THE EFFECT OF EL NINO AND DIPOLE MODE ON INDEX OF RICE FARMING AND RICE PRODUCTION RESULT BASED ON THE LEVEL OF THE SURFACE SEA IN WEST TIMOR

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ABSTRACT

Global warming has an impact on climate variability that causes changes in rain patterns, shifts in seasons and impacts on crop failure. The phenomenon of climate variability is usually associated with the El Nino and Dipole Mode phenomena which have an impact on changes in rainfall and food production. Topographical conditions also contribute to weather and climate variability, especially in the Timor Barat region. Agricultural Rainfall Index At an altitude of 0 - 600 meters in West Timor, the phenomenon of El Nino, SOI neutral and neutral IOD will affect the Agricultural Rainfall Index. While at an altitude of 601 - 1200 meters the neutral IOD phenomenon affects the Agricultural Rainfall Index. The effect of rainfall will reduce agricultural production in Belu, TTU and TTS Regencys by 0.004 to 0.005 tons, while in Kupang the rainfall will also increase the amount of agricultural production by 0.087 tons.

Keyword: ***SOI, IOD, ARI, agricultural production.***

INTRODUCTION

Global warming is temperature increasing in the earth's surface due to increased gas concentrations greenhouse in the atmosphere, which can cause climate variability. Climate change is already occur, where the rates of change grow faster than predicted, such as rain patterns change, shifts in seasons (come earlier or slower), rainfall periods (short occasion but heavy rain), increasing temperatures and sea levels, can give impact on various sector and human life, especially in agriculture sector due to extreme climate events, e.g: El Niño, La Niña, Dipole Mode.

El Niño - Southern Oscillation (ENSO) is a global phenomenon that impacts on rainfall and food production, also gives climate variability in Timor Barat which can be interpreted as a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean which causes global climate anomalies such as El Niño and La Niña. The Southern Oscillation Index (SOI) is an index the difference in air pressure above sea level between Tahiti and Darwin that was not like normal circumstances. The El Niño phenomenon characterized by an inclined SOI index into negative value, while during the La Niña SOI index values tend to be positive. A big

This condition shows that the season in Indonesian territory is not only formed by the monsoon, but also formed by other factors that interact with the monsoon to shape the season (Sulistya, et al., 2000). These factors are global scale phenomenon namely El Niño and Indian Ocean Dipole.

This study will look at the interaction of two global phenomenon namely El Niño and Dipole Mode using SOI index, IOD Index, and Agricultural Rainfall Index (ARI) to changes in the Agricultural Rainfall Index and Paddy Production in Timor Barat.

RESEARCH METHODS

1. Data

This study uses rainfall data, SOI index data, IOD index data, Agricultural Rainfall index data (ARI) in the Baun, Lasiana, Betun, and Kefamenanu, Eban, Oelbubuk, Kesetnana, and Niki, and food production data in Belu Regency, Timor tengah Selatan (TTS), Timor tengah Utara (TTU), and Kupang Regency.

2. Method

This analytical method using descriptive statistical analysis method to determine the effect of the El Nino phenomenon and Dipole Mode on the Agricultural Rainfall Index (ARI) and food production based on altitude above sea level in Timor Barat

DISCUSSION

The location of this study was carried out on the island of Timor, western NTT with 8 research location points with different elevations. The locations taken for the study are as follows:

a. Elevation 0 - 600 m (Baun, Lasiana, Betun and Kefamenanu)
b. Elevation 601 - 1200 m (Eban, Oelbubuk, Kesetnana and Niki-Niki)

The locations are in Belu Regency (Betun), South Central Timor Regency (TTS) (Oelbubuk, Kesetnana, Niki-Niki), North Central Timor Regency (TTU) (Kefamenanu and Eban), and Kupang Regency (Baun and Lasiana).

positive value of SOI Index (where air pressure in Tahiti is much higher than in Darwin) is related to La Niña conditions, relatively large negative SOI index (pressure the air in Tahiti is much lower than the air pressure in Darwin) due to El Niño conditions (Haryanto, 1998). The value of the South Oscillation Index (SOI) is at -5 to +5, which is neutral, while for -5 to -10, it is classified as weak El Niño and less than -10, it is relatively strong after going on for 3 months in a row can be said El Niño occured. According to observation result, El Niño will return after 2 to 7 years (Yananto and Sibarani, 2016).

