A BENEFIT-COST ANALYSIS OF WSPA's 2012 INTERVENTION IN THE DHEMAJI DISTRICT OF ASSAM, INDIA

Final report

Prepared for the World Society for the Protection of Animals

2014

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ADDING VALUE TO SOCIETY

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Citation:
Economists at Large, 2014, *A Benefit-cost analysis of WSPA's 2012 Intervention in the Dhemaji district of Assam, India.* A report for The World Society for the Protection of Animals, prepared by Economists at Large, Melbourne, Australia.

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Acknowledgements:
We would like to thank everybody who made the fieldwork required for this trip so productive and enjoyable. The entire team at WSPA India, Dr. Ditul Barman and Dr Kandarpa Boruah from the College of Veterinary Science in Guwahati, Dr. Sashanka Dutta from Just Be Friendly, Dr. Changmai and the team at the Department of Animal Husbandry in Dhemaji, Mr. Dilip Baruah for his amazing work as a translator and fixer during our time in Dhemaji and lastly, the people of Seuji Pathar. Without the professionalism and hospitality of everybody involved the fieldwork would not have been as successful nor enjoyable.

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SUMMARY

In June 2012, heavy rainfall in the northeastern Indian states of Arunachal Pradesh and Assam led to flooding across northern areas of Assam. Across the seven most severely affected districts[1], 1.7 million large animals and 378 thousand small animals were affected. Over one thousand animals are estimated to have drowned or been washed away in the floods and their immediate aftermath (Nema 2012).

In July 2012, a team from WSPA went to Assam to provide post-disaster assistance to livestock and livestock owners. Working with regional and district departments, WSPA began short-term and long-term responses to the impacts of the disaster. WSPA's interventions focus on the district of Dhemaji, one of the districts most severely affected by the flooding. WSPA's short-term response (STR) is the focus of this report.

WSPA's STR was designed to assist with the impacts in the immediate aftermath of the flooding. This involved distribution of feed and medicine as well as providing treatments to injured and sick animals.

An estimated 56,206 animals and 4,265 households in Dhemaji District benefited from the STR. The actual cost of the STR was INR 2,211,179 (US $49,324). Activities comprising the STR included:

In November and December 2013, Economists at Large undertook fieldwork assessing the economic benefits of WSPA's 2012 intervention in Assam, India.

Meetings were held with WSPA India's team based in Delhi. Interviews were then undertaken with partner organisations in the state capital of Assam, Guwahati and in Dhemaji District.

The purpose of the fieldwork was to obtain qualitative and quantitative data on the economic value of livestock to the local economy. This data was used to construct a benefit-cost model to estimate the 'benefits' of the intervention.

Costs included in the analysis are those financial costs that were incurred by WSPA in undertaking the STR. The total cost of the STR was USD 49,324. The distribution of rice bran and veterinary medicines account for 78% of this cost. Staff related costs (including travel) account for a further 17%. For this reason, we have counted the entire cost of the STR and not just the costs relating directly to the distribution of rice bran and conducting veterinary clinics.

The benefits of the intervention consist of the value of animals assisted by WSPA. More specifically, the net present value of the animals which benefitted from WSPA's intervention.

The benefits in this case can be attributed to the animals which received feed and veterinary care as part of the STR. The total number of animals which benefitted from both of these initiatives is estimated by WSPA at 56,206 animals.

Establishing which animals survived as a result of the STR and which might have survived otherwise is problematic as it is hard to draw a causal link between the STR's treatment of an individual animal and the reduced chance of mortality or state of productivity for that animal. During an intervention, the emphasis is on feeding and treating as many animals as possible, as quickly as possible. It is unrealistic for WSPA's Disaster Assessment and Response Team (DART) to accurately assess quantitatively, the extent to which the intervention directly led to reduced mortality.

[1] The most severely affected districts were Dhemaji, Barpeta, Sonitpur, Lakkhimpur, Tinsukhia, Jorhat and Dibrugarh.
[2] Economists at Large, 2013, *Benefit-cost analysis of WSPA's Mwingi Intervention in Kenya.* A report for The World Society for the Protection of Animals, prepared by Economists at Large, Melbourne, Australia. Unpublished, for internal WSPA use.

Because of causal uncertainty, our approach is to include all the productive value of the treated animals as a 'benefit' of the STR, but to apply a high discount rate to this stream of benefits. While not all animals treated may have died or become entirely unproductive, in the short term respondents overwhelmingly suggested that the STR was extremely beneficial in returning these animals to production and that more animals would have died, or been sold at reduced rates were it not for the STR. In addition, rather than using the term 'benefit-cost ratio', we refer to the 'animal-assistance ratio'. This represents the economic value supported by each dollar of intervention money.

Our approach to valuing livestock is to estimate the 'instrinsic' value of the livestock measured as the net present value (NPV) of the livestock over the potential life of the animal. Discount cash flow calculations are used to estimate NPV and involve summing the discounted future value of the costs and income derived from an animal to a single capitalised value. The values we estimated for each animal are listed in the table below, followed by our results.

