AGRO-CLIMATIC RISK AND IRRIGATION NEED OF THE NILWALA BASIN, SOUTHERN SRI LANKA

K.D.N.Weerasinghe[1] W.K.B.Elkaduwa[2]
C.R.Panabokke[2]

ABSTRACT

Climate potential in respect to onset, magnitude and risk associated with rainfall for crop production in the Nilwala basin, Southern Sri Lanka was assessed using the daily rainfall of 12 stations scattered in different locations for more than 35 consecutive years (1950-1995). The program CROPWAT was used to assess the irrigation need.

It was revealed that rainfall of the basin increases from south to north with increasing elevation and altitude. Within a 70-km distance in the south north gradient, rainfall elevates from 1656 mm at Kekanadura to 4216 mm at Kudawa.

The net irrigation requirement of Yala rice in different locations varied from 1012 mm to 1246 mm. It was established that the irrigation need in the Nilwala upper catchment is below 40 % of the total water requirement, but in downstream areas it constitutes above 70% of the total water demand. Therefore both the Yala and Maha seasons in Nilwala downstream areas appeared to be unsuitable for rice cultivation without supplementary irrigation.

From April 10th onward until May 20th is the best period for establishment of perennial crops at upper catchment areas. Optimum dates for crop establishment at the mid and lower part of the catchment falls on the 14th meteorological week. It is important to note that delaying crop establishment in Yala by 2 or 3 weeks from the optimum date would result in a considerable increase of irrigation need even in the upper catchment areas; it is not advisable to delay the establishment of Maha rice until October when rice varieties of four month duration are cultivated.

INTRODUCTION

The Nilwala Ganga watershed is situated entirely in the Matara district, southern Sri Lnaka covering 960 sq. km. The river rises in the vicinity of Deniyaya at an altitude of 1050m and flows into the sea at Matara after traversing nearly 72 km.

[1] Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya.
[2] SCORE Project, IWMI, Battaramulla

The rainfall of the basin increases from south to north with the increasing elevation and the altitude.

In respect of the rainfall pattern, the Nilwala upper catchment belongs to the wet and ultra-wet zones and the lower basin to the intermediate zone according to the climate classification of Sri Lanka.

There are five physiological regions in the basin; the flood plain (less than 6m above msl), the mantle plain (less than 50 m msl), highland region (50-300m msl) and the mountain region (300-1000 m msl). The climate gradient of the basin varies with the altitude gradient. In respect of agro-ecology, five agro-ecological zones, namely Wet zone Law country,2 (WL2), Wet zone Low country,4 (WL4), Wet zone Up country ,1 (WU1), Intermediate Low country, 2(IL2) and Wet zone Mid country,1 (WM1) zones are demarcated in the basin according to the agro-ecological map of Sri Lanka.

The present study deals with the rainfall probabilities and climatic water balance of the Nilwala watershed to improve the agronomy of the major crops grown in the basin with a particular emphasis on paddy and tea, which are the major crops grown in the area.

The major objective of the study is to identify optimum cropping calendars and planting times for major crops in different agro-ecological regions of the basin. This includes the ideal time for the commencement of tea and paddy while identifying the critical water deficit periods based on the water balance to provide supplementary irrigation.

When the genetic composition management and soil fertility level are at optimum, the ultimate growth and development of any crop is mainly governed by the weather regime. If a particular crop is considered, the limitation in climatic conditions to achieve high yields vary with the growth stage. Therefore, land use, cropping pattern and production schedules in a given geographical area are influenced by characteristics of rainfall and other climatic factors while influencing the farming operations besides crop growth.

Among climatic parameters in the tropics, rainfall shows the greatest spatial and temporal variations. There for the analysis of agro-climatic data in respect of a given amount of rainfall is extremely useful for agricultural operational planning. Studies in Sri Lanka by Parnabokke and Walgama (1974) have closely demonstrated that the arithmetic mean usually calculated directly from rainfall figures does not take into account the inherent skewness of the raw data that results from a large amount of rain falling in heavy tropical downpours thereby raising the mean level much above the normal amount of rainfall received or expected. Abeyasekara et al., (1983) have shown that the past attempts to use total or average values of rainfall for identification the best times for crop establishment

has many inherent limitations such as lack of information on dry spells, etc. This is because the successful establishment of a crop depends not only on the soil moisture status at the time of planting but also on the length and repetition of dry periods during the crop season. Therefore the recommendations based on mean monthly averages may sometimes be hazardous as shown by Oldeman and Frere (1982).

