15.5	1075	0.0	0.0	0.0	0.0	1179	0.0	0.0	0.0	0.0
972	1.0	0.0	0.0	0.0	1076	0.0	0.0	0.0	0.0	1180	0.0	0.0	0.0	0.0
973	0.4	0.0	0.0	0.0	1077	0.0	0.0	0.0	0.0	1181	0.0	0.0	0.0	0.0
974	2.0	0.0	0.0	0.0	1078	0.0	0.0	0.0	0.0	1182	0.0	0.0	0.0	0.0
975	2.2	0.0	0.0	0.0	1079	0.0	0.0	0.0	0.0	1183	0.0	0.0	0.0	0.0
976	0.0	0.0	0.0	0.0	1080	0.0	0.0	0.0	0.0	1184	0.0	0.0	0.0	0.0
977	3.4	0.0	0.0	0.0	1081	0.0	0.0	0.0	0.0	1185	0.0	0.0	0.0	0.0
978	1.5	0.0	0.0	0.0	1082	0.0	0.0	0.0	0.0	1186	0.0	0.0	0.0	0.0
979	0.8	0.0	0.0	0.0	1083	0.0	0.0	0.0	0.0	1187	0.0	0.0	0.0	0.0
980	11.2	0.5	0.7	0.5	1084	0.0	0.0	0.0	0.0	1188	0.0	0.0	0.0	0.0
981	1.2	0.0	0.0	0.0	1085	0.0	0.0	0.0	0.0	1189	0.0	0.0	0.0	0.0
982	0.0	0.0	0.0	0.0	1086	0.0	0.0	0.0	0.0	1190	0.0	0.0	0.0	0.0
983	0.0	0.0	0.0	0.0	1087	0.0	0.0	0.0	0.0	1191	0.0	0.0	0.0	0.0
984	0.6	0.0	0.0	0.0	1088	0.0	0.0	0.0	0.0	1192	0.0	0.0	0.0	0.0
985	0.3	0.0	0.0	0.0	1089	0.0	0.0	0.0	0.0	1193	0.0	0.0	0.0	0.0
986	0.3	0.0	0.0	0.0	1090	0.0	0.0	0.0	0.0	1194	0.0	0.0	0.0	0.0
987	0.0	0.0	0.0	0.0	1091	0.0	0.0	0.0	0.0	1195	0.0	0.0	0.0	0.0
988	10.5	0.0	0.0	0.0	1092	0.0	0.0	0.0	0.0	1196	0.0	0.0	0.0	0.0
989	0.0	0.0	0.0	0.0	1093	0.0	0.0	0.0	0.0	1197	18.0	2.8	3.9	2.7
990	19.0	8.4	11.6	8.1	1094	0.0	0.0	0.0	0.0	1198	0.0	0.0	0.0	0.0
991	1.3	0.0	0.0	0.0	1095	0.0	0.0	0.0	0.0	1199	0.0	0.0	0.0	0.0
992	0.3	0.0	0.0	0.0	1096	0.0	0.0	0.0	0.0	1200	0.0	0.0	0.0	0.0
993	0.4	0.0	0.0	0.0	1097	0.0	0.0	0.0	0.0	1201	0.0	0.0	0.0	0.0
994	0.0	0.0	0.0	0.0	1098	0.0	0.0	0.0	0.0	1202	0.0	0.0	0.0	0.0
995	12.0	0.7	1.0	0.7	1099	0.0	0.0	0.0	0.0	1203	1.4	0.0	0.0	0.0
996	0.3	0.0	0.0	0.0	1100	0.1	0.0	0.0	0.0	1204	0.0	0.0	0.0	0.0
997	0.5	0.0	0.0	0.0	1101	0.0	0.0	0.0	0.0	1205	1.3	0.0	0.0	0.0
998	0.0	0.0	0.0	0.0	1102	0.0	0.0	0.0	0.0	1206	1.5	0.0	0.0	0.0
999	0.0	0.0	0.0	0.0	1103	0.0	0.0	0.0	0.0	1207	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.0	0.0	1104	0.0	0.0	0.0	0.0	1208	0.2	0.0	0.0	0.0
1001	5.4	0.0	0.0	0.0	1105	0.0	0.0	0.0	0.0	1209	13.7	1.2	1.6	1.1
1002	0.2	0.0	0.0	0.0	1106	0.0	0.0	0.0	0.0	1210	28.8	16.3	22.6	15.8
1003	0.0	0.0	0.0	0.0	1107	21.0	4.2	5.9	4.1	1211	0.0	0.0	0.0	0.0
1004	0.0	0.0	0.0	0.0	1108	5.2	0.0	0.0	0.0	1212	0.0	0.0	0.0	0.0
1005	0.0	0.0	0.0	0.0	1109	5.8	0.5	0.8	0.4	1213	12.5	3.8	5.2	3.7
1006	0.0	0.0	0.0	0.0	1110	0.0	0.0	0.0	0.0	1214	0.0	0.0	0.0	0.0
1007	0.0	0.0	0.0	0.0	1111	0.0	0.0	0.0	0.0	1215	0.0	0.0	0.0	0.0
1008	0.0	0.0	0.0	0.0	1112	0.0	0.0	0.0	0.0	1216	0.0	0.0	0.0	0.0
1009	0.0	0.0	0.0	0.0	1113	0.1	0.0	0.0	0.0	1217	0.0	0.0	0.0	0.0
1010	0.0	0.0	0.0	0.0	1114	0.0	0.0	0.0	0.0	1218	0.0	0.0	0.0	0.0
1011	0.0	0.0	0.0	0.0	1115	0.0	0.0	0.0	0.0	1219	1.2	0.0	0.0	0.0
1012	15.0	1.6	2.2	1.6	1116	0.0	0.0	0.0	0.0	1220	5.5	0.0	0.0	0.0
1013	0.0	0.0	0.0	0.0	1117	0.0	0.0	0.0	0.0	1221	8.6	0.1	0.1	0.1
1014	0.0	0.0	0.0	0.0	1118	0.0	0.0	0.0	0.0	1222	0.0	0.0	0.0	0.0
1015	0.0	0.0	0.0	0.0	1119	0.0	0.0	0.0	0.0	1223	0.0	0.0	0.0	0.0
1016	0.0	0.0	0.0	0.0	1120	0.0	0.0	0.0	0.0	1224	0.0	0.0	0.0	0.0
1017	0.0	0.0	0.0	0.0	1121	0.0	0.0	0.0	0.0	1225	0.0	0.0	0.0	0.0
1018	0.0	0.0	0.0	0.0	1122	0.0	0.0	0.0	0.0	1226	0.0	0.0	0.0	0.0
1019	0.0	0.0	0.0	0.0	1123	0.0	0.0	0.0	0.0	1227	0.0	0.0	0.0	0.0
1020	0.0	0.0	0.0	0.0	1124	0.0	0.0	0.0	0.0	1228	0.0	0.0	0.0	0.0
1021	0.0	0.0	0.0	0.0	1125	0.0	0.0	0.0	0.0	1229	21.6	4.5	6.3	4.4
1022	0.7	0.0	0.0	0.0	1126	0.0	0.0	0.0	0.0	1230	0.0	0.0	0.0	0.0
1023	49.1	35.0	48.6	34.0	1127	0.0	0.0	0.0	0.0	1231	0.6	0.0	0.0	0.0
1024	0.5	0.0	0.0	0.0	1128	0.0	0.0	0.0	0.0	1232	0.0	0.0	0.0	0.0
1025	3.0	0.0	0.0	0.0	1129	0.0	0.0	0.0	0.0	1233	0.9	0.0	0.0	0.0
1026	3.9	0.1	0.1	0.1	1130	0.0	0.0	0.0	0.0	1234	0.0	0.0	0.0	0.0
1027	1.4	0.0	0.0	0.0	1131	0.0	0.0	0.0	0.0	1235	0.0	0.0	0.0	0.0
1028	2.5	0.0	0.0	0.0	1132	0.0	0.0	0.0	0.0	1236	0.0	0.0	0.0	0.0
1029	0.0	0.0	0.0	0.0	1133	0.0	0.0	0.0	0.0	1237	1.8	0.0	0.0	0.0
1030	0.0	0.0	0.0	0.0	1134	0.0	0.0	0.0	0.0	1238	0.8	0.0	0.0	0.0
1031	4.5	0.0	0.0	0.0	1135	0.0	0.0	0.0	0.0	1239	0.8	0.0	0.0	0.0
1032	9.8	0.2	0.3	0.2	1136	0.0	0.0	0.0	0.0	1240	0.1	0.0	0.0	0.0
1033	2.4	0.0	0.0	0.0	1137	0.0	0.0	0.0	0.0	1241	0.0	0.0	0.0	0.0
1034	2.8	0.0	0.0	0.0	1138	0.0	0.0	0.0	0.0	1242	0.0	0.0	0.0	0.0
1035	4.5	0.0	0.0	0.0	1139	0.1	0.0	0.0	0.0	1243	0.0	0.0	0.0	0.0
1036	0.0	0.0	0.0	0.0	1140	0.1	0.0	0.0	0.0	1244	0.0	0.0	0.0	0.0
1037	1.2	0.0	0.0	0.0	1141	0.0	0.0	0.0	0.0	1245	0.0	0.0	0.0	0.0
1038	0.0	0.0	0.0	0.0	1142	8.5	0.0	0.0	0.0	1246	0.0	0.0	0.0	0.0

Table continued......