Local scale (topography and elevation) weather in Timor Barat play an important role in weather and climate variability. In several places of Timor Barat region with vary elevations, we can find differences of the rainy season commencement, the rainy season period and the rainfall amount every year. Therefore, it is considered that elevation is the most important climate controlling factor in the tropics, because the higher a place above sea level, the higher the rainfall tends to a certain extent and then it will decrease (Tadjang, 1992).

Adaptation and mitigation efforts of two extreme climate phenomenon that occur simultaneously such as El Niño and Dipole Mode, will have impact on the increase and decrease in rainfall and food production. Adaptation carried out by utilizing the Planting Calendar Information (ARI) in accordance with research (Allan, 2000) states that the establishment of a planting calendar is part of a food crop cultivation strategy that is closely related to climate anomalies. Climate anomaly phenomena such as El Niño Southern Oscillation (ENSO) in the Pacific Ocean and Indian Ocean Dipole (IOD) in the Indian Ocean are increasingly occurring with increasingly extreme seasonal conditions and longer durations that have a real impact on agricultural production. Climate information and planting calendar (ARI) is an effort to adapt to climate anomalies that occur. The determination of the planting calendar is determined based on 10 days or monthly range, most of which have an Agricultural Rainfall Index (ARI) greater than 1, which is one of the parameters to determine the level of groundwater availability needed by plants, as well as to find out the initial rainy season, long and short rainy season. The rainy season and the dry season occur periodically, with the length of the season and the amount of rainfall intensity in each season not the same.

1. Effect of SOI and IOD on Agricultural Rainfall Index (ARI) at an altitude of 0 - 600 meters

The South Oscillation Index (SOI) can be calculated as follows according to the Australian Bureau of Meteorology:

$$SOI = \frac{10\ [\ Pdiff - Pdiffav\ ]}{SD(Pdiff\ )}$$

where:
Pdiff = Average Tahiti sea level pressure for that month
Pdiffav= Average Darwinian sea level pressure for that month
SD (Pdiff) = long-term average Pdiff for that month standard deviation

Pdiff for the month was SOI positively related to strong trade wind in the western Pacific and high sea surface temperatures in northern Australia. In case of in a positive SOI situation between Australia there is a lot of rain, and vice versa if the SOI is negatively related to the markets in the Pacific being weak. When SOI is negative in eastern and northern Australia it is dry, in Indonesia which is adjacent to Australia it is also dry. Based on the Southern Oscillation Index, the El Niño phenomenon occurs if the SOI value is less than -10 (<-10) and lasts for at least 3 consecutive months.

Table 1 Strength Indicators Based on SOI

SOI VALUE (P TAHITI – P DARWIN)	Expected Phenomena
Under - 10 for 3 months in a row	*El Niño* Strong
-10sd -5 for 3 months in a row	*El Niño* weak – moderate
-5 to + 5 for 3 months in a row	Normal
+5 to 10 for 3 months in a row	*La Niña* weak – moderate
Above + 10 for 3 months in a row	*La Niña* Strong

Souce: MMS (*Malaysian Meteorological Service*, 2001)

Whereas the Indian Ocean Dipole Index is obtained from differences in sea surface temperature for the region of 50°E - 70°E / 10°S - 10°N (center of the Indian Ocean) minus 90°E - 110°E/ 10°S - equator (next to west coast of Sumatra). While the Agricultural Rainfall Index (ARI), the formula to count ARI:

$$\mathbf{ARI = P / PE}$$

Where:
P = precipitation
PE = Potential evapotranspiration

In this research, South Oscillation Index data (SOI) and the Sea Surface Temperature Anomaly Index (IOD) defined as Independent Variable, while the Dependent Variable is the Agricultural Rainfall Index (ARI).

