A preliminary economic assessment of World Animal Protection's 2012 drought intervention in Chihuahua, Mexico

economists | at | large
adding value to society

Report prepared by:
Economists at Large Pty Ltd
Melbourne, Australia
www.ecolarge.com
research@ecolarge.com
Phone: +61 3 9005 0154

Citation:
Economists at Large, 2015, *A preliminary economic assessment of World Animal Protection's 2012 drought intervention in Chihuahua, Mexico.* A report for World Animal Protection, prepared by Economists at Large, Melbourne, Australia.

Report author/s:
Tristan Knowles

Acknowledgements:
I would like to thank everybody who made the fieldwork required for this trip so productive and enjoyable. The entire team at WSPA Latin American including a special thanks to Sergio Vasquez for accompanying the author for the fieldwork and the help and hospitality of Jorge Alberto Solís Santacruz and Cesar D'Avila in Chihuahua. I would also like to thank the various individuals and organisations who took the time to meet with us and discuss the situation in Chihuahua; Mr. Luis Carlos Nieto, Mr. Mario Melendez Monarrez, Mr. Leonel Gutierrez, Mr. Serdio Cano del Val and Dr. Hector Esteban Rodriguez.

1. SUMMARY

This report looks at the economics of World Animal Protection's 2012 intervention in Chihuahua, Mexico.

The state of Chihuahua is located in northwest Mexico and borders the United States to the north.

The beef-cattle industry is the most significant livestock industry in Chihuahua. Much of its produce is exported as live-cattle to the United States of America (USA), where they are fattened in feedlots prior to slaughter. As many as 30 per cent of the cattle exported from Mexico annually come from Chihuahua. In 2012, approximately 450,000 head of cattle, valued at an estimated US $218 million, were exported from Chihuahua to the USA.

Nearly 40 per cent of land in Chihuahua is managed under Ejidos, or communal lands, a type of land tenure dating back to the pre-Hispanic period. The remaining 60 per cent is privately held.

Climatic conditions make Chihuahua prone to droughts. Poor land management over decades has exacerbated the impacts of these droughts. 2011 was a particularly bad year for drought, with most of Chihuahua in a state of exceptional drought, the highest level possible, in the Mexican statistical yearbook for the rural sector.

In early 2012, World Animal Protection undertook a disaster assessment needs analysis of exceptional drought conditions in Chihuahua in 2011. World Animal Protection identified that drought intervention activities should focus on land management practices in Ejidos. Ejidos land continues to be poorly managed, tending to be overstocked and continually grazed by comparison to privately owned land.

No comprehensive economic assessment of the impacts of the 2011 drought conditions in Chihuahua is available.

Data on losses of livestock is also hard to come by. While some media reports were talking about losses of up to 600,000 head of cattle, in June 2011 the agriculture and livestock department of Mexico stated that only 5000 head of cattle were lost, with the remainder slaughtered. Meanwhile, World Animal Protection estimated that over 8 years, more than 500,000 head of cattle were lost due to drought conditions. In three particular districts assessed by World Animal Protection, approximately 12,500 head of cattle died and up to 3000 more were suffering from extremely poor condition that may have led to eventual mortality.

Drought impact assessment can be more difficult than assessments of rapid-onset disasters because of difficulties defining the onset and end of an emergency situation as well as the often broad spatial coverage. Additionally, the costs of mitigation are upfront and more certain while the benefits will occur in the future and are necessarily more uncertain.

Analysis is also complicated by the ways in which producers respond to drought conditions. For example, drought conditions can actually lead to higher levels of export, as producers seek to sell more cattle, seeking to avoid drought-induced losses. If breeding cattle are sold, however, this may diminish long-term productivity.

Additionally, some producers may simply wait for government support to restock. World Animal Protection reported that 62 per cent of producers interviewed said that they will wait for government funds to recover their animals.

Some stakeholders in Chihuahua suggested that poor land management practices politics, corruption and US manipulation of prices at the border are bigger problems than the drought, though the drought exacerbates the situation, particularly for unsophisticated producers.

These factors make it particularly difficult to assess the economic impacts of World Animal Protection's 2012 intervention in Chihuahua, compared to rapid-onset interventions such as in Assam, India or relief-only interventions such as Mwingi, Kenya; examples where a cause-and-effect situation is more apparent.

For this reason, it is only possible to refer to potential economic impact of World Animal Protection's intervention. Calculating the costs of the intervention is straight-forward and is based on the cost of the intervention to World Animal Protection. This was approximately $60,000 and benefited 2500 head of cattle, or $24 per animal.

The benefits of the intervention are more difficult to estimate and depend on whether, in a future drought, the activities of World Animal Protection reduce mortality or loss of condition of animals. These benefits can be approximated through the potential market price of the cattle.

The present market value of the herd based on prices reported by producers is estimated at 2500 head x $170, which is $425,000. This is only half of typical value of 2500 x $340, or $850,000. This range of $425,000 to $850,000 can also be thought of the value of livestock assisted. Meaning for every $1 of money spent on the intervention, World Animal Protection assisted between $7-$14 in livestock assets.

Given a 50 per cent reduction in the market value per animal, or $170, the cost of the drought in terms of reduced value of assets at the time of the World Animal Protection assessment was $425,000.

The maximum possible benefit for an improved-condition scenario is therefore $425,000, the difference between the loss caused by the drought and the 'normal' market price. The maximum benefit-cost ratio based on an improved-condition scenario is therefore 7.1. Or seven dollars of benefits for every dollar of costs. This is the situation in which the mitigation program leads to improved condition of animals during future drought events, compared with the condition had the mitigation not taken place.

The maximum possible benefit for a total mortality scenario is therefore $850,000. This results in a benefit-cost ratio for a total mortality scenario of 14, or fourteen dollars of benefits for every one dollar of costs. This is the scenario in which the mitigation avoids the total loss of value of livestock caused by mortality.

These estimates are very rough and intended as preliminary attempts to quantify World Animal Protection's intervention in Chihuahua, Mexico. As much as anything, we hope that this analysis provides insight into the issues that arise when conducting economic assessment of slow-onset disaster mitigation programs. Economic assessment of mitigation programs for slow-onset disasters is made difficult due to:

- The time lapse between costs of the mitigation and any future benefits.
- The effect of other factors on the economics of the industry.

- The effect of producer responses to economic conditions.

These factors make it difficult to attribute improved condition or reduced mortality to the intervention.

To improve the robustness of estimates for mitigation interventions, we recommend the monitoring of a small sample group of beneficiaries over a period of years, with in-depth microeconomic surveys pre- and post-mitigation and regular follow-up surveys to assess producer responses to changing market conditions.

2. INTRODUCTION

This report looks at the economics of World Animal Protection's 2012 intervention in Chihuahua, Mexico.

The state of Chihuahua is located in north-west Mexico and borders the United States to the north. Chihuahua is the largest state in Mexico by area, covering nearly 250,000km^2 and is home to nearly 3.5 million people (Instituto Nacional De Estadistica Y Geografia 2014).

In early 2012, World Animal Protection undertook a disaster assessment needs analysis of exceptional drought conditions in Chihuahua in 2011. The analysis showed that in the three districts assed for which data was obtained, Aldama, Ojinaga and San Francisco Borja, over 30,000 head of cattle were affected or between 70-90 per cent of the total herd in those districts, (Vasquez 2012).