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
1247	0.0	0.0	0.0	0.0	1351	9.3	0.2	0.2	0.2	1455	0.0	0.0	0.0	0.0
1248	0.0	0.0	0.0	0.0	1352	6.2	0.0	0.0	0.0	1456	0.0	0.0	0.0	0.0
1249	2.0	0.0	0.0	0.0	1353	3.8	0.0	0.0	0.0	1457	0.0	0.0	0.0	0.0
1250	0.0	0.0	0.0	0.0	1354	0.6	0.0	0.0	0.0	1458	0.0	0.0	0.0	0.0
1251	0.1	0.0	0.0	0.0	1355	0.0	0.0	0.0	0.0	1459	0.0	0.0	0.0	0.0
1252	0.0	0.0	0.0	0.0	1356	22.1	10.8	15.0	10.5	1460	0.0	0.0	0.0	0.0
1253	0.0	0.0	0.0	0.0	1357	0.9	0.0	0.0	0.0	1461	0.0	0.0	0.0	0.0
1254	0.0	0.0	0.0	0.0	1358	0.0	0.0	0.0	0.0	1462	0.0	0.0	0.0	0.0
1255	0.0	0.0	0.0	0.0	1359	5.5	0.4	0.5	0.4	1463	0.0	0.0	0.0	0.0
1256	0.0	0.0	0.0	0.0	1360	2.3	0.0	0.0	0.0	1464	0.0	0.0	0.0	0.0
1257	0.0	0.0	0.0	0.0	1361	2.6	0.0	0.0	0.0	1465	0.0	0.0	0.0	0.0
1258	1.3	0.0	0.0	0.0	1362	0.1	0.0	0.0	0.0	1466	0.0	0.0	0.0	0.0
1259	0.0	0.0	0.0	0.0	1363	0.4	0.0	0.0	0.0	1467	0.0	0.0	0.0	0.0
1260	0.1	0.0	0.0	0.0	1364	2.5	0.0	0.0	0.0	1468	0.0	0.0	0.0	0.0
1261	0.0	0.0	0.0	0.0	1365	0.1	0.0	0.0	0.0	1469	0.0	0.0	0.0	0.0
1262	0.6	0.0	0.0	0.0	1366	0.0	0.0	0.0	0.0	1470	0.0	0.0	0.0	0.0
1263	0.1	0.0	0.0	0.0	1367	0.1	0.0	0.0	0.0	1471	0.0	0.0	0.0	0.0
1264	6.4	0.0	0.0	0.0	1368	0.0	0.0	0.0	0.0	1472	0.0	0.0	0.0	0.0
1265	0.0	0.0	0.0	0.0	1369	0.0	0.0	0.0	0.0	1473	0.0	0.0	0.0	0.0
1266	5.8	0.0	0.0	0.0	1370	0.0	0.0	0.0	0.0	1474	0.0	0.0	0.0	0.0
1267	0.2	0.0	0.0	0.0	1371	0.0	0.0	0.0	0.0	1475	0.5	0.0	0.0	0.0
1268	0.5	0.0	0.0	0.0	1372	0.0	0.0	0.0	0.0	1476	0.0	0.0	0.0	0.0
1269	0.6	0.0	0.0	0.0	1373	16.5	2.2	3.0	2.1	1477	0.0	0.0	0.0	0.0
1270	0.6	0.0	0.0	0.0	1374	12.1	3.5	4.9	3.4	1478	0.0	0.0	0.0	0.0
1271	19.1	3.3	4.6	3.2	1375	5.0	0.3	0.3	0.2	1479	0.0	0.0	0.0	0.0
1272	33.0	20.2	28.0	19.6	1376	0.0	0.0	0.0	0.0	1480	0.0	0.0	0.0	0.0
1273	1.1	0.0	0.0	0.0	1377	0.0	0.0	0.0	0.0	1481	0.0	0.0	0.0	0.0
1274	0.9	0.0	0.0	0.0	1378	0.0	0.0	0.0	0.0	1482	0.0	0.0	0.0	0.0
1275	0.0	0.0	0.0	0.0	1379	32.8	20.0	27.8	19.4	1483	0.0	0.0	0.0	0.0
1276	1.0	0.0	0.0	0.0	1380	18.6	8.1	11.2	7.8	1484	0.0	0.0	0.0	0.0
1277	4.6	0.0	0.0	0.0	1381	8.3	1.4	2.0	1.4	1485	0.0	0.0	0.0	0.0
1278	3.2	0.0	0.0	0.0	1382	0.1	0.0	0.0	0.0	1486	0.0	0.0	0.0	0.0
1279	9.6	0.2	0.3	0.2	1383	0.0	0.0	0.0	0.0	1487	0.0	0.0	0.0	0.0
1280	0.0	0.0	0.0	0.0	1384	0.0	0.0	0.0	0.0	1488	0.0	0.0	0.0	0.0
1281	3.5	0.0	0.0	0.0	1385	0.0	0.0	0.0	0.0	1489	0.0	0.0	0.0	0.0
1282	3.6	0.0	0.0	0.0	1386	0.0	0.0	0.0	0.0	1490	0.0	0.0	0.0	0.0
1283	0.1	0.0	0.0	0.0	1387	0.0	0.0	0.0	0.0	1491	0.0	0.0	0.0	0.0
1284	0.0	0.0	0.0	0.0	1388	0.0	0.0	0.0	0.0	1492	0.0	0.0	0.0	0.0
1285	0.5	0.0	0.0	0.0	1389	0.0	0.0	0.0	0.0	1493	0.0	0.0	0.0	0.0
1286	30.5	9.8	13.6	9.5	1390	0.0	0.0	0.0	0.0	1494	0.0	0.0	0.0	0.0
1287	0.0	0.0	0.0	0.0	1391	0.0	0.0	0.0	0.0	1495	0.0	0.0	0.0	0.0
1288	9.4	2.0	2.7	1.9	1392	0.0	0.0	0.0	0.0	1496	0.0	0.0	0.0	0.0
1289	10.2	2.4	3.3	2.3	1393	0.0	0.0	0.0	0.0	1497	0.0	0.0	0.0	0.0
1290	2.3	0.0	0.0	0.0	1394	0.0	0.0	0.0	0.0	1498	0.0	0.0	0.0	0.0
1291	16.1	6.2	8.6	6.0	1395	0.0	0.0	0.0	0.0	1499	0.0	0.0	0.0	0.0
1292	0.7	0.0	0.0	0.0	1396	0.0	0.0	0.0	0.0	1500	0.0	0.0	0.0	0.0
1293	1.1	0.0	0.0	0.0	1397	0.0	0.0	0.0	0.0	1501	0.0	0.0	0.0	0.0
1294	21.0	9.9	13.8	9.7	1398	0.0	0.0	0.0	0.0	1502	0.0	0.0	0.0	0.0
1295	10.5	2.6	3.6	2.5	1399	0.0	0.0	0.0	0.0	1503	0.0	0.0	0.0	0.0
1296	10.4	2.5	3.5	2.4	1400	0.0	0.0	0.0	0.0	1504	0.0	0.0	0.0	0.0
1297	2.3	0.0	0.0	0.0	1401	0.0	0.0	0.0	0.0	1505	0.0	0.0	0.0	0.0
1298	5.5	0.4	0.5	0.4	1402	0.0	0.0	0.0	0.0	1506	0.0	0.0	0.0	0.0
1299	0.0	0.0	0.0	0.0	1403	0.0	0.0	0.0	0.0	1507	0.0	0.0	0.0	0.0
1300	16.4	6.4	8.9	6.2	1404	0.0	0.0	0.0	0.0	1508	0.0	0.0	0.0	0.0
1301	4.6	0.2	0.2	0.2	1405	0.0	0.0	0.0	0.0	1509	0.0	0.0	0.0	0.0
1302	4.0	0.1	0.1	0.1	1406	0.0	0.0	0.0	0.0	1510	0.0	0.0	0.0	0.0
1303	0.2	0.0	0.0	0.0	1407	0.0	0.0	0.0	0.0	1511	0.0	0.0	0.0	0.0
1304	0.6	0.0	0.0	0.0	1408	0.0	0.0	0.0	0.0	1512	0.0	0.0	0.0	0.0
1305	1.3	0.0	0.0	0.0	1409	0.0	0.0	0.0	0.0	1513	0.0	0.0	0.0	0.0
1306	10.9	0.4	0.6	0.4	1410	0.0	0.0	0.0	0.0	1514	0.0	0.0	0.0	0.0
1307	5.0	0.0	0.0	0.0	1411	0.0	0.0	0.0	0.0	1515	0.0	0.0	0.0	0.0
1308	22.9	11.5	15.9	11.2	1412	0.0	0.0	0.0	0.0	1516	0.0	0.0	0.0	0.0
1309	17.0	6.9	9.5	6.7	1413	0.0	0.0	0.0	0.0	1517	0.0	0.0	0.0	0.0
1310	0.2	0.0	0.0	0.0	1414	0.0	0.0	0.0	0.0	1518	0.0	0.0	0.0	0.0
1311	25.3	13.5	18.7	13.1	1415	0.0	0.0	0.0	0.0	1519	0.0	0.0	0.0	0.0
1312	11.7	3.3	4.5	3.2	1416	0.0	0.0	0.0	0.0	1520	0.0	0.0	0.0	0.0
1313	3.5	0.0	0.0	0.0	1417	0.0	0.0	0.0	0.0	1521	0.0	0.0	0.0	0.0
1314	2.9	0.0	0.0	0.0	1418	0.0	0.0	0.0	0.0	1522	0.0	0.0	0.0	0.0
1315	23.4	11.9	16.5	11.6	1419	0.0	0.0	0.0	0.0	1523	0.1	0.0	0.0	0.0
1316	8.4	1.5	2.0	1.4	1420	0.0	0.0	0.0	0.0	1524	0.0	0.0	0.0	0.0
1317	3.0	0.0	0.0	0.0	1421	0.0	0.0	0.0	0.0	1525	3.8	0.0	0.0	0.0
1318	4.6	0.2	0.2	0.2	1422	0.0	0.0	0.0	0.0	1526	0.2	0.0	0.0	0.0
1319	16.7	6.6	9.2	6.5	1423	0.0	0.0	0.0	0.0	1527	0.0	0.0	0.0	0.0
1320	3.1	0.0	0.0	0.0	1424	0.0	0.0	0.0	0.0	1528	0.0	0.0	0.0	0.0
1321	3.8	0.0	0.1	0.0	1425	0.0	0.0	0.0	0.0	1529	3.2	0.0	0.0	0.0
1322	3.1	0.0	0.0	0.0	1426	0.0	0.0	0.0	0.0	1530	0.4	0.0	0.0	0.0
1323	0.3	0.0	0.0	0.0	1427	0.0	0.0	0.0	0.0	1531	0.0	0.0	0.0	0.0
1324	27.7	15.5	21.5	15.1	1428	0.0	0.0	0.0	0.0	1532	0.0	0.0	0.0	0.0
1325	7.4	1.0	1.4	1.0	1429	0.0	0.0	0.0	0.0	1533	6.4	0.0	0.0	0.0
1326	17.3	7.1	9.8	6.9	1430	0.0	0.0	0.0	0.0	1534	2.2	0.0	0.0	0.0
1327	0.7	0.0	0.0	0.0	1431	0.0	0.0	0.0	0.0	1535	0.0	0.0	0.0	0.0
1328	3.7	0.0	0.1	0.0	1432	0.0	0.0	0.0	0.0	1536	0.1	0.0	0.0	0.0
1329	0.2	0.0	0.0	0.0	1433	0.0	0.0	0.0	0.0	1537	0.0	0.0	0.0	0.0
1330	1.4	0.0	0.0	0.0	1434	0.0	0.0	0.0	0.0	1538	0.0	0.0	0.0	0.0
1331	10.7	0.4	0.8	0.4	1435	0.0	0.0	0.0	0.0	1539	0.0	0.0	0.0	0.0
1332	70.0	55.0	76.4	53.4	1436	0.0	0.0	0.0	0.0	1540	0.0	0.0	0.0	0.0
1333	2.2	0.0	0.0	0.0	1437	0.0	0.0	0.0	0.0	1541	0.0	0.0	0.0	0.0
1334	0.0	0.0	0.0	0.0	1438	0.0	0.0	0.0	0.0	1542	0.0	0.0	0.0	0.0
1335	21.3	10.2	14.1	9.9	1439	0.0	0.0	0.0	0.0	1543	0.0	0.0	0.0	0.0
1336	0.3	0.0	0.0	0.0	1440	0.0	0.0	0.0	0.0	1544	0.0	0.0	0.0	0.0
1337	0.1	0.0	0.0	0.0	1441	0.0	0.0	0.0	0.0	1545	0.0	0.0	0.0	0.0
1338	3.6	0.0	0.0	0.0	1442	0.0	0.0	0.0	0.0	1546	0.0	0.0	0.0	0.0
1339	0.0	0.0	0.0	0.0	1443	0.0	0.0	0.0	0.0	1547	0.0	0.0	0.0	0.0
1340	2.2	0.0	0.0	0.0	1444	0.0	0.0	0.0	0.0	1548	3.6	0.0	0.0	0.0
1341	2.7	0.0	0.0	0.0	1445	0.0	0.0	0.0	0.0	1549	0.0	0.0	0.0	0.0
1342	5.5	0.0	0.0	0.0	1446	0.0	0.0	0.0	0.0	1550	16.8	2.3	3.2	2.2
1343	14.3	1.4	1.9	1.3	1447	0.0	0.0	0.0	0.0	1551	0.0	0.0	0.0	0.0
1344	0.8	0.0	0.0	0.0	1448	0.0	0.0	0.0	0.0	1552	0.0	0.0	0.0	0.0
1345	6.8	0.8	1.1	0.8	1449	0.0	0.0	0.0	0.0	1553	0.0	0.0	0.0	0.0
1346	0.5	0.0	0.0	0.0	1450	0.0	0.0	0.0	0.0	1554	0.0	0.0	0.0	0.0
1347	2.8	0.0	0.0	0.0	1451	0.0	0.0	0.0	0.0	1555	0.0	0.0	0.0	0.0
1348	4.3	0.0	0.0	0.0	1452	0.0	0.0	0.0	0.0	1556	0.0	0.0	0.0	0.0
1349	1.5	0.0	0.0	0.0	1453	0.0	0.0	0.0	0.0	1557	0.0	0.0	0.0	0.0
1350	0.0	0.0	0.0	0.0	1454	0.0	0.0	0.0	0.0	1558	0.0	0.0	0.0	0.0

Table continued...........