If the SOI value in a specified month is less than -10 (<-10) for at least 3 consecutive months, it means that El Niño phenomenon occurs. If the SOI value in a particular month is greater than +10 (> +10) for three consecutive months, the La Niña phenomenon occurs. If the IOD index is negative, it means that the middle temperature of the Indonesian Ocean is warmer than on the west coast of Sumatra, Indonesia is at risk of drought. But if it converselly, the region of Indonesia experiences high rainfall (Aldrian, 2008).

1.1. Baun

Table 3.2 *Estimates Parameter*

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[ARI_Y=1.00]	-.037	.359	.010	1	.919	-.741	.667
	[ARI_Y=2.00]	.165	.359	.211	1	.646	-.539	.869
Location	[SOI_X1=1.00]	-.554	.378	2.154	1	.142	-1.294	.186
	[SOI_X1=2.00]	-.864	.309	7.797	1	.005	-1.470	-.257
	[SOI_X1=3.00]	0[a]	.	.	0	.	.	.
	[IOD_X2=1.00]	.131	.774	.029	1	.865	-1.386	1.648
	[IOD_X2=2.00]	1.018	.275	13.712	1	.000	.479	1.557
	[IOD_X2=3.00]	0[a]	.	.	0	.	.	.

Link function: Logit.

Intercept values of ARI (β) wet = -0.37, dry β = 0.165, β El Niño = -.0554, β La Niña = -0.864, β Negative = 0.131 and Positive β = 1.018. With the logit equation f (x) = log (x / (1-x)), then the regression model equation is:

$$(P\left(Y \geq \frac{1}{ARI_{Dry}}\right)) = \frac{\exp(-0.037_{Y} + 0.554_{\mathrm{El\ Nino}} - 0.131_{\mathrm{IOD\ negative}})}{1 + \exp(-0.037_{Y} + 0.554_{\mathrm{El\ Nino}} - 0.131_{\mathrm{IOD\ negative}})}$$

$$(P\left(Y \leq \frac{1}{ARI_{Wet}}\right)) = \frac{\exp(0.165_{Y} + 0.864_{\mathrm{SOI\ neutral}} - 1.018_{\mathrm{IOD\ neutral}})}{1 + \exp(\exp(0.165_{Y} + 0.864_{\mathrm{SOI\ neutral}} - 1.018_{\mathrm{IOD\ neutral}})}$$

Based on Wald's value and its significance, it shows that of all the independent variables used in this regression model the SOI neutral variable model and the significant neutral IOD variable (P

<0.05) or in other words, the SOI neutral and neutral IOD variables that significantly affect the ARI variables . With the odds ratio = exp (β) equation, then exp (-0.864) = 0.421, this means that with a neutral SOI will decrease the ARI odds by 0.421 units and the odds ratio equation = exp (β), then exp (1,018) = 2,768, then this means that with a neutral IOD will increase the chance of ARI by 2,768 units.

1.2.Betun

Table 3. *Estimates Parameter*

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[ARI_Y = 1.00]	-.610	.362	2.844	1	.092	-1.319	.099
	[ARI_Y = 2.00]	-.383	.361	1.129	1	.288	-1.091	.324
Location	[SOI_X1=1.00]	-.768	.383	4.018	1	.045	-1.519	-.017
	[SOI_X1=2.00]	-.835	.318	6.872	1	.009	-1.459	-.211
	[SOI_X1=3.00]	0ᵃ	.	.	0	.	.	.
	[IOD_X2=1.00]	-.416	.769	.293	1	.588	-1.923	1.090
	[IOD_X2=2.00]	.684	.263	6.747	1	.009	.168	1.200
	[IOD_X2=3.00]	0ᵃ	.	.	0	.	.	.

Link function: Logit.

The results of the measurement of the pseudo determination coefficient *(Pseudo R^2)* shows that the coefficient of determination of the independent variable with respect to the dependent variable only ranges from 0.029 – 0.059 or 2.9% - 5.9%. That means just 2.9% - 5.9% from ARI variations that can be explained through SOI and IOD variables. In other words, there is 94.1% - 97.1% ARI variations that will be influenced by other variables outside SOI and IOD. Intercept value of ARI (β) wet = -0.610, β dry = -0.383, β *El Niño* = -0.768, β *La Niña* = -0.835, β Negatif = 0.416 and β Positif = 0.684. With logit equations f(x) = log(x/(1-x)), then the equation of the regression model is:

$$\left(P\left(Y \geq \frac{1}{ARI_{Kering}}\right)\right) = \frac{\exp(-0.610_{\mathrm{Y}} + 0.835_{\mathrm{El\ Nino\ netral}} - 0.416_{\mathrm{IOD\ negatif}})}{1 + \exp(-0.610_{\mathrm{Y}} + 0.835_{\mathrm{El\ Nino\ netral}} - 0.416_{\mathrm{IOD\ negatif}})}$$

$$\left(P\left(Y \leq \frac{1}{ARI_{Lembab}}\right)\right) = \frac{\exp(-0.383_{\mathrm{Y}} + 0.835_{\mathrm{SOI\ netral}} - 0.684_{\mathrm{IOD\ netral}})}{1 + \exp(-0.383_{\mathrm{Y}} + 0.835_{\mathrm{SOI\ netral}} - 0.684_{\mathrm{IOD\ netral}})}$$

Based on Wald's value and its significance, it shows that of all the independent variables used in this regression model the SOI model is a neutral variable and a significant neutral IOD variable ($P<0.05$). In other words, the SOI neutral variable and the neutral IOD that significantly affect the ARI variable. With the odds ratio equation for SOI neutral = exp (β), then exp (-0.835) = 0.434 then this means that with a neutral SOI will reduce ARI opportunities by as much 0.434 units and the odds ratio equation for IOD neutral = exp (β), then exp (0.684) = 1.982 this means that a neutral IOD will increase ARI opportunities by as much 1.982 units.

1.3.Kefamenanu

Table 4. *Estimates Parameter*

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[ARI_Y = 1.00]	-.015	.478	.001	1	.975	-.952	.923
	[ARI_Y = 2.00]	.212	.479	.195	1	.659	-.727	1.150
Location	[SOI_X1=1.00]	-1.217	.648	3.525	1	.060	-2.488	.053
	[SOI_X1=2.00]	-.815	.469	3.015	1	.083	-1.734	.105
	[SOI_X1=3.00]	0a	.	.	0	.	.	.
	[IOD_X2=1.00]	20.149	.000	.	1	.	20.149	20.149
	[IOD_X2=2.00]	1.188	.415	8.211	1	.004	.375	2.001
	[IOD_X2=3.00]	0a	.	.	0	.	.	.

Link function: Logit.

Intercept value from ARI (β) dry = -0.15, (β) wet = 0.212, SOI (β) *El Niño* = -1.127, (β) SOI neutral = -0.815 IOD (β) Negative = 20.149 and (β) Positive = 1.118. With logit equations f(x) = log(x/(1-x)), then the equation of the regression model is :

$$(P(Y\geq 1/ARI_{Dry})) = \frac{\exp(-0.015_{Y} - 1.217_{El\ Nino} + 20.149_{IOD\ nega\ tive})}{1+\exp(0.212_{Y} - 1.217_{El\ Nino} + 20.149_{IOD\ negative})}$$

$$(P(Y\leq 1/ARI_{Wet})) = \frac{\exp(0.212_{Y} - 0.815_{El\ Nino} + 1.188_{IOD})}{1+\exp(0.212_{Y} - 0815_{El\ Nino} + 1.188_{IOD})}$$

However, from Wald's value and its significance, it shows that of all the independent variables used in this regression model only the neutral IOD variable model is significant ($P<0.05$). In other words, only the neutral IOD variable has a significant effect on the ARI variable. With the odds ratio equation = exp (β), then exp (1.188) = 3.281 then this means that a neutral IOD will increase ARI opportunities by as much 3.281 units.

1.4.Lasiana

Table 5. *Estimates Parameter*

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[ARI_Y = 1.00]	-.234	.362	.417	1	.518	-.944	.476
	[ARI_Y = 2.00]	-.042	.362	.014	1	.907	-.752	.667
Location	[SOI_X1=1.00]	-1.177	.382	9.481	1	.002	-1.926	-.428
	[SOI_X1=2.00]	-.973	.313	9.664	1	.002	-1.586	-.359
	[SOI_X1=3.00]	0a	.	.	0	.	.	.
	[IOD_X2=1.00]	.348	.758	.211	1	.646	-1.137	1.833
	[IOD_X2=2.00]	.927	.276	11.258	1	.001	.386	1.469
	[IOD_X2=3.00]	0a	.	.	0	.	.	.