Ejidos producers, who rely on communal rangelands for pasture, were hit hardest by the drought. World Animal Protection reported that larger producers with large areas of land were able to apply appropriate rotational grazing to maintain adequate pasture for their cattle, even with the drought conditions (Vasquez 2012).

Because of the scale of the problem facing cattle farmers and the stage of the disaster, World Animal Protection decided that support for a change in livestock management practices was more practical than a feeding program.

3. METHODOLOGY AND FIELD WORK

Research for this report included fieldwork in Chihuahua, Mexico. The purpose of the fieldwork was to visit key projects that were part of World Animal Protection's intervention and to meet key stakeholders involved in the projects. Where possible, we obtained data from stakeholders and stakeholder groups on prices and sizes of cattle and the impacts of the drought on the economics of the beef-cattle industry in Chihuahua. Time did not permit a survey of all families that were beneficiaries of the intervention, though we did meet with one larger producer who was involved in an aquaponics initiative to develop alternative income streams from the production of fish and vegetables in an integrated system.

The producers or producer representatives were reluctant to provide data on profitability of their enterprises, so we were unable to obtain data on this subject.

Along with discussions with World Animal Protection's staff and contractors, Jorge Alberto Solís Santacruz and Cesar D'Avila, we met with the following stakeholders:

Sr.Luis Carlos Nieto	Presidente Del Comisariado Del Ejido Aldama, Chihuahua, Del Período 2014-2017
Ing. Mario Meléndez Monárrez	Presidente De La Junta Municipal De Aguas Y Saneamiento De Aldama .
Ing. Leonel Gutiérrez	Presidente Municipal De Ciudad Aldama, Chihuahua, Período 2013-2016
Ing. Sergio Cano Del Val	Jefe Del Distrito 08 Chihuahua De La Secretaría De Agricultura, Ganadería, Desarrollo Rural, Pesca Y Alimentación, Sagarpa) Delegación. Chihuahua.
Dr.Héctor Esteban Rodríguez	Jefe Del Programa Ganadero De La Secretaría De Agricultura, Ganadería, Desarrollo Rural, Pesca Y Alimentación, Sagarpa) Delegación. Chihuahua.

4. THE CATTLE INDUSTRY IN CHIHUAHUA

Beef-cattle is the most significant livestock industry in Chihuahua. Beef-cattle refers to the raising of cattle for beef production, as opposed to dairy production. Much of its produce is exported to the United States of America (USA), mostly as live-cattle that are fattened in feedlots prior to slaughter. As many as 30 per cent of the cattle exported from Mexico annually come from Chihuahua (Ortega-Ochoa et al. 2008). A survey by indicated that nearly three quarters of cattle exported from Chihuahua are between 300 and 440 pounds in weight (140 to 200kg) (Martínez et al. 2007).

In 2012, Mexico was estimated to have exported 1.5 million head of cattle to the USA (Hernandez 2013). Hernandez reports that the value of beef-cattle exports in this year was US $725 million. From this, we can estimate that approximately 450,000 head of cattle, valued at an estimated US $218 million were exported from Chihuahua to the USA in 2012. This is in-line with estimated exports from Chihuahua provided by SAGARPA, who reported exports of cattle from Chihuahua in 2010 and 2011 of 480,000 and 580,000 respectively (SAGARPA 2011).

The US market is widely reported to be more lucrative for Mexican beef producers than the domestic market, with World Animal Protection reporting that prices can be up to double domestic prices, or $1.80 per kg as opposed to $0.90 per kg in 2012 (Vasquez 2012). Cattle imported from Mexico into the USA tend to be lightweight and are intended for fattening in feedlots prior to slaughter. Peel et al. (2011) report that most cattle imported weight less than 400 pounds (180 kg).

The industry is comprised of extensive beef-cattle production across Chihuahua's rainfall dependent rangelands, along with some intensive feedlots.

Nearly 40 per cent of land in Chihuahua is managed under Ejidos, or communal lands, a type of land tenure dating back to the pre-Hispanic period. The remaining 60 per cent is privately held (Ortega-Ochoa et al. 2008).

Ortega-Ochoa et al. (2008) cite a study showing that between 1978 and 1996, biomass production in certain areas of Chihuahua declined by between 42-52 per cent. Informal conversations between the author and local stakeholders confirmed that recent decades have seen a significant reduction in biomass.

Ortega-Ochoa et al. (2008) and conversations the author had with stakeholders highlight that drought cycles, combined with poor land management and overgrazing, have led to this large reduction in biomass.

Although private land management has shown signs of improvement, Ejidosl lands continue to be poorly managed and tend to be overstocked and continually grazed, (Ortega-Ochoa et al. 2008) and (Peel et al. 2010). This supports World Animal Protection's conclusion that drought intervention activities should focus on land management practices in Ejidos.

The long-term result of drought and mismanagement mean that the carrying capacity of the land is reduced, as Ortego-Ochoa et al. (2008) said:

It is the result of cumulative effects resulting from a decade of drought and improper grazing that has lessened the potential of rangelands to support livestock and wildlife over the long-term. (p.4)

Ortego-Ochoa et al. (2008) suggest that a decade of drought, mismanagement and economic crisis in Mexico between 1990 and 2000 led to Chihuahua's cattle herd decreasing from over 2 million head to just over 1 million head.

According to the Secretaria de Agricultura Ganaderia Desarrollo Rural y Alimentacion (SAGARPA)[1], in 2009, and prior to the most recent significant years of severe drought, Chihuahua had 1.7 million head of cattle.

[1] Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food

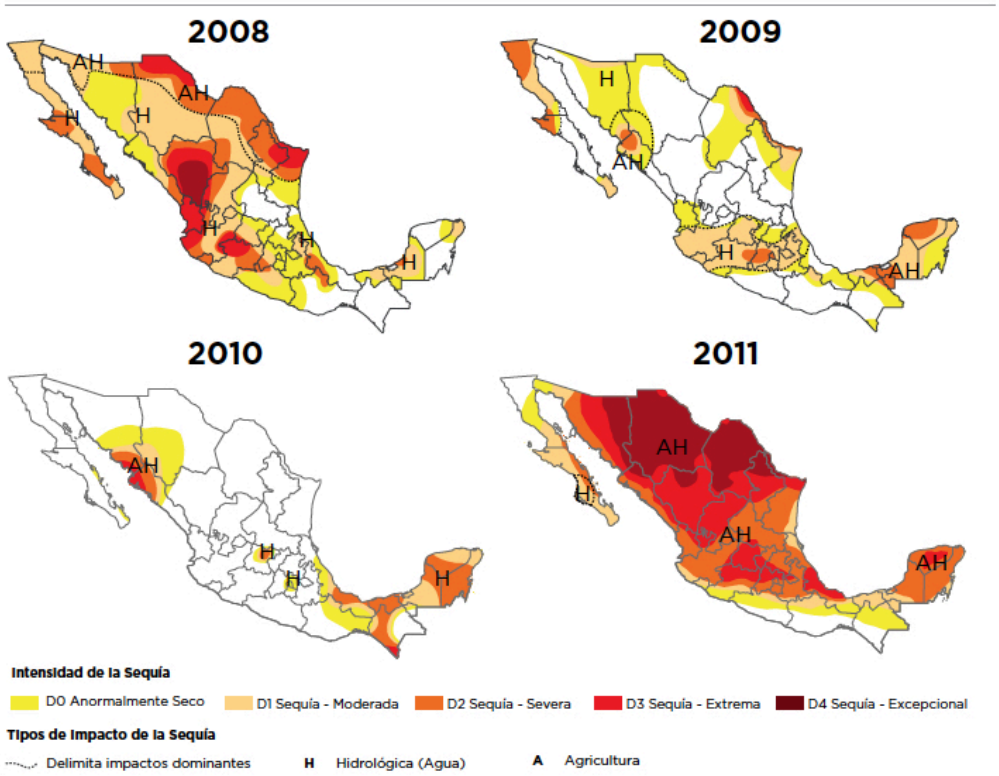
5. DROUGHT IN CHIHUAHUA

Climatic conditions make Chihuahua prone to droughts. Poor land management over decades has exacerbated the impacts of these droughts. 2011 was a particularly bad year for drought, with most of Chihuahua in a state of exceptional drought, the highest level possible, in the Mexican statistical yearbook for the rural sector (Secretaría de Desarrollo Agropecuario 2011).

