Effect of *El Niño* Southern Oscillation (ENSO) events on inter-seasonal variability of rainfall in Wet and Intermediate zones of Sri Lanka

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Abstract

Ocean-atmospheric teleconnections such as *El Niño* Southern Oscillation (ENSO) are important climatic determinants in studying inter-and intra-seasonal variability of rainfall. The ENSO takes place in the central eastern equatorial Pacific Ocean. Warm and cold phases of ENSO cycle are termed as *El Niño* and *La Niña*, respectively. As it influences the global climate, the present study was carried out to find out such teleconnections in the seasonal rainfall climatology of Wet and Intermediate zones of Sri Lanka during four rainfall seasons using daily rainfall time series from 1976-2018 (February) for 15 locations scattered throughout Wet and Intermediate zones. *El Niño, La Niña* and neutral years during the study period were identified using Oceanic Nino Index (ONI). The mean cumulative rainfall of ENSO years were statistically compared with the remaining neutral years. The results clearly revealed a significant reduction of rainfall during both First Inter Monsoon (FIM) and North East Monsoon (NEM) seasons during *El Niño* years. The Second Inter Monsoon (SIM) season showed a positive anomaly of rainfall during the *El Niño* years. However, the effect of *El Niño* condition on the Southwest Monsoon season (SWM) was not consistent across both climatic zones under review. During *La Niña* conditions, an above normal rainfall was observed in the FIM, SWM and NEM seasons where the strongest correlation was evident during the NEM season. The SIM season has shown a below normal rainfall during the *La Niña* period. These teleconnections can be effectively used as a forecasting tool

of seasonal rainfall in the two climatic zones of the country and thereby minimizing climate-related risks in agricultural and hydrological operations.

Key words: *El Niño* Southern Oscillation, Oceanic Nino Index, Rainfall variability, Wet and Intermediate zones

Introduction

The *El Niño*–Southern Oscillation (ENSO) cycle, is the most prominent climate variation on Earth. This global event changes the normal weather pattern of the entire world including global patterns of atmospheric pressure (Bjerknes, 1966), atmospheric circulation (Arkin, 1982), precipitation, and temperature (Rasmusson and Carpenter, 1983).

El Niño (warm) and *La Niña* (cold) are the two complementary phases of ENSO cycle, which typically recur every two to seven years, in the central-eastern equatorial Pacific Ocean approximately between the International Date Line and 120 degrees West (Wang, 2012; Kousky and Higgins, 2007; McPhaden *et al*., 2006; Philander, 1985). The trade winds normally pile up warm surface water in the Western Pacific while upwelling colder water in the east from below the surface along the equator and off the west coast of South America (McPhaden *et al*., 2011; Kousky and Higgins, 2007; Gill, 1980). The physics behind the ENSO cycle has been described in detail by Abeysekera *et al*. (2017) through an extensive literature survey. Climate variability links between non-contiguous geographical regions is known as the teleconnection in climatological studies (Nigam and Baxter, 2015), which can also be observed due to the ENSO phenomenon.

The ENSO affects the normal weather patterns in most parts of the world. *El Niño*, a warming in the central and eastern Pacific region, changes precipitation patterns bringing drought to Australia, Indonesia, and neighbouring countries whereas, the island states of the central Pacific and the west coast of south America are often inundated with heavy rains including world's driest countries such as Chile. *La Niña* often produces climate impacts that are opposite to those of *El Niño* (McPhaden *et al*., 2006).