It is worthwhile to consider the suggestions made by Krishnan (1980) to consider the week as the unit of time in the tropics where the rainfall is highly erratic in intensity, amount and distribution. This helps to take decisions based on the probability of receiving a certain amount of rainfall during a week to select crops and to identify the ideal time of planting while avoiding probable water stress periods and floods during sensitive phenological phases etc. This approach was widely used by Robertson (1976), Virmani (1980), and Virmani et. al., (1982) to characterise the agro-climatological potential in different locations.

MATERIALS AND METHODS

Daily rainfall data from 21 rain gauge stations in the Nilwala basin for the period of 1950-1995 were collected from the meteorological department for the analysis. However the continuous data were available for 12 stations (Table 1) which were selected for the analysis. Consistency of the data was assessed by the double mass curve and regression analysis for each pair of stations.

Within the Nilwala basin, actual pan evaporation data for a long period were available only at the university meteorological station, Mapalana. They were used to calculate potential evaporation for the locations situated at the Nilwala downstream.

The available data of average temperature and relative humidity of the Deniyaya station were used to calculate the potential evaporation for Nilwala upper catchment area using the Ivanov's model that has been tested for Sri Lanka in previous studies. (Weerasinghe, 1986)

The computer program "first" (Weerasinghe, Sabatier, Luc, 1990) has been used for rainfall probability assessment based on Markov Chain procedure. The computer programs BIL (developed at IRAT/CIRAD,Montpellier, France, (Franquin and Forest, 1982) and "CROPWAT" were used for computation of water balance and irrigation need.

RESULTS AND DISCUSSION

Annual and monthly rainfall statistics of the NILWALA rainfall: The locations of the rain-gauge stations, mean annual rainfall and the annual rainfall at 75 % probability levels are given in table 1.

Table.1 location of rain gauge stations and the annual rainfall

Station	Database	Lati-tude	Longi-tude	Altitude (m)	Mean Annual rainfall mm	De-pen-dable .Rf (mm)#	Zone *
Kudawa	1980 –95	6.28'	80.25'	600	4216	2829	WU1
Anninkanda	1951-95	6.35'	80.32'	554	3867	2593	WU1
Panilkanda	1951-95	6.22'	80.38'	600	3092	2100	WU1
Arpthorp	1985 – 95	6. 13'	80. 20'	100	3246	2172	WM1
Mawarala	1951- 94	6.12'	80.35'	200	3041	2033	WM2
Hiyare	1951- 95	6.05'	80.20'	<30	2796	1867	WL2
Mapalana	1951- 95	6.03'	80.34'	58	2352	1567	WL2
Tihagoda	1951- 95	6.01'	80.34'	50	2041	1356	WL4
Kekanadura	1957- 92	5.58'	80.35'	<30	1656	1096	WL4
Charley Mount	1951-95	5.58'	80.28'	20	2527	1685	WL4
Dandeniya	1951-95	6.00'	80.39'	30	1686	1146	IL2
Denagama	1951-95	6.06'	80.39'	<30	1863	1236	IL2

* Agro-ecological zones as identified in the Agroecological map
# At 75 % probability level

It is evident that the mean annual rainfall in Kudawa, Arpthorp and Anninkanda, exceeds 3810 mm and are in the ultra-wet zone according to the National Atlas (Agro-Ecology) of Sri Lanka. Mawarala, Hiyare, Panilkanda, Charley Mount and Mapalana receives greater than 2160 mm of rains, which is typical for the wet-zone. Thihagoda and Kekanadura come under the Wet zone Low country (WL4) according to the agro-ecological map. However with respect to dependable rainfall as well as annual rainfall, these two locations appeared to be much drier and are representative of IL2 zones as in the case of Dandeniya and Denagama stations.

Rainfall of the Nilwala basin increases from south to north with the elevation and altitude increase. The topography strongly influences the spatial distribution of rainfall, thus comparatively high rainfall is observed in the Deniyaya region. The dryness prevailing in the eastern part of the area is evident from the rainfall figures of the Dandeniya, Denagama, and Kekanadura stations. It appears that within a 70 km distance in a south - north gradient, rainfall elevates from 1656mm

(Kekanadura) to 4216 mm (Kudawa) and in a west -east gradient rainfall decreases from 2527mm (Charley Mount) to 1686 mm (at Dandeniya).

The dominant characteristics of the rainfall in all the locations are the bimodal rainfall distribution with two dry periods, one at January-February and second at July- August. Thus the rainfall pattern may be conveniently discussed in terms of Yala and Maha rains.

The rainfall year could be differentiated in to following cycles based on the types of rains received during the Yala and Maha seasons.

