Gashua Journal of Irrigation and Desertification Studies
Available online at www.gjidsfugashua.org.ng
Volume 2, Issue 2

EVALUATION OF IRRIGATION WATER REQUIREMENTS OF SOME CROPS IN DADINKOWA DAM IRRIGATION SCHEME OF NIGERIA

[*1]Alhassan, I., [2]Saddiq, A. M., [1]Gashua, A. G., [1]Dantata, I. J. and [1]Gwio-Kura, K. K.

[1] Federal University Gashua, Yobe State, Nigeria
[2] Modibbo Adama University of Technology, Yola, Nigeria

* Corresponding author's email: ialhassand@gmail.com
Tel: +2348034961817

Abstract

Evapotranspiration is important in evaluation of the irrigation potentialities of various agricultural zones and helps improve the practices of water management and crop production. In this study, meteorological data were collected from Upper Benue River Basin Development Authority, Area office Dadinkowa, Gombe state, Nigeria for the last 15 years (2001-2015). Cabbage, sweet pepper, sweet melon, tomato, wheat and small vegetables were planted during the dry season on the 1st of November. FAO-CROPWAT 8.0 model was used to determine reference evapotranspiration (ET_o) and Crop water requirement (CWR) of various crops grown in Dadinkowa area using crop coefficient and ET_o. The results from CROPWAT model showed that reference evapotranspiration (ET_o) in the study area varied from 3.83 to 5.55 mm/day and effective rainfall of 611.18mm. CWR of cabbage varied from 2.80 to 5.49mm/day, sweet pepper varied from 2.40 to 4.43mm/day, sweet melon varied from 2.03 to 4.30mm/day, tomato varied from 2.40 to 5.18mm/day, wheat varied from 1.20 to 4.66mm/day and small vegetables varied from 2.84 to 3.93mm/day. The scheme irrigation requirement (NIWR) ranged between 0.04 to 0.42 l/s/ha or 0.3 to 3.6 mm/day with an application efficiency of 50%. The gross irrigation requirement of scheme is 206MCM; therefore the dam capacity of 800MCM can meet three times this requirement. For areas such as Dadinkowa, where measured data on climate are readily available, an adaptation of the CROPWAT model serves a tool for the determination of crop and irrigation water requirements of the area and for irrigation planning and management.

Keywords: CropWat, crops, water requirements, irrigation, vegetables, Dadinkowa

INTRODUCTION

Crops need water in sufficient quantity for optimal growth. FAO (1984) defined crop water requirement (CWR) as the depth of water needed to meet the water loss through evapotranspiration of a disease-free crop growing in large fields under non restricting soil conditions in a given growing environment while, irrigation requirements (IR) refer to the water that must be supplied through the irrigation system to ensure that the crop receives its full crop water requirements (FAO, 1984). If irrigation is the sole source of water supply for plants the IR will always be greater than the crop water requirement to allow for inefficiencies in the irrigation system. It is necessary to estimate crop water needs in order to calculate deficiencies in the crop water requirement caused by shortage in precipitation or soil moisture storage capacities. Irrigation systems are designed and constructed to meet water deficits and to ensure that adequate supplies of water to plant at the critical stages of growth are provided. Generally, development of farm water management programmes requires knowledge of when to irrigate and how much water should be provided in order to realize the full potential yield of the crop (Okyereh, 2009).

Proper estimation of crops water requirements is vital to sustainable water management in any given area. Knowing the crop water requirements enables to determinethe proper irrigation schedule at any given time**;** irrigation managers need to calculate the best time to irrigate, and how much water to use so that crops are produced economically, and water resources are managed in a sustainable manner (Diakhate, 2014).Due to difficulty in obtaining accurate field measurements, the prediction methods are applied to determine CWR. The CWR can be estimated using historical, meteorological and cropping conditions. Several methods of estimating CWR were developed from climatic, soil and crop data and used by many researchers, such as Penman, Penman-Monteith, Thornthwaite, Makkink, Rohwer, Priestley-Taylor, Hargreaves and Blaney-Criddle (Xu and Singh, 2002). These methods were modeled into computer softwares for easy operation; some of them need many weather parameters as inputs while others need fewer. The simulation models, information systems and decision support systems can be relevant to support farmer's selection of water-use options, including crop patterns and irrigation systems, and to implement appropriate irrigation scheduling (Diakhate, 2014). Among them FAO softwares, such as *CROPWAT, ET_0 Calculator or AquaCrop*, are nowadays wildly used to calculate CWR and IR and to develop irrigation schedules for different management conditions (FAO, 1992).

