Agricultural risk management using NDVI pasture index-based insurance for livestock producers in south west Buenos Aires province

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Abstract

Purpose – Based on the Normalized Difference Vegetation Index (NDVI)-based insurance developed by the Ministry of Agriculture, Livestock and Fisheries of Argentina (MAGyP) with technical assistance of the World Bank (WB), the purpose of this paper is to evaluate the out-of-sample performance of the NDVI-based insurance in Bahía Blanca Department of the south west of Buenos Aires (SWBA) Province in Argentina, by calculating the technical premium with the methodology developed by MAGyP-WB and NDVI information up to 2007, and analyzing the results that would have been obtained in 2008 and 2009.

Design/methodology/approach – With the available NDVI information (1982-2009), the authors uses the out-of-sample method to analyze the rating of the contract and the reasonability of the premium payment through a comparison of the frequency and severity of payouts in the NDVI coverage with the losses suffered by droughts in SWBA. Specifically, it has been taken the data until 2006 to set the Triggers and Exits values and to calculate the premium rates, and the payout and loss ratio in 2007 was then analyzed. A similar analysis was done for years 2007-2008 and 2008-2009.

Findings – According with the rating methodology described in this paper, payouts determined by the NDVI-based insurance fit with falls in forage production and reduced meat production yields, which confers reasonability to this tool as a coverage option for cattle and fodder producers. Definite technical premiums based on 1982-2007 period, capture the occurrence of severe drought events, defining a risk profile that is consistent with the used information. Adding more observations to the sample, this profile is redefined, showing the sensitivity of the results to the quality and quantity of data used in the analysis.

Research limitations/implications – There is a subjective assessment in the determination of the sample and the weighting of this information. The election of the period to be considered, how to incorporate the changes in the patterns of climate behavior in the medium- and long-term and the expected effects in the NDVI, etc. will impact on the values of resulting technical premiums. In the specific case of this analysis, the fact of not having considered in the sample two extreme years (2008 and 2009) has a concrete implication in the obtained premiums. In this paper, only the Bahía Blanca Department was considered. Rainfall pattern and extensive grazing of natural grassland in the SWBA area might vary from Department to Department, so the results and payouts might change according to these circumstances.

Practical implications – The situation shown in the findings could be seen as an underestimation of the risk to which the producer is exposed and should be taken into account for further researches and insurance products to be designed. When the considered data series shows atypical or extreme values and these are incorporated into the sample, significant changes can be registered in the triggers and premiums.

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Originality/value – This paper analyzes how a risk profile is redefined depending on the sample considered and shows the sensitivity of the results to used data when using index-based insurance.
Keywords Risk management, Insurance, Argentina, Livestock, Actuarial studies, Agricultural finance
Paper type Research paper

1. Introduction

Pasture and fodder production depends largely on natural and weather conditions. Drought and other climatic events can affect it significantly. The production of natural pastures in the south west of Buenos Aires (SWBA) Province in Argentina is a key resource for cattle rearing and fattening producers.

In the last decades, catastrophic and unforeseen extreme events have been causing a major impact on livestock production and activity at a regional level, generating unfavorable dynamic effects in the medium and long term on the economy.

Nowadays, producers risk management focusses on adopting more efficient agricultural practices and diversifying production. The lack of coverage options exposes producers to recurring situations of loss of productive capital and financial constraints that affect their maintenance in the region when catastrophic and/or extended in time adverse events take place.

In this context, public and private stakeholders began to collaborate in the design of an insurance alternative that protect livestock producers in SWBA. The Ministry of Agriculture, Livestock and Fisheries of Argentina (MAGyP) with technical assistance of the World Bank (WB) developed an Index Insurance based on the Normalized Difference Vegetation Index (NDVI) with the intention of counting with a plausible coverage option in which efforts at the private, provincial, and federal levels may converge as a concrete alternative.

The aim of this paper is to evaluate the out-of-sample performance of the NDVI-based insurance in Bahía Blanca Department of SWBA following the methodology developed by MAGyP-WB. The NDVI data up to 2006 were used to define triggers and to calculate premiums, and then the NDVI data of 2007 was used to analyze the results that would have been obtained. The same performance analysis has been carried out in years 2007-2008 and 2008-2009.

Moreover, climate data and water balance indexes as well as economic losses, as measured by reduction in livestock herd, are contrasted with the theoretical payouts to assess the opportunity and usefulness of this NDVI-based insurance.

The article is structure as follows. Section 2 provides a description of the cattle production in SWBA and its risks and coverage options. Section 3 presents the alternative insurances based on remote sensing imagery. Section 4 introduces NDVI and describes the data used in this paper. Section 5 explains the rating methodology and in Section 6 the performance analysis is presented. In Section 7 climate indexes are compared to the hypothetical payouts of the NDVI-based insurance, and Section 8 concludes.