Sri Lanka has been delineated into three major climatic zones, namely, Wet (WZ), Intermediate (IZ) and Dry (DZ) zones, based on the annual rainfall, contribution from the SWM rains, major soil type and predominant land use. The average annual rainfall in WZ is over 2,500 mm, in DZ is less than 1,750 mm and in the IZ is between 1,750 mm to 2,500 mm (Punyawardena *et al*., 2013). Even though Sri Lanka is a small island, its spatial and temporal heterogeneity of climate increases the complexity of the studies related to the ENSO. Previous studies have identified a considerable influence of the ENSO cycle on four rainfall seasons of Sri Lanka (Abeysekera *et al*., 2017; Punyawardena *et al*., 2004; Punyawardena and Cherry, 1999; Kane, 1998; Sumathipala and Punyadeva, 1998; Suppiah, 1989, 1996, 1997; Rasmusson and Carpenter, 1982). This study therefore, was undertaken to ascertain any possible teleconnection between the occurrence of ENSO events in the central-eastern Pacific Ocean with the seasonal rainfall of the WZ and IZ of Sri Lanka with the aim of using such teleconnections as a tool in seasonal climate forecasting.

Materials and methods

Daily rainfall data for the period of 43 years (1976-2018) were collected from 15 meteorological observation stations scattered throughout the WZ and IZ, representing different Agro Ecological Regions (AERs) of Sri Lanka (Figure 1).

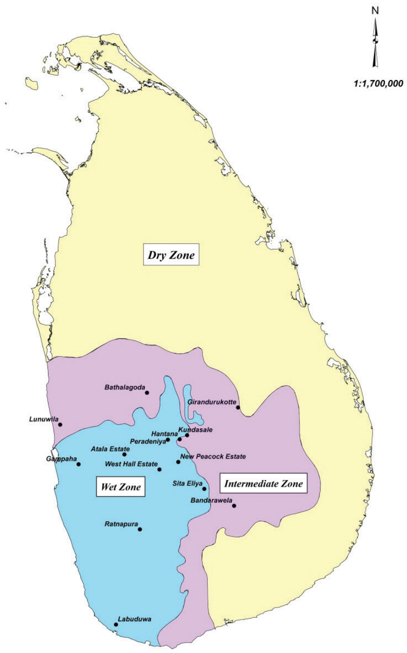

Figure 1. Locations of the meteorological observation stations in the Wet and Intermediate zones from which data were extracted for the study

Based on the different ocean-atmospheric parameters, several indices are used to identify the *El Niño* and *La Niña* events (Abeysekera *et al*., 2017). In the present study, Oceanic Nino Index (ONI) was used to identify the Sea Surface Temperature (SST) anomalies in the central eastern Pacific Ocean during ENSO events. National Oceanic and Atmospheric Administration (NOAA) of the United States Climate Prediction Centre (CPC) has defined the ONI for identifying ENSO events in the Nino 3.4 region, a region stretching along the equator from 5^{o}N to 5^{o}S latitude and from 170^{o}W to 120^{o}W longitude. The ENSO events are defined as five consecutive over-lapping 3-month periods at or above the + 0.5^{o} anomaly for warm (*El Niño*) events, and at or below the -0.5^{o} anomaly for cold (*La Niña*) events (Kousky and Higgins, 2007) (Table 1).

Table 1. ENSO episodes based on a threshold of +/- 0.5^{o}C for the Oceanic Niño Index (ONI) (based period is between 1971-2000)