Surface temperatures are likely to increase due to global warming, making heat waves longer and more frequent, (IPCC 2014). This makes improvements to land and water management even more necessary.

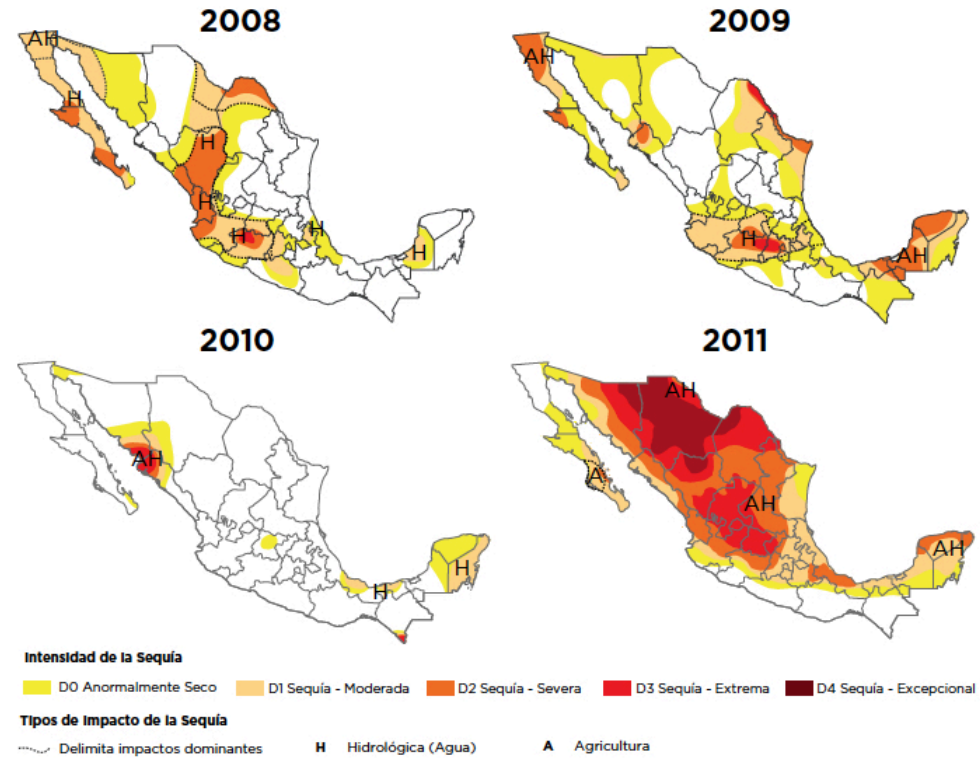
The maps on the following page show the extremity of the drought in Mexico in 2011 and illustrate that Chihuahua was the state most-severely affected, with exception drought conditions covering nearly all of the state in June and July.

Figure 1: Severity of drought in June in Mexico (2008-2011)



Source: (Secretaría de Desarrollo Agropecuario 2011)
Note: Maps are derived from the North American Drought Monitor program. Maps are available at: http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm/nadm-maps.php

Figure 2: Severity of drought in July in Mexico (2008-2011)



Source: (Secretaría de Desarrollo Agropecuario 2011)

5.1. Economic impacts of drought conditions in Chihuahua

No comprehensive assessment of the economic impacts of drought conditions Chihuahua is available.

Boyd & Ibarrarán (2008) undertook an exploratory analysis of drought in Mexico looking at the costs of the disaster, along with which sectors were affected and who might benefit from any adaptation efforts. Unsurprisingly, the authors found that rural sectors suffered the biggest losses from drought: their model suggested output in the livestock sector dropped by nearly 14 per cent. Interestingly, the authors found that rural impacts can affect urban communities too, through higher prices for food and energy, and as a result of an influx of workers from drought-affected areas. Concerning mitigation, Boyd & Ibarrarán found that:

Investment policies geared to enhance technology, adaptation, and irrigation can indeed mitigate losses in agriculture due to climate change. At best, however, these policies can only serve to limit those losses and not to prevent them entirely. (p.392)

Drought impact assessment can be more difficult than for sudden-onset disasters, as (Ding et al. 2011) point out:

Compared to other natural disasters, drought typically has an unclear onset or ending, a large spatial coverage, and an extended duration; which all make the drought impact assessment an even more challenging task. (p.443)

Ding et al. highlight the difficulties involved with assessing the economic impacts of drought, highlighting that "the costs of a mitigation project are usually up-front; while the benefits of the project are more uncertain and harder to predict" (p.435). Ding et al. suggest that:

The benefits of mitigation programs can be approximated by using the estimated costs of the disaster that would be otherwise avoided by the mitigation programs. Therefore, in order to understand the monetary benefits of drought mitigation programs, quantification of the economic impacts of drought need to be available. (p.435)

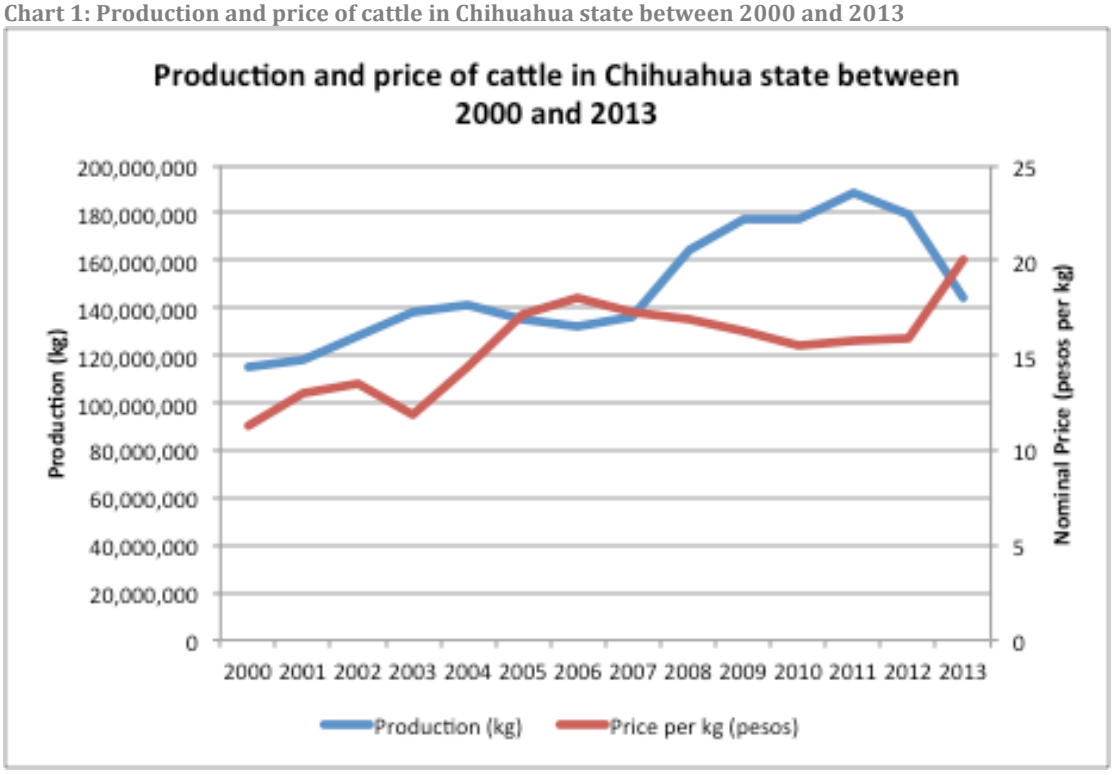
Data on losses of livestock is hard to come by. San Juan et al. (2011) highlight that while media reports discussed losses of up to 600,000 head of cattle, in June 2011 SAGARPA stated that only 5000 head of cattle were lost, with the remainder slaughtered. Meanwhile, World Animal Protection has estimated that over eight years, over 500,000 head of cattle were lost due to drought conditions, (World Animal Protection 2013). World Animal Protection estimated that in three districts assessed, approximately 12,500 head of cattle died and up to 3000 more died or lost condition.