2. Cattle production: risks and insurance[1]

2.1 Cattle production in SWBA

The Buenos Aires Province, located in the Pampas region of Argentina, a grassy plain, is a significant producer of food, especially grains and livestock. Cattle production in SWBA is an important economic and social activity, and accounts for 15 percent of gross geographic product of the SWBA region. The SWBA is basically a cattle rearing zone. There are over 8,000 registered cattle producers with more than two million head of mainly beef cattle production in an area of about three million hectares of pasture

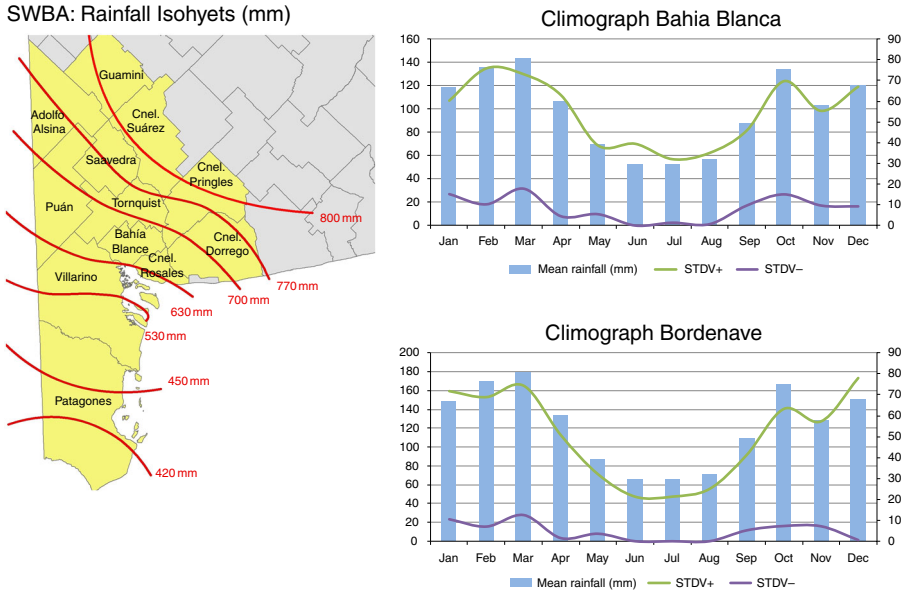
(of which more than 85 percent is natural pasture). Cattle production is based on extensive grazing of natural grassland which is grown under rain fed conditions. Cattle rearing and fattening is therefore highly dependent on adequate rainfall during the spring and autumn to produce the pasture production and grazing required by the cattle.

2.2 Drought exposure of cattle and pasture production

Average annual rainfall is low in SWBA and agricultural crop and livestock production is very exposed to drought. Average annual rainfall varies from a maximum of about 700 mm, in the north of SWBA, to less than 400 mm in the center and south of the region, which is classified as semi-arid, and rainfall is too low to sustain crop production. Figure 1 exhibits the mean monthly rainfall and its deviation for the weather stations at Bahia Blanca and Bordenave (Department of Puan) and the isohyets for the region. Cattle production in SWBA is closely synchronized with the agro-climatic seasons in order to match the nutritional requirements of the cow with periods of peak pasture production.

In the period from 1982 to date, weak or moderate droughts have been recorded in this region in nine years, while severe droughts have been registered in 1994-1995, 2008-2009 and again in the spring 2011 and summer 2011-2012. There has been a major decline in the beef cattle herd in SWBA over the first decade of twenty-first century on account of the severe droughts. The impacts of these catastrophic events in the stock of animals are substantial (Table I).

The stability of the beef cattle herd in SWBA is highly dependent on maintaining numbers of reproductive cows and replacement heifers. The effects of drought are not only seen in the drop in head of cattle, but are also manifested in the following years to be adversely affected calving and restocking of animals. The last droughts induced losses in the livestock industry for many millions of dollars.



Sources: World Bank (2012) and ORA-MAGyP

Figure 1.
Isohyets of SWBA and climograph of two weather stations

Table I.
Evolution of livestock holdings in SWBA (2002-2010)

Year	Cows	Heifers	Total cattle
2002	1,315,860	556,336	3,642,192
2003	1,298,040	552,068	3,553,766
2004	1,287,984	514,219	3,409,954
2005	1,299,376	485,032	3,437,098
2006	1,254,120	511,888	3,288,419
2007	1,217,072	504,746	3,237,107
2008	1,143,064	483,277	3,123,519
2009	901,576	375,622	2,404,576
2010	863,258	291,669	2,166,319

Source: Authors based on breeding stocks (SENASA)

2.3 Insurance for cattle producers in Argentina

Argentina has more than 100 years experience with traditional indemnity-based crop hail insurance with a large and mature agricultural insurance market. However, indemnity-based insurance has not been able to provide practical solutions for insuring extensive natural pasture and grazing lands against production and yield losses due to climatic and natural perils (Bacchini, 2013).