Months	**Yala season**	**Months**	**Maha season**
March - April	Convectional rains	Oct.-Nov.	Convectional rains
May - Sept	South-west Monsoon	Dec.-Feb.	North-east Monsoon

Table 2 indicates the average monthly rainfall at the different locations. According to Oldeman's (1980) criteria, wet months for rice would be a month with more than 200 mm rains and there should be at least three consecutive wet months in the season to cultivate wetland rice without irrigation. As experience reveals, the criteria of 200 mm may hold true for fluvial rice; it can be less for phreatic rice lands where lateral seepage of ground water occurs in areas such as the upper Nilwala catchment. Nevertheless water requirement for dryland crops could be met with an average monthly precipitation of about 90 mm. (Oldeman, 1980).

Table 2. average monthly rainfall (mm) at different locations of the Nilwala basin.

STATIONS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kudawa	171	117										177
Anningkanda							191					
Panilkanda	198						169	179				
Arpthorp	115	87	180									
Mawarala	160	146					178					
Hiyare	133	140	190									
Mapalana	122	96	117	162		224	150	169				163
Tihagoda	71	54	91	176		212	171					116
Kekanadura	72	45	75	106		155	127	141	172			120
Charley Mont	95	75	109	175			147	155				149
Dandeniya	69	51	76	137		167	148	147	189		172	94
Denagama	107	94	124	146		161	114	110	163			172

It is evident from table 2 that in the upper Nilwala regions, the number of wet months with more than 200 mm in the annual cycle is 9-10 months and towards the flood plain, the number of wet months becomes considerably less. For instances, in Mapalana and Thihagoda, there are only 2 wet months in the Yala

season and 3 to 4 wet months in the Maha season. Both Yala and Maha seasons in Dandeniya and Denagama seem to be not suitable for rice cultivation without supplementary irrigation. Minor tanks in the Nilwala basin are concentrated in WL2, WL4, IL1, and IL2 agro-ecological regions, which is a clear indication of the historical acceptance of irrigation water requirement in these areas, where rice could not be grown without supplementary irrigation.

Initial probability of rainfall: In a growing season of a given crop, a decision has to be made many times based on the probability of receiving certain amount of rainfall during a given week. A weekly rainfall of 10 mm at 75 % probability is considered in the present work as the sufficient level to satisfy the moisture requirement of the crops in three out of four years. This criterion is adopted by many authors in demarcating the wet and dry periods (Virmani 1976, Virmani et al 1982, Oldeman 1980) .

Commencement of the Yala and Maha seasons in respect to the 10 mm rainfall limit at 75% probability at different locations are highlighted in the table 3. It is evident that the 10^{th} to 50^{th} meteorological weeks are wet in Kudawa. In Anninkanda, wet weeks in Yala and Maha seasons fall during the 9^{th} to 29^{th} and 35^{th} to 52^{nd} weeks. It is evident that the duration of the Yala season as well as Maha season is much shorter in Nilwala downstream and in the flood plain. It is worth noting the prevailing dryness in Denagama, Dandeniya, Thihagoda Kekenadura compared to Mapalana in both Yala and Maha seasons.

Optimum cropping calendar and planting time of rice: The optimum cropping calendar and planting time based on the water balance, calculated by "CROPWAT" for the rice in Yala and Maha seasons are given in tables 4 and 5. The optimum date of crop commencement was simulated by changing the date of planting and assessing the irrigation requirement. When cropping date is changed, the irrigation requirement is also changed, so the optimum date of planting was selected on the basis of the least irrigation requirement.

Table 3 Initial probability of weekly rains (Limit 10 mm)