Link function: Logit.

Intercept value from ARI (β) wet = -0,234, β dry = -0.042, β *El Niño* = -1.177, β *La Niña* = -0.973, β Negative =0.348 and β Positive = 0.927 With logit equations f(x) = log(x/(1-x)), then the equation of the regression model is:

$$\left(P\left(Y \geq \frac{1}{ARI_{Dry}}\right)\right) = \frac{\exp(-0.234_{\mathrm{Y}} + 1.177_{\mathrm{El\ Nino}} - 0.348_{\mathrm{IOD\ negative}})}{1 + \exp(-0.234_{\mathrm{Y}} + 1.177_{\mathrm{El\ Nino}} - 0.348_{\mathrm{IOD\ negative}})}$$

$$\left(P\left(Y \leq \frac{1}{ARI_{Wet}}\right)\right) = \frac{\exp(-0.383_{\mathrm{Y}} + 0.835_{\mathrm{SOI\ netral}} - 0.684_{\mathrm{IOD\ netral}})}{1 + \exp(-0.383_{\mathrm{Y}} + 0.835_{\mathrm{SOI\ netral}} - 0.684_{\mathrm{IOD\ netral}})}$$

However, the Wald value and its significance, show that of all the independent variables used in this regression model only the El Niño SOI variable is neutral and the IOD variable is significant (P<0.05). In other words, the El Niño, SOI neutral variables and IOD neutral variables have a significant effect on the ARI variable. With the odds ratio equation for El Niño = exp (β), then exp (-1.177) = 0.308 this means that with El Niño it will reduce ARI opportunities by as much 0.308 units.

For SOI Neutral = exp (β), then exp (-0.973) = 2.646 this means that with a neutral SOI will reduce ARI opportunities by as much 2.646 units. For IOD Neutral = exp (β), then exp(0.927) = 2.527 this means that a neutral IOD will increase ARI opportunities by as much 2.527 units.

2. Effect of SOI and IOD on Agricultural Rainfall Index (ARI) at Altitude 601 – 1200 meter

2.1.Eban

Table 6. *Estimates Parameter*

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[ARI_Y = 1.00]	-.025	.397	.004	1	.950	-.802	.752
	[ARI_Y = 2.00]	.220	.397	.308	1	.579	-.558	.998
Location	[SOI_X1=1.00]	.491	.501	.960	1	.327	-.492	1.474
	[SOI_X1=2.00]	-.499	.349	2.043	1	.153	-1.183	.185
	[SOI_X1=3.00]	0[a]	.	.	0	.	.	.
	[IOD_X2=1.00]	-18.702	.000	.	1	.	-18.702	-18.702
	[IOD_X2=2.00]	1.098	.318	11.916	1	.001	.474	1.721
	[IOD_X2=3.00]	0[a]	.	.	0	.	.	.

Link function: Logit.

Intercept value from ARI (β) wet = -0.25, β dry = 0.220, β *El Niño* = 0.491, β *La Niña* = -0.499, β Negative = =-18.702 and β Positive = 1.098. With logit equations f(x) = log(x/(1-x)), then the equation of the regression model is :

$$(P(Y\geq 1/ARI_{Dry})) = \frac{\exp(-0.025_{Y}+0.491_{El\ Nino}-18.702_{IOD\ negatif})}{1+\exp(-0.025_{Y}+0.491_{El\ Nino}-18.702_{IOD\ negatif})}$$

$$(P(Y\leq 1/ARI_{Wet})) = \frac{\exp(0.220_{Y}-0.499_{SIO\ neutral}+1.098_{IOD\ neutral})}{1+\exp(0.220_{Y}-0.499_{SOI\ neutral}+1.098_{IOD\ neutral})}$$

However, from Wald's value and its significance, it shows that of all the independent variables used in this regression model only the neutral IOD variable model is significant (P<0.05). In other words, only the neutral IOD variable has a significant effect on the ARI variable. With the odds ratio equation = exp (β), then exp(1.098) = 2.998 this means that a neutral IOD will increase ARI opportunities by as much 2.998 units.