The livestock insurance market is almost non-existent and is restricted to livestock accident and mortality insurance (disease and/or loss production can be included in the dairy cattle activity) and specialist bloodstock insurance for high value breeding or show animals. Liability Insurance and Theft of Livestock Insurance can be purchased by feedlot beef fatteners. In 2012, livestock premiums amount to AR$0.387 million or less than 0.04 percent of total agricultural insurance premiums (Superintendent of Insurance of the Nation (Superintendencia de Seguros de la Nación, SSN), 2013).

However, currently there is no commercial insurance product available in Argentina for livestock producers to protect them against quantitative and qualitative losses in natural pasture or sown pasture. This situation led public sector and beef cattle breeders to explore new developments and index-based products.

3. Pasture insurance using satellite-based remote sensing indexes

Traditional indemnity-based crop insurance has not been successfully developed for pasture and natural grazing, but recent innovations in remote sensing indexes appears to offer a viable alternative for insuring pasture against climatic perils such as drought (WB, 2012). These index-based solutions to insure against production losses in pasture use satellite imagery to measure the NDVI in pasture.

Remote sensing NDVI offer potential for insuring pasture and grazing lands against natural and climatic perils and several commercial schemes are now offering this insurance cover to livestock producers. The NDVI is a measure of the difference in reflectance between two wavelength ranges, the Red (R) and Near Infra Red (NIR) radiation (Jackson and Huete, 1991; Di Bella *et al.*, 2009). Healthy vegetation tends to absorb strongly the Red (R) wavelengths of sunlight and to reflect light in the Near Infra Red (NIR) wavelength, and as such the NDVI index provides a very good indicator of the vegetative growth condition or plant vigor of any type of vegetation (Chantarat *et al.*, 2012; Baez Barraza, 2010), for example annual crops, pasture, and forestry. There are some doubts relative to the usefulness of NDVI to measure losses in some planted crops, but its use to predict losses in natural pastures is widely accepted

(see, for instance, McLaurin and Turvey, 2011) By analyzing monthly NDVI values for pasture and rangelands over a series of 20 or more years, it is possible to construct an NDVI index for insurance purposes, which can be calibrated according to the frequency of extreme climate years (e.g. major droughts) and the required frequency and magnitude of payouts.

Since 2000, four major agricultural insurance markets including the USA, Canada, Spain, and Mexico have developed commercial pasture insurance programs based on NDVI. Three of the four programs in USA, Canada, and Spain are designed as individual farmer (livestock producer) voluntary pasture NDVI insurance programs, and are being promoted using high levels of premium subsidies: uptake rates are relatively low for this voluntary pasture index insurance product. Conversely, the Mexican index product is designed as a macro-level *ex-ante* contingency financing instrument for State Governments to compensate small livestock producers in the event that pasture and fodder supplies are impacted due to extreme climatic events, with premiums fully paid by government.

4. NDVI: data and indexed insurance

With the technical assistance of the WB (2012), the MAGyP carried out the development of an index-based solution to cattle production losses in pasture, using NDVI. The NDVI metric was based on LTDR monthly imagery from 1981 to 1999 at a resolution of 5×5 km (2,500 hectares) grids (or pixels) and MODIS 16-daily imagery from 2000 to 2009 at a resolution of 250×250 meters (6.25 hectares).

The final spatial resolution of the combined 28-year NDVI data sets was 2,500 Ha per pixel with a monthly temporal resolution. The mapping and classification of the vegetation cover and land use in each of the pixels was specifically made for identifying and distinguishing areas of natural pasture and grazing from other types of land use and ground cover (Texeira *et al.*, 2011a, b). For the purposes of the NDVI index insurance a decision was made to classify a forage pixel as having 60 percent or more of its area allocated to natural pasture and grazing.

The definition of the Insured Unit for this NDVI insurance was based on the Cuartel (equal to a county, of which there are 117 in SWBA). It was not deemed feasible to operate an NDVI insurance program in SWBA with the individual pixel as the Insured Unit given the very large number of pixels and the complications of: trying to establish a system of identifying and allocating livestock producers and their animals to these very small grids; and the issue of basis risk of operating at this scale; and the potentially high administrative costs of managing triggered payouts in the very large number of about 1,500 forage resource pixels. The other reason for choosing the Cuartel as the Insured Unit is that this is the smallest administrative area recognized in Argentina and in most cases this represents a relatively homogeneous risk zone for the operation of the NDVI-pasture insurance program.