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
1559	0.0	0.0	0.0	0.0	1663	2.4	0.0	0.0	0.0	1767	0.0	0.0	0.0	0.0
1560	0.0	0.0	0.0	0.0	1664	6.1	0.6	0.8	0.5	1768	0.0	0.0	0.0	0.0
1561	0.0	0.0	0.0	0.0	1665	1.1	0.0	0.0	0.0	1769	0.0	0.0	0.0	0.0
1562	0.0	0.0	0.0	0.0	1666	0.0	0.0	0.0	0.0	1770	0.0	0.0	0.0	0.0
1563	0.0	0.0	0.0	0.0	1667	20.0	9.1	12.7	8.9	1771	0.0	0.0	0.0	0.0
1564	0.0	0.0	0.0	0.0	1668	0.3	0.0	0.0	0.0	1772	0.0	0.0	0.0	0.0
1565	0.1	0.0	0.0	0.0	1669	17.4	7.2	9.9	7.0	1773	0.0	0.0	0.0	0.0
1566	0.0	0.0	0.0	0.0	1670	0.3	0.0	0.0	0.0	1774	0.0	0.0	0.0	0.0
1567	0.0	0.0	0.0	0.0	1671	2.4	0.0	0.0	0.0	1775	0.0	0.0	0.0	0.0
1568	0.0	0.0	0.0	0.0	1672	9.2	1.9	2.6	1.8	1776	0.0	0.0	0.0	0.0
1569	0.0	0.0	0.0	0.0	1673	0.8	0.0	0.0	0.0	1777	0.0	0.0	0.0	0.0
1570	0.0	0.0	0.0	0.0	1674	12.2	0.8	1.0	0.7	1778	0.0	0.0	0.0	0.0
1571	0.0	0.0	0.0	0.0	1675	0.0	0.0	0.0	0.0	1779	0.0	0.0	0.0	0.0
1572	0.0	0.0	0.0	0.0	1676	11.2	3.0	4.1	2.9	1780	0.0	0.0	0.0	0.0
1573	0.0	0.0	0.0	0.0	1677	5.2	0.3	0.4	0.3	1781	0.0	0.0	0.0	0.0
1574	0.0	0.0	0.0	0.0	1678	22.0	10.7	14.9	10.4	1782	0.0	0.0	0.0	0.0
1575	0.0	0.0	0.0	0.0	1679	4.2	0.1	0.1	0.1	1783	0.0	0.0	0.0	0.0
1576	0.0	0.0	0.0	0.0	1680	4.2	0.1	0.1	0.1	1784	0.0	0.0	0.0	0.0
1577	0.0	0.0	0.0	0.0	1681	1.5	0.0	0.0	0.0	1785	0.0	0.0	0.0	0.0
1578	0.0	0.0	0.0	0.0	1682	4.2	0.1	0.1	0.1	1786	0.0	0.0	0.0	0.0
1579	0.0	0.0	0.0	0.0	1683	53.6	39.2	54.5	38.1	1787	0.0	0.0	0.0	0.0
1580	0.0	0.0	0.0	0.0	1684	13.0	4.1	5.7	4.0	1788	0.0	0.0	0.0	0.0
1581	0.0	0.0	0.0	0.0	1685	31.5	18.8	26.2	18.3	1789	0.0	0.0	0.0	0.0
1582	0.0	0.0	0.0	0.0	1686	7.1	0.9	1.3	0.9	1790	0.0	0.0	0.0	0.0
1583	0.0	0.0	0.0	0.0	1687	19.6	8.8	12.3	8.8	1791	0.0	0.0	0.0	0.0
1584	0.0	0.0	0.0	0.0	1688	0.0	0.0	0.0	0.0	1792	0.0	0.0	0.0	0.0
1585	0.0	0.0	0.0	0.0	1689	18.1	7.7	10.7	7.5	1793	0.0	0.0	0.0	0.0
1586	0.0	0.0	0.0	0.0	1690	2.9	0.0	0.0	0.0	1794	0.0	0.0	0.0	0.0
1587	0.0	0.0	0.0	0.0	1691	0.1	0.0	0.0	0.0	1795	0.0	0.0	0.0	0.0
1588	0.0	0.0	0.0	0.0	1692	0.0	0.0	0.0	0.0	1796	0.0	0.0	0.0	0.0
1589	0.0	0.0	0.0	0.0	1693	0.4	0.0	0.0	0.0	1797	0.0	0.0	0.0	0.0
1590	0.0	0.0	0.0	0.0	1694	3.6	0.0	0.0	0.0	1798	0.0	0.0	0.0	0.0
1591	0.0	0.0	0.0	0.0	1695	0.0	0.0	0.0	0.0	1799	0.0	0.0	0.0	0.0
1592	0.0	0.0	0.0	0.0	1696	14.0	1.3	1.8	1.2	1800	0.0	0.0	0.0	0.0
1593	0.0	0.0	0.0	0.0	1697	0.0	0.0	0.0	0.0	1801	0.0	0.0	0.0	0.0
1594	0.0	0.0	0.0	0.0	1698	1.5	0.0	0.0	0.0	1802	0.1	0.0	0.0	0.0
1595	0.0	0.0	0.0	0.0	1699	0.0	0.0	0.0	0.0	1803	0.0	0.0	0.0	0.0
1596	0.0	0.0	0.0	0.0	1700	16.1	6.2	8.6	6.0	1804	0.0	0.0	0.0	0.0
1597	0.0	0.0	0.0	0.0	1701	0.0	0.0	0.0	0.0	1805	0.0	0.0	0.0	0.0
1598	0.0	0.0	0.0	0.0	1702	6.4	0.0	0.0	0.0	1806	0.0	0.0	0.0	0.0
1599	0.0	0.0	0.0	0.0	1703	0.0	0.0	0.0	0.0	1807	0.0	0.0	0.0	0.0
1600	0.0	0.0	0.0	0.0	1704	6.1	0.6	0.8	0.5	1808	0.0	0.0	0.0	0.0
1601	0.0	0.0	0.0	0.0	1705	0.0	0.0	0.0	0.0	1809	0.0	0.0	0.0	0.0
1602	0.0	0.0	0.0	0.0	1706	0.4	0.0	0.0	0.0	1810	0.0	0.0	0.0	0.0
1603	0.0	0.0	0.0	0.0	1707	0.6	0.0	0.0	0.0	1811	0.0	0.0	0.0	0.0
1604	0.0	0.0	0.0	0.0	1708	6.9	0.0	0.0	0.0	1812	0.0	0.0	0.0	0.0
1605	0.0	0.0	0.0	0.0	1709	0.0	0.0	0.0	0.0	1813	0.0	0.0	0.0	0.0
1606	0.0	0.0	0.0	0.0	1710	0.0	0.0	0.0	0.0	1814	0.0	0.0	0.0	0.0
1607	0.0	0.0	0.0	0.0	1711	6.9	0.0	0.0	0.0	1815	0.0	0.0	0.0	0.0
1608	0.0	0.0	0.0	0.0	1712	0.0	0.0	0.0	0.0	1816	0.0	0.0	0.0	0.0
1609	0.2	0.0	0.0	0.0	1713	0.0	0.0	0.0	0.0	1817	0.0	0.0	0.0	0.0
1610	0.0	0.0	0.0	0.0	1714	0.0	0.0	0.0	0.0	1818	0.0	0.0	0.0	0.0
1611	0.0	0.0	0.0	0.0	1715	0.0	0.0	0.0	0.0	1819	0.0	0.0	0.0	0.0
1612	9.8	0.0	0.0	0.0	1716	0.6	0.0	0.0	0.0	1820	0.0	0.0	0.0	0.0
1613	14.7	1.5	2.1	1.5	1717	4.5	0.0	0.0	0.0	1821	0.0	0.0	0.0	0.0
1614	0.8	0.0	0.0	0.0	1718	4.0	0.0	0.0	0.0	1822	0.0	0.0	0.0	0.0
1615	0.2	0.0	0.0	0.0	1719	0.0	0.0	0.0	0.0	1823	0.0	0.0	0.0	0.0
1616	5.7	0.0	0.0	0.0	1720	5.8	0.0	0.0	0.0	1824	0.0	0.0	0.0	0.0
1617	0.0	0.0	0.0	0.0	1721	3.0	0.0	0.0	0.0	1825	0.0	0.0	0.0	0.0
1618	0.0	0.0	0.0	0.0	1722	1.8	0.0	0.0	0.0	1826	0.0	0.0	0.0	0.0
1619	0.0	0.0	0.0	0.0	1723	0.0	0.0	0.0	0.0	1827	0.0	0.0	0.0	0.0
1620	0.0	0.0	0.0	0.0	1724	0.5	0.0	0.0	0.0	1828	0.0	0.0	0.0	0.0
1621	0.0	0.0	0.0	0.0	1725	11.9	0.7	0.9	0.7	1829	0.0	0.0	0.0	0.0
1622	0.0	0.0	0.0	0.0	1726	0.0	0.0	0.0	0.0	1830	0.0	0.0	0.0	0.0
1623	3.2	0.0	0.0	0.0	1727	0.1	0.0	0.0	0.0	1831	0.0	0.0	0.0	0.0
1624	0.0	0.0	0.0	0.0	1728	0.0	0.0	0.0	0.0	1832	0.0	0.0	0.0	0.0
1625	0.1	0.0	0.0	0.0	1729	0.6	0.0	0.0	0.0	1833	0.0	0.0	0.0	0.0
1626	6.9	0.0	0.0	0.0	1730	0.0	0.0	0.0	0.0	1834	0.0	0.0	0.0	0.0
1627	25.8	13.7	19.1	13.3	1731	0.0	0.0	0.0	0.0	1835	0.0	0.0	0.0	0.0
1628	0.0	0.0	0.0	0.0	1732	0.0	0.0	0.0	0.0	1836	0.0	0.0	0.0	0.0
1629	0.0	0.0	0.0	0.0	1733	0.0	0.0	0.0	0.0	1837	0.0	0.0	0.0	0.0
1630	0.0	0.0	0.0	0.0	1734	1.2	0.0	0.0	0.0	1838	0.0	0.0	0.0	0.0
1631	0.1	0.0	0.0	0.0	1735	3.1	0.0	0.0	0.0	1839	0.0	0.0	0.0	0.0
1632	0.1	0.0	0.0	0.0	1736	0.0	0.0	0.0	0.0	1840	0.0	0.0	0.0	0.0
1633	78.0	62.7	87.1	61.0	1737	0.0	0.0	0.0	0.0	1841	0.0	0.0	0.0	0.0
1634	0.0	0.0	0.0	0.0	1738	7.9	0.0	0.0	0.0	1842	0.0	0.0	0.0	0.0
1635	0.0	0.0	0.0	0.0	1739	0.0	0.0	0.0	0.0	1843	0.0	0.0	0.0	0.0
1636	3.6	0.0	0.0	0.0	1740	20.0	3.7	5.2	3.6	1844	0.0	0.0	0.0	0.0
1637	0.1	0.0	0.0	0.0	1741	11.2	3.0	4.1	2.9	1845	0.0	0.0	0.0	0.0
1638	1.6	0.0	0.0	0.0	1742	9.5	2.0	2.8	2.0	1846	0.0	0.0	0.0	0.0
1639	18.4	3.0	4.1	2.9	1743	24.5	12.8	17.8	12.4	1847	0.0	0.0	0.0	0.0
1640	18.1	7.7	10.7	7.5	1744	2.8	0.0	0.0	0.0	1848	0.0	0.0	0.0	0.0
1641	0.1	0.0	0.0	0.0	1745	0.0	0.0	0.0	0.0	1849	0.0	0.0	0.0	0.0
1642	0.0	0.0	0.0	0.0	1746	0.0	0.0	0.0	0.0	1850	0.0	0.0	0.0	0.0
1643	0.0	0.0	0.0	0.0	1747	0.0	0.0	0.0	0.0	1851	0.0	0.0	0.0	0.0
1644	74.0	58.8	81.7	57.2	1748	0.0	0.0	0.0	0.0	1852	0.0	0.0	0.0	0.0
1645	0.2	0.0	0.0	0.0	1749	0.0	0.0	0.0	0.0	1853	0.0	0.0	0.0	0.0
1646	2.6	0.0	0.0	0.0	1750	0.0	0.0	0.0	0.0	1854	0.0	0.0	0.0	0.0
1647	24.0	12.4	17.2	12.0	1751	0.9	0.0	0.0	0.0	1855	0.0	0.0	0.0	0.0
1648	0.0	0.0	0.0	0.0	1752	7.8	0.0	0.0	0.0	1856	0.0	0.0	0.0	0.0
1649	12.0	3.4	4.8	3.3	1753	13.2	1.0	1.4	1.0	1857	0.0	0.0	0.0	0.0
1650	14.8	5.3	7.3	5.1	1754	21.9	10.7	14.8	10.4	1858	0.0	0.0	0.0	0.0
1651	0.3	0.0	0.0	0.0	1755	0.0	0.0	0.0	0.0	1859	0.0	0.0	0.0	0.0
1652	0.3	0.0	0.0	0.0	1756	0.0	0.0	0.0	0.0	1860	0.0	0.0	0.0	0.0
1653	3.0	0.0	0.0	0.0	1757	0.0	0.0	0.0	0.0	1861	0.0	0.0	0.0	0.0
1654	23.5	12.0	16.6	11.6	1758	0.0	0.0	0.0	0.0	1862	0.0	0.0	0.0	0.0
1655	0.0	0.0	0.0	0.0	1759	0.0	0.0	0.0	0.0	1863	0.0	0.0	0.0	0.0
1656	22.0	10.7	14.9	10.4	1760	0.0	0.0	0.0	0.0	1864	0.0	0.0	0.0	0.0
1657	0.3	0.0	0.0	0.0	1761	0.0	0.0	0.0	0.0	1865	0.0	0.0	0.0	0.0
1658	0.0	0.0	0.0	0.0	1762	0.0	0.0	0.0	0.0	1866	0.0	0.0	0.0	0.0
1659	1.5	0.0	0.0	0.0	1763	0.0	0.0	0.0	0.0	1867	0.0	0.0	0.0	0.0
1660	37.9	24.6	34.1	23.9	1764	0.0	0.0	0.0	0.0	1868	0.0	0.0	0.0	0.0
1661	21.8	10.8	14.7	10.3	1765	0.0	0.0	0.0	0.0	1869	0.0	0.0	0.0	0.0
1662	0.5	0.0	0.0	0.0	1766	0.0	0.0	0.0	0.0	1870	0.0	0.0	0.0	0.0

Table continued.............