The ways in which producers respond to drought conditions complicate the analysis. For example, drought conditions can actually lead to higher levels of export, as producers seek to sell more cattle, seeking to avoid drought-induced losses, (San Juan et al. 2011). This may, however, diminish long-term productivity if breeding cattle are sold, as Hernandez (2013) pointed out:

The 2012 drought and attractive beef prices enticed producers to sell not only steers and heifers but breeding cattle, as well. Also, Mexico's low breeding rate, currently averaging 1 calf every 2 years, along with increased calf exports has strained production systems and reduced domestic slaughter from traditional levels for the remainder of 2013 and, likely, the beginning of 2014.

Data available from SAGARPA (2014) shows a noticeable drop in production following a peak in 2011. Prices tend to show the opposite trend to production, suggesting a typical supply-demand price response. This fits with the explanation that producers will sell more during drought years, depressing prices and also reducing productivity in following years. The drop is quite significant, with production peaking in 2011 at 188 million kg and dropping nearly 25 per cent to 145 million kg in 2013. An equivalent increase in price per kg helped to offset a major reduction in production value.

Chart 1: Production and price of cattle in Chihuahua state between 2000 and 2013



Source: (SAGARPA 2014)

Additionally, some producers may simply wait for government support to restock. World Animal Protection reported that 62 per cent of producers interviewed said that they will wait for government funds to recover their animals (World Animal Protection 2013).

Some stakeholders in Chihuahua suggested that poor land management practices politics, corruption and US manipulation of prices at the border are bigger problems than the drought, although the drought exacerbates the situation, particularly for unsophisticated producers.

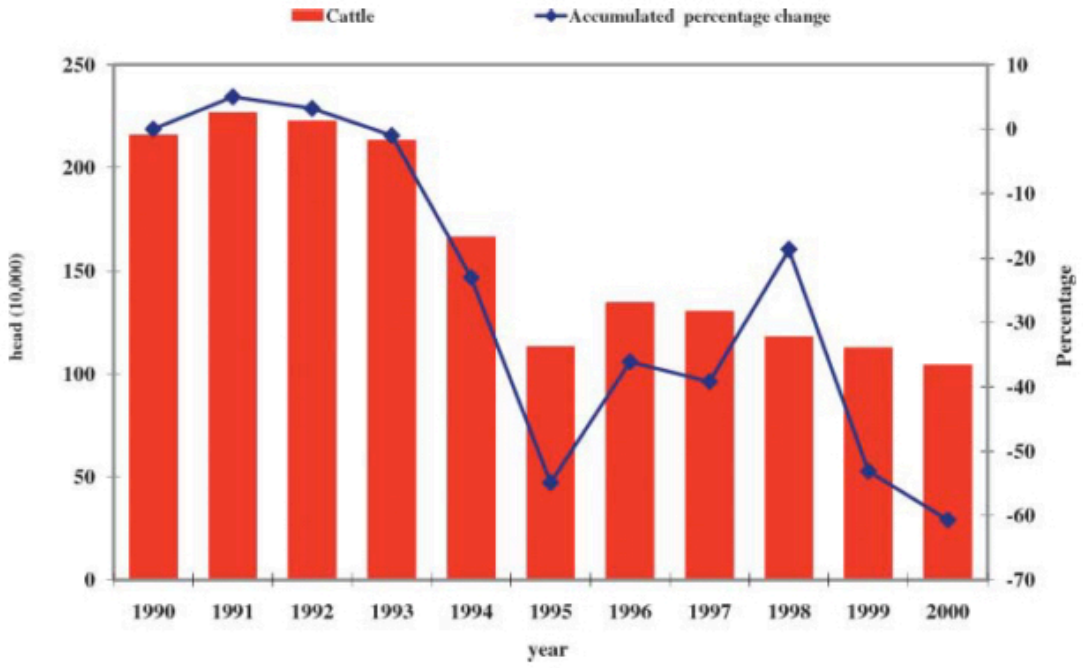
These factors make it particularly difficult to assess the economic impacts of World Animal Protection's 2012 intervention in Chihuahua, compared to rapid-onset interventions such as in Assam, India or relief-only interventions such as Mwingi, Kenya, where a cause-and-effect situation is more apparent.

For this reason, it is only possible to refer to potential impacts, acknowledging the variety of factors that will influence viability of cattle producers.

5.2. Effect of previous droughts

Analysis of beef cattle inventories in Chihuahua during the 1990s showed that long-running drought reduced herd size by 60 per cent from over 2 million head to under 1 million head.

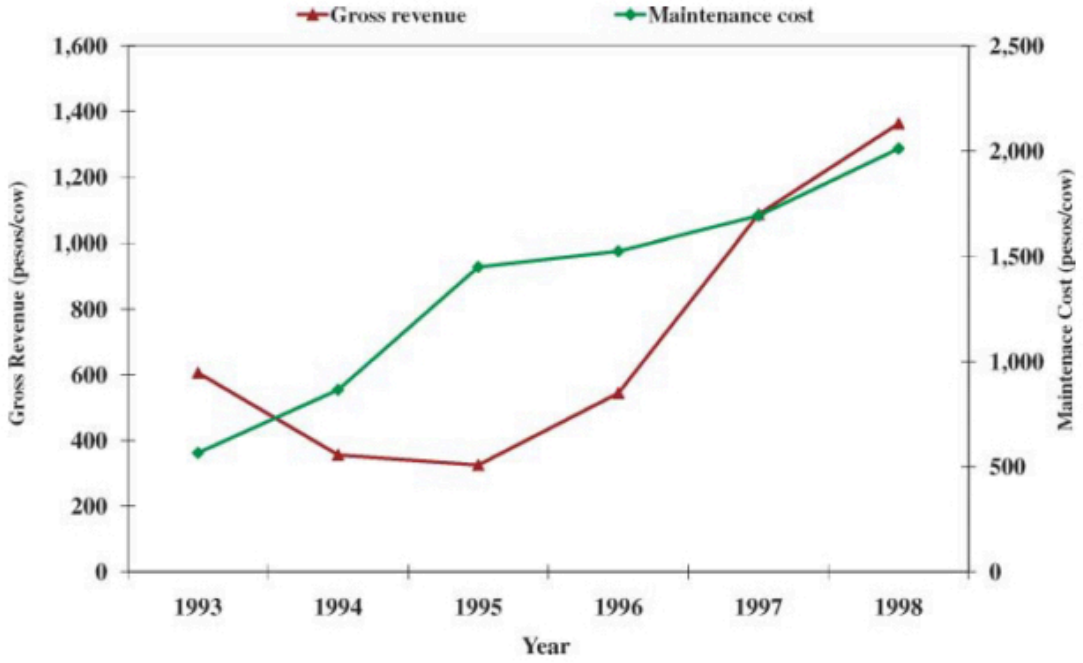
Figure 3: Cattle inventory in Chihuahua, Mexico, and cumulative percent change from 1990 to 2000