Two cover periods were selected for the NDVI pasture Index insurance product according with the point of view of local livestock technicians and needs of beef cattle breeders in SWBA. The two cover periods were selected for the NDVI pasture Index insurance program namely, September to November and March to May. During the conduct of the study the cover period was refined on the basis of discussions with local livestock technicians and beef cattle breeders in SWBA. The two coverage periods were timed to coincide with peak periods of rainfall and pasture production in the region namely in spring (September to November) and again in autumn (March to May). These cover periods also coincide with critical periods on the beef cattle rearing

systems: calving occurs in early spring following which it is important that the cows receive adequate nutrition before being serviced in November; in autumn following weaning the cows must again receive adequate nutrition before they enter the winter period (see Figure 2). Droughts in either of these cover periods can impact very severely on the cow-calf cattle production systems in SWBA.

As the primary objective of the NDVI-based insurance was to protect the breeding animals (cows and heifers) in the event of severe drought induced pasture and fodder shortages, the basis of valuation and the sum insured was determined according to their nutritional requirements during the insurance cover period. The sum insured was based on the daily and monthly nutritional requirements of breeding cows expressed in terms of cow equivalents (EV) published by the Livestock Department (MAGyP). It was not, however, the purpose of this NDVI-based insurance product to replace sound pasture grazing and fodder management practices by a cover which will meet the full nutritional requirements of the insured cattle and consequently only a 50 percent of the cost of feed was assumed to be covered. The annual total sum insured (TSI) is calculated considering: the cost of feeding one cow (or cow equivalent), the cover period, the percentage of the cost of feed that will be assured, and the number of breeding cows in Bahía Blanca included in the insurance. The allocation of the TSI to each one of the months in the coverage period was made according to the nutritional requirements of one EV. The total sum insured under the assumption of herd and feed costs at 2014 is approximately ARS$33.8 million (ARS$24.4 for cows and 9.4 for heifers) (see Table II).

5. Payouts and rating methodology

This section describes the methodology followed in the design of the coverage, which is mainly based on the development described in WB (2012).

5.1 Payouts and rating

The payouts of the insurance for each Insured Unit (Cuartel) are triggered when the Index (average NDVI of the pixels belonging to the Cuartel) in any month "*m*" of the

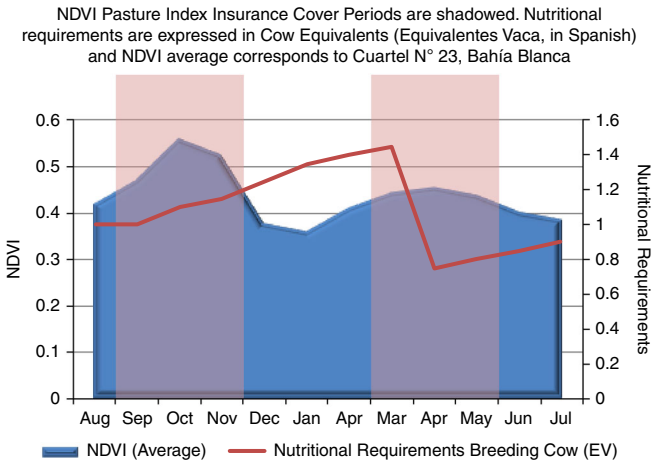


Figure 2.
Seasonality of NDVI values and nutritional requirements

Sources: World Bank (2012) and ORA-MAGyP

Feed based on Maize		
E.V. per Ton	ARS per Ton	ARS per EV
170	1.400,00	8,24

Nutritional Requirements	Calving							Weaning				
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
E.V. per Cow	1,00	1,00	1,10	1,15	1,25	1,35	1,40	1,45	0,75	0,80	0,85	0,90
E.V. per Heifer	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,81	0,81
% of Cost of Feed Insured	0%	50%	50%	50%	0%	0%	0%	50%	50%	50%	0%	0%
Sum Insured: ARS per day per cow	0,00	4,12	4,53	4,74	0,00	0,00	0,00	5,97	3,09	3,29	0,00	0,00
Sum Insured: ARS per day per heifer	0,00	3,34	3,34	3,34	0,00	0,00	0,00	3,34	3,34	3,34	0,00	0,00
Covered days in the month	31	30	31	30	31	31	28	31	30	31	30	31

	Cows	*Heifers*
Total Annual Sum Insured per animal	785,85	610,36
Number of Animals Insured	31.107	15.347
Total Annual Sum Insured (ARS millions)	24,45	9,37

Notes: It is assumed that cows and heifers in Bahía Blanca at 2014 are insured and the nutritional requirements are covered with maize (approximate price in 2014 is ARS$ 1,400 per ton)

Table II.
Calculation of the sum insured

cover period in a year "y", $I_{m,y}$, falls below a predetermined value for that month called Trigger Index (TI_m). In case the Index is lower than another monthly predetermined value called Exit Index (EI_m), the total sum insured of the Cuartel allocated to that month (SI_m) is paid out. In case the observed Index value is between Trigger and Exit, there is a proportional payout. To avoid minimal payments, the insurance designed includes a qualifying franchise (non-deductible), QF, at Cuartel level.

