IRRIGATION SCHEDULING USING CROPWAT 8.0 FOR IRRIGATION COMMAND

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CERTIFICATE

This is to certify that the thesis entitled **"Irrigation Scheduling using CROPWAT 8.0 for Irrigation Command"** being submitted to **Indian Institute of Technology Roorkee** by **Mrs. Shashi Bharti, 08547005** in partial fulfillment of the requirements for the award of the degree of **MASTER OF TECHNOLOGY** in Irrigation Water Management is a bonafide record of work carried out by her. The contents of this thesis, in full or in parts, have not been submitted and neither will be submitted to any other Institute or University for the award of any degree or diploma.

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Date: 14/6/10
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ABSTRACT

Keywords: *Irrigation Scheduling, CROPWAT, Evapotranspiration, Crop Water Requirement.*

Increasing the efficiency of water use in agriculture sector is crucial for national development. Thus the improvement of irrigation water management has become a major priority to meet our present agricultural demand as our population is ever increasing. The purpose of irrigation is to enable the farmers to improve their agricultural production. The efficient management of irrigation water for maximising productivity requires both the on-farm development of the irrigated area and optimisation of the use of water and land through appropriate cropping, irrigation scheduling and water application method.

Irrigation scheduling consists of applying the right amount of water at the right time-in other words, making sure water is available when the crops need it. It is the primary tool to improve water use efficiency and raise yield as it minimize the runoff and percolation losses. The irrigation schedule indicates when irrigation water has to be given to the crop. Since the cost of irrigation application has been increasing, elimination of unnecessary irrigation applications would improve economics of crop production. Scheduling is an accurate irrigation strategy to conserve water, minimize water wastage and to keep the associated costs down. In order to save both water and energy scheduling is required.

This study is primarily aimed at to determine reference evapotranspiration, irrigation water requirement and to schedule the irrigation. The command area selected for the present study is Gadarjudda minor canal off taking from Deoband branch of Upper Ganga Canal System situated in Haridwar District, Uttrakhand. Different methods of determining ETo viz. Modified Penman; Penman Monteith; Radiation and Blaney Criddle are used to make a comparative study on ETo determination. For Penman Monteith method CROPWAT package is used. Irrigation requirements were worked out for wheat, sugarcane and rice crops. A Microsoft Excel based computer program was developed to work out the irrigation schedules using ETo inputs

calculated by different methods. CROPWAT software was also used for preparing irrigation schedules.

The values obtained from Radiation and Modified Penman methods are nearly same and closure to USWB Pan Evaporation data. It is safer to go for these methods as the lower values by Penman Monteith method are bound to underestimate crop water requirement. As we shift the planting dates onwards their Crop Water Requirement is increased whether it is wheat or sugarcane or rice crop. Sugarcane planted in November need more water than that planted in April. Irrigation schedules prepared by CROPWAT do not match with the irrigation schedules in actual practice followed in the study area. Therefore further improvements in the CROPWAT software to make it applicable to Gadarjudda command area is suggested.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Water is indispensable resource that permeates every aspect of human society. In India total annual rainfall is about 1200mm, but nearly 75 to 90 percent of this pours down in the monsoon season of 3 to 4 months in a major portion of country generating an average annual runoff of about 185 million hectares meters (mham). About 92 percent of the harnessed water resources are used in agriculture for irrigation (central water commission). Increasing the efficiency of water use in this sector is, therefore, crucial for national development. Thus the improvement of irrigation water management has become a major priority to meet our present agricultural demand as our population is ever increasing. The purpose of irrigation is to enable the farmers to improve their agricultural production. The modern irrigation also aims at high efficiency of water conveyance and application. The efficient management of irrigation water for maximising productivity requires both the on-farm development of the irrigated area and optimisation of the use of water and land through appropriate cropping, irrigation scheduling and water application method.

Irrigation scheduling implies the application of water keeping a complete control of the available root zone soil moisture reservoir. Irrigation scheduling consists of applying the right amount of water at the right time-in other words, making sure water is available when crops need it. It is the primary tool to improve water use efficiency and raise yield as it allows timely irrigation. The irrigation schedule indicates how often or when this water is given and how much irrigation water has to be given to the crop. How much means 'as much as the soil is depleted since the previous irrigation' and how often means 'often enough to prevent the plants suffering from drought. How much and how often water has to be given depends on the irrigation water need of

the crop. Irrigation application is however limited, the maximum amount which can be given has to be determined and may be influenced by: the soil type, the root depth and the irrigation method. With basic knowledge of soil type and crop water use information an irrigator can easily learn to schedule more scientifically and to anticipate irrigation demands.

1.2 NEED OF IRRIGATION SCHEDULING

Water deficit is a major limiting factor of plant growth and biomass production. On the other hand, growing water scarcity has further constrained the attainment of goals of food security and sustainable natural resource management. Hence, the worsening situation can only be reverted if water is managed more efficiently and judiciously. The aim of irrigation is to provide the amount of water that a crop requires during the growing season, which is not supplied by natural rainfall. Irrigation is essential to overcome deficiencies in rainfall and to stabilize agricultural production. The efficiency of water in agricultural production is, however, low. Only 40 to 60 percent of the water is effectively used by the crop, the remaining water is lost in the system in the farms and on the field, either through runoff to the drainage system or by percolation into the ground water. Part of the lost water can perhaps be recovered, but additional cost will be incurred. Since the cost of irrigation application has been increasing, elimination of unnecessary irrigation applications would improve economics of crop production. Scheduling is an accurate irrigation strategy to conserve water, minimize water wastage and to keep the associated costs down. In order to save both water and energy irrigation scheduling is essentially required.

1.3 OBJECTIVES OF THE STUDY

Keeping these facts in view the study entitled " Irrigation Scheduling using CROPWAT 8.0 for Irrigation Command" was undertaken with the under mentioned objectives.

1) To make a comparative study of different methods of ETo (Reference Evapotranspiration) determination.
2) To work out the crop water requirement for wheat, sugarcane and rice for the command of Gadarjudda minor.
3) To prepare the irrigation schedules for wheat, sugarcane and rice by using water balance approach and CROPWAT.
4) To make comparative analysis of irrigation schedules developed and suggest a suitable method.

1.4 SCOPE OF THE STUDY

This study is primarily aimed to determine crop evapotranspiration, irrigation water requirement and to schedule the irrigation. For this, different methods of determining ETo viz. Modified Penman; Penman Monteith; Radiation and Blaney Criddle are used. For Penman Monteith method CROPWAT package is used. The command area selected for the present study is Gadarjudda minor canal off taking from Deoband branch of Upper Ganga Canal System situated in Haridwar District, Uttrakhand. Lat/long of Gadarjudda minor is ($29^0 18'$ & $77^0 38'$) and its length is approximately 5.21 km. The crops grown in the command area is mainly sugarcane, wheat, mustard during Rabi season and rice during kharif season.

CHAPTER 2

LITERATURE REVIEW

2.1 REFERENCE CROP EVAPOTRANSPIRATION

The rate of evapotranspiration from an extensive surface of 8 to 15 cm tall, green grass cover of uniform height, actively growing, completely shading the ground and not short of watering is defined as reference crop evapotranspiration and is denoted as ETo. The concept of the reference crop evapotranspiration was introduced to study the evaporative demand of the atmosphere independently of crop type, crop development and management practices. Factors affecting ETo are climatic parameters. Consequently, ETo is a climatic parameter and can be computed from weather data.

Chiew et.al. (1995) estimated ETo using the Penman- Monteith and FAO-24 methods and class-A pan data for 16 Australian locations with a wide range of climate conditions and reported that the FAO-24 Penman ETo, estimates are generally 20 to 40% higher than the Penman-Monteith estimates. There is reasonably good agreement between the Penman-Monteith and FAO-24 radiation methods although, on average, the radiation method ETo, estimates are 10-20% higher than the Penman-Monteith estimates. The FAO-24 Blaney-Criddle method, which uses only temperature data, gives similar monthly ETo, estimates as Penman-Monteith, and is therefore adequate for applications where only long-term ET, estimates are required. The comparisons also show that there is a satisfactory correlation between class-A pan data and Penman-Monteith ETo.

An intelligent front-end expert system for ETES has been developed by Arumugam and Mohan (1995) to select suitable ET estimation methods under South Indian climatic conditions. Ten meteorological stations located in different climatic regions and thirteen ET estimation methods have been considered in this ES. A PC-based ES development shell, VP-EXPERT (Paperback

Software, 1987), was selected as the intelligent software tool to solve the problem of ETES in a systematic manner. Like a human consultant, the system asks the user for detailed information regarding the details of the project site such as location, season, climatic zone, and data availability. It then makes a recommendation based on this information and the system's own knowledge of such a situation. Along with the recommended method, ETES will also suggest suitable correction factors for converting the resulting ET from other than the recommended method to improve the precision of estimation.

Alexandris et.al. (2008) has took six empirical formulae (Piestley-Taylor, Turc, Makkink, Hargreaves-Samani, Copais and adjusted Hargreaves by Trajkovic (2007) method) for the calculation of ETo and compared it with the Penman Monteith formulae standardised by FAO. Daily ETo values obtained during two growing seasons (2005 and 2006) were compared using linear regression and statistical indices (MBE, RMSE, MAE). Pristley-Taylor method ranked first among the methods evaluated. Copais method ranked second, the third and fourth place was occupied by the Turc and Adjusted Hargreaves method and the remaining two methods produced significant underestimates.

2.2 WATER REQUIREMENT

Water requirement may be defined as the quantity of water, regardless of its source, required by a crop or diversified pattern of crops in a given period of time for its normal growth under field conditions at a place. Water requirement includes the losses due to evapotranspiration or consumptive use plus the losses during the application of irrigation water and the quantity of water required for special operations such as land preparation, leaching, etc. Crop water requirement is defined as the quantity of water utilised by the plant during its growing period; this water may be supplied either entirely by rainfall, entirely by irrigation or by a combination of both.

2.2.1 Net Irrigation Requirement

The net irrigation requirement is the depth of irrigation water, exclusive of precipitation, carry over soil moisture or ground water contribution or other gains in soil moisture that is required consumptively for crop production. It is the amount of irrigation water required to bring the soil moisture level in the root zone to field capacity.

2.2.2 Gross Irrigation Requirement

The total amount of water applied through irrigation is termed as 'gross irrigation requirement'. In other words, it is net irrigation requirement plus losses in water application and other losses. The gross irrigation requirement can be determined for a field, for a farm, for an outlet command area or for an irrigation project, depending upon the net need and adding the appropriate losses at various stages of the crop.

Kuo et.al. (2001) measured the crop evapotranspiration both in field and lysimeter (3m*5m*3m). The crop coefficient (Kc) was determined by dividing the measured actual ET by reference crop ETo, as computed from the Modified Penman Method. And then CROPWAT model is used for simulating the on farm water balance in the paddy fields ChiaNan Irrigation Association's area (Southern Taiwan). The CROPWAT model simulated results show that for the single rice cropping pattern area, the annual agricultural water demand amounted to 537 mm, which peak of 126 mm monthly scheme water requirements happened in the October; and for the double rice cropping pattern area, the annual demand was 1019 mm, which peak of 192 mm monthly scheme water requirements happened in the January.

Ali et.al (2008) carried out simulation study to find out the probable difference among maize yield reduction, crop water requirements (CWR) and irrigation water requirements (IWR) sown on different dates (12th June, 22nd June, 02nd July, 12th July and 22nd July) using FAO CROPWAT model. Significant differences were found among the yield reduction of the different sowing dates at 0.05% probability level using LSD test. The crop water requirements (CWR) and

irrigation water requirements (IWR) also decreasing with changing sowing dates from 12th June to 22nd July.

Chauhan and Shrivastava (2007) the crop water requirements of 17 crops sown in Mahanadi main canal (MMC) command area were computed for January 1986 to December 2005. Monthly reference evapotranspiration values were estimated using Penman-Monteith method using 20 years meteorological data. Crop coefficient curves were developed to estimate crop water requirement and monthly irrigation demands were estimated by considering the effective rainfall. Monthly crop coefficients for crops sown in MMC command area were determined by developing crop coefficient curves with available meteorological data. Further frequency analysis based on 80% probability was carried out to select crop evapotranspiration for planning and design purpose.

Jalota et.al. (2009) field experiments were conducted for 2 years (2006 and 2007) at Punjab Agricultural University Farm, Ludhiana on a deep alluvial loamy sand Typic Ustipsamment soils developed under hyper-thermic regime. Treatments included three dates of transplanting (25 May, 10 June and 25 June and the model used was CropSyst. Shifting of transplanting date to lower evaporative demand (from 5 May to 25 June) concomitant with growing of short duration hybrid variety (90 days from transplanting to harvest), the total real water saving (wet saving) through reduction in evapotranspiration (ET) was 140 mm, which was almost double than managing the single, i.e. 66 mm by shifting transplanting or 71 mm by growing short duration hybrid variety.

2.3 MANAGEMENT ALLOWABLE DEPLETION

The management allowable depletion (MAD) is the percent of available soil water that is allowed to be depleted before irrigation is applied. Depletion beyond the allowable limit stresses plant and reduces crop yield. As crops reaches mid-season stage, typical period for most crop's critical growth stage and the peak crop water use, the allowable soil moisture depletion limit can

be reduced to minimize the risk of plant moisture stress. Similarly, as crops near maturity, the soil water depletion may be increased to greater limits without causing stress.

Panda (2003) conducted field experiments on the wheat crop over a period of 3 years with five different irrigation treatments. Irrigation treatments consisted of different levels of depletion of available soil water. The five levels of depletion considered in the study were 10, 30, 45, 60 and 75%. The field water use efficiency of wheat was found to be the highest when irrigation was scheduled at 45% depletion of available soil water (ASW).

2.4 WATER BALANCE APPROACH

The water balance method of irrigation scheduling is simply an accounting procedure similar to the book keeping required to balance a checking account. In field, for irrigation scheduling, soil water content is balanced. The amount of water that is lost as ETc is analogous to writing cheques for withdrawals. The water that enters the soil reservoir (as rain or irrigation) is analogous to depositing funds in the checking account. By keeping these records of transactions, it is possible to know how much water is left in the soil reservoir at anytime, thus indicating whether or not irrigation is needed. The initial balance can be determined by directly observation or assessed after a thorough wetting of the soil by irrigation or rains.

Jorge (1998) a visual device in the form of a plastic container was designed and tested to schedule sugarcane irrigation. The calibrated plastic bucket was field tested and proved to be an effective way to program sugarcane irrigation. It works simultaneously as a pluviometer and as an evaporimeter and, once it is marked, there is no need for human intervention beyond checking the position of the water level in relation to the irrigation control marks.

Kukal (2005) a 4-year field study was conducted at Punjab Agricultural University Research Farm, Ludhiana (India) to assess the feasibility of rice irrigation scheduling on the basis of soil matric potential and to determine the optimum matric potential so as to optimize irrigation water without any adverse effect on the yield. The treatments included scheduling irrigation to rice

with tensiometers installed at 15–20 cm soil depth at five levels of soil matric suction viz. 80, 120, 160, 200 and 240±20 cm, in addition to the recommended practice of alternate wetting and drying with an interval of 2 days after complete infiltration of ponded water. The grain yield of rice remained unaffected up to soil moisture suction of 160±20 cm each year. With a soil matric potential irrigation criterion the total amount of irrigation water used was a function of the number of rainy days and evaporation during the rice season.

Sarr et.al. (2004) developed a water balance model taking into account of plant development and soil water status. The proposed model expresses evapotranspiration as a function of the observed leaf area index (LAI) and simulated soil water status. Compared to classical tools, mostly based on crop coefficients, the conceptual advantage of the developed model is to take into account not only the impact of water availability on leaf development of the crop but also their incidence on transpiration. Irrigation scheduling consists of determining net irrigation levels by adjusting the Fraction of Transpirable Soil Water (FTSW). The developed model has an advantage in simulating soil and crop water balance based on data related to climate, soil, and onsite specific development status of the groundnut crop.

2.5 CROPWAT PROGRAM FOR IRRIGATION SCHEDULING

CROPWAT is a decision support system developed by the Land and Water Development Division of FAO for determination of the Reference evapotranspiration, Crop water requirement, Irrigation schedule, Scheme water supply. An important element of CROPWAT 8.0 is the irrigation scheduling module, which has several application possibilities:

- To develop indicative irrigation schedules.
- To evaluate existing irrigation practices on water use efficiency and water stress conditions.
- To evaluate crop production under rain fed conditions, to assess feasibility of supplementary irrigation and to develop appropriate irrigation schedules.

- To develop alternative water delivery schedules under restricted water supply conditions.

The calculations of the scheduling module are based on a soil water balance, where, on a daily basis, the soil moisture status is determined, accounting for incoming and outgoing water in the root zone.

The effect of irrigation scheduling on crop yield and net benefit was analysed by Dechmi (2002) using the CROPWAT simulation model. Simulations of the 1997 irrigation practices performed on a limited number of plots detected a 12% decrease in crop yield due to deficit irrigation and/or large irrigation intervals. The introduction of an optimal irrigation schedule (avoiding yield reductions) would imply increasing the alfalfa seasonal irrigation depth by 101 mm, and applying light, frequent irrigation events.

CHAPTER 3

DESCRIPTION OF STUDY AREA

3.1 STUDY AREA

The command area selected for the present study is Gadarjudda minor canal command. The Gadarjudda minor is off taking from Deoband branch of Upper Ganga Canal System. It is situated in Haridwar District, Uttrakhand and is very near to Indian Institute of Technology Roorkee.

3.1.1 Location

Geographically, the command area falls at longitude of $77^0$38`E and latitude of $29^0$18` N. The area lies at the elevation of 268 m above mean sea level. Length of Gadarjudda minor is approximately 5.21 km. It is lined and the total no of outlets are 21.

3.1.2 Climate

The atmospheric temperature ranges from 2.5^0c to 34^0c in winter and from 13^0c to 45^0c in summer season. The average annual rainfall is 1041mm. The rainy season starts from June month and is up to September. In winter also rain occurs but its frequency and amount is very less.

3.1.3 Cropping Pattern

Culturable command area (CCA) of Gadarjudda minor is 526 ha. The crops grown in the command area is mainly sugarcane, wheat, mustard, berseem in Rabi season and paddy in kharif season. Currently wheat is grown in 114 ha, sugarcane 232 ha and rice in 75 ha of canal command. Mainly three types of crop rotation is popular in this area i.e. paddy- wheat-sugarcane, paddy-wheat-berseem, paddy-sugarcane-sugarcane. Among which paddy-wheat-sugarcane is most popular crop rotation.

3.1.4 Canal Discharge

The designed head discharge of the canal is ten cusec and the discharge available at outlet is one cusec. The canal is gated but that gate is not working properly.

CHAPTER 4

METHODOLOGY

4.1 WEATHER DATA

The meteorological data such as maximum and minimum temperature, maximum and minimum humidity, wind speed and sunshine hours as recorded at Agro met Observatory of the Department of Water Resources Development and Management, Indian Institute of Roorkee (29°52'N,77°54'E and 252 msl) were collected. This is a class II level observatory set-up using IMD certified instruments.

Table 4.1 Average monthly (1992-2006) climatic data for Roorkee

Month	Min Temp(°c)	Max Temp(°c)	RH (%)	Wind Speed (km/day)	Sunshine Hr	Total rainfall (mm)
Jan	6.9	19.1	74	1.3	5.5	32.1
Feb	9.8	23.4	69	1.8	7.1	36.9
Mar	13.7	28.7	98	2.1	8.8	26.5
Apr	18.2	35.2	45	2.2	9.8	17.9
May	23	37.6	49	2.6	10.5	33.8
June	25	36	59	2.5	9.5	106.8
July	25.5	33	75	2.1	6.6	272.4
Aug	25.2	32.2	76	1.7	6.9	271.4
Sept	23.6	32.2	73	1.5	7.3	142.4
Oct	18.1	30.9	66	0.9	9.1	23.7
Nov	11.9	27	67	0.7	8.5	6
Dec	7.8	22.3	62	0.8	7.6	13.6

4.2 SOIL PHYSICAL ANALYSIS

4.2.1 Soil Texture

Relative proportion of sand, silt and clay in a soil determine its texture. Soils are given textural class names according to the weight percentage of sand, silt and clay. In the field soil texture is determined by feeling the soil with the fingers and if necessary this determination can be checked latter in the laboratory. For the selected study area it is determined by feeling the soil with the fingers and found sandy loam texture.

4.2.2 Field Capacity

The field water capacity of a soil is the moisture content after drainage of gravitational water has become very slow and the moisture content has become relatively stable. This situation usually exists 1 to 3 days after the soil has been thoroughly wetted by rain or irrigation. The soil moisture tension at field water capacity varies from soil to soil and ranges between 0.1 to 0.3 atm. Field water capacity is determined by ponding water on the soil surface in the area of about 2 to 5 square meter, and permitting it to drain for I to 3 days with surface evaporation prevented. The moisture content was determined by the gravimetric method and was found to be 20% at field capacity. The following ranges soil moisture of different soils are suggested by the Ministry of Water Resources, GOI:

1. **Light Soils** 5-20%
2. Medium Soils 20-30%
3. Heavy Soils 30-45%

The moisture content (dry weight basis) at the field water capacity for the canal command was determined 20%.

4.2.3 Wilting Point

Permanent wilting point, the wilting moisture is the soil moisture content at which plants can no longer obtain enough moisture to meet transpiration requirement and remain wilted unless water is added to soil. The soil moisture tension at permanent wilting point ranges from 7 to 32 atm. Commonly 15 atm is the usual tension that is used for this point. The soil samples collected from the field were subjected to 15 bar soil suction head in the pressure plate apparatus in order to find the permanent wilting point. The moisture content at this point for the selected area is determined as 8 % (dry weight basis).

4.2.4 Available Water-holding Capacity

The soil moisture between the field water capacity and the moisture of permanent wilting is the total available water for plant use. The depth of this available water per unit of soil depth is referred to as the available water holding capacity (AWHC) of soil.

$$AWHC = \frac{(FC - WP) * bd * Rz}{dw * 100} \quad (4.1)$$

Where,

AWHC= available water holding capacity; m/m

FC= moisture content at field capacity; % by dry weight

WP= moisture content of permanent wilting point; % by dry weight

bd= bulk density of soil; kg/m^3

Rz = root zone depth; m

dw= density of water, kg/m^3

4.2.5 Readily Available Water

Water is not equally available for plant growth between field water capacity and the wilting point. Penman (1961) and others have the concept that to a certain degree of soil moisture content, the water to plant is equally available and then the availability gradually decreases. This points out that the readily available water distinguishes itself from the hardly available one. It may not be practical and probably not be desirable to maintain the same soil moisture level throughout the growing season. In arid and semi arid regions however, crop can be irrigated for optimum yields with soil moisture level maintained at about 50 % of the AWHC for most crops. For this study also 50 % criteria is used for wheat and sugarcane crop.

4.3 ROOTING DEPTH

The root system is extremely variable in different crop plants. The depth from which the roots of an average mature plant are capable of reducing soil moisture is referred to effective root zone depth. Root growth is very much influenced by the soil. The spread of root system in the soil depth of 15-30 cm zone plays a greater role in water absorption. The average effective rooting depth of wheat, sugarcane and rice is presented in Table 4.2. Rooting depth of initial stage, normally taken as 0.25- 0.30 m representing the effective soil depth from which the small seedling abstracts water.

Table 4.2 Average rooting depth and characteristics for wheat, sugarcane and rice

Crop	Average rooting depth(m)	Rooting characteristic
Wheat	0.3 – 1.5	Moderately deep rooted
Sugarcane	0.3 – 2.0	Deep rooted
Rice	0.2 – 0.6	Shallow rooted

Sources: Taylor (1965), FAO-24 Paper and others.

4.4 METHODS OF ETo CALCULATION

Reliable estimates of reference crop evapotranspiration (ETo) is essential for efficient irrigation management and improved water use efficiency. Four different methods viz.(i) the Blaney Criddle (ii) the Radiation method (iii) the Modified penman and (iv) the Penman Montieth for the calculation of ETo have been used in this study and the obtained results were compared with the measured USWB pan evaporation data to find out the most suitable method for this region. In the first three methods ETo was calculated as per the procedure given in FAO Irrigation and Drainage Paper No. 27 (Doorenbos and Pruitt,1977) and for the Penman Monteith method CROPWAT software (FAO Irrigation and Drainage paper no. 56) is used.

4.4.1 Blaney Criddle Method

$$ETo = c * [p*(0.46*Tmean+8)] \quad (4.2)$$

Where,

ETo = reference crop evapotranspiration in mm/day;

p=mean daily % of total annual daytime for a given month and latitude and

c= adjustment factor which depends on minimum relative humidity, sunshine hours and daytime wind estimates.

4.4.2 Radiation Method

$$ETo = [c * (W*Rs)] \quad (4.3)$$

Where,

ETo = reference crop evapotranspiration in mm/day;

W= weighing factor which depends on temperature and altitude;

Rs= total solar radiation in mm/day and c= adjustment factor which depends on mean humidity and daytime wind.

4.4.3 Modified Penman Method

$$ETo = c\ [\ W.Rn + (1-W)\ f(u)\ (ed-ea)\ ] \quad (4.4)$$

Where,

ETo = reference crop evapotranspiration in mm/day;

W= weighing factor which depends on temperature and altitude;

Rn= net total solar radiation in mm/day;

f(u) is wind related function, f(u)=0.27(1+u2/100);

u2= wind velocity at 2 m height (m s^{-1});

(ed- ea)= difference between the saturation vapour pressure at mean air temp and the mean actual vapour pressure of the air, both in mbar.

4.4.4 Penman Monteith Method

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma\frac{900}{T+273}u_2(e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)} \quad (4.5)$$

Where,

ETo is the reference crop evapotranspiration (mm d^{-1});

R_n is the net radiation at the crop surface [MJ^{-2} day^{-1}];

G is the Soil heat flux [MJ^{-2} day^{-1}];

T is the mean daily air temperature at 2 m height [°C];

U_2 is the wind speed at 2 m height (m s^{-1});

e_s is the saturation vapour pressure (kPa);

e_a is the actual vapour pressure [kPa] ;

[e_s – ea] is the saturation vapour pressure deficit (kPa);

Δ is the slope vapour pressure curve (kPa°C);

γ is the psychometric constant (kPa°C);

and 900 is the conversion factor for daily-basis calculation.

The detail calculation procedure and values obtained for ETo by all these four methods are presented in Table 4.3 and Table4.4. Reference table for all the correction factors used for the calculation is given in Annexure A.

Table 4.3 ETo computed by CROPWAT

Monthly ETo Penman-Monteith - C:\ProgramData\CROPWAT\data\climate\rk eto.PEM

Country: india Station: roorkee

Altitude: 252 m. Latitude: 29.87 °N Longitude: 77.96 °E

Month	Min Temp	Max Temp	Humidity	Wind	Sun	Rad	ETo
	°C	°C	%	km/day	hours	MJ/m?/day	mm/day
January	6.9	19.1	74	1	5.5	11.1	1.19
February	9.8	23.4	69	2	7.1	14.8	1.80
March	13.7	28.7	98	2	8.8	19.7	3.23
April	18.2	35.2	45	2	9.8	23.4	3.89
May	23.0	37.6	49	3	10.5	25.5	4.89
June	25.0	36.0	59	3	9.5	24.3	5.03
July	25.2	33.0	75	2	6.6	19.8	4.26
August	25.2	32.2	76	2	6.9	19.5	4.07
September	23.6	32.2	73	2	7.3	18.3	3.67
October	18.1	30.9	66	1	9.1	17.9	3.03
November	11.9	27.0	67	1	8.5	14.6	1.98
December	7.8	22.3	72	1	7.6	12.5	1.38
Average	17.4	29.8	69	2	8.1	18.4	3.20

Table 4.4 Calculation of ETo by Different Methods

Data	Unit	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Z	252	(elevation in m)											
cons	4.903E-09	stephen boltzman const											
n	hr/day	5.5	7.1	8.8	9.8	10.5	9.5	6.6	6.9	7.3	9.1	8.5	7.6
N	hr/day	10.4	11.1	12.0	12.9	13.6	14.0	13.9	13.2	12.4	11.5	10.6	10.2
n/N		0.5	0.6	0.7	0.8	0.8	0.7	0.5	0.5	0.6	0.8	0.8	0.7
Tmax	^{0}c	19.1	23.4	28.7	35.2	37.6	36.0	33.0	32.2	32.2	30.9	27.0	22.3
Tmin	^{0}c	6.9	9.8	13.7	18.2	23.0	25.0	25.5	25.2	23.6	18.1	11.9	7.8
Tmean	^{0}c	13.0	16.6	21.2	26.7	30.3	30.5	29.3	28.7	27.9	24.5	19.5	15.0
RH	%	73.6	68.9	97.9	44.8	48.9	59.2	74.8	75.8	72.9	65.9	66.5	71.6
U2	km/day	1.3	1.8	2.1	2.2	2.6	2.5	2.1	1.7	1.5	0.9	0.7	0.8
U2	m/sec	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01
Ra	mm/day	8.8	10.7	13.1	15.7	16.5	17.0	16.8	15.7	13.9	11.6	9.5	8.3
Ra	Mj/m^2/day	21.6	26.2	32.1	38.5	40.4	41.7	41.2	38.5	34.1	28.4	23.3	20.3
e0(Tmax)		2.2	2.9	3.9	5.7	6.5	5.9	5.0	4.8	4.8	4.5	3.6	2.7
e0(Tmin)		1.0	1.2	1.6	2.1	2.8	3.2	3.3	3.2	2.9	2.1	1.4	1.1
Es	kPa	1.6	2.0	2.8	3.9	4.6	4.6	4.2	4.0	3.9	3.3	2.5	1.9
Ea	kPa	1.2	1.4	2.7	1.7	2.3	2.7	3.1	3.0	2.8	2.2	1.7	1.3
Rs	Mj/m^2/day	11.1	14.9	19.8	24.2	25.7	24.5	20.1	19.7	18.5	18.3	15.2	12.7

Rso	$Mj/m^2/day$	16.3	19.8	24.2	29.0	30.5	31.4	31.1	29.0	25.7	21.5	17.6	15.4
Rs/Rs0		0.7	0.8	0.8	0.8	0.8	0.8	0.6	0.7	0.7	0.9	0.9	0.8
Rns	$Mj/m^2/day$	8.5	11.5	15.2	18.7	19.8	18.9	15.4	15.1	14.3	14.1	11.7	9.7
Rnl	$Mj/m^2/day$	3.5	4.0	3.1	4.8	4.2	3.2	2.0	2.2	2.6	4.2	4.7	4.6
Rn	$Mj/m^2/day$	5.0	7.5	12.2	13.9	15.6	15.7	13.4	12.9	11.6	10.0	7.0	5.1
f(u)		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
1-W		0.41	0.35	0.31	0.24	0.22	0.21	0.21	0.21	0.23	0.26	0.32	0.38
W		0.6	0.65	0.7	0.76	0.78	0.79	0.77	0.77	0.77	0.74	0.67	0.63
c for Blaney Criddel		0.3	0.5	0.5	1.2	1.2	0.5	0.3	0.3	0.5	0.5	0.5	0.5
p for Blaney Criddel		0.24	0.25	0.27	0.29	0.31	0.32	0.31	0.30	0.28	0.26	0.24	0.23
c for Radiation Method		0.63	0.8	0.63	0.9	0.9	0.8	0.63	0.63	0.63	0.8	0.8	0.63

Calculated ETo (mm/day)	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Blaney Criddle	1.10	2.00	2.45	6.80	7.90	3.55	2.00	1.91	2.92	2.51	2.04	1.71
Radiation Method	1.71	2.97	3.56	6.91	7.53	5.94	3.97	3.89	3.67	4.16	3.15	2.05
Modified Penman	1.70	2.59	3.88	5.43	6.08	6.13	5.32	5.09	4.32	3.8	2.67	1.87
*Penman Monteith	1.19	1.8	3.23	3.88	4.89	5.03	4.27	4.08	3.67	3.03	1.98	1.38

*CROPWAT model is used for Penman Monteith method.

4.5 DETERMINATION OF THE EFFECTIVE RAINFALL

Effective rainfall means useful or utilizable rainfall. Rainfall is not necessarily useful or desirable at the time, rate or amount in which it is received. The term effective rainfall is used to define as a fraction of total rainfall useful for crop water needs. In other words the effective rainfall is the total rainfall minus infiltration, minus runoff, minus evaporation and minus deep percolation i.e. only the water retained in the root zone. For the purpose of this study USDA, SCS method is used but in the case of rice FAO empirical formulae is used. And instead of total rainfall 75% probable rainfall is taken for the determination of effective rainfall as it is more reliable in irrigation planning.