	CATTLE	GOATS	PIGS	CHICKENS	DUCKS	OTHERS	TOTAL
TOTAL ANIMALS ASSISTED	25,600	3513	13892	9381	3788	32	56,206
Net present value per animal (INR)	8867	1500	4177	252	200	NA	NA
Total economic value (INR)	226,989,650	5,269,500	58,022,664	2,361,935	757,600	NA	NA
Sub-total direct economic value (USD)	3,667,336	85,136	937,437	38,160	12,240	NA	NA
Total direct economic value (USD)	4,740,310						

Total costs (USD)	49,324
Total benefits (USD)	4,740,310
Net benefits (USD)	4,690,986
Animal-assistance ratio (AAR)	96

The animal-assistance ratio of 96 for the Assam STR suggests it was a very effective intervention from an economic perspective, helping to support the health and welfare of animals worth approximately USD $4.7 million to the local economy. By assisting livestock and their owners, WSPA speeds up the economic recovery of the region to a state of normalcy. The intervention helps to avoid mortality and morbidity among livestock, reduce unwanted sales of livestock due to lack of feed or poor health and in the long-run, allows for livestock owners to continue farming in the way they're accustomed.

BACKGROUND

The World Society for the Protection of Animals (WSPA) Disaster Management programme has been responding to the needs of animals in disasters since 1964. Since 2000 WSPA has conducted 141 interventions in 43 countries. While these interventions are important for the economic welfare of local people, there has been little research that attempts to quantify these economic benefits.

In 2011, WSPA and Economists at Large began to investigate the economics of losing livestock in natural disasters (Campbell & Knowles, 2011). Particularly in low-income countries, where livestock play a complex role in people's economic welfare, losing livestock in a disaster has serious economic consequences. Livestock play important roles not just in providing food and draft power, but as a source of income, provide key inputs for agriculture and serve as a means of saving and insurance.

In 2011, WSPA began an operation in the Mwingi district in Kenya, in response to long-running drought conditions. In 2013, Economists at Large undertook a benefit-cost analysis of this intervention, (Economist at Large, 2013)[2]. Based on our analysis, WSPA's Mwingi intervention generated between $2.74 to $9.21 of benefits in the form of avoided losses for every $1 spent, depending on the time frame used. The lower value is estimated based on 1 year while the higher value attributes 5 years of income to the WSPA's intervention.

Following strong interest in these results from stakeholders, WSPA and Economists at Large decided to conduct further work on quantifying the economic benefits of WSPA's interventions.

2012 FLOODS IN ASSAM

Northeast India is home to the Brahmaputra River and much of its mountainous catchment area. Floods have been a part of life in what is now North-east India for millennia.

In June 2012, heavy rainfall in the northeastern Indian states of Arunachal Pradesh and Assam led to flooding across northern areas of Assam. Across the seven most severely affected districts[3], an estimated 1.7 million large animals and 378 thousand small animals were affected and over one thousand animals are estimated to have drowned or been washed away in the floods and their immediate aftermath (Nema 2012). Following the floods much grazing land was submerged, reducing the area available for animals to graze. In addition, fodder storage facilities were inadequate and many had also been flooded or washed away, leading to feed shortages and poor animal health.

[2] Economists at Large, 2013, *Benefit-cost analysis of WSPA's Mwingi Intervention in Kenya.* A report for The World Society for the Protection of Animals, prepared by Economists at Large, Melbourne, Australia. Unpublished, for internal WSPA use.
[3] The most severely affected districts were Dhemaji, Barpeta, Sonitpur, Lakkhimpur, Tinsukhia, Jorhat and Dibrugarh.

In July 2012, a team from WSPA went to Assam to provide post-disaster assistance to livestock and livestock owners. Working with regional and district departments, WSPA began short-term (STR) and long-term responses (LTR) to the impacts of the disaster. WSPA's interventions focus on the district of Dhemaji, one of the districts most severely affected by the flooding. Dhemaji is no stranger to flooding, indeed, the name Dhemaji means "playground of the floods".

Figure 1: Location of Dhemaji in Assam, India (red marker in map below)

Map Source: Google Maps

SHORT-TERM RESPONSE

WSPA's short-term response (STR) was designed to assist with the impacts in the immediate aftermath of the flooding. This involved distribution of feed and medicine as well as providing treatments to injured and sick animals.

The objectives of the STR were to:

- Save the flood-affected animals and protect the livelihood of the people dependant on livestock.
- Build the capacity of the veterinary department in treating the sick and injured animals.
- Identify the long term needs of animals in the flood affected District and the State.

Source: (Thambi Prem & Sutar, 2012)

An estimated 56,206 animals and 4,265 households in Dhemaji District benefited from the STR. The actual cost of the STR was INR 2,211,179 (US $49,324). Activities comprising the STR included:

- **Distribution of rice bran to pigs and cattle:** Benefitting a total of 9,320 pigs and 18,516 cattle owned by 3,113 households.
- **Conduct of temporary veterinary health camps:** Benefitting 28,370 animals owned by 1,152 households.
- **Distribution of veterinary surgical kits:** Indirectly benefitting 191,661 animals (92,522 large animals; 56,438 small animals; and 42,701 poultry birds) in Dhemaji District.
- **Conduct of an in-depth assessment:** To establish longer-term needs for mitigation of the impact of floods in the future.