Week	Kuda-wa	Annin-kan	Panilk-anda	Arpth-orp	Mawa-rala	Hiyara	Mapal-ana	Tihag-oda	Kek'd-ura	Char-ley	Dand-eniya	Denag-ama
1	81	77	70	64	53	63	51	40	28	51	27	51
2	68	77	77	61	63	65	63	54	42	63	54	60
3	56	70	75	41	56	39	46	30	33	48	38	54
4	62	59	75	54	60	63	44	35	17	44	38	49
5	44	68	75	45	56	51	51	30	36	51	40	39
6	56	61	70	50	49	51	40	40	19	46	32	44
7	56	66	65	52	60	53	40	37	42	41	22	47
8	31	70	77	59	74	63	46	30	33	51	41	53
9	63	86	83	56	63	72	53	49	33	61	38	49
10	75	82	73	63	67	67	51	30	25	56	22	60
11	94	86	85	66	76	74	58	19	28	54	35	56
12	56	95	95	57	79	67	62	43	28	61	54	53
13	88	93	90	64	81	79	49	54	31	44	57	56
14	88	95	80	66	88	74	72	57	55	76	57	74
15	88	84	73	66	74	76	60	59	42	59	54	70
16	100	95	88	80	86	86	74	68	50	85	59	84
17	100	95	88	89	95	86	84	76	61	78	62	77
18	42	91	93	86	90	81	77	76	75	78	73	67
19	93	86	80	84	86	81	74	70	69	76	67	67
20	100	89	80	86	83	83	77	62	72	78	81	65
21	94	91	72	82	88	81	74	68	64	78	70	81
22	94	91	75	90	86	81	81	68	81	83	76	86
23	94	86	75	91	88	84	88	70	69	87	73	81
24	88	79	75	89	86	84	76	73	72	78	62	67
25	94	84	80	89	77	79	72	65	72	76	68	72
26	88	86	85	75	74	72	74	81	78	76	73	63
27	88	75	58	70	70	67	65	62	67	73	65	56
28	94	81	65	84	81	81	74	59	69	83	54	74
29	88	81	65	80	65	72	65	54	64	76	59	63
30	81	70	65	77	60	74	70	56	58	66	65	56
31	81	68	60	73	72	67	65	51	42	59	65	51
32	88	79	65	75	74	70	63	78	64	73	54	67
33	75	73	63	73	74	70	63	70	69	66	57	60
34	81	68	73	63	63	72	58	54	53	59	59	49
35	87	75	70	70	70	74	63	59	53	61	68	63
36	69	82	68	64	65	60	58	51	53	68	57	60
37	75	81	80	77	79	76	77	70	61	78	70	67
38	88	84	78	86	86	91	77	70	64	83	81	72
39	88	86	73	86	81	79	83	81	75	83	70	74
40	88	84	70	80	76	79	74	70	69	73	73	70
41	88	86	85	5	79	67	79	65	69	88	78	72
42	88	84	85	80	79	72	81	70	72	83	76	79
43	88	84	88	82	88	74	76	86	75	93	81	81
44	94	95	85	89	93	74	88	81	89	93	86	98
45	94	95	83	89	86	72	81	76	92	88	81	95
46	94	100	85	84	88	81	91	78	83	93	7	93
47	81	86	83	73	88	81	84	73	7	80	73	86
48	69	89	80	77	83	81	79	65	69	80	57	81
49	88	93	88	70	88	74	84	62	53	71	49	91
50	88	80	78	59	70	65	63	49	44	61	35	63
51	63	89	70	61	88	70	67	49	58	71	35	67
52	50	93	83	79	81	79	63	59	58	76	54	74

Table 4. Irrigation requirement of Yala rice depending on the date of crop establishment.

DATE	Kudawa	Anninkanda	Panilkanda	Arpthorp	Mawarala	Hiyare	Mapalana	Tihagoda	Kekanadura	Charley Mount	Dandeniya	Denagama
Mar. 15	248	234	466	641	454	606	720	802	857	660	893	803
Mar. 20	205	213*	455	562	426	560	672	755	806	608	855	760
April 01	183	233	453*	456	411*	522	621	711	754	556	820	718
April 10	161	266	466	365	415	521*	607*	699*	736*	542*	808*	711*
April 20	145*	305	493	322*	437	565	639	729	760	575	824	747
April 30	144	360	530	333	471	630	694	782	806	633	854	806
May 10	145	413	566	364	505	691	744	835	849	692	887	866
May 20	145	462	599	396	540	742	787	886	884	750	923	922
May 30	160	509	630	443	573	782	822	930	914	802	957	970

- Optimum date of crop establishment for maximum rainfall utility

Table 5. Irrigation Requirement of Maha Rice depending on the date of crop establishment.

Date	Kudawa	Anningkanda	Panilkanda	Arpthorp	Mawarala	Hiyare	Mapalana	Tihagoda	Kekanadura	Charley	Dandeniya	Denagama
July 30	228	528	673	544	558	755	767	871	952	744	921	1074
Aug 10	200	468	621	482	494	684	691	817	898	676	880	998
Aug 20	354	413	580	450	439	663	668	798	882	646	866	923
Sep. 01	415	363	557	463	412	669	675	805	894	641	873	863
Sep. 10	473	345	531	483	417	690	696	825	914	653	894	820
Sep 20	530	357	500	503	437	724	729	859	938	681	930	820
Sep. 25	244*	230*	347*	376*	312*	606*	613*	744*	818*	563*	817*	699*
Sep. 30	592	389	465	532	474	770	773	905	969	724	974	843

* Optimum date of crop establishment for maximum rainfall utility

It is evident from table 4 that the optimum date for crop establishment at Kudawa falls on April 20th, since there would be sufficient rainfall until the 2nd week of August to meet the crop water demand. However it is worth noting that from April 10th onward until May 20th is the best period for crop as establishment at Kudawa. Analogically, dates for crop establishment at Nilwala upper catchment areas fall on March 20th at Anninkanda, April 1st at Paninkanda, April 20th at Arpthorp and April 1st at Mawarala areas.