Therefore, the loss in a Cuartel insured, in any month "m" of the cover period in year "y", is calculated as follows[2]:

$$L_{m;y} = \begin{cases} 0 & if\ I_{m;y} > TI_m \\ \frac{TI_m - I_{m;y}}{TI_m - EI_m} \times SI_m & if\ EI_m < I_{m;y} \leqslant TI_m \\ SI_m & if\ I_{m;y} \leqslant EI_m \end{cases}$$

The actual payout in the Cuartel, including the franchise, is:

$$P_{m;y} = \begin{cases} 0 & if\ L_{m;y} < QF \\ L_{m;y} & if\ L_{m;y} \geqslant QF \end{cases}$$

Figure 3 illustrates the payout rule for Cuartel 22 of Bahía Blanca in October. Notice that the franchise is "non-deductible": in case the loss is greater than the franchise, the full loss is paid out.

The Trigger Index was set according to a recurrence of ten years any month in the cover period, and for the Exit Trigger was used a recurrence of 40 years any month.

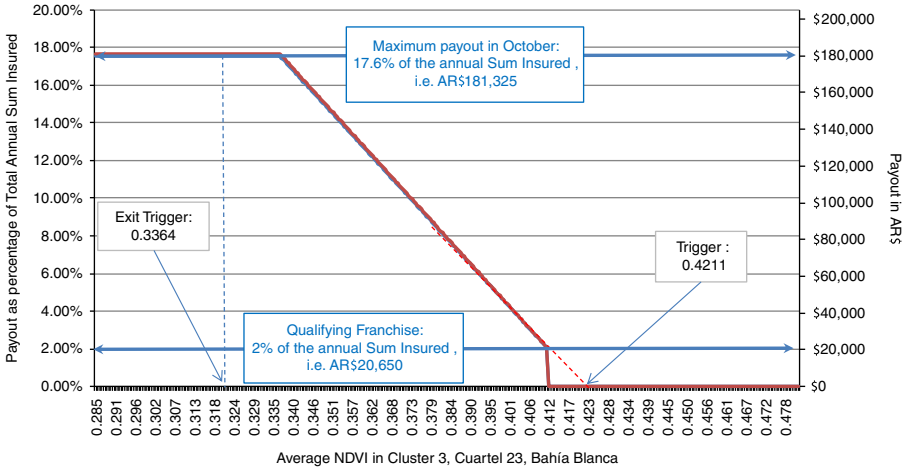


Figure 3.
Example of the NDVI pasture index payout structure for Cuartel 22, Bahia Blanca Department for the month of October

Notes: Cuartel Total sum insured = AR$1,032,499, method = normal, franchise = 2% of Cuartel total sum insured, exit trigger deviation = 1

Source: World Bank (2012)

The annual payout (loss cost) is simply the addition of the monthly payouts. Note that in this paper we used calendar year as an insurance year, that is, the cover period in an insurance year includes autumn and spring of the same year, that is:

$$P_y = \sum_{m=3}^{5} P_{m;y} + \sum_{m=9}^{11} P_{m;y}.$$

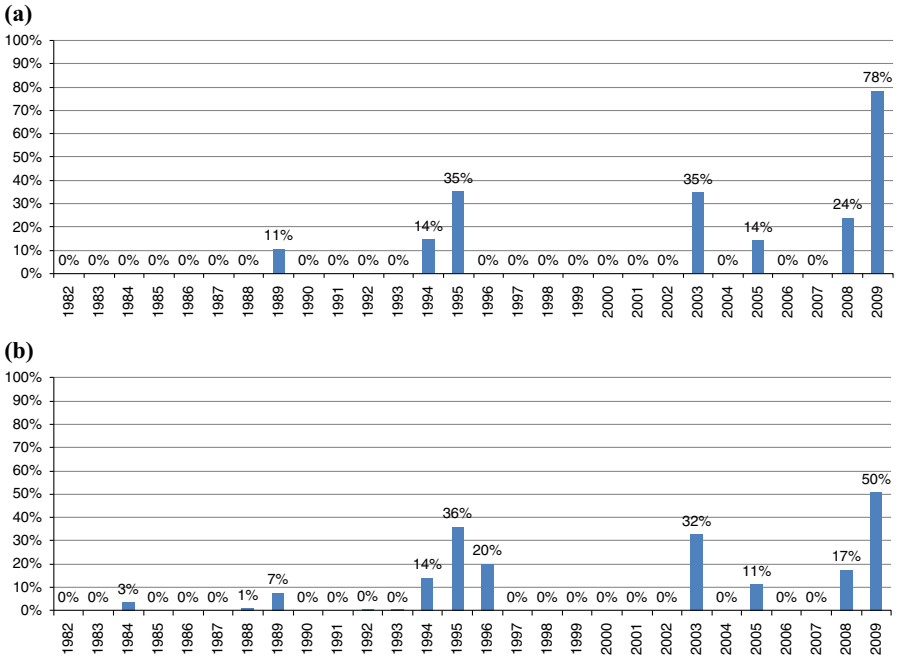
Figure 4 exhibits the historical payouts over the 28-years of sample data: Panel (a) shows the payouts (as percentage of sum insured) in Cuartel 19 and Panel (b) the payouts in Bahía Blanca, calculated as the sum insured weighted average of the payouts in each Cuartel.

