CLIMATE EFFECTS ON RAINFALL INDEX INSURANCE PURCHASE DECISIONS

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Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Atlanta, Georgia, January 31-February 3, 2009

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Introduction

Rainfall Index insurance (RI) is a pilot group risk insurance product offered to the producers of hay and pasture in 9 states. RI premiums and estimates of potential indemnity payments are based on past averages of rainfall as determined for two month Intervals under all climatic conditions. However, indemnifying 2-month Intervals based on alternative climate phases, in particular those associated with the El Nino Southern Oscillation (ENSO), may change the bi-monthly intervals that, if insured, would provide the largest potential insurance protection level to the farm operation. The ENSO impact on the bi-monthly rainfall insurance is likely to be more pronounced than the impact on annual yield/revenue insurance (1) because of the nature of the insured variable and (2) because ENSO phases, particularly in the Southeastern U.S., affect regional climate most strongly in late fall and winter. This analysis examines the expected payoff of the RI insurance for two month periods based on probabilities of rainfall shortage during alternative climate phases (El Nino, La Nina, and Neutral) at 4 Alabama Agricultural Experiment Station sites under varying Coverage Levels. Policy makers and producers are expected to benefit from results that show the varying effects of climate ENSO phases on maximum likely payouts from indemnifying 2 2-month periods.

Crop Production and ENSO Phase

The relationship between ENSO climate phases and crop production in the southeastern U.S. has been well documented (Baigorria et al. 2008; Hansen, Hodges and Jones, 1998). Mjelde, Hill, and Griffiths cite a correlation between U.S. weather parameters and ENSO along the Gulf Coast, Northeast, Southwest, and Northwestern regions of the country. Gershunov examined intra-seasonal impacts of ENSO on rainfall. Carriquiry and Osgood (2008) examined the interaction of climate forecasts and index insurance as a way to manage climates risk on agriculture in in marginal areas. Podesta et al. (2002) highlighted the implications of ENSO phase for agricultural decision making in Argentina. Khalil et al. (2007) examined ESNO phase and proposed rainfall index insurance as protection against crop losses due to floods in Peru. Nadolnyak, Vedenov, and Novak (2008) found significant differences in yield distributions of cotton, corn and peanuts under different ENSO phases in the southeastern U.S. and cited implications for actuarial improvements in group risk insurance products through use of ENSO phase data. A common observation in the climatologic literature is that, in the southeastern United States, the impact of ENSO signal on regional climate is the strongest during the late fall and winter months, which makes insurance with narrow time intervals a particularly relevant subject of research on climate impacts.

Rainfall Index Insurance

The concept of rainfall and weather related index insurance has been presented in Miranda, (1991), Skees et al. (2001), and Martin et al. (2001) studies. Although presented as a workable concept in these papers, the implementation of rainfall index insurance in the U.S. was only introduced relatively recently and is currently being conducted as a pilot insurance program available in 9 states in 2009. Five pilot states are currently in areas cited as being affected by strong ENSO signals with implications for additional U.S. coastal and southwestern states as they are added to the RI program. (www.rma.usda.gov/policies/pasturerangeforage).

Rainfall Index insurance in the U.S. is an insurance program that indemnifies a 12 x 12 mile "Grid" against shortages of rainfall during 2-month "Intervals" during a production year. For insurance purposes, the production year is divided into 6 Intervals starting in February-March and ending in December-January. Producers must indemnify at least two Intervals and distribute a minimum of 10% and a maximum of 50% of their crop (forage, pasture, or hay) acreage in the indemnified periods. More than 2 Intervals may be indemnified but not more than 100% of acreage can be insured in the Intervals.

Normal rainfall for the 2-month intervals within each 12 x 12 Grids has been determined based on National Oceanic and Atmospheric Administration (NOAA) data which goes back to 1948. Rainfall value for forage, pasture or hay production is related through the index into dollar denominated County Base Values (CBV) for each Grid. Insurance coverage levels of 70%, 75%, 80%, 85%, and 90% of the CBV are available to producers. Producers may adjust RI coverage within a Grid for acreage productivity above or below average by multiplying dollar protection levels by factors ranging from 60% to 150%.