The optimum dates for crop establishment at the mid and lower part of the catchment fall on 10th April. However it is worth noting the increment of irrigation water requirement in these areas compared to the upper catchment areas due to the prevailing dryness in lower and mid areas of the catchment.

In respect to the crop establishment in Yala season, one should keep in mind that delaying it by 2 or 3 weeks from the optimum date would result in a considerable increase of irrigation water need even in the upper catchment areas. Therefor, it is important to assure the establishment of the Yala crop before the Sinhala-Tamil New Year. This is the actual practice accepted by the farmers as experienced in many locations of the Nilwala areas and reported by Elkaduwa in 1997.

Optimum planting time for rice in Maha season.: It is evident from table 5 that Sep 25th is the optimum date of crop establishment for the Maha rice. This agrees with the results of the survey conducted by Elkaduwa (1997), by interviewing the farmers in the Nilwala upper catchment areas. According to the farmer's experience, the best period for crop establishment in Yala falls on April 10th and Maha in the latter part of the September.

It is evident that delay of cropping date beyond September 25th will result with the increase of irrigation water demand. Delay of the crop establishment will increase the water demand in January and February which are very dry at all the locations. As such it is not recommended to delay the crop until October when four-month varieties are cultivated.

Irrigation Requirement of Rice: Total water requirement, effective rainfall and the percentage irrigation demand from the total water need during the Yala and Maha seasons in different locations are given in tables 6 and 7.

In general the total water requirement of the Yala crop varies from 1012 - 1457 mm in different locations which agrees with the crop water need of rice under prevailing climatological situations in Nilwala areas. The irrigation requirement increases in the drier part of the Nilwala areas, which is associated with a decrease in effective rainfall. It is evident that irrigation need is below 40% in the Nilwala upper catchment, but it is considerably increases in the drier part. When the irrigation requirement exceeds 50% of the total, the risk will be very high. As indicated by the data, Dandeniya and Denagama have very high irrigation water

demand, which constitutes above 70% of the total water demand. As such, rice in those areas cannot be cultivated if irrigation facilities are not provided.

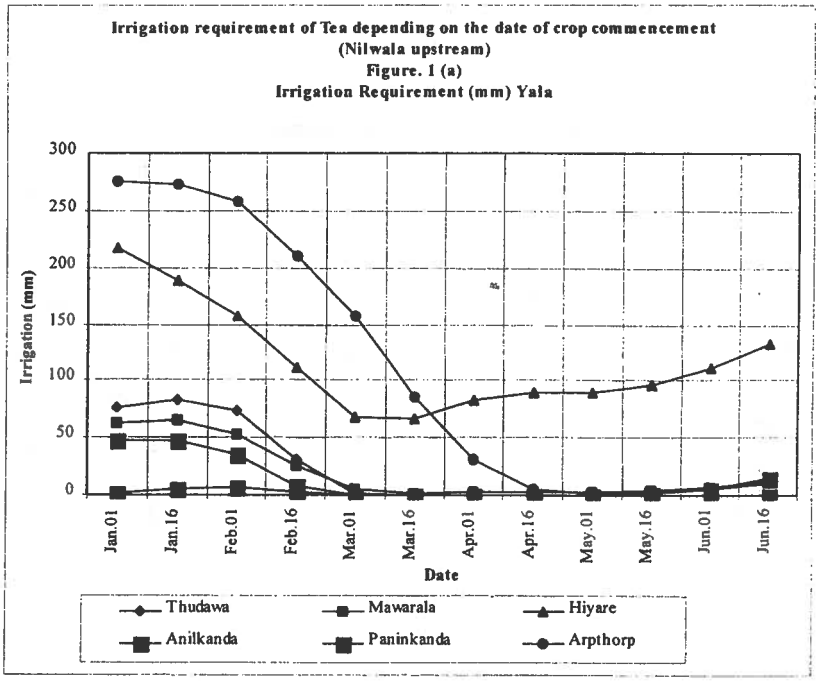
Table.6 Effective rainfall and Irrigation water requirement of rice during the Yala season