Table 4.5 75 % Probable Rainfall

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Total Rainfall(mm)	32.1	36.9	26.5	17.9	33.8	106.8	272.4	271.4	142.4	23.7	6	13.6
75% Probable Rainfall (mm)	8.1	9.1	4.8	2.6	10.2	49.9	190.7	191.5	46.2	2	1.2	2.2

4.5.1 USDA, SCS Method

The U.S. Department of Agriculture's Soil Conservation Service has developed a procedure for effective rainfall by processing long term climatic and soil moisture data. A comprehensive analysis was made by perusing 50 years of precipitation records at 22 experimental stations representing different climatic and soil conditions. From total rainfall and monthly consumptive use, effective rainfall values were computed (Annexure A). The monthly effective rainfall at the most is equal to consumptive use.

4.5.2 FAO Empirical Formulae

$$Pe = 0.8P - 25 \text{ if } P > 75 \text{ mm/day} \quad (4.6)$$

$$Pe = 0.6P - 10 \text{ if } P < 75 \text{ mm/day} \quad (4.7)$$

With P= rainfall or precipitation (mm/month);

Pe= effective rainfall or effective precipitation (mm/month).

Pe is always equal or greater than zero, it can never be negative.

4.6 CROPWAT PROGRAM

CROPWAT is a decision support system developed by the Land and Water Development Division of FAO for determination of the Reference evapotranspiration, Crop water requirement, Irrigation schedule, Scheme water supply. CROPWAT is meant as a practical tool to help agro-meteorologists, agronomists and irrigation engineers to carry out calculation for evapotranspiration and crop water use studies, and more specifically the design and management of irrigation scheme and irrigation schedule. However, the methods often need to be applied under climatic and agronomic very different from those under which they are originally developed.

Procedures for calculation of the ETo and CWR are based on the methodologies presented in FAO Irrigation and Drainage Paper No 24 'Crop Water Requirement' and No. 33 'Yield Response to Water', many of which are summarised in FAO Irrigation and Drainage Paper No.56 'Crop Evapotranspiration'. CROPWAT uses the FAO (1992) Penman-Monteith methods for calculating reference evapotranspiration. The CROPWAT, version 8.0, currently used for all the calculations.

4.6.1 Crop Water Requirement

Crop water requirement and irrigation requirements are carried out with input of climatic, crop and soil data. ETo values are calculated using the FAO Penman-Monteith equation based on the monthly climatic data. To calculate CWR, measured values of the ETo can be directly entered. The effective rainfall was calculated by selecting the 'USDA soil conservation method' for wheat and sugarcane calculation.

$$P_{eff} = P_{tot} \times \frac{125 - 0.2P_{tot}}{125} \quad \text{for } P_{tot} < 250 \text{ mm/month} \tag{4.8}$$

$$P_{eff} = 125 + 0.1P_{tot} \quad \text{for } P_{tot} > 250 \text{ mm/month} \tag{4.9}$$

In the case of rice it is calculated by selecting the 'dependable' option. This formula is as follows:

$$Pe = 0.8P - 10 \text{ if } P > 70 \text{ mm/day} \tag{4.10}$$

$$Pe = 0.6P - 10 \text{ if } P < 70 \text{ mm/day} \tag{4.11}$$

With P= rainfall (mm/month); Pe= effective rainfall (mm/month).

CWR files obtained from CROPWAT for wheat, sugarcane and rice are given in Annexure B.

4.6.2 Scheduling Criteria

Before any irrigation requirements can be carried out a scheduling criteria must be defined. Several options can be selected regarding the calculation of application timing and application depth. For wheat and sugarcane scheduling it is opted that 'irrigate when critical depletion (50% depletion) occurs and refill it up to field capacity'. But in the case of rice as it requires ponding so irrigation is given at saturation level to maintain 100 mm of ponding. All scheduling files are presented in Annexure C.

4.7 CALCULATION OF CROP WATER REQUIREMENT

The estimation of crop water requirement is one of the basic needs for crop planning on the farm and for the planning of any irrigation project. The crop water need (ETc) is defined as depth (amount) of water needed to meet the water loss through evapotranspiration. In other words, it is the amount of water needed by various crops to grow optimally. The crop water requirement mainly depends on:

- The climate: in a sunny and hot climate crop needs more water than in cloudy and cool water.
- The crop types: crops like maize or sugarcane need more water than crops like millet or sorghum.
- The growth stage of the crop: fully grown crops need more water than crop that have just been planted.

The influence of climate is given by the reference crop evapotranspiration (ETo) and the influence of crop is expressed in the crop factor (kc). Here for ETo calculation four methods have been selected that is already discussed in section 4.4. Mainly three crops have selected for this study and all these three crops have been staggered in four planting dates. General information i.e. crop duration, growing period and kc values for these crops are given in Table 4.6. Detailed calculation for ETc and Net Irrigation Need for all these crops according to their planting dates are given in Annexure B.

Rice is somewhat different from others crops, it is a semi aquatic plant. In the month before transplanting, water is needed to saturate the root zone. Here that amount is assumed 300mm including percolation loss i.e. 5mm/day. In CROPWAT model percolation loss is not considered in CWR module, it is taken in Scheduling module.

Table 4.6 Crop duration, growing period and kc for Wheat, Sugarcane and Rice

Growing Period	Initial	Development	Mid	Late
Wheat				**Crop Duration - 135 days**
No. Of Days	20	30	55	30
Kc	0.4	-	1.12	0.68
Sugarcane				**Crop Duration - 365 days**
No. Of Days	30	60	180	95
Kc	0.4	-	1.25	0.75
Rice				**Crop Duration - 150 days (30 days nursery)**
No. Of Days	20	30	40	30
Kc	1	-	1.2	0.9

Source: FAO publication.

4.8 DETERMINATION OF IRRIGATION SCHEDULES

Irrigation could be scheduled by continuously monitoring the soil moisture. The root zone should be filled with moisture just before the period of peak water use. The amount of usable water available in the root zone and the rate at which water is being used determine irrigation timing. The daily water budget equation for irrigation scheduling can be expressed as:

$$\Delta S = (R + I) - (ETc + D - Ro) \quad (4.12)$$

Where,

S = change in soil water storage (mm);

R= Rainfall (mm);

I= irrigation applied (mm);

ETc = estimated crop evapotranspiration (mm);

D+ Ro = drainage and runoff calculated as rainfall in excess of that which can be stored in the soil profile up to field capacity.

Using daily values of ETo, Kc and rainfall, the daily water balance is carried out. It is assumed that initially 75 % water is available in the root zone. When depletion reaches a specified value, next irrigation is applied to bring the soil moisture again to the field capacity. The irrigations were scheduled at 50 percent depletion in available soil moisture in the root zone for wheat and

sugarcane. But in the case of rice, scheduling is not done on the basis of specified percentage of depletion although irrigation is given at saturation level to maintain the specified ponding. And here the specified ponding is of 100 mm. A Microsoft Excel based computer program was developed to determine the irrigation schedules; the same thing is also done by CROPWAT program.

4.9 FIELD SURVEY: INTERVIEW WITH FARMERS

In order to evaluate existing practices, actual data should be collected through field surveys and interviews with farmers. For this purpose several farmers are interviewed and data information has been collected that include:

- Crop information: Planting date, Harvesting date;
- Soil: Soil texture;
- Irrigation frequency: Average irrigation interval, No. of irrigation over the growing period;
- Irrigation application: Average irrigation depth per irrigation

These all information were collected, and it was found that the number of watering for wheat is 4 to 5 times, sugarcane is 14 to 16 times, for paddy ponding to the height of bunds or as available in the discharge at the outlet. For wheat they provide first irrigation after 21-25 days after sowing and after the interval of 21 to sometimes 30 days. For sugarcane also they normally practiced of 21 to 30 days. In the case of rice first irrigation after 8 to10 days and then also the interval of 8 to 12 days; total 10 to 12 irrigation is in practiced.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 SOIL PHYSICAL ANALYSIS

The soil of the Gadarjudda minor command was sandy loam. The soil water property of soil is presented in Table 5.1.

Table 5.1 Soil water properties of the soil in command area

Soil Texture	Field Capacity (g/g %)	PWP (g/g %)
Sandy Loam	20	8

5.2 REFERENCE CROP EVAPOTRANSPIRATION

Four different methods viz.(i) the Blaney Criddle (ii) the Radiation method (iii) the Modified penman and (iv) the Penman Montieth were used to calculate the ETo. The comparative analysis of ETo using USWB Pan Evaporation, Blaney Criddel, Radiation, Modified Penman and Penman Monteith methods are presented in Table 5.2.

Table 5.2.Comparative analysis of ETo calculated using different methods.

Month	Monthly Average ETo (mm/day)				Ep USWB Pan
	Blaney Criddle	Radiation	Modified Penman	CROPWAT	
Jan	1.1	1.71	1.7	1.19	1.43
Feb	2.0	2.97	2.59	1.8	2.06
Mar	2.45	3.56	3.88	3.23	3.98
Apr	6.8	6.91	5.43	3.88	6.42
May	7.9	7.53	6.08	4.89	6.29
Jun	3.55	5.94	6.13	5.03	5.85
Jul	2.0	3.97	5.32	4.27	4.07
Aug	1.91	3.89	5.09	4.08	4.28
Sept	2.92	3.67	4.32	3.67	4.16
Oct	2.51	4.16	3.8	3.03	3.73
Nov	2.04	3.15	2.63	1.98	1.82
Dec	1.71	2.05	1.87	1.38	1.43
Average	3.07	4.13	4.07	3.20	3.79

Ep: Pan evaporation by USWB Pan

The obtained results are compared with the measured USWB pan evaporation data to find out the most suitable method for this region as discussed in the section 4.4 in previous chapter. The average annual values of ETo obtained by Blaney Criddle, Radiation, Modified Penman and Penman Monteith methods are 3.07, 4.13, 4.07 and 4.13 mm/day respectively. The Table 5.2 shows that the highest average value is obtained from Radiation Method and the lowest average value obtained from Blaney Criddel Method, among all four methods taken for the comparative analysis. The values obtained from Radiation and Modified Penman methods are closer to each other but little higher to USWB Pan Evaporation values. The Penman Monteith method estimated ETo is slightly above the Blaney Criddel but much lower than the Radiation and the Modified Penman methods.

The use of Modified Penman method for the calculation of ETo and crop water requirements was made mandatory by international donor agencies for water resources projects before the CROPWAT software was developed by FAO. So from the present analysis we find that Penman Monteith method is bound to underestimate crop water requirement as compare to Modified Penman method.

5.3 EFFECTIVE RAINFALL

In the present study two methods were used for the determination of effective rainfall one is USDA, SCS and another is FAO. These two methods were also used by CROPWAT to determine the effective rainfall but the findings differ from the manual calculation for the USDA, SCS method. As in USDA method effective rainfall depends on Evapotranspiration of the crop, so it varies from crop to crop. This can be seen from the calculation sheets of CWR for different crop (Annexure B). Table 5.3 represents the effective rainfall obtained through CROPWAT program by opting USDA method in its rainfall module.

Table 5.3 Effective Rainfall obtained through CROPWAT using USDA, SCS method.

Month	Rainfall (mm)	Effec. Rainfall (mm)
Jan	8.1	8.00
Feb	9.1	9.00
Mar	4.8	4.80
Apr	2.6	2.60
May	10.2	10.00
Jun	49.9	45.90
Jul	190.7	132.50
Aug	191.5	132.80
Sept	46.2	42.80
Oct	2	2.00
Nov	1.2	1.20
Dec	2.2	2.20

5.4 CROP WATER REQUIREMENT

ETc and Net Irrigation Requirement for all the crops (wheat, sugarcane and rice) varied according to their planting dates and methods of ETo calculated are presented in Table 5.4, 5.5 and 5.6.

Table 5.4 Irrigation Water Requirement of Wheat

Methods	**Unit**	**B. Criddle**	**Radiation**	**Mod. Penman**	**CROPWAT**
Wheat1: Planting Date: 16- Nov					
ETc	mm	214.02	308.91	298.56	226.00
NIR	mm	214.02	308.91	298.56	201.50
Wheat2: Planting Date: 22- Nov					
ETc	mm	234.12	328.63	315.92	238.00
NIR	mm	234.12	328.63	315.92	214.00
Wheat3: Planting Date: 29- Nov					
ETc	mm	263.98	356.17	337.91	255.60
NIR	mm	263.98	356.17	337.91	230.80
Wheat4: Planting Date: 6- Dec					
ETc	mm	299.56	389.96	363.82	274.10
NIR	mm	299.56	389.96	363.82	249.10

Table 5.5 Irrigation Water Requirement of Sugarcane

Methods	Unit	B. Criddle	Radiation	Mod. Penman	CROPWAT
Sugarcane 1: Planting Date: 16- Nov					
ETc	mm	1260.46	1677.95	1669.82	1323.40
NIR	mm	1040.60	1341.03	1299.92	929.30
Sugarcane 2: Planting Date: 26- Nov					
ETc	mm	1267.50	1689.87	1682.21	1333.40
NIR	mm	1045.94	1351.98	1310.53	939.30
Sugarcane 3: Planting Date: 01-Apr					
ETc	mm	1004.26	1450.69	1492.59	1184.20
NIR	mm	783.07	1116.04	1124.14	790.00
Sugarcane 4: Planting Date: 10-Apr					
ETc	mm	994.17	1436.59	1477.24	1169.30
NIR	mm	774.30	1104.63	1112.23	797.00

Table 5.6 Irrigation Water Requirement of Rice

Methods	Unit	B. Criddle	Radiation	Mod. Penman	CROPWAT
Rice 1: Transplanting Date: 20-June					
ETc	mm	330.00	549.50	653.90	226.00
NIR	mm	1036.60	1256.10	1360.50	201.50
Rice 2: Transplanting Date: 01-July					
ETc	mm	315.20	527.10	626.00	238.00
NIR	mm	1021.80	1233.70	1332.50	214.00
Rice 3: Transplanting Date: 10-July					
ETc	mm	314.10	517.40	598.30	255.60
NIR	mm	1020.60	1243.90	1304.90	230.80
Rice 4: Transplanting Date: 20-July					
ETc	mm	318.20	514.30	574.20	274.10
NIR	mm	1042.60	1237.20	1297.00	249.10

From the all above tables it is clear that as we shift the planting dates their Crop Water Requirement is changed whether it is wheat or sugarcane or rice crop (Table 5.4-5.6). The increasing trend in CWR is obtained with delay in planting of the crops. For the wheat crop CWR is higher for Radiation method; the reason behind this is the calculated ETo by Radiation method is giving higher value than the other methods in most of the month of its growing period (Table 5.4). Table 5.5 shows that Sugarcane planted in November need more water than those planted in April and this statement is valid for all the four methods. The CWR for rice crop is

high by Modified Penman Method but the reason behind this is same i.e. ETo by Modified Penman Method is giving higher value than the other methods in most of the month of its growing period.

5.5 IRRIGATION SCHEDULES

CROPWAT model is used to determine the irrigation schedules. A Microsoft Excel based computer program was also developed to determine the irrigation schedules by three other methods. All calculation procedure is presented in Annexure C. In order to make comparison of irrigation schedules, Farmer's Practices is also taken into consideration that is the most important part of this research. Here the crop wise irrigation schedules are presented in the table 5.7 to 5.9.

It can be seen from the Table 5.7 that CROPWAT is giving only two irrigations for wheat whether it is planted in Nov or Dec and that does not appear to be justified as farmers normal practice is five irrigations. Radiation method is continuously giving six irrigations. However, Modified Penman and Blaney Criddel method gives five and four irrigations for Nov. planted and for the planting date of 6-Dec, gives six and five irrigations respectively. The CROPWAT result is hardly acceptable as only with the two irrigations plant cannot sustain for the whole crop period. Determination of irrigation schedules by Modified Penman and Blaney Criddel is acceptable from the agronomic point of view and the obtained schedule is also having the general practice of farmers in this area.

Table 5.8 shows the irrigation schedules for sugarcane obtained by different methods. The highest no. of schedule is obtained by Radiation Method i.e. 18 for November planted crop. CROPWAT is giving only 9 irrigations, Modified Penman 17 and by Blaney Criddle Method it is 14 irrigations. However, the Farmers practice is 16-17 no. of irrigations. Here also CROPWAT is underestimating the CWR of sugarcane crop. Schedules obtained by other methods can be justified as the amount applied through irrigation is comparable to the amount given by farmers as at each irrigation they have about one cusec flow of water.

Table 5.7 Irrigation Schedules for wheat

Location: Roorkee
Crop: Wheat 1
Date of Planting: 16-Nov
Date of Harvesting: 30-Mar

S.No.	Methods	Irrigations (Days After Sowing)						
		i	ii	iii	iv	v	vi	Total
1	B.Criddle	16	41	70	101			4
2	Radiation	11	34	52	76	97	122	6
3	Modified Penman	13	38	58	82	106		5
4	CROPWAT	57	115					2
5	Farmers Practice	20	41	61	82	103		4 - 5

Location: Roorkee
Crop: Wheat 2
Date of Planting: 22-Nov
Date of Harvesting: 05-Apr

S.No.	Methods	Irrigations (Days After Sowing)						
		i	ii	iii	iv	v	vi	Total
1	B.Criddle	19	44	75	104			4
2	Radiation	12	36	55	77	97	121	6
3	Modified Penman	15	39	59	81	104		5
4	CROPWAT	61	112					2
5	Farmers Practice	20	41	62	83	104		4 - 5

Location: Roorkee
Crop: Wheat 3
Date of Planting: 29-Nov
Date of Harvesting: 12-Apr

S.No.	Methods	Irrigations (Days After Sowing)						
		i	ii	iii	iv	v	vi	Total
1	B.Criddle	20	47	74	101			4
2	Radiation	16	39	59	77	97	120	6
3	Modified Penman	18	41	62	82	102		5
4	CROPWAT	63	108					2
5	Farmers Practice	20	41	62	85	105		4 - 5

Location: Roorkee
Crop: Wheat 4
Date of Planting: 06-Dec
Date of Harvesting: 19-Apr

S.No.	Methods	Irrigations (Days After Sowing)						
		i	ii	iii	iv	v	vi	Total
1	B.Criddle	20	50	73	99	123		5
2	Radiation	17	41	60	76	94	115	6
3	Modified Penman	19	42	61	79	97	117	6
4	CROPWAT	63	104					2
5	Farmers Practice	20	41	62	85	105		4 - 5

Table 5.8 Irrigation Schedules for Sugarcane

Location: Roorkee
Crop: Sugarcane1

Date of Planting: 16-Nov
Date of Harvesting: 15-Nov

S.No.	Methods	Irrigations (Days After Sowing)																		
		i	ii	iii	iv	v	vi	vii	viii	ix	x	Xi	xii	xiii	xiv	xv	xvi	xvii	xviii	Total
1	B.Criddle	17	57	87	107	126	140	148	157	167	176	186	196	226	338					14
2	Radiation	11	42	70	87	101	114	127	139	147	156	166	176	186	197	214	260	324	340	18
3	Modified Penman	13	47	75	92	107	119	131	142	153	165	177	190	205	224	262	315	347		17
4	CROPWAT	46	106	133	155	174	192	211	321	363										9
5	Farmers Practice	20	41	61	82	103	124	145	166	187	208	229	250	271	292	313	334			16-17

Location: Roorkee
Crop: Sugarcane2

Date of Planting: 26-Nov
Date of Harvesting: 25-Nov

S.No.	Methods	Irrigations (Days After Sowing)																		
		i	ii	iii	iv	v	vi	vii	viii	ix	x	Xi	xii	xiii	xiv	xv	xvi	xvii	xviii	Total
1	B.Criddle	17	57	87	107	126	140	148	157	167	176	186	196	226	339					14
2	Radiation	11	42	70	87	101	114	127	139	147	156	166	176	186	197	214	249	324	340	18
3	Modified Penman	13	47	75	92	107	119	131	142	153	165	177	190	205	224	262	315	347		17
4	CROPWAT	62	106	131	152	170	188	207	309	347										9
5	Farmers Practice	20	41	61	82	103	124	145	166	187	208	229	250	271	292	313	334			16-17

Location: Roorkee
Crop: Sugarcane3

Date of Planting: 01-Apr
Date of Harvesting: 31-Mar

S.No.	Methods	Irrigations (Days After Sowing)																		
		i	ii	iii	iv	v	vi	vii	viii	ix	x	Xi	xii	xiii	xiv	xv	xvi	xvii	xviii	Total
1	B.Criddle	5	15	26	36	44	51	58	70	89	171	203	243	310						13
2	Radiation	5	15	26	37	45	53	60	69	78	88	120	174	196	217	245	294	338		17
3	Modified Penman	7	20	34	45	54	62	71	81	89	105	127	164	184	206	235	280	332		17
4	CROPWAT	14	42	65	91	179	205	242	310	360										9
5	Farmers Practice	10	24	38	52	66	80	101	131	161	182	203	224	254	275	305	335			16-17

Location: Roorkee
Crop: Sugarcane4

Date of Planting: 10-Apr
Date of Harvesting: 09-Apr

S.No.	Methods	Irrigations (Days After Sowing)																		
		i	ii	iii	iv	v	vi	vii	viii	ix	x	Xi	xii	xiii	xiv	xv	xvi	xvii	xviii	Total
1	B.Criddle	5	15	25	35	43	50	67	97	170	200	242	308	340						13
2	Radiation	5	15	25	35	44	52	62	73	82	118	163	183	203	230	272	318	340		17
3	Modified Penman	7	20	33	44	53	65	74	82	102	125	156	175	196	224	267	318	340		17
4	CROPWAT	11	38	63	170	196	233	299	348											8
5	Farmers Practice	10	24	38	52	66	80	101	131	161	182	203	224	254	275	305	335			16-17

Table 5.9 Irrigation Schedules for Rice

Location: Roorkee
Crop: Rice 1
Date of Planting: 20-Jun
Date of Harvesting: 17-Oct

S.No.	Methods	Irrigations (Days After Sowing)											
		i	ii	iii	iv	v	vi	Vii	viii	ix	x	xi	Total
1	B.Criddle	1	17	45	75	87	99	110					6
2	Radiation	1	11	30	46	66	80	91	102	110			9
3	Modified Penman	1	10	24	38	52	66	78	88	98	108		10
4	CROPWAT	3	43	83	98	114							5
5	Farmers Practice	8	22	32	40	48	58	66	76	86	96	106	10 – 11

Location: Roorkee
Crop: Rice 2
Date of Planting: 01-Jul
Date of Harvesting: 28-Oct

S.No.	Methods	Irrigations (Days After Sowing)											
		i	ii	iii	iv	v	vi	Vii	viii	ix	x	xi	Total
1	B.Criddle	1	23	47	76	89	101	110					7
2	Radiation	1	16	32	51	68	82	93	103	110			9
3	Modified Penman	1	11	25	39	53	68	81	91	102	110		10
4	CROPWAT	12	68	84	99	115							5
5	Farmers Practice	8	22	32	40	48	58	66	76	86	96	106	10 – 11

Location: Roorkee
Crop: Rice 3
Date of Planting: 10-Jul
Date of Harvesting: 06-Nov

S.No.	Methods	Irrigations (Days After Sowing)											
		i	ii	iii	iv	v	vi	Vii	viii	ix	x	xi	Total
1	B.Criddle	1	24	53	76	89	102	110					7
2	Radiation	1	16	32	51	68	82	92	102	110			9
3	Modified Penman	1	11	25	39	53	69	82	92	103	110		10
4	CROPWAT	34	67	82	97	113							5
5	Farmers Practice	8	22	32	40	48	58	66	76	86	96	106	10 – 11

Location: Roorkee
Crop: Rice 4
Date of Planting: 20-Jul
Date of Harvesting: 16-Nov

S.No.	Methods	Irrigations (Days After Sowing)											
		i	ii	iii	iv	v	vi	Vii	viii	ix	x	xi	Total
1	B.Criddle	1	24	51	74	87	100	110					7
2	Radiation	1	16	32	51	68	82	92	102	110			9
3	Modified Penman	1	11	25	39	54	73	84	94	105			9
4	CROPWAT	2	53	68	83	98	115						6
5	Farmers Practice	8	22	32	40	48	58	66	76	86	96	106	10 - 11

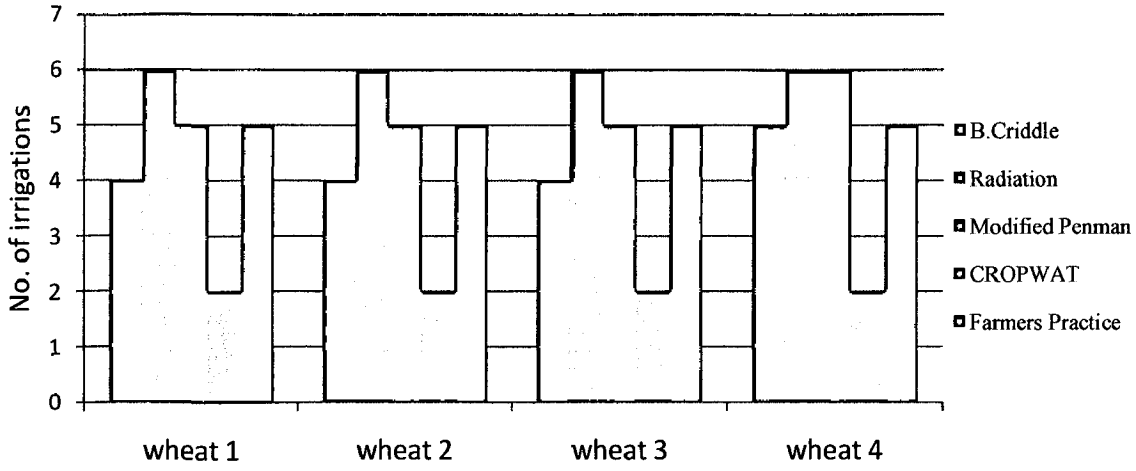

Fig. 5.1 Irrigation Schedules for Wheat

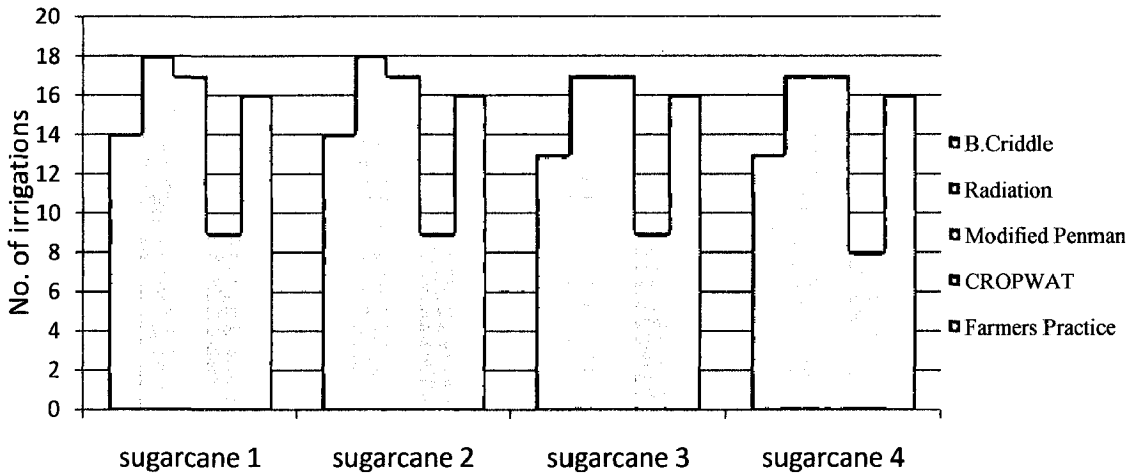

Fig. 5.2 Irrigation Schedules for Sugarcane

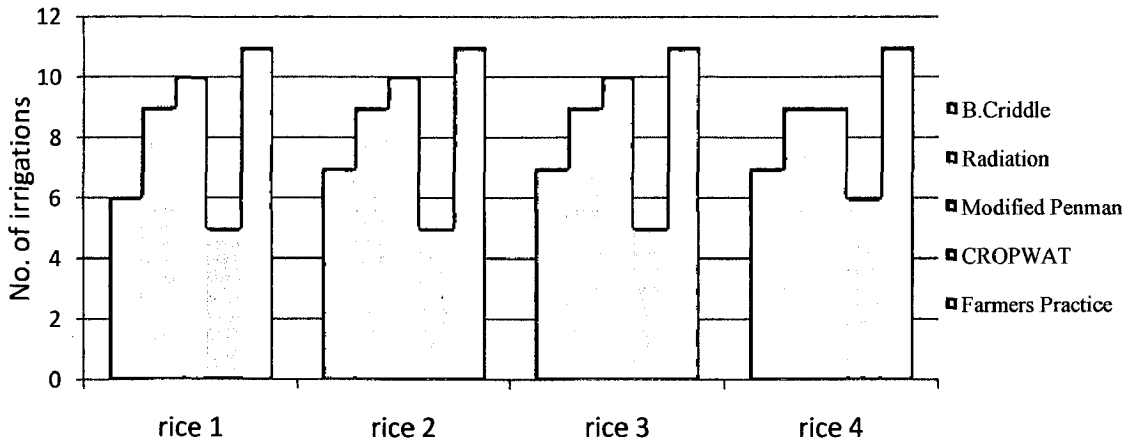

Fig. 5.3 Irrigation Schedules for Rice

As rice is semi-aquatic plant, ponding is required during its growing period. For scheduling of rice 100 mm of ponding is maintained in order to avoid the plant stress. It can be seen from the Table 5.9 in manual calculation irrigation starts from the first date of the transplanting as it is assumed that it is at saturation level. CROPWAT also used the same criteria i.e. irrigation is given at saturation level to maintain 100 mm of ponding. Schedules obtained are 5 or 6 by CROPWAT, 10 or 9 by Mod.Penman, 9 by Radiation and 6 or 7 by Blaney Criddel method respectively. However, farmers practice is 10-11 no. of irrigations. The result obtained from CROPWAT and also from Blaney Criddel does not appear to be justified.

Summary of the schedules of wheat, sugarcane and rice are presented in fig 5.1, 5.2 and 5.3 respectively.

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

The present study "Irrigation Scheduling using CROPWAT 8.0 for irrigation Command" has been aimed to make comparative study for irrigation schedules obtained from CROPWAT and other methods. The command area selected for the present study is Gadarjudda minor canal off taking from Deoband branch of Upper Ganga Canal System situated in Haridwar District, Uttrakhand. Lat/long of Gadarjudda minor is ($29^0 18`$ & $77^0 38`$). In the first step ETo was determined by CROPWAT (Penman Monteith), Modified Penman, Radiation and Blaney Criddel Method and made a comparative study. The annual average values of ETo obtained by Blaney Criddle, Radiation, Modified Penman and Penman Monteith method was 3.07, 4.13, 4.07 and 4.13 mm/day respectively. In the second step Irrigation Water Requirement is worked out for wheat, sugarcane and rice crop. In the next step irrigation scheduling is carried out with CROPWAT and other three methods by preparing a program on Microsoft Excel. Farmers were also interviewed to know about their irrigation practices. And finally a comparison was made on irrigation schedules.

6.2 CONCLUSIONS

Based on the present study the following conclusions can be asserted:

1. The ETo values obtained from Radiation and Modified Penman methods are nearly same and closer to USWB Pan Evaporation data. From the present analysis it is clear that the Penman-Monteith (CROPWAT) method records lower values as compared to Modified Penman and Radiation methods.
2. As the planting dates are shifted onwards, their Crop Water Requirement increases whether it is wheat or sugarcane or rice crop.

3. Sugarcane planted in November needed more water than that planted in April.

4. Irrigation schedules prepared using ETo calculated by different methods with different sowing dates in terms of number of irrigations given is recorded as below:

Table 6.1 Summary of Irrigation Schedules

Methods	Farmers	B. Criddle	Radiation	Mod. Penman	CROPWAT
Number of Irrigations					
Wheat 1	4-5	4	6	5	2
Wheat 2	4-5	4	6	5	2
Wheat 3	4-5	4	6	5	2
Wheat 4	4-5	5	6	6	2
Range	**4-5**	**4-5**	**6**	**5-6**	**2**
Sugarcane 1	12-16	14	18	17	9
Sugarcane 2	12-16	14	18	17	9
Sugarcane 3	12-16	13	17	17	9
Sugarcane 4	12-16	13	17	17	8
Range	**12-16**	**13-14**	**17-18**	**17**	**8-9**
Rice 1	10-12	6	9	10	5
Rice 2	10-12	7	9	10	5
Rice 3	10-12	7	9	10	5
Rice 4	10-12	7	9	9	6
Range	**10-12**	**6-7**	**9**	**9-10**	**5-6**

5. Irrigation schedules prepared by CROPWAT do not look to be practical as it gives less no. of irrigations in comparison to actual farmer's practice and other methods for the study area.