DISTRIBUTION OF RICE BRAN TO PIGS AND CATTLE

Across Dhemaji district, a total of 9 distribution programmes were organized to distribute approximately 119 tonnes of rice bran. Feed was distributed to a total of 9,320 pigs and 18,516 cattle owned by 3,113 households between the 24th July and 18th August 2012.

CONDUCT OF TEMPORARY VETERINARY HEALTH CAMPS

The table below provides details of the animals treated by WSPA at temporary veterinary health camps during the Assam STR.

Figure 2: Number of animals treated at temporary health camps - by village and animal

VILLAGE NAME	NO. OF BENEFICIARIES (households)	AVG. ANIMALS PER HOUSEHOLD	CATTLE	GOAT	PIGS	CHICKEN	DUCKS	OTHERS	TOTAL
Jorkata Kathgaon	128	9	450	234	228	119	78	1	**1110**
Durpadi	129	24	609	341	521	1341	313	0	**3125**
Pamuah	191	29	1578	591	986	1681	752	29	**5617**
Lotachur Taid	184	34	1214	592	1015	2385	1026	0	**6232**
Jorkata Bengali	236	23	1223	852	774	1871	637	0	**5357**
Seuji Pathar	90	27	492	329	209	1162	248	0	**2440**
Borpak Tiniali	119	23	838	386	503	410	561	0	**2698**
Borpak Tiniali	75	24	680	188	336	412	173	2	**1791**
TOTAL	**1152**	**25**	**7084**	**3513**	**4572**	**9381**	**3788**	**32**	**28370**

Source: (World Society for Protection of Animals, 2012). “Other” category includes cats, pigeons, buffalo and horses. “Goats” also includes 19 sheep, 10 of which were in Pamuah.

LONG-TERM RESPONSE

To mitigate the impacts of future severe flooding in the region, 15 households in Seuji Pathar village, Dhemaji, were chosen to participate in a long-term response effort. All of the participants in the LTR also received assistance as part of the STR.

The LTR is focused on construction of raised feed storage shelters. These shelters allow households to better cope with reduced fodder following flooding by keeping feed dry and available once pastures are flooded. The LTR is co-funded by WSPA and participating households.

OBJECTIVE AND SCOPE OF THIS RESEARCH

The objective of this analysis is to help WSPA understand the economic impact of its short-term response (STR) on local and regional economies in Dhemaji district, Assam, India.

A secondary research objective is to test the usefulness of benefit-cost analysis as a framework for assessing the return on investment from disaster response efforts.

This analysis focuses on the direct impacts of WSPA's STR, specifically, the distribution of feed and provision of veterinary health services in the aftermath of the 2012 flooding. This analysis focuses on the household income impacts to owners of livestock who brought their animals to WSPA's intervention locations for treatment as part of the STR. It does not consider indirect costs and benefits of the intervention relating to the distribution of veterinary kits, nor does it discuss the benefits of the "Long Term Response" (LTR), as it is too early to assess the effectiveness of this program and outside the scope of this analysis.

DATA SOURCES

This analysis is based on data collected by WSPA during and following their intervention in Dhemaji and provided to Economists at Large. These documents were used to assess the number of animals reached and the total cost of WSPA's intervention and included:

- Disaster Assessment and Needs Analysis (Abridged Report)
- Disaster Assessment and Needs Analysis (Full Report)
- Post Intervention Report, Assam Floods - Short Term Response (STR)
- In-Depth Assessment Report

In addition to reviewing desktop-based material, fieldwork was conducted for this research.

FIELDWORK

In November and December 2013, Economists at Large undertook fieldwork assessing the economic benefits of WSPA's 2012 intervention in Assam, India.

Meetings were held with WSPA India's team based in Delhi. Interviews were then undertaken with partner organisations in the state capital of Assam, Guwahati and in Dhemaji District. Stakeholders interviewed included:

- The provincial Department of Animal Husbandry [Guwahati]
- Assam Veterinary College [Guwahati]
- Just Be Friendly (a local NGO) [Guwahati]
- The District Veterinary Department [Dhemaji]
- Households in Seuji Pathar village who participated in the long-term intervention project [close to Dhemaji)

The purpose of the fieldwork was to obtain qualitative and quantitative data on the economic value of livestock to the local economy. Researchers also met with and interviewed participants in the long-

term response effort. These people were selected for interviews because they had a close interaction with WSPA's interventions in Dhemaji and their addresses were known.

Figure 3: Approximate location of fieldwork in Dhemaji

Map Source: Google Maps
Note: Interviews were also conducted with stakeholders in Dhemaji, Guwahati and Delhi.

Figure 4: A photo of one of the long-term response buildings, taken after an interview

Figure 5: An animal shelter cum feed bank in Seuji Pathar, taken after an interview

HOUSEHOLD LEVEL IMPACTS OF 2012 FLOOD

Using surveys, we gathered information on the impacts of the 2012 on selected households participating in WSPA's LTR.

The floods affected livestock and livelihoods of households surveyed significantly. Households surveyed reported very low or no rice production, loss or injury and sickness of animals and a chronic lack of feed.