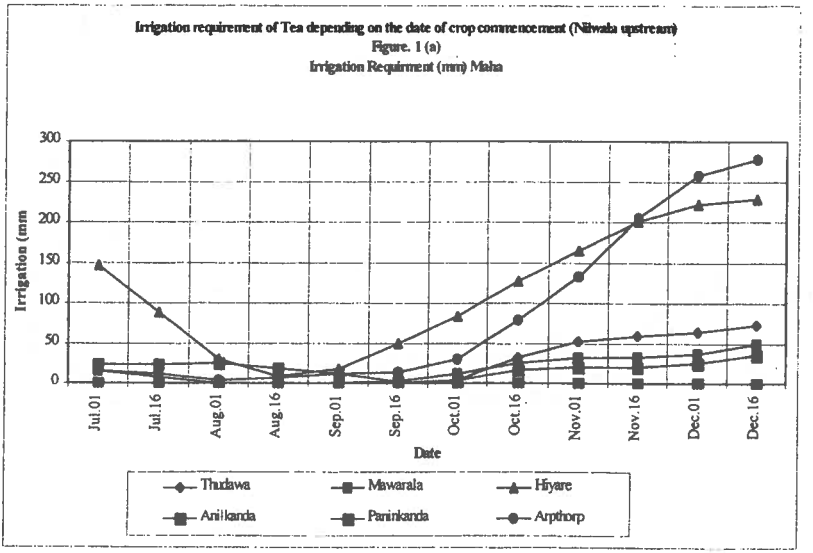
Station	Total water requirement	Effective rainfall	Irrigation requirement	Percentage irrigation requirement
Kudawa	1457	1293	164	11,25
Anningkanda	1085	872	213	19.63
Panilkanda	1042	589	453	43.47
Arpthorp	1070	748	322	30.09
Mawarala	1042	631	411	39.44
Hiyare	1016	494	521	20.22
Mapalana	1014	407	607	59.86
Tihagoda	1012	313	699	69.07
Kekanadura	1013	277	736	50.18
Charley Mount	1015	473	542	53.40
Dandeniya	1061	253	808	76.15
Denagama	1013	302	711	70.19

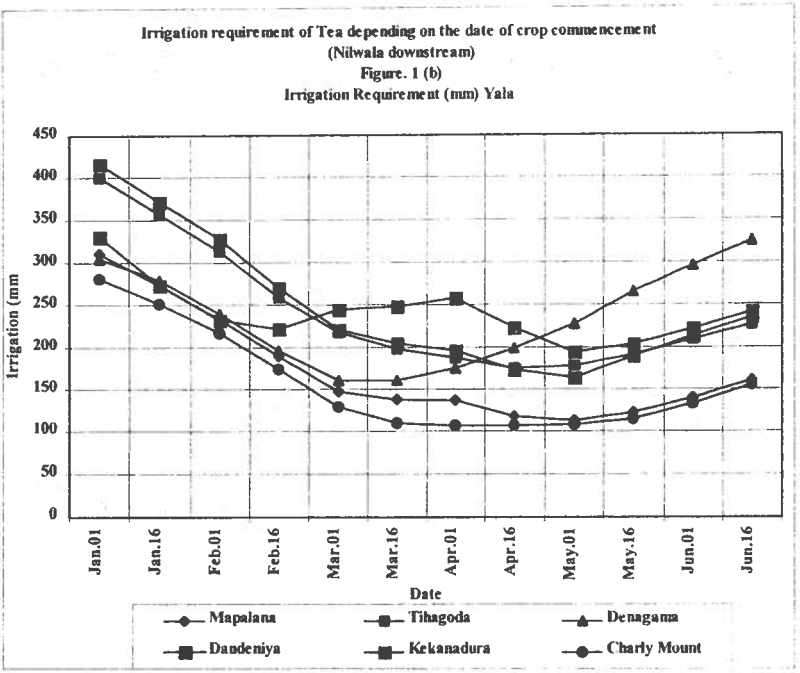
Table.7 Effective rainfall and irrigation water requirement of rice during the Maha season.

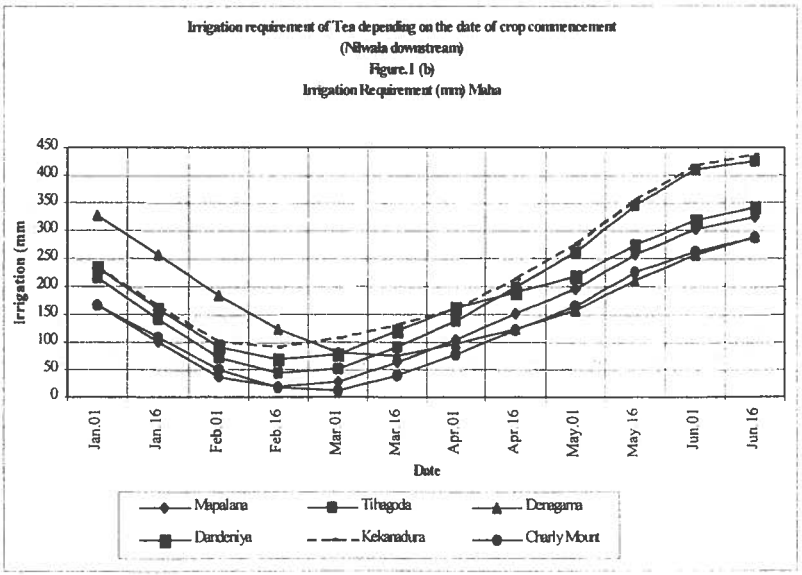
Station	Total water requirement	Effective rainfall	Irrigation requirement	Percentage irrigation requirement
Kudawa	1262	1018	244	19.38
Anningkanda	1175	945	230	19.5
Panilkanda	1042	695	347	33.33
Arpthorp	1201	825	376	31.30
Mawarala	1078	767	312	28.94
Hiyare	1143	537	606	53.01
Mapalana	1148	535	613	53.39
Tihagoda	1012	313	699	69.07
Kekanadura	1157	339	818	70.70
Charleymount	1148	584	563	49.04
Dandeniya	1155	338	817	70.73
Denagama	1163	464	699	60.01