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
1871	0.0	0.0	0.0	0.0	1975	0.6	0.0	0.0	0.0	2079	0.0	0.0	0.0	0.0
1872	0.0	0.0	0.0	0.0	1978	2.0	0.0	0.0	0.0	2080	9.2	0.2	0.2	0.2
1873	0.0	0.0	0.0	0.0	1977	0.0	0.0	0.0	0.0	2081	0.0	0.0	0.0	0.0
1874	0.0	0.0	0.0	0.0	1978	5.2	0.0	0.0	0.0	2082	3.0	0.0	0.0	0.0
1675	0.0	0.0	0.0	0.0	1979	0.0	0.0	0.0	0.0	2083	8.8	0.1	0.2	0.1
1876	0.0	0.0	0.0	0.0	1980	0.0	0.0	0.0	0.0	2084	10.0	2.3	3.2	2.2
1877	0.0	0.0	0.0	0.0	1981	0.0	0.0	0.0	0.0	2085	15.4	5.7	7.9	5.5
1878	0.0	0.0	0.0	0.0	1982	4.2	0.0	0.0	0.0	2086	17.4	7.2	9.9	7.0
1879	0.0	0.0	0.0	0.0	1983	2.0	0.0	0.0	0.0	2087	0.0	0.0	0.0	0.0
1880	0.0	0.0	0.0	0.0	1984	5.0	0.0	0.0	0.0	2088	3.4	0.0	0.0	0.0
1881	0.0	0.0	0.0	0.0	1985	3.8	0.0	0.0	0.0	2089	0.0	0.0	0.0	0.0
1882	0.0	0.0	0.0	0.0	1986	0.0	0.0	0.0	0.0	2090	2.2	0.0	0.0	0.0
1883	0.0	0.0	0.0	0.0	1987	0.0	0.0	0.0	0.0	2091	0.0	0.0	0.0	0.0
1884	0.0	0.0	0.0	0.0	1988	0.8	0.0	0.0	0.0	2092	25.0	13.2	18.4	12.8
1885	0.0	0.0	0.0	0.0	1989	7.8	0.0	0.0	0.0	2093	3.2	0.0	0.0	0.0
1686	0.0	0.0	0.0	0.0	1990	1.0	0.0	0.0	0.0	2094	0.0	0.0	0.0	0.0
1887	0.0	0.0	0.0	0.0	1991	0.1	0.0	0.0	0.0	2095	0.4	0.0	0.0	0.0
1888	0.0	0.0	0.0	0.0	1992	0.0	0.0	0.0	0.0	2096	1.2	0.0	0.0	0.0
1889	0.0	0.0	0.0	0.0	1993	10.8	0.4	0.6	0.4	2097	11.4	0.8	0.8	0.5
1890	0.0	0.0	0.0	0.0	1994	2.8	0.0	0.0	0.0	2098	0.1	0.0	0.0	0.0
1891	0.0	0.0	0.0	0.0	1995	0.6	0.0	0.0	0.0	2099	2.8	0.0	0.0	0.0
1892	0.0	0.0	0.0	0.0	1996	0.0	0.0	0.0	0.0	2100	1.2	0.0	0.0	0.0
1893	0.0	0.0	0.0	0.0	1997	0.0	0.0	0.0	0.0	2101	14.8	5.1	7.1	5.0
1894	0.0	0.0	0.0	0.0	1998	0.0	0.0	0.0	0.0	2102	0.0	0.0	0.0	0.0
1895	0.0	0.0	0.0	0.0	1999	0.2	0.0	0.0	0.0	2103	0.0	0.0	0.0	0.0
1896	0.0	0.0	0.0	0.0	2000	0.8	0.0	0.0	0.0	2104	19.6	8.8	12.3	8.6
1897	0.0	0.0	0.0	0.0	2001	6.6	0.0	0.0	0.0	2105	0.2	0.0	0.0	0.0
1898	0.0	0.0	0.0	0.0	2002	14.0	1.3	1.8	1.2	2106	2.2	0.0	0.0	0.0
1899	0.0	0.0	0.0	0.0	2003	1.6	0.0	0.0	0.0	2107	0.0	0.0	0.0	0.0
1900	0.0	0.0	0.0	0.0	2004	5.2	0.3	0.4	0.3	2108	0.0	0.0	0.0	0.0
1901	0.0	0.0	0.0	0.0	2005	1.0	0.0	0.0	0.0	2109	0.0	0.0	0.0	0.0
1902	0.0	0.0	0.0	0.0	2006	0.0	0.0	0.0	0.0	2110	0.0	0.0	0.0	0.0
1903	0.0	0.0	0.0	0.0	2007	2.0	0.0	0.0	0.0	2111	2.4	0.0	0.0	0.0
1904	0.0	0.0	0.0	0.0	2008	7.6	0.0	0.0	0.0	2112	0.0	0.0	0.0	0.0
1905	0.0	0.0	0.0	0.0	2009	0.1	0.0	0.0	0.0	2113	0.0	0.0	0.0	0.0
1906	0.0	0.0	0.0	0.0	2010	12.8	0.9	1.3	0.9	2114	0.0	0.0	0.0	0.0
1907	0.0	0.0	0.0	0.0	2011	0.0	0.0	0.0	0.0	2115	0.0	0.0	0.0	0.0
1908	0.0	0.0	0.0	0.0	2012	5.8	0.0	0.0	0.0	2116	0.0	0.0	0.0	0.0
1909	0.0	0.0	0.0	0.0	2013	33.4	20.5	28.5	19.9	2117	0.0	0.0	0.0	0.0
1910	0.0	0.0	0.0	0.0	2014	4.4	0.1	0.2	0.1	2118	0.0	0.0	0.0	0.0
1911	0.0	0.0	0.0	0.0	2015	8.4	1.5	2.0	1.4	2119	0.0	0.0	0.0	0.0
1912	0.0	0.0	0.0	0.0	2016	0.0	0.0	0.0	0.0	2120	0.8	0.0	0.0	0.0
1913	0.0	0.0	0.0	0.0	2017	7.8	1.2	1.7	1.2	2121	0.0	0.0	0.0	0.0
1914	0.0	0.0	0.0	0.0	2018	11.0	2.8	4.0	2.8	2122	0.0	0.0	0.0	0.0
1915	0.0	0.0	0.0	0.0	2019	0.1	0.0	0.0	0.0	2123	0.0	0.0	0.0	0.0
1916	0.0	0.0	0.0	0.0	2020	0.9	0.0	0.0	0.0	2124	0.0	0.0	0.0	0.0
1917	8.8	0.0	0.0	0.0	2021	4.4	0.0	0.0	0.0	2125	0.0	0.0	0.0	0.0
1916	15.8	1.9	2.6	1.8	2022	0.6	0.0	0.0	0.0	2126	0.0	0.0	0.0	0.0
1919	1.0	0.0	0.0	0.0	2023	1.2	0.0	0.0	0.0	2127	0.0	0.0	0.0	0.0
1920	0.0	0.0	0.0	0.0	2024	0.4	0.0	0.0	0.0	2128	0.1	0.0	0.0	0.0
1921	0.0	0.0	0.0	0.0	2025	47.0	33.0	45.8	32.1	2129	0.2	0.0	0.0	0.0
1922	0.0	0.0	0.0	0.0	2028	0.7	0.0	0.0	0.0	2130	0.0	0.0	0.0	0.0
1923	0.8	0.0	0.0	0.0	2027	8.0	1.3	1.8	1.3	2131	0.0	0.0	0.0	0.0
1924	0.0	0.0	0.0	0.0	2028	13.0	4.1	5.7	4.0	2132	0.0	0.0	0.0	0.0
1925	0.0	0.0	0.0	0.0	2029	4.5	0.1	0.2	0.1	2133	0.0	0.0	0.0	0.0
1926	0.0	0.0	0.0	0.0	2030	15.6	5.8	8.1	5.7	2134	0.0	0.0	0.0	0.0
1927	0.0	0.0	0.0	0.0	2031	17.6	7.3	10.1	7.1	2135	0.0	0.0	0.0	0.0
1928	0.0	0.0	0.0	0.0	2032	6.8	0.8	1.1	0.8	2138	0.0	0.0	0.0	0.0
1929	0.0	0.0	0.0	0.0	2033	13.0	4.1	5.7	4.0	2137	0.0	0.0	0.0	0.0
1930	0.0	0.0	0.0	0.0	2034	0.0	0.0	0.0	0.0	2138	0.1	0.0	0.0	0.0
1931	0.4	0.0	0.0	0.0	2035	21.6	10.4	14.5	10.1	2139	23.2	5.4	7.5	5.2
1932	0.0	0.0	0.0	0.0	2036	0.0	0.0	0.0	0.0	2140	0.2	0.0	0.0	0.0
1933	0.0	0.0	0.0	0.0	2037	1.4	0.0	0.0	0.0	2141	0.0	0.0	0.0	0.0
1934	4.2	0.0	0.0	0.0	2038	3.6	0.0	0.0	0.0	2142	0.0	0.0	0.0	0.0
1935	15.6	1.8	2.5	1.8	2039	0.4	0.0	0.0	0.0	2143	0.0	0.0	0.0	0.0
1936	0.0	0.0	0.0	0.0	2040	0.0	0.0	0.0	0.0	2144	0.0	0.0	0.0	0.0
1937	0.0	0.0	0.0	0.0	2041	0.4	0.0	0.0	0.0	2145	0.0	0.0	0.0	0.0
1938	0.0	0.0	0.0	0.0	2042	12.8	0.9	1.3	0.9	2146	0.0	0.0	0.0	0.0
1939	0.6	0.0	0.0	0.0	2043	13.2	1.0	1.4	1.0	2147	0.0	0.0	0.0	0.0
1940	0.4	0.0	0.0	0.0	2044	12.0	3.4	4.8	3.3	2148	0.0	0.0	0.0	0.0
1941	0.0	0.0	0.0	0.0	2045	1.2	0.0	0.0	0.0	2149	0.0	0.0	0.0	0.0
1942	0.0	0.0	0.0	0.0	2046	0.2	0.0	0.0	0.0	2150	0.0	0.0	0.0	0.0
1943	0.0	0.0	0.0	0.0	2047	5.8	0.5	0.6	0.4	2151	0.0	0.0	0.0	0.0
1944	0.0	0.0	0.0	0.0	2048	6.0	0.0	0.0	0.0	2152	0.0	0.0	0.0	0.0
1945	0.1	0.0	0.0	0.0	2049	1.0	0.0	0.0	0.0	2153	0.0	0.0	0.0	0.0
1946	7.0	0.0	0.0	0.0	2050	15.6	5.8	8.1	5.7	2154	0.0	0.0	0.0	0.0
1947	4.8	0.0	0.0	0.0	2051	16.8	6.7	9.3	6.5	2155	0.0	0.0	0.0	0.0
1948	1.6	0.0	0.0	0.0	2052	2.4	0.0	0.0	0.0	2156	0.0	0.0	0.0	0.0
1949	27.2	15.1	21.0	14.7	2053	27.0	14.9	20.7	14.5	2157	0.0	0.0	0.0	0.0
1950	1.0	0.0	0.0	0.0	2054	0.2	0.0	0.0	0.0	2158	0.0	0.0	0.0	0.0
1951	16.2	8.3	8.7	6.1	2055	0.4	0.0	0.0	0.0	2159	0.0	0.0	0.0	0.0
1952	3.8	0.0	0.1	0.0	2056	19.2	8.5	11.8	8.3	2160	0.0	0.0	0.0	0.0
1953	5.8	0.5	0.6	0.4	2057	1.8	0.0	0.0	0.0	2181	0.0	0.0	0.0	0.0
1954	0.0	0.0	0.0	0.0	2058	0.2	0.0	0.0	0.0	2162	0.0	0.0	0.0	0.0
1955	0.2	0.0	0.0	0.0	2059	0.6	0.0	0.0	0.0	2183	0.0	0.0	0.0	0.0
1956	0.0	0.0	0.0	0.0	2060	2.2	0.0	0.0	0.0	2164	0.0	0.0	0.0	0.0
1957	0.2	0.0	0.0	0.0	2061	1.4	0.0	0.0	0.0	2165	0.0	0.0	0.0	0.0
1958	0.0	0.0	0.0	0.0	2062	9.0	0.1	0.2	0.1	2188	0.0	0.0	0.0	0.0
1959	0.0	0.0	0.0	0.0	2063	8.6	0.1	0.1	0.1	2167	0.0	0.0	0.0	0.0
1960	0.0	0.0	0.0	0.0	2064	8.2	1.4	1.9	1.3	2168	0.0	0.0	0.0	0.0
1961	0.0	0.0	0.0	0.0	2065	7.6	1.1	1.6	1.1	2169	0.0	0.0	0.0	0.0
1962	0.0	0.0	0.0	0.0	2066	0.4	0.0	0.0	0.0	2170	0.0	0.0	0.0	0.0
1963	0.0	0.0	0.0	0.0	2067	5.0	0.3	0.3	0.2	2171	0.1	0.0	0.0	0.0
1964	0.0	0.0	0.0	0.0	2068	0.0	0.0	0.0	0.0	2172	0.0	0.0	0.0	0.0
1965	0.0	0.0	0.0	0.0	2069	0.0	0.0	0.0	0.0	2173	0.4	0.0	0.0	0.0
1966	0.0	0.0	0.0	0.0	2070	10.8	0.4	0.6	0.4	2174	0.0	0.0	0.0	0.0
1967	0.0	0.0	0.0	0.0	2071	0.1	0.0	0.0	0.0	2175	0.4	0.0	0.0	0.0
1968	0.0	0.0	0.0	0.0	2072	0.4	0.0	0.0	0.0	2176	0.0	0.0	0.0	0.0
1969	0.0	0.0	0.0	0.0	2073	0.0	0.0	0.0	0.0	2177	0.0	0.0	0.0	0.0
1970	0.0	0.0	0.0	0.0	2074	7.0	0.0	0.0	0.0	2178	2.6	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	2075	12.4	0.8	1.1	0.8	2179	0.0	0.0	0.0	0.0
1972	0.1	0.0	0.0	0.0	2078	5.0	0.0	0.0	0.0	2180	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	2077	0.0	0.0	0.0	0.0	2181	0.0	0.0	0.0	0.0
1974	1.6	0.0	0.0	0.0	2076	0.0	0.0	0.0	0.0	2182	0.0	0.0	0.0	0.0

Table continued..........