(Source:National Oceanic and Atmospheric Administration)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1976	-1.5	-1.1	-0.7	-0.4	-0.3	-0.1	0.1	0.3	0.5	0.7	0.8	0.8
1977	0.7	0.6	0.4	0.3	0.3	0.4	0.4	0.4	0.5	0.6	0.8	0.8
1978	0.7	0.4	0.1	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4	-0.3	-0.1	0
1979	0	0.1	0.2	0.3	0.3	0.1	0.1	0.2	0.3	0.5	0.5	0.6
1980	0.6	0.5	0.3	0.4	0.5	0.5	0.3	0.2	0	0.1	0.1	0
1981	-0.2	-0.4	-0.4	-0.3	-0.2	-0.3	-0.3	-0.3	-0.2	-0.1	-0.1	0
1982	0	0.1	0.2	0.5	0.6	0.7	0.8	1	1.5	1.9	2.1	2.1
1983	2.1	1.8	1.5	1.2	1	0.7	0.3	0	-0.3	-0.6	-0.8	-0.8
1984	-0.5	-0.3	-0.3	-0.4	-0.4	-0.4	-0.3	-0.2	-0.3	-0.6	-0.9	-1.1
1985	-0.9	-0.7	-0.7	-0.7	-0.7	-0.6	-0.4	-0.4	-0.4	-0.3	-0.2	-0.3
1986	-0.4	-0.4	-0.3	-0.2	-0.1	0	0.2	0.4	0.7	0.9	1	1.1
1987	1.1	1.2	1.1	1	0.9	1.1	1.4	1.6	1.6	1.4	1.2	1.1
1988	0.8	0.5	0.1	-0.3	-0.8	-1.2	-1.2	-1.1	-1.2	-1.4	-1.7	-1.8
1989	-1.6	-1.4	-1.1	-0.9	-0.6	-0.4	-0.3	-0.3	-0.3	-0.3	-0.2	-0.1
1990	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.3	0.4	0.4
1991	0.4	0.3	0.2	0.2	0.4	0.6	0.7	0.7	0.7	0.8	1.2	1.4
1992	1.6	1.5	1.4	1.2	1	0.8	0.5	0.2	0	-0.1	-0.1	0
1993	0.2	0.3	0.5	0.7	0.8	0.6	0.3	0.2	0.2	0.2	0.1	0.1
1994	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.6	0.9	1

Table 1(continued). ENSO episodes based on a threshold of +/- 0.5°C for the Oceanic Niño Index (ONI) (based period is between 1971-2000)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1995	0.9	0.7	0.5	0.3	0.2	0	-0.2	-0.5	-0.7	-0.9	-1	-0.9
1996	-0.9	-0.7	-0.6	-0.4	-0.2	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5
1997	-0.5	-0.4	-0.2	0.1	0.6	1	1.4	1.7	2	2.2	2.3	2.3
1998	2.1	1.8	1.4	1	0.5	-0.1	-0.7	-1	-1.2	-1.2	-1.3	-1.4
1999	-1.4	-1.2	-1	-0.9	-0.9	-1	-1	-1	-1.1	-1.2	-1.4	-1.6
2000	-1.6	-1.4	-1.1	-0.9	-0.7	-0.7	-0.6	-0.5	-0.6	-0.7	-0.8	-0.8
2001	-0.7	-0.5	-0.4	-0.3	-0.2	-0.1	-0.1	-0.1	-0.2	-0.3	-0.4	-0.3
2002	-0.2	0	0.1	0.2	0.4	0.6	0.8	0.8	0.9	1.1	1.2	1.1
2003	0.9	0.7	0.4	0	-0.2	-0.1	0.1	0.2	0.2	0.3	0.3	0.3
2004	0.3	0.3	0.2	0.1	0.2	0.3	0.5	0.6	0.7	0.7	0.6	0.7
2005	0.7	0.6	0.5	0.5	0.3	0.2	0	-0.1	0	-0.2	-0.5	-0.7
2006	-0.7	-0.6	-0.4	-0.2	0	0	0.1	0.3	0.5	0.7	0.9	0.9
2007	0.7	0.4	0.1	-0.1	-0.2	-0.3	-0.4	-0.6	-0.9	-1.1	-1.3	-1.3
2008	-1.4	-1.3	-1.1	-0.9	-0.7	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.7	-0.6	-0.4	-0.1	0.2	0.4	0.5	0.5	0.6	0.9	1.1	1.3
2010	1.3	1.2	0.9	0.5	0	-0.4	-0.9	-1.2	-1.4	-1.5	-1.4	-1.4
2011	-1.3	-1	-0.7	-0.5	-0.4	-0.3	-0.3	-0.6	-0.8	-0.9	-1	-0.9
2012	-0.7	-0.5	-0.4	-0.4	-0.3	-0.1	0.1	0.3	0.3	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.3	-0.3	-0.3
2014	-0.5	-0.5	-0.4	-0.2	-0.1	0	-0.1	0	0.1	0.4	0.5	0.6
2015	0.6	0.5	0.6	0.7	0.8	1	1.2	1.4	1.7	2	2.2	2.3
2016	2.2	2	1.6	1.1	0.6	0.1	-0.3	-0.6	-0.8	-0.8	-0.8	-0.7
2017	-0.4	-0.1	0.1	0.3	0.4	0.4	0.2	-0.1	-0.4	-0.7	-0.9	-1
2018	-0.9	-0.8										