Planting dates and irrigation requirement of tea and perennial crops: The most suitable dates for planting tea in the Nilwala areas based on the water balance is given in fig.1 (a,b)


Irrigation requirement of Tea depending on the date of crop commencement
(Nilwala upstream)
Figure. 1 (a)
Irrigation Requirement (mm) Yala
Irrigation (mm)
300
250
200
150
100
50
0
Jan.01
Jan.16
Feb.01
Feb.16
Mar.01
Mar.16
Apr.01
Apr.16
May.01
May.16
Jun.01
Jun.16
Date
Thudawa
Mawarala
Hiyare
Anilkanda
Paninkanda
Arpthorp


Irrigation requirement of Tea depending on the date of crop commencement (Nilwala upstream)
Figure. 1 (a)
Irrigation Requirment (mm) Maha
Irrigation (mm
300
250
200
150
100
50
0
Jul.01
Jul.16
Aug.01
Aug.16
Sep.01
Sep.16
Oct.01
Oct.16
Nov.01
Nov.16
Dec.01
Dec.16
Date
Thudawa
Mawarala
Hiyare
Anilkanda
Paninkanda
Arpthorp


Irrigation requirement of Tea depending on the date of crop commencement
(Nilwala downstream)
Figure. 1 (b)
Irrigation Requirement (mm) Yala
Irrigation (mm
450
400
350
300
250
200
150
100
50
0
Jan.01
Jan.16
Feb.01
Feb.16
Mar.01
Mar.16
Apr.01
Apr.16
May.01
May.16
Jun.01
Jun.16
Date
Mapalana
Tihagoda
Denagama
Dandeniya
Kekanadura
Charly Mount


Irrigation requirement of Tea depending on the date of crop commencement
(Nilwala downstream)
Figure.1 (b)
Irrigation Requirement (mm) Maha
Irrigation (mm
450
400
350
300
250
200
150
100
50
0
Jan.01
Jan 16
Feb 01
Feb 16
Mar 01
Mar 16
Apr 01
Apr 16
May.01
May 16
Jun 01
Jun 16
Date
Mapalana
Tihagoda
Denagama
Dandeniya
Kekanadura
Charly Mount

The water balance is calculated using the program CROPWAT considering the requirement of a wet period for 120 days for the crop to establish the root system. Rooting depth was considered as 45 cm at the planting time and 60 cm at the latter stages. The accepted soil moisture depletion level was taken as 75%.

Results of the simulation revealed that there will be no irrigation requirement if the planting was done during March 15th to May 15th in Kudawa, Anningkanda, Panilkanda and Mawarala. However in Arpthorp the suitable period falls within April15th to May 15th. It is not advisable to delay the planting date beyond May 15th in all the locations of the Nilwala upper and mid catchment areas. However in Hiyara the best time for planting would be around March 15th with an irrigation requirement of about 75 mm.

For most of the locations in the Nilwala upper and mid catchment areas, establishment of the crop in Maha seems to be not advisable due to the dry spells in January-February. However at Kudawa, Paningkanda and Anningkanda the crop may be established during Sep 1st - October 1st. (Fig.1 a)

In the flood plain and the lower regions of the Nilwala river, the best crop establishment period with least irrigation water requirement falls during the mid-August to mid-September. If the crop could be established during this period, the irrigation requirement prior to root establishment will be low.

From the water balance point of view, it could be concluded that the best period for crop establishment in the Nilwala upper and mid catchment areas falls before May 15th. In the lower flood plain, it falls before September 15th.

CONCLUSIONS

Rainfall of the Nilwala basin increases from south to north with the increasing elevation and altitude. The topography strongly influences the spatial distribution of rainfall and comparatively high rainfall is observed in the head waters of the Nilwala river at Deniyaya region. Within a 70 km distance in the south north gradient, rainfall elevates from 1656 mm (at Kekanadura) to 4216mm (at Kudawa). In the west east gradient, rainfall decreases from 2527 mm at Charley Mount to 1686 mm at Deniyaya.