Based on the above mentioned findings it can be concluded that the CROPWAT needs improvement for its practical use under agro-climatic condition of Gadarjudda Canal command.

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ANNEXURE A (Reference Table for ETo Calculation and USDA, SCS Method)

Table A.1 P, Ra & N at Latitude 30^0 N for different months

Description (at Latitude 30^0 N)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mean Daily Percentage (p) of Annual Daytime Hours	0.24	0.25	0.27	0.29	0.31	0.32	0.31	0.30	0.28	0.26	0.24	0.23
Extra Terrestrial Radiation (Ra) expressed in equivalent evaporation in mm/day	8.8	10.7	13.1	15.2	16.5	17.0	16.8	15.7	13.9	11.6	9.5	8.3
Mean Daily Duration of Maxmum Possible Sunshine Hours (N)	10.4	11.1	12.0	12.9	13.6	14.0	13.9	13.2	12.4	11.5	10.6	10.2

Table A.2 Weighing Factor (W) for the Effect of Radiation on ETo (for Radiation method)

W	Temperature °C																			
(at altitude)	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
0 m	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.66	0.68	0.71	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.84	0.85
500 m	0.45	0.48	0.51	0.54	0.57	0.60	0.62	0.65	0.67	0.70	0.72	0.74	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.86

Table A.3 Weighing Factor (1-W) for the Effect of Wind and Humidity on ETo

1-W	Temperature °C																			
(at altitude)	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
0 m	0.57	0.54	0.51	0.48	0.45	0.42	0.39	0.36	0.34	0.32	0.29	0.27	0.25	0.23	0.22	0.20	0.19	0.17	0.16	0.15
500 m	0.56	0.52	0.49	0.46	0.43	0.40	0.38	0.35	0.33	0.30	0.28	0.26	0.24	0.22	0.21	0.19	0.18	0.16	0.15	0.14

Table A.4 Weighing Factor (W) for the Effect of Radiation on ETo (for Penman method)

W (at altitude)	Temperature °C																			
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
0 m	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.66	0.69	0.71	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.84	0.85
500 m	0.44	0.48	0.51	0.54	0.57	0.60	0.62	0.65	0.67	0.70	0.72	0.74	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.86

Table A.5 Average Monthly Effective Rainfall as Related to Mean Monthly Rainfall and Mean Monthly Consumptive Use (USDA, SCS)

Monthly mean rainfall mm	Mean monthly consumptive use mm													
	25	50	75	100	125	150	175	200	225	250	275	300	325	350
	Mean monthly effective rainfall mm													
12.5	7.5	8.0	8.7	9.0	9.2	10.0	10.5	11.2	11.7	12.5	12.5	12.5	12.5	12.5
25.0	15.0	16.2	17.5	18.0	18.5	19.7	20.5	22.0	24.5	25.0	25.0	25.0	25.0	25.0
37.5	22.5	24.0	26.2	27.5	28.2	29.2	30.5	33.0	36.2	37.5	37.5	37.5	37.5	37.5
50.0	25	32.2	34.5	35.7	36.7	39.0	40.5	43.7	47.0	50.0	50.0	50.0	50.0	50.0
62.5	at 41.7	39.7	42.5	44.5	46.0	48.5	50.5	53.7	57.5	62.5	62.5	62.5	62.5	62.5
75.0		46.2	49.7	52.7	55.0	57.5	60.2	63.7	67.5	73.7	75.0	75.0	75.0	75.0
87.5		50.0	56.7	60.2	63.7	66.0	69.7	73.7	77.7	84.5	87.5	87.5	87.5	87.5
100.0		at 80.7	63.7	67.7	72.0	74.2	78.7	83.0	87.7	95.0	100	100	100	100
112.5			70.5	75.0	80.2	82.5	87.2	92.7	98.0	105	111	112	112	112
125.0			75.0	81.5	87.7	90.5	95.7	102	108	115	121	125	125	125
137.5			at 122	88.7	95.2	98.7	104	111	118	126	132	137	137	137
150.0				95.2	102	106	112	120	127	136	143	150	150	150
162.5				100	109	113	120	128	135	145	153	160	162	162
175.0				at 160	115	120	127	135	143	154	164	170	175	175
187.5					121	126	134	142	151	161	170	179	185	187
200.0					125	133	140	148	158	168	178	188	196	200
225					at 197	144	151	160	171	182				
250						150	161	170	183	194				
275						at 240	171	181	194	205				
300							175	190	203	215				
325							at 287	198	213	224				
350								200	220	232				
375								at 331	225	240				
400									at 372	247				
425										250				
										at 412				
450	25	50	75	100	125	150	175	200	225	250				

ANNEXURE B (CALCULATION OF CROP WATER REQUIREMENT)

Table B.1 Calculation of Crop water requirement for Wheat using Blaney Criddle Method

Crop: Wheat							Crop Season: Rabi												Planting date: 16 Nov				
Months	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		**Total**
ET_O (mm/day)	**1.10**		**2.00**		**2.45**		**6.80**		**7.90**		**3.55**		**2.00**		**1.91**		**2.92**		**2.51**		**2.04**		**1.71**		
P (mm/month)	**8.1**		**9.1**		**4.8**		**2.6**		**10.2**		**49.9**		**190.7**		**191.5**		**46.2**		**2.0**		**1.2**		**2.2**		
Growth stages	2	3	3	3	4	4																1	1	2	
No of days	4	27	15	13	15	15																15	5	26	**135**
Kc	1.08	1.12	1.12	1.12	1.00	0.78																0.40	0.40	0.72	
ETcrop (mm/day)	1.19	1.23	2.24	2.24	2.45	1.91																0.82	0.68	1.24	
ETcrop (mm/month)	38.03		62.72		65.42																12.24		35.61		**214.02**
Pe (mm/month)	0.00		0.00		0.00																0.00		0.00		**0.00**
IN (mm/month)	38.03		62.72		65.42																12.24		35.61		**214.02**
field application efficiency = 75%																			**conveyance efficiency = 80%**						
FIR (mm/month)	50.71		83.63		87.22		0.00		0.00		0.00		0.00		0.00		0.00		0.00		16.32		47.48		**285.36**
GIR (mm/month)	63.39		104.53		109.03		0.00		0.00		0.00		0.00		0.00		0.00		0.00		20.40		59.35		**356.70**

Total Crop water Requirement = 357 mm

* Pe by USDA SCS method

Table B.2 Calculation of Crop water requirement for Sugarcane using Blaney Criddle Method

Crop: Sugarcane											Crop Season: Annual												Planting date: 16 Nov				
Months	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		**Total**
ET_O (mm/day)	**1.10**		**2.00**		**2.45**		**6.80**		**7.90**		**3.55**		**2.00**		**1.91**		**2.92**		**2.51**		**2.04**		**1.71**		
P (mm/month)	**8.1**		**9.1**		**4.8**		**2.6**		**10.2**		**49.9**		**190.7**		**191.5**		**46.2**		**2.0**		**1.2**		**2.2**		
Growth stages	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	1	1	2	
No of days	15	16	13	15	15	16	15	15	15	16	15	15	15	16	12	19	15	15	15	16	15	15	15	16	**365**
Kc	0.74	0.96	1.17	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.20	1.11	1.03	0.95	0.87	0.78	0.40	0.40	0.52	
ETcrop (mm/day)	0.8	1.1	2.3	2.5	3.1	3.1	8.5	8.5	9.9	9.9	4.4	4.4	2.5	2.5	2.4	2.3	3.2	3.0	2.4	2.2	1.6	0.8	0.7	0.9	
ETcrop (mm/month)	29.11		67.92		94.94		255.00		306.13		133.13		77.50		72.09		93.47		70.47		36.23		24.49		**1260.46**
Pe (mm/month)	0.00		0.00		0.00		0.00		0.00		37.38		77.50		72.09		32.89		0.00		0.00		0.00		**219.86**
IN (mm/month)	29.11		67.92		94.94		255.00		306.13		95.75		0.00		0.00		60.58		70.47		36.23		24.49		**1040.60**
field application efficiency = 75%																			**conveyance efficiency = 80%**						
FIR (mm/month)	38.81		90.56		126.58		340.00		408.17		127.66		0.00		0.00		80.77		93.96		48.31		32.65		**1387.47**
GIR (mm/month)	48.51		113.20		158.23		425.00		510.21		159.58		0.00		0.00		100.97		117.45		60.38		40.81		**1734.34**

Total Crop water Requirement = 1734 mm

* Pe by USDA SCS method

Table B.3 Calculation of Crop water requirement for Rice using Blaney Criddle Method

Crop: Rice					Crop Season: Kharif								Planting date: 20 June
Months	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
ET_O (mm/day)	**1.10**	**2.00**	**2.45**	**6.80**	**7.90**	**3.55**	**2.00**	**1.91**	**2.92**	**2.51**	**2.04**	**1.71**	
P (mm/month)	**8.1**	**9.1**	**4.8**	**2.6**	**10.2**	**49.9**	**190.7**	**191.5**	**46.2**	**2.0**	**1.2**	**2.2**	
land preparation					300								
Nursary preparation					95.6	74.2							
Growth stages						1	1	2	2	3	3	4	4					
No of days						12	8	23	7	23	17	14	16					**120**
Kc						1.00	1.00	1.08	1.18	1.20	1.20	1.13	0.98					
ETcrop (mm/day)						3.55	2.00	2.16	2.25	2.29	3.50	3.29	2.45					
ETcrop (mm/month)					4.78	3.71	42.60		65.68		68.49		105.56		39.16			**330.0**
Pe (mm/month)	0.0	0.0	0.0	0.0	0.0	19.9		127.6		128.2		17.7		0.0		0.0	0.0	**293.4**
PERC (mm/month)						60.0		155.00		150.00		155.00		80.00				5mm/day
WL (mm)						100.0												
IN (mm/month)					4.78	486.4		93.12		90.29		242.84		119.16				**1036.6**
field application and conveyance efficiency = 70%																		
GIR (mm/month)					6.83	694.81		133.03		128.99		346.91		170.22				**1480.8**

Total Crop water Requirement = 1481 mm

* Pe by FAO Emperical Formulae

Table B.4 Calculation of Crop water requirement for Wheat using Radiation Method

Crop: Wheat							Crop Season: Rabi											Planting date: 16 Nov
Months	Jan		Feb		Mar		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov		Dec		Total
ET_O (mm/day)	**1.71**		**2.97**		**3.56**		**6.91**	**7.53**	**5.94**	**3.97**	**3.89**	**3.67**	**4.16**	**3.15**		**2.05**		
P (mm/month)	**8.1**		**9.1**		**4.8**		**2.6**	**10.2**	**49.9**	**190.7**	**191.5**	**46.2**	**2.0**	**1.2**		**2.2**		
Growth stages	2	3	3	3	4	4									1	1	2	
No of days	4	27	15	13	15	15									15	5	26	**135**
Kc	1.08	1.12	1.12	1.12	1.00	0.78									0.40	0.40	0.72	
ETcrop (mm/day)	1.85	1.92	3.33	3.33	3.56	2.78									1.26	0.82	1.48	
ETcrop (mm/month)	59.12		93.14		95.05									18.90		42.69		**308.91**
Pe (mm/month)	0.00		0.00		0.00									0.00		0.00		**0.00**
IN (mm/month)	59.12		93.14		95.05									18.90		42.69		**308.91**
field application efficiency = 75%											**conveyance efficiency = 80%**							
FIR (mm/month)	78.83		124.19		126.74		0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.20		56.92		**411.87**
GIR (mm/month)	98.54		155.23		158.42		0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.50		71.15		**514.84**

Total Crop water Requirement = 515 mm

* Pe by USDA SCS method

Table B.5 Calculation of Crop water requirement for Sugarcane using Radiation Method

Crop: Sugarcane								Crop Season: Annual														Planting date: 16 Nov		
Months	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Total
ET_o (mm/day)	**1.71**		**2.97**		**3.56**		**6.91**		**7.53**		**5.94**		**3.97**		**3.89**		**3.67**		**4.16**		**3.15**		**2.05**		
P (mm/month)	**8.1**		**9.1**		**4.8**		**2.6**		**10.2**		**49.9**		**190.7**		**191.5**		**46.2**		**2.0**		1.2		**2.2**		
Growth stages	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	1	1	2	
No of days	15	16	13	15	15	16	15	15	15	16	15	15	15	16	12	19	15	15	15	16	15	15	15	16	365
Kc	0.74	0.96	1.17	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.20	1.11	1.03	0.95	0.87	0.78	0.40	0.40	0.52	
ETcrop (mm/day)	1.3	1.6	3.5	3.7	4.5	4.5	8.6	8.6	9.4	9.4	7.4	7.4	5.0	5.0	4.9	4.7	4.1	3.8	3.9	3.6	2.5	1.3	0.8	1.1	
ETcrop (mm/month)	45.25		100.86		137.95		259.13		291.79		222.75		153.84		146.82		117.48		116.80		55.94		29.36		**1677.95**
Pe (mm/month)	0.00		0.00		0.00		0.00		0.00		46.62		128.98		127.48		33.84		0.00		0.00		0.00		**336.92**
IN (mm/month)	45.25		100.86		137.95		259.13		291.79		176.13		24.86		19.34		83.64		116.80		55.94		29.36		**1341.03**
field application efficiency = 75%																									**conveyance efficiency = 80%**
FIR (mm/month)	60.33		134.48		183.93		345.50		389.05		234.84		33.14		25.79		111.52		155.73		74.59		39.14		**1788.04**
GIR (mm/month)	75.41		168.10		229.92		431.88		486.31		293.55		41.43		32.23		139.39		194.66		93.24		48.93		**2235.05**

Total Crop water Requirement = 2235 mm

* Pe by USDA SCS method

Table B.6 Calculation of Crop water requirement for Rice using Radiation Method

Crop: Rice								Crop Season: Kharif														Planting date: 20 June		
Months	Jan		Feb		Mar		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec		Total
ET_o (mm/day)	**1.71**		**2.97**		**3.56**		**6.91**		**7.53**		**5.94**		**3.97**		**3.89**		**3.67**		**4.16**		**3.15**		**2.05**		
P (mm/month)	**8.1**		**9.1**		**4.8**		**2.6**		**10.2**		**49.9**		**190.7**		**191.5**		**46.2**		**2.0**		**1.2**		**2.2**		
land preparation									300																
Nursary preparation									91.1	124.1															
Growth stages											1	1	2	2	3	3	4	4							
No of days											12	8	23	7	23	17	14	16							120
Kc											1.00	1.00	1.08	1.18	1.20	1.20	1.13	0.98							
ETcrop (mm/day)											5.94	3.97	4.29	4.59	4.67	4.40	4.13	4.06							
ETcrop (mm/month)									4.56	6.21	71.28	130.37		139.50		132.67		64.90							549.5
Pe (mm/month)	0.0		0.0		0.0		0.0		0.0		19.9	127.6		128.2		17.7		0.0		0.0		0.0			293.4
PERC (mm/month)											60.0	155.00		150.00		155.00		80.00							5mm/day
WL (mm)											100.0														
IN (mm/month)									4.56		517.5	157.81		161.30		269.95		144.90							1256.1
field application and conveyance efficiency = 70%																									
GIR (mm/month)									6.51		739.35	225.45		230.42		385.64		206.99							1794.4

Total Crop water Requirement = 1794 mm

* Pe by FAO Emperical Formulae

Table B.7 Calculation of Crop water requirement for Wheat using Modified Penman Method

Crop: Wheat							Crop Season: Rabi												Planting date: 16 Nov			
Months	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	Total
ET_O (mm/day)	1.70		2.59		3.88		5.43		6.08		6.13		5.32		5.09		4.32		3.80		2.67		1.87	
P (mm/month)	8.1		9.1		4.8		2.6		10.2		49.9		190.7		191.5		46.2		2.0		1.2		2.2	
Growth stages	2	3	3	3	4	4															1	1	2	
No of days	4	27	15	13	15	15															15	5	26	135
Kc	1.08	1.12	1.12	1.12	1.00	0.78															0.40	0.40	0.72	
ETcrop (mm/day)	1.84	1.90	2.90	2.90	3.88	3.03															1.07	0.75	1.35	
ETcrop (mm/month)	58.78		81.22		103.60																16.02		38.94	298.56
Pe (mm/month)	0.00		0.00		0.00																0.00		0.00	0.00
IN (mm/month)	58.78		81.22		103.60																16.02		38.94	298.56
field application efficiency = 75%																			**conveyance efficiency = 80%**					
FIR (mm/month)	78.37		108.30		138.13		0.00		0.00		0.00		0.00		0.00		0.00		0.00		21.36		51.92	398.08
GIR (mm/month)	97.97		135.37		172.66		0.00		0.00		0.00		0.00		0.00		0.00		0.00		26.70		64.90	497.60

Total Crop water Requirement = 498 mm

* Pe by USDA SCS method

Table B.8 Calculation of Crop water requirement for Sugarcane using Modified Penman Method

Crop: Sugarcane											Crop Season: Annual												Planting date: 16 Nov			
Months	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Total
ET_O (mm/day)	1.70		2.59		3.88		5.43		6.08		6.13		5.32		5.09		4.32		3.80		2.67		1.87		
P (mm/month)	8.1		9.1		4.8		2.6		10.2		49.9		190.7		191.5		46.2		2.0		1.2		2.2		
Growth stages	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	1	1	2	
No of days	15	16	13	15	15	16	15	15	15	16	15	15	15	16	12	19	15	15	15	16	15	15	15	16	365
Kc	0.74	0.96	1.17	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.20	1.11	1.03	0.95	0.87	0.78	0.40	0.40	0.52	
ETcrop (mm/day)	1.3	1.6	3.0	3.2	4.9	4.9	6.8	6.8	7.6	7.6	7.7	7.7	6.7	6.7	6.4	6.1	4.8	4.4	3.6	3.3	2.1	1.1	0.7	1.0	
ETcrop (mm/month)	44.98		87.96		150.35		203.63		235.60		229.88		206.15		192.11		138.28		106.69		47.42		26.78		1669.82
Pe (mm/month)	0.00		0.00		0.00		0.00		0.00		47.56		145.81		141.40		35.13		0.00		0.00		0.00		369.90
IN (mm/month)	44.98		87.96		150.35		203.63		235.60		182.32		60.34		50.71		103.15		106.69		47.42		26.78		1299.92
field application efficiency = 75%																			**conveyance efficiency = 80%**						
FIR (mm/month)	59.98		117.28		200.47		271.50		314.13		243.09		80.45		67.62		137.54		142.25		63.23		35.70		1733.23
GIR (mm/month)	74.97		146.59		250.58		339.38		392.67		303.86		100.57		84.52		171.92		177.81		79.03		44.63		2166.53

Total Crop water Requirement = 2167 mm

* Pe by USDA SCS method

Table B.9 Calculation of Crop water requirement for Rice using Modified Penman Method

Crop: Rice					Crop Season: Kharif						Planting date: 20 June
Months	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
ET_o (mm/day)	**1.70**	**2.59**	**3.88**	**5.43**	**6.08**	**6.13**	**5.32**	**5.09**	**4.32**	**3.80**	**2.67**	**1.87**	
P (mm/month)	**8.1**	**9.1**	**4.8**	**2.6**	**10.2**	**49.9**	**190.7**	**191.5**	**46.2**	**2.0**	**1.2**	**2.2**	
land preparation					300								
Nursary preparation					73.6	128.1							
Growth stages						1	1	2	2	3	3	4	4					
No of days						11	8	23	7	23	17	14	17					**120**
Kc						1.00	1.00	1.08	1.18	1.20	1.20	1.13	0.98					
ETcrop (mm/day)						6.13	5.32	5.75	6.01	6.11	5.18	4.86	3.71					
ETcrop (mm/month)					3.68	6.41	67.43	174.71		182.53		156.17	62.99					**653.9**
Pe (mm/month)	0.0	0.0	0.0	0.0	0.0	19.9		127.6		128.2		17.7	0.0	0.0	0.0			**293.4**
PERC (mm/month)							55.0	155.00		150.00		155.00	85.00					5mm/day
WL (mm)							100.0											
IN (mm/month)					3.68	508.9		202.15		204.33		293.45	147.99					**1360.5**
field application and conveyance efficiency = 70%																		
GIR (mm/month)					5.25	726.99		288.78		291.90		419.21	211.41					**1943.5**

Total Crop water Requirement = 1944 mm

* Pe by FAO Emperical Formulae

Table B.10 Crop Water Requirements for Wheat by CROPWAT

ETo station: roorkee
Crop: Wheat
Rain station: roorkee
Planting date: 16/11

Month	Decade	Stage	Kc coeff	ETc mm/day	ETc mm/dec	Eff rain mm/dec	Irr. Req. mm/dec
Nov	2	Init	0.40	0.79	4.0	0.2	3.8
Nov	3	Init	0.40	0.71	7.1	0.5	6.6
Dec	1	Deve	0.44	0.69	6.9	0.5	6.4
Dec	2	Deve	0.65	0.90	9.0	0.5	8.5
Dec	3	Deve	0.90	1.19	13.1	1.2	11.9
Jan	1	Mid	1.11	1.39	13.9	2.2	11.7
Jan	2	Mid	1.12	1.34	13.4	2.9	10.5
Jan	3	Mid	1.12	1.56	17.2	2.9	14.3
Feb	1	Mid	1.12	1.79	17.9	3.0	14.9
Feb	2	Mid	1.12	2.01	20.1	3.2	16.9
Feb	3	Mid	1.12	2.55	20.4	2.7	17.7
Mar	1	Late	1.04	2.86	28.6	2.0	26.6
Mar	2	Late	0.89	2.88	28.8	1.5	27.3
Mar	3	Late	0.75	2.57	25.7	1.2	24.4
					226.0	24.4	201.5

Table B.11 Crop Water Requirements for Rice by CROPWAT

ETo station: roorkee
Rain station: roorkee
Crop: Rice
Planting date: 20/06

Month	Decade	Stage	Kc coeff	ETc mm/day	ETc mm/dec	Eff rain mm/dec	Irr. Req. mm/dec
May	3	Nurs/LPr	1.10	0.74	8.2	0.1	78.9
Jun	1	Nurs/LPr	1.10	5.56	55.6	1.6	54.0
Jun	2	Init	1.09	5.60	56.0	2.4	206.6
Jun	3	Init	1.00	4.84	48.4	15.9	32.5
Jul	1	Deve	1.00	4.52	45.2	34.2	11.0
Jul	2	Deve	1.04	4.45	44.5	48.0	0.0
Jul	3	Deve	1.11	4.67	51.4	46.3	5.1
Aug	1	Mid	1.18	4.89	48.9	46.5	2.3
Aug	2	Mid	1.20	4.89	48.9	48.4	0.5
Aug	3	Mid	1.20	4.73	52.0	34.2	17.8
Sep	1	Mid	1.20	4.57	45.7	15.3	30.3
Sep	2	Late	1.19	4.38	43.8	1.5	42.4
Sep	3	Late	1.11	3.86	38.6	1.0	37.6
Oct	1	Late	1.02	3.30	33.0	0.1	32.8
Oct	2	Late	0.93	2.82	19.8	0.0	19.8
					639.7	295.6	571.7

Table B.12 Crop Water Requirements for Sugercane by CROPWAT

ETo station: roorkee
Rain station: roorkee

Crop: Sugarcane
Planting date: 16/11

Month	Decade	Stage	Kc coeff	ETc mm/day	ETc mm/dec	Eff rain mm/dec	Irr. Req. mm/dec
Nov	2	Init	0.76	1.50	7.5	0.2	7.3
Nov	3	Init	0.40	0.71	7.1	0.5	6.6
Dec	1	Init	0.40	0.63	6.3	0.5	5.8
Dec	2	Deve	0.42	0.58	5.8	0.5	5.3
Dec	3	Deve	0.56	0.73	8.1	1.2	6.8
Jan	1	Deve	0.70	0.89	8.9	2.2	6.7
Jan	2	Deve	0.85	1.01	10.1	2.9	7.2
Jan	3	Deve	0.99	1.39	15.3	2.9	12.4
Feb	1	Deve	1.14	1.82	18.2	3.0	15.2
Feb	2	Mid	1.25	2.24	22.4	3.2	19.2
Feb	3	Mid	1.25	2.84	22.7	2.7	20.1
Mar	1	Mid	1.25	3.44	34.4	2.0	32.4
Mar	2	Mid	1.25	4.04	40.4	1.5	38.8
Mar	3	Mid	1.25	4.31	47.4	1.3	46.1
Apr	1	Mid	1.25	4.59	45.9	0.8	45.0
Apr	2	Mid	1.25	4.86	48.6	0.5	48.1
Apr	3	Mid	1.25	5.28	52.8	1.4	51.4
May	1	Mid	1.25	5.70	57.0	1.7	55.3
May	2	Mid	1.25	6.12	61.2	2.0	59.1
May	3	Mid	1.25	6.17	67.9	6.5	61.5
Jun	1	Mid	1.25	6.32	63.2	9.7	53.5
Jun	2	Mid	1.25	6.42	64.2	12.9	51.3
Jun	3	Mid	1.25	6.05	60.5	23.3	37.2
Jul	1	Mid	1.25	5.65	56.5	37.2	19.2
Jul	2	Mid	1.25	5.33	53.3	48.2	5.0
Jul	3	Mid	1.25	5.25	57.7	46.9	10.8
Aug	1	Mid	1.25	5.17	51.7	47.1	4.6
Aug	2	Late	1.23	5.02	50.2	48.5	1.6
Aug	3	Late	1.18	4.63	51.0	37.1	13.9
Sep	1	Late	1.12	4.27	42.7	22.7	19.9
Sep	2	Late	1.07	3.92	39.2	12.0	27.3
Sep	3	Late	1.02	3.51	35.1	8.2	26.9
Oct	1	Late	0.96	3.13	31.3	2.0	29.2
Oct	2	Late	0.91	2.76	27.6	0.0	27.6
Oct	3	Late	0.86	2.29	25.2	0.1	25.2
Nov	1	Late	0.80	1.86	18.6	0.5	18.2
Nov	2	Late	0.76	1.50	7.5	0.2	7.3
					1323.4	394.1	929.3

ANNEXURE C (ESTIMATION OF IRRIGATION SCHEDULES)

Table C.1 Water Balance for Wheat using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
1	16-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	12.68
2	17-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	11.87
3	18-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	11.05
4	19-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	10.24
5	20-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	9.42
6	21-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	8.60
7	22-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	7.79
8	23-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	6.97
9	24-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	6.16
10	25-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	5.34
11	26-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	4.52
12	27-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	3.71
13	28-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	2.89
14	29-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	2.08
15	30-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	1.26
16	1-Dec	90.00	0.30	27.00	0.00	25.74	1.71	0.40	0.68	26.32
17	2-Dec	90.00	0.30	27.00	0.00		1.71	0.40	0.68	25.63
18	3-Dec	90.00	0.30	27.00	0.00		1.71	0.40	0.68	24.95
19	4-Dec	90.00	0.30	27.00	0.00		1.71	0.40	0.68	24.26
20	5-Dec	90.00	0.30	27.00	0.00		1.71	0.40	0.68	23.58
21	6-Dec	90.00	0.30	27.00	0.00		1.71	0.42	0.73	22.85
22	7-Dec	90.00	0.30	27.00	0.00		1.71	0.45	0.77	22.09
23	8-Dec	90.00	0.30	27.00	0.00		1.71	0.47	0.81	21.28
24	9-Dec	90.00	0.30	27.00	0.00		1.71	0.50	0.85	20.43
25	10-Dec	90.00	0.30	27.00	0.00		1.71	0.52	0.89	19.54
26	11-Dec	90.00	0.31	27.72	0.00		1.71	0.54	0.93	18.61
27	12-Dec	90.00	0.32	28.44	0.00		1.71	0.57	0.97	17.64
28	13-Dec	90.00	0.32	29.16	0.00		1.71	0.59	1.01	16.63
29	14-Dec	90.00	0.33	29.88	0.00		1.71	0.62	1.05	15.58
30	15-Dec	90.00	0.34	30.60	0.00		1.71	0.64	1.09	14.48
31	16-Dec	90.00	0.35	31.32	0.00		1.71	0.66	1.14	13.35
32	17-Dec	90.00	0.36	32.04	0.00		1.71	0.69	1.18	12.17
33	18-Dec	90.00	0.36	32.76	0.00		1.71	0.71	1.22	10.95
34	19-Dec	90.00	0.37	33.48	0.00		1.71	0.74	1.26	9.69
35	20-Dec	90.00	0.38	34.20	0.00		1.71	0.76	1.30	8.40
36	21-Dec	90.00	0.39	34.92	0.00		1.71	0.78	1.34	7.05
37	22-Dec	90.00	0.40	35.64	0.00		1.71	0.81	1.38	5.67
38	23-Dec	90.00	0.40	36.36	0.00		1.71	0.83	1.42	4.25
39	24-Dec	90.00	0.41	37.08	0.00		1.71	0.86	1.46	2.79
40	25-Dec	90.00	0.42	37.80	0.00		1.71	0.88	1.50	1.28
41	26-Dec	90.00	0.43	38.52	0.00	37.24	1.71	0.90	1.55	36.97
42	27-Dec	90.00	0.44	39.24	0.00		1.71	0.93	1.59	35.39

Table C.1 Water Balance for Wheat using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
43	28-Dec	90.00	0.44	39.96	0.00		1.71	0.95	1.63	33.76
44	29-Dec	90.00	0.45	40.68	0.00		1.71	0.98	1.67	32.09
45	30-Dec	90.00	0.46	41.40	0.00		1.71	1.00	1.71	30.38
46	31-Dec	90.00	0.47	42.12	0.00		1.71	1.02	1.75	28.63
47	1-Jan	90.00	0.48	42.84	0.00		1.10	1.05	1.15	27.48
48	2-Jan	90.00	0.48	43.56	0.00		1.10	1.07	1.18	26.30
49	3-Jan	90.00	0.49	44.28	0.00		1.10	1.10	1.21	25.09
50	4-Jan	90.00	0.50	45.00	0.00		1.10	1.12	1.23	23.86
51	5-Jan	90.00	0.51	45.90	0.00		1.10	1.12	1.23	22.63
52	6-Jan	90.00	0.52	46.80	0.00		1.10	1.12	1.23	21.40
53	7-Jan	90.00	0.53	47.70	0.00		1.10	1.12	1.23	20.16
54	8-Jan	90.00	0.54	48.60	0.00		1.10	1.12	1.23	18.93
55	9-Jan	90.00	0.55	49.50	0.00		1.10	1.12	1.23	17.70
56	10-Jan	90.00	0.56	50.40	0.00		1.10	1.12	1.23	16.47
57	11-Jan	90.00	0.57	51.30	0.00		1.10	1.12	1.23	15.24
58	12-Jan	90.00	0.58	52.20	0.00		1.10	1.12	1.23	14.00
59	13-Jan	90.00	0.59	53.10	0.00		1.10	1.12	1.23	12.77
60	14-Jan	90.00	0.60	54.00	0.00		1.10	1.12	1.23	11.54
61	15-Jan	90.00	0.61	54.90	0.00		1.10	1.12	1.23	10.31
62	16-Jan	90.00	0.62	55.80	0.00		1.10	1.12	1.23	9.08
63	17-Jan	90.00	0.63	56.70	0.00		1.10	1.12	1.23	7.84
64	18-Jan	90.00	0.64	57.60	0.00		1.10	1.12	1.23	6.61
65	19-Jan	90.00	0.65	58.50	0.00		1.10	1.12	1.23	5.38
66	20-Jan	90.00	0.66	59.40	0.00		1.10	1.12	1.23	4.15
67	21-Jan	90.00	0.67	60.30	0.00		1.10	1.12	1.23	2.92
68	22-Jan	90.00	0.68	61.20	0.00		1.10	1.12	1.23	1.68
69	23-Jan	90.00	0.69	62.10	0.00		1.10	1.12	1.23	0.45
70	24-Jan	90.00	0.70	63.00	0.00	62.55	1.10	1.12	1.23	61.77
71	25-Jan	90.00	0.71	63.90	0.00		1.10	1.12	1.23	60.54
72	26-Jan	90.00	0.72	64.80	0.00		1.10	1.12	1.23	59.30
73	27-Jan	90.00	0.73	65.70	0.00		1.10	1.12	1.23	58.07
74	28-Jan	90.00	0.74	66.60	0.00		1.10	1.12	1.23	56.84
75	29-Jan	90.00	0.75	67.50	0.00		1.10	1.12	1.23	55.61
76	30-Jan	90.00	0.76	68.40	0.00		1.10	1.12	1.23	54.38
77	31-Jan	90.00	0.77	69.30	0.00		1.10	1.12	1.23	53.14
78	1-Feb	90.00	0.78	70.20	0.00		2.00	1.12	2.24	50.90
79	2-Feb	90.00	0.79	71.10	0.00		2.00	1.12	2.24	48.66
80	3-Feb	90.00	0.80	72.00	0.00		2.00	1.12	2.24	46.42
81	4-Feb	90.00	0.81	72.90	0.00		2.00	1.12	2.24	44.18
82	5-Feb	90.00	0.82	73.80	0.00		2.00	1.12	2.24	41.94
83	6-Feb	90.00	0.83	74.70	0.00		2.00	1.12	2.24	39.70
84	7-Feb	90.00	0.84	75.60	0.00		2.00	1.12	2.24	37.46
85	8-Feb	90.00	0.85	76.50	0.00		2.00	1.12	2.24	35.22