The NOAA has broken down this SST threshold further into Weak (+/-0.5 °C to +/-0.9 °C), Moderate (+/-1.0 °C to +/-1.4 °C), Strong (+/-1.5 °C to +/-1.9 °C) and Very Strong (≥ +/-2.0 °C) events (Figure 2). Strong events like those in 1982-1983, 1997-1998 and 2015-2016 had dramatic worldwide consequences, whereas weak events e.g. 2004–2005, may have impacts that are muted or even undetectable above the background weather noise of the atmosphere (Trenberth, 2016).

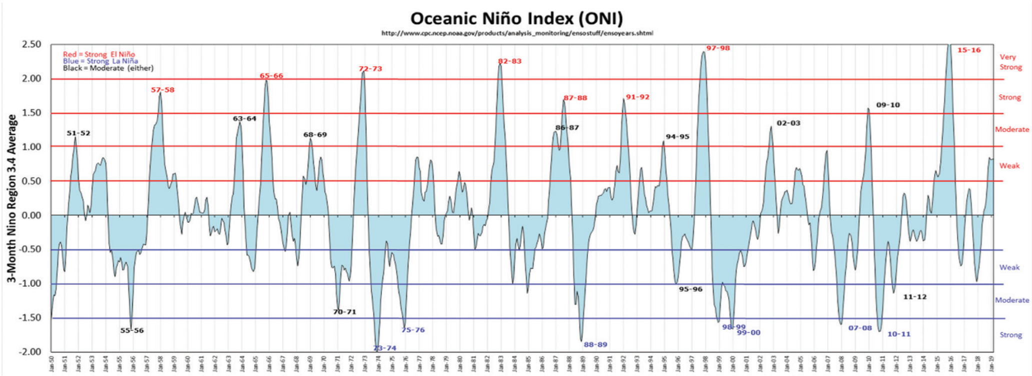

Figure 2. Strength of ENSO events (source: https://ggweather.com/enso/oni.htm)

According to Table 1, only six years during the study period was left as neutral years. As it was not sufficient to get a strong statistical correlation, weak ENSO events were also taken into the standard period as neutral years (i.e. +1 ^{o}C to -1 ^{o}C). During the study period, both *El Niño* and *La Niña* events were flagged according to the temporal pattern of four rainfall seasons (Table 2).

Seasonal mean cumulative rainfall values of ENSO events were compared with the neutral years. The statistical significance was tested using one way ANOVA and the means were compared with Tukey test at p=0.05 using Minitab statistical software.

Table 2. Rainfall seasons affected by years relevant to *El Niño* (E), *La Niña* (L) and Neutral (N) events

Year	FIM	SWM	SIM	NEM
1982	N	N	E	E
1983	E	N	N	N
1986	N	N	E	E
1987	E	E	E	N
1988	N	L	L	L
1989	L	N	N	N
1991	N	N	E	E
1992	E	N	N	N
1997	N	E	E	E
1998	E	L	L	L

Table 2(continued). Rainfall seasons affected by years relevant to El Nino (E), La Nina (L) and Neutral (N) events

Year	FIM	SWM	SIM	NEM
1999	L	L	L	L
2000	L	N	N	N
2002	N	N	E	N
2003	N	N	N	N
2007	N	N	L	L
2008	L	N	N	N
2010	N	N	L	L
2011	N	N	L	N
2015	N	E	E	E
2016	E	N	N	N

Results and discussion

First Inter-monsoon season (FIM)

Among 15 stations considered in this study, 14 showed an apparent decrease in the mean cumulative rainfall of *El Niño* years during the FIM season. Rathnapura, Bombuwela and Bandarawela stations showed a statistically significant negative anomaly. Twelve out of 15 meteorological stations have recorded a positive anomaly of rainfall during the *La Niña* years while Lunuwila showed a statistically significant above-average cumulative rainfall (Table 3).