Days	Rainfall	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/	Days	Rainfall(n	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
2183	0.0	0.0	0.0	0.0	2267	0.0	0.0	0.0	0.0	2391	3.4	0.0	0.0	0.0
2184	0.0	0.0	0.0	0.0	2268	0.0	0.0	0.0	0.0	2392	25.6	13.7	19.1	13.3
2185	0.0	0.0	0.0	0.0	2289	0.0	0.0	0.0	0.0	2393	25.4	13.6	16.8	13.2
2186	0.0	0.0	0.0	0.0	2290	0.0	0.0	0.0	0.0	2394	2.6	0.0	0.0	0.0
2167	0.0	0.0	0.0	0.0	2291	0.0	0.0	0.0	0.0	2395	4.2	0.1	0.1	0.1
2188	0.0	0.0	0.0	0.0	2292	0.0	0.0	0.0	0.0	2396	0.0	0.0	0.0	0.0
2189	0.0	0.0	0.0	0.0	2293	0.0	0.0	0.0	0.0	2397	13.4	4.3	6.0	4.2
2190	0.0	0.0	0.0	0.0	2294	0.0	0.0	0.0	0.0	2398	5.4	0.0	0.0	0.0
2191	0.0	0.0	0.0	0.0	2295	0.0	0.0	0.0	0.0	2399	7.4	1.0	1.4	1.0
2192	0.0	0.0	0.0	0.0	2296	0.0	0.0	0.0	0.0	2400	11.0	2.8	4.0	2.8
2193	0.0	0.0	0.0	0.0	2297	3.4	0.0	0.0	0.0	2401	13.2	4.2	5.8	4.1
2194	0.0	0.0	0.0	0.0	2298	0.0	0.0	0.0	0.0	2402	2.0	0.0	0.0	0.0
2195	0.0	0.0	0.0	0.0	2299	0.0	0.0	0.0	0.0	2403	0.8	0.0	0.0	0.0
2196	0.0	0.0	0.0	0.0	2300	0.0	0.0	0.0	0.0	2404	2.4	0.0	0.0	0.0
2197	0.0	0.0	0.0	0.0	2301	0.0	0.0	0.0	0.0	2405	28.4	14.4	20.0	14.0
2198	0.0	0.0	0.0	0.0	2302	0.0	0.0	0.0	0.0	2406	6.4	0.7	0.9	0.6
2199	0.0	0.0	0.0	0.0	2303	2.4	0.0	0.0	0.0	2407	0.0	0.0	0.0	0.0
2200	0.0	0.0	0.0	0.0	2304	1.1	0.0	0.0	0.0	2408	1.3	0.0	0.0	0.0
2201	0.0	0.0	0.0	0.0	2305	5.2	0.0	0.0	0.0	2409	2.0	0.0	0.0	0.0
2202	0.0	0.0	0.0	0.0	2306	7.6	0.0	0.0	0.0	2410	11.2	0.5	0.7	0.5
2203	0.0	0.0	0.0	0.0	2307	0.0	0.0	0.0	0.0	2411	1.6	0.0	0.0	0.0
2204	0.1	0.0	0.0	0.0	2308	0.0	0.0	0.0	0.0	2412	12.6	3.8	5.3	3.7
2205	0.0	0.0	0.0	0.0	2309	0.0	0.0	0.0	0.0	2413	2.8	0.0	0.0	0.0
2206	0.0	0.0	0.0	0.0	2310	0.0	0.0	0.0	0.0	2414	1.2	0.0	0.0	0.0
2207	0.0	0.0	0.0	0.0	2311	2.1	0.0	0.0	0.0	2415	0.1	0.0	0.0	0.0
2208	0.0	0.0	0.0	0.0	2312	0.0	0.0	0.0	0.0	2416	0.0	0.0	0.0	0.0
2209	0.0	0.0	0.0	0.0	2313	0.1	0.0	0.0	0.0	2417	0.0	0.0	0.0	0.0
2210	0.0	0.0	0.0	0.0	2314	0.0	0.0	0.0	0.0	2418	0.2	0.0	0.0	0.0
2211	0.0	0.0	0.0	0.0	2315	4.4	0.0	0.0	0.0	2419	0.2	0.0	0.0	0.0
2212	0.0	0.0	0.0	0.0	2316	2.8	0.0	0.0	0.0	2420	4.9	0.0	0.0	0.0
2213	0.0	0.0	0.0	0.0	2317	6.4	0.0	0.0	0.0	2421	0.0	0.0	0.0	0.0
2214	0.0	0.0	0.0	0.0	2316	0.3	0.0	0.0	0.0	2422	26.3	14.3	19.9	13.9
2215	0.0	0.0	0.0	0.0	2319	0.0	0.0	0.0	0.0	2423	0.0	0.0	0.0	0.0
2216	0.0	0.0	0.0	0.0	2320	5.3	0.0	0.0	0.0	2424	2.1	0.0	0.0	0.0
2217	0.0	0.0	0.0	0.0	2321	4.4	0.0	0.0	0.0	2425	28.8	16.5	22.9	16.0
2218	0.0	0.0	0.0	0.0	2322	3.8	0.0	0.0	0.0	2426	0.0	0.0	0.0	0.0
2219	0.0	0.0	0.0	0.0	2323	7.5	0.0	0.0	0.0	2427	2.4	0.0	0.0	0.0
2220	0.0	0.0	0.0	0.0	2324	0.4	0.0	0.0	0.0	2426	0.2	0.0	0.0	0.0
2221	0.0	0.0	0.0	0.0	2325	0.1	0.0	0.0	0.0	2429	6.4	0.7	0.9	0.6
2222	0.0	0.0	0.0	0.0	2326	3.3	0.0	0.0	0.0	2430	1.2	0.0	0.0	0.0
2223	0.0	0.0	0.0	0.0	2327	13.4	1.1	1.5	1.1	2431	0.1	0.0	0.0	0.0
2224	0.0	0.0	0.0	0.0	2326	13.7	4.5	6.3	4.4	2432	0.2	0.0	0.0	0.0
2225	0.0	0.0	0.0	0.0	2329	0.0	0.0	0.0	0.0	2433	1.6	0.0	0.0	0.0
2226	0.0	0.0	0.0	0.0	2330	0.0	0.0	0.0	0.0	2434	0.4	0.0	0.0	0.0
2227	0.0	0.0	0.0	0.0	2331	0.0	0.0	0.0	0.0	2435	2.4	0.0	0.0	0.0
2228	0.0	0.0	0.0	0.0	2332	0.0	0.0	0.0	0.0	2438	1.4	0.0	0.0	0.0
2229	0.0	0.0	0.0	0.0	2333	0.0	0.0	0.0	0.0	2437	1.4	0.0	0.0	0.0
2230	0.0	0.0	0.0	0.0	2334	0.0	0.0	0.0	0.0	2438	0.2	0.0	0.0	0.0
2231	0.0	0.0	0.0	0.0	2335	0.8	0.0	0.0	0.0	2439	0.0	0.0	0.0	0.0
2232	4.4	0.0	0.0	0.0	2336	0.0	0.0	0.0	0.0	2440	0.0	0.0	0.0	0.0
2233	0.2	0.0	0.0	0.0	2337	0.0	0.0	0.0	0.0	2441	15.2	1.7	2.3	1.6
2234	0.0	0.0	0.0	0.0	2338	0.4	0.0	0.0	0.0	2442	0.0	0.0	0.0	0.0
2235	0.0	0.0	0.0	0.0	2339	10.0	0.0	0.0	0.0	2443	0.1	0.0	0.0	0.0
2236	0.0	0.0	0.0	0.0	2340	0.0	0.0	0.0	0.0	2444	0.1	0.0	0.0	0.0
2237	0.0	0.0	0.0	0.0	2341	19.7	8.9	12.4	8.7	2445	4.0	0.0	0.0	0.0
2238	0.0	0.0	0.0	0.0	2342	4.4	0.1	0.2	0.1	2448	0.8	0.0	0.0	0.0
2239	0.0	0.0	0.0	0.0	2343	3.0	0.0	0.0	0.0	2447	0.4	0.0	0.0	0.0
2240	0.0	0.0	0.0	0.0	2344	0.8	0.0	0.0	0.0	2446	0.0	0.0	0.0	0.0
2241	0.0	0.0	0.0	0.0	2345	0.0	0.0	0.0	0.0	2449	16.0	2.8	3.9	2.7
2242	0.0	0.0	0.0	0.0	2346	0.0	0.0	0.0	0.0	2450	11.0	2.8	4.0	2.8
2243	0.0	0.0	0.0	0.0	2347	0.0	0.0	0.0	0.0	2451	0.0	0.0	0.0	0.0
2244	0.0	0.0	0.0	0.0	2348	0.0	0.0	0.0	0.0	2452	11.5	3.1	4.4	3.1
2245	0.0	0.0	0.0	0.0	2349	0.2	0.0	0.0	0.0	2453	0.0	0.0	0.0	0.0
2248	0.0	0.0	0.0	0.0	2350	5.5	0.0	0.0	0.0	2454	0.0	0.0	0.0	0.0
2247	0.0	0.0	0.0	0.0	2351	4.2	0.0	0.0	0.0	2455	0.3	0.0	0.0	0.0
2248	0.0	0.0	0.0	0.0	2352	0.0	0.0	0.0	0.0	2456	0.0	0.0	0.0	0.0
2249	0.0	0.0	0.0	0.0	2353	0.0	0.0	0.0	0.0	2457	0.1	0.0	0.0	0.0
2250	0.0	0.0	0.0	0.0	2354	0.1	0.0	0.0	0.0	2456	0.0	0.0	0.0	0.0
2251	0.0	0.0	0.0	0.0	2355	2.0	0.0	0.0	0.0	2459	0.0	0.0	0.0	0.0
2252	0.0	0.0	0.0	0.0	2356	2.4	0.0	0.0	0.0	2460	0.0	0.0	0.0	0.0
2253	0.0	0.0	0.0	0.0	2357	0.1	0.0	0.0	0.0	2461	0.0	0.0	0.0	0.0
2254	0.0	0.0	0.0	0.0	2358	1.4	0.0	0.0	0.0	2462	0.0	0.0	0.0	0.0
2255	0.0	0.0	0.0	0.0	2359	0.0	0.0	0.0	0.0	2463	0.0	0.0	0.0	0.0
2256	0.8	0.0	0.0	0.0	2360	1.6	0.0	0.0	0.0	2464	0.0	0.0	0.0	0.0
2257	1.8	0.0	0.0	0.0	2361	9.7	0.2	0.3	0.2	2465	0.0	0.0	0.0	0.0
2258	0.1	0.0	0.0	0.0	2362	16.2	6.3	8.7	6.1	2466	0.0	0.0	0.0	0.0
2259	0.2	0.0	0.0	0.0	2363	3.6	0.0	0.0	0.0	2467	15.8	1.9	2.6	1.8
2260	3.5	0.0	0.0	0.0	2364	0.1	0.0	0.0	0.0	2466	0.0	0.0	0.0	0.0
2261	2.4	0.0	0.0	0.0	2365	5.3	0.3	0.4	0.3	2469	0.0	0.0	0.0	0.0
2262	4.4	0.0	0.0	0.0	2366	1.9	0.0	0.0	0.0	2470	0.0	0.0	0.0	0.0
2263	0.6	0.0	0.0	0.0	2367	0.1	0.0	0.0	0.0	2471	0.0	0.0	0.0	0.0
2264	22.6	11.2	15.6	10.9	2366	21.6	10.6	14.7	10.3	2472	0.0	0.0	0.0	0.0
2265	2.6	0.0	0.0	0.0	2369	2.9	0.0	0.0	0.0	2473	0.0	0.0	0.0	0.0
2266	7.6	1.1	1.6	1.1	2370	0.1	0.0	0.0	0.0	2474	0.0	0.0	0.0	0.0
2267	6.2	0.8	0.8	0.6	2371	0.0	0.0	0.0	0.0	2475	0.0	0.0	0.0	0.0
2266	14.0	4.7	6.6	4.6	2372	0.0	0.0	0.0	0.0	2476	0.0	0.0	0.0	0.0
2269	0.4	0.0	0.0	0.0	2373	0.0	0.0	0.0	0.0	2477	0.0	0.0	0.0	0.0
2270	3.4	0.0	0.0	0.0	2374	0.0	0.0	0.0	0.0	2478	0.0	0.0	0.0	0.0
2271	1.0	0.0	0.0	0.0	2375	21.4	4.4	6.1	4.3	2479	0.0	0.0	0.0	0.0
2272	0.0	0.0	0.0	0.0	2376	0.0	0.0	0.0	0.0	2480	0.0	0.0	0.0	0.0
2273	0.0	0.0	0.0	0.0	2377	0.0	0.0	0.0	0.0	2481	0.0	0.0	0.0	0.0
2274	0.0	0.0	0.0	0.0	2378	13.6	4.5	6.2	4.3	2462	0.0	0.0	0.0	0.0
2275	27.2	15.1	21.0	14.7	2379	16.3	6.3	8.8	6.2	2483	0.0	0.0	0.0	0.0
2276	0.0	0.0	0.0	0.0	2380	36.0	24.7	34.3	24.0	2484	0.0	0.0	0.0	0.0
2277	15.4	5.7	7.9	5.5	2361	0.2	0.0	0.0	0.0	2485	0.0	0.0	0.0	0.0
2278	3.9	0.1	0.1	0.1	2382	2.6	0.0	0.0	0.0	2486	0.0	0.0	0.0	0.0
2279	0.0	0.0	0.0	0.0	2383	0.0	0.0	0.0	0.0	2467	0.0	0.0	0.0	0.0
2280	39.0	25.6	35.5	24.9	2384	5.4	0.3	0.5	0.3	2466	0.0	0.0	0.0	0.0
2261	6.8	0.8	1.1	0.8	2385	1.6	0.0	0.0	0.0	2469	0.0	0.0	0.0	0.0
2282	1.8	0.0	0.0	0.0	2386	3.8	0.0	0.0	0.0	2490	0.0	0.0	0.0	0.0
2283	0.0	0.0	0.0	0.0	2387	12.0	0.7	1.0	0.7	2491	21.4	4.4	6.1	4.3
2284	0.0	0.0	0.0	0.0	2386	18.4	6.4	8.9	6.2	2492	0.0	0.0	0.0	0.0
2285	0.0	0.0	0.0	0.0	2389	0.0	0.0	0.0	0.0	2493	0.0	0.0	0.0	0.0
2286	0.0	0.0	0.0	0.0	2390	4.2	0.1	0.1	0.1	2494	0.0	0.0	0.0	0.0

Table continued..........