Source: (Ortega-Ochoa et al. 2008)

Over this time, profitability of producers also fluctuated greatly due to a number of factors, including the financial instability that affected the Mexican economy in 1995 and 1996 and low cattle prices in the US.

Figure 4: Annual cost of maintaining a cow and her gross revenue (in pesos) from 1993 to 1998 in a cow/calf enterprise located in a semiarid region of Chihuahua, Mexico



Source: (Ortega-Ochoa et al. 2008)

Based on Ortega-Ochoa et al.'s analysis and fieldwork undertaken for this report, the economic impacts on Chihuahua's beef-cattle industry due to drought can be summarised as follows:

- Increased calf mortality due to tougher conditions and reduced water and feed availability.
- Degraded condition of animals sold due to tougher conditions and reduced water and feed.
- Potential for producers to sell-down herd (sell heifers) due to reduced water and feed availability, diminishing future income and slowing down a recovery post-drought.

6. WORLD ANIMAL PROTECTION 2012 INTERVENTION IN CHIHUAHUA

In 2012, World Animal Protection undertook a disaster assessment needs analysis of the drought in Chihuahua. The key documents this report relied on to assess the intervention are summarised in the table below.

Report	Purpose
Vasquez, S (2012) Disaster Assessment Needs Analysis Chihuahua, Mexico Drought Crisis, World Animal Protection, internal report, Glide number: DR-2011-000177-MEX.	Initial analysis of situation in Chihuahua used to inform design of intervention.
World Animal Protection (2013) Chihuahua Drought RR pilot Update 06/13, internal report.	Update on World Animal Protection's work in Chihuahua as at June 2013.
World Animal Protection (2013) Chihuahua Drought RR pilot Update 12/13, internal report.	Update on World Animal Protection's work in Chihuahua as at November 2013.

World Animal Protection (no date), Chihuahua, drought case study.	Summary of World Animal Protection's work in Chihuahua
World Animal Protection (2013) The big picture: How healthy animals protect livelihoods and build community resilience, case study.	Summary of World Animal Protection's work in Chihuahua

In 2012, World Animal Protection undertook a Disaster Assessment Needs Analysis for the Ojinaga and Aldama districts in Chihuahua, areas badly affected by a severe drought in 2011 that followed up to eight years of low-rainfall.

In partnership with local authorities and the Aldama Ejidos, a communal land management group, World Animal Protection began an intervention to assist with drought mitigation activities.

World Animal Protection's assessment concluded that 30,500 animals were affected in the areas they assessed; Aldama, Ojinaga and San Francisco de Borja.

Table 1: Estimated of number of animals affected by drought in 2011 in areas assessed by World Animal Protection

Location	Numbers of Animals & Affected %	Impact
Aldama	**2,500** 70% affected	Death by starvation
Ojinaga	**25,000** 90% population Over **10,000** cattle dead	Death and lost of body condition
San Francisco de Borja	**3,000** 70% affected	Death & loss of body condition, diseases
TOTAL	**30,500**	

Source: (Vasquez 2012)

6.1. Activities undertaken

The first assessment identified 220 beneficiary families owning 2500 cattle. According World Animal Protection's assessment the operation had the following purpose:

The operation is aiming at promoting good practice methods for water management and soil and pastures rehabilitation; this will allow the communities to adapt to climate change effects, preserve their means of life and thus the family core avoiding migration; providing at the same time a better living situation for the animals in these areas thus improving their well being. (Vasquez 2012) (p.14)

Activities were placed into three phases.

First Phase: Relief assistance: $3000

- Formation of Emergency Community Committees.
- Distribution of mineral blocks during the community meeting.

Second Phase: Land & Water management: $41,680

- Construction of 'presones', small dams that act as retention ponds during rain, increasing groundwater replenishment.
- Construction of mechanised irrigation systems.
- Development of improved pastures.

Third Phase: Research & Awareness: $15,000

- Assessing the success of the intervention and the adoption of new approaches to land and water management within target communities

6.2. Costs of the intervention

The estimated cost of the intervention in the preliminary assessment was $59,680. 70 per cent of this was to be spent on land and water management programs for target communities. In the final approved budget for 2014, the cost came to a similar amount, $58,770. For simplicity, we have rounded this amount up to $60,000. A full breakdown of costs is provided in the appendices.

This budget was intended to assist 220 families and 2500 cattle, (Vasquez 2012). This works out to $273 per family and $24 per animal.

As per previous studies, we have not included the cost of the time spent by World Animal Protection staff as they typically fly into affected regions — there is thus little opportunity cost of this labour to the Mexican economy, as it does not use labour resources that would otherwise be used elsewhere.

If inputs are sourced locally, they would be considered costs as they use up resources that could be used elsewhere. But if inputs were imported, this would not impose a cost on the Mexican economy in terms of resource use. From the materials provided to the author, most of the inputs for this work were provided locally, and we have therefore taken the full budget as the cost of the intervention.

Additionally, it makes sense to simply take the actual monetary cost of the intervention as the cost to World Animal Protection, against which to assess any potential benefits.

6.3. Benefits of the intervention

This intervention is essentially a mitigation programme designed to improve producers' resilience to drought conditions through improved land and water management. This makes it difficult to draw a direct cause-and-effect relationship between the immediate costs of the intervention and the long-term benefits received by families and livestock assisted.

Benefits should be realised through reduced mortality or higher prices received during a future drought as a result of the improved condition of the animals due to improved land and water management.

Stakeholders reported that producers typically aim to sell calves at between 11 and 13 months of age for around 13,000 pesos ($975). This price is in line with prices we observed from Chihuahua cattle auction data. These prices are lower than estimates available from the United States Department of Agriculture (USDA) and World Animal Protection estimates for reasons discussed below.

Chihuahua cattle auction data for the month to July 1, 2014 indicate prices per head of between $463 and $893 for calves weighing between 150 kg and 284 kg (Union Ganadera Regional De Chihuahua 2014). Steers, bulls and cows were able to fetch higher prices per head but calves sold for the highest prices per kg and accounted for 60 per cent of sales. More data across more months of the year would be needed for more robust analysis. We attempted to obtain this data but were unable to. Enquiries indicated that auction prices and cattle weights were not affected during June and July of 2011, the worst months for the drought, though we were unable to verify this with auction data.

According to the 2012 Mexico Livestock and Products Annual, produced by the USDA, the average value per head of cattle exported from Mexico to the USA was $470, (Hernandez 2013).