Vegetables are the best resource for overcoming micronutrient deficiencies in human nutrition and provide smallholder farmers with much higher income and more jobs per hectare than staple crops (AVRDC, 2006). Most vegetables prefer cooler temperatures, thus productivity is lowest in the hot and humid lowlands (Ali, 2000). Because of these vegetables are mostly grown in the dry season with irrigation in most part of the Sahel, Sudan and Guinea savanna zones due to the relative low temperatures suitable for their growth during the season. The dry season farming depends wholly on irrigation. Dadinkowa dam irrigation project area is situated in Sudan savanna agro-ecological zone which is characterized by short rainfall periods and long dry spells In order to meet the demand for food by the ever growing population in the area, it becomes paramount to exploit and expand all avenues for sustainable food production in the area. Rainfall is erratic and irregular in distribution which affects rain-fed agriculture and resulted in serious decline in output that often culminate in widespread food scarcity and poverty among the local farmers. To reduce the impact of low productivity in rainfed farming, irrigated agriculture has to be encouraged and promoted through rapid expansion of the irrigated area and facilities.

One of the knowledge gap among the smallholder irrigated agriculture farmers in the area and by extension in the Sudan and Sahel savanna region of Nigeria is inadequate data on crops and irrigation water requirements. This lack of information may lead to improper water management and failure of some irrigation schemes, because investigation of water requirements is one of the main steps in the design and planning of an irrigation system. In view of that, this work was aimed to provide an easy methodology for the estimation of the crop water requirements of some vegetable crops (cabbage, sweet pepper, sweet melon, tomato, winter wheat and small vegetables) and the Net Irrigation Water Requirements in Dadinkowa area using *FAO- CROPWAT 8.0* simulation model because of its less intense data requirements and relative ease to use (FAO, 2009).

MATERIALS AND METHOD

Study area

The Dadin Kowa Dam is in Yamaltu local government area of Gombe State in the north east of Nigeria. The dam is located about 35 kilometers to the east of Gombe town, and provides drinking water for the town. It is situated between the following coordinates 10°19′19″N and 10.32194°N; 11°28′54″E and 11.48167°E and altitude of about 370 meters above sea level. The dam was completed by the Federal Government of Nigeria in 1984, with the goal of providing irrigation and electricity for the planned Gongola sugar plantation project. The Dam has a surface area of 300km^2 and a reservoir capacity of 800,000,000m^3 that can potentially irrigate over 25, 000ha of land net downstream which can produce about 20 0,000tons of grains equivalent twice a year that can generate about N6 billion gross (Muazu, 2011). Presently only 100ha is under irrigation, by abstraction of water from the river, due to non completion of the irrigation scheme.

CropWat Model

CROPWAT 8.0 was developed by the FAO using Penman-Monteith method of determination of evapotranspiration. It is a computer program for the calculation of crop water requirements and irrigation requirements based on soil, climate and crop data. CropWat is a practical tool to carry out standard calculations for reference evapotranspiration, crop water requirements, and crop irrigation requirements, and more specifically the design and management of irrigation schemes. CROPWAT 8.0 is based on the DOS versions CROPWAT 5.7 of 1992 and CROPWAT 7.0 of 1999. Based on publication No. 56 of the Irrigation and Drainage Series of FAO, entitled "Crop evapotranspiration - Guidelines for computing crop water requirements" (FAO, 2009a).

CropWat Model Data Input

In order to determine the crop and irrigation water requirements for the crops in the area, four sets of data were collected; these include climate (monthly maximum and minimum temperature, relative humidity, sunshine hour and wind speed), rainfall (mean monthly rainfall), soil (total available soil moisture, maximum rooting depth, initial soil moisture depletion (percentage of total available moisture) and maximum infiltration rate) and crop data (planting date, crop coefficient data files (including Kc values, stage days, root depth, depletion fraction) and the area planted (0-100% of the total area).

Climate

Fifteen years (2001 - 2015) monthly maximum and minimum temperature, relative humidity, sunshine hour and wind speed data were collected from the Upper Benue River Basin Development Authority office in Dadinkowa, Gombe State, Nigeria. The mean values were used in the model for the calculation of reference evapotranspiration (Table 2).

Rainfall

Rainfall data for fifteen years (2000 – 2015) were also collected from the Upper Benue River Basin Development Authority office in Dadinkowa, Gombe State, Nigeria and used for input into CropWat where effective rainfall was calculated (Table 3).