Table C.1 Water Balance for Wheat using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
86	9-Feb	90.00	0.86	77.40	0.00		2.00	1.12	2.24	32.98
87	10-Feb	90.00	0.87	78.30	0.00		2.00	1.12	2.24	30.74
88	11-Feb	90.00	0.88	79.20	0.00		2.00	1.12	2.24	28.50
89	12-Feb	90.00	0.89	80.10	0.00		2.00	1.12	2.24	26.26
90	13-Feb	90.00	0.90	81.00	0.00		2.00	1.12	2.24	24.02
91	14-Feb	90.00	0.91	81.90	0.00		2.00	1.12	2.24	21.78
92	15-Feb	90.00	0.92	82.80	0.00		2.00	1.12	2.24	19.54
93	16-Feb	90.00	0.93	83.70	0.00		2.00	1.12	2.24	17.30
94	17-Feb	90.00	0.94	84.60	0.00		2.00	1.12	2.24	15.06
95	18-Feb	90.00	0.95	85.50	0.00		2.00	1.12	2.24	12.82
96	19-Feb	90.00	0.96	86.40	0.00		2.00	1.12	2.24	10.58
97	20-Feb	90.00	0.97	87.30	0.00		2.00	1.12	2.24	8.34
98	21-Feb	90.00	0.98	88.20	0.00		2.00	1.12	2.24	6.10
99	22-Feb	90.00	0.99	89.10	0.00		2.00	1.12	2.24	3.86
100	23-Feb	90.00	1.00	90.00	0.00		2.00	1.12	2.24	1.62
101	24-Feb	90.00	1.00	90.36	0.00	88.74	2.00	1.12	2.24	88.12
102	25-Feb	90.00	1.01	90.72	0.00		2.00	1.12	2.24	85.88
103	26-Feb	90.00	1.01	91.08	0.00		2.00	1.12	2.24	83.64
104	27-Feb	90.00	1.02	91.44	0.00		2.00	1.12	2.24	81.40
105	28-Feb	90.00	1.02	91.80	0.00		2.00	1.12	2.24	79.16
106	1-Mar	90.00	1.02	92.16	0.00		2.45	1.11	2.71	76.45
107	2-Mar	90.00	1.03	92.52	0.00		2.45	1.09	2.67	73.78
108	3-Mar	90.00	1.03	92.88	0.00		2.45	1.08	2.63	71.15
109	4-Mar	90.00	1.04	93.24	0.00		2.45	1.06	2.60	68.55
110	5-Mar	90.00	1.04	93.60	0.00		2.45	1.05	2.56	65.99
111	6-Mar	90.00	1.04	93.96	0.00		2.45	1.03	2.52	63.47
112	7-Mar	90.00	1.05	94.32	0.00		2.45	1.02	2.49	60.98
113	8-Mar	90.00	1.05	94.68	0.00		2.45	1.00	2.45	58.53
114	9-Mar	90.00	1.06	95.04	0.00		2.45	0.99	2.41	56.12
115	10-Mar	90.00	1.06	95.40	0.00		2.45	0.97	2.38	53.74
116	11-Mar	90.00	1.06	95.76	0.00		2.45	0.96	2.34	51.40
117	12-Mar	90.00	1.07	96.12	0.00		2.45	0.94	2.30	49.10
118	13-Mar	90.00	1.07	96.48	0.00		2.45	0.93	2.27	46.83
119	14-Mar	90.00	1.08	96.84	0.00		2.45	0.91	2.23	44.60
120	15-Mar	90.00	1.08	97.20	0.00		2.45	0.90	2.19	42.41
121	16-Mar	90.00	1.08	97.56	0.00		2.45	0.88	2.16	40.25
122	17-Mar	90.00	1.09	97.92	0.00		2.45	0.87	2.12	38.13
123	18-Mar	90.00	1.09	98.28	0.00		2.45	0.85	2.08	36.05
124	19-Mar	90.00	1.10	98.64	0.00		2.45	0.84	2.05	34.01
125	20-Mar	90.00	1.10	99.00	0.00		2.45	0.82	2.01	32.00
				Total	0.00	214.26			195.77	18.50
				Total water applied =	**214.26**		**Total Water used =**		**214.26**	

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
1	16-Nov	45.00	0.30	13.50	0.00		2.04	0.40	0.82	12.68
2	17-Nov	45.00	0.30	13.65	0.00		2.04	0.40	0.82	11.87
3	18-Nov	45.00	0.31	13.80	0.00		2.04	0.40	0.82	11.05
4	19-Nov	45.00	0.31	13.94	0.00		2.04	0.40	0.82	10.24
5	20-Nov	45.00	0.31	14.09	0.00		2.04	0.40	0.82	9.42
6	21-Nov	45.00	0.32	14.24	0.00		2.04	0.40	0.82	8.60
7	22-Nov	45.00	0.32	14.39	0.00		2.04	0.40	0.82	7.79
8	23-Nov	45.00	0.32	14.53	0.00		2.04	0.40	0.82	6.97
9	24-Nov	45.00	0.33	14.68	0.00		2.04	0.40	0.82	6.16
10	25-Nov	45.00	0.33	14.83	0.00		2.04	0.40	0.82	5.34
11	26-Nov	45.00	0.33	14.98	0.00		2.04	0.40	0.82	4.52
12	27-Nov	45.00	0.34	15.12	0.00		2.04	0.40	0.82	3.71
13	28-Nov	45.00	0.34	15.27	0.00		2.04	0.40	0.82	2.89
14	29-Nov	45.00	0.34	15.42	0.00		2.04	0.40	0.82	2.08
15	30-Nov	45.00	0.35	15.57	0.00		2.04	0.40	0.82	1.26
16	1-Dec	45.00	0.35	15.71	0.00		1.71	0.40	0.68	0.58
17	2-Dec	90.00	0.35	31.72	0.00	31.15	1.71	0.40	0.68	31.04
18	3-Dec	90.00	0.36	32.02	0.00		1.71	0.40	0.68	30.35
19	4-Dec	90.00	0.36	32.31	0.00		1.71	0.40	0.68	29.67
20	5-Dec	90.00	0.36	32.61	0.00		1.71	0.40	0.68	28.99
21	6-Dec	90.00	0.37	32.90	0.00		1.71	0.40	0.68	28.30
22	7-Dec	90.00	0.37	33.20	0.00		1.71	0.40	0.68	27.62
23	8-Dec	90.00	0.37	33.49	0.00		1.71	0.40	0.68	26.93
24	9-Dec	90.00	0.38	33.79	0.00		1.71	0.40	0.68	26.25
25	10-Dec	90.00	0.38	34.08	0.00		1.71	0.40	0.68	25.57
26	11-Dec	90.00	0.38	34.38	0.00		1.71	0.40	0.68	24.88
27	12-Dec	90.00	0.39	34.67	0.00		1.71	0.40	0.68	24.20
28	13-Dec	90.00	0.39	34.97	0.00		1.71	0.40	0.68	23.51
29	14-Dec	90.00	0.39	35.26	0.00		1.71	0.40	0.68	22.83
30	15-Dec	90.00	0.40	35.56	0.00		1.71	0.40	0.68	22.15
31	16-Dec	90.00	0.40	35.85	0.00		1.71	0.41	0.71	21.44
32	17-Dec	90.00	0.40	36.15	0.00		1.71	0.43	0.73	20.70
33	18-Dec	90.00	0.40	36.44	0.00		1.71	0.44	0.76	19.95
34	19-Dec	90.00	0.41	36.74	0.00		1.71	0.46	0.78	19.17
35	20-Dec	90.00	0.41	37.03	0.00		1.71	0.47	0.81	18.36
36	21-Dec	90.00	0.41	37.33	0.00		1.71	0.49	0.83	17.53
37	22-Dec	90.00	0.42	37.62	0.00		1.71	0.50	0.85	16.68
38	23-Dec	90.00	0.42	37.92	0.00		1.71	0.51	0.88	15.80
39	24-Dec	90.00	0.42	38.21	0.00		1.71	0.53	0.90	14.90
40	25-Dec	90.00	0.43	38.51	0.00		1.71	0.54	0.93	13.97
41	26-Dec	90.00	0.43	38.80	0.00		1.71	0.56	0.95	13.02
42	27-Dec	90.00	0.43	39.10	0.00		1.71	0.57	0.98	12.04
43	28-Dec	90.00	0.44	39.39	0.00		1.71	0.58	1.00	11.04
44	29-Dec	90.00	0.44	39.69	0.00		1.71	0.60	1.02	10.02
45	30-Dec	90.00	0.44	39.98	0.00		1.71	0.61	1.05	8.97

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
46	31-Dec	90.00	0.45	40.28	0.00		1.71	0.63	1.07	7.90
47	1-Jan	90.00	0.45	40.57	0.00		1.10	0.64	0.71	7.19
48	2-Jan	90.00	0.45	40.87	0.00		1.10	0.66	0.72	6.47
49	3-Jan	90.00	0.46	41.16	0.00		1.10	0.67	0.74	5.74
50	4-Jan	90.00	0.46	41.46	0.00		1.10	0.68	0.75	4.98
51	5-Jan	90.00	0.46	41.75	0.00		1.10	0.70	0.77	4.22
52	6-Jan	90.00	0.47	42.05	0.00		1.10	0.71	0.78	3.43
53	7-Jan	90.00	0.47	42.34	0.00		1.10	0.73	0.80	2.63
54	8-Jan	90.00	0.47	42.64	0.00		1.10	0.74	0.81	1.82
55	9-Jan	90.00	0.48	42.93	0.00		1.10	0.76	0.83	0.99
56	10-Jan	90.00	0.48	43.23	0.00		1.10	0.77	0.85	0.14
57	11-Jan	90.00	0.48	43.52	0.00	43.38	1.10	0.78	0.86	42.66
58	12-Jan	90.00	0.49	43.82	0.00		1.10	0.80	0.88	41.79
59	13-Jan	90.00	0.49	44.11	0.00		1.10	0.81	0.89	40.89
60	14-Jan	90.00	0.49	44.41	0.00		1.10	0.83	0.91	39.98
61	15-Jan	90.00	0.50	44.70	0.00		1.10	0.84	0.92	39.06
62	16-Jan	90.00	0.50	45.00	0.00		1.10	0.85	0.94	38.12
63	17-Jan	90.00	0.50	45.30	0.00		1.10	0.87	0.96	37.16
64	18-Jan	90.00	0.51	45.59	0.00		1.10	0.88	0.97	36.19
65	19-Jan	90.00	0.51	45.89	0.00		1.10	0.90	0.99	35.21
66	20-Jan	90.00	0.51	46.18	0.00		1.10	0.91	1.00	34.20
67	21-Jan	90.00	0.52	46.48	0.00		1.10	0.93	1.02	33.19
68	22-Jan	90.00	0.52	46.77	0.00		1.10	0.94	1.03	32.15
69	23-Jan	90.00	0.52	47.07	0.00		1.10	0.95	1.05	31.10
70	24-Jan	90.00	0.53	47.36	0.00		1.10	0.97	1.06	30.04
71	25-Jan	90.00	0.53	47.66	0.00		1.10	0.98	1.08	28.96
72	26-Jan	90.00	0.53	47.95	0.00		1.10	1.00	1.10	27.86
73	27-Jan	90.00	0.54	48.25	0.00		1.10	1.01	1.11	26.75
74	28-Jan	90.00	0.54	48.54	0.00		1.10	1.02	1.13	25.62
75	29-Jan	90.00	0.54	48.84	0.00		1.10	1.04	1.14	24.48
76	30-Jan	90.00	0.55	49.13	0.00		1.10	1.05	1.16	23.32
77	31-Jan	90.00	0.55	49.43	0.00		1.10	1.07	1.17	22.15
78	1-Feb	90.00	0.55	49.72	0.00		2.00	1.08	2.16	19.98
79	2-Feb	90.00	0.56	50.02	0.00		2.00	1.10	2.19	17.79
80	3-Feb	90.00	0.56	50.31	0.00		2.00	1.11	2.22	15.57
81	4-Feb	90.00	0.56	50.61	0.00		2.00	1.12	2.25	13.32
82	5-Feb	90.00	0.57	50.90	0.00		2.00	1.14	2.28	11.05
83	6-Feb	90.00	0.57	51.20	0.00		2.00	1.15	2.31	8.74
84	7-Feb	90.00	0.57	51.49	0.00		2.00	1.17	2.33	6.41
85	8-Feb	90.00	0.58	51.79	0.00		2.00	1.18	2.36	4.05
86	9-Feb	90.00	0.58	52.08	0.00		2.00	1.20	2.39	1.66
87	10-Feb	90.00	0.58	52.38	0.00	50.72	2.00	1.21	2.42	49.96
88	11-Feb	90.00	0.59	52.67	0.00		2.00	1.22	2.45	47.51
89	12-Feb	90.00	0.59	52.97	0.00		2.00	1.24	2.48	45.04
90	13-Feb	90.00	0.59	53.26	0.00		2.00	1.25	2.50	42.53

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
91	14-Feb	90.00	0.60	53.56	0.00		2.00	1.25	2.50	40.03
92	15-Feb	90.00	0.60	53.85	0.00		2.00	1.25	2.50	37.53
93	16-Feb	90.00	0.60	54.15	0.00		2.00	1.25	2.50	35.03
94	17-Feb	90.00	0.60	54.44	0.00		2.00	1.25	2.50	32.53
95	18-Feb	90.00	0.61	54.74	0.00		2.00	1.25	2.50	30.03
96	19-Feb	90.00	0.61	55.03	0.00		2.00	1.25	2.50	27.53
97	20-Feb	90.00	0.61	55.33	0.00		2.00	1.25	2.50	25.03
98	21-Feb	90.00	0.62	55.62	0.00		2.00	1.25	2.50	22.53
99	22-Feb	90.00	0.62	55.92	0.00		2.00	1.25	2.50	20.03
100	23-Feb	90.00	0.62	56.21	0.00		2.00	1.25	2.50	17.53
101	24-Feb	90.00	0.63	56.51	0.00		2.00	1.25	2.50	15.03
102	25-Feb	90.00	0.63	56.80	0.00		2.00	1.25	2.50	12.53
103	26-Feb	90.00	0.63	57.10	0.00		2.00	1.25	2.50	10.03
104	27-Feb	90.00	0.64	57.39	0.00		2.00	1.25	2.50	7.53
105	28-Feb	90.00	0.64	57.69	0.00		2.00	1.25	2.50	5.03
106	1-Mar	90.00	0.64	57.98	0.00		2.45	1.25	3.06	1.97
107	2-Mar	90.00	0.65	58.28	0.00	56.31	2.45	1.25	3.06	55.22
108	3-Mar	90.00	0.65	58.57	0.00		2.45	1.25	3.06	52.15
109	4-Mar	90.00	0.65	58.87	0.00		2.45	1.25	3.06	49.09
110	5-Mar	90.00	0.66	59.16	0.00		2.45	1.25	3.06	46.03
111	6-Mar	90.00	0.66	59.46	0.00		2.45	1.25	3.06	42.97
112	7-Mar	90.00	0.66	59.75	0.00		2.45	1.25	3.06	39.90
113	8-Mar	90.00	0.67	60.05	0.00		2.45	1.25	3.06	36.84
114	9-Mar	90.00	0.67	60.34	0.00		2.45	1.25	3.06	33.78
115	10-Mar	90.00	0.67	60.64	0.00		2.45	1.25	3.06	30.72
116	11-Mar	90.00	0.68	60.93	0.00		2.45	1.25	3.06	27.65
117	12-Mar	90.00	0.68	61.23	0.00		2.45	1.25	3.06	24.59
118	13-Mar	90.00	0.68	61.52	0.00		2.45	1.25	3.06	21.53
119	14-Mar	90.00	0.69	61.82	0.00		2.45	1.25	3.06	18.47
120	15-Mar	90.00	0.69	62.11	0.00		2.45	1.25	3.06	15.40
121	16-Mar	90.00	0.69	62.41	0.00		2.45	1.25	3.06	12.34
122	17-Mar	90.00	0.70	62.70	0.00		2.45	1.25	3.06	9.28
123	18-Mar	90.00	0.70	63.44	0.00		2.45	1.25	3.06	6.22
124	19-Mar	90.00	0.71	64.18	0.00		2.45	1.25	3.06	3.15
125	20-Mar	90.00	0.72	64.92	0.00		2.45	1.25	3.06	0.09
126	21-Mar	90.00	0.73	65.66	0.00	65.56	2.45	1.25	3.06	62.59
127	22-Mar	90.00	0.74	66.39	0.00		2.45	1.25	3.06	59.53
128	23-Mar	90.00	0.75	67.13	0.00		2.45	1.25	3.06	56.47
129	24-Mar	90.00	0.75	67.87	0.00		2.45	1.25	3.06	53.41
130	25-Mar	90.00	0.76	68.61	0.00		2.45	1.25	3.06	50.34
131	26-Mar	90.00	0.77	69.34	0.00		2.45	1.25	3.06	47.28
132	27-Mar	90.00	0.78	70.08	0.00		2.45	1.25	3.06	44.22
133	28-Mar	90.00	0.79	70.82	0.00		2.45	1.25	3.06	41.16
134	29-Mar	90.00	0.80	71.56	0.00		2.45	1.25	3.06	38.09
135	30-Mar	90.00	0.80	72.30	0.00		2.45	1.25	3.06	35.03

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
136	31-Mar	90.00	0.81	73.03	0.00		2.45	1.25	3.06	31.97
137	1-Apr	90.00	0.82	73.77	0.00		6.80	1.25	8.50	23.47
138	2-Apr	90.00	0.83	74.51	0.00		6.80	1.25	8.50	14.97
139	3-Apr	90.00	0.84	75.25	0.00		6.80	1.25	8.50	6.47
140	4-Apr	90.00	0.84	75.98	0.00	69.52	6.80	1.25	8.50	67.48
141	5-Apr	90.00	0.85	76.72	0.00		6.80	1.25	8.50	58.98
142	6-Apr	90.00	0.86	77.46	0.00		6.80	1.25	8.50	50.48
143	7-Apr	90.00	0.87	78.20	0.00		6.80	1.25	8.50	41.98
144	8-Apr	90.00	0.88	78.93	0.00		6.80	1.25	8.50	33.48
145	9-Apr	90.00	0.89	79.67	0.00		6.80	1.25	8.50	24.98
146	10-Apr	90.00	0.89	80.41	0.00		6.80	1.25	8.50	16.48
147	11-Apr	90.00	0.90	81.15	0.00		6.80	1.25	8.50	7.98
148	12-Apr	90.00	0.91	81.89	0.00	73.90	6.80	1.25	8.50	73.39
149	13-Apr	90.00	0.92	82.62	0.00		6.80	1.25	8.50	64.89
150	14-Apr	90.00	0.93	83.36	0.00		6.80	1.25	8.50	56.39
151	15-Apr	90.00	0.93	84.10	0.00		6.80	1.25	8.50	47.89
152	16-Apr	90.00	0.94	84.84	0.00		6.80	1.25	8.50	39.39
153	17-Apr	90.00	0.95	85.57	0.00		6.80	1.25	8.50	30.89
154	18-Apr	90.00	0.96	86.31	0.00		6.80	1.25	8.50	22.39
155	19-Apr	90.00	0.97	87.05	0.00		6.80	1.25	8.50	13.89
156	20-Apr	90.00	0.98	87.79	0.00		6.80	1.25	8.50	5.39
157	21-Apr	90.00	0.98	88.52	0.00	83.14	6.80	1.25	8.50	80.02
158	22-Apr	90.00	0.99	89.26	0.00		6.80	1.25	8.50	71.52
159	23-Apr	90.00	1.00	90.00	0.00		6.80	1.25	8.50	63.02
160	24-Apr	90.00	1.01	90.74	0.00		6.80	1.25	8.50	54.52
161	25-Apr	90.00	1.02	91.48	0.00		6.80	1.25	8.50	46.02
162	26-Apr	90.00	1.02	92.21	0.00		6.80	1.25	8.50	37.52
163	27-Apr	90.00	1.03	92.95	0.00		6.80	1.25	8.50	29.02
164	28-Apr	90.00	1.04	93.69	0.00		6.80	1.25	8.50	20.52
165	29-Apr	90.00	1.05	94.43	0.00		6.80	1.25	8.50	12.02
166	30-Apr	90.00	1.06	95.16	0.00		6.80	1.25	8.50	3.52
167	1-May	90.00	1.07	95.90	0.00	92.38	7.90	1.25	9.88	86.03
168	2-May	90.00	1.07	96.64	0.00		7.90	1.25	9.88	76.15
169	3-May	90.00	1.08	97.38	0.00		7.90	1.25	9.88	66.28
170	4-May	90.00	1.09	98.11	0.00		7.90	1.25	9.88	56.40
171	5-May	90.00	1.10	98.85	0.00		7.90	1.25	9.88	46.53
172	6-May	90.00	1.11	99.59	0.00		7.90	1.25	9.88	36.65
173	7-May	90.00	1.11	100.33	0.00		7.90	1.25	9.88	26.78
174	8-May	90.00	1.12	101.07	0.00		7.90	1.25	9.88	16.90
175	9-May	90.00	1.13	101.80	0.00		7.90	1.25	9.88	7.03
176	10-May	90.00	1.14	102.54	0.00	95.51	7.90	1.25	9.88	92.67
177	11-May	90.00	1.15	103.28	0.00		7.90	1.25	9.88	82.79
178	12-May	90.00	1.16	104.02	0.00		7.90	1.25	9.88	72.92
179	13-May	90.00	1.16	104.75	0.00		7.90	1.25	9.88	63.04
180	14-May	90.00	1.17	105.49	0.00		7.90	1.25	9.88	53.17

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
181	15-May	90.00	1.18	106.23	0.00		7.90	1.25	9.88	43.29
182	16-May	90.00	1.19	106.97	0.00		7.90	1.25	9.88	33.42
183	17-May	90.00	1.20	107.70	0.00		7.90	1.25	9.88	23.54
184	18-May	90.00	1.20	107.85	0.00		7.90	1.25	9.88	13.67
185	19-May	90.00	1.20	108.00	0.00		7.90	1.25	9.88	3.79
186	20-May	90.00	1.20	108.15	0.00	104.36	7.90	1.25	9.88	98.27
187	21-May	90.00	1.20	108.30	0.00		7.90	1.25	9.88	88.40
188	22-May	90.00	1.20	108.44	0.00		7.90	1.25	9.88	78.52
189	23-May	90.00	1.21	108.59	0.00		7.90	1.25	9.88	68.65
190	24-May	90.00	1.21	108.74	0.00		7.90	1.25	9.88	58.77
191	25-May	90.00	1.21	108.89	0.00		7.90	1.25	9.88	48.90
192	26-May	90.00	1.21	109.03	0.00		7.90	1.25	9.88	39.02
193	27-May	90.00	1.21	109.18	0.00		7.90	1.25	9.88	29.15
194	28-May	90.00	1.21	109.33	0.00		7.90	1.25	9.88	19.27
195	29-May	90.00	1.22	109.48	0.00		7.90	1.25	9.88	9.40
196	30-May	90.00	1.22	109.62	0.00	100.23	7.90	1.25	9.88	99.75
197	31-May	90.00	1.22	109.77	0.00		7.90	1.25	9.88	89.87
198	1-Jun	90.00	1.22	109.92	0.00		3.55	1.25	4.44	85.44
199	2-Jun	90.00	1.22	110.07	0.00		3.55	1.25	4.44	81.00
200	3-Jun	90.00	1.22	110.21	0.00		3.55	1.25	4.44	76.56
201	4-Jun	90.00	1.23	110.36	9.35		3.55	1.25	4.44	81.47
202	5-Jun	90.00	1.23	110.51	0.00		3.55	1.25	4.44	77.03
203	6-Jun	90.00	1.23	110.66	0.00		3.55	1.25	4.44	72.59
204	7-Jun	90.00	1.23	110.80	0.00		3.55	1.25	4.44	68.16
205	8-Jun	90.00	1.23	110.95	0.00		3.55	1.25	4.44	63.72
206	9-Jun	90.00	1.23	111.10	0.00		3.55	1.25	4.44	59.28
207	10-Jun	90.00	1.24	111.25	0.00		3.55	1.25	4.44	54.84
208	11-Jun	90.00	1.24	111.39	9.35		3.55	1.25	4.44	59.75
209	12-Jun	90.00	1.24	111.54	0.00		3.55	1.25	4.44	55.31
210	13-Jun	90.00	1.24	111.69	0.00		3.55	1.25	4.44	50.88
211	14-Jun	90.00	1.24	111.84	0.00		3.55	1.25	4.44	46.44
212	15-Jun	90.00	1.24	111.98	0.00		3.55	1.25	4.44	42.00
213	16-Jun	90.00	1.25	112.13	0.00		3.55	1.25	4.44	37.56
214	17-Jun	90.00	1.25	112.28	0.00		3.55	1.25	4.44	33.13
215	18-Jun	90.00	1.25	112.43	9.35		3.55	1.25	4.44	38.03
216	19-Jun	90.00	1.25	112.57	0.00		3.55	1.25	4.44	33.60
217	20-Jun	90.00	1.25	112.72	0.00		3.55	1.25	4.44	29.16
218	21-Jun	90.00	1.25	112.87	0.00		3.55	1.25	4.44	24.72
219	22-Jun	90.00	1.26	113.02	0.00		3.55	1.25	4.44	20.28
220	23-Jun	90.00	1.26	113.16	0.00		3.55	1.25	4.44	15.85
221	24-Jun	90.00	1.26	113.31	0.00		3.55	1.25	4.44	11.41
222	25-Jun	90.00	1.26	113.46	9.35		3.55	1.25	4.44	16.32
223	26-Jun	90.00	1.26	113.61	0.00		3.55	1.25	4.44	11.88
224	27-Jun	90.00	1.26	113.75	0.00		3.55	1.25	4.44	7.44
225	28-Jun	90.00	1.27	113.90	0.00		3.55	1.25	4.44	3.00

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
226	29-Jun	90.00	1.27	114.05	0.00	111.05	3.55	1.25	4.44	109.61
227	30-Jun	90.00	1.27	114.20	0.00		3.55	1.25	4.44	105.17
228	1-Jul	90.00	1.27	114.34	0.00		2.00	1.25	2.50	102.67
229	2-Jul	90.00	1.27	114.49	15.50		2.00	1.25	2.50	115.67
230	3-Jul	90.00	1.27	114.64	0.00		2.00	1.25	2.50	113.17
231	4-Jul	90.00	1.28	114.79	0.00		2.00	1.25	2.50	110.67
232	5-Jul	90.00	1.28	114.93	0.00		2.00	1.25	2.50	108.17
233	6-Jul	90.00	1.28	115.08	0.00		2.00	1.25	2.50	105.67
234	7-Jul	90.00	1.28	115.23	0.00		2.00	1.25	2.50	103.17
235	8-Jul	90.00	1.28	115.38	0.00		2.00	1.25	2.50	100.67
236	9-Jul	90.00	1.28	115.52	15.50		2.00	1.25	2.50	113.67
237	10-Jul	90.00	1.29	115.67	0.00		2.00	1.25	2.50	111.17
238	11-Jul	90.00	1.29	115.82	0.00		2.00	1.25	2.50	108.67
239	12-Jul	90.00	1.29	115.97	0.00		2.00	1.25	2.50	106.17
240	13-Jul	90.00	1.29	116.11	0.00		2.00	1.25	2.50	103.67
241	14-Jul	90.00	1.29	116.26	0.00		2.00	1.25	2.50	101.17
242	15-Jul	90.00	1.29	116.41	0.00		2.00	1.25	2.50	98.67
243	16-Jul	90.00	1.30	116.56	15.50		2.00	1.25	2.50	111.67
244	17-Jul	90.00	1.30	116.70	0.00		2.00	1.25	2.50	109.17
245	18-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	106.67
246	19-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	104.17
247	20-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	101.67
248	21-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	99.17
249	22-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	96.67
250	23-Jul	90.00	1.30	117.00	15.50		2.00	1.25	2.50	109.67
251	24-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	107.17
252	25-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	104.67
253	26-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	102.17
254	27-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	99.67
255	28-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	97.17
256	29-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	94.67
257	30-Jul	90.00	1.30	117.00	15.50		2.00	1.25	2.50	107.67
258	31-Jul	90.00	1.30	117.00	0.00		2.00	1.25	2.50	105.17
259	1-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	102.79
260	2-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	100.40
261	3-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	98.01
262	4-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	95.62
263	5-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	93.24
264	6-Aug	90.00	1.30	117.00	18.02		1.91	1.25	2.39	108.87
265	7-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	106.48
266	8-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	104.09
267	9-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	101.71
268	10-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	99.32
269	11-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	96.93
270	12-Aug	90.00	1.30	117.00	0.00		1.91	1.25	2.39	94.54

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
271	13-Aug	90.00	1.30	117.00	18.02		1.91	1.24	2.38	110.19
272	14-Aug	90.00	1.30	117.00	0.00		1.91	1.24	2.37	107.82
273	15-Aug	90.00	1.30	117.00	0.00		1.91	1.23	2.36	105.46
274	16-Aug	90.00	1.30	117.00	0.00		1.91	1.23	2.35	103.12
275	17-Aug	90.00	1.30	117.00	0.00		1.91	1.22	2.34	100.78
276	18-Aug	90.00	1.30	117.00	0.00		1.91	1.22	2.33	98.45
277	19-Aug	90.00	1.30	117.00	0.00		1.91	1.21	2.32	96.14
278	20-Aug	90.00	1.30	117.00	18.02		1.91	1.21	2.31	111.85
279	21-Aug	90.00	1.30	117.00	0.00		1.91	1.20	2.30	109.55
280	22-Aug	90.00	1.30	117.00	0.00		1.91	1.20	2.29	107.27
281	23-Aug	90.00	1.30	117.00	0.00		1.91	1.19	2.28	104.99
282	24-Aug	90.00	1.30	117.00	0.00		1.91	1.19	2.27	102.72
283	25-Aug	90.00	1.30	117.00	0.00		1.91	1.18	2.26	100.47
284	26-Aug	90.00	1.30	117.00	0.00		1.91	1.18	2.25	98.22
285	27-Aug	90.00	1.30	117.00	18.02		1.91	1.17	2.24	114.01
286	28-Aug	90.00	1.30	117.00	0.00		1.91	1.17	2.23	111.78
287	29-Aug	90.00	1.30	117.00	0.00		1.91	1.16	2.22	109.57
288	30-Aug	90.00	1.30	117.00	0.00		1.91	1.15	2.21	107.36
289	31-Aug	90.00	1.30	117.00	0.00		1.91	1.15	2.20	105.17
290	1-Sep	90.00	1.30	117.00	0.00		2.92	1.14	3.34	101.82
291	2-Sep	90.00	1.30	117.00	0.00		2.92	1.14	3.33	98.50
292	3-Sep	90.00	1.30	117.00	8.22		2.92	1.13	3.31	103.41
293	4-Sep	90.00	1.30	117.00	0.00		2.92	1.13	3.29	100.12
294	5-Sep	90.00	1.30	117.00	0.00		2.92	1.12	3.28	96.84
295	6-Sep	90.00	1.30	117.00	0.00		2.92	1.12	3.26	93.57
296	7-Sep	90.00	1.30	117.00	0.00		2.92	1.11	3.25	90.33
297	8-Sep	90.00	1.30	117.00	8.22		2.92	1.11	3.23	95.31
298	9-Sep	90.00	1.30	117.00	0.00		2.92	1.10	3.22	92.10
299	10-Sep	90.00	1.30	117.00	0.00		2.92	1.10	3.20	88.90
300	11-Sep	90.00	1.30	117.00	0.00		2.92	1.09	3.19	85.71
301	12-Sep	90.00	1.30	117.00	0.00		2.92	1.09	3.17	82.54
302	13-Sep	90.00	1.30	117.00	0.00		2.92	1.08	3.15	79.39
303	14-Sep	90.00	1.30	117.00	0.00		2.92	1.08	3.14	76.25
304	15-Sep	90.00	1.30	117.00	8.22		2.92	1.07	3.12	81.34
305	16-Sep	90.00	1.30	117.00	0.00		2.92	1.06	3.11	78.23
306	17-Sep	90.00	1.30	117.00	0.00		2.92	1.06	3.09	75.14
307	18-Sep	90.00	1.30	117.00	0.00		2.92	1.05	3.08	72.06
308	19-Sep	90.00	1.30	117.00	0.00		2.92	1.05	3.06	69.00
309	20-Sep	90.00	1.30	117.00	0.00		2.92	1.04	3.05	65.96
310	21-Sep	90.00	1.30	117.00	0.00		2.92	1.04	3.03	62.92
311	22-Sep	90.00	1.30	117.00	8.22		2.92	1.03	3.02	68.13
312	23-Sep	90.00	1.30	117.00	0.00		2.92	1.03	3.00	65.13
313	24-Sep	90.00	1.30	117.00	0.00		2.92	1.02	2.98	62.14
314	25-Sep	90.00	1.30	117.00	0.00		2.92	1.02	2.97	59.18
315	26-Sep	90.00	1.30	117.00	0.00		2.92	1.01	2.95	56.22