2.2.Kesetnana

Table 7. *Estimates Parameter*

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[ARI_Y = 1.00]	-.467	.426	1.205	1	.272	-1.302	.367
	[ARI_Y = 2.00]	-.219	.425	.265	1	.607	-1.052	.614
Location	[SOI_X1=1.00]	-1.433	.497	8.299	1	.004	-2.408	-.458
	[SOI_X1=2.00]	-1.453	.388	14.041	1	.000	-2.213	-.693
	[SOI_X1=3.00]	0ª	.	.	0	.	.	.
	[IOD_X2=1.00]	-18.129	.000	.	1	.	-18.129	-18.129
	[IOD_X2=2.00]	1.252	.334	14.076	1	.000	.598	1.906
	[IOD_X2=3.00]	0ª	.	.	0	.	.	.

Link function: Logit.

Intercept values of ARI (β) wet = -0.467, β dry = -0.219, β El Niño = -1.433, β La Niña = -1.453, β Negative = -18.129 and β Positive = 1.252. With the logit equation f (x) = log (x / (1-x)), the regression model equation is:

$$(P(Y\geq 1/ARI_{Dry})) = \frac{\exp(-0.467_{Y} - 1.433_{El\ Nino} - 18.129_{IOD\ negatif})}{1 + -0.467_{Y} - 1.433_{El\ Nino} - 18.129_{IOD\ negatif}}$$

$$(P(Y\leq 1/ARI_{Wet})) = \frac{\exp(-0.219_{Y} - 1.453_{SOI\ netral} + 1.252_{IOD\ netral})}{1 + \exp(-0.219_{Y} - 1.453_{SOI\ netral} + 1.252_{IOD\ netral})}$$

Based on Wald's value and its significance, it shows that of all the independent variables used in this regression model the El Niño variable model, the SOI neutral variable and the IOD neutral variable are significant (P <0.05). Or in other words, the neutral SOI variable and the neutral IOD variable that significantly affect the ARI variable.

With the El Niño odds ratio equation = exp (β), then exp (-1.433) = 0.238 then this means that the El Niño variable will increase or decrease the ARI chance by 0.238 units. The odds ratio equation for neutral SOI = exp (β), then exp (-1.453) = 0.234, this means that with a neutral SOI variable, it reduces ARI odds by 0.234 units. The odds ratio equation for neutral

IOD = exp (β), then exp (1,252) = 3,497 then this means that a neutral IOD variable will increase the chance of ARI by 3,497 the unit.

2.3.Niki – Niki

Table 8. *Estimates Parameter*

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[ARI_Y = 1.00]	-.015	.478	.001	1	.975	-.952	.923
	[ARI_Y = 2.00]	.212	.479	.195	1	.659	-.727	1.150
Location	[SOI_X1=1.00]	-1.217	.648	3.525	1	.060	-2.488	.053
	[SOI_X1=2.00]	-.815	.469	3.015	1	.083	-1.734	.105
	[SOI_X1=3.00]	0ª	.	.	0	.	.	.
	[IOD_X2=1.00]	20.149	.000	.	1	.	20.149	20.149
	[IOD_X2=2.00]	1.188	.415	8.211	1	.004	.375	2.001
	[IOD_X2=3.00]	0ª	.	.	0	.	.	.

Link function: Logit.

Intercept values of ARI (β) wet = -0.015, β dry = -0.212, β El Niño = -1.217, β La Niña = -0.815, β Negative = 20.149 and β Positive = 1.188 With logitic equation f (x) = logit (x / (1-x)), then the regression model equation is:

$$(P(Y\geq 1/ARI_{Dry})) = \frac{\exp(-0.015_{Y} + 1.217_{El\ Nino} - 20.149_{IOD\ negative})}{1+\exp(-0.015_{Y} + 1.217_{El\ Nino} - 20.149_{IOD\ negative})}$$

$$(P(Y\leq 1/ARI_{Wet})) = \frac{\exp(-0.212_{Y} + 0.815_{SOI\ neutral} - 1.188_{IOD\ neutral})}{1+\exp(-0.212_{Y} + 0.815_{SOI\ neutral} - 1.188_{IOD\ neutral})}$$

However, from Wald's value and its significance, it shows that of all the independent variables used in this regression model only a neutral IOD variable model is significant (P <0.05). Or in other words, only the neutral IOD variable has a significant effect on the ARI variable. With the odds ratio = exp (β) equation, then exp (1,188) = 3,281, this means that a neutral IOD will increase the chance of ARI by 3,281 units.