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
2495	0.0	0.0	0.0	0.0	2599	0.0	0.0	0.0	0.0	2703	0.0	0.0	0.0	0.0
2496	0.0	0.0	0.0	0.0	2600	0.0	0.0	0.0	0.0	2704	0.0	0.0	0.0	0.0
2497	0.0	0.0	0.0	0.0	2601	0.0	0.0	0.0	0.0	2705	0.0	0.0	0.0	0.0
2498	0.0	0.0	0.0	0.0	2602	0.0	0.0	0.0	0.0	2706	0.0	0.0	0.0	0.0
2499	0.0	0.0	0.0	0.0	2603	0.0	0.0	0.0	0.0	2707	0.0	0.0	0.0	0.0
2500	0.0	0.0	0.0	0.0	2604	0.1	0.0	0.0	0.0	2708	0.0	0.0	0.0	0.0
2501	0.0	0.0	0.0	0.0	2605	0.0	0.0	0.0	0.0	2709	0.2	0.0	0.0	0.0
2502	0.0	0.0	0.0	0.0	2606	0.0	0.0	0.0	0.0	2710	0.0	0.0	0.0	0.0
2503	0.0	0.0	0.0	0.0	2607	0.0	0.0	0.0	0.0	2711	0.3	0.0	0.0	0.0
2504	0.0	0.0	0.0	0.0	2608	0.0	0.0	0.0	0.0	2712	0.0	0.0	0.0	0.0
2505	0.0	0.0	0.0	0.0	2609	0.0	0.0	0.0	0.0	2713	5.2	0.0	0.0	0.0
2506	0.0	0.0	0.0	0.0	2610	0.0	0.0	0.0	0.0	2714	0.0	0.0	0.0	0.0
2507	0.0	0.0	0.0	0.0	2611	0.0	0.0	0.0	0.0	2715	0.1	0.0	0.0	0.0
2508	0.0	0.0	0.0	0.0	2612	0.0	0.0	0.0	0.0	2716	1.2	0.0	0.0	0.0
2509	0.0	0.0	0.0	0.0	2613	0.0	0.0	0.0	0.0	2717	1.6	0.0	0.0	0.0
2510	0.0	0.0	0.0	0.0	2614	0.0	0.0	0.0	0.0	2718	0.1	0.0	0.0	0.0
2511	0.0	0.0	0.0	0.0	2615	0.0	0.0	0.0	0.0	2719	14.6	1.5	2.0	1.4
2512	0.0	0.0	0.0	0.0	2616	0.0	0.0	0.0	0.0	2720	19.0	8.4	11.6	8.1
2513	0.0	0.0	0.0	0.0	2617	0.0	0.0	0.0	0.0	2721	0.0	0.0	0.0	0.0
2514	0.0	0.0	0.0	0.0	2618	0.0	0.0	0.0	0.0	2722	3.8	0.0	0.1	0.0
2515	0.0	0.0	0.0	0.0	2619	7.0	0.0	0.0	0.0	2723	21.2	10.1	14.0	9.8
2516	0.0	0.0	0.0	0.0	2620	0.8	0.0	0.0	0.0	2724	1.9	0.0	0.0	0.0
2517	0.0	0.0	0.0	0.0	2621	20.0	3.7	5.2	3.6	2725	1.7	0.0	0.0	0.0
2518	0.0	0.0	0.0	0.0	2622	0.0	0.0	0.0	0.0	2726	0.0	0.0	0.0	0.0
2519	0.0	0.0	0.0	0.0	2623	0.0	0.0	0.0	0.0	2727	0.1	0.0	0.0	0.0
2520	0.0	0.0	0.0	0.0	2624	0.0	0.0	0.0	0.0	2728	0.0	0.0	0.0	0.0
2521	0.0	0.0	0.0	0.0	2625	0.2	0.0	0.0	0.0	2729	5.0	0.0	0.0	0.0
2522	0.0	0.0	0.0	0.0	2626	0.0	0.0	0.0	0.0	2730	3.9	0.0	0.0	0.0
2523	0.0	0.0	0.0	0.0	2627	0.1	0.0	0.0	0.0	2731	4.5	0.0	0.0	0.0
2524	0.0	0.0	0.0	0.0	2628	0.1	0.0	0.0	0.0	2732	0.0	0.0	0.0	0.0
2525	0.0	0.0	0.0	0.0	2629	0.0	0.0	0.0	0.0	2733	0.0	0.0	0.0	0.0
2526	0.0	0.0	0.0	0.0	2630	0.0	0.0	0.0	0.0	2734	0.0	0.0	0.0	0.0
2527	5.1	0.0	0.0	0.0	2631	0.0	0.0	0.0	0.0	2735	7.2	0.0	0.0	0.0
2528	2.2	0.0	0.0	0.0	2632	13.2	1.0	1.4	1.0	2736	0.1	0.0	0.0	0.0
2529	0.0	0.0	0.0	0.0	2633	0.8	0.0	0.0	0.0	2737	1.9	0.0	0.0	0.0
2530	0.0	0.0	0.0	0.0	2634	0.0	0.0	0.0	0.0	2738	9.0	0.1	0.2	0.1
2531	0.0	0.0	0.0	0.0	2635	6.0	0.0	0.0	0.0	2739	0.1	0.0	0.0	0.0
2532	0.1	0.0	0.0	0.0	2636	0.1	0.0	0.0	0.0	2740	0.1	0.0	0.0	0.0
2533	0.0	0.0	0.0	0.0	2637	0.0	0.0	0.0	0.0	2741	0.0	0.0	0.0	0.0
2534	0.0	0.0	0.0	0.0	2638	0.2	0.0	0.0	0.0	2742	0.0	0.0	0.0	0.0
2535	0.0	0.0	0.0	0.0	2639	0.0	0.0	0.0	0.0	2743	0.0	0.0	0.0	0.0
2536	0.0	0.0	0.0	0.0	2640	0.0	0.0	0.0	0.0	2744	10.7	0.0	0.0	0.0
2537	0.0	0.0	0.0	0.0	2641	0.0	0.0	0.0	0.0	2745	0.0	0.0	0.0	0.0
2538	1.3	0.0	0.0	0.0	2642	0.0	0.0	0.0	0.0	2746	0.0	0.0	0.0	0.0
2539	0.0	0.0	0.0	0.0	2643	0.0	0.0	0.0	0.0	2747	2.4	0.0	0.0	0.0
2540	0.0	0.0	0.0	0.0	2644	0.1	0.0	0.0	0.0	2748	1.2	0.0	0.0	0.0
2541	0.0	0.0	0.0	0.0	2645	0.0	0.0	0.0	0.0	2749	24.9	13.1	18.2	12.8
2542	0.0	0.0	0.0	0.0	2646	0.0	0.0	0.0	0.0	2750	8.5	1.5	2.1	1.5
2543	0.0	0.0	0.0	0.0	2647	0.0	0.0	0.0	0.0	2751	0.0	0.0	0.0	0.0
2544	0.0	0.0	0.0	0.0	2648	0.0	0.0	0.0	0.0	2752	1.2	0.0	0.0	0.0
2545	0.0	0.0	0.0	0.0	2649	0.0	0.0	0.0	0.0	2753	9.8	2.2	3.0	2.1
2546	0.0	0.0	0.0	0.0	2650	0.0	0.0	0.0	0.0	2754	0.4	0.0	0.0	0.0
2547	0.0	0.0	0.0	0.0	2651	0.0	0.0	0.0	0.0	2755	0.1	0.0	0.0	0.0
2548	0.0	0.0	0.0	0.0	2652	28.0	15.8	21.9	15.3	2756	0.0	0.0	0.0	0.0
2549	0.0	0.0	0.0	0.0	2653	0.0	0.0	0.0	0.0	2757	8.4	0.1	0.1	0.1
2550	0.0	0.0	0.0	0.0	2654	0.0	0.0	0.0	0.0	2758	1.7	0.0	0.0	0.0
2551	0.0	0.0	0.0	0.0	2655	0.0	0.0	0.0	0.0	2759	0.2	0.0	0.0	0.0
2552	0.0	0.0	0.0	0.0	2656	0.0	0.0	0.0	0.0	2760	0.0	0.0	0.0	0.0
2553	0.0	0.0	0.0	0.0	2657	0.0	0.0	0.0	0.0	2761	1.1	0.0	0.0	0.0
2554	0.0	0.0	0.0	0.0	2658	3.0	0.0	0.0	0.0	2762	10.2	0.3	0.4	0.3
2555	0.0	0.0	0.0	0.0	2659	0.0	0.0	0.0	0.0	2763	44.7	30.9	42.9	30.0
2556	0.0	0.0	0.0	0.0	2660	0.2	0.0	0.0	0.0	2764	0.8	0.0	0.0	0.0
2557	0.0	0.0	0.0	0.0	2661	0.0	0.0	0.0	0.0	2765	15.1	5.5	7.6	5.3
2558	0.0	0.0	0.0	0.0	2662	2.3	0.0	0.0	0.0	2766	15.2	5.6	7.7	5.4
2559	5.1	0.0	0.0	0.0	2663	0.0	0.0	0.0	0.0	2767	13.2	4.2	5.8	4.1
2560	2.2	0.0	0.0	0.0	2664	0.0	0.0	0.0	0.0	2768	21.6	10.4	14.5	10.1
2561	0.0	0.0	0.0	0.0	2665	0.1	0.0	0.0	0.0	2769	3.0	0.0	0.0	0.0
2562	0.0	0.0	0.0	0.0	2666	0.0	0.0	0.0	0.0	2770	0.0	0.0	0.0	0.0
2563	0.0	0.0	0.0	0.0	2667	1.1	0.0	0.0	0.0	2771	0.5	0.0	0.0	0.0
2564	0.1	0.0	0.0	0.0	2668	0.0	0.0	0.0	0.0	2772	0.5	0.0	0.0	0.0
2565	0.0	0.0	0.0	0.0	2669	0.0	0.0	0.0	0.0	2773	0.5	0.0	0.0	0.0
2566	0.0	0.0	0.0	0.0	2670	0.0	0.0	0.0	0.0	2774	0.5	0.0	0.0	0.0
2567	0.0	0.0	0.0	0.0	2671	0.0	0.0	0.0	0.0	2775	6.7	0.0	0.0	0.0
2568	0.0	0.0	0.0	0.0	2672	0.0	0.0	0.0	0.0	2776	0.0	0.0	0.0	0.0
2569	0.0	0.0	0.0	0.0	2673	0.0	0.0	0.0	0.0	2777	0.0	0.0	0.0	0.0
2570	1.3	0.0	0.0	0.0	2674	0.0	0.0	0.0	0.0	2778	1.8	0.0	0.0	0.0
2571	0.0	0.0	0.0	0.0	2675	0.1	0.0	0.0	0.0	2779	6.5	0.0	0.0	0.0
2572	0.0	0.0	0.0	0.0	2676	0.0	0.0	0.0	0.0	2780	9.6	0.2	0.3	0.2
2573	0.0	0.0	0.0	0.0	2677	0.0	0.0	0.0	0.0	2781	7.2	0.0	0.0	0.0
2574	0.0	0.0	0.0	0.0	2678	0.1	0.0	0.0	0.0	2782	0.2	0.0	0.0	0.0
2575	0.0	0.0	0.0	0.0	2679	0.0	0.0	0.0	0.0	2783	5.7	0.4	0.6	0.4
2576	0.0	0.0	0.0	0.0	2680	0.0	0.0	0.0	0.0	2784	10.5	2.6	3.6	2.5
2577	0.0	0.0	0.0	0.0	2681	2.0	0.0	0.0	0.0	2785	0.0	0.0	0.0	0.0
2578	0.0	0.0	0.0	0.0	2682	1.2	0.0	0.0	0.0	2786	10.8	0.4	0.6	0.4
2579	0.0	0.0	0.0	0.0	2683	3.7	0.0	0.0	0.0	2787	9.3	1.9	2.7	1.9
2580	0.0	0.0	0.0	0.0	2684	0.1	0.0	0.0	0.0	2788	27.9	15.7	21.8	15.2
2581	0.0	0.0	0.0	0.0	2685	0.0	0.0	0.0	0.0	2789	4.0	0.1	0.1	0.1
2582	0.0	0.0	0.0	0.0	2686	0.0	0.0	0.0	0.0	2790	27.3	15.2	21.1	14.7
2583	0.0	0.0	0.0	0.0	2687	0.1	0.0	0.0	0.0	2791	3.2	0.0	0.0	0.0
2584	0.0	0.0	0.0	0.0	2688	0.0	0.0	0.0	0.0	2792	20.5	9.5	13.3	9.3
2585	0.0	0.0	0.0	0.0	2689	0.0	0.0	0.0	0.0	2793	7.4	1.0	1.4	1.0
2586	0.0	0.0	0.0	0.0	2690	0.0	0.0	0.0	0.0	2794	14.0	4.7	6.6	4.6
2587	0.0	0.0	0.0	0.0	2691	0.0	0.0	0.0	0.0	2795	2.7	0.0	0.0	0.0
2588	0.0	0.0	0.0	0.0	2692	0.0	0.0	0.0	0.0	2796	3.2	0.0	0.0	0.0
2589	0.0	0.0	0.0	0.0	2693	0.0	0.0	0.0	0.0	2797	0.5	0.0	0.0	0.0
2590	0.0	0.0	0.0	0.0	2694	0.9	0.0	0.0	0.0	2798	0.1	0.0	0.0	0.0
2591	0.0	0.0	0.0	0.0	2695	0.0	0.0	0.0.	0.0	2799	0.0	0.0	0.0	0.0
2592	0.0	0.0	0.0	0.0	2696	0.0	0.0	0.0	0.0	2800	0.0	0.0	0.0	0.0
2593	0.0	0.0	0.0	0.0	2697	2.1	0.0	0.0	0.0	2801	0.1	0.0	0.0	0.0
2594	0.0	0.0	0.0	0.0	2696	0.1	0.0	0.0	0.0	2802	3.8	0.0	0.0	0.0
2595	0.0	0.0	0.0	0.0	2699	1.1	0.0	0.0	0.0	2803	1.0	0.0	0.0	0.0
2596	0.0	0.0	0.0	0.0	2700	0.1	0.0	0.0	0.0	2804	4.0	0.0	0.0	0.0
2597	0.0	0.0	0.0	0.0	2701	0.0	0.0	0.0	0.0	2805	0.0	0.0	0.0	0.0
2598	0.0	0.0	0.0	0.0	2702	0.0	0.0	0.0	0.0	2606	0.0	0.0	0.0	0.0

Table continued.............

Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)	Days	Rainfall(mm)	Q (mm)	Wadecha R. Q in M^3/s)	Belbela R. Q (m^3/sec)
2807	1.5	0.0	0.0	0.0	2911	0.0	0.0	0.0	0.0	3015	0.0	0.0	0.0	0.0
2808	0.4	0.0	0.0	0.0	2912	1.1	0.0	0.0	0.0	3016	0.0	0.0	0.0	0.0
2809	0.1	0.0	0.0	0.0	2913	4.7	0.0	0.0	0.0	3017	0.0	0.0	0.0	0.0
2810	0.0	0.0	0.0	0.0	2914	0.0	0.0	0.0	0.0	3018	0.0	0.0	0.0	0.0
2811	1.5	0.0	0.0	0.0	2915	0.2	0.0	0.0	0.0	3019	0.0	0.0	0.0	0.0
2812	0.0	0.0	0.0	0.0	2916	0.6	0.0	0.0	0.0	3020	0.0	0.0	0.0	0.0
2813	0.0	0.0	0.0	0.0	2917	0.0	0.0	0.0	0.0	3021	0.0	0.0	0.0	0.0
2814	0.0	0.0	0.0	0.0	2918	0.2	0.0	0.0	0.0	3022	0.0	0.0	0.0	0.0
2815	12.7	0.9	1.2	0.9	2919	13.7	1.2	1.6	1.1	3023	0.0	0.0	0.0	0.0
2816	11.1	0.5	0.7	0.5	2920	0.0	0.0	0.0	0.0	3024	10.6	0.0	0.0	0.0
2817	7.8	1.2	1.7	1.2	2921	0.0	0.0	0.0	0.0	3025	0.0	0.0	0.0	0.0
2818	0.0	0.0	0.0	0.0	2922	0.0	0.0	0.0	0.0	3026	0.0	0.0	0.0	0.0
2819	5.6	0.4	0.6	0.4	2923	0.0	0.0	0.0	0.0	3027	4.4	0.0	0.0	0.0
2820	5.8	0.4	0.6	0.4	2924	0.0	0.0	0.0	0.0	3028	17.0	6.9	9.5	6.7
2821	0.0	0.0	0.0	0.0	2925	0.0	0.0	0.0	0.0	3029	0.1	0.0	0.0	0.0
2822	0.0	0.0	0.0	0.0	2926	0.0	0.0	0.0	0.0	3030	0.0	0.0	0.0	0.0
2823	0.0	0.0	0.0	0.0	2927	0.0	0.0	0.0	0.0	3031	4.4	0.0	0.0	0.0
2824	3.4	0.0	0.0	0.0	2928	0.0	0.0	0.0	0.0	3032	2.4	0.0	0.0	0.0
2825	0.0	0.0	0.0	0.0	2929	0.0	0.0	0.0	0.0	3033	1.6	0.0	0.0	0.0
2826	0.0	0.0	0.0	0.0	2930	0.0	0.0	0.0	0.0	3034	13.8	1.2	1.7	1.2
2827	0.0	0.0	0.0	0.0	2931	0.0	0.0	0.0	0.0	3035	0.0	0.0	0.0	0.0
2828	0.0	0.0	0.0	0.0	2932	0.0	0.0	0.0	0.0	3036	0.0	0.0	0.0	0.0
2829	0.0	0.0	0.0	0.0	2933	0.0	0.0	0.0	0.0	3037	0.0	0.0	0.0	0.0
2830	0.0	0.0	0.0	0.0	2934	0.0	0.0	0.0	0.0	3038	0.9	0.0	0.0	0.0
2831	0.0	0.0	0.0	0.0	2935	0.0	0.0	0.0	0.0	3039	0.0	0.0	0.0	0.0
2832	0.0	0.0	0.0	0.0	2936	0.0	0.0	0.0	0.0	3040	4.4	0.0	0.0	0.0
2833	0.0	0.0	0.0	0.0	2937	0.0	0.0	0.0	0.0	3041	11.8	0.7	0.9	0.6
2834	0.0	0.0	0.0	0.0	2938	0.0	0.0	0.0	0.0	3042	0.0	0.0	0.0	0.0
2835	0.0	0.0	0.0	0.0	2939	0.0	0.0	0.0	0.0	3043	0.0	0.0	0.0	0.0
2836	0.0	0.0	0.0	0.0	2940	0.0	0.0	0.0	0.0	3044	0.0	0.0	0.0	0.0
2837	0.0	0.0	0.0	0.0	2941	0.0	0.0	0.0	0.0	3045	0.0	0.0	0.0	0.0
2838	0.0	0.0	0.0	0.0	2942	0.0	0.0	0.0	0.0	3046	0.0	0.0	0.0	0.0
2839	0.0	0.0	0.0	0.0	2943	0.0	0.0	0.0	0.0	3047	0.0	0.0	0.0	0.0
2840	0.0	0.0	0.0	0.0	2944	0.0	0.0	0.0	0.0	3048	0.0	0.0	0.0	0.0
2841	0.0	0.0	0.0	0.0	2945	0.0	0.0	0.0	0.0	3049	0.0	0.0	0.0	0.0
2842	0.0	0.0	0.0	0.0	2946	0.0	0.0	0.0	0.0	3050	0.1	0.0	0.0	0.0
2843	0.0	0.0	0.0	0.0	2947	0.0	0.0	0.0	0.0	3051	0.0	0.0	0.0	0.0
2844	0.0	0.0	0.0	0.0	2948	0.0	0.0	0.0	0.0	3052	9.3	0.0	0.0	0.0
2845	0.0	0.0	0.0	0.0	2949	38.3	25.0	34.7	24.3	3053	0.0	0.0	0.0	0.0
2846	0.0	0.0	0.0	0.0	2950	0.0	0.0	0.0	0.0	3054	0.0	0.0	0.0	0.0
2847	0.0	0.0	0.0	0.0	2951	0.0	0.0	0.0	0.0	3055	0.0	0.0	0.0	0.0
2848	0.0	0.0	0.0	0.0	2952	0.0	0.0	0.0	0.0	3056	0.1	0.0	0.0	0.0
2849	0.0	0.0	0.0	0.0	2953	0.0	0.0	0.0	0.0	3057	11.8	0.0	0.0	0.0
2850	0.0	0.0	0.0	0.0	2954	12.3	0.0	0.0	0.0	3058	0.0	0.0	0.0	0.0
2851	0.0	0.0	0.0	0.0	2955	0.0	0.0	0.0	0.0	3059	0.0	0.0	0.0	0.0
2852	0.0	0.0	0.0	0.0	2956	0.0	0.0	0.0	0.0	3060	0.0	0.0	0.0	0.0
2853	0.0	0.0	0.0	0.0	2957	0.0	0.0	0.0	0.0	3061	0.0	0.0	0.0	0.0
2854	0.0	0.0	0.0	0.0	2958	0.0	0.0	0.0	0.0	3062	0.0	0.0	0.0	0.0
2855	0.0	0.0	0.0	0.0	2959	0.0	0.0	0.0	0.0	3063	0.0	0.0	0.0	0.0
2856	0.0	0.0	0.0	0.0	2960	0.0	0.0	0.0	0.0	3064	0.0	0.0	0.0	0.0
2857	0.0	0.0	0.0	0.0	2961	0.0	0.0	0.0	0.0	3065	0.0	0.0	0.0	0.0
2858	0.0	0.0	0.0	0.0	2962	0.0	0.0	0.0	0.0	3066	0.0	0.0	0.0	0.0
2859	0.1	0.0	0.0	0.0	2963	0.0	0.0	0.0	0.0	3067	0.0	0.0	0.0	0.0
2860	0.0	0.0	0.0	0.0	2964	0.0	0.0	0.0	0.0	3068	0.0	0.0	0.0	0.0
2861	0.0	0.0	0.0	0.0	2965	0.0	0.0	0.0	0.0	3069	0.0	0.0	0.0	0.0
2862	0.0	0.0	0.0	0.0	2966	0.0	0.0	0.0	0.0	3070	0.0	0.0	0.0	0.0
2863	0.0	0.0	0.0	0.0	2967	0.0	0.0	0.0	0.0	3071	0.0	0.0	0.0	0.0
2864	0.0	0.0	0.0	0.0	2968	0.0	0.0	0.0	0.0	3072	0.0	0.0	0.0	0.0
2865	0.0	0.0	0.0	0.0	2969	0.0	0.0	0.0	0.0	3073	0.0	0.0	0.0	0.0
2866	0.0	0.0	0.0	0.0	2970	0.0	0.0	0.0	0.0	3074	0.0	0.0	0.0	0.0
2867	0.0	0.0	0.0	0.0	2971	0.0	0.0	0.0	0.0	3075	0.0	0.0	0.0	0.0
2868	0.0	0.0	0.0	0.0	2972	0.0	0.0	0.0	0.0	3076	4.2	0.0	0.0	0.0
2869	0.0	0.0	0.0	0.0	2973	0.0	0.0	0.0	0.0	3077	0.0	0.0	0.0	0.0
2870	0.0	0.0	0.0	0.0	2974	0.0	0.0	0.0	0.0	3078	0.0	0.0	0.0	0.0
2871	0.0	0.0	0.0	0.0	2975	0.0	0.0	0.0	0.0	3079	0.0	0.0	0.0	0.0
2872	0.0	0.0	0.0	0.0	2976	0.0	0.0	0.0	0.0	3080	2.1	0.0	0.0	0.0
2873	0.0	0.0	0.0	0.0	2977	0.0	0.0	0.0	0.0	3081	0.0	0.0	0.0	0.0
2874	0.0	0.0	0.0	0.0	2978	19.8	3.6	5.0	3.5	3082	0.1	0.0	0.0	0.0
2875	0.0	0.0	0.0	0.0	2979	0.4	0.0	0.0	0.0	3083	1.2	0.0	0.0	0.0
2876	0.0	0.0	0.0	0.0	2980	22.9	11.5	15.9	11.2	3084	0.0	0.0	0.0	0.0
2877	0.0	0.0	0.0	0.0	2981	0.0	0.0	0.0	0.0	3085	0.4	0.0	0.0	0.0
2878	0.0	0.0	0.0	0.0	2982	0.4	0.0	0.0	0.0	3086	0.0	0.0	0.0	0.0
2879	0.0	0.0	0.0	0.0	2983	0.2	0.0	0.0	0.0	3087	0.2	0.0	0.0	0.0
2880	0.0	0.0	0.0	0.0	2984	0.0	0.0	0.0	0.0	3088	15.4	1.8	2.4	1.7
2881	0.0	0.0	0.0	0.0	2985	0.0	0.0	0.0	0.0	3089	1.0	0.0	0.0	0.0
2882	0.0	0.0	0.0	0.0	2986	0.0	0.0	0.0	0.0	3090	0.0	0.0	0.0	0.0
2883	0.0	0.0	0.0	0.0	2987	0.0	0.0	0.0	0.0	3091	1.6	0.0	0.0	0.0
2884	0.0	0.0	0.0	0.0	2988	0.0	0.0	0.0	0.0	3092	0.1	0.0	0.0	0.0
2885	0.0	0.0	0.0	0.0	2989	0.0	0.0	0.0	0.0	3093	0.0	0.0	0.0	0.0
2886	0.0	0.0	0.0	0.0	2990	0.0	0.0	0.0	0.0	3094	8.6	0.0	0.0	0.0
2887	0.0	0.0	0.0	0.0	2991	0.0	0.0	0.0	0.0	3095	12.4	0.8	1.1	0.8