Table C.2 Water Balance for Sugarcane using Blaney Criddle method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
316	27-Sep	90.00	1.30	117.00	0.00		2.92	1.01	2.94	53.28
317	28-Sep	90.00	1.30	117.00	0.00		2.92	1.00	2.92	50.36
318	29-Sep	90.00	1.30	117.00	0.00		2.92	1.00	2.91	47.45
319	30-Sep	90.00	1.30	117.00	0.00		2.92	0.99	2.89	44.56
320	1-Oct	90.00	1.30	117.00	0.00		2.51	0.98	2.47	42.09
321	2-Oct	90.00	1.30	117.00	0.00		2.51	0.98	2.46	39.63
322	3-Oct	90.00	1.30	117.00	0.00		2.51	0.97	2.45	37.19
323	4-Oct	90.00	1.30	117.00	0.00		2.51	0.97	2.43	34.75
324	5-Oct	90.00	1.30	117.00	0.00		2.51	0.96	2.42	32.33
325	6-Oct	90.00	1.30	117.00	0.00		2.51	0.96	2.41	29.93
326	7-Oct	90.00	1.30	117.00	0.00		2.51	0.95	2.39	27.54
327	8-Oct	90.00	1.30	117.00	0.00		2.51	0.95	2.38	25.16
328	9-Oct	90.00	1.30	117.00	0.00		2.51	0.94	2.37	22.79
329	10-Oct	90.00	1.30	117.00	0.00		2.51	0.94	2.35	20.44
330	11-Oct	90.00	1.30	117.00	0.00		2.51	0.93	2.34	18.10
331	12-Oct	90.00	1.30	117.00	0.00		2.51	0.93	2.33	15.77
332	13-Oct	90.00	1.30	117.00	0.00		2.51	0.92	2.31	13.46
333	14-Oct	90.00	1.30	117.00	0.00		2.51	0.92	2.30	11.16
334	15-Oct	90.00	1.30	117.00	0.00		2.51	0.91	2.29	8.87
335	16-Oct	90.00	1.30	117.00	0.00		2.51	0.91	2.27	6.60
336	17-Oct	90.00	1.30	117.00	0.00		2.51	0.90	2.26	4.34
337	18-Oct	90.00	1.30	117.00	0.00		2.51	0.89	2.25	2.10
338	19-Oct	90.00	1.30	117.00	0.00	65.00	2.51	0.89	2.23	64.86
339	20-Oct	90.00	1.30	117.00	0.00		2.51	0.88	2.22	62.64
340	21-Oct	90.00	1.30	117.00	0.00		2.51	0.88	2.21	60.44
341	22-Oct	90.00	1.30	117.00	0.00		2.51	0.87	2.19	58.24
342	23-Oct	90.00	1.30	117.00	0.00		2.51	0.87	2.18	56.06
343	24-Oct	90.00	1.30	117.00	0.00		2.51	0.86	2.17	53.90
344	25-Oct	90.00	1.30	117.00	0.00		2.51	0.86	2.15	51.74
345	26-Oct	90.00	1.30	117.00	0.00		2.51	0.85	2.14	49.61
346	27-Oct	90.00	1.30	117.00	0.00		2.51	0.85	2.13	47.48
347	28-Oct	90.00	1.30	117.00	0.00		2.51	0.84	2.11	45.37
348	29-Oct	90.00	1.30	117.00	0.00		2.51	0.84	2.10	43.27
349	30-Oct	90.00	1.30	117.00	0.00		2.51	0.83	2.09	41.18
350	31-Oct	90.00	1.30	117.00	0.00		2.51	0.83	2.07	39.11
				Total	219.84	1042.20			1236.43	25.61
Total water applied =					**1262.04**		**Total Water used =**		**1262.04**	

Table C.3 Water Balance for Rice using Blaney Criddle method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
1	20-Jun	4.98	100.00	3.55	1.00	3.55	5.00	96.43
2	21-Jun	0.00		3.55	1.00	3.55	5.00	87.88
3	22-Jun	0.00		3.55	1.00	3.55	5.00	79.33
4	23-Jun	0.00		3.55	1.00	3.55	5.00	70.78
5	24-Jun	0.00		3.55	1.00	3.55	5.00	62.23
6	25-Jun	4.98		3.55	1.00	3.55	5.00	58.66
7	26-Jun	0.00		3.55	1.00	3.55	5.00	50.11
8	27-Jun	0.00		3.55	1.00	3.55	5.00	41.56
9	28-Jun	0.00		3.55	1.00	3.55	5.00	33.01
10	29-Jun	0.00		3.55	1.00	3.55	5.00	24.46
11	30-Jun	0.00		3.55	1.00	3.55	5.00	15.91
12	1-Jul	0.00		2.00	1.00	2.00	5.00	8.91
13	2-Jul	25.52		2.00	1.00	2.00	5.00	27.43
14	3-Jul	0.00		2.00	1.00	2.00	5.00	20.43
15	4-Jul	0.00		2.00	1.00	2.00	5.00	13.43
16	5-Jul	0.00		2.00	1.00	2.00	5.00	6.43
17	6-Jul	0.00	93.57	2.00	1.00	2.00	5.00	93.00
18	7-Jul	0.00		2.00	1.00	2.00	5.00	86.00
19	8-Jul	0.00		2.00	1.00	2.00	5.00	79.00
20	9-Jul	25.52		2.00	1.00	2.00	5.00	97.52
21	10-Jul	0.00		2.00	1.01	2.01	5.00	90.51
22	11-Jul	0.00		2.00	1.01	2.03	5.00	83.48
23	12-Jul	0.00		2.00	1.02	2.04	5.00	76.44
24	13-Jul	0.00		2.00	1.03	2.05	5.00	69.39
25	14-Jul	0.00		2.00	1.03	2.07	5.00	62.32
26	15-Jul	0.00		2.00	1.04	2.08	5.00	55.24
27	16-Jul	25.52		2.00	1.05	2.09	5.00	73.67
28	17-Jul	0.00		2.00	1.05	2.11	5.00	66.56
29	18-Jul	0.00		2.00	1.06	2.12	5.00	59.44
30	19-Jul	0.00		2.00	1.07	2.13	5.00	52.31
31	20-Jul	0.00		2.00	1.07	2.15	5.00	45.16
32	21-Jul	0.00		2.00	1.08	2.16	5.00	38.00
33	22-Jul	0.00		2.00	1.09	2.17	5.00	30.83
34	23-Jul	25.52		2.00	1.09	2.19	5.00	49.16
35	24-Jul	0.00		2.00	1.10	2.20	5.00	41.96
36	25-Jul	0.00		2.00	1.11	2.21	5.00	34.75
37	26-Jul	0.00		2.00	1.11	2.23	5.00	27.52
38	27-Jul	0.00		2.00	1.12	2.24	5.00	20.28
39	28-Jul	0.00		2.00	1.13	2.25	5.00	13.03
40	29-Jul	0.00		2.00	1.13	2.27	5.00	5.76
41	30-Jul	25.52		2.00	1.14	2.28	5.00	24.00
42	31-Jul	0.00		2.00	1.15	2.29	5.00	16.70
43	1-Aug	0.00		1.91	1.15	2.20	5.00	9.50

Table C.3 Water Balance for Rice using Blaney Criddle method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
44	2-Aug	0.00		1.91	1.16	2.22	5.00	2.29
45	3-Aug	0.00	97.71	1.91	1.17	2.23	5.00	92.77
46	4-Aug	0.00		1.91	1.17	2.24	5.00	85.53
47	5-Aug	0.00		1.91	1.18	2.25	5.00	78.28
48	6-Aug	32.05		1.91	1.19	2.27	5.00	103.06
49	7-Aug	0.00		1.91	1.19	2.28	5.00	95.78
50	8-Aug	0.00		1.91	1.20	2.29	5.00	88.49
51	9-Aug	0.00		1.91	1.20	2.29	5.00	81.20
52	10-Aug	0.00		1.91	1.20	2.29	5.00	73.90
53	11-Aug	0.00		1.91	1.20	2.29	5.00	66.61
54	12-Aug	0.00		1.91	1.20	2.29	5.00	59.32
55	13-Aug	32.05		1.91	1.20	2.29	5.00	84.08
56	14-Aug	0.00		1.91	1.20	2.29	5.00	76.79
57	15-Aug	0.00		1.91	1.20	2.29	5.00	69.49
58	16-Aug	0.00		1.91	1.20	2.29	5.00	62.20
59	17-Aug	0.00		1.91	1.20	2.29	5.00	54.91
60	18-Aug	0.00		1.91	1.20	2.29	5.00	47.62
61	19-Aug	0.00		1.91	1.20	2.29	5.00	40.33
62	20-Aug	32.05		1.91	1.20	2.29	5.00	65.08
63	21-Aug	0.00		1.91	1.20	2.29	5.00	57.79
64	22-Aug	0.00		1.91	1.20	2.29	5.00	50.50
65	23-Aug	0.00		1.91	1.20	2.29	5.00	43.21
66	24-Aug	0.00		1.91	1.20	2.29	5.00	35.92
67	25-Aug	0.00		1.91	1.20	2.29	5.00	28.62
68	26-Aug	0.00		1.91	1.20	2.29	5.00	21.33
69	27-Aug	32.05		1.91	1.20	2.29	5.00	46.09
70	28-Aug	0.00		1.91	1.20	2.29	5.00	38.80
71	29-Aug	0.00		1.91	1.20	2.29	5.00	31.51
72	30-Aug	0.00		1.91	1.20	2.29	5.00	24.21
73	31-Aug	0.00		1.91	1.20	2.29	5.00	16.92
74	1-Sep	0.00		2.92	1.20	3.50	5.00	8.42
75	2-Sep	0.00	91.58	2.92	1.20	3.50	5.00	91.50
76	3-Sep	4.43		2.92	1.20	3.50	5.00	87.42
77	4-Sep	0.00		2.92	1.20	3.50	5.00	78.91
78	5-Sep	0.00		2.92	1.20	3.50	5.00	70.41
79	6-Sep	0.00		2.92	1.20	3.50	5.00	61.91
80	7-Sep	0.00		2.92	1.20	3.50	5.00	53.40
81	8-Sep	4.43		2.92	1.20	3.50	5.00	49.32
82	9-Sep	0.00		2.92	1.20	3.50	5.00	40.82
83	10-Sep	0.00		2.92	1.20	3.50	5.00	32.31
84	11-Sep	0.00		2.92	1.20	3.50	5.00	23.81
85	12-Sep	0.00		2.92	1.20	3.50	5.00	15.31
86	13-Sep	0.00		2.92	1.20	3.50	5.00	6.80

Table C.3 Water Balance for Rice using Blaney Criddle method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
87	14-Sep	0.00	93.20	2.92	1.20	3.50	5.00	91.50
88	15-Sep	4.43		2.92	1.20	3.50	5.00	87.42
89	16-Sep	0.00		2.92	1.20	3.50	5.00	78.91
90	17-Sep	0.00		2.92	1.20	3.50	5.00	70.41
91	18-Sep	0.00		2.92	1.19	3.47	5.00	61.93
92	19-Sep	0.00		2.92	1.18	3.45	5.00	53.49
93	20-Sep	0.00		2.92	1.17	3.42	5.00	45.07
94	21-Sep	0.00		2.92	1.16	3.39	5.00	36.69
95	22-Sep	4.43		2.92	1.15	3.36	5.00	32.75
96	23-Sep	0.00		2.92	1.14	3.33	5.00	24.42
97	24-Sep	0.00		2.92	1.13	3.30	5.00	16.12
98	25-Sep	0.00		2.92	1.12	3.27	5.00	7.85
99	26-Sep	0.00	92.15	2.92	1.11	3.24	5.00	91.76
100	27-Sep	0.00		2.92	1.10	3.21	5.00	83.55
101	28-Sep	0.00		2.92	1.09	3.18	5.00	75.36
102	29-Sep	0.00		2.92	1.08	3.15	5.00	67.21
103	30-Sep	0.00		2.92	1.07	3.12	5.00	59.09
104	1-Oct	0.00		2.51	1.06	2.66	5.00	51.43
105	2-Oct	0.00		2.51	1.05	2.64	5.00	43.79
106	3-Oct	0.00		2.51	1.04	2.61	5.00	36.18
107	4-Oct	0.00		2.51	1.03	2.59	5.00	28.59
108	5-Oct	0.00		2.51	1.02	2.56	5.00	21.03
109	6-Oct	0.00		2.51	1.01	2.54	5.00	13.50
110	7-Oct	0.00	67.00	2.51	1.00	2.51	5.00	72.99
111	8-Oct	0.00		2.51	0.99	2.48	5.00	65.50
112	9-Oct	0.00		2.51	0.98	2.46	5.00	58.04
113	10-Oct	0.00		2.51	0.97	2.43	5.00	50.61
114	11-Oct	0.00		2.51	0.96	2.41	5.00	43.20
115	12-Oct	0.00		2.51	0.95	2.38	5.00	35.82
116	13-Oct	0.00		2.51	0.94	2.36	5.00	28.46
117	14-Oct	0.00		2.51	0.93	2.33	5.00	21.12
118	15-Oct	0.00		2.51	0.92	2.31	5.00	13.81
119	16-Oct	0.00		2.51	0.91	2.28	5.00	6.53
120	17-Oct	0.00		2.51	0.90	2.26	5.00	-0.73
	Total	283.46	635.21			319.40	600.00	-0.73
Total water applied =		**918.67**		**Total Water used =**		**918.67**		

Table C.4 Water Balance for Wheat using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
1	16-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	12.24
2	17-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	10.98
3	18-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	9.72
4	19-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	8.46
5	20-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	7.20
6	21-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	5.94
7	22-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	4.68
8	23-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	3.42
9	24-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	2.16
10	25-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	0.90
11	26-Nov	90.00	0.30	27.00	0.00	26.10	3.15	0.40	1.26	25.74
12	27-Nov	90.00	0.30	27.00	0.00		3.15	0.40	1.26	24.48
13	28-Nov	90.00	0.30	27.00	0.00		3.15	0.40	1.26	23.22
14	29-Nov	90.00	0.30	27.00	0.00		3.15	0.40	1.26	21.96
15	30-Nov	90.00	0.30	27.00	0.00		3.15	0.40	1.26	20.70
16	1-Dec	90.00	0.30	27.00	0.00		2.05	0.40	0.82	19.88
17	2-Dec	90.00	0.30	27.00	0.00		2.05	0.40	0.82	19.06
18	3-Dec	90.00	0.30	27.00	0.00		2.05	0.40	0.82	18.24
19	4-Dec	90.00	0.30	27.00	0.00		2.05	0.40	0.82	17.42
20	5-Dec	90.00	0.30	27.00	0.00		2.05	0.40	0.82	16.60
21	6-Dec	90.00	0.30	27.00	0.00		2.05	0.42	0.87	15.73
22	7-Dec	90.00	0.30	27.00	0.00		2.05	0.45	0.92	14.81
23	8-Dec	90.00	0.30	27.00	0.00		2.05	0.47	0.97	13.84
24	9-Dec	90.00	0.30	27.00	0.00		2.05	0.50	1.02	12.83
25	10-Dec	90.00	0.30	27.00	0.00		2.05	0.52	1.07	11.76
26	11-Dec	90.00	0.31	27.72	0.00		2.05	0.54	1.12	10.65
27	12-Dec	90.00	0.32	28.44	0.00		2.05	0.57	1.16	9.48
28	13-Dec	90.00	0.32	29.16	0.00		2.05	0.59	1.21	8.27
29	14-Dec	90.00	0.33	29.88	0.00		2.05	0.62	1.26	7.01
30	15-Dec	90.00	0.34	30.60	0.00		2.05	0.64	1.31	5.69
31	16-Dec	90.00	0.35	31.32	0.00		2.05	0.66	1.36	4.33
32	17-Dec	90.00	0.36	32.04	0.00		2.05	0.69	1.41	2.92
33	18-Dec	90.00	0.36	32.76	0.00		2.05	0.71	1.46	1.46
34	19-Dec	90.00	0.37	33.48	0.00	32.02	2.05	0.74	1.51	31.97
35	20-Dec	90.00	0.38	34.20	0.00		2.05	0.76	1.56	30.41
36	21-Dec	90.00	0.39	34.92	0.00		2.05	0.78	1.61	28.81
37	22-Dec	90.00	0.40	35.64	0.00		2.05	0.81	1.66	27.15
38	23-Dec	90.00	0.40	36.36	0.00		2.05	0.83	1.71	25.44
39	24-Dec	90.00	0.41	37.08	0.00		2.05	0.86	1.75	23.69
40	25-Dec	90.00	0.42	37.80	0.00		2.05	0.88	1.80	21.89
41	26-Dec	90.00	0.43	38.52	0.00		2.05	0.90	1.85	20.03
42	27-Dec	90.00	0.44	39.24	0.00		2.05	0.93	1.90	18.13
43	28-Dec	90.00	0.44	39.96	0.00		2.05	0.95	1.95	16.18

Table C.4 Water Balance for Wheat using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
44	29-Dec	90.00	0.45	40.68	0.00		2.05	0.98	2.00	14.18
45	30-Dec	90.00	0.46	41.40	0.00		2.05	1.00	2.05	12.13
46	31-Dec	90.00	0.47	42.12	0.00		2.05	1.02	2.10	10.03
47	1-Jan	90.00	0.48	42.84	0.00		1.71	1.05	1.79	8.24
48	2-Jan	90.00	0.48	43.56	0.00		1.71	1.07	1.83	6.40
49	3-Jan	90.00	0.49	44.28	0.00		1.71	1.10	1.87	4.53
50	4-Jan	90.00	0.50	45.00	0.00		1.71	1.12	1.92	2.61
51	5-Jan	90.00	0.51	45.90	0.00		1.71	1.12	1.92	0.70
52	6-Jan	90.00	0.52	46.80	0.00	46.10	1.71	1.12	1.92	44.88
53	7-Jan	90.00	0.53	47.70	0.00		1.71	1.12	1.92	42.97
54	8-Jan	90.00	0.54	48.60	0.00		1.71	1.12	1.92	41.05
55	9-Jan	90.00	0.55	49.50	0.00		1.71	1.12	1.92	39.14
56	10-Jan	90.00	0.56	50.40	0.00		1.71	1.12	1.92	37.22
57	11-Jan	90.00	0.57	51.30	0.00		1.71	1.12	1.92	35.31
58	12-Jan	90.00	0.58	52.20	0.00		1.71	1.12	1.92	33.39
59	13-Jan	90.00	0.59	53.10	0.00		1.71	1.12	1.92	31.48
60	14-Jan	90.00	0.60	54.00	0.00		1.71	1.12	1.92	29.56
61	15-Jan	90.00	0.61	54.90	0.00		1.71	1.12	1.92	27.65
62	16-Jan	90.00	0.62	55.80	0.00		1.71	1.12	1.92	25.73
63	17-Jan	90.00	0.63	56.70	0.00		1.71	1.12	1.92	23.82
64	18-Jan	90.00	0.64	57.60	0.00		1.71	1.12	1.92	21.90
65	19-Jan	90.00	0.65	58.50	0.00		1.71	1.12	1.92	19.99
66	20-Jan	90.00	0.66	59.40	0.00		1.71	1.12	1.92	18.07
67	21-Jan	90.00	0.67	60.30	0.00		1.71	1.12	1.92	16.16
68	22-Jan	90.00	0.68	61.20	0.00		1.71	1.12	1.92	14.24
69	23-Jan	90.00	0.69	62.10	0.00		1.71	1.12	1.92	12.33
70	24-Jan	90.00	0.70	63.00	0.00		1.71	1.12	1.92	10.41
71	25-Jan	90.00	0.71	63.90	0.00		1.71	1.12	1.92	8.50
72	26-Jan	90.00	0.72	64.80	0.00		1.71	1.12	1.92	6.58
73	27-Jan	90.00	0.73	65.70	0.00		1.71	1.12	1.92	4.67
74	28-Jan	90.00	0.74	66.60	0.00		1.71	1.12	1.92	2.75
75	29-Jan	90.00	0.75	67.50	0.00		1.71	1.12	1.92	0.84
76	30-Jan	90.00	0.76	68.40	0.00	67.56	1.71	1.12	1.92	66.48
77	31-Jan	90.00	0.77	69.30	0.00		1.71	1.12	1.92	64.57
78	1-Feb	90.00	0.78	70.20	0.00		2.97	1.12	3.33	61.24
79	2-Feb	90.00	0.79	71.10	0.00		2.97	1.12	3.33	57.92
80	3-Feb	90.00	0.80	72.00	0.00		2.97	1.12	3.33	54.59
81	4-Feb	90.00	0.81	72.90	0.00		2.97	1.12	3.33	51.26
82	5-Feb	90.00	0.82	73.80	0.00		2.97	1.12	3.33	47.94
83	6-Feb	90.00	0.83	74.70	0.00		2.97	1.12	3.33	44.61
84	7-Feb	90.00	0.84	75.60	0.00		2.97	1.12	3.33	41.28
85	8-Feb	90.00	0.85	76.50	0.00		2.97	1.12	3.33	37.96
86	9-Feb	90.00	0.86	77.40	0.00		2.97	1.12	3.33	34.63

Table C.4 Water Balance for Wheat using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
87	10-Feb	90.00	0.87	78.30	0.00		2.97	1.12	3.33	31.31
88	11-Feb	90.00	0.88	79.20	0.00		2.97	1.12	3.33	27.98
89	12-Feb	90.00	0.89	80.10	0.00		2.97	1.12	3.33	24.65
90	13-Feb	90.00	0.90	81.00	0.00		2.97	1.12	3.33	21.33
91	14-Feb	90.00	0.91	81.90	0.00		2.97	1.12	3.33	18.00
92	15-Feb	90.00	0.92	82.80	0.00		2.97	1.12	3.33	14.67
93	16-Feb	90.00	0.93	83.70	0.00		2.97	1.12	3.33	11.35
94	17-Feb	90.00	0.94	84.60	0.00		2.97	1.12	3.33	8.02
95	18-Feb	90.00	0.95	85.50	0.00		2.97	1.12	3.33	4.69
96	19-Feb	90.00	0.96	86.40	0.00		2.97	1.12	3.33	1.37
97	20-Feb	90.00	0.97	87.30	0.00	85.93	2.97	1.12	3.33	83.97
98	21-Feb	90.00	0.98	88.20	0.00		2.97	1.12	3.33	80.65
99	22-Feb	90.00	0.99	89.10	0.00		2.97	1.12	3.33	77.32
100	23-Feb	90.00	1.00	90.00	0.00		2.97	1.12	3.33	73.99
101	24-Feb	90.00	1.00	90.36	0.00		2.97	1.12	3.33	70.67
102	25-Feb	90.00	1.01	90.72	0.00		2.97	1.12	3.33	67.34
103	26-Feb	90.00	1.01	91.08	0.00		2.97	1.12	3.33	64.02
104	27-Feb	90.00	1.02	91.44	0.00		2.97	1.12	3.33	60.69
105	28-Feb	90.00	1.02	91.80	0.00		2.97	1.12	3.33	57.36
106	1-Mar	90.00	1.02	92.16	0.00		3.56	1.11	3.93	53.43
107	2-Mar	90.00	1.03	92.52	0.00		3.56	1.09	3.88	49.55
108	3-Mar	90.00	1.03	92.88	0.00		3.56	1.08	3.83	45.72
109	4-Mar	90.00	1.04	93.24	0.00		3.56	1.06	3.77	41.95
110	5-Mar	90.00	1.04	93.60	0.00		3.56	1.05	3.72	38.23
111	6-Mar	90.00	1.04	93.96	0.00		3.56	1.03	3.67	34.56
112	7-Mar	90.00	1.05	94.32	0.00		3.56	1.02	3.61	30.95
113	8-Mar	90.00	1.05	94.68	0.00		3.56	1.00	3.56	27.39
114	9-Mar	90.00	1.06	95.04	0.00		3.56	0.99	3.51	23.88
115	10-Mar	90.00	1.06	95.40	0.00		3.56	0.97	3.45	20.43
116	11-Mar	90.00	1.06	95.76	0.00		3.56	0.96	3.40	17.03
117	12-Mar	90.00	1.07	96.12	0.00		3.56	0.94	3.35	13.68
118	13-Mar	90.00	1.07	96.48	0.00		3.56	0.93	3.29	10.39
119	14-Mar	90.00	1.08	96.84	0.00		3.56	0.91	3.24	7.15
120	15-Mar	90.00	1.08	97.20	0.00		3.56	0.90	3.19	3.96
121	16-Mar	90.00	1.08	97.56	0.00		3.56	0.88	3.13	0.83
122	17-Mar	90.00	1.09	97.92	0.00	25.50	3.56	0.87	3.08	23.25
123	18-Mar	90.00	1.09	98.28	0.00		3.56	0.85	3.03	20.22
124	19-Mar	90.00	1.10	98.64	0.00		3.56	0.84	2.97	17.25
125	20-Mar	90.00	1.10	99.00	0.00		3.56	0.82	2.92	14.33
					0.00	283.22			282.38	0.83
Total water applied =					**283.22**		**Total Water used =**		**283.22**	

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
1	16-Nov	45.00	0.30	13.50	0.00		3.15	0.40	1.26	12.24
2	17-Nov	45.00	0.30	13.65	0.00		3.15	0.40	1.26	10.98
3	18-Nov	45.00	0.31	13.80	0.00		3.15	0.40	1.26	9.72
4	19-Nov	45.00	0.31	13.94	0.00		3.15	0.40	1.26	8.46
5	20-Nov	45.00	0.31	14.09	0.00		3.15	0.40	1.26	7.20
6	21-Nov	45.00	0.32	14.24	0.00		3.15	0.40	1.26	5.94
7	22-Nov	45.00	0.32	14.39	0.00		3.15	0.40	1.26	4.68
8	23-Nov	45.00	0.32	14.53	0.00		3.15	0.40	1.26	3.42
9	24-Nov	45.00	0.33	14.68	0.00		3.15	0.40	1.26	2.16
10	25-Nov	45.00	0.33	14.83	0.00		3.15	0.40	1.26	0.90
11	26-Nov	90.00	0.33	29.95	0.00	29.05	3.15	0.40	1.26	28.69
12	27-Nov	90.00	0.34	30.25	0.00		3.15	0.40	1.26	27.43
13	28-Nov	90.00	0.34	30.54	0.00		3.15	0.40	1.26	26.17
14	29-Nov	90.00	0.34	30.84	0.00		3.15	0.40	1.26	24.91
15	30-Nov	90.00	0.35	31.13	0.00		3.15	0.40	1.26	23.65
16	1-Dec	90.00	0.35	31.43	0.00		2.05	0.40	0.82	22.83
17	2-Dec	90.00	0.35	31.72	0.00		2.05	0.40	0.82	22.01
18	3-Dec	90.00	0.36	32.02	0.00		2.05	0.40	0.82	21.19
19	4-Dec	90.00	0.36	32.31	0.00		2.05	0.40	0.82	20.37
20	5-Dec	90.00	0.36	32.61	0.00		2.05	0.40	0.82	19.55
21	6-Dec	90.00	0.37	32.90	0.00		2.05	0.40	0.82	18.73
22	7-Dec	90.00	0.37	33.20	0.00		2.05	0.40	0.82	17.91
23	8-Dec	90.00	0.37	33.49	0.00		2.05	0.40	0.82	17.09
24	9-Dec	90.00	0.38	33.79	0.00		2.05	0.40	0.82	16.27
25	10-Dec	90.00	0.38	34.08	0.00		2.05	0.40	0.82	15.45
26	11-Dec	90.00	0.38	34.38	0.00		2.05	0.40	0.82	14.63
27	12-Dec	90.00	0.39	34.67	0.00		2.05	0.40	0.82	13.81
28	13-Dec	90.00	0.39	34.97	0.00		2.05	0.40	0.82	12.99
29	14-Dec	90.00	0.39	35.26	0.00		2.05	0.40	0.82	12.17
30	15-Dec	90.00	0.40	35.56	0.00		2.05	0.40	0.82	11.35
31	16-Dec	90.00	0.40	35.85	0.00		2.05	0.41	0.85	10.50
32	17-Dec	90.00	0.40	36.15	0.00		2.05	0.43	0.88	9.62
33	18-Dec	90.00	0.40	36.44	0.00		2.05	0.44	0.91	8.72
34	19-Dec	90.00	0.41	36.74	0.00		2.05	0.46	0.94	7.78
35	20-Dec	90.00	0.41	37.03	0.00		2.05	0.47	0.97	6.81
36	21-Dec	90.00	0.41	37.33	0.00		2.05	0.49	0.99	5.82
37	22-Dec	90.00	0.42	37.62	0.00		2.05	0.50	1.02	4.80
38	23-Dec	90.00	0.42	37.92	0.00		2.05	0.51	1.05	3.74
39	24-Dec	90.00	0.42	38.21	0.00		2.05	0.53	1.08	2.66
40	25-Dec	90.00	0.43	38.51	0.00		2.05	0.54	1.11	1.55
41	26-Dec	90.00	0.43	38.80	0.00		2.05	0.56	1.14	0.41
42	27-Dec	90.00	0.43	39.10	0.00	38.69	2.05	0.57	1.17	37.93
43	28-Dec	90.00	0.44	39.39	0.00		2.05	0.58	1.20	36.73
44	29-Dec	90.00	0.44	39.69	0.00		2.05	0.60	1.23	35.50
45	30-Dec	90.00	0.44	39.98	0.00		2.05	0.61	1.26	34.25