Floods affected the households interviewed in the following way:

- Most or all of their wet season crop (rice) is destroyed
- Acute death or injury to livestock.
- Lack of feed for animals which survive floods – animals are often weakened due to stress and possible injury.
- Animals may eat unsafe feed such as poisonous weeds, rotten plants etc.
- Lack of proper feed leads to malnutrition and prolonged sickness and weakness among surviving animals.
- Fields remain flooded and unsuitable for ploughing and planting crops.
- Households may sell of livestock due to financial distress and lack of feed.
- Greater reliance on dry season cash crops to compensate for severely reduced rice production.

Some household specific examples of impacts include:

- One household lost 3 goats and 10-12 chickens. Worth an estimated INR 8000 (USD 130).
- One household that previously bred pigs had to sell the two sows for approximately INR 13,500 but in doing so, reducing annual cash income by an estimated INR 20,000. The same household also lost three goats valued at 7,500.

METHODOLOGY

This report is a benefit-cost analysis of WSPA's 2012 intervention in Assam, India. As the name suggests, benefit-cost analysis aims to compare the costs of undertaking the intervention with the benefits derived from it.

SCOPE

Deciding the scope of assessment - who's costs and benefits should be included - is one of the most important steps in a CBA. The scope of this assessment is Dhemaji district. Costs and benefits that may have resulted from the intervention outside the district are not included, for example potential price impacts in neighboring districts. An exception to this is costs that were incurred by WSPA outside of Dhemaji district, but related directly to the intervention, such as travel for staff from Delhi and other communications requirements with stakeholders outside the district.

COSTS

Costs included in the analysis are those financial costs that were incurred by WSPA in undertaking the STR. Specifically, we are concerned with the cost of distributing rice bran and conducting temporary veterinary clinics. This data was obtained from reports outlined in the Data Sources section above. Costs associated with participation such as time recipients spent travelling to STR locations are not included due to the likely low opportunity cost of participation and the difficulty in measuring such costs.

The total cost of the STR was USD 49,324. The distribution of rice bran and veterinary medicines account for 78% of this cost. Staff related costs (including travel) account for a further 17%. For this reason, we have counted the entire cost of the STR and not just the costs relating directly to the distribution of rice bran and conducting veterinary clinics.

Table 1: Costs of STR as reported in WSPA's Post-Intervention Report

	INR	USD
STR cost	2,211,179	49,324
Break up of intervention cost		
Rice bran for cattle and pigs	1,551,329	34,605
Veterinary medicines	176,962	3947
Veterinary surgical kits	24,511	547
In-depth assessment	73,455	1639
Transportation cum distribution of aid	Inclusive of procurement cost	
DART local travel including airfare	32,800	732
Accommodation, food, staffing, etc.	352,122	7855

BENEFITS

The benefits of the intervention consist of the value of animals assisted by WSPA. More specifically, the net present value of the animals that benefitted from WSPA's intervention.

The benefits in this case can be attributed to the animals which received feed and veterinary care as part of the STR. The total number of animals that benefitted from both of these initiatives is estimated by WSPA at 56,206 animals.

Establishing what production is due to the STR and what might have occurred otherwise is problematic as it is hard to draw a causal link between the STR's treatment of an individual animal and the reduced chance of mortality or state of productivity for that animal. During an intervention, the emphasis is on feeding and treating as many animals as possible, as quickly as possible. It is unrealistic for WSPA's Disaster Assessment and Response Team (DART) to accurately assess quantitatively, the extent to which the intervention directly led to reduced mortality.

In the case of veterinary care, it is more likely that there may be a greater causal link between the intervention and avoided mortality. For provision of feed, the outcome is less clear. In the absence of sufficient feed, livestock owners may be forced to sell their livestock in a suboptimal state, assuming they are even able to find a buyer. If they are able to find a buyer, the 'benefit' of the intervention would be the difference between the NPV of the animal at the time it is sold (assuming it survives) and the depressed market price received by the owner. For example, if the NPV of an animal is INR 6000 but the suboptimal condition post-disaster results in the owner selling the animal for INR 4000, the benefit of the provision of feed which would avoid the need for this sale could be said to be INR 2000.

Because of this uncertainty, our approach is to include all the productive value of the treated animals as a 'benefit' of the STR, but to apply a high discount rate to this stream of benefits. While not all animals treated may have died or become entirely unproductive, in the short term respondents overwhelmingly suggested that the STR was extremely beneficial in returning these animals to production. However, rather than using the term 'benefit-cost ratio', we refer to the 'animal-assistance ratio'. This represents the economic value supported by each dollar of intervention money.

The high discount rate means that most of these early benefits are included in their entirety. In periods after the STR more uncertainty enters around the benefits actually caused by the STR and what improvement in productivity would have otherwise occurred. By using a high discount rate the more uncertain benefits are largely excluded, although some residual value of the STR remains. The discount rate used is 25% per annum. This is a much higher discount rate than those applied to projects with social goals, which are typically set between 4% and 10% by national governments and multilateral agencies (European Commission, 2002). The same discount rate was used in our assessment of WSPA's intervention in Mwingi, Kenya.

Another difficulty with valuing benefits of the STR is how to value an animal. In economic theory the market price of an asset should reflect the present value of the stream of benefits it brings and some scarcity value. However this theoretical approach often does not hold in rural areas of low-income countries due to the complex roles that animals play in local economies (Campbell & Knowles, 2011).