2.4. Oelbubuk

Intercept values of ARI (β) wet = -0.015, dry β = -17.427, β El Niño = -17.187, β La Niña = -18.113 β Negative = 0.799 and Positive β = 1.357. With the logit equation f (x) = log (x / (1-x)), the regression model equation is:

$$(P(Y \geq 1/ARI_{dry})) = \frac{\exp(-17.427_{Y} + 18.113_{El\ Nino} - 0.799_{IOD\ negative})}{1 + \exp(-17.427_{Y} + 18.113_{El\ Nino} - 0.799_{IOD\ negative})}$$

$$(P(Y \leq 1/ARI_{Wet})) = \frac{\exp(-17.187_{Y} + 18.140_{SOI\ netral} - 1.357_{IOD\ neutral})}{1 + \exp(-17.187_{Y} + 18.140_{SOI\ netral} - 1.357_{IOD\ neutral})}$$

However, from Wald's value and its significance, it shows that of all the independent variables used in this regression model only the El Niño variable model and the significant neutral IOD variable ($P < 0.05$). Or in other words, the El Niño variable and the neutral IOD variable which have a significant effect on the ARI variable. With the odds ratio for El Niño = exp (β), then exp (-18,133) = 1,333 then this means that with a neutral IOD will reduce the chance of ARI by 1,333 units. For Neutral IOD = exp (β), then exp (1,357) = 3,885 then this means that a neutral IOD will increase the chance of ARI by 3,885 units.

3. Analysis of rainfall Impact and rainy days on rice paddy production

3.1. Belu Regency

The result of a double linear regression analysis of rainfall and rainy days on agricultural production in the Belu Regency, NTT can be seen in table 10

Table 10. Double Linear Regression Analysis

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound
1	(Constant)	32.248	21.019		1.534	.265	-58.188	122.685
	HUJAN_X1	-.004	.013	-.398	-.278	.807	-.062	.054
	HARIHUJAN_X2	.010	.348	.040	.028	.980	-1.486	1.505

a. *Dependent Variable*: **PRODUKSI_Y**

Based on table 3.10 we can get a multiple linear regression equation, that is,

$$Y = 32{,}248 - 0.004X1 + 0.010X2$$

The results of the equation above show that the value of rainfall variable (X1) of 0.004 means that every increase of 1 (one) value of rainfall variable will decrease agricultural production in Belu Regency by 0.004 tons, each increase of 1 (one) variable of rainy day will increase agricultural production in the Regency Belu of 0.010 tons. T test shows that the value of t or sig of rainfall 0.087 and day of rain 0.980 is greater than the probability value (sig> 0.05), so rainfall and rainy days are partially not significantly (ho accepted) on rice production in Belu Regency.

3.2. Timor Tengah Selatan (TTS) Regency

The result of a double linear regression analysis of rainfall and rainy days on agricultural production in the Timor Tengah Selatan Regency, NTT can be seen in table 11.

Table 11. Double Linear Regression Analysis

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound
1	(Constant)	17.023	19.332		.881	.471	-66.156	100.202
	HUJAN_X1	-.005	.012	-.331	-.411	.721	-.056	.046
	HARIHUJAN_X2	.075	.236	.255	.316	.782	-.942	1.092

a. *Dependent Variable*: PRODUKSI_Y

The results of the equation above show that: the value of rainfall variable (X1) of 0.005 means that each increase of 1 (one) value of the rainfall variable will reduce agricultural production in TTS by 0.005 tons, each increase of 1 (one) variable rainy day will increase agricultural production in TTS by 0.075 tons. T (partial) test results of rainfall and rainy days on rice production in TTS. The t test shows that the t value or sig of rainfall -0.721 and the rainy day of 0.782 is greater than the probability value (sig> 0.05), so the rainfall and rainy days are partially not significant (h0 accepted) on rice production in TTS.