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
46	31-Dec	90.00	0.45	40.28	0.00		2.05	0.63	1.29	32.96
47	1-Jan	90.00	0.45	40.57	0.00		1.71	0.64	1.10	31.86
48	2-Jan	90.00	0.45	40.87	0.00		1.71	0.66	1.12	30.74
49	3-Jan	90.00	0.46	41.16	0.00		1.71	0.67	1.15	29.60
50	4-Jan	90.00	0.46	41.46	0.00		1.71	0.68	1.17	28.43
51	5-Jan	90.00	0.46	41.75	0.00		1.71	0.70	1.19	27.23
52	6-Jan	90.00	0.47	42.05	0.00		1.71	0.71	1.22	26.02
53	7-Jan	90.00	0.47	42.34	0.00		1.71	0.73	1.24	24.77
54	8-Jan	90.00	0.47	42.64	0.00		1.71	0.74	1.27	23.51
55	9-Jan	90.00	0.48	42.93	0.00		1.71	0.76	1.29	22.22
56	10-Jan	90.00	0.48	43.23	0.00		1.71	0.77	1.32	20.90
57	11-Jan	90.00	0.48	43.52	0.00		1.71	0.78	1.34	19.56
58	12-Jan	90.00	0.49	43.82	0.00		1.71	0.80	1.36	18.20
59	13-Jan	90.00	0.49	44.11	0.00		1.71	0.81	1.39	16.81
60	14-Jan	90.00	0.49	44.41	0.00		1.71	0.83	1.41	15.40
61	15-Jan	90.00	0.50	44.70	0.00		1.71	0.84	1.44	13.96
62	16-Jan	90.00	0.50	45.00	0.00		1.71	0.85	1.46	12.50
63	17-Jan	90.00	0.50	45.30	0.00		1.71	0.87	1.49	11.01
64	18-Jan	90.00	0.51	45.59	0.00		1.71	0.88	1.51	9.50
65	19-Jan	90.00	0.51	45.89	0.00		1.71	0.90	1.53	7.97
66	20-Jan	90.00	0.51	46.18	0.00		1.71	0.91	1.56	6.41
67	21-Jan	90.00	0.52	46.48	0.00		1.71	0.93	1.58	4.83
68	22-Jan	90.00	0.52	46.77	0.00		1.71	0.94	1.61	3.22
69	23-Jan	90.00	0.52	47.07	0.00		1.71	0.95	1.63	1.59
70	24-Jan	90.00	0.53	47.36	0.00	45.77	1.71	0.97	1.66	45.71
71	25-Jan	90.00	0.53	47.66	0.00		1.71	0.98	1.68	44.03
72	26-Jan	90.00	0.53	47.95	0.00		1.71	1.00	1.70	42.32
73	27-Jan	90.00	0.54	48.25	0.00		1.71	1.01	1.73	40.59
74	28-Jan	90.00	0.54	48.54	0.00		1.71	1.02	1.75	38.84
75	29-Jan	90.00	0.54	48.84	0.00		1.71	1.04	1.78	37.06
76	30-Jan	90.00	0.55	49.13	0.00		1.71	1.05	1.80	35.26
77	31-Jan	90.00	0.55	49.43	0.00		1.71	1.07	1.83	33.44
78	1-Feb	90.00	0.55	49.72	0.00		2.97	1.08	3.21	30.23
79	2-Feb	90.00	0.56	50.02	0.00		2.97	1.10	3.25	26.97
80	3-Feb	90.00	0.56	50.31	0.00		2.97	1.11	3.30	23.67
81	4-Feb	90.00	0.56	50.61	0.00		2.97	1.12	3.34	20.34
82	5-Feb	90.00	0.57	50.90	0.00		2.97	1.14	3.38	16.96
83	6-Feb	90.00	0.57	51.20	0.00		2.97	1.15	3.42	13.53
84	7-Feb	90.00	0.57	51.49	0.00		2.97	1.17	3.47	10.07
85	8-Feb	90.00	0.58	51.79	0.00		2.97	1.18	3.51	6.56
86	9-Feb	90.00	0.58	52.08	0.00		2.97	1.20	3.55	3.01
87	10-Feb	90.00	0.58	52.38	0.00	49.37	2.97	1.21	3.59	48.79
88	11-Feb	90.00	0.59	52.67	0.00		2.97	1.22	3.63	45.15
89	12-Feb	90.00	0.59	52.97	0.00		2.97	1.24	3.68	41.47
90	13-Feb	90.00	0.59	53.26	0.00		2.97	1.25	3.72	37.76

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
91	14-Feb	90.00	0.60	53.56	0.00		2.97	1.25	3.71	34.04
92	15-Feb	90.00	0.60	53.85	0.00		2.97	1.25	3.71	30.33
93	16-Feb	90.00	0.60	54.15	0.00		2.97	1.25	3.71	26.62
94	17-Feb	90.00	0.60	54.44	0.00		2.97	1.25	3.71	22.91
95	18-Feb	90.00	0.61	54.74	0.00		2.97	1.25	3.71	19.19
96	19-Feb	90.00	0.61	55.03	0.00		2.97	1.25	3.71	15.48
97	20-Feb	90.00	0.61	55.33	0.00		2.97	1.25	3.71	11.77
98	21-Feb	90.00	0.62	55.62	0.00		2.97	1.25	3.71	8.06
99	22-Feb	90.00	0.62	55.92	0.00		2.97	1.25	3.71	4.34
100	23-Feb	90.00	0.62	56.21	0.00		2.97	1.25	3.71	0.63
101	24-Feb	90.00	0.63	56.51	0.00	55.88	2.97	1.25	3.71	52.80
102	25-Feb	90.00	0.63	56.80	0.00		2.97	1.25	3.71	49.08
103	26-Feb	90.00	0.63	57.10	0.00		2.97	1.25	3.71	45.37
104	27-Feb	90.00	0.64	57.39	0.00		2.97	1.25	3.71	41.66
105	28-Feb	90.00	0.64	57.69	0.00		2.97	1.25	3.71	37.95
106	1-Mar	90.00	0.64	57.98	0.00		3.56	1.25	4.45	33.50
107	2-Mar	90.00	0.65	58.28	0.00		3.56	1.25	4.45	29.05
108	3-Mar	90.00	0.65	58.57	0.00		3.56	1.25	4.45	24.60
109	4-Mar	90.00	0.65	58.87	0.00		3.56	1.25	4.45	20.15
110	5-Mar	90.00	0.66	59.16	0.00		3.56	1.25	4.45	15.70
111	6-Mar	90.00	0.66	59.46	0.00		3.56	1.25	4.45	11.25
112	7-Mar	90.00	0.66	59.75	0.00		3.56	1.25	4.45	6.80
113	8-Mar	90.00	0.67	60.05	0.00		3.56	1.25	4.45	2.35
114	9-Mar	90.00	0.67	60.34	0.00	58.00	3.56	1.25	4.45	55.89
115	10-Mar	90.00	0.67	60.64	0.00		3.56	1.25	4.45	51.44
116	11-Mar	90.00	0.68	60.93	0.00		3.56	1.25	4.45	46.99
117	12-Mar	90.00	0.68	61.23	0.00		3.56	1.25	4.45	42.54
118	13-Mar	90.00	0.68	61.52	0.00		3.56	1.25	4.45	38.09
119	14-Mar	90.00	0.69	61.82	0.00		3.56	1.25	4.45	33.64
120	15-Mar	90.00	0.69	62.11	0.00		3.56	1.25	4.45	29.19
121	16-Mar	90.00	0.69	62.41	0.00		3.56	1.25	4.45	24.74
122	17-Mar	90.00	0.70	62.70	0.00		3.56	1.25	4.45	20.29
123	18-Mar	90.00	0.70	63.44	0.00		3.56	1.25	4.45	15.84
124	19-Mar	90.00	0.71	64.18	0.00		3.56	1.25	4.45	11.39
125	20-Mar	90.00	0.72	64.92	0.00		3.56	1.25	4.45	6.94
126	21-Mar	90.00	0.73	65.66	0.00		3.56	1.25	4.45	2.49
127	22-Mar	90.00	0.74	66.39	0.00	63.90	3.56	1.25	4.45	61.94
128	23-Mar	90.00	0.75	67.13	0.00		3.56	1.25	4.45	57.49
129	24-Mar	90.00	0.75	67.87	0.00		3.56	1.25	4.45	53.04
130	25-Mar	90.00	0.76	68.61	0.00		3.56	1.25	4.45	48.59
131	26-Mar	90.00	0.77	69.34	0.00		3.56	1.25	4.45	44.14
132	27-Mar	90.00	0.78	70.08	0.00		3.56	1.25	4.45	39.69
133	28-Mar	90.00	0.79	70.82	0.00		3.56	1.25	4.45	35.24
134	29-Mar	90.00	0.80	71.56	0.00		3.56	1.25	4.45	30.79
135	30-Mar	90.00	0.80	72.30	0.00		3.56	1.25	4.45	26.34

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
136	31-Mar	90.00	0.81	73.03	0.00		3.56	1.25	4.45	21.89
137	1-Apr	90.00	0.82	73.77	0.00		6.91	1.25	8.64	13.26
138	2-Apr	90.00	0.83	74.51	0.00		6.91	1.25	8.64	4.62
139	3-Apr	90.00	0.84	75.25	0.00	70.63	6.91	1.25	8.64	66.61
140	4-Apr	90.00	0.84	75.98	0.00		6.91	1.25	8.64	57.97
141	5-Apr	90.00	0.85	76.72	0.00		6.91	1.25	8.64	49.33
142	6-Apr	90.00	0.86	77.46	0.00		6.91	1.25	8.64	40.70
143	7-Apr	90.00	0.87	78.20	0.00		6.91	1.25	8.64	32.06
144	8-Apr	90.00	0.88	78.93	0.00		6.91	1.25	8.64	23.42
145	9-Apr	90.00	0.89	79.67	0.00		6.91	1.25	8.64	14.78
146	10-Apr	90.00	0.89	80.41	0.00		6.91	1.25	8.64	6.15
147	11-Apr	90.00	0.90	81.15	0.00	75.00	6.91	1.25	8.64	72.51
148	12-Apr	90.00	0.91	81.89	0.00		6.91	1.25	8.64	63.87
149	13-Apr	90.00	0.92	82.62	0.00		6.91	1.25	8.64	55.24
150	14-Apr	90.00	0.93	83.36	0.00		6.91	1.25	8.64	46.60
151	15-Apr	90.00	0.93	84.10	0.00		6.91	1.25	8.64	37.96
152	16-Apr	90.00	0.94	84.84	0.00		6.91	1.25	8.64	29.32
153	17-Apr	90.00	0.95	85.57	0.00		6.91	1.25	8.64	20.69
154	18-Apr	90.00	0.96	86.31	0.00		6.91	1.25	8.64	12.05
155	19-Apr	90.00	0.97	87.05	0.00		6.91	1.25	8.64	3.41
156	20-Apr	90.00	0.98	87.79	0.00	84.38	6.91	1.25	8.64	79.15
157	21-Apr	90.00	0.98	88.52	0.00		6.91	1.25	8.64	70.51
158	22-Apr	90.00	0.99	89.26	0.00		6.91	1.25	8.64	61.87
159	23-Apr	90.00	1.00	90.00	0.00		6.91	1.25	8.64	53.24
160	24-Apr	90.00	1.01	90.74	0.00		6.91	1.25	8.64	44.60
161	25-Apr	90.00	1.02	91.48	0.00		6.91	1.25	8.64	35.96
162	26-Apr	90.00	1.02	92.21	0.00		6.91	1.25	8.64	27.32
163	27-Apr	90.00	1.03	92.95	0.00		6.91	1.25	8.64	18.69
164	28-Apr	90.00	1.04	93.69	0.00		6.91	1.25	8.64	10.05
165	29-Apr	90.00	1.05	94.43	0.00		6.91	1.25	8.64	1.41
166	30-Apr	90.00	1.06	95.16	0.00	93.75	6.91	1.25	8.64	86.53
167	1-May	90.00	1.07	95.90	0.00		7.53	1.25	9.41	77.11
168	2-May	90.00	1.07	96.64	0.00		7.53	1.25	9.41	67.70
169	3-May	90.00	1.08	97.38	0.00		7.53	1.25	9.41	58.29
170	4-May	90.00	1.09	98.11	0.00		7.53	1.25	9.41	48.88
171	5-May	90.00	1.10	98.85	0.00		7.53	1.25	9.41	39.46
172	6-May	90.00	1.11	99.59	0.00		7.53	1.25	9.41	30.05
173	7-May	90.00	1.11	100.33	0.00		7.53	1.25	9.41	20.64
174	8-May	90.00	1.12	101.07	0.00		7.53	1.25	9.41	11.23
175	9-May	90.00	1.13	101.80	0.00		7.53	1.25	9.41	1.81
176	10-May	90.00	1.14	102.54	0.00	100.73	7.53	1.25	9.41	93.13
177	11-May	90.00	1.15	103.28	0.00		7.53	1.25	9.41	83.72
178	12-May	90.00	1.16	104.02	0.00		7.53	1.25	9.41	74.30
179	13-May	90.00	1.16	104.75	0.00		7.53	1.25	9.41	64.89
180	14-May	90.00	1.17	105.49	0.00		7.53	1.25	9.41	55.48

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
181	15-May	90.00	1.18	106.23	0.00		7.53	1.25	9.41	46.07
182	16-May	90.00	1.19	106.97	0.00		7.53	1.25	9.41	36.65
183	17-May	90.00	1.20	107.70	0.00		7.53	1.25	9.41	27.24
184	18-May	90.00	1.20	107.85	0.00		7.53	1.25	9.41	17.83
185	19-May	90.00	1.20	108.00	0.00		7.53	1.25	9.41	8.42
186	20-May	90.00	1.20	108.15	0.00	99.73	7.53	1.25	9.41	98.74
187	21-May	90.00	1.20	108.30	0.00		7.53	1.25	9.41	89.32
188	22-May	90.00	1.20	108.44	0.00		7.53	1.25	9.41	79.91
189	23-May	90.00	1.21	108.59	0.00		7.53	1.25	9.41	70.50
190	24-May	90.00	1.21	108.74	0.00		7.53	1.25	9.41	61.09
191	25-May	90.00	1.21	108.89	0.00		7.53	1.25	9.41	51.67
192	26-May	90.00	1.21	109.03	0.00		7.53	1.25	9.41	42.26
193	27-May	90.00	1.21	109.18	0.00		7.53	1.25	9.41	32.85
194	28-May	90.00	1.21	109.33	0.00		7.53	1.25	9.41	23.44
195	29-May	90.00	1.22	109.48	0.00		7.53	1.25	9.41	14.02
196	30-May	90.00	1.22	109.62	0.00		7.53	1.25	9.41	4.61
197	31-May	90.00	1.22	109.77	0.00	105.16	7.53	1.25	9.41	100.36
198	1-Jun	90.00	1.22	109.92	0.00		5.94	1.25	7.43	92.93
199	2-Jun	90.00	1.22	110.07	0.00		5.94	1.25	7.43	85.51
200	3-Jun	90.00	1.22	110.21	0.00		5.94	1.25	7.43	78.08
201	4-Jun	90.00	1.23	110.36	11.66		5.94	1.25	7.43	82.31
202	5-Jun	90.00	1.23	110.51	0.00		5.94	1.25	7.43	74.89
203	6-Jun	90.00	1.23	110.66	0.00		5.94	1.25	7.43	67.46
204	7-Jun	90.00	1.23	110.80	0.00		5.94	1.25	7.43	60.04
205	8-Jun	90.00	1.23	110.95	0.00		5.94	1.25	7.43	52.61
206	9-Jun	90.00	1.23	111.10	0.00		5.94	1.25	7.43	45.19
207	10-Jun	90.00	1.24	111.25	0.00		5.94	1.25	7.43	37.76
208	11-Jun	90.00	1.24	111.39	11.66		5.94	1.25	7.43	41.99
209	12-Jun	90.00	1.24	111.54	0.00		5.94	1.25	7.43	34.57
210	13-Jun	90.00	1.24	111.69	0.00		5.94	1.25	7.43	27.14
211	14-Jun	90.00	1.24	111.84	0.00		5.94	1.25	7.43	19.72
212	15-Jun	90.00	1.24	111.98	0.00		5.94	1.25	7.43	12.29
213	16-Jun	90.00	1.25	112.13	0.00		5.94	1.25	7.43	4.87
214	17-Jun	90.00	1.25	112.28	0.00	107.41	5.94	1.25	7.43	104.85
215	18-Jun	90.00	1.25	112.43	11.66		5.94	1.25	7.43	109.08
216	19-Jun	90.00	1.25	112.57	0.00		5.94	1.25	7.43	101.66
217	20-Jun	90.00	1.25	112.72	0.00		5.94	1.25	7.43	94.23
218	21-Jun	90.00	1.25	112.87	0.00		5.94	1.25	7.43	86.81
219	22-Jun	90.00	1.26	113.02	0.00		5.94	1.25	7.43	79.38
220	23-Jun	90.00	1.26	113.16	0.00		5.94	1.25	7.43	71.96
221	24-Jun	90.00	1.26	113.31	0.00		5.94	1.25	7.43	64.53
222	25-Jun	90.00	1.26	113.46	11.66		5.94	1.25	7.43	68.76
223	26-Jun	90.00	1.26	113.61	0.00		5.94	1.25	7.43	61.34
224	27-Jun	90.00	1.26	113.75	0.00		5.94	1.25	7.43	53.91
225	28-Jun	90.00	1.27	113.90	0.00		5.94	1.25	7.43	46.49

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
226	29-Jun	90.00	1.27	114.05	0.00		5.94	1.25	7.43	39.06
227	30-Jun	90.00	1.27	114.20	0.00		5.94	1.25	7.43	31.64
228	1-Jul	90.00	1.27	114.34	0.00		3.97	1.25	4.96	26.68
229	2-Jul	90.00	1.27	114.49	25.80		3.97	1.25	4.96	47.51
230	3-Jul	90.00	1.27	114.64	0.00		3.97	1.25	4.96	42.55
231	4-Jul	90.00	1.28	114.79	0.00		3.97	1.25	4.96	37.58
232	5-Jul	90.00	1.28	114.93	0.00		3.97	1.25	4.96	32.62
233	6-Jul	90.00	1.28	115.08	0.00		3.97	1.25	4.96	27.66
234	7-Jul	90.00	1.28	115.23	0.00		3.97	1.25	4.96	22.70
235	8-Jul	90.00	1.28	115.38	0.00		3.97	1.25	4.96	17.73
236	9-Jul	90.00	1.28	115.52	25.80		3.97	1.25	4.96	38.57
237	10-Jul	90.00	1.29	115.67	0.00		3.97	1.25	4.96	33.61
238	11-Jul	90.00	1.29	115.82	0.00		3.97	1.25	4.96	28.64
239	12-Jul	90.00	1.29	115.97	0.00		3.97	1.25	4.96	23.68
240	13-Jul	90.00	1.29	116.11	0.00		3.97	1.25	4.96	18.72
241	14-Jul	90.00	1.29	116.26	0.00		3.97	1.25	4.96	13.76
242	15-Jul	90.00	1.29	116.41	0.00		3.97	1.25	4.96	8.79
243	16-Jul	90.00	1.30	116.56	25.80		3.97	1.25	4.96	29.63
244	17-Jul	90.00	1.30	116.70	0.00		3.97	1.25	4.96	24.66
245	18-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	19.70
246	19-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	14.74
247	20-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	9.78
248	21-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	4.81
249	22-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	-0.15
250	23-Jul	90.00	1.30	117.00	25.80		3.97	1.25	4.96	20.69
251	24-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	15.72
252	25-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	10.76
253	26-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	5.80
254	27-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	0.84
255	28-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	-4.13
256	29-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	-9.09
257	30-Jul	90.00	1.30	117.00	25.80		3.97	1.25	4.96	11.74
258	31-Jul	90.00	1.30	117.00	0.00		3.97	1.25	4.96	6.78
259	1-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	1.92
260	2-Aug	90.00	1.30	117.00	0.00	115.08	3.89	1.25	4.86	112.14
261	3-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	107.28
262	4-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	102.41
263	5-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	97.55
264	6-Aug	90.00	1.30	117.00	31.87		3.89	1.25	4.86	124.56
265	7-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	119.70
266	8-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	114.83
267	9-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	109.97
268	10-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	105.11
269	11-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	100.25
270	12-Aug	90.00	1.30	117.00	0.00		3.89	1.25	4.86	95.38

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
271	13-Aug	90.00	1.30	117.00	31.87		3.89	1.24	4.84	122.41
272	14-Aug	90.00	1.30	117.00	0.00		3.89	1.24	4.82	117.59
273	15-Aug	90.00	1.30	117.00	0.00		3.89	1.23	4.80	112.79
274	16-Aug	90.00	1.30	117.00	0.00		3.89	1.23	4.78	108.01
275	17-Aug	90.00	1.30	117.00	0.00		3.89	1.22	4.76	103.25
276	18-Aug	90.00	1.30	117.00	0.00		3.89	1.22	4.74	98.51
277	19-Aug	90.00	1.30	117.00	0.00		3.89	1.21	4.72	93.79
278	20-Aug	90.00	1.30	117.00	31.87		3.89	1.21	4.70	120.96
279	21-Aug	90.00	1.30	117.00	0.00		3.89	1.20	4.68	116.29
280	22-Aug	90.00	1.30	117.00	0.00		3.89	1.20	4.66	111.63
281	23-Aug	90.00	1.30	117.00	0.00		3.89	1.19	4.64	107.00
282	24-Aug	90.00	1.30	117.00	0.00		3.89	1.19	4.62	102.38
283	25-Aug	90.00	1.30	117.00	0.00		3.89	1.18	4.59	97.79
284	26-Aug	90.00	1.30	117.00	0.00		3.89	1.18	4.57	93.21
285	27-Aug	90.00	1.30	117.00	31.87		3.89	1.17	4.55	120.53
286	28-Aug	90.00	1.30	117.00	0.00		3.89	1.17	4.53	116.00
287	29-Aug	90.00	1.30	117.00	0.00		3.89	1.16	4.51	111.48
288	30-Aug	90.00	1.30	117.00	0.00		3.89	1.15	4.49	106.99
289	31-Aug	90.00	1.30	117.00	0.00		3.89	1.15	4.47	102.52
290	1-Sep	90.00	1.30	117.00	0.00		3.67	1.14	4.20	98.32
291	2-Sep	90.00	1.30	117.00	0.00		3.67	1.14	4.18	94.14
292	3-Sep	90.00	1.30	117.00	8.46		3.67	1.13	4.16	98.45
293	4-Sep	90.00	1.30	117.00	0.00		3.67	1.13	4.14	94.31
294	5-Sep	90.00	1.30	117.00	0.00		3.67	1.12	4.12	90.18
295	6-Sep	90.00	1.30	117.00	0.00		3.67	1.12	4.10	86.08
296	7-Sep	90.00	1.30	117.00	0.00		3.67	1.11	4.08	82.00
297	8-Sep	90.00	1.30	117.00	8.46		3.67	1.11	4.06	86.40
298	9-Sep	90.00	1.30	117.00	0.00		3.67	1.10	4.04	82.36
299	10-Sep	90.00	1.30	117.00	0.00		3.67	1.10	4.02	78.33
300	11-Sep	90.00	1.30	117.00	0.00		3.67	1.09	4.00	74.33
301	12-Sep	90.00	1.30	117.00	0.00		3.67	1.09	3.98	70.34
302	13-Sep	90.00	1.30	117.00	0.00		3.67	1.08	3.97	66.38
303	14-Sep	90.00	1.30	117.00	0.00		3.67	1.08	3.95	62.43
304	15-Sep	90.00	1.30	117.00	8.46		3.67	1.07	3.93	66.97
305	16-Sep	90.00	1.30	117.00	0.00		3.67	1.06	3.91	63.06
306	17-Sep	90.00	1.30	117.00	0.00		3.67	1.06	3.89	59.17
307	18-Sep	90.00	1.30	117.00	0.00		3.67	1.05	3.87	55.31
308	19-Sep	90.00	1.30	117.00	0.00		3.67	1.05	3.85	51.46
309	20-Sep	90.00	1.30	117.00	0.00		3.67	1.04	3.83	47.63
310	21-Sep	90.00	1.30	117.00	0.00		3.67	1.04	3.81	43.82
311	22-Sep	90.00	1.30	117.00	8.46		3.67	1.03	3.79	48.49
312	23-Sep	90.00	1.30	117.00	0.00		3.67	1.03	3.77	44.72
313	24-Sep	90.00	1.30	117.00	0.00		3.67	1.02	3.75	40.97
314	25-Sep	90.00	1.30	117.00	0.00		3.67	1.02	3.73	37.24
315	26-Sep	90.00	1.30	117.00	0.00		3.67	1.01	3.71	33.52

Table C.5 Water Balance for Sugarcane using Radiation method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
316	27-Sep	90.00	1.30	117.00	0.00		3.67	1.01	3.69	29.83
317	28-Sep	90.00	1.30	117.00	0.00		3.67	1.00	3.67	26.16
318	29-Sep	90.00	1.30	117.00	0.00		3.67	1.00	3.65	22.50
319	30-Sep	90.00	1.30	117.00	0.00		3.67	0.99	3.63	18.87
320	1-Oct	90.00	1.30	117.00	0.00		4.16	0.98	4.10	14.77
321	2-Oct	90.00	1.30	117.00	0.00		4.16	0.98	4.08	10.70
322	3-Oct	90.00	1.30	117.00	0.00		4.16	0.97	4.05	6.64
323	4-Oct	90.00	1.30	117.00	0.00		4.16	0.97	4.03	2.61
324	5-Oct	90.00	1.30	117.00	0.00	114.39	4.16	0.96	4.01	112.99
325	6-Oct	90.00	1.30	117.00	0.00		4.16	0.96	3.99	109.00
326	7-Oct	90.00	1.30	117.00	0.00		4.16	0.95	3.97	105.04
327	8-Oct	90.00	1.30	117.00	0.00		4.16	0.95	3.94	101.09
328	9-Oct	90.00	1.30	117.00	0.00		4.16	0.94	3.92	97.17
329	10-Oct	90.00	1.30	117.00	0.00		4.16	0.94	3.90	93.27
330	11-Oct	90.00	1.30	117.00	0.00		4.16	0.93	3.88	89.40
331	12-Oct	90.00	1.30	117.00	0.00		4.16	0.93	3.86	85.54
332	13-Oct	90.00	1.30	117.00	0.00		4.16	0.92	3.83	81.71
333	14-Oct	90.00	1.30	117.00	0.00		4.16	0.92	3.81	77.90
334	15-Oct	90.00	1.30	117.00	0.00		4.16	0.91	3.79	74.11
335	16-Oct	90.00	1.30	117.00	0.00		4.16	0.91	3.77	70.34
336	17-Oct	90.00	1.30	117.00	0.00		4.16	0.90	3.74	66.60
337	18-Oct	90.00	1.30	117.00	0.00		4.16	0.89	3.72	62.87
338	19-Oct	90.00	1.30	117.00	0.00		4.16	0.89	3.70	59.17
339	20-Oct	90.00	1.30	117.00	0.00		4.16	0.88	3.68	55.50
340	21-Oct	90.00	1.30	117.00	0.00	35	4.16	0.88	3.66	86.84
341	22-Oct	90.00	1.30	117.00	0.00		4.16	0.87	3.63	83.20
342	23-Oct	90.00	1.30	117.00	0.00		4.16	0.87	3.61	79.59
343	24-Oct	90.00	1.30	117.00	0.00		4.16	0.86	3.59	76.00
344	25-Oct	90.00	1.30	117.00	0.00		4.16	0.86	3.57	72.43
345	26-Oct	90.00	1.30	117.00	0.00		4.16	0.85	3.55	68.89
346	27-Oct	90.00	1.30	117.00	0.00		4.16	0.85	3.52	65.36
347	28-Oct	90.00	1.30	117.00	0.00		4.16	0.84	3.50	61.86
348	29-Oct	90.00	1.30	117.00	0.00		4.16	0.84	3.48	58.38
349	30-Oct	90.00	1.30	117.00	0.00		4.16	0.83	3.46	54.92
350	31-Oct	90.00	1.30	117.00	0.00		4.16	0.83	3.44	51.48
				Total	336.92	1341.91			1640.8	37.98
Total water applied =					**1678.83**		**Total Water used =**		**1678.83**	

Table C.6 Water Balance for Rice using Radiation method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
1	20-Jun	4.98	100.00	5.94	1.00	5.94	5.00	94.04
2	21-Jun	0.00		5.94	1.00	5.94	5.00	83.10
3	22-Jun	0.00		5.94	1.00	5.94	5.00	72.16
4	23-Jun	0.00		5.94	1.00	5.94	5.00	61.22
5	24-Jun	0.00		5.94	1.00	5.94	5.00	50.28
6	25-Jun	4.98		5.94	1.00	5.94	5.00	44.32
7	26-Jun	0.00		5.94	1.00	5.94	5.00	33.38
8	27-Jun	0.00		5.94	1.00	5.94	5.00	22.44
9	28-Jun	0.00		5.94	1.00	5.94	5.00	11.50
10	29-Jun	0.00		5.94	1.00	5.94	5.00	0.56
11	30-Jun	0.00	99.44	5.94	1.00	5.94	5.00	89.06
12	1-Jul	0.00		3.97	1.00	3.97	5.00	80.09
13	2-Jul	25.52		3.97	1.00	3.97	5.00	96.64
14	3-Jul	0.00		3.97	1.00	3.97	5.00	87.67
15	4-Jul	0.00		3.97	1.00	3.97	5.00	78.70
16	5-Jul	0.00		3.97	1.00	3.97	5.00	69.73
17	6-Jul	0.00		3.97	1.00	3.97	5.00	60.76
18	7-Jul	0.00		3.97	1.00	3.97	5.00	51.79
19	8-Jul	0.00		3.97	1.00	3.97	5.00	42.82
20	9-Jul	25.52		3.97	1.00	3.97	5.00	59.37
21	10-Jul	0.00		3.97	1.01	4.00	5.00	50.37
22	11-Jul	0.00		3.97	1.01	4.02	5.00	41.35
23	12-Jul	0.00		3.97	1.02	4.05	5.00	32.30
24	13-Jul	0.00		3.97	1.03	4.08	5.00	23.23
25	14-Jul	0.00		3.97	1.03	4.10	5.00	14.12
26	15-Jul	0.00		3.97	1.04	4.13	5.00	4.99
27	16-Jul	25.52		3.97	1.05	4.16	5.00	21.36
28	17-Jul	0.00		3.97	1.05	4.18	5.00	12.18
29	18-Jul	0.00		3.97	1.06	4.21	5.00	2.97
30	19-Jul	0.00	97.03	3.97	1.07	4.23	5.00	90.77
31	20-Jul	0.00		3.97	1.07	4.26	5.00	81.50
32	21-Jul	0.00		3.97	1.08	4.29	5.00	72.22
33	22-Jul	0.00		3.97	1.09	4.31	5.00	62.90
34	23-Jul	25.52		3.97	1.09	4.34	5.00	79.08
35	24-Jul	0.00		3.97	1.10	4.37	5.00	69.71
36	25-Jul	0.00		3.97	1.11	4.39	5.00	60.32
37	26-Jul	0.00		3.97	1.11	4.42	5.00	50.90
38	27-Jul	0.00		3.97	1.12	4.45	5.00	41.45
39	28-Jul	0.00		3.97	1.13	4.47	5.00	31.98
40	29-Jul	0.00		3.97	1.13	4.50	5.00	22.48
41	30-Jul	25.52		3.97	1.14	4.53	5.00	38.47
42	31-Jul	0.00		3.97	1.15	4.55	5.00	28.92
43	1-Aug	0.00		3.89	1.15	4.49	5.00	19.44

Table C.6 Water Balance for Rice using Radiation method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
44	2-Aug	0.00		3.89	1.16	4.51	5.00	9.92
45	3-Aug	0.00		3.89	1.17	4.54	5.00	0.38
46	4-Aug	0.00	99.62	3.89	1.17	4.56	5.00	90.44
47	5-Aug	0.00		3.89	1.18	4.59	5.00	80.84
48	6-Aug	32.05		3.89	1.19	4.62	5.00	103.28
49	7-Aug	0.00		3.89	1.19	4.64	5.00	93.64
50	8-Aug	0.00		3.89	1.20	4.67	5.00	83.97
51	9-Aug	0.00		3.89	1.20	4.67	5.00	74.30
52	10-Aug	0.00		3.89	1.20	4.67	5.00	64.63
53	11-Aug	0.00		3.89	1.20	4.67	5.00	54.96
54	12-Aug	0.00		3.89	1.20	4.67	5.00	45.30
55	13-Aug	32.05		3.89	1.20	4.67	5.00	67.68
56	14-Aug	0.00		3.89	1.20	4.67	5.00	58.01
57	15-Aug	0.00		3.89	1.20	4.67	5.00	48.34
58	16-Aug	0.00		3.89	1.20	4.67	5.00	38.67
59	17-Aug	0.00		3.89	1.20	4.67	5.00	29.01
60	18-Aug	0.00		3.89	1.20	4.67	5.00	19.34
61	19-Aug	0.00		3.89	1.20	4.67	5.00	9.67
62	20-Aug	32.05		3.89	1.20	4.67	5.00	32.05
63	21-Aug	0.00		3.89	1.20	4.67	5.00	22.38
64	22-Aug	0.00		3.89	1.20	4.67	5.00	12.72
65	23-Aug	0.00		3.89	1.20	4.67	5.00	3.05
66	24-Aug	0.00	96.95	3.89	1.20	4.67	5.00	90.33
67	25-Aug	0.00		3.89	1.20	4.67	5.00	80.66
68	26-Aug	0.00		3.89	1.20	4.67	5.00	71.00
69	27-Aug	32.05		3.89	1.20	4.67	5.00	93.38
70	28-Aug	0.00		3.89	1.20	4.67	5.00	83.71
71	29-Aug	0.00		3.89	1.20	4.67	5.00	74.04
72	30-Aug	0.00		3.89	1.20	4.67	5.00	64.37
73	31-Aug	0.00		3.89	1.20	4.67	5.00	54.71
74	1-Sep	0.00		3.67	1.20	4.40	5.00	45.30
75	2-Sep	0.00		3.67	1.20	4.40	5.00	35.90
76	3-Sep	4.43		3.67	1.20	4.40	5.00	30.92
77	4-Sep	0.00		3.67	1.20	4.40	5.00	21.52
78	5-Sep	0.00		3.67	1.20	4.40	5.00	12.11
79	6-Sep	0.00		3.67	1.20	4.40	5.00	2.71
80	7-Sep	0.00	97.29	3.67	1.20	4.40	5.00	90.60
81	8-Sep	4.43		3.67	1.20	4.40	5.00	85.62
82	9-Sep	0.00		3.67	1.20	4.40	5.00	76.21
83	10-Sep	0.00		3.67	1.20	4.40	5.00	66.81
84	11-Sep	0.00		3.67	1.20	4.40	5.00	57.41
85	12-Sep	0.00		3.67	1.20	4.40	5.00	48.00
86	13-Sep	0.00		3.67	1.20	4.40	5.00	38.60