Indemnity payments are triggered when the rainfall index falls below the coverage index level of protection chosen for a two month indemnified period. At the end of each Interval period, NOAA calculates a Final Grid Index value (FGI) for each Interval. Payments are based on the difference between the normal and the final grid indexes.

Hay acreages insured under RI were modeled in this analysis using data from 4 Alabama Experiment Stations. Distinct production regions were represented in the study including Coastal Plains (Fairhope, Grid 38088), Wiregrass (Headland, Grid 37135), Piedmont (Chilton, Grid 34882) and the Tennessee Valley (Belle Mina, Grid 33914) stations. To avoid needless complication, hay acreage at the 4 stations was assumed to be contained within single Grids and not across multiple Grids at each location. Base County Values for hay as established by

RMA/USDA for the respective experiment station Grids were used for this analysis.[1] NOAA historic rainfall and Grid data used in this analysis are available at prfri-rma-map.tamu.edu.

ENSO Phase and Climate

The ENSO phases affect climate along the Nothern Gulf coast and adjacent in-land areas through the Pacific Ocean temperature changes (www.agroclimate.org). The phase in which the eastern Pacific ocean temperature is cooler than normal is called a La Nina and a warmer than normal phase an El Nino. A Neutral phase is also recognized as being a period in which ocean temperature does not deviate beyond +/- 5 degrees C. from normal temperature.

Heat and humidity conditions resulting from ENSO phase result in changes in the global atmospheric circulation and change weather and climate patterns in the southeast and other regions of the country by varying degrees. Climatic conditions within Alabama are affected to greater or lesser extent depending on the ENSO phase and the time of the year. In general, La Nina leads to dry periods during critical moisture recharge and planting periods for the southeastern Gulf region leading to higher production risk.

Because of the increasing distance from the coast and differences in soil and topography, climate at the four sites selected for this study is expected to vary differently in response to ENSO (www.cpc.ncep.noaa.gov/products/ predictions/threats2 /enso/elnino/al_bar.html).

ENSO and Rainfall Index Insurance

The question to be answered by this study is whether maximum expected payoffs from RI insurance for indemnified 2-month Intervals differ by distinct ENSO phases as opposed to pooled climate data estimation. The hypothesis of this study is that maximum expected payoffs

[1] Unfortunately, data on monthly/seasonal hay yields is lacking. Obtaining such data would be useful in more in-depth insurance analysis.

differ by ENSO phase which affects producer's choice of indemnified intervals to provide maximum economic protection for hay production under climate risk.

RI insurance actuarial rates are set by RMA/USDA and are based on pooled climate data going back to 1948. The ENSO is not currently considered in setting insurance premium rates. It is assumed for this analysis that insurance rates will continue to be based on averages over all weather events and will not be set based on specific ENSO event distributions. The question is thus whether producers can potentially use ENSO phase predictions to minimize the error of insuring the wrong Intervals. An implication does of course exist for policy makers to base future rates on ENSO phase.

Although difficulty exists in predicting specific ENSO events or the persistence of such events, climate predictions (www.agroclimate.org) are often given well before the sign up for the RI insurance. Using this information, producers could potentially use ENSO predictions in their assessments of which two Intervals are best to insure to minimize the climate risk.

Method

Dollar Income Protection (DIP) levels net of insurance costs were determined for each of the four locations selected for this study using Hay premium costs and BCV's determined by the USDA Risk Management Agency. Indemnity levels were calculated at 70%, 75%, 80%, 85% and 90% Coverage Levels (CL) and for 60%, 100% and 150% Productivity Factors (PF). It was determined that the 150% PF always resulted in the highest dollars of protection. Therefore for this paper only 150% PF estimated values were reported.