Following the worse of the drought conditions in 2011, World Animal Protection's assessment in 2012 in certain districts in Chihuahua identified that cattle prices were on a downward trend. A thin adult cow was reportedly worth 2500 pesos ($170) compared with the regular price of 5000 pesos ($340). Discussions with stakeholders indicated that declining cattle prices were due to multiple reasons:

- Increased supply as Mexican producers sought to sell cattle to avoid losses or further worsening of condition.
- Already decreased condition resulting in lower prices per animal.
- Bargaining power of buyers due to the above two factors.

This regular price of 5000 pesos, or $340, is lower than figures reported from stakeholders interviewed for this research and on the lower range of data provided by the cattle association of Chihuahua. Data provided by the Union Ganadera Regional De Chihuahua (2014) for indicate that three cows weighing between 230 and 320 pounds sold for between $261 and $498 while 41 normal weight cows (3560 pounds) sold for $776 in June 2014.

Lower prices reported in World Animal Protection's assessment could be due to the drought conditions at the time affecting prices and the poor condition of the animals owned by producers who were surveyed. Additionally, World Animal Protection reports refer to cows, whereas stakeholder discussions referred to calves.

Nevertheless, based on figures reported by producers World Animal Protection surveyed, we will take 5000 pesos or $340 to be the normal maximum price received for a thin cow.

World Animal Protection's intervention was carried out in respect of 2500 head of cattle, with activities as set out in 6.1 above. For the purpose of this analysis, we will assume this refers to 2500 as a base herd size from which calves are bred for sale. In other words, the population will increase over the calving season and then revert back to 2500 once the calves are sold. Herds are likely to be more dynamic than this — some older animals are also sold for meat, changing the age profile of the herd from year to year — but we are using a simple assumption for this analysis.

The value of this herd can be thought of as the present sale value or the capitalised value of the future income the asset can earn. These may not always be the same value. The value of each will vary based on current demand and supply conditions and future risks and uncertainty.

In a drought prices will be affected by numerous factors such as:

- Market conditions in the US;
- Exchange rates;
- Supply (willingness of other producers to sell their cattle);
- Condition of animals, which determines current market price but also their potential future value as breeding cattle.

Of these factors, World Animal Protection's efforts can only affect the condition of animals. Though to some extent, if the intervention avoids mortality or forced sales, it would have some impact on supply. But based on previous herd estimates from the '90s, there are between 1 and 2 million cattle in Chihuahua. Even if all 2500 cattle had been sold, this would have been unlikely to affect prices if the market is reasonably fungible. If the market exhibits local dynamics, for example, a limited pool of exporters who buy cattle from producers in Aldama, it is possible that local prices could be affected by the sale of 2500 head of cattle.

Present market value

Present market value of the herd based on prices reported by producers is crudely estimated at 2500 x $170, which is $425,000. This is only half of typical value of 2500 x $340, or $850,000. This range of $425,000-850,000 can be considered the value of livestock assisted – a measure we used in our report looking at World Animal Protection's intervention in Assam, India, .

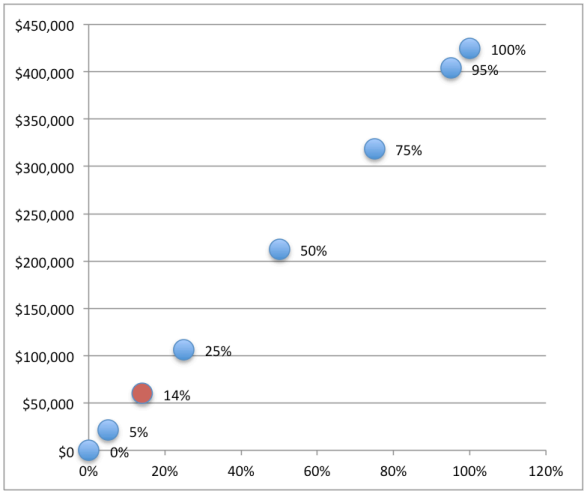
Given a 50 per cent reduction in the market value per animal, or $170, the cost of the drought in terms of reduced value of assets at the time of the World Animal Protection assessment was $425,000.

The table and chart below estimates the potential benefits based on reduced asset value impacts.

Figure 5: Estimated potential benefits of Chihuahua intervention

Costs	$60,000
Potential benefits	$425,000

% reduction in value	*$ reduction in value*	*BCR*
0%	$0	NA
5%	$21,250	0.35
14%	**$60,000**	1
25%	$106,250	1.8
50%	$212,500	3.5
75%	$318,750	5.3
95%	$403,750	6.7
100%	$425,000	7.1



Source: Ecolarge analysis

If we assume the intervention cost $60,000, it would require a 14 per cent reduction of the loss in asset value for the intervention to break even, resulting in a benefit-cost ratio of 1. In other words, if, instead of the price dropping from $340 to $170, the price

received by cattle producers only dropped to $194, this would represent a 14 per cent improvement on the situation as assessed at the time of the intervention.[2]

Another, more simple way to assess this is to consider that the intervention cost $24 per animal (i.e. $60,000 divided by 2500). Therefore, to break even, on a per-animal basis, the intervention would have to increase prices received by $24 per head. Any increase in price received over $24 would be a net benefit.

The maximum possible benefit cost ratio based on an improved condition scenario assumes that solely because of the intervention, the future drought has no impact on prices received. This would represent a cost benefit ratio of 7.1. Without more data on cattle auctions in Chihuahua, it is difficult to isolate the effect of condition on price. Data from June 2014 provided by the cattle association of Chihuahua only includes data for sales of two "skinny" cows for a price of $1.60 per pound, while 11 "fat" cows were sold at a price of $2 per pound. This indicates that condition could account for approximately an extra 25 per cent, though this data is very limited.

The maximum possible benefit cost ratio assuming a total mortality scenario is therefore 14, since the avoided costs in that situation would be $340 per animal or a total asset value of $850,000.

Capitalised value of future income

The gross capitalised value of the herd based future income depends on the breeding rate and the price of cattle. Hernandez (2013) reports that cattle in Mexico currently average one calf every two years. This is equivalent to half the breeding population annually in calves.

This means in any one year, a breeding herd of 2500 cows is able to produce approximately 1250 calves. At an average price of 9939 pesos ($745) according to the cattle association of Chihuahua, this works out at a potential undiscounted income value over one year $932,000.