It is worth noting that the payouts exhibit an irregular pattern which is virtually is impossible to forecast accurately.

The pure loss cost rates were calculated on a historical burning cost basis. The average loss cost rate (pure risk premium rate) for each Cuartel was calculated as the simple average of the 28-year loss costs. Formally, the pure premium rate was:

$$PPR_C = \frac{1}{28} \sum_{y=1982}^{2009} P_y.$$

Technical and indicative commercial premiums were calculated by loading the pure rates. Technical premium was calculated by adding to the pure rate 15 percent of the



Notes: (a) Historical Payouts in Cuartel 19 (as Percentage of Annual Sum Insured); and (b) Historical Payouts in Bahía Blanca (as Percentage of Annual Sum Insured)

Figure 4. Historical payouts: Cuartel 19 of Bahía Blanca isolated and Bahía Blanca as a whole

annual payout (loss cost) standard deviation, σ_p. The indicative commercial premium was calculated by the addition of 10 percent percent to the technical premium (gross mark-up). That is, the technical and commercial premiums rate were calculated as follows[3]:

$$TPR_C = PPR_C + 0.15\sigma_P$$

$$CPR_C = TPR_C\ (1 + 0.10).$$

Table III presents a summary of the pure premium rates at Cuartel level and the total including the technical and indicative commercial premium rates. The table also shows the number of cows and heifers by Cuartel at March 2014, and the corresponding sum insured, which in turn are used to calculate the pure premiums and technical premiums expressed in Argentine pesos.

6. Performance of the NDVI-insurance out of sample

An out of sample analysis was carried out to evaluate how the NDVI-based insurance would have worked in the past. The rating in Table III, which includes NDVI data from 1982 to 2009, was replicated but using only the data until year "*t*", with $t = 2006, 2007, 2008$: the triggers were set using the sample from 1982 to "*t*" and the rating was performed using this information. In turn, the performance of the insurance in year "*t*+1" was analyzed. Table IV summarized the results.

The premium rates in 2006 are lower than in Table III because the sample does not include the years 2008 and 2009 in which there was severe drought. The year 2007 was a normal year in terms of rainfall, and therefore the NDVI-based insurance would have not paid out at all (see last column in Table IV).

In 2007, the rates would have been a bit lower than in 2006, because in the sample was added one year without payouts. However, there are large losses in 2008 due to the drought experienced in the region in that year, which were translated into low values of NDVI that triggered the insurance. In 2008 the loss ratio (Total loss/commercial premium) amounted to more than 479 percent (see Table IV).

Finally, due to the high losses of the year 2008, the premiums rates were upward adjusted. This adjustment was not as high as could be expected because the NDVI trigger values were downward adjusted: the triggers in 2009 will be lower than the triggers used in 2008 (i.e. a more severe event have to occur to trigger the insurance). However, as the severe drought continued in 2009, this year also experienced high losses because of the low NDVI values observed in Bahía Blanca. A total of 56.71 percent of the sum insured would have been paid out in this year, which amounts a loss ratio of more than 576 percent (see Table IV).

Notice that the number of cows and heifers as well as the sum insured differ in each year, because in Table IV it was entered the approximated stock holdings in each year "*t*".

The rating in 2009 is also shown in Table IV, but no out of sample analysis was performed because no NDVI data was available.

7. Insurance payouts and losses suffered by droughts

The payouts that have been shown in Section 6 are compared to climate indexes to validate the functionality of the NDVI-based insurance.