Soil

Soil data were updated from the information generated from the soil surveys carried out by the current authors and other workers in the study area (Table 1).

RESULTS AND DISCUSSION

Soil

The soil of the study has a sandy clay loam texture, slightly acidic, low in major nutrients and CEC and moderate in available soil moisture content (Table 1). This is typical of savanna soils that are highly depleted with poor structurethat requires close monitoring and adoption of best soil management practices to maintain its productivity (Odunze, 2003; Ogunwole and Ogunleye, 2005).

Reference Crop Evapotranspiration

The 15 year climate/ rainfall data used in the determination of reference crop evapotranspiration (ET_o) for the study area showed that minimum ET_o (3.57mm/day) was recorded in the month of September and the maximum (5.55mm/day) was in the month of April. The highest $ET_o$was recorded at the peak of dry season where temperatures are high and the lowest was at the peak of rainy season. The total ET_o for the study area was 1566.15mm (Table 2).

Crop and Irrigation Water Requirements of Crops

The selected crops (cabbage, sweet pepper, sweet melon, tomato, winter wheat and small vegetables) are commonly grown in the area during the dry season. For this research the 1st of November was chosen as the planting date for the determination of the water needs that will reflect the period commonly used by farmers for vegetable production in the study area. Therefore the information to be generated from analysis will be directly relevant and beneficial to farmers in the area for proper irrigation planning and management.

The crop evapotranspiration (ET_c) for cabbage in the Dadinkowa irrigation project area varied from 2.80mm/day to 5.49mm/day and irrigation requirement varied from 28.0mm/decade to 58.1mm/decade, while the total ET_c and irrigation requirement for the Cabbage growing period was 650.70mm and 641.20mm respectively (Table 4). The sweet pepper’s ET_c ranged between 2.40 to 4.42mm/day while irrigation requirement is between 21.90 to 44.9mm/decade with a total ET_c and irrigation requirement for the growing period of 433.8 and 433.2mm respectively (Table 5). Sweet melon minimum crop evapotranspiration and irrigation requirement were 2.03mm/day and 20.2mm/decade, while the maximum were 4.30mm/day and 45.1mm/decade respectively. The total ET_c and irrigation requirement for sweet melon were 394.1 and 393.8mm/ its growing period (Table 6).

The crop evapotranspiration (ET_c)and irrigation requirement of tomato in Dadinkowa varied from 2.40 to 5.18mm/day and 20.1 to 49.8mm/decade, while the total for whole growing period are 558.7 and 555.9mm respectively (Table 7). Adeniran *et al*. (2010) reported 589mm as ET_c for tomato in Kampe Dam irrigation project. For wheat ET_c and irrigation requirements varied from 1.20 to 4.66mm/day and from 12.0 and 49.1mm/decade, with a total of 390.2 and 389.4mm for the cropping period respectively (Table 8). The ET_c and irrigation requirements for small vegetable varied from 2.84 to 3.93mm/day and from 11.8 and 43.1mm/decade and a total of 333.6 and 333.5mm respectively (Table 9).The CWR of these crops indicated a decreasing trend in the order of cabbage>tomato>sweet pepper>sweet melon>wheat>small vegetables like Amaranthus and Lettuce.

Irrigation Requirement for the Scheme

The calculated net scheme irrigation requirements for Dadinkowa irrigation project is 412mm/year (Table 10). This is the total of all net scheme irrigation requirements for the growing period. Taking into account 50% irrigation efficiency the gross scheme irrigation requirements will be 824mm/year which is equivalent to 8240m^3/ha/year. In view of this, the 1000 hectares under irrigation now will require 8.24 MCM to meet the gross irrigation water requirement of the area for the selected vegetables cultivation. The estimated 25, 000 hectares potentially irrigable land for the scheme from the Dadinkowa dam will require irrigation 206 MCM of water. Therefore the Dam capacity of 800 MCM can conveniently irrigate more than three times the potential area (i.e. about 75, 000ha) for the cultivation of cabbage, sweet pepper, sweet melon, tomato, winter wheat and small vegetables during the dry season.

CONCLUSION

For areas such as Dadinkowa, where measured data on temperature, humidity, wind and sunshine duration or radiation are available, CropWat model can effectively and efficiently be utilized for the estimation the crop and irrigation water requirements and for testing the efficiency of different irrigation strategies (e.g., irrigation scheduling, improved irrigation efficiency) under climate change. Considering the selected vegetables scheme net irrigation water requirements (NIWR), the dam capacity can conveniently irrigate more than 75, 000 hectares of land.