Total Base Coverage Level (TBCL) available for a Grid is determined by multiplying the Base County Value of hay acreage by the varying PF's to adjust for different land quality. RMA has established Base County Values for hay land at the four experiment stations to be $148.60 per acre. TBCL for all 4 locations at the 150% PF was calculated as:

1.) TBCL= $148.60 x 1 acre x 150% PF = $222.90.

Multiplication of the TBCL times Insurance CL gives Dollars of Insurance Protection (DIP) available for the alternative locations as:

2.) DIP_i = TBCL x % Insurance CL_i

for i = CL's of 70%, 75%, 80%, 85% and 90%.

Table 1 lists the DIP levels estimated for alternative CL's at the 4 Experiment Station sites. These values reflect the protection offered based on the total of historic climate events from 1948 to present.

Insurance Premiums

Intervals within a Grid are insured separately based on historic rain shortfall risks and therefore have different premiums calculated by the RMA. Relative risks of hay production at the four locations are reflected in the insurance premium rates charged per Interval regardless of ENSO phases. Premium subsidy levels decline with coverage. Insurance costs are calculated by multiplying the dollars of insurance protection by a "Base Premium Rate" and by farmer's share of the insured acreage. Protection estimates calculated for this analysis assumes a 100% share.

Net Dollars of Income Protection for hay land were estimated (after subsidies) for the 4 Experiment Station sites. These were calculated as:

3) Unsubsidized Premium (UPD_{ij}) = DIP_i x 100% Share x % Base $Premium_j$

4) Producer Premium Due (PPD_{ij}) = UPD_{ij} - (UPD_{ij} x Subsidy)

5.) Net DIP_{ij} = UPD_{ij} - PPD_{ij} = UPD_{ij} * (1 – Base Premium*(1-Subsidy))

where j = Intervals 1 to 6 at site i.

Table 2 shows the Net DIP's. Over all ENSO events, net DIP did not vary a great deal within a CL and Interval between the four sites.

Probabilities of Loss

Probabilities of rainfall shortfall should condition farmer's willingness to purchase RI insurance. The higher the probability of the shortfall the more compelling should be the case for purchasing RI. Probability density estimates of rainfall shortages for distinct ENSO phases were developed for the 4 study sites for each 2-month Interval (NOAA historic data http://prfri-rma-map.tamu.edu/) using Simetar©. Probabilities of the Final Grid Index (FGI) falling below coverage levels for all climate ENSO phases and distinct ENSO phases were calculated for the four locations for each Interval and CL at the four sites.

Using polled rainfall data, the two intervals in which rainfall has the highest probability of being short of the trigger level are February-March and December-January for Belle Mina; April-May and June-July for Chilton; April-May and October-November for both Fairhope and Headland.

In contrast, when considering the data resulting from specific climate phases, estimated probabilities of falling below coverage levels are maximized during August-September and October-November during La Nina climate phase for the Belle Mina Agricultural Experiment Station. Closer to the Gulf Coast at the Chilton Experiment Station during a La Nina year, the maximum chances of falling below coverage level occurs during the August-September and February-March Intervals. Fairhope shows the greatest potential for collecting on the RI insurance during the February-March Interval during a La Nina. The highest probabilities of falling below CL at Headland during a La Nina are in the Intervals October-November and

December-January, which is consistent with the general regional pattern of La Nina years being drier and warmer in the fall/winter season.

While there does seem to be a difference in concurrence with the results contrasting all climate and specific ENSO phases during La Nina events except for October-November Intervals at Headland and Fairhope, during the Neutral and El Nino years, the highest probabilities of rainfall shortage seem to be more in agreement with the overall climate probabilities than during La Nina years.