Use of net profit (value added) as a benefit

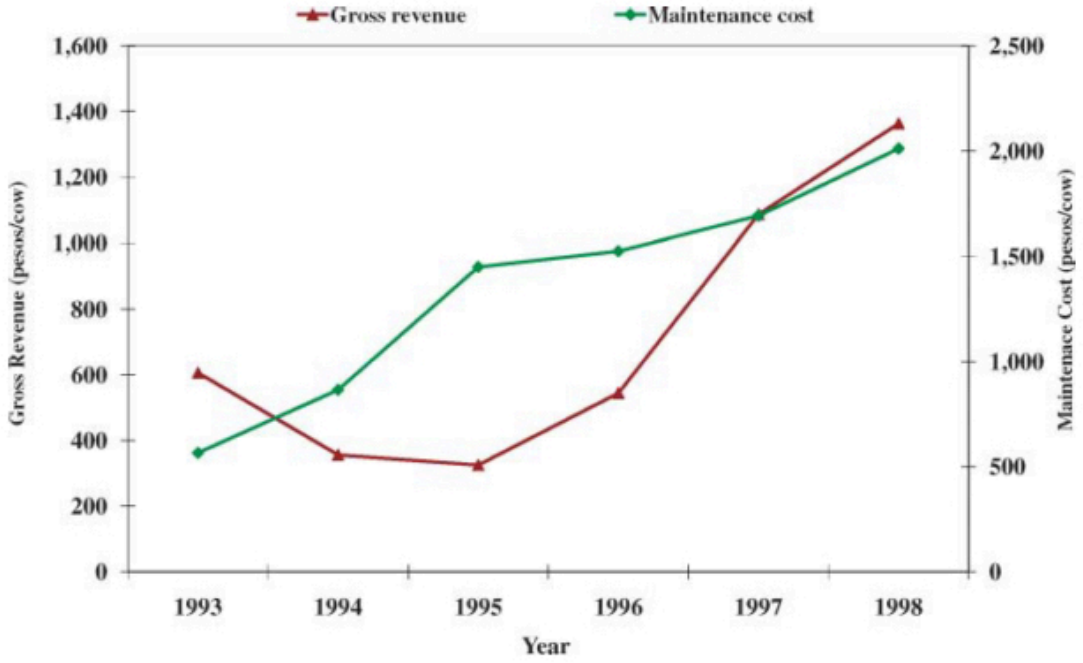
Ideally, the profitability of producers serves as the best measure of the value of their livestock as this accounts for any value over and above the costs to producers.

Analysis by Ortega-Ochoa et al. (2008) of the industry in the 1990s indicated that profitability can vary significantly from year to year. The key determinants of these fluctuations include: cattle inventories (herd size), conception rates, mortality rates, maintenance costs, and cattle prices. The latter two factors are also affected by USD to Peso exchange rates.

Of the six years for which Ortega-Ochoa et al. list data, they showed that profitability was marginal or flat in three years (1993, 1997, 1998), while losses per animal were high in three years (1994, 1995 and 1996). In 1995, for example, revenue per head of cattle was between 300 and 400 pesos while costs were between 900 and 1000 pesos.

Figure 6: Annual cost of maintaining a cow and her gross revenue (in pesos) from 1993 to 1998 in a cow/calf enterprise located in a semiarid region of Chihuahua, Mexico

[2] 14 per cent of the $170 reduction in asset value is $23.8. $170 plus $23.8 = ~$194



Source: (Ortega-Ochoa et al. 2008)

Ortega-Ochoa et al. cite a more recent study showing that average returns for cattle producers in areas assessed was −5.4%.

In the absence of profitability data for the producers targeted by World Animal Protection's intervention, and given difficulties isolating the influence of the various determinants of profitability listed above, we have opted to look solely at potential revenue as the benefit. This approach represents the potential gross benefit of the intervention. Although net benefit after costs would be desirable, other factors affect this and are outside of the control of the intervention.

Additionally, in times of drought, avoiding mortality — a scenario in which revenue equals zero — can be seen as a benefit, even if the revenue received for a particular animal didn't equate to a profit. This is because the animal returns *some* resources to producers that would otherwise be lost entirely. In simple terms, some money is better than no money. Or put another way, the benefit in this situation is the reduction in losses or the avoided cost.

7. RESULTS & CONCLUSIONS

Mitigation interventions for slow-onset disasters are more difficult to assess than response interventions for rapid-onset disasters. This is because the disaster is more difficult to define spatially and temporally. Additionally, producer and economic responses can alter or even make the idea of a baseline irrelevant.

To properly assess mitigation interventions, longer-term studies are necessary and require significant baseline surveying and ongoing monitoring to isolate and track the progress of the mitigation work against other factors.

Nevertheless, in an attempt to conduct a rapid assessment of World Animal Protection's work in Chihuahua, Mexico, we have undertaken a simple economic evaluation. Our analysis shows that the maximum possible benefit cost ratio for World Animal Protections Chihuahua intervention based on an improved-condition scenario is 7.1. This is the situation in which the mitigation program leads to improved condition of animals during future drought events, compared with the condition had the mitigation not taken place.

The maximum possible benefit cost ratio assuming a total mortality scenario is therefore 14. This is the scenario in which the mitigation avoids livestock mortality.

These estimates are very rough and intended as preliminary attempts to quantify World Animal Protection's intervention in Chihuahua, Mexico. As much as anything, we hope that this analysis provides insight into the issues that arise when conducting economic assessment of slow-onset disaster mitigation programs. Economic assessment of mitigation programs for slow-onset disasters is made difficult due to:

- Time lapse between costs of the mitigation and any future benefits.
- Effect of other factors on economics of the industry.
- Producer responses to economic conditions.

These factors make it difficult to attribute improved condition or reduced mortality to the intervention.

To improve the robustness of estimates for mitigation interventions, we recommend that a small sample group of beneficiaries is monitored over a period of years with in-depth microeconomic surveys pre- and post-mitigation and regular follow-up surveys to assess producer responses to changing market conditions.

8. APPENDICES

8.1. Appendix I: Costs identified in disaster assessment needs analysis

Phase	Objective	Activities	Responsibility	Timetable	Cost per activity (USD)	Cost per phase (USD)
First Phase: Relief assistance	Presentation of proposal and acceptance by community reps, of chosen sites to work on, methodology and RR measures to be adopted such as: herd reduction, destocking, water management and commitment to respect pasture rotation systems to be implemented by all participants.	Emergency Community Committees formation	Aldama Ejido-District President / WSPA consultant/ SAGARPA	Mid March	1000	3000
		Distribution of mineral blocks during the community meeting	During the Initial meeting	Mid March	2000	
Second phase: Land & Water management	Build 2 medium retention ponds to improve water management, rehabilitate large portions of pasture land and replenishment of underground aquifers	**"Presones" construction** Land movements creating a small dam like retention pond, used for irrigation and replenishment of groundwater aquifers	WSPA /ALDAMA Presidency/SAGARPA	Beginning in April 2012	7680	41,680
		Mechanized irrigation systems (using the water reservoirs)	WSPA /ALDAMA Presidency/SAGARPA/ producers	Approx. May and June	29,000	
		Development of improved pastures (crops) This will be used under the "cut & carry" model thus preventing animals from entering the cultivated area	SAGARPA/Aldama Presidency/Producers	Approx. May - June		
		Project management	Consultant	March-July	5000	
Third phase: Research & Awareness	Assess the success of the intervention and the adoption of new approaches to land and water management within target communities	Research of cultural behaviour: community baseline information	WSPA Coms & Consultant	September – December 2012	15,000	15,000
		Rationale for reluctance to adopt official recommendations				
		Messages to promote adoption of official recommendations: focus groups				
		Metrics pre- and post-campaign				
Total					*59,680*	59,680

8.2. Appendix II: Costs identified in Mexico Approved Budget 2014 (Chihuahua only)

Activity	Details	Type of expenditure	Cost (USD)
Chihuahua			
Project Manager Consultant (Chihuahua)	Monthly fee for two consultants	Consultancy	15,400
		Sundries (Telephone, mobile, couriers, etc.)	110
		Printing and Materials	110
	Vehicles- expenses	Equipment	1,650
Acuaponic Systems	Greenhouse at C.B.Ta	Equipment	2,500
	Small-scale system for 3 producers	Equipment	13,500
	Two water reservoirs	Equipment	-
	Water well retrofit	Equipment	-
Food Security & Improved pastures	Maintenance of Triticale Plots	Equipment	5,000
	Development of 2 ha. Protein banks and apiculture	Equipment	13,500
	One water reservoir	Equipment	-
	Irrigation equipment	Equipment	-
	Pasture seed and operational 4 ha.	Equipment	-
	Land preparation 4 ha.	Equipment	-
Community Education	Monitoring and result evaluation	Fees for Service (Project Costs)	2,000
Fundraising Efforts	Grant writing	Consultancy	1,000
Stakeholder Training	Needs analysis and Training	Fees for Service (Project Costs)	4,000
TOTAL			58,770

Source: World Animal Protection (2014) Mexico Approved Budget 2014, internal document.