ACKNOWLEDGEMENTS

The authors would like to thank the Upper Benue River Basin Development Authority office Dadinkowa, Gombe State, Nigeria for supplying the 15 years meteorological data used in this study area

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Table 1. Soil Physico-chemical properties of the Dadinkowa, Nigeria

Soil Properties	Values
Sand (g/kg)	56.9 *
Silt (g/kg)	18.8 *
Clay (g/kg)	24.3 *
pH	5.75 *
Organic Carbon	6.55 *
Total Nitrogen (g/kg)	0.09 **
Available P (mg/kg)	6.32 **
Potassium (cmol (+)/kg)	0.26 **
Cation Exchange Capacity (cmol (+)/kg)	9.52 **
Field Capacity (%)	21.5 ***
Permanent Wilting Point (%)	7.5 ***
Available Water Capacity (%)	14 ***
Steady Infiltration Rate (mm/day)	390 ***

Source:* Mustapha *et al*., 2010; **Babawuro, 2014 and ***Author's field experiment, 2015

Table 2: Climatic Data and Reference Evapotranspiration of Dadinkowa

Country: Nigeria — Station: Dadinkowa

Altitude: 234m — Latitude: 11.70^{o} N — Longitude: 11.11^{o}E

Month	Min Temp (0C)	Max Temp (0C)	Humidity (%)	Wind (km/day)	Sunshine (hours)	Radiation MJ/m2/day	ET_o (mm/day)
January	22.80	34.70	61.00	68.00	6.80	17.20	3.83
February	24.40	37.40	59.00	88.00	6.60	18.10	4.47
March	27.20	39.90	58.00	94.00	7.20	20.20	5.30
April	28.20	39.70	62.00	98.00	7.20	20.60	5.55
May	26.60	36.00	76.00	89.00	6.60	19.40	4.81
June	24.60	32.50	81.00	84.00	6.80	19.40	4.36
July	24.10	31.50	83.00	81.00	5.40	17.40	3.86
August	23.50	30.00	87.00	73.00	5.80	18.20	3.83
September	23.30	30.10	87.00	64.00	5.20	17.20	3.57
October	24.10	31.90	85.00	57.00	7.30	19.40	4.02
November	23.70	33.70	67.00	57.00	8.20	19.30	4.08
December	22.90	33.70	52.00	68.00	7.30	17.40	3.84
Average	24.62	34.26	71.50	76.75	6.70	18.65	4.29

Table 3: Monthly Rain and Effective Rain for Dadinkowa

Station: Dadinkowa Eff. Rain method: USDA S.C Method

Month	Rain (mm)	Effective rain (mm)
January	0.00	0.00
February	0.00	0.00
March	3.60	3.60
April	16.60	16.20
May	54.80	50.00
June	104.90	87.30
July	187.60	131.30
August	226.20	144.30
September	135.10	105.90
October	84.70	73.20
November	0.00	0.00
December	0.00	0.00
Total	813.50	611.80

Table 4: Crop and Irrigation water requirements of cabbage

ET_o station: Dadinkowa Crop: CABBAGE
Rain station: Dadinkowa Planting date: 01/11

Month	Decade	Growth Stage	Crop Coeff (K_c)	ET_c (mm/day)	ET_c (mm/dec)	Eff. rain (mm/dec)	Irr. Req. (mm/dec)
Nov	1	I	0.70	2.84	28.4	0.1	28.3
Nov	2	I	0.70	2.86	28.6	0	28.6
Nov	3	I	0.70	2.80	28.0	0	28.0
Dec	1	I	0.70	2.75	27.5	0	27.5
Dec	2	D	0.73	2.80	28.0	0	28.0
Dec	3	D	0.79	3.02	33.2	0	33.2
Jan	1	D	0.84	3.23	32.3	0	32.3
Jan	2	D	0.90	3.43	34.3	0	34.3
Jan	3	D	0.95	3.85	42.4	0	42.4
Feb	1	M	1.01	4.29	42.9	0	42.9
Feb	2	M	1.02	4.57	45.7	0	45.7
Feb	3	M	1.02	4.85	38.8	0.1	38.6
Mar	1	M	1.02	5.13	51.3	0.5	50.8
Mar	2	M	1.02	5.41	54.1	0.8	53.3
Mar	3	L	1.02	5.49	60.4	2.3	58.1
Apr	1	L	0.98	5.39	53.9	3.4	50.6
Apr	2	L	0.93	5.23	20.9	1.8	18.7
					650.7	9.1	641.2