Expected Values

Expected values or payoffs of RI insurance at various CL's for maximum levels of Net DIP were estimated for all climate phases and then for specific ENSO events as

$$6)\ EV(NDIPijk) = (\text{Probability of RI less than } CL_{ijk}) \times (\text{Net } DIP_{ij})$$

for all i and j where k = ENSO phase. Expected values of the insurance over all ENSO climate phases are shown in Tables 3 through 6.

Results

Based on pooled data analysis, the Intervals with two highest expected values for Belle Mina occur during February-March and December-January. For Chilton, the highest expected value Intervals for all ENSO events are April-May and June-July and for Fairhope and Headland April-May and October-November.

When comparisons (Table 3) are made across ENSO phases, the Intervals that appear to be most at risk are those influenced by a La Nina climate event. The insurance intervals with the highest expected values for Belle Mina are August-September and October-November in La Nina, February-March and December-January in Neutral, and April-May for lower and February-March for higher coverage levels in El Nino. La Nina years are noticeably different

Neutral, El Nino, and pooled years, consistent with the observation of LaNna being drier and warmer in the region.

Table 4 shows the two intervals with the highest expected return levels for the Chilton (Thorsby) Agricultural Experiment Station which are February-March and August-September in a La Nina, April-May and June-July in Neutral, and April-May and October-November during El Nino events.

Fairhope maximum expected values as shown in Table 5 occur in April-May and October-November in La Nina, June-July and October-November in Neutral, and August-September and October-November in El Nino.

The two Intervals with highest expected values for the Headland Agricultural Experiment Station reported in Table 6 are October-November and December-January in La Nina, June-July and October-November in Neutral, and April-May in El Nino year. Several Intervals at lower CL's during El Nino events have an expected value of zero indicating no insurance payoff.

There does not appear to be a consistent pattern of difference between estimates based on overall ENSO and individual ENSO events between the four sites. However, within the sites, differences do seem to exist between specific ENSO phases and pooled data estimation. There are also cases where optimal indemnity periods vary depending on CL.

At Belle Mina, the expected payoff advantage from indemnifying August-September and October-November instead of periods based on pooled data analysis ranges from an additional $10.22 per acre at a 90% CL to $11.56 at a 70% CL. Coverage based on Neutral year events shows the highest returns consistent with all ENSO events except for October-November results during a Neutral year ENSO phase. Although the optimal indemnification period does not change in a Neutral year a higher payoff can be expected during this climate phase. El Nino results show the highest expected payoff in April-May for 70%, 75% and 80% coverage and February-March for the 85% and 90% CL. The general conclusion is that optimal intervals differ by phase but also that payoff from insuring the same intervals may differ year by year. This analysis can be extended by estimating densities parametrically and testing the differences.

Highest payoff intervals in Chilton are the same for pooled and Neutral years, but the Neutral year expected payoff is $15.31 to $27.77 higher per acre. The payoff expected during La Nina is $9.53-$16.46 per acre less than that in El Nino.

In Fairhope, specific climate phase results are consistent with the overall ENSO expected payoff in October-November except in the case of La Nina at a 70% CL. During La Nina the optimal payoff Intervals are also consistent with the all ENSO results during April-May. During a La Nina year, the economic advantage over expectations based on pooled data is an additional payoff of $14.61 at the 70% CL and $22.99 per acre at the 90% CL. Neutral year results show an additional $3.86 per acre at the 70% CL to $11.15 per acre at the 90% CL over the all ENSO results.

In Headland, La Nina and Neutral year results agree with the overall ENSO highest Intervals being October-November. The other highest payoff interval is December-January during a La Nina event. For Neutral years it is June-July. El Nino specific results also list April-May as one of the highest payoff Intervals but splits second highest payoffs between December-January at 70% to 80% CL and August-September at 85% and 90% CL. Additional payoff is shown for La Nina and Neutral year optimal Interval indemnification. Less than expected payoff is shown for El Nino years.