Further, in the aftermath of a disaster markets are often distorted as buyers and sellers face pressures such as lack of feed, scarcity of stock, or need for liquidity in their efforts to recover.

Therefore, using the market price of animals begs the question of which market price. Market price may reflect the value provided when it is needed most – in the aftermath of the disaster, exactly when the STR occurred. Further, during this time, the quality of the animals is usually lower due to stress, illness and malnourishment, which temporarily reduces the price owners could receive.

USING NET PRESENT VALUE ESTIMATES

Instead of using market price, our approach is to estimate the net present value (NPV) of the livestock over the duration of ownership. Discount cash flow calculations are used to estimate NPV and involve summing the discounted future value of the costs and income derived from an animal to a single capitalised value. In theory, market prices should approximate this net present value, though in theory they may not, for reasons outlined in Economists at Large (2012)[4].

RESULTS

ROLE OF LIVESTOCK IN HOUSEHOLD ECONOMY

LOCAL CATTLE

Local cattle are primarily kept to plough fields. Households will also consume or sell milk when cows are calving, though this is secondary to ploughing. Males are generally used for ploughing. Our analysis assumes a cow is purchased at 2 years old at a cost of 7000rp and does not consume feed purchased externally, relying on cut grass and crop residues – as reported by interviewees.

Cattle are used for ploughing, which is valued using an avoided cost approach, based on the cost for the next best alternative, a tractor, of 1700rp for the same area. Interviewees generally responded that no rice production is possible without the cows to plough the fields. So rather than look at marginal increases in productivity from ploughing, we have used an avoided cost method. This is because the marginal productivity of ploughing is the entire rice crop, according to interviews.

Respondents emphasized the importance of cattle to rice production in the region. Many farmers cannot afford to hire tractors and some also commented that cattle are better for certain stages of ploughing, particularly the first plough when stubble from previous crops is still high. Cattle are generally also more effective when fields are very muddy. The relationship between livestock and indirect values such as crop production is difficult to evaluate and this value is likely to be an underestimate. Certainly it discounts the option value of using cattle in rice production.

Respondents suggested that after about 12-15 years cows can no longer be used for ploughing, so we have adopted a lifespan of 14 years and run a DCF over 12 years, assuming the cows are obtained at 2 years old and sold after 12 years of ownership. At the end of their working life cattle are sold to members of the Muslim community who slaughter the cows for beef.

CROSS-BREED CATTLE

Cross-breed cattle (typically local bred with jersey) are owned by some households and used for milk production. Government agencies generally provided x-breed dairy cows as part of initiatives to increase rural incomes. In some cases owners of the x-breeds plan to continue breeding and growing their herd. Ownership of cross-breed cattle was still not high. Of the households participating in the LTR, two owned cross-breed cattle. One household owned a single cow and another owned two cows.

[4] Economists at Large. 2012. *Economic concepts and methods for modelling the direct and indirect impacts of natural disasters on livestock,* a working paper for the World Society for the Protection of Animals (WSPA), prepared by Economists at Large, Melbourne, Australia.

CHICKENS

Chickens are generally kept for eggs and for breeding though the latter is very informal and any chicks are sold locally. Female chickens are usually kept for eggs or sold for meat while males would typically be sold for meat at around 4 months old.

Breeding of chickens is generally not controlled for a number of reasons:

- Animals are generally kept in a 'free range' or semi-free range condition, resulting in uncontrolled breeding.
- Households lack the expertise and access to genetically optimum livestock for breeding.
- Households we interviewed mostly lacked the land and capital to invest in more serious chicken rearing equipment.

Most households owned 100% local breed chickens though some were trying croilers (local breed cross-bred with broiler hens).

PIGS

Pigs are reared to sell for meat at between 9 and 18 months old.

Interviewees reported that pigs cost between INR 900-1500 to purchase, aged between 1.5 and 3 months.

Pigs are typically sold at 12 months old for around INR 8,000-10,000 or at 18 months old for around INR 10,000-12,000. The live-weight price for pigs was reported as INR 120 per kg and the deadweight price INR 150 per kg. Some households reported feeding their pigs supplemental feed. These households generally reported selling their pigs within one year, suggesting they put on weight faster and reduced their time to sale. By contrast, households that did not feed their pigs supplemental feed reported a longer time to sale of around 18 months.

Pig feed (rice meal) was reported to cost 5rp per kg with a single pig consuming 21kg per week, resulting in an estimated cost of INR 420 per month.

GOATS

Goats are reared for to sell for meat 12 to 24 months old. Many livestock owners reported that they previously owned higher numbers of goats but they were susceptible to illness. Many stated that they wouldn't focus as much on goats anymore.

Goats are generally kept in a free-range manner, allowed to graze for food in the village. This can lead to problems as one household reported losing goats due to pesticide poisoning from a nearby tea plantation. Another household reported a desire to reduce the number of goats owned as they were too susceptible to death and disease during floods.

Goats sell for between INR 1000 and 2000 depending on the age and gender, with males fetching a higher price.

Interestingly, households would rarely slaughter and eat their own pigs and goats, preferring to sell the animals and buy meat from the market. They did this because they said they got too attached to the animals to slaughter them themselves. As most Assamese are Hindu, they do not eat beef.