Where I = Initial stage, D = Developmental stage, M = Mid-season stage and L = Late-season stage, K_c = crop coefficient, ET_c = crop evapotranspiration, dec = decade (10days), Eff. Rain = Effective rain, Irr. Req = Irrigation requirement

Table 5: Crop and Irrigation water requirements of sweet pepper

ET_o station: Dadinkowa — Crop: SWEET PEPPER
Rain station: Dadinkowa — Planting date: 01/11

Month	Decade	Growth Stage	Crop Coeff (K_c)	ET_c (mm/day)	ET_c (mm/dec)	Eff. rain (mm/dec)	Irr. Req. (mm/dec)
Nov	1	I	0.60	2.44	24.4	0.1	24.2
Nov	2	I	0.60	2.45	24.5	0	24.5
Nov	3	I	0.60	2.40	24.0	0	24.0
Dec	1	D	0.66	2.61	26.1	0	26.1
Dec	2	D	0.78	3.00	30.0	0	30.0
Dec	3	D	0.90	3.47	38.2	0	38.2
Jan	1	M	1.0	3.84	38.4	0	38.4
Jan	2	M	1.01	3.87	38.7	0	38.7
Jan	3	M	1.01	4.08	44.9	0	44.9
Feb	1	M	1.01	4.30	43.0	0	43.0
Feb	2	L	0.99	4.42	44.2	0	44.2
Feb	3	L	0.93	4.40	35.2	0.1	35.1
Mar	1	L	0.88	4.43	22.1	0.3	21.9
					433.8	0.5	433.2

Where I = Initial stage, D = Developmental stage, M = Mid-season stage and L = Late-season stage, K_c = crop coefficient, ET_c = crop evapotranspiration, dec = decade (10days), Eff. Rain = Effective rain, Irr. Req = Irrigation requirement

Table 6: Crop and Irrigation water requirements of sweet melon

ET_o station: Dadinkowa — Crop: SWEET MELON
Rain station: Dadinkowa — Planting date: 01/11

Month	Decade	Growth Stage	Crop Coeff (K_c)	ET_c (mm/day)	ET_c (mm/dec)	Eff. rain (mm/dec)	Irr. Req. (mm/dec)
Nov	1	I	0.50	2.03	20.3	0.1	20.2
Nov	2	I	0.50	2.04	20.4	0	20.4
Nov	3	D	0.52	2.09	20.9	0	20.9
Dec	1	D	0.65	2.57	25.7	0	25.7
Dec	2	D	0.80	3.08	30.8	0	30.8
Dec	3	M	0.95	3.66	40.3	0	40.3
Jan	1	M	1.01	3.89	38.9	0	38.9
Jan	2	M	1.01	3.89	38.9	0	38.9
Jan	3	M	1.01	4.10	45.1	0	45.1
Feb	1	L	1.01	4.30	43.0	0	43.0
Feb	2	L	0.90	4.05	40.5	0	40.5
Feb	3	L	0.77	3.67	29.4	0.1	29.2
					394.1	0.3	393.8

Where I = Initial stage, D = Developmental stage, M = Mid-season stage and L = Late-season stage, K_c = crop coefficient, ET_c = crop evapotranspiration, dec = decade (10days), Eff. Rain = Effective rain, Irr. Req = Irrigation requirement

Table 7: Crop and Irrigation water requirements of tomato

ET_o station: Dadinkowa   Crop: TOMATO
Rain station: Dadinkowa   Planting date: 01/11

Month	Decade	Growth Stage	Crop Coeff (K_c)	ET_c (mm/day)	ET_c (mm/dec)	Eff. rain (mm/dec)	Irr. Req. (mm/dec)
Nov	1	I	0.60	2.44	24.4	0.1	24.2
Nov	2	I	0.60	2.45	24.5	0	24.5
Nov	3	I	0.60	2.40	24.0	0	24.0
Dec	1	D	0.67	2.63	26.3	0	26.3
Dec	2	D	0.80	3.07	30.7	0	30.7
Dec	3	D	0.93	3.58	39.4	0	39.4
Jan	1	M	1.07	4.09	40.9	0	40.9
Jan	2	M	1.11	4.27	42.7	0	42.7
Jan	3	M	1.11	4.50	49.5	0	49.5
Feb	1	M	1.11	4.74	47.4	0	47.4
Feb	2	M	1.11	4.98	49.8	0	49.8
Feb	3	L	1.09	5.18	41.5	0.1	41.3
Mar	1	L	0.99	4.98	49.8	0.5	49.3
Mar	2	L	0.88	4.64	46.4	0.8	45.6
Mar	3	L	0.79	4.25	21.3	1.1	20.1
					558.7	2.7	555.9