Conclusions

Differences shown in expected returns between the specific La Nina, Neutral, and El Nino ENSO phases indicate that the selection of ENSO-specific optimal Intervals may result in higher overall returns than those based on pooled rainfall series. The two optimal Intervals to indemnify based on specific ENSO phase vary, but do not always differ from the optimal intervals based on pooled data. A consistent result for all sites is that during El Nino years, expected returns are smaller than those calculated using pooled data. This is consistent with the general consensus that El Nino years are wetter and cooler in the Southeast. With the exception of Chilton, Neutral and La Nina years show higher expected returns than those shown by the all ENSO phase results.

Expected payoffs differ by ENSO phase and specific ENSO phase provides more accurate information on payoffs to managers than does payoff based on all ENSO phase data. Management decisions based on selecting ENSO phase specific events optimal Intervals in some cases increase expected payoffs and in others show that the results may be less than expected. Information provided in this study should help managers condition their expectations to more realistic expected results. Implications from this study also exist for setting actuarial rates based on specific ENSO phase.

Table 1: Estimated total hay Dollar Income Protection (DIP) provided under alternative insurance Coverage Levels at 150% PF for all ENSO phases.

Coverage Level	Alabama DIP
70%	$156.03
75%	$167.18
80%	$178.32
85%	$189.47
90%	$200.61

Table 2: Net DIP for hay per acre under alternative CL's for 4 Alabama locations.

Station	CL	Feb–Mar	Apr–May	June-July	Aug–Sept	Oct–Nov	Dec–Jan
B. Mina	70%	$153.97	$154.12	$154.02	$152.11	$151.87	$152.37
	75%	$164.09	$164.28	$164.30	$161.99	$161.60	$162.14
	80%	$173.32	$173.58	$173.66	$170.98	$170.09	$170.83
	85%	$182.64	$182.93	$183.03	$180.62	$179.34	$180.17
	90%	$190.74	$191.10	$191.22	$189.06	$187.33	$188.13
Chilton	70%	$153.63	$152.73	$153.18	$153.26	$152.84	$153.11
	75%	$163.67	$162.47	$163.04	$163.40	$162.72	$163.05
	80%	$172.76	$171.09	$171.90	$172.74	$171.51	$171.94
	85%	$182.01	$180.10	$181.03	$182.35	$180.62	$181.12
	90%	$189.99	$187.75	$188.85	$190.82	$188.33	$189.01
Fairhope	70%	$153.42	$148.89	$154.04	$152.92	$151.28	$153.31
	75%	$163.46	$158.26	$164.17	$162.90	$160.80	$163.28
	80%	$172.67	$166.21	$173.30	$171.77	$168.76	$172.24
	85%	$182.04	$175.37	$182.47	$180.92	$177.30	$181.44
	90%	$190.39	$182.79	$190.57	$188.72	$184.33	$189.59
Headland	70%	$154.01	$151.37	$154.13	$154.25	$150.15	$152.59
	75%	$164.36	$161.28	$164.34	$164.50	$159.48	$162.49
	80%	$173.72	$169.96	$173.76	$173.89	$167.36	$171.20
	85%	$183.44	$179.36	$183.14	$183.30	$176.16	$180.48
	90%	$192.18	$187.35	$191.37	$191.55	$183.06	$188.42