OTHER ANIMALS

Some households owned **ducks** sold at between 6 and 12 months old and one household owned **pigeons**, which were either sold or consumed by the household. We have not included the value of these animals in any analysis due to low levels of ownership.

NET PRESENT VALUE ESTIMATES FOR LIVESTOCK

The tables below provide illustrative examples of a discounted cash flow valuation for livestock owned in Dhemaji. The analysis is based on our fieldwork in the region. All estimates except cattle include the sunk cost of acquiring (or the opportunity cost of not selling) of an animal at a young age. Calculating NPV is possible at any stage of ownership, however.

For cattle, we have used the average NPV over each possible year for both male and female cattle. In other words, we assume an 'average' cattle value. This was done because the NPV of a male cattle if calculated from year 0 is INR -407. This is due to the high opportunity cost of between INR 7000-8000. Thus, if we used the year 0 average (male and female) for cattle we would end up with an NPV of just INR 1355. We believe this is unrealistically low. Using the average NPV value results in an average (male and female) NPV of INR 8867. This is slightly above the reported price paid for males at 2 years, 7000-8000. We believe this is a reasonable estimate.

The types of livestock ownership we created NPV estimates for include:

- Local cattle (male) used for ploughing;
- Local cattle (female) used for breeding/milk;
- Local chicken reared for meat;
- Local chicken kept for eggs;
- Cross-breed chicken reared for meat;
- Cross-breed chicken kept for eggs;
- Pigs reared for meat and sold at either 12 months or 21 months old (9 or 18 months after acquisition).
- Due to a lack of data, we have used simple market prices to value goats. Many households also reported that they planned to reduce the number of goats they owned because they were too prone to sickness during floods.
- We have not looked at cros-breed cows used for milking because these were still relatively uncommon in the area and in many cases animals had been given to households as part of government programs. One small-scale commercial dairy farm operates near Dhemaji town.

For some animals we have used a potential range of costs and benefits, based on stakeholder interviews. However for eggs we just used a simple average of low and high figures reported for both number of eggs laid per year and price per egg.

Table 6 below summarises the net present value of production attributable to livestock in Dhemaji.

Table 2: Summary of net present values estimated for livestock in Dhemaji (INR)

	Low	*Mid*	*High*	*Average*	*Average*
Unit	INR	INR	INR	INR	USD
Local chicken reared to sell for meat	86	132	178	132	2
Local chicken kept for eggs	371			371	6
X-breed (croiler) reared for meat	93	208	346	216	3
X-breed chicken kept for eggs	189			189	3
Pig reared to sell for meat (9 months)	1249	NA	2079	1664	27
Pig reared to sell for meat (18 months)	5999	NA	7379	6689	108
Local cattle	6740	NA	10993	8867	143

By applying these estimates to the numbers of animals assisted, as recorded in WSPA's documentation of the STR, an estimate of the total benefits of the STR can be derived.

Because we do not know the percentage of female and male animals treated, we average values for all animals.

For cattle, this is the average NPV value over the life of an animal. In other words, we calculate an NPV at each year (age) for male and female cattle and then we then use the average of those values as our point estimate.

For goats, we assume the average market price for all ages and sexes.

For pigs, we assume the average NPV based on rearing to sell within 9 and 18 months.

For chickens, we assume the average NPV for local chickens only, based on rearing to sell for meat and for egg production.

For ducks, we use the market price reported by an interviewee that owned ducks.

Other animals are not valued in this estimate.

Table 3: Estimated benefits of Assam STR

	CATTLE	GOATS	PIGS	CHICKENS	DUCKS	OTHERS	TOTAL
TOTAL ANIMALS ASSISTED	25,600	3513	13892	9381	3788	32	56,206
Average direct value per animal (NPV)	8867	1500	4177	252	200	NA	NA
Total direct economic value (INR)	226,989,650	5,269,500	58,022,664	2,361,935	757,600	NA	NA
Sub-total direct economic value (USD)	3,667,336	85,136	937,437	38,160	12,240	NA	NA
Total direct economic value (USD)	4,740,310						

Note: "Others" category includes cats, pigeons, buffalo and horses. "Goats" also includes 19 sheep, 10 of which were in Pamuah.

The table above provides an estimate of the benefits of the Assam STR. 'Benefits' represent the value of animals which the STR assisted through distribution of feed and temporary veterinary clinics. Net present values and market prices were recorded from interviews with stakeholders. The total benefits in USD are nearly 4.7 million. The discount rate used to calculate present values was 25% annually.

Table 4: Benefit-cost analysis of Assam STR

Total costs (USD)	49,324
Total benefits (USD)	4,740,310
Net benefits (USD)	4,690,986
Animal-assistance ratio (AAR)	96

The table above presents the results of our benefit-cost analysis undertaken on the Assam STR. The Assam STR is estimated to have supported livestock worth an estimated US $4,740,310. The STR cost USD 49,324 and so has an animal-assistance ratio of 96. In other words, for every $1 of money spent on the Dhemaji intervention, $96 worth of economic value was assisted.