Table C.6 Water Balance for Rice using Radiation method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
87	14-Sep	0.00		3.67	1.20	4.40	5.00	29.19
88	15-Sep	4.43		3.67	1.20	4.40	5.00	24.21
89	16-Sep	0.00		3.67	1.20	4.40	5.00	14.81
90	17-Sep	0.00		3.67	1.20	4.40	5.00	5.41
91	18-Sep	0.00	94.59	3.67	1.19	4.37	5.00	90.63
92	19-Sep	0.00		3.67	1.18	4.33	5.00	81.30
93	20-Sep	0.00		3.67	1.17	4.29	5.00	72.01
94	21-Sep	0.00		3.67	1.16	4.26	5.00	62.75
95	22-Sep	4.43		3.67	1.15	4.22	5.00	57.96
96	23-Sep	0.00		3.67	1.14	4.18	5.00	48.77
97	24-Sep	0.00		3.67	1.13	4.15	5.00	39.62
98	25-Sep	0.00		3.67	1.12	4.11	5.00	30.51
99	26-Sep	0.00		3.67	1.11	4.07	5.00	21.44
100	27-Sep	0.00		3.67	1.10	4.04	5.00	12.40
101	28-Sep	0.00		3.67	1.09	4.00	5.00	3.40
102	29-Sep	0.00	96.60	3.67	1.08	3.96	5.00	91.04
103	30-Sep	0.00		3.67	1.07	3.93	5.00	82.11
104	1-Oct	0.00		4.16	1.06	4.41	5.00	72.70
105	2-Oct	0.00		4.16	1.05	4.37	5.00	63.33
106	3-Oct	0.00		4.16	1.04	4.33	5.00	54.01
107	4-Oct	0.00		4.16	1.03	4.28	5.00	44.72
108	5-Oct	0.00		4.16	1.02	4.24	5.00	35.48
109	6-Oct	0.00		4.16	1.01	4.20	5.00	26.28
110	7-Oct	0.00	72.00	4.16	1.00	4.16	5.00	89.12
111	8-Oct	0.00		4.16	0.99	4.12	5.00	80.00
112	9-Oct	0.00		4.16	0.98	4.08	5.00	70.92
113	10-Oct	0.00		4.16	0.97	4.04	5.00	61.89
114	11-Oct	0.00		4.16	0.96	3.99	5.00	52.89
115	12-Oct	0.00		4.16	0.95	3.95	5.00	43.94
116	13-Oct	0.00		4.16	0.94	3.91	5.00	35.03
117	14-Oct	0.00		4.16	0.93	3.87	5.00	26.16
118	15-Oct	0.00		4.16	0.92	3.83	5.00	17.33
119	16-Oct	0.00		4.16	0.91	3.79	5.00	8.55
120	17-Oct	0.00		4.16	0.90	3.74	5.00	-0.20
	Total	283.46	853.52	489.82	1.12	537.18	600.00	
Total water applied =		**1136.98**		**Total Water used =**		**1136.98**		

Table C.7 Water Balance for Wheat using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
1	16-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	12.43
2	17-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	11.36
3	18-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	10.30
4	19-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	9.23
5	20-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	8.16
6	21-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	7.09
7	22-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	6.02
8	23-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	4.96
9	24-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	3.89
10	25-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	2.82
11	26-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	1.75
12	27-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	0.68
13	28-Nov	90.00	0.30	27.00	0.00	26.32	2.67	0.40	1.07	25.93
13	29-Nov	90.00	0.30	27.00	0.00		2.67	0.40	1.07	24.86
15	30-Nov	90.00	0.30	27.00	0.00		2.67	0.40	1.07	23.80
16	1-Dec	90.00	0.30	27.00	0.00		1.87	0.40	0.75	23.05
17	2-Dec	90.00	0.30	27.00	0.00		1.87	0.40	0.75	22.30
18	3-Dec	90.00	0.30	27.00	0.00		1.87	0.40	0.75	21.55
19	4-Dec	90.00	0.30	27.00	0.00		1.87	0.40	0.75	20.80
20	5-Dec	90.00	0.30	27.00	0.00		1.87	0.40	0.75	20.06
21	6-Dec	90.00	0.30	27.00	0.00		1.87	0.42	0.79	19.26
22	7-Dec	90.00	0.30	27.00	0.00		1.87	0.45	0.84	18.43
23	8-Dec	90.00	0.30	27.00	0.00		1.87	0.47	0.88	17.54
24	9-Dec	90.00	0.30	27.00	0.00		1.87	0.50	0.93	16.62
25	10-Dec	90.00	0.30	27.00	0.00		1.87	0.52	0.97	15.64
26	11-Dec	90.00	0.31	27.72	0.00		1.87	0.54	1.02	14.63
27	12-Dec	90.00	0.32	28.44	0.00		1.87	0.57	1.06	13.56
28	13-Dec	90.00	0.32	29.16	0.00		1.87	0.59	1.11	12.46
29	14-Dec	90.00	0.33	29.88	0.00		1.87	0.62	1.15	11.30
30	15-Dec	90.00	0.34	30.60	0.00		1.87	0.64	1.20	10.11
31	16-Dec	90.00	0.35	31.32	0.00		1.87	0.66	1.24	8.87
32	17-Dec	90.00	0.36	32.04	0.00		1.87	0.69	1.29	7.58
33	18-Dec	90.00	0.36	32.76	0.00		1.87	0.71	1.33	6.25
34	19-Dec	90.00	0.37	33.48	0.00		1.87	0.74	1.38	4.87
35	20-Dec	90.00	0.38	34.20	0.00		1.87	0.76	1.42	3.45
36	21-Dec	90.00	0.39	34.92	0.00		1.87	0.78	1.47	1.98
37	22-Dec	90.00	0.40	35.64	0.00		1.87	0.81	1.51	0.47
38	23-Dec	90.00	0.40	36.36	0.00	35.89	1.87	0.83	1.56	34.80
39	24-Dec	90.00	0.41	37.08	0.00		1.87	0.86	1.60	33.20
40	25-Dec	90.00	0.42	37.80	0.00		1.87	0.88	1.65	31.56
41	26-Dec	90.00	0.43	38.52	0.00		1.87	0.90	1.69	29.87
42	27-Dec	90.00	0.44	39.24	0.00		1.87	0.93	1.74	28.13
43	28-Dec	90.00	0.44	39.96	0.00		1.87	0.95	1.78	26.35

Table C.7 Water Balance for Wheat using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
44	29-Dec	90.00	0.45	40.68	0.00		1.87	0.98	1.83	24.53
45	30-Dec	90.00	0.46	41.40	0.00		1.87	1.00	1.87	22.66
46	31-Dec	90.00	0.47	42.12	0.00		1.87	1.02	1.91	20.74
47	1-Jan	90.00	0.48	42.84	0.00		1.70	1.05	1.78	18.96
48	2-Jan	90.00	0.48	43.56	0.00		1.70	1.07	1.82	17.14
49	3-Jan	90.00	0.49	44.28	0.00		1.70	1.10	1.86	15.27
50	4-Jan	90.00	0.50	45.00	0.00		1.70	1.12	1.90	13.37
51	5-Jan	90.00	0.51	45.90	0.00		1.70	1.12	1.90	11.47
52	6-Jan	90.00	0.52	46.80	0.00		1.70	1.12	1.90	9.56
53	7-Jan	90.00	0.53	47.70	0.00		1.70	1.12	1.90	7.66
54	8-Jan	90.00	0.54	48.60	0.00		1.70	1.12	1.90	5.75
55	9-Jan	90.00	0.55	49.50	0.00		1.70	1.12	1.90	3.85
56	10-Jan	90.00	0.56	50.40	0.00		1.70	1.12	1.90	1.95
57	11-Jan	90.00	0.57	51.30	0.00		1.70	1.12	1.90	0.04
58	12-Jan	90.00	0.58	52.20	0.00	52.16	1.70	1.12	1.90	50.30
59	13-Jan	90.00	0.59	53.10	0.00		1.70	1.12	1.90	48.39
60	14-Jan	90.00	0.60	54.00	0.00		1.70	1.12	1.90	46.49
61	15-Jan	90.00	0.61	54.90	0.00		1.70	1.12	1.90	44.58
62	16-Jan	90.00	0.62	55.80	0.00		1.70	1.12	1.90	42.68
63	17-Jan	90.00	0.63	56.70	0.00		1.70	1.12	1.90	40.78
64	18-Jan	90.00	0.64	57.60	0.00		1.70	1.12	1.90	38.87
65	19-Jan	90.00	0.65	58.50	0.00		1.70	1.12	1.90	36.97
66	20-Jan	90.00	0.66	59.40	0.00		1.70	1.12	1.90	35.06
67	21-Jan	90.00	0.67	60.30	0.00		1.70	1.12	1.90	33.16
68	22-Jan	90.00	0.68	61.20	0.00		1.70	1.12	1.90	31.26
69	23-Jan	90.00	0.69	62.10	0.00		1.70	1.12	1.90	29.35
70	24-Jan	90.00	0.70	63.00	0.00		1.70	1.12	1.90	27.45
71	25-Jan	90.00	0.71	63.90	0.00		1.70	1.12	1.90	25.54
72	26-Jan	90.00	0.72	64.80	0.00		1.70	1.12	1.90	23.64
73	27-Jan	90.00	0.73	65.70	0.00		1.70	1.12	1.90	21.74
74	28-Jan	90.00	0.74	66.60	0.00		1.70	1.12	1.90	19.83
75	29-Jan	90.00	0.75	67.50	0.00		1.70	1.12	1.90	17.93
76	30-Jan	90.00	0.76	68.40	0.00		1.70	1.12	1.90	16.02
77	31-Jan	90.00	0.77	69.30	0.00		1.70	1.12	1.90	14.12
78	1-Feb	90.00	0.78	70.20	0.00		2.59	1.12	2.90	11.22
79	2-Feb	90.00	0.79	71.10	0.00		2.59	1.12	2.90	8.32
80	3-Feb	90.00	0.80	72.00	0.00		2.59	1.12	2.90	5.42
81	4-Feb	90.00	0.81	72.90	0.00		2.59	1.12	2.90	2.52
82	5-Feb	90.00	0.82	73.80	0.00	71.28	2.59	1.12	2.90	70.90
83	6-Feb	90.00	0.83	74.70	0.00		2.59	1.12	2.90	68.00
84	7-Feb	90.00	0.84	75.60	0.00		2.59	1.12	2.90	65.10
85	8-Feb	90.00	0.85	76.50	0.00		2.59	1.12	2.90	62.20
86	9-Feb	90.00	0.86	77.40	0.00		2.59	1.12	2.90	59.30

Table C.7 Water Balance for Wheat using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Irrig (mm)	Eto (mm)	Kc	ETc (mm)	RAWB
87	10-Feb	90.00	0.87	78.30	0.00		2.59	1.12	2.90	56.40
88	11-Feb	90.00	0.88	79.20	0.00		2.59	1.12	2.90	53.49
89	12-Feb	90.00	0.89	80.10	0.00		2.59	1.12	2.90	50.59
90	13-Feb	90.00	0.90	81.00	0.00		2.59	1.12	2.90	47.69
91	14-Feb	90.00	0.91	81.90	0.00		2.59	1.12	2.90	44.79
92	15-Feb	90.00	0.92	82.80	0.00		2.59	1.12	2.90	41.89
93	16-Feb	90.00	0.93	83.70	0.00		2.59	1.12	2.90	38.99
94	17-Feb	90.00	0.94	84.60	0.00		2.59	1.12	2.90	36.09
95	18-Feb	90.00	0.95	85.50	0.00		2.59	1.12	2.90	33.19
96	19-Feb	90.00	0.96	86.40	0.00		2.59	1.12	2.90	30.29
97	20-Feb	90.00	0.97	87.30	0.00		2.59	1.12	2.90	27.39
98	21-Feb	90.00	0.98	88.20	0.00		2.59	1.12	2.90	24.49
99	22-Feb	90.00	0.99	89.10	0.00		2.59	1.12	2.90	21.59
100	23-Feb	90.00	1.00	90.00	0.00		2.59	1.12	2.90	18.68
101	24-Feb	90.00	1.00	90.36	0.00		2.59	1.12	2.90	15.78
102	25-Feb	90.00	1.01	90.72	0.00		2.59	1.12	2.90	12.88
103	26-Feb	90.00	1.01	91.08	0.00		2.59	1.12	2.90	9.98
104	27-Feb	90.00	1.02	91.44	0.00		2.59	1.12	2.90	7.08
105	28-Feb	90.00	1.02	91.80	0.00		2.59	1.12	2.90	4.18
106	1-Mar	90.00	1.02	92.16	0.00	87.98	3.88	1.11	4.29	87.87
107	2-Mar	90.00	1.03	92.52	0.00		3.88	1.09	4.23	83.64
108	3-Mar	90.00	1.03	92.88	0.00		3.88	1.08	4.17	79.47
109	4-Mar	90.00	1.04	93.24	0.00		3.88	1.06	4.11	75.36
110	5-Mar	90.00	1.04	93.60	0.00		3.88	1.05	4.05	71.31
111	6-Mar	90.00	1.04	93.96	0.00		3.88	1.03	4.00	67.31
112	7-Mar	90.00	1.05	94.32	0.00		3.88	1.02	3.94	63.37
113	8-Mar	90.00	1.05	94.68	0.00		3.88	1.00	3.88	59.49
114	9-Mar	90.00	1.06	95.04	0.00		3.88	0.99	3.82	55.67
115	10-Mar	90.00	1.06	95.40	0.00		3.88	0.97	3.76	51.91
116	11-Mar	90.00	1.06	95.76	0.00		3.88	0.96	3.71	48.20
117	12-Mar	90.00	1.07	96.12	0.00		3.88	0.94	3.65	44.55
118	13-Mar	90.00	1.07	96.48	0.00		3.88	0.93	3.59	40.96
119	14-Mar	90.00	1.08	96.84	0.00		3.88	0.91	3.53	37.43
120	15-Mar	90.00	1.08	97.20	0.00		3.88	0.90	3.47	33.96
121	16-Mar	90.00	1.08	97.56	0.00		3.88	0.88	3.41	30.55
122	17-Mar	90.00	1.09	97.92	0.00		3.88	0.87	3.36	27.19
123	18-Mar	90.00	1.09	98.28	0.00		3.88	0.85	3.30	23.89
124	19-Mar	90.00	1.10	98.64	0.00		3.88	0.84	3.24	20.65
125	20-Mar	90.00	1.10	99.00	0.00		3.88	0.82	3.18	17.47
				Total	0.00	273.62			269.65	3.97
Total water applied =					**273.62**		**Total Water used =**		**273.62**	

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
1	16-Nov	45.00	0.30	13.50	0.00		2.67	0.40	1.07	12.43
2	17-Nov	45.00	0.30	13.65	0.00		2.67	0.40	1.07	11.36
3	18-Nov	45.00	0.31	13.80	0.00		2.67	0.40	1.07	10.30
4	19-Nov	45.00	0.31	13.94	0.00		2.67	0.40	1.07	9.23
5	20-Nov	45.00	0.31	14.09	0.00		2.67	0.40	1.07	8.16
6	21-Nov	45.00	0.32	14.24	0.00		2.67	0.40	1.07	7.09
7	22-Nov	90.00	0.32	28.77	0.00		2.67	0.40	1.07	6.02
8	23-Nov	90.00	0.32	29.07	0.00		2.67	0.40	1.07	4.96
9	24-Nov	90.00	0.33	29.36	0.00		2.67	0.40	1.07	3.89
10	25-Nov	90.00	0.33	29.66	0.00		2.67	0.40	1.07	2.82
11	26-Nov	90.00	0.33	29.95	0.00		2.67	0.40	1.07	1.75
12	27-Nov	90.00	0.34	30.25	0.00		2.67	0.40	1.07	0.68
13	28-Nov	90.00	0.34	30.54	0.00	29.86	2.67	0.40	1.07	29.47
13	29-Nov	90.00	0.34	30.84	0.00		2.67	0.40	1.07	28.40
15	30-Nov	90.00	0.35	31.13	0.00		2.67	0.40	1.07	27.34
16	1-Dec	90.00	0.35	31.43	0.00		1.87	0.40	0.75	26.59
17	2-Dec	90.00	0.35	31.72	0.00		1.87	0.40	0.75	25.84
18	3-Dec	90.00	0.36	32.02	0.00		1.87	0.40	0.75	25.09
19	4-Dec	90.00	0.36	32.31	0.00		1.87	0.40	0.75	24.34
20	5-Dec	90.00	0.36	32.61	0.00		1.87	0.40	0.75	23.60
21	6-Dec	90.00	0.37	32.90	0.00		1.87	0.40	0.75	22.85
22	7-Dec	90.00	0.37	33.20	0.00		1.87	0.40	0.75	22.10
23	8-Dec	90.00	0.37	33.49	0.00		1.87	0.40	0.75	21.35
24	9-Dec	90.00	0.38	33.79	0.00		1.87	0.40	0.75	20.60
25	10-Dec	90.00	0.38	34.08	0.00		1.87	0.40	0.75	19.86
26	11-Dec	90.00	0.38	34.38	0.00		1.87	0.40	0.75	19.11
27	12-Dec	90.00	0.39	34.67	0.00		1.87	0.40	0.75	18.36
28	13-Dec	90.00	0.39	34.97	0.00		1.87	0.40	0.75	17.61
29	14-Dec	90.00	0.39	35.26	0.00		1.87	0.40	0.75	16.86
30	15-Dec	90.00	0.40	35.56	0.00		1.87	0.40	0.75	16.12
31	16-Dec	90.00	0.40	35.85	0.00		1.87	0.41	0.77	15.34
32	17-Dec	90.00	0.40	36.15	0.00		1.87	0.43	0.80	14.54
33	18-Dec	90.00	0.40	36.44	0.00		1.87	0.44	0.83	13.71
34	19-Dec	90.00	0.41	36.74	0.00		1.87	0.46	0.85	12.86
35	20-Dec	90.00	0.41	37.03	0.00		1.87	0.47	0.88	11.98
36	21-Dec	90.00	0.41	37.33	0.00		1.87	0.49	0.91	11.07
37	22-Dec	90.00	0.42	37.62	0.00		1.87	0.50	0.93	10.14
38	23-Dec	90.00	0.42	37.92	0.00		1.87	0.51	0.96	9.18
39	24-Dec	90.00	0.42	38.21	0.00		1.87	0.53	0.99	8.19
40	25-Dec	90.00	0.43	38.51	0.00		1.87	0.54	1.01	7.18
41	26-Dec	90.00	0.43	38.80	0.00		1.87	0.56	1.04	6.14
42	27-Dec	90.00	0.43	39.10	0.00		1.87	0.57	1.07	5.07
43	28-Dec	90.00	0.44	39.39	0.00		1.87	0.58	1.09	3.98
44	29-Dec	90.00	0.44	39.69	0.00		1.87	0.60	1.12	2.86
45	30-Dec	90.00	0.44	39.98	0.00		1.87	0.61	1.15	1.71

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
46	31-Dec	90.00	0.45	40.28	0.00		1.87	0.63	1.17	0.54
47	1-Jan	90.00	0.45	40.57	0.00	40.04	1.70	0.64	1.09	39.48
48	2-Jan	90.00	0.45	40.87	0.00		1.70	0.66	1.11	38.37
49	3-Jan	90.00	0.46	41.16	0.00		1.70	0.67	1.14	37.23
50	4-Jan	90.00	0.46	41.46	0.00		1.70	0.68	1.16	36.07
51	5-Jan	90.00	0.46	41.75	0.00		1.70	0.70	1.19	34.88
52	6-Jan	90.00	0.47	42.05	0.00		1.70	0.71	1.21	33.67
53	7-Jan	90.00	0.47	42.34	0.00		1.70	0.73	1.24	32.43
54	8-Jan	90.00	0.47	42.64	0.00		1.70	0.74	1.26	31.17
55	9-Jan	90.00	0.48	42.93	0.00		1.70	0.76	1.28	29.89
56	10-Jan	90.00	0.48	43.23	0.00		1.70	0.77	1.31	28.58
57	11-Jan	90.00	0.48	43.52	0.00		1.70	0.78	1.33	27.25
58	12-Jan	90.00	0.49	43.82	0.00		1.70	0.80	1.36	25.90
59	13-Jan	90.00	0.49	44.11	0.00		1.70	0.81	1.38	24.52
60	14-Jan	90.00	0.49	44.41	0.00		1.70	0.83	1.40	23.11
61	15-Jan	90.00	0.50	44.70	0.00		1.70	0.84	1.43	21.68
62	16-Jan	90.00	0.50	45.00	0.00		1.70	0.85	1.45	20.23
63	17-Jan	90.00	0.50	45.30	0.00		1.70	0.87	1.48	18.75
64	18-Jan	90.00	0.51	45.59	0.00		1.70	0.88	1.50	17.25
65	19-Jan	90.00	0.51	45.89	0.00		1.70	0.90	1.52	15.73
66	20-Jan	90.00	0.51	46.18	0.00		1.70	0.91	1.55	14.18
67	21-Jan	90.00	0.52	46.48	0.00		1.70	0.93	1.57	12.61
68	22-Jan	90.00	0.52	46.77	0.00		1.70	0.94	1.60	11.01
69	23-Jan	90.00	0.52	47.07	0.00		1.70	0.95	1.62	9.39
70	24-Jan	90.00	0.53	47.36	0.00		1.70	0.97	1.65	7.74
71	25-Jan	90.00	0.53	47.66	0.00		1.70	0.98	1.67	6.07
72	26-Jan	90.00	0.53	47.95	0.00		1.70	1.00	1.69	4.38
73	27-Jan	90.00	0.54	48.25	0.00		1.70	1.01	1.72	2.66
74	28-Jan	90.00	0.54	48.54	0.00		1.70	1.02	1.74	0.92
75	29-Jan	90.00	0.54	48.84	0.00	47.92	1.70	1.04	1.77	47.07
76	30-Jan	90.00	0.55	49.13	0.00		1.70	1.05	1.79	45.28
77	31-Jan	90.00	0.55	49.43	0.00		1.70	1.07	1.81	43.46
78	1-Feb	90.00	0.55	49.72	0.00		2.59	1.08	2.80	40.66
79	2-Feb	90.00	0.56	50.02	0.00		2.59	1.10	2.84	37.83
80	3-Feb	90.00	0.56	50.31	0.00		2.59	1.11	2.87	34.95
81	4-Feb	90.00	0.56	50.61	0.00		2.59	1.12	2.91	32.04
82	5-Feb	90.00	0.57	50.90	0.00		2.59	1.14	2.95	29.09
83	6-Feb	90.00	0.57	51.20	0.00		2.59	1.15	2.99	26.11
84	7-Feb	90.00	0.57	51.49	0.00		2.59	1.17	3.02	23.08
85	8-Feb	90.00	0.58	51.79	0.00		2.59	1.18	3.06	20.02
86	9-Feb	90.00	0.58	52.08	0.00		2.59	1.20	3.10	16.93
87	10-Feb	90.00	0.58	52.38	0.00		2.59	1.21	3.13	13.80
88	11-Feb	90.00	0.59	52.67	0.00		2.59	1.22	3.17	10.63
89	12-Feb	90.00	0.59	52.97	0.00		2.59	1.24	3.21	7.42
90	13-Feb	90.00	0.59	53.26	0.00		2.59	1.25	3.24	4.18

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
91	14-Feb	90.00	0.60	53.56	0.00		2.59	1.25	3.24	0.94
92	15-Feb	90.00	0.60	53.85	0.00	52.91	2.59	1.25	3.24	50.61
93	16-Feb	90.00	0.60	54.15	0.00		2.59	1.25	3.24	47.38
94	17-Feb	90.00	0.60	54.44	0.00		2.59	1.25	3.24	44.14
95	18-Feb	90.00	0.61	54.74	0.00		2.59	1.25	3.24	40.90
96	19-Feb	90.00	0.61	55.03	0.00		2.59	1.25	3.24	37.66
97	20-Feb	90.00	0.61	55.33	0.00		2.59	1.25	3.24	34.43
98	21-Feb	90.00	0.62	55.62	0.00		2.59	1.25	3.24	31.19
99	22-Feb	90.00	0.62	55.92	0.00		2.59	1.25	3.24	27.95
100	23-Feb	90.00	0.62	56.21	0.00		2.59	1.25	3.24	24.71
101	24-Feb	90.00	0.63	56.51	0.00		2.59	1.25	3.24	21.48
102	25-Feb	90.00	0.63	56.80	0.00		2.59	1.25	3.24	18.24
103	26-Feb	90.00	0.63	57.10	0.00		2.59	1.25	3.24	15.00
104	27-Feb	90.00	0.64	57.39	0.00		2.59	1.25	3.24	11.76
105	28-Feb	90.00	0.64	57.69	0.00		2.59	1.25	3.24	8.53
106	1-Mar	90.00	0.64	57.98	0.00		3.88	1.25	4.85	3.68
107	2-Mar	90.00	0.65	58.28	0.00	54.60	3.88	1.25	4.85	53.43
108	3-Mar	90.00	0.65	58.57	0.00		3.88	1.25	4.85	48.58
109	4-Mar	90.00	0.65	58.87	0.00		3.88	1.25	4.85	43.73
110	5-Mar	90.00	0.66	59.16	0.00		3.88	1.25	4.85	38.88
111	6-Mar	90.00	0.66	59.46	0.00		3.88	1.25	4.85	34.03
112	7-Mar	90.00	0.66	59.75	0.00		3.88	1.25	4.85	29.18
113	8-Mar	90.00	0.67	60.05	0.00		3.88	1.25	4.85	24.33
114	9-Mar	90.00	0.67	60.34	0.00		3.88	1.25	4.85	19.48
115	10-Mar	90.00	0.67	60.64	0.00		3.88	1.25	4.85	14.63
116	11-Mar	90.00	0.68	60.93	0.00		3.88	1.25	4.85	9.78
117	12-Mar	90.00	0.68	61.23	0.00		3.88	1.25	4.85	4.93
118	13-Mar	90.00	0.68	61.52	0.00		3.88	1.25	4.85	0.08
119	14-Mar	90.00	0.69	61.82	0.00	61.74	3.88	1.25	4.85	56.97
120	15-Mar	90.00	0.69	62.11	0.00		3.88	1.25	4.85	52.12
121	16-Mar	90.00	0.69	62.41	0.00		3.88	1.25	4.85	47.27
122	17-Mar	90.00	0.70	62.70	0.00		3.88	1.25	4.85	42.42
123	18-Mar	90.00	0.70	63.44	0.00		3.88	1.25	4.85	37.57
124	19-Mar	90.00	0.71	64.18	0.00		3.88	1.25	4.85	32.72
125	20-Mar	90.00	0.72	64.92	0.00		3.88	1.25	4.85	27.87
126	21-Mar	90.00	0.73	65.66	0.00		3.88	1.25	4.85	23.02
127	22-Mar	90.00	0.74	66.39	0.00		3.88	1.25	4.85	18.17
128	23-Mar	90.00	0.75	67.13	0.00		3.88	1.25	4.85	13.32
129	24-Mar	90.00	0.75	67.87	0.00		3.88	1.25	4.85	8.47
130	25-Mar	90.00	0.76	68.61	0.00		3.88	1.25	4.85	3.62
131	26-Mar	90.00	0.77	69.34	0.00	65.72	3.88	1.25	4.85	64.49
132	27-Mar	90.00	0.78	70.08	0.00		3.88	1.25	4.85	59.64
133	28-Mar	90.00	0.79	70.82	0.00		3.88	1.25	4.85	54.79
134	29-Mar	90.00	0.80	71.56	0.00		3.88	1.25	4.85	49.94
135	30-Mar	90.00	0.80	72.30	0.00		3.88	1.25	4.85	45.09

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
136	31-Mar	90.00	0.81	73.03	0.00		3.88	1.25	4.85	40.24
137	1-Apr	90.00	0.82	73.77	0.00		5.43	1.25	6.79	33.46
138	2-Apr	90.00	0.83	74.51	0.00		5.43	1.25	6.79	26.67
139	3-Apr	90.00	0.84	75.25	0.00		5.43	1.25	6.79	19.88
140	4-Apr	90.00	0.84	75.98	0.00		5.43	1.25	6.79	13.09
141	5-Apr	90.00	0.85	76.72	0.00		5.43	1.25	6.79	6.31
142	6-Apr	90.00	0.86	77.46	0.00	71.15	5.43	1.25	6.79	70.67
143	7-Apr	90.00	0.87	78.20	0.00		5.43	1.25	6.79	63.88
144	8-Apr	90.00	0.88	78.93	0.00		5.43	1.25	6.79	57.10
145	9-Apr	90.00	0.89	79.67	0.00		5.43	1.25	6.79	50.31
146	10-Apr	90.00	0.89	80.41	0.00		5.43	1.25	6.79	43.52
147	11-Apr	90.00	0.90	81.15	0.00		5.43	1.25	6.79	36.73
148	12-Apr	90.00	0.91	81.89	0.00		5.43	1.25	6.79	29.95
149	13-Apr	90.00	0.92	82.62	0.00		5.43	1.25	6.79	23.16
150	14-Apr	90.00	0.93	83.36	0.00		5.43	1.25	6.79	16.37
151	15-Apr	90.00	0.93	84.10	0.00		5.43	1.25	6.79	9.58
152	16-Apr	90.00	0.94	84.84	0.00		5.43	1.25	6.79	2.80
153	17-Apr	90.00	0.95	85.57	0.00	82.78	5.43	1.25	6.79	78.79
154	18-Apr	90.00	0.96	86.31	0.00		5.43	1.25	6.79	72.00
155	19-Apr	90.00	0.97	87.05	0.00		5.43	1.25	6.79	65.21
156	20-Apr	90.00	0.98	87.79	0.00		5.43	1.25	6.79	58.42
157	21-Apr	90.00	0.98	88.52	0.00		5.43	1.25	6.79	51.64
158	22-Apr	90.00	0.99	89.26	0.00		5.43	1.25	6.79	44.85
159	23-Apr	90.00	1.00	90.00	0.00		5.43	1.25	6.79	38.06
160	24-Apr	90.00	1.01	90.74	0.00		5.43	1.25	6.79	31.27
161	25-Apr	90.00	1.02	91.48	0.00		5.43	1.25	6.79	24.49
162	26-Apr	90.00	1.02	92.21	0.00		5.43	1.25	6.79	17.70
163	27-Apr	90.00	1.03	92.95	0.00		5.43	1.25	6.79	10.91
164	28-Apr	90.00	1.04	93.69	0.00		5.43	1.25	6.79	4.12
165	29-Apr	90.00	1.05	94.43	0.00	90.30	5.43	1.25	6.79	87.64
166	30-Apr	90.00	1.06	95.16	0.00		5.43	1.25	6.79	80.85
167	1-May	90.00	1.07	95.90	0.00		6.08	1.25	7.60	73.25
168	2-May	90.00	1.07	96.64	0.00		6.08	1.25	7.60	65.65
169	3-May	90.00	1.08	97.38	0.00		6.08	1.25	7.60	58.05
170	4-May	90.00	1.09	98.11	0.00		6.08	1.25	7.60	50.45
171	5-May	90.00	1.10	98.85	0.00		6.08	1.25	7.60	42.85
172	6-May	90.00	1.11	99.59	0.00		6.08	1.25	7.60	35.25
173	7-May	90.00	1.11	100.33	0.00		6.08	1.25	7.60	27.65
174	8-May	90.00	1.12	101.07	0.00		6.08	1.25	7.60	20.05
175	9-May	90.00	1.13	101.80	0.00		6.08	1.25	7.60	12.45
176	10-May	90.00	1.14	102.54	0.00		6.08	1.25	7.60	4.85
177	11-May	90.00	1.15	103.28	0.00	98.43	6.08	1.25	7.60	95.68
178	12-May	90.00	1.16	104.02	0.00		6.08	1.25	7.60	88.08
179	13-May	90.00	1.16	104.75	0.00		6.08	1.25	7.60	80.48
180	14-May	90.00	1.17	105.49	0.00		6.08	1.25	7.60	72.88