Table 3: Expected Value, Net DIP by ENSO Phase for Belle Mina at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
All CL	$EV	$EV	$EV	$EV	$EV	$EV
70%	$37.94	$31.36	$31.36	$30.78	$29.95	$40.59
75%	$49.13	$42.00	$41.62	$38.12	$40.46	$50.33
80%	$61.68	$54.17	$53.48	$46.41	$52.74	$60.65
85%	$75.54	$67.79	$67.01	$56.26	$67.05	$72.06
90%	$89.73	$81.99	$81.43	$67.32	$82.27	$83.76
La Nina	$EV	$EV	$EV	$EV	$EV	$EV
70%	$19.95	$20.25	$23.94	$54.06	$36.03	$27.66
75%	$26.86	$31.14	$33.01	$65.15	$45.82	$35.42
80%	$34.70	$44.59	$44.72	$76.90	$56.44	$43.92
85%	$43.50	$60.36	$59.91	$89.97	$68.27	$53.48
90%	$52.84	$77.41	$78.07	$103.36	$80.35	$63.38
Neutral	$EV	$EV	$EV	$EV	$EV	$EV
70%	$44.82	$31.65	$31.42	$16.60	$23.20	$47.90
75%	$57.27	$41.97	$42.40	$21.24	$35.26	$57.24
80%	$71.10	$53.37	$54.98	$26.53	$50.79	$66.98
85%	$86.21	$65.83	$69.12	$33.05	$69.81	$77.81
90%	$101.39	$78.75	$84.00	$40.90	$90.50	$88.92

Table 3 Continued: Expected Value, Net DIP by ENSO Phase for Belle Mina at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
El Nino	$EV	$EV	$EV	$EV	$EV	$EV
70%	$20.61	$31.25	$24.48	$12.11	$19.92	$36.80
75%	$34.12	$40.65	$32.45	$16.09	$27.03	$47.77
80%	$50.32	$51.30	$41.50	$25.02	$35.41	$59.81
85%	$70.17	$63.26	$51.72	$36.40	$45.60	$73.45
90%	$93.99	$75.80	$62.63	$49.90	$57.29	$87.88

Table 4: Expected Value, Net DIP by ENSO Phase for Chilton (Thorsby) at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
All CL	$EV	$EV	$EV	$EV	$EV	$EV
70%	$36.65	$42.75	$42.01	$23.76	$35.12	$31.19
75%	$47.65	$52.96	$52.90	$32.01	$45.48	$40.92
80%	$59.94	$63.79	$64.42	$42.57	$56.98	$52.04
85%	$73.54	$75.60	$76.70	$55.70	$69.95	$64.67
90%	$87.50	$87.52	$88.85	$70.68	$83.56	$78.01
ENSO	La Nina	La Nina	La Nina	La Nina	La Nina	La Nina
70%	$35.94	$25.82	$28.97	$39.29	$29.62	$32.22
75%	$45.65	$34.16	$35.72	$48.19	$38.33	$41.08
80%	$56.23	$43.63	$43.05	$57.94	$47.95	$50.77
85%	$67.80	$54.43	$51.26	$68.85	$58.75	$61.46
90%	$79.56	$65.87	$59.95	$80.35	$70.15	$72.46
ENSO	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
70%	$41.85	$47.05	$53.02	$10.89	$23.98	$39.59
75%	$53.61	$58.35	$66.30	$18.92	$33.19	$49.22
80%	$66.56	$70.19	$80.11	$30.64	$44.60	$59.57
85%	$80.82	$82.91	$94.61	$46.34	$63.81	$70.97
90%	$95.43	$95.50	$108.64	$64.98	$92.16	$82.69

Table 4 Continued: Expected Value, Net DIP by ENSO Phase for Chilton (Thorsby) at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
ENSO	El Nino	El Nino	El Nino	El Nino	El Nino	El Nino
70%	$16.46	$41.72	$24.44	$12.73	$34.45	$7.11
75%	$21.70	$51.20	$33.36	$19.70	$42.18	$12.72
80%	$31.12	$61.27	$43.56	$29.04	$50.47	$22.07
85%	$42.62	$72.31	$55.06	$40.79	$59.66	$36.93
90%	$55.64	$83.49	$67.09	$54.57	$69.13	$57.44