LIMITATIONS

We are aware of the following limitations of this study:

- Uncertainty about the number of male and female cattle in the region and how many calves a cow is likely to birth on average over a lifetime.
- Market prices rather than NPV estimates were used for goats and ducks.
- Lack of access to more people who benefitted from the short-term response, many of whom arrived at treatment locations by boat. We relied on interviews with organizational stakeholders and participants in the LTR who also received benefits from the STR.
- Inability to accurately draw quantifiable causal link between intervention and increased survival of animals. Though interviewees all reported that without the intervention they would have lost more animals.

DISCUSSION

WSPA's response to the 2012 Assam floods has clearly delivered great benefits to the people and animals of Dhemaji district. This much is evident from the enthusiasm and appreciation shown by recipients and partners when interviewed about the response. Furthermore, this is emphasized by evaluation through cost benefit analysis.

By comparing the value of production likely to have been enabled by WSPA's response with the costs to WSPA of conducting the STR, we estimate $96 dollars of economic value was directly supported for every $1 spent in Dhemaji. A total of approximately $4.7 million worth of economic value was supported from just $50,000 WSPA spent on the intervention.

Part of the reason these benefits are so great is that the response is aimed directly at local people's most productive assets, which form the basis of their livelihoods – their livestock. By ensuring the community's asset base is not eroded they can quickly return to productive activity following the disaster. By assisting existing livestock, animals and breeds that local people are comfortable with and are adapted to local conditions better results are likely to have been achieved than by later efforts at replacement, or assistance by other means.

While there is uncertainty attached to this central result, sensitivity testing shows that even if only 5% of animals treated avoided mortality as a result, the intervention would have still generated $5 of benefits for every $1 spent. This demonstrates that these results are robust to changes in assumptions and key data inputs.

While an animal assistance ratio of 96 is high, it is not disproportionate to that achieved in other disaster responses by WSPA. While attempts to evaluate the economics of disaster response are still evolving, it is useful to compare these two responses.

COMPARING RESULTS IN DHEMAJI TO RESULTS IN MWINGI

While the central estimate of the Dhemaji STR of $96 of value for every $1 spent is higher than the range of from 2.7 to 9.2 in Mwingi, this does not suggest that one was more successful than the other. It is too early in this line of analysis to draw subjective comparisons. Despite this, it is worth comparing why the results differ.

The intervention in Mwingi District, Kenya was in response to a drought, a slow-onset disaster, whereas flooding in Dhemaji District, India was a rapid-onset disaster. But most importantly, the methodologies used to conduct an economic evaluation of each intervention differ.

For example, in Mwingi, we used a 'herd' model that aimed to model the overall size of the herd in the region and attempt to value the recovery of the herd size to the 'status quo' size. Benefits were estimated based on the annual income or what we called "Total Operating Benefits" of different livestock.

By contrast, in Dhemaji, we opted for a per-animal NPV approach. We believe the latter approach is preferable because it requires fewer assumptions, particularly about reproduction rates and the baseline herd size. The individual animal intrinsic value NPV approach is also favourable because it removes the need to pick an arbitrary number of years in the future over which to count the 'benefits' of the intervention. In other words, if an animal is saved, over what period of time do you attribute the future income derived from the animal to the intervention? In the case of Mwingi, we estimated three separate values, 1 year, 3 years and 5 years. Using individual animal NPVs avoids the need to do this. In effect we're including all future income, though discounting future income at a high rate. Another reason this approach is preferable is because for non-income generating livestock, or animals that generate sporadic income, calculating a single year income value is difficult. It was possible in Mwingi because of the greater importance of milk production. However in Dhemaji, male cattle were used for ploughing and females for breeding and some milk, making it hard to calculate a flat yearly income per animal.

Other factors that result in a much higher animal assistance ratio (note that in the Mwingi report we still called this a benefit-cost ratio) include:

- In Mwingi we assumed a 50% survival rate of treated animals. Thus, only approximately 10,000 animals were considered in calculating the 'benefits'. This is compared to the 56,000 animals considered in Dhemaji.
- The cost per animal assisted in Mwingi ($1.93) was over twice the cost in Dhemaji ($0.88).
- Using intrinsic NPV values for livestock in Dhemaji results in higher per animal values than we used for Mwingi. For example, cattle in Dhemaji were given a mean value of $143 (NPV) compared to just $36 (annual income value) in Mwingi.
- In Dhemaji an estimated 25,600 cattle were assisted, compared to 4,858 in Mwingi, of which we only counted the 'value' of 50%, or 2,429. This means in Dhemaji over ten times as many cattle, the highest value livestock were counted towards the animal-assistance ratio.

Once these factors are taken into consideration, the vastly higher animal-assistance ratio in Dhemaji is not surprising. The comparison above is drawn not to compare the two interventions, but to better understand the appropriateness of the methodology used.

The discount rate used for both studies was 25% and based on the cost of borrowing through informal means in the region for Mwingi. We kept this discount rate for Dhemaji for reasons outlined above relating to discounting future benefits though we did not verify borrowing costs to households in Dhemaji.