8.3. Data from cattle auctions in Chihuahua for June 1 to July 1, 2014

Cant.	**Descripcion**	**Description**	**Peso promedio (kg)**	**Precio promedio**		**Precio por cabeza**	
Qty.	Description	Description	Average weight (kg)	Average price (pesos per kg)	Average price (USD per kg)	Price per head (pesos)	Price per head (USD)
25	Becerro exp pewee	Tiny male calves	128	79	5.9	10,112	758
58	Becerros exp pesado	Heavy male calves	167	71	5.3	11906	893
21	Becerras livianas exp	Light female calves	149	58	4.3	8593	644
22	Becerras exp pesada	Heavy female calves	227	51	3.8	11579	868
4	Becerras CN	Female calves	147	42	3.2	6174	463
3	Becerros CN	Male calves	284	40	3.0	11268	845
1	Vaquilla 2 paleta	Heifers	306	39	2.9	11905	893
5	Vacas paridas	Cows	454	37	2.8	16955	1272
3	Novillo 2 paleta	Steer	349	37	2.8	12842	963
3	Vaquilla 4 paleta	Heifers	256	36	2.7	9105	683
4	Toretes no.1	Steers	452	33	2.5	15120	1134
7	Toros gordos	Fat bulls	719	32	2.4	22946	1721
41	Vaca (s) joven	Cows	357	29	2.2	10346	776
1	Vacas rendidas	Cows	516	28	2.1	15245	1143
11	Vacas gordas	Fat cows	398	27	2.0	10642	798
1	Vacas/carnudas	Fleshy cows	284	25	1.8	6958	522
2	Vacas Flacas	Skinny cows	318	21	1.6	6645	498
1	Vaca desecho	Cows	232	15	1.1	3480	261

Source: (Union Ganadera Regional De Chihuahua 2014)

8.4. Production, price, value of production and cattle weight Chihuahua state between 2000 and 2013 (liveweight)

es	Producción, Precio, Valor de la Producción y Peso del Ganado en Pié del estado de Chihuahua entre 2000 y 2013, SIAP, SAGARPA				
en	Production , Price , Value of Production and cattle weight Chihuahua state between 2000 and 2013				
es	**Año**	**Producción kg**	**Precio Pesos Mx por Kg**	**Valor de la Producción (pesos)**	**Peso**
en	**Year**	**Production (kg)**	**Average price per kg (pesos)**	**Value of production (pesos)**	**Weight (kg)**
	2000	114,976,000	11.3	1,466,676,000	359
	2001	118,322,000	12.97	1,534,909,000	404
	2002	128,252,000	13.49	1,729,701,000	406
	2003	137,856,000	11.89	1,639,498,000	391
	2004	141,250,000	14.34	2,024,807,000	328
	2005	134,842,000	17.11	2,307,468,000	296
	2006	132,334,000	18.02	2,384,660,000	325
	2007	136,119,000	17.24	2,346,553,000	347
	2008	164,444,000	16.9	2,779,167,000	385
	2009	177,348,000	16.34	2,897,200,000	384
	2010	177,096,000	15.58	2,759,806,000	347
	2011	188,381,000	15.72	2,961,913,000	349
	2012	179,756,000	15.91	2,859,972,000	334
	2013	144,803,000	20.05	2,903,817,000	295
	2014	Not available			

Source: (SAGARPA 2014)

Notes: Multiplying figures for production by average price per kilo does not result in the total value of production figures for the table above. The discrepancy is largest for the year 2000 (11% difference). For other years the difference is neglibible. (<0.1%)

Data above is for live weight cattle. (Martínez et al. 2007) reports cattle weights of between 300-400 pounds (136-181kg(are normal for Chihuahua.

9. REFERENCES

Boyd, R. & Ibarrarán, M.E., 2008. Extreme climate events and adaptation: an exploratory analysis of drought in Mexico. *Environment and Development Economics*, 14(03), p.371. Available at: http://www.journals.cambridge.org/abstract_S1355770X08004956 [Accessed May 30, 2014].

Ding, Y., Hayes, M.J. & Widhalm, M., 2011. Measuring economic impacts of drought: a review and discussion. *Disaster Prevention and Management*, 20(4), pp.434–446. Available at: http://www.emeraldinsight.com/10.1108/09653561111161752 [Accessed June 5, 2014].

Hernandez, G., 2013. *Mexico Livestock and Products Annual: Outlook for Production and Trade Bright While Consumption Remains Affected by Prices*,

Instituto Nacional De Estadistica Y Geografia, 2014. Mexico en Cifras - Informacion nacional, porentidad federativa y municipios: Total state, Chihuahua.

IPCC, 2014. *CLIMATE CHANGE 2014: Synthesis Report - Headline statements fro mthe Summary for Policymakers*, Interngovernmental Panel on Climate Change, IPCC Secretariat, Geneva. Available at: http://www.ipcc.ch/news_and_events/docs/ar5/ar5_syr_headlines_en.pdf.

Martínez, C.C. et al., 2007. *Results of a Survey of Cattle Exporters in Chihuahua, Mexico*,

Ortega-Ochoa, C. et al., 2008. Chihuahua's Cattle Industry and a Decade of Drought: Economical and Ecological Implications. *Rangelands*, 30(6), pp.2–7. Available at: http://www.bioone.org/doi/abs/10.2111/1551-501X-30.6.2.

Peel, D.S., Johnson, R.J. & Mathews, K.H., 2010. *Cow-Calf Beef Production in Mexico*, A Report from the Economic Research Service, United States Department of Agriculture.

Peel, D.S., Mathews, K.H. & Johnson, R.J., 2011. *Trade, the Expanding Mexican Beef Industry, and Feedlot and Stocker Cattle Production in Mexico*, A Report from the Economic Research Service, United States Department of Agriculture, LDP-M-206-01. Available at: http://www.ers.usda.gov/media/118317/ldpm20601.pdf.

SAGARPA, 2011. Reunion de trabajo con Coordinator General de Ganaderia.

SAGARPA, 2014. Servicio de Información Agroalimentaria y Pesquera (SIAP).

San Juan, Z., Juarez, B. & Williams II, D.R., 2011. *Livestock Producers Manage Drought Conditions*, United States Department of Agriculture, Foreign Agriculture Service, Global Agriculture Information Network, GAIN Report Number: MX 1057.

Secretaría de Desarrollo Agropecuario, 2011. *Anuário Estatístico del Sector Rural 2011*, La Precipitación Pluvial y Sequía Enero 2008 / Octubre 2011.

Union Ganadera Regional De Chihuahua, 2014. Promedio de peso y precio de los animalese vendidos.

Vasquez, S., 2012. *WSPA Disaster Needs Analysis: Chihuahua, Mexico Drought Crisis*, GLIDE number: DR-2011-000177-MEX.

World Animal Protection, 2013. *Chihuahua Drought RR pilot Update*, Internal document.

www.ecolarge.com

economists | at | large |

adding value to society