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
181	15-May	90.00	1.18	106.23	0.00		6.08	1.25	7.60	65.28
182	16-May	90.00	1.19	106.97	0.00		6.08	1.25	7.60	57.68
183	17-May	90.00	1.20	107.70	0.00		6.08	1.25	7.60	50.08
184	18-May	90.00	1.20	107.85	0.00		6.08	1.25	7.60	42.48
185	19-May	90.00	1.20	108.00	0.00		6.08	1.25	7.60	34.88
186	20-May	90.00	1.20	108.15	0.00		6.08	1.25	7.60	27.28
187	21-May	90.00	1.20	108.30	0.00		6.08	1.25	7.60	19.68
188	22-May	90.00	1.20	108.44	0.00		6.08	1.25	7.60	12.08
189	23-May	90.00	1.21	108.59	0.00		6.08	1.25	7.60	4.48
190	24-May	90.00	1.21	108.74	0.00	104.26	6.08	1.25	7.60	101.14
191	25-May	90.00	1.21	108.89	0.00		6.08	1.25	7.60	93.54
192	26-May	90.00	1.21	109.03	0.00		6.08	1.25	7.60	85.94
193	27-May	90.00	1.21	109.18	0.00		6.08	1.25	7.60	78.34
194	28-May	90.00	1.21	109.33	0.00		6.08	1.25	7.60	70.74
195	29-May	90.00	1.22	109.48	0.00		6.08	1.25	7.60	63.14
196	30-May	90.00	1.22	109.62	0.00		6.08	1.25	7.60	55.54
197	31-May	90.00	1.22	109.77	0.00		6.08	1.25	7.60	47.94
198	1-Jun	90.00	1.22	109.92	0.00		6.13	1.25	7.66	40.28
199	2-Jun	90.00	1.22	110.07	0.00		6.13	1.25	7.66	32.61
200	3-Jun	90.00	1.22	110.21	0.00		6.13	1.25	7.66	24.95
201	4-Jun	90.00	1.23	110.36	11.89		6.13	1.25	7.66	29.18
202	5-Jun	90.00	1.23	110.51	0.00		6.13	1.25	7.66	21.52
203	6-Jun	90.00	1.23	110.66	0.00		6.13	1.25	7.66	13.85
204	7-Jun	90.00	1.23	110.80	0.00		6.13	1.25	7.66	6.19
205	8-Jun	90.00	1.23	110.95	0.00	104.76	6.13	1.25	7.66	103.29
206	9-Jun	90.00	1.23	111.10	0.00		6.13	1.25	7.66	95.63
207	10-Jun	90.00	1.24	111.25	0.00		6.13	1.25	7.66	87.96
208	11-Jun	90.00	1.24	111.39	11.89		6.13	1.25	7.66	92.19
209	12-Jun	90.00	1.24	111.54	0.00		6.13	1.25	7.66	84.53
210	13-Jun	90.00	1.24	111.69	0.00		6.13	1.25	7.66	76.87
211	14-Jun	90.00	1.24	111.84	0.00		6.13	1.25	7.66	69.20
212	15-Jun	90.00	1.24	111.98	0.00		6.13	1.25	7.66	61.54
213	16-Jun	90.00	1.25	112.13	0.00		6.13	1.25	7.66	53.88
214	17-Jun	90.00	1.25	112.28	0.00		6.13	1.25	7.66	46.22
215	18-Jun	90.00	1.25	112.43	11.89		6.13	1.25	7.66	50.44
216	19-Jun	90.00	1.25	112.57	0.00		6.13	1.25	7.66	42.78
217	20-Jun	90.00	1.25	112.72	0.00		6.13	1.25	7.66	35.12
218	21-Jun	90.00	1.25	112.87	0.00		6.13	1.25	7.66	27.46
219	22-Jun	90.00	1.26	113.02	0.00		6.13	1.25	7.66	19.79
220	23-Jun	90.00	1.26	113.16	0.00		6.13	1.25	7.66	12.13
221	24-Jun	90.00	1.26	113.31	0.00		6.13	1.25	7.66	4.47
222	25-Jun	90.00	1.26	113.46	11.89		6.13	1.25	7.66	8.70
223	26-Jun	90.00	1.26	113.61	0.00		6.13	1.25	7.66	1.03
224	27-Jun	90.00	1.26	113.75	0.00	112.72	6.13	1.25	7.66	106.09
225	28-Jun	90.00	1.27	113.90	0.00		6.13	1.25	7.66	98.43

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
226	29-Jun	90.00	1.27	114.05	0.00		6.13	1.25	7.66	90.77
227	30-Jun	90.00	1.27	114.20	0.00		6.13	1.25	7.66	83.10
228	1-Jul	90.00	1.27	114.34	0.00		5.32	1.25	6.65	76.45
229	2-Jul	90.00	1.27	114.49	29.16		5.32	1.25	6.65	98.96
230	3-Jul	90.00	1.27	114.64	0.00		5.32	1.25	6.65	92.31
231	4-Jul	90.00	1.28	114.79	0.00		5.32	1.25	6.65	85.66
232	5-Jul	90.00	1.28	114.93	0.00		5.32	1.25	6.65	79.01
233	6-Jul	90.00	1.28	115.08	0.00		5.32	1.25	6.65	72.36
234	7-Jul	90.00	1.28	115.23	0.00		5.32	1.25	6.65	65.71
235	8-Jul	90.00	1.28	115.38	0.00		5.32	1.25	6.65	59.06
236	9-Jul	90.00	1.28	115.52	29.16		5.32	1.25	6.65	81.57
237	10-Jul	90.00	1.29	115.67	0.00		5.32	1.25	6.65	74.92
238	11-Jul	90.00	1.29	115.82	0.00		5.32	1.25	6.65	68.27
239	12-Jul	90.00	1.29	115.97	0.00		5.32	1.25	6.65	61.62
240	13-Jul	90.00	1.29	116.11	0.00		5.32	1.25	6.65	54.97
241	14-Jul	90.00	1.29	116.26	0.00		5.32	1.25	6.65	48.32
242	15-Jul	90.00	1.29	116.41	0.00		5.32	1.25	6.65	41.67
243	16-Jul	90.00	1.30	116.56	29.16		5.32	1.25	6.65	64.18
244	17-Jul	90.00	1.30	116.70	0.00		5.32	1.25	6.65	57.53
245	18-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	50.88
246	19-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	44.23
247	20-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	37.58
248	21-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	30.93
249	22-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	24.28
250	23-Jul	90.00	1.30	117.00	29.16		5.32	1.25	6.65	46.79
251	24-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	40.14
252	25-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	33.49
253	26-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	26.84
254	27-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	20.19
255	28-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	13.54
256	29-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	6.89
257	30-Jul	90.00	1.30	117.00	29.16		5.32	1.25	6.65	29.40
258	31-Jul	90.00	1.30	117.00	0.00		5.32	1.25	6.65	22.75
259	1-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	16.39
260	2-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	10.03
261	3-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	3.67
262	4-Aug	90.00	1.30	117.00	0.00	113.33	5.09	1.25	6.36	110.64
263	5-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	104.28
264	6-Aug	90.00	1.30	117.00	35.35		5.09	1.25	6.36	133.26
265	7-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	126.90
266	8-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	120.54
267	9-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	114.18
268	10-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	107.81
269	11-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	101.45
270	12-Aug	90.00	1.30	117.00	0.00		5.09	1.25	6.36	95.09

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
271	13-Aug	90.00	1.30	117.00	35.35		5.09	1.24	6.34	124.10
272	14-Aug	90.00	1.30	117.00	0.00		5.09	1.24	6.31	117.79
273	15-Aug	90.00	1.30	117.00	0.00		5.09	1.23	6.28	111.51
274	16-Aug	90.00	1.30	117.00	0.00		5.09	1.23	6.25	105.26
275	17-Aug	90.00	1.30	117.00	0.00		5.09	1.22	6.23	99.03
276	18-Aug	90.00	1.30	117.00	0.00		5.09	1.22	6.20	92.83
277	19-Aug	90.00	1.30	117.00	0.00		5.09	1.21	6.17	86.66
278	20-Aug	90.00	1.30	117.00	35.35		5.09	1.21	6.15	115.86
279	21-Aug	90.00	1.30	117.00	0.00		5.09	1.20	6.12	109.74
280	22-Aug	90.00	1.30	117.00	0.00		5.09	1.20	6.09	103.65
281	23-Aug	90.00	1.30	117.00	0.00		5.09	1.19	6.07	97.58
282	24-Aug	90.00	1.30	117.00	0.00		5.09	1.19	6.04	91.54
283	25-Aug	90.00	1.30	117.00	0.00		5.09	1.18	6.01	85.53
284	26-Aug	90.00	1.30	117.00	0.00		5.09	1.18	5.98	79.55
285	27-Aug	90.00	1.30	117.00	35.35		5.09	1.17	5.96	108.94
286	28-Aug	90.00	1.30	117.00	0.00		5.09	1.17	5.93	103.01
287	29-Aug	90.00	1.30	117.00	0.00		5.09	1.16	5.90	97.10
288	30-Aug	90.00	1.30	117.00	0.00		5.09	1.15	5.88	91.23
289	31-Aug	90.00	1.30	117.00	0.00		5.09	1.15	5.85	85.38
290	1-Sep	90.00	1.30	117.00	0.00		4.32	1.14	4.94	80.43
291	2-Sep	90.00	1.30	117.00	0.00		4.32	1.14	4.92	75.51
292	3-Sep	90.00	1.30	117.00	8.78		4.32	1.13	4.90	79.40
293	4-Sep	90.00	1.30	117.00	0.00		4.32	1.13	4.87	74.52
294	5-Sep	90.00	1.30	117.00	0.00		4.32	1.12	4.85	69.67
295	6-Sep	90.00	1.30	117.00	0.00		4.32	1.12	4.83	64.85
296	7-Sep	90.00	1.30	117.00	0.00		4.32	1.11	4.80	60.04
297	8-Sep	90.00	1.30	117.00	8.78		4.32	1.11	4.78	64.04
298	9-Sep	90.00	1.30	117.00	0.00		4.32	1.10	4.76	59.28
299	10-Sep	90.00	1.30	117.00	0.00		4.32	1.10	4.74	54.55
300	11-Sep	90.00	1.30	117.00	0.00		4.32	1.09	4.71	49.83
301	12-Sep	90.00	1.30	117.00	0.00		4.32	1.09	4.69	45.14
302	13-Sep	90.00	1.30	117.00	0.00		4.32	1.08	4.67	40.47
303	14-Sep	90.00	1.30	117.00	0.00		4.32	1.08	4.64	35.83
304	15-Sep	90.00	1.30	117.00	8.78		4.32	1.07	4.62	39.99
305	16-Sep	90.00	1.30	117.00	0.00		4.32	1.06	4.60	35.39
306	17-Sep	90.00	1.30	117.00	0.00		4.32	1.06	4.58	30.81
307	18-Sep	90.00	1.30	117.00	0.00		4.32	1.05	4.55	26.26
308	19-Sep	90.00	1.30	117.00	0.00		4.32	1.05	4.53	21.73
309	20-Sep	90.00	1.30	117.00	0.00		4.32	1.04	4.51	17.22
310	21-Sep	90.00	1.30	117.00	0.00		4.32	1.04	4.48	12.74
311	22-Sep	90.00	1.30	117.00	8.78		4.32	1.03	4.46	17.06
312	23-Sep	90.00	1.30	117.00	0.00		4.32	1.03	4.44	12.62
313	24-Sep	90.00	1.30	117.00	0.00		4.32	1.02	4.42	8.21
314	25-Sep	90.00	1.30	117.00	0.00		4.32	1.02	4.39	3.81
315	26-Sep	90.00	1.30	117.00	0.00	113.19	4.32	1.01	4.37	112.63

Table C.8 Water Balance for Sugarcane using Modified Penman method

days		RAW (mm/m)	RZ (m)	RAW*RZ	P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	RAWB
316	27-Sep	90.00	1.30	117.00	0.00		4.32	1.01	4.35	108.28
317	28-Sep	90.00	1.30	117.00	0.00		4.32	1.00	4.32	103.96
318	29-Sep	90.00	1.30	117.00	0.00		4.32	1.00	4.30	99.66
319	30-Sep	90.00	1.30	117.00	0.00		4.32	0.99	4.28	95.38
320	1-Oct	90.00	1.30	117.00	0.00		3.80	0.98	3.74	91.64
321	2-Oct	90.00	1.30	117.00	0.00		3.80	0.98	3.72	87.91
322	3-Oct	90.00	1.30	117.00	0.00		3.80	0.97	3.70	84.21
323	4-Oct	90.00	1.30	117.00	0.00		3.80	0.97	3.68	80.53
324	5-Oct	90.00	1.30	117.00	0.00		3.80	0.96	3.66	76.87
325	6-Oct	90.00	1.30	117.00	0.00		3.80	0.96	3.64	73.22
326	7-Oct	90.00	1.30	117.00	0.00		3.80	0.95	3.62	69.60
327	8-Oct	90.00	1.30	117.00	0.00		3.80	0.95	3.60	66.00
328	9-Oct	90.00	1.30	117.00	0.00		3.80	0.94	3.58	62.42
329	10-Oct	90.00	1.30	117.00	0.00		3.80	0.94	3.56	58.86
330	11-Oct	90.00	1.30	117.00	0.00		3.80	0.93	3.54	55.32
331	12-Oct	90.00	1.30	117.00	0.00		3.80	0.93	3.52	51.79
332	13-Oct	90.00	1.30	117.00	0.00		3.80	0.92	3.50	48.29
333	14-Oct	90.00	1.30	117.00	0.00		3.80	0.92	3.48	44.81
334	15-Oct	90.00	1.30	117.00	0.00		3.80	0.91	3.46	41.35
335	16-Oct	90.00	1.30	117.00	0.00		3.80	0.91	3.44	37.91
336	17-Oct	90.00	1.30	117.00	0.00		3.80	0.90	3.42	34.49
337	18-Oct	90.00	1.30	117.00	0.00		3.80	0.89	3.40	31.09
338	19-Oct	90.00	1.30	117.00	0.00		3.80	0.89	3.38	27.71
339	20-Oct	90.00	1.30	117.00	0.00		3.80	0.88	3.36	24.35
340	21-Oct	90.00	1.30	117.00	0.00		3.80	0.88	3.34	21.01
341	22-Oct	90.00	1.30	117.00	0.00		3.80	0.87	3.32	17.69
342	23-Oct	90.00	1.30	117.00	0.00		3.80	0.87	3.30	14.39
343	24-Oct	90.00	1.30	117.00	0.00		3.80	0.86	3.28	11.11
344	25-Oct	90.00	1.30	117.00	0.00		3.80	0.86	3.26	7.85
345	26-Oct	90.00	1.30	117.00	0.00		3.80	0.85	3.24	4.61
346	27-Oct	90.00	1.30	117.00	0.00		3.80	0.85	3.22	1.39
347	28-Oct	90.00	1.30	117.00	0.00	57.00	3.80	0.84	3.20	55.19
348	29-Oct	90.00	1.30	117.00	0.00		3.80	0.84	3.18	52.01
349	30-Oct	90.00	1.30	117.00	0.00		3.80	0.83	3.16	48.85
350	31-Oct	90.00	1.30	117.00	0.00		3.80	0.83	3.14	45.71
				Total	369.88	1300.7			1638.4	32.21
Total water applied =					**1670.59**		**Total Water used =**		**1670.59**	

Table C.9 Water Balance for Rice using Modified Penman method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
1	20-Jun	4.98	100.00	6.13	1.00	6.13	5.00	93.85
2	21-Jun	0.00		6.13	1.00	6.13	5.00	82.72
3	22-Jun	0.00		6.13	1.00	6.13	5.00	71.59
4	23-Jun	0.00		6.13	1.00	6.13	5.00	60.46
5	24-Jun	0.00		6.13	1.00	6.13	5.00	49.33
6	25-Jun	4.98		6.13	1.00	6.13	5.00	43.18
7	26-Jun	0.00		6.13	1.00	6.13	5.00	32.05
8	27-Jun	0.00		6.13	1.00	6.13	5.00	20.92
9	28-Jun	0.00		6.13	1.00	6.13	5.00	9.79
10	29-Jun	0.00	90.21	6.13	1.00	6.13	5.00	88.87
11	30-Jun	0.00		6.13	1.00	6.13	5.00	77.74
12	1-Jul	0.00		5.32	1.00	5.32	5.00	67.42
13	2-Jul	25.52		5.32	1.00	5.32	5.00	82.62
14	3-Jul	0.00		5.32	1.00	5.32	5.00	72.30
15	4-Jul	0.00		5.32	1.00	5.32	5.00	61.98
16	5-Jul	0.00		5.32	1.00	5.32	5.00	51.66
17	6-Jul	0.00		5.32	1.00	5.32	5.00	41.34
18	7-Jul	0.00		5.32	1.00	5.32	5.00	31.02
19	8-Jul	0.00		5.32	1.00	5.32	5.00	20.70
20	9-Jul	25.52		5.32	1.00	5.32	5.00	35.90
21	10-Jul	0.00		5.32	1.01	5.36	5.00	25.54
22	11-Jul	0.00		5.32	1.01	5.39	5.00	15.15
23	12-Jul	0.00		5.32	1.02	5.43	5.00	4.73
24	13-Jul	0.00	95.27	5.32	1.03	5.46	5.00	89.54
25	14-Jul	0.00		5.32	1.03	5.50	5.00	79.04
26	15-Jul	0.00		5.32	1.04	5.53	5.00	68.51
27	16-Jul	25.52		5.32	1.05	5.57	5.00	83.46
28	17-Jul	0.00		5.32	1.05	5.60	5.00	72.86
29	18-Jul	0.00		5.32	1.06	5.64	5.00	62.22
30	19-Jul	0.00		5.32	1.07	5.67	5.00	51.54
31	20-Jul	0.00		5.32	1.07	5.71	5.00	40.83
32	21-Jul	0.00		5.32	1.08	5.75	5.00	30.09
33	22-Jul	0.00		5.32	1.09	5.78	5.00	19.30
34	23-Jul	25.52		5.32	1.09	5.82	5.00	34.01
35	24-Jul	0.00		5.32	1.10	5.85	5.00	23.15
36	25-Jul	0.00		5.32	1.11	5.89	5.00	12.27
37	26-Jul	0.00		5.32	1.11	5.92	5.00	1.34
38	27-Jul	0.00	98.66	5.32	1.12	5.96	5.00	89.04
39	28-Jul	0.00		5.32	1.13	5.99	5.00	78.05
40	29-Jul	0.00		5.32	1.13	6.03	5.00	67.02
41	30-Jul	25.52		5.32	1.14	6.07	5.00	81.47
42	31-Jul	0.00		5.32	1.15	6.10	5.00	70.37
43	1-Aug	0.00		5.09	1.15	5.87	5.00	59.50

Table C.9 Water Balance for Rice using Modified Penman method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
44	2-Aug	0.00		5.09	1.16	5.90	5.00	48.60
45	3-Aug	0.00		5.09	1.17	5.94	5.00	37.66
46	4-Aug	0.00		5.09	1.17	5.97	5.00	26.68
47	5-Aug	0.00		5.09	1.18	6.01	5.00	15.68
48	6-Aug	32.05		5.09	1.19	6.04	5.00	36.69
49	7-Aug	0.00		5.09	1.19	6.07	5.00	25.61
50	8-Aug	0.00		5.09	1.20	6.11	5.00	14.50
51	9-Aug	0.00		5.09	1.20	6.11	5.00	3.40
52	10-Aug	0.00	96.60	5.09	1.20	6.11	5.00	88.89
53	11-Aug	0.00		5.09	1.20	6.11	5.00	77.78
54	12-Aug	0.00		5.09	1.20	6.11	5.00	66.68
55	13-Aug	32.05		5.09	1.20	6.11	5.00	87.62
56	14-Aug	0.00		5.09	1.20	6.11	5.00	76.51
57	15-Aug	0.00		5.09	1.20	6.11	5.00	65.40
58	16-Aug	0.00		5.09	1.20	6.11	5.00	54.29
59	17-Aug	0.00		5.09	1.20	6.11	5.00	43.19
60	18-Aug	0.00		5.09	1.20	6.11	5.00	32.08
61	19-Aug	0.00		5.09	1.20	6.11	5.00	20.97
62	20-Aug	32.05		5.09	1.20	6.11	5.00	41.91
63	21-Aug	0.00		5.09	1.20	6.11	5.00	30.80
64	22-Aug	0.00		5.09	1.20	6.11	5.00	19.70
65	23-Aug	0.00		5.09	1.20	6.11	5.00	8.59
66	24-Aug	0.00	91.41	5.09	1.20	6.11	5.00	88.89
67	25-Aug	0.00		5.09	1.20	6.11	5.00	77.78
68	26-Aug	0.00		5.09	1.20	6.11	5.00	66.68
69	27-Aug	32.05		5.09	1.20	6.11	5.00	87.62
70	28-Aug	0.00		5.09	1.20	6.11	5.00	76.51
71	29-Aug	0.00		5.09	1.20	6.11	5.00	65.40
72	30-Aug	0.00		5.09	1.20	6.11	5.00	54.29
73	31-Aug	0.00		5.09	1.20	6.11	5.00	43.19
74	1-Sep	0.00		4.32	1.20	5.18	5.00	33.00
75	2-Sep	0.00		4.32	1.20	5.18	5.00	22.82
76	3-Sep	4.43		4.32	1.20	5.18	5.00	17.06
77	4-Sep	0.00		4.32	1.20	5.18	5.00	6.87
78	5-Sep	0.00	93.13	4.32	1.20	5.18	5.00	89.82
79	6-Sep	0.00		4.32	1.20	5.18	5.00	79.63
80	7-Sep	0.00		4.32	1.20	5.18	5.00	69.45
81	8-Sep	4.43		4.32	1.20	5.18	5.00	63.69
82	9-Sep	0.00		4.32	1.20	5.18	5.00	53.51
83	10-Sep	0.00		4.32	1.20	5.18	5.00	43.32
84	11-Sep	0.00		4.32	1.20	5.18	5.00	33.14
85	12-Sep	0.00		4.32	1.20	5.18	5.00	22.95
86	13-Sep	0.00		4.32	1.20	5.18	5.00	12.77

Table C.9 Water Balance for Rice using Modified Penman method

days		P (mm)	Net Irrig (mm)	ETo (mm)	Kc	ETc (mm)	Percolation	RAWB
87	14-Sep	0.00		4.32	1.20	5.18	5.00	2.59
88	15-Sep	4.43	97.42	4.32	1.20	5.18	5.00	94.24
89	16-Sep	0.00		4.32	1.20	5.18	5.00	84.06
90	17-Sep	0.00		4.32	1.20	5.18	5.00	73.87
91	18-Sep	0.00		4.32	1.19	5.14	5.00	63.73
92	19-Sep	0.00		4.32	1.18	5.10	5.00	53.63
93	20-Sep	0.00		4.32	1.17	5.05	5.00	43.58
94	21-Sep	0.00		4.32	1.16	5.01	5.00	33.57
95	22-Sep	4.43		4.32	1.15	4.97	5.00	28.03
96	23-Sep	0.00		4.32	1.14	4.92	5.00	18.10
97	24-Sep	0.00		4.32	1.13	4.88	5.00	8.22
98	25-Sep	0.00	91.78	4.32	1.12	4.84	5.00	90.16
99	26-Sep	0.00		4.32	1.11	4.80	5.00	80.37
100	27-Sep	0.00		4.32	1.10	4.75	5.00	70.61
101	28-Sep	0.00		4.32	1.09	4.71	5.00	60.91
102	29-Sep	0.00		4.32	1.08	4.67	5.00	51.24
103	30-Sep	0.00		4.32	1.07	4.62	5.00	41.62
104	1-Oct	0.00		3.80	1.06	4.03	5.00	32.59
105	2-Oct	0.00		3.80	1.05	3.99	5.00	23.60
106	3-Oct	0.00		3.80	1.04	3.95	5.00	14.65
107	4-Oct	0.00		3.80	1.03	3.91	5.00	5.73
108	5-Oct	0.00	94.27	3.80	1.02	3.88	5.00	91.12
109	6-Oct	0.00		3.80	1.01	3.84	5.00	82.29
110	7-Oct	0.00		3.80	1.00	3.80	5.00	73.49
111	8-Oct	0.00		3.80	0.99	3.76	5.00	64.72
112	9-Oct	0.00		3.80	0.98	3.72	5.00	56.00
113	10-Oct	0.00		3.80	0.97	3.69	5.00	47.31
114	11-Oct	0.00		3.80	0.96	3.65	5.00	38.67
115	12-Oct	0.00		3.80	0.95	3.61	5.00	30.06
116	13-Oct	0.00		3.80	0.94	3.57	5.00	21.48
117	14-Oct	0.00		3.80	0.93	3.53	5.00	12.95
118	15-Oct	0.00		3.80	0.92	3.50	5.00	4.45
119	16-Oct	0.00		3.80	0.91	3.46	5.00	-4.00
120	17-Oct	0.00		3.80	0.90	3.42	5.00	-12.42
	Total	283.46	948.74	584.34	1.12	644.63	600.00	
Total water applied =		**1232.20**		**Total Water used =**		**1232.20**		

Table C.10 Crop Irrigation Schedule for Wheat by CROPWAT

ETo station: roorkee Crop: Wheat Planting date: 16/11
Rain station: roorkee Soil: Medium (loam) Harvest date: 30/03

Yield red.: 0.0 %

Crop scheduling options
Timing: Irrigate at 100 % depletion
Application: Refill to 100 % of field capacity
Field eff. 60 %

Table format: Irrigation schedule

Date	Day	Stage	Rain mm	Ks fract.	Eta %	Depl %	Net Irr mm	Deficit mm	Loss mm	Gr. Irr mm	Flow l/s/ha
11 Jan	57	Mid	0.0	1.00	100	50	99.7	0.0	0.0	166.2	0.34
10 Mar	115	End	0.0	1.00	100	50	99.4	0.0	0.0	165.7	0.33
30 Mar	End	End	0.0	1.00	0	25					

Totals:

Total gross irrigation	331.9	mm	Total rainfall	24.8	mm
Total net irrigation	199.1	mm	Effective rainfall	24.7	mm
Total irrigation losses	0.0	mm	Total rain loss	0.1	mm
Actual water use by crop	223.5	mm	Moist deficit at harvest	49.1	mm
Potential water use by crop	223.5	mm	Actual irrigation requirement	198.7	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	99.5	%
Deficiency irrigation schedule	0.0	%			

Yield reductions:

Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.0	0.0	0.0	0.0	0.0	%
Yield response factor	0.20	0.60	0.50	0.50	1.00	
Yield reduction	0.0	0.0	0.0	0.0	0.0	%
Cumulative yield reduction	0.0	0.0	0.0	0.0		%

Table C.11 Crop Irrigation Schedule for Sugercane by CROPWAT

ETo station: roorkee Crop: Sugarcane Planting date: 16/11
Rain station: roorkee Soil: Medium (loam) Harvest date: 15/11

Yield red.: 0.0 %

Crop scheduling options
Timing: Irrigate at 100 % depletion
Application: Refill to 100 % of field capacity
Field eff. 60 %

Table format: Irrigation schedule

Date	Day	Stage	Rain mm	Ks fract.	Eta %	Depl %	Net Irr mm	Deficit mm	Loss mm	Gr. Irr mm	Flow l/s/ha
31 Dec	46	Dev	0.0	1.00	100	50	64.0	0.0	0.0	106.7	0.27
1 Mar	106	Mid	0.0	1.00	100	51	101.4	0.0	0.0	169.0	0.33
28 Mar	133	Mid	0.0	1.00	100	51	100.9	0.0	0.0	168.1	0.72
19 Apr	155	Mid	0.0	1.00	100	51	101.3	0.0	0.0	168.8	0.89
8 May	174	Mid	0.0	1.00	100	51	100.3	0.0	0.0	167.1	1.02
26 May	192	Mid	0.0	1.00	100	53	104.3	0.0	0.0	173.8	1.12
14 Jun	211	Mid	0.0	1.00	100	53	104.7	0.0	0.0	174.5	1.06
2 Oct	321	End	0.0	1.00	100	51	100.1	0.0	0.0	166.8	0.18
13 Nov	363	End	0.2	1.00	100	50	99.3	0.0	0.0	165.5	0.46
15 Nov	End	End	0.0	1.00	0	1					

Totals:

Total gross irrigation	1460.4	mm	Total rainfall	518.9	mm
Total net irrigation	876.2	mm	Effective rainfall	493.6	mm
Total irrigation losses	0.0	mm	Total rain loss	25.3	mm
Actual water use by crop	1321.9	mm	Moist deficit at harvest	1.5	mm
Potential water use by crop	1321.9	mm	Actual irrigation requirement	828.2	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	95.1	%
Deficiency irrigation schedule	0.0	%			

Yield reductions:

Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.0	0.0	0.0	0.0	0.0	%
Yield response factor	0.75	0.55	0.50	0.10	1.20	
Yield reduction	0.0	0.0	0.0	0.0	0.0	%
Cumulative yield reduction	0.0	0.0	0.0	0.0		%

Table C.12 Crop Irrigation Schedule for Rice by CROPWAT

ETo station: roorkee | Crop: Rice | Planting date: 20/06
Rain station: roorkee | Soil: Medium (loam) | Harvest date: 17/10

Yield red.: 0.0 %

Rice scheduling options

Pre puddling:
- Soaking depth on day 1: 0.5 m
- Timing: Irrigate at 20 % depletion of Field Capacity
- Application: Refill soil moisture content to 100 % saturation

Puddling
- Timing: Irrigate at 0 mm waterdepth
- Application: Refill waterdepth to 50 mm

Growth stages
- Timing: Irrigate at 0 mm waterdepth
- Application: Refill waterdepth to 100 mm

Field efficiency: 70 %

Table format: Irrigation schedule

Date	Day	Stage	Rain mm	Ks fract.	Eta %	Puddl state	Percol. mm	Depl. mm	SMNet mm	Gif mm	Loss mm	Depl.SA mm
31 May	-19	PrePu	0.0	1.00	100	Prep	0.0	19	72.4	0.0		48.0
15 Jun	-4	Puddl	0.0	1.00	100	Prep	0.0	9	98.0	0.0		48.0
17 Jun	-2	Puddl	5.9	1.00	100	OK	15.0	0	53.8	0.0		3.8
22 Jun	3	Init	0.0	1.00	100	OK	3.4	0	101.5	0.0		1.5
1 Aug	43	Dev	0.0	1.00	100	OK	3.4	0	101.8	0.0		1.8
10 Sep	83	Mid	0.0	1.00	100	OK	3.4	0	107.6	0.0		7.6
25 Sep	98	End	0.0	1.00	100	OK	3.4	0	100.1	0.0		0.1
11 Oct	114	End	0.0	1.00	100	OK	3.4	0	104.0	0.0		4.0
17 Oct	End	End	0.0	1.00	0	OK	0.0	0				

Totals:

Total gross irrigation	1055.9	mm	Total rainfall	480.5	mm
Total net irrigation	739.1	mm	Effective rainfall	480.5	mm
Total irrigation losses	0.0	mm	Total rain loss	0.0	mm
Total percolation losses	510.7	mm			
Actual water use by crop	522.8	mm	Moist deficit at harvest	0.0	mm
Potential water use by crop	522.8	mm	Actual irrigation requirement	42.3	mm
Efficiency irrigation schedule	100.0	%	Efficiency rain	100.0	%
Deficiency irrigation schedule	0.0	%			

Yield reductions:

Stagelabel	A	B	C	D	Season	
Reductions in ETc	0.0	0.0	0.0	0.0	0.0	%
Yield response factor	1.00	1.09	1.32	0.50	1.10	
Yield reduction	0.0	0.0	0.0	0.0	0.0	%
Cumulative yield reduction	0.0	0.0	0.0	0.0		%