The FIM season normally brings a considerable amount of convectional rainfalls to the WZ and IZ. Some of the previous studies did not show a clear contrasting pattern during FIM season for ENSO events (Hapuarachchi *et al*., 2015; Premalal, 2013; Punyawardena and Cherry, 1999; Suppiah, 1989, 1996, 1997). This could be probably attributed to the fact whether FIM was selected either from genesis year or decaying year of the ENSO event. In this study, ENSO events were flagged from the decaying year where as most of the other studies have used the genesis year where *El Niño* signals are very weak on the FIM season.

Table 3. Comparison of mean cumulative rainfall (mm) during *El Niño, La Niña* and Neutral years in the selected locations of the WZ and IZ during FIM season

Station	AER	Neutral	*El Niño*	*La Niña*
Pussallawa (West Hall)	WU2b	422.5[a]	238.3[a]	444.2[a]
Pussallawa (New Peacock)	WU2b	300.9[a]	182.5[a]	393.4[a]
Sita-Eliya	WU3	237.7[a]	109.7[a]	244.4[a]
Hanthana	WM2b	293.9[a]	135.1[a]	292.3[a]
Peradeniya	WM2b	296.3[ab]	182.5[b]	393.4[a]
Rathnapura	WL1a	591.7[a]	374.1[b]	712.0[a]
Arandara (Atala)	WL1a	454.5[a]	486.2[a]	660.9[a]
Bombuwela	WL1b	428.2[a]	221.0[b]	565.6[a]
Labuduwa	WL2a	348.7[ab]	170.7[b]	574.0[a]
Gampaha-Henarathgoda	WL3	335.1[ab]	216.1[b]	522.6[a]
Bandarawela	IU3c	275.1[a]	145.1[b]	306.8[a]
Kundasale	IM3a	225.9[ab]	110.5[b]	311.0[a]
Lunuwila	IL1a	252.6[b]	203.3[b]	453.0[a]
Batalagoda	IL1a	320.8[a]	287.0[a]	309.8[a]
Girandurukotte	IL2	271.2[a]	162.4[a]	241.9[a]

The means with-in a row followed by the same letter are not significantly different at p=0.05

South West Monsoon season (SWM)

The mean cumulative rainfall of *El Niño* years showed a negative anomaly of rainfall in WU and WM regions compared to the neutral years. Nevertheless, WL regions and IZ have shown an above average rainfall. Labuduwa (WL2a), Bandarawela (IU3c) and Batalagoda (IL1a) showed a statistically significant increase. Meanwhile, the mean cumulative rainfall during *La Niña* years in the SWM season exemplified an apparent increase except three stations which do not possess any spatial relationship (Hanthana-WM2b, Bandarawela-IU3c and Girandurukotte-IL2) (Table 4).

Table 4. Comparison of mean cumulative rainfall (mm) of *El Niño*, *La Niña* and Neutral years in the selected locations of the WZ and IZ in SWM season