Table III. Rating of the NDVI-based insurance

Cuartel	No. of pixels	Pure risk rate (%)	Technical premium (%)[a]	Commercial premium (%)[a,b]	No. of cows	No. of heifers	Total sum insured	Pure premium (ARS)	Technical Premium (ARS)[a]
18	2	6.59	8.63	9.50	281	302	$404,997	$26,676	$34,970
19	25	7.53	10.12	11.13	6,191	4,019	$7,317,764	$550,716	$$740,330
20	22	6.60	8.54	9.39	12,664	5,048	$13,032,723	$860,042	$1,112,445
21	12	6.73	8.68	9.55	6,912	3,036	$7,284,656	$490,295	$632,246
22	5	6.79	8.55	9.40	2,130	2,040	$2,919,065	$198,303	$249,434
23	5	7.30	9.41	10.35	2,186	652	$2,115,710	$154,473	$199,142
24	4	7.36	9.89	10.88	744	251	$737,789	$54,312	$72,968
Total	75	6.91	8.87	9.76	31,107	15,347	$33,812,704	$2,334,817	$3,000,477

Notes: Number of cows and heifers at 2014. [a]The total considers the diversification effect. The total percentage rate does not equal the weighted average of the Cuartel-level rates. The sum of the Cuartel-level technical premiums expressed in ARS$ do not add up the total technical premium, because the latter includes the benefits from diversification; [b]A 10.00 percent gross markup was added to the technical premium

Table IV.
Premium rating until year "*t*" and performance in year "*t*+1"

	Rating in year "*t*"						Performance in year "*t*+1"	
Year "*t*"	Pure risk rate (%)	Technical premium (%)	Commercial premium (%)[a]	No. of cows	No. of heifers	Total sum insured (TSI) in ARS$	Payout (as % of TSI)	Loss ratio (total loss/commercial premium) (%)
2006	6.51	8.47	9.32	36,482	15,624	38,205,733	0.00	0.0
2007	6.45	8.42	9.26	39,644	16,978	41,517,503	44.37	479.4
2008	6.96	8.94	9.84	37,269	15,961	39,029,890	56.71	576.5
2009	6.91	8.87	9.76	31,107	15,347	33,812,704	Not available	Not available

Notes: Number of cows and heifers at March of year "*t*". Sum insured calculated using cost of feed in 2014; [a]A 10.00 percent gross markup was added to the technical premium

The year 2007 performed well in terms of rainfall, and this is reflected in the Palmer and water balance indexes (see Figure 5). While the final months of both cover periods (shadowed in Figure 5) show a worsening drought conditions, it can be seen that the water storage exceeds average or normal values for the area. The NDVI index captures the availability of forage resources and, as it was shown in the previous section, the insurance did not trigger any payout in the Cuarteles of Bahía Blanca in 2007.

However, the two following years (2008-2009) recorded one of the most severe droughts of the last few decades, in strength and duration. This situation had a major impact on fodder and grazing availability and lack of drinking water for cattle leading to the need for livestock owners to either: sell their animals to prevent them starving or to purchase feed supplements; and /or to wait for government to provide emergency relief (Figure 6).