2888	0.0	0.0	0.0	0.0	2992	0.0	0.0	0.0	0.0	3096	1.0	0.0	0.0	0.0
2889	0.0	0.0	0.0	0.0	2993	0.0	0.0	0.0	0.0	3097	3.0	0.0	0.0	0.0
2890	0.0	0.0	0.0	0.0	2994	0.0	0.0	0.0	0.0	3098	2.0	0.0	0.0	0.0
2891	0.0	0.0	0.0	0.0	2995	0.0	0.0	0.0	0.0	3099	0.0	0.0	0.0	0.0
2892	0.0	0.0	0.0	0.0	2996	0.0	0.0	0.0	0.0	3100	1.4	0.0	0.0	0.0
2893	0.0	0.0	0.0	0.0	2997	0.0	0.0	0.0	0.0	3101	7.4	0.0	0.0	0.0
2894	0.0	0.0	0.0	0.0	2998	0.0	0.0	0.0	0.0	3102	19.5	8.8	12.2	8.5
2895	0.0	0.0	0.0	0.0	2999	0.0	0.0	0.0	0.0	3103	0.0	0.0	0.0	0.0
2896	0.0	0.0	0.0	0.0	3000	6.4	0.0	0.0	0.0	3104	0.0	0.0	0.0	0.0
2897	0.0	0.0	0.0	0.0	3001	8.2	0.1	0.1	0.1	3105	0.0	0.0	0.0	0.0
2898	0.0	0.0	0.0	0.0	3002	0.0	0.0	0.0	0.0	3106	24.0	12.4	17.2	12.0
2899	0.0	0.0	0.0	0.0	3003	0.6	0.0	0.0	0.0	3107	21.6	10.4	14.5	10.1
2900	0.0	0.0	0.0	0.0	3004	45.6	31.7	44.0	30.8	3108	1.6	0.0	0.0	0.0
2901	0.0	0.0	0.0	0.0	3005	0.0	0.0	0.0	0.0	3109	12.4	3.7	5.1	3.6
2902	0.0	0.0	0.0	0.0	3006	0.0	0.0	0.0	0.0	3110	3.4	0.0	0.0	0.0
2903	0.0	0.0	0.0	0.0	3007	0.0	0.0	0.0	0.0	3111	5.6	0.4	0.6	0.4
2904	0.0	0.0	0.0	0.0	3008	0.0	0.0	0.0	0.0	3112	0.0	0.0	0.0	0.0
2905	0.0	0.0	0.0	0.0	3009	0.0	0.0	0.0	0.0	3113	1.0	0.0	0.0	0.0
2906	0.8	0.0	0.0	0.0	3010	0.0	0.0	0.0	0.0	3114	14.2	1.3	1.9	1.3
2907	0.1	0.0	0.0	0.0	3011	0.0	0.0	0.0	0.0	3115	0.2	0.0	0.0	0.0
2908	0.0	0.0	0.0	0.0	3012	0.0	0.0	0.0	0.0	3116	0.1	0.0	0.0	0.0
2909	0.0	0.0	0.0	0.0	3013	29.0	16.6	23.1	16.2	3117	12.2	0.8	1.0	0.7
2910	0.0	0.0	0.0	0.0	3014	0.0	0.0	0.0	0.0	3118	0.5	0.0	0.0	0.0

Table continued..................

Days	Rainfall	Q (mm)	Wadecha R. Q in M^3/s	Belbela R. Q (m^3/	Days	Rainfall(m	Q (mm)	Wadecha R. Q in M^3/s	Belbela R. Q (m^3/sec)
3119	15.8	6.0	8.3	5.8	3203	0.0	0.0	0.0	0.0
3120	8.6	1.6	2.2	1.5	3204	0.0	0.0	0.0	0.0
3121	1.6	0.0	0.0	0.0	3205	0.0	0.0	0.0	0.0
3122	16.0	6.1	8.5	6.0	3206	0.0	0.0	0.0	0.0
3123	2.6	0.0	0.0	0.0	3207	0.0	0.0	0.0	0.0
3124	17.6	7.3	10.1	7.1	3208	0.0	0.0	0.0	0.0
3125	28.2	15.9	22.1	15.5	3209	0.0	0.0	0.0	0.0
3126	0.6	0.0	0.0	0.0	3210	0.0	0.0	0.0	0.0
3127	42.6	28.9	40.2	28.1	3211	0.0	0.0	0.0	0.0
3128	9.8	2.2	3.0	2.1	3212	0.0	0.0	0.0	0.0
3129	18.8	8.2	11.4	8.0	3213	0.0	0.0	0.0	0.0
3130	0.0	0.0	0.0	0.0	3214	0.0	0.0	0.0	0.0
3131	0.0	0.0	0.0	0.0	3215	0.0	0.0	0.0	0.0
3132	0.0	0.0	0.0	0.0	3216	0.0	0.0	0.0	0.0
3133	0.8	0.0	0.0	0.0	3217	0.0	0.0	0.0	0.0
3134	18.2	2.9	4.0	2.8	3218	0.0	0.0	0.0	0.0
3135	6.2	0.0	0.0	0.0	3219	0.0	0.0	0.0	0.0
3136	10.3	2.4	3.4	2.4	3220	0.0	0.0	0.0	0.0
3137	7.4	1.0	1.4	1.0	3221	0.0	0.0	0.0	0.0
3138	16.0	6.1	8.5	6.0	3222	0.0	0.0	0.0	0.0
3139	0.0	0.0	0.0	0.0	3225	0.0	0.0	0.0	0.0
3140	0.2	0.0	0.0	0.0	3226	0.0	0.0	0.0	0.0
3141	32.4	19.6	27.3	19.1	3227	0.0	0.0	0.0	0.0
3142	18.4	7.9	11.0	7.7	3228	0.0	0.0	0.0	0.0
3143	9.0	1.8	2.4	1.7	3229	0.0	0.0	0.0	0.0
3144	10.2	2.4	3.3	2.3	3230	0.0	0.0	0.0	0.0
3145	17.7	7.4	10.3	7.2	3231	0.0	0.0	0.0	0.0
3146	32.4	19.6	27.3	19.1	3232	0.0	0.0	0.0	0.0
3147	19.4	8.7	12.1	8.4	3233	0.0	0.0	0.0	0.0
3148	6.0	0.5	0.7	0.5	3234	0.0	0.0	0.0	0.0
3149	1.0	0.0	0.0	0.0	3235	0.0	0.0	0.0	0.0
3150	0.0	0.0	0.0	0.0	3236	0.0	0.0	0.0	0.0
3151	1.2	0.0	0.0	0.0	3237	3.6	0.0	0.0	0.0
3152	0.7	0.0	0.0	0.0	3238	0.0	0.0	0.0	0.0
3153	0.1	0.0	0.0	0.0	3239	0.0	0.0	0.0	0.0
3154	8.6	0.0	0.0	0.0	3240	0.0	0.0	0.0	0.0
3155	17.0	2.4	3.3	2.3	3241	0.0	0.0	0.0	0.0
3156	33.2	20.3	28.3	19.8	3242	0.0	0.0	0.0	0.0
3157	3.6	0.0	0.0	0.0	3243	0.0	0.0	0.0	0.0
3158	9.5	2.0	2.8	2.0	3244	0.0	0.0	0.0	0.0
3159	9.2	1.9	2.6	1.8	3245	0.0	0.0	0.0	0.0
3160	0.1	0.0	0.0	0.0	3246	0.0	0.0	0.0	0.0
3161	19.8	9.0	12.5	8.7	3247	0.0	0.0	0.0	0.0
3162	1.2	0.0	0.0	0.0	3248	0.0	0.0	0.0	0.0
3163	1.8	0.0	0.0	0.0	3249	0.0	0.0	0.0	0.0
3164	1.6	0.0	0.0	0.0	3250	0.0	0.0	0.0	0.0
3165	0.4	0.0	0.0	0.0	3251	0.0	0.0	0.0	0.0
3166	22.6	5.0	7.0	4.9	3252	0.0	0.0	0.0	0.0
3167	0.0	0.0	0.0	0.0	3253	0.0	0.0	0.0	0.0
3168	0.1	0.0	0.0	0.0	3254	0.0	0.0	0.0	0.0
3169	0.0	0.0	0.0	0.0	3255	0.0	0.0	0.0	0.0
3170	0.0	0.0	0.0	0.0	3256	0.0	0.0	0.0	0.0
3171	17.3	2.5	3.5	2.4	3257	1.0	0.0	0.0	0.0
3172	2.6	0.0	0.0	0.0	3258	0.8	0.0	0.0	0.0
3173	5.8	0.0	0.0	0.0	3259	0.0	0.0	0.0	0.0
3174	3.5	0.0	0.0	0.0	3260	0.0	0.0	0.0	0.0
3175	12.2	3.6	5.0	3.5	3261	0.0	0.0	0.0	0.0
3176	7.7	1.2	1.6	1.1	3262	0.0	0.0	0.0	0.0
3177	0.7	0.0	0.0	0.0	3263	33.2	20.3	28.3	19.8
3178	2.8	0.0	0.0	0.0	3264	0.1	0.0	0.0	0.0
3179	0.4	0.0	0.0	0.0	3265	0.4	0.0	0.0	0.0
3180	34.8	21.8	30.2	21.2	3266	0.0	0.0	0.0	0.0
3181	1.8	0.0	0.0	0.0	3267	0.0	0.0	0.0	0.0
3182	0.6	0.0	0.0	0.0	3268	0.0	0.0	0.0	0.0
3183	0.6	0.0	0.0	0.0	3269	0.0	0.0	0.0	0.0
3184	0.1	0.0	0.0	0.0	3270	0.0	0.0	0.0	0.0
3185	0.0	0.0	0.0	0.0	3271	0.0	0.0	0.0	0.0
3186	3.2	0.0	0.0	0.0	3272	0.0	0.0	0.0	0.0
3187	1.8	0.0	0.0	0.0	3273	0.0	0.0	0.0	0.0
3188	0.0	0.0	0.0	0.0	3274	0.0	0.0	0.0	0.0
3189	0.1	0.0	0.0	0.0	3275	0.0	0.0	0.0	0.0
3190	0.0	0.0	0.0	0.0	3276	0.0	0.0	0.0	0.0
3191	0.0	0.0	0.0	0.0	3277	0.0	0.0	0.0	0.0
3192	0.6	0.0	0.0	0.0	3278	0.0	0.0	0.0	0.0
3193	0.7	0.0	0.0	0.0	3279	0.0	0.0	0.0	0.0
3194	0.3	0.0	0.0	0.0	3280	0.0	0.0	0.0	0.0
3195	0.0	0.0	0.0	0.0	3281	0.0	0.0	0.0	0.0
3196	6.0	0.0	0.0	0.0	3282	0.0	0.0	0.0	0.0
3197	0.0	0.0	0.0	0.0	3283	0.0	0.0	0.0	0.0
3198	0.0	0.0	0.0	0.0	3284	0.0	0.0	0.0	0.0
3199	0.0	0.0	0.0	0.0	3285	0.0	0.0	0.0	0.0
3200	0.0	0.0	0.0	0.0	3286	0.0	0.0	0.0	0.0
3201	0.0	0.0	0.0	0.0	3287	0.0	0.0	0.0	0.0
3202	0.0	0.0	0.0	0.0		7983.3	2568.3	3567.4	2496.4