Station	AER	Neutral	*El Niño*	*La Niña*
Pussallawa (West Hall)	WU2b	2104.9[a]	2075.2[a]	2662.2[a]
Pussallawa (New Peacock)	WU2b	743.6[a]	710.4[a]	922.9[a]
Sita-Eliya	WU3	779.1[a]	767.3[a]	847.9[a]
Hanthana	WM2b	1073.1[a]	644.4[a]	915.9[a]
Peradeniya	WM2b	726.5[a]	710.4[a]	922.9[a]
Rathnapura	WL1a	1899.2[ab]	1376.0[b]	2353.0[a]
Arandara (Atala)	WL1a	1394.9[a]	1500.6[a]	1683.1[a]
Bombuwela	WL1b	1339.3[a]	1654.5[a]	1656.4[a]
Labuduwa	WL2a	1040.2[b]	1668.5[a]	1400.5[ab]
Gampaha-Henarathgoda	WL3	952.9[a]	1070.9[a]	1261.8[a]
Bandarawela	IU3c	404.4[b]	610.0[a]	401.2[ab]
Kundasale	IM3a	436.2[a]	459.8[a]	493.3[a]
Lunuwila	IL1a	625.7[a]	743.8[a]	833.0[a]
Batalagoda	IL1a	493.3[b]	799.0[a]	711.0[ab]
Girandurukotte	IL2	315.6[a]	433.7[a]	279.0[a]

The means within a row followed by the same letter are not significantly different at p=0.05

The WZ and windward side of IZ of Sri Lanka receive rains mainly due to SWM season. Some previous studies have shown a negative anomaly of rainfall in SWM period during *El Niño* years and positive anomaly during *La Niña* years (Punyawardena *et al*., 2004; Punyawardena and Cherry, 1999; Kane, 1998; Suppiah, 1989, 1996, 1997; Rasmusson and Carpenter, 1982). A more recent study conducted by Premalal (2013) has concluded that the southern part of Sri Lanka receives a little higher rainfall during the *El Niño* years and probability of receiving below normal rainfall is high over rest of the island during the SWM season. Hapuarachchi *et al*. (2015) reported that central part of the island receives below normal SWM rains during *El Niño* years. Conversely, southern parts of the island indicate higher probability of receiving excess of seasonal rainfall.

Second Inter Monsoon season (SIM)

Eleven out of 15 stations used in the study showed a positive ansomaly of mean cumulative rainfall during *El Niño* years in SIM season. Nevertheless, none of these relationships were statistically significant. Stations belonging to WL1 agro-ecological sub-regions and Lunuwila (IL1a) showed a below normal rains. During *La Niña* years, a decrease of mean cumulative SIM rainfall was observed in all locations except Pussallawa-West Hall, Labuduwa and Gampaha-Henarathgoda. However, these relationships were statistically insignificant except Batalagoda (Table 5).

Table 5. Comparison of mean cumulative rainfall (mm) of *El Niño*, *La Niña* and Neutral years in the selected locations of the WZ and IZ during the SIM season

Station	AER	Neutral	*El Niño*	*La Niña*
Pussallawa (West Hall)	WU2b	853.2[a]	903.3[a]	905.1[a]
Pussallawa (New Peacock)	WU2b	612.9[a]	654.8[a]	475.7[a]
Sita-Eliya	WU3	563.4[ab]	637.6[a]	380.6[b]
Hanthana	WM2b	524.8[a]	607.4[a]	417.5[a]
Peradeniya	WM2b	631.7[a]	654.8[a]	475.7[a]
Rathnapura	WL1a	923.0[a]	847.0[a]	777.0[a]
Arandara (Atala)	WL1a	879.8[a]	796.6[a]	758.9[a]
Bombuwela	WL1b	851.1[a]	849.6[a]	729.3[a]
Labuduwa	WL2a	706.4[a]	745.2[a]	721.2[a]
Gampaha-Henarathgoda	WL3	620.2[a]	768.7[a]	629.6[a]
Bandarawela	IU3c	541.9[a]	643.6[a]	424.6[a]
Kundasale	IM3a	464.6[a]	560.8[a]	363.2[a]
Lunuwila	IL1a	646.6[a]	639.4[a]	574.9[a]
Batalagoda	IL1a	685.9[a]	745.0[a]	450.4[b]
Girandurukotte	IL2	609.4[a]	625.6[a]	400.3[a]

The means within a row followed by the same letter are not significantly different at p=0.05

The SIM season brings considerable amount of rains to all three major climatic zones of Sri Lanka. The results of this study are comparable with the earlier findings related to the SIM season (Hapuarachchi *et al*., 2015; Premalal, 2013; Punyawardena *et al*., 2004; Suppiah, 1989; Rasmusson and Carpenter, 1983). Above normal rains during *El Niño* period may result in mainly positive impacts on the *Maha* season (the major cultivation season; October to February), by improving the inflows of both ephemeral and perennial rivers of the country. These rivers will feed both minor and major irrigation tank network in the DZ and IZ, which will provide both irrigation and drinking water and environmental needs during the *Maha* season in the entire country.