The upper mountainous region of the Nilwala basin has 9-10 months with more than 200 mm monthly rains in the annual cycle where high probabilities exist to receive more than 200 mm monthly rain during both the Yala and Maha seasons.

During both the Yala and Maha seasons in Nilwala, the downstream areas seem to be unsuitable for rice cultivation without supplementary irrigation. Minor tanks for irrigation purposes in the Nilwala basin are concentrated in WL2, WL4, IL1, and

IL2 agroecological regions, which is a clear indication of the historical acceptance of the necessity for irrigation in the downstream areas.

From April 10th onward until May 20th seems to be the best period for establishment of crops at the Nilwala upper catchment areas. Optimum time for establishment of rice falls on March 20th at Anningkanda, April 01st at Panilkanda, April 20th at Arpthorp, and April 1st at Mawarala. Optimum dates for crop establishment at the mid and lower part of the catchment falls on April 10th.

In respect to the crop establishment in the Yala season, it is important to note that delaying it by 2 or 3 weeks from the optimum date would result in a considerable increases in irrigation water need even in the upper catchment areas. Therefore it is important to assure the establishment of the Yala crop before the Sinhala-Tamil New Year.

This is the actual method practised by farmers as experienced in many locations of the Nilwala areas. With respect to the Maha season, it is not advisable to delay the establishment of crop till October when four month varieties are cultivated.

The total water requirement of Yala rice varies from 1012 to 1267 mm in different locations of the Nilwala basin. The irrigation requirement increases in the flood plain, which is associated with a decrease in effective rainfall. Deniyaya and Denagama have a very high irrigation demand, which constitutes above 70% of the total water requirement. As such, these are high-risk areas of the Nilwala basin for rice production.

There will be no irrigation requirement for tea and other perennial crops if the planting is practised during March 15th to May 15th in Nilwala upper and mid catchment areas. Establishment of tea in Maha seems to be not advisable due to the dry spells falling on the January and February months. However, at Kudawa, Panilkanda and Anningkanda tea may be established during September 1st to October 1st of the Maha season.

ACKNOWLEDGEMENT

Technical Assistance offered by Mr. C.P. Gunasena in data analysis and preparation of this paper is greatly acknowledged.

REFERENCES

Abeyasekara S. Senviratne E.K., Leaker A. and Stem R.D (1983) The analysis of daily rainfall for Agricultural purposes. J.Nat.Sci.Coun.Sri Lanka II (No 1)

Elkaduwa W.K.B, (1997), Analysis of Agro-Climatic data of the Nilwala basin in relation to irrigation agronomy, SCORE Project, IIMI, Unpublished data.

Franquin A.Forest F. (1982) Des programmes pour l' evaluation et l' analyse frequentielle des termes du bilan hydrique. Agro Trop XXXII – 1

Krishnan A. (1980) Agro climatic Classification methods and their application to India, Climate Classification. A Consultants meeting ICRISAT, India.

Oldeman L.R. (1980) The Agro Climatic Classification of Rice growing environment in Indonesia. Proc. Symp. Agro climatology of the Rice crop, IRRI, Philippines.

Oldeman L.R. and Frere M. (1982) A study of the Agro Climatology of the humid tropics of South East Asia. FAO/UNESCO/WMO inter agency project on Agro climatology. Technical note 179,WMO, Geneva.

Panabokke C.R. and Walgama A (1974) The application of rainfall confidence limits to crop water requirement in dry zone agriculture in Sri Lanka. J.Natn.Sci.Coun.Sri Lanka 2 (2).

Roberston G.W. (1976) Dry and Wet spells. Tun.Razak. Agric. Res. Centre. Sung, Tekam, Malayasia project final report: Agro Meteorology A-615.

Virmani S.M. (1976) The Agricultural climate of the Hyderabad region in relation to crop planning. A sample analysis. ICRISAT, India.

Virmani S.M (1980) Need relevance and objectives of the consultants meeting on climate classification ; A consultants meeting ICRISAT, India.

Virmani S.M. Sivakumar M.V.K. and Reddy S.J. (1982) Rainfall probability estimates for selected locations of semi arid India; Research report, ICRISAT India.

Weerasinghe K.D.N. Comparative study of temperature based equations in estimation of potential evaporation for Angunukolapelessa in the arid zone of southern Sri Lanka. J.Natn. Sci. Coun. Sri Lanka, 1986 14 (1) : 75-82.

Weerasinghe K.D.N., Sabatier J.L. and Grandgean Luc (1990) Manual for FIRST; A computer program for Agro climatological data analysis, Users manual, University of Ruhuna, Matara, Sri Lanka.