3.3.Timor Tengah Utara (TTU) Regency

The result of a double linear regression analysis of rainfall and rainy days on agricultural production in the Timor Tengah Utara Regency, NTT can be seen in table 12.

Table 12. Double Linear Regression Analysis

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	32.248	21.019		1.534	.265	-58.188	122.685
	HUJAN_X1	-.004	.013	-.398	-.278	.807	-.062	.054
	HARIHUJAN_X2	.010	.348	.040	.028	.980	-1.486	1.505

a. *Dependent Variable*: PRODUKSI_Y

Based on table 3.12 can be obtained multiple linear regression equation, namely:

$$Y = 32{,}248 - 0.004X1 + 0.010X2$$

The results of the equation above show that the value of rainfall variable (X1) of 0.004 means that each increase of 1 (one) value of the rainfall variable will reduce agricultural production in TTU by 0.004 tons, each increase of 1 (one) variable of rainy day will reduce agricultural production in TTU by 0.010 tons.

The t test shows that the t value or sig of rainfall is 0.807 and the rain day is 0.980 greater than the probability value (sig> 0.05), so the rainfall is partially not significant (ho is accepted) on rice production in TTU. While rainy days have a significant effect on rice production in TTU.

3.4.Kupang Regency

The result of a double linear regression analysis of rainfall and rainy days on agricultural production in the Kupang Regency, NTT can be seen in table 13.

Table 13. Double Linear Regression Analysis

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	32.248	21.019		1.534	.265	-58.188	122.685
	HUJAN_X1	-.004	.013	-.398	-.278	.807	-.062	.054
	HARIHUJAN_X2	.010	.348	.040	.028	.980	-1.486	1.505

a. *Dependent Variable*: PRODUKSI_Y

Based on table 3.13 we can get a multiple linear regression equation, namely:

$$Y = 100,008 + 0.087X1 + 1,779X2$$

The results of the equation above shows that the value of rainfall variable (X1) of 0.087 means that each increase of 1 (one) value of rainfall variable will reduce the agricultural production of Kupang Regency by 0.087 tons, each increase of 1 (one) variable of rainy days will reduce agricultural production in the Regency Kupang of 1,779 tons. T (partial) test results of rainfall and rainy days on rice production in Kupang Regency. T test shows that the value of t or sig of rainfall is 0.142 and rainy day -2.185 is greater than the probability value (sig> 0.05), so rainfall and rainy days have no significant effect (ho accepted) on rice production in Kupang Regency.

CONCLUSION

At an altitude of 0 - 600 meters, the El Nino phenomenon, neutral SOI and neutral IOD significantly affect upon Agricultural Rainfall Index in Timor Barat. The neutral SOI able to reduce ARI odds by 0.421 units in Baun, 0.434 units in Betun, and 0.308 units in Lasiana while neutral IOD increasing ARI opportunities by 2,768 units in Baun, 1,982 units in Betun, 3,281 units in Kefamenanu and 2,527 units in Lasiana.

At an altitude of 601 - 1200 meters, generally the neutral IOD phenomenon has a significant effect upon Agricultural Rainfall Index, for the Kesetnana and Oelbubuk regions of the El Nino phenomenon also influencing the Agricultural Raindrop Index. The neutral IOD variable increasing ARI opportunities by 2,998 in Eban, 3,497 units in Kesetnana, 3,281 units in Niki - Niki and 3,885 units in Oelbubuk, for two locations of Kesetnana and Oelbubuk the El Nino variable able to reduce ARI opportunities by 0.238, 1,333 units.

The influence of rainfall in Belu, Timor Tengah Selatan (TTS) and Timor Tengah Utara (TTU) regency decreased agricultural production by -0.004, -0.005, -0.004 tons while for the effect of rainy days it would increase agricultural production by 0.010, 0.075, 0.010 tons. Whereas for Kupang regency the production will increase by 0.087 tons, for rainy days it will reduce agricultural production by -1.779 tons. Suggestions for further researchers can create a model for this study, by using existing data.

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