North East Monsoon season (NEM)

The mean cumulative rainfall during NEM season in *El Niño* years have shown a negative anomaly in all 15 locations considered in this study. However, those values are not statistically significant. The mean cumulative rainfall during *La Niña* years in NEM season showed above normal values for the all selected meteorological stations in this study. Among them, Kundasale showed a statistically significant increase ($p<0.05$; Table 6).

Table 6. Comparison of mean cumulative rainfall (mm) of *El Niño*, *La Niña* and Neutral years in the selected locations of the WZ and IZ during the NEM season

Station	AER	Neutral	*El Niño*	*La Niña*
Pussallawa (West Hall)	WU2b	323.9[a]	288.6[a]	557.9[a]
Pussallawa (New Peacock)	WU2b	331.9[a]	187.6[a]	432.2[a]
Sita-Eliya	WU3	431.8[a]	387.7[a]	633.0[a]
Hanthana	WM2b	301.7[a]	255.3[a]	565.9[a]
Peradeniya	WM2b	314.8[a]	187.6[a]	432.2[a]
Rathnapura	WL1a	502.7[a]	471.7[a]	571.0[a]
Arandara (Atala)	WL1a	332.8[a]	229.2[a]	556.2[a]
Bombuwela	WL1b	378.3[a]	378.2[a]	557.5[a]
Labuduwa	WL2a	376.0[a]	312.2[a]	545.9[a]
Gampaha-Henarathgoda	WL3	248.9[a]	193.8[a]	366.7[a]
Bandarawela	IU3c	378.2[a]	283.5[a]	487.0[a]
Kundasale	IM3a	278.7[b]	269.3[b]	607.0[a]
Lunuwila	IL1a	185.8[ab]	69.6[b]	290.1[a]
Batalagoda	IL1a	295.1[a]	257.1[a]	506.3[a]
Girandurukotte	IL2	851.3[a]	820.1[a]	1191.0[a]

The means within a row followed by the same letter are not significantly different at p=0.05

As WZ and IZ do not receive higher amount of rains during NEM period, this reduction of rainfall during *El Niño* years may influence the agronomic practices during the *Maha* season. Although most of the previous studies do not show a contrasting pattern during NEM season, some research findings reveal similar findings to this study, showing strong negative anomalies during *El Niño* period and above averages during *La Niña* period (Abeysekera *et al*., 2017; Hapuarachchi *et al*., 2015; Sumathipala and Punyadeva, 1998).

Conclusion

This study was carried out to ascertain the impact of ENSO events on four rainfall seasons of the WZ and IZ of Sri Lanka. The results revealed that there is a strong relationship between *El Niño* years and reduction of rainfall during FIM and NEM seasons. In contrast, a positive anomaly of rainfall was evident in SIM season during *El Niño* years. However, the behaviour of the rainfall during SWM showed a negative relationship for WU and WM regions and positive relationship for WL and Intermediate zone. Therefore, it will be important to carry out further studies on this regard.

During *La Niña* years, the occurrence of higher rainfall in FIM and SWM seasons was evident. An apparent above normal rainfall that was observed in *La Niña* years, during NEM season, while the opposite was true for the SIM season.

In addition to the impact of ENSO events, the rainfall climatology of the country is influenced by other global meteorological phenomenon such as Indian Ocean Dipole (IOD) and Madden Julian Oscillation (MJO). Therefore, further studies are recommended to see how the teleconnecton of ENSO events on seasonal rainfall of Sri Lanka is being altered by such meteorological forcings.

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