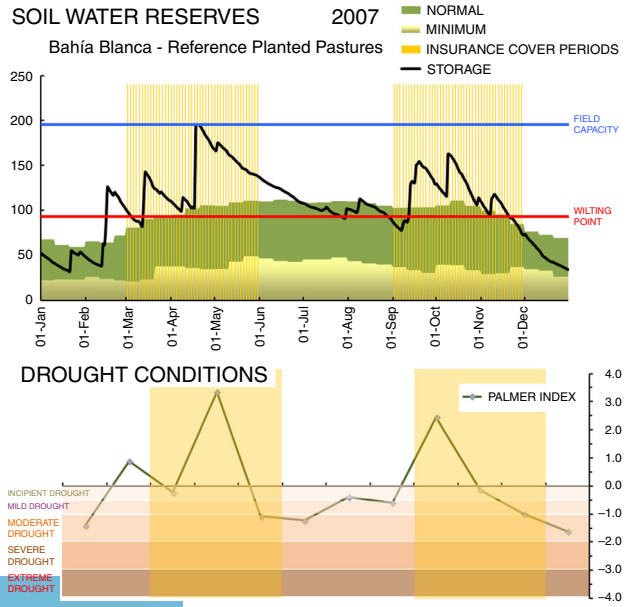


Figure 5.
Soil water reserves and drought conditions in 2007 in Bahía Blanca

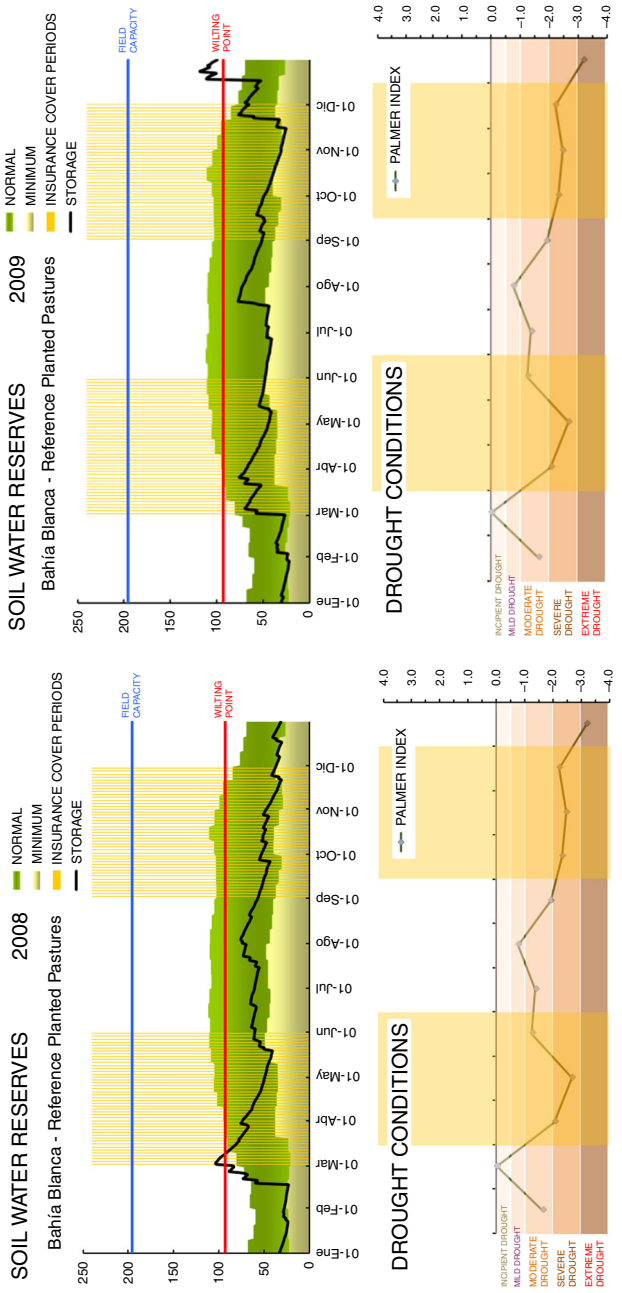


Figure 6.
Soil water reserves and drought conditions in 2008 and 2009 in Bahía Blanca

Throughout this two-year period, NDVI values were significantly lower, which is consistent with drought conditions reflected by the Palmer and water balance indexes. Theoretical payouts of the NDVI-based insurance were substantial in 2008 and 2009 but might not have been sufficient to cover actual losses by farmers.

8. Conclusions

The purpose of this paper was to assess the efficacy of an NDVI-based insurance for Argentinian cattle and fodder producers located in natural pasture lands recurrently exposed to droughts.

Based on the rating methodology described in this paper, we found that this type of index perform quite well reflecting production and capital losses experienced by cattle ranchers. Our results show that payouts determined by the NDVI index-based insurance fit with falls in forage production and reduced meat production yields, which confers reasonability to this tool as a coverage option for cattle and fodder producers.

Definite technical premiums based on 1982-2007 period, capture the occurrence of severe drought events, defining a risk profile that is consistent with the used information. Adding more observations to the sample, this profile is redefined, showing the sensitivity of the results to the quality and quantity of data used in the analysis.

Likewise, there is a subjective assessment in the determination of the sample and the weighting of this information. The election of the period to be considered, how to incorporate the changes in the patterns of climate behavior in the medium and long term, etc. will impact on the values of resulting technical premiums. In the specific case of this analysis, the fact of not having considered in the sample two extreme years (2008 and 2009) has a concrete implication in the obtained premiums. This situation could be seen as an underestimation of the risk to which the producer is exposed.

Finally, when the costs of drought and the cost of the NDVI-based insurance are analyzed, it is important to take into account some factors and variables such as: sum insured per animal (linked to the costs of supplementary feeding), degree of coverage (recurrence period), safety margin of the system (in this case, calculated from the standard deviations), amount of lost production (sick, dead, undersold animals, reduction of sales weight) replacement cost of stock, loss of potential output (decline in pregnancy and birth rates), indirect costs in the activity (economic, social, regional), fall in tax revenues and resources for states to mitigate the effects of adverse events. The election of these will be decisive to assessing the reasonability of the premium payouts and usefulness as a hedging tool.

Notes

1. This section is mainly based on the report of the World Bank (2012), and on publications by ORA – Agricultural Risk Office (Oficina de Riesgo Agropecuario), SENASA – National Service for Animal Health (Servicio Nacional de Sanidad Animal), INTA – National Institute of Agricultural Technology (Instituto Nacional de Tecnología Agropecuaria), MAGyP-Ministry of Agriculture, Livestock and Fisheries, Argentina.
2. Notice that the product is an Index Insurance, and the "Loss" is measured indirectly through the index, and could be different to the actual damage suffered by an individual producer or a region as a consequence of deterioration in pastures.
3. The loading factors of 15 and 10 percent were set to obtain a long-term loss ratio of approximately 70 percent. However, this parameter must be set by the insurer according to his/her tolerance for risk.

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Further reading

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