Table 5: Expected Value, Net DIP by ENSO Phase for Fairhope at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
All CL	$EV	$EV	$EV	$EV	$EV	$EV
70%	$38.49	$49.20	$35.59	$33.11	$47.67	$24.13
75%	$47.76	$58.05	$46.86	$43.33	$58.29	$33.63
80%	$57.70	$67.05	$59.30	$55.13	$69.04	$45.08
85%	$68.66	$77.20	$72.85	$68.76	$80.52	$58.65
90%	$80.29	$87.22	$86.69	$83.45	$91.62	$73.74
ENSO	La Nina	La Nina	La Nina	La Nina	La Nina	La Nina
70%	$49.91	$61.57	$22.76	$20.52	$48.91	$27.92
75%	$61.33	$71.17	$34.94	$27.23	$61.74	$41.13
80%	$73.18	$80.56	$49.80	$35.26	$74.76	$56.83
85%	$85.91	$90.96	$66.96	$44.82	$88.31	$74.77
90%	$99.15	$100.83	$85.18	$55.47	$101.00	$94.08
ENSO	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
70%	$43.32	$46.90	$49.66	$26.59	$51.07	$20.41
75%	$54.00	$55.67	$61.34	$38.98	$60.80	$29.23
80%	$65.52	$64.66	$73.41	$53.34	$70.62	$39.91
85%	$78.09	$74.80	$85.99	$69.75	$81.25	$52.74
90%	$91.09	$84.76	$98.33	$87.61	$91.66	$67.29

Table 5 Continued: Expected Value, Net DIP by ENSO Phase for Fairhope at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
ENSO	El Nino	El Nino	El Nino	El Nino	El Nino	El Nino
70%	***	$27.33	***	$47.13	$32.57	$14.75
75%	***	$34.38	$19.60	$57.33	$40.37	$21.05
80%	***	$42.21	$26.37	$68.00	$48.69	$28.82
85%	***	$51.45	$36.95	$79.47	$58.01	$38.29
90%	***	$61.20	$49.21	$90.85	$67.56	$49.11

*** Probability = 0

Table 6: Expected Value, Net DIP by ENSO Phase for Headland at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
All CL	$EV	$EV	$EV	$EV	$EV	$EV
70%	$29.31	$39.59	$29.19	$20.97	$48.77	$36.16
75%	$38.00	$48.83	$39.81	$31.08	$58.15	$45.66
80%	$47.92	$58.93	$52.45	$43.94	$67.71	$55.99
85%	$59.51	$70.45	$67.28	$59.25	$77.86	$67.54
90%	$72.34	$82.42	$83.46	$75.97	$87.56	$79.50
ENSO	La Nina	La Nina	La Nina	La Nina	La Nina	La Nina
70%	$43.33	$36.19	***	$23.80	$63.23	$46.47
75%	$53.24	$44.84	***	$31.58	$75.06	$58.28
80%	$63.84	$54.24	$25.44	$41.00	$86.59	$70.72
85%	$75.71	$64.87	$46.93	$52.41	$98.71	$84.26
90%	$88.50	$75.86	$73.24	$65.55	$109.67	$97.87
ENSO	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
70%	$30.20	$39.80	$49.82	$16.97	$51.92	$33.45
75%	$40.60	$49.55	$63.07	$28.40	$60.92	$41.47
80%	$52.49	$60.17	$77.01	$43.35	$69.87	$50.36
85%	$66.12	$72.20	$91.54	$61.27	$79.61	$60.59
90%	$80.92	$84.67	$105.73	$80.56	$88.78	$71.51

*** Probability = 0

Table 6: Continued: Expected Value, Net DIP by ENSO Phase for Headland at 150% PF.

Interval	Feb-Mar	Apr-May	Jun-July	Aug-Sep	Oct-Nov	Dec-Jan
ENSO	El Nino	El Nino	El Nino	El Nino	El Nino	El Nino
70%	***	$32.92	***	***	$20.84	$21.57
75%	***	$40.70	***	$22.78	$27.00	$29.31
80%	***	$49.14	***	$35.11	$33.93	$38.22
85%	***	$58.71	$21.46	$50.04	$42.05	$48.49
90%	$21.92	$68.65	$32.68	$66.68	$50.65	$59.43

*** Probability = 0

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