Table 8: Crop and Irrigation water requirements of wheat

ET_o station: Dadinkowa   Crop: WHEAT
Rain station: Dadinkowa   Planting date: 01/11

Month	Decade	Growth Stage	Crop Coeff (K_c)	ET_c (mm/day)	ET_c (mm/dec)	Eff. rain (mm/dec)	Irr. Req. (mm/dec)
Nov	1	I	0.30	1.22	12.2	0.1	12.1
Nov	2	I	0.30	1.23	12.3	0	12.3
Nov	3	I	0.30	1.20	12.0	0	12.0
Dec	1	D	0.45	1.75	17.5	0	17.5
Dec	2	D	0.71	2.75	27.5	0	27.5
Dec	3	M	0.99	3.81	41.9	0	41.9
Jan	1	M	1.10	4.23	42.3	0	42.3
Jan	2	M	1.10	4.23	42.3	0	42.3
Jan	3	M	1.10	4.46	49.1	0	49.1
Feb	1	L	1.09	4.66	46.6	0	46.6
Feb	2	L	0.90	4.03	40.3	0	40.3
Feb	3	L	0.66	3.14	25.1	0.1	25.0
Mar	1	L	0.42	2.11	21.1	0.5	20.6
					390.2	0.8	389.4

Table 9: Crop and Irrigation water requirements of small vegetables

ET_o station: Dadinkowa				Crop: SMALL VEGETABLES			
Rain station: Dadinkowa				Planting date: 01/11			
Month	Decade	Growth Stage	Crop Coeff (K_c)	ET_c (mm/day)	ET_c (mm/dec)	Eff. rain (mm/dec)	Irr. Req. (mm/dec)
Nov	1	I	0.7	2.84	28.4	0.1	28.3
Nov	2	I	0.7	2.86	28.6	0	28.6
Nov	3	D	0.76	3.03	30.3	0	30.3
Dec	1	D	0.86	3.38	33.8	0	33.8
Dec	2	D	0.97	3.71	37.1	0	37.1
Dec	3	M	1.01	3.89	42.8	0	42.8
Jan	1	M	1.01	3.89	38.9	0	38.9
Jan	2	L	1.01	3.88	38.8	0	38.8
Jan	3	L	0.97	3.92	43.1	0	43.1
Feb	1	L	0.92	3.93	11.8	0	11.8
					333.6	0.1	333.5

Where I = Initial stage, D = Developmental stage, M = Mid-season stage and L = Late-season stage, K_c = crop coefficient, ET_c = crop evapotranspiration, dec = decade (10days), Eff. Rain = Effective rain, Irr. Req = Irrigation requirement

Table 10: Irrigation Scheme Requirements

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1. Cabbage	109	127.2	162.2	69.3	0	0	0	0	0	0	84.9	88.7	641.30
2. Sweet Peppers	122	122.3	21.9	0	0	0	0	0	0	0	72.8	94.3	433.30
3. Sweet Melon	122.9	112.7	0	0	0	0	0	0	0	0	61.5	96.7	393.80
4. Tomato	133.1	138.5	115	0	0	0	0	0	0	0	72.8	96.4	555.80
5. Winter Wheat	133.6	111.9	20.6	0	0	0	0	0	0	0	36.3	87.0	389.40
6. Small Vegetables	120.7	11.8	0	0	0	0	0	0	0	0	87.2	113.7	333.40
Net scheme irr.req.													
in mm/day	3.6	3.3	1.5	0.3	0	0	0	0	0	0	2.1	2.8	13.60
in mm/month	111.2	93.7	47.9	10.4	0	0	0	0	0	0	62.3	86.5	412.00
in l/s/h	0.42	0.39	0.18	0.04	0	0	0	0	0	0	0.24	0.32	1.59
Irrigated area (% of total area)	90	90	60	15	0	0	0	0	0	0	90	90	
Irr.req. for actual area (l/s/h)	0.46	0.43	0.3	0.27	0	0	0	0	0	0	0.27	0.36	2.09