Table 5: Comparing Results of benefit-cost analysis of Dhemaji and Mwingi interventions

Intervention details	Unit	Dhemaji	Mwingi
Animals treated / assisted	Animals	56,206	20,707
Number of animals whose value is considered to be a 'benefit' of the intervention	Animals	56,206	10,354
Cost of Intervention	USD	49,324	39,968
Cost per animal	USD	0.88	1.93
Discount Rate	%	25%	25%
Estimates			
Attributed survival rate	%	100%	50%
Value of 'benefits'	**USD**	**4,740,310**	**368,230**
Average benefit per animal treated	USD	84	18
Animal-assistance ratio	**USD**	**96**	**9.21**

Source: Economists at Large (2013). Used 5-year NPV for Mwingi.
Note: The different attributed survival rates are not based on actual data but reflect methodological differences between the two approaches. All future evaluations will most likely use 100% survival rate as the standard benefit calculation.

A 'MODEL' FOR ASSESSING INTERVENTIONS

A secondary research objective for this project is to test the usefulness of benefit-cost analysis as a framework for assessing the return on investment from disaster response efforts.

We did not use the same excel model for analysis of the Assam STR as we used for analysis of the Mwingi Intervention.

Our experience so far from analysis of two interventions (Mwingi and Dhemaji) suggests that benefit-cost analysis is an appropriate framework for analysis of the economic benefits resulting from disaster response efforts. The only limitation is in interpretation of the term, 'benefits'. Uncertainty concerning the percentage of animals that would have died in the absence of the intervention (the 'counter factual' scenario) makes it difficult to assess causality. Put simply, it's hard to say if an animal would have survived even without the intervention. Stakeholders resoundingly reported that they would have lost more animals were it not for the intervention, though our sample of beneficiaries was small. Because of the nature of the intervention and the population density in the region it would have taken more resources than we had available to conduct a larger survey of beneficiaries of the STR. Due to this uncertainty, we use the term 'benefits' to refer to the value of the livestock that the intervention reached. Once more interventions are analyzed, meta-analysis may allow for more meaningful comparisons between interventions.

CONCLUSIONS

Based on our analysis, WSPA's Assam STR supported $96 of economic value (benefits) for every $1 spent. This illustrates the importance of supporting livestock in post-disaster response efforts. This is not news for owners of livestock who understand fully the direct and indirect impacts of losing livestock on their livelihoods.

Further, the results demonstrate that simply replacing animals is a less efficient option for two reasons:

i. Market values are often less than net present value, because subsistence livestock owners in the region buy (or are given) livestock at a young age. In other words, they rely on time to generate a return and often have minimum startup and ongoing costs, especially for local breeds.
ii. Animals brought into a disaster-affected region from other regions are often maladapted to local conditions and can die or prove unproductive.

The animal-assistance ratio of 96 for the Assam STR suggests it was a very effective intervention from an economic perspective, helping to support the health and welfare of animals worth approximately USD $4.7 million to the local economy. By assisting livestock and their owners, WSPA speeds up the economic recovery of the region to a state of normalcy. The intervention helps to avoid mortality and morbidity among livestock, reduce unwanted sales of livestock due to lack of feed or poor health and in the long-run, allows for livestock owners to continue farming in the way they're accustomed.

Further, the methodology employed for this study appears to be preferable to that used to assess WSPA's Mwingi intervention for the following reasons:

- Owners of livestock are more likely to know the economic lifecycle of livestock than they are to know the herd size and reproduction rates.
- The model used is more simple and transparent.
- The model better allows for livestock that don't provide consistent annual benefits.

RECOMMENDATIONS

- It would be ideal if DART members were in some way able record an indication of health and likelihood of survival had treatment not been provided. We realise, however that in the aftermath of a disaster this kind of appraisal and record keeping might be difficult.
- Based on this fieldwork and the results of two studies (Assam and Dhemaji), we feel that the use of intrinsic value measurements using animal-specific NPV estimates is the best way to approach valuation for practical and theoretical reasons.
- Rather than the term 'benefit-cost ratio', we recommend using the term 'animal-assistance ratio'. This is a measure of the intrinsic value of the animals which WSPA provided assistance to

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APPENDICES

Table 6: Discount cash flow valuation of local chicken reared for meat (INR)

Monthly discount rate: 0.021

	Time (months)	Cost (INR)	Benefit (INR)	Net Benefit (INR)	Discount Factor	Discounted Net Benefit (INR)	Notes
	0	6	0	-6	1.000	-6	Cost in first month is an opportunity cost of not selling the egg.
	1	0	0	0	1.021	0	No ongoing costs because local chickens forage and don't require extra feed, unlike croilers (x-breed chickens.
	2	0	0	0	1.042	0	
	3	0	0	0	1.064	0	
Low	4	0	100	100	1.086	92	Low: 100rp, Mid: 150rp and High: 200rp per chicken depending on size. Reportedly sell at around 0.5-1kg for 200rp per kg This model assumes 1kg. Sold "After 4 months" so placed in month 4 row because I have a month 0 (undiscounted) row.
Medium			150	150	1.086	138	
High			200	200	1.086	184	

Estimated NPV (INR)	
Low	86
Medium	132
High	178

Table 7: Discount cash flow valuation of a local chicken kept for eggs (INR)

Note: We only included the value up to 2 years of production. Chickens will lay for longer than this but we have chosen two years to keep estimates conservative.

Monthly discount rate: 0.021

Time (months)	Cost (INR)	Benefit (INR)	Net Benefit (INR)	Discount Factor	Discounted Net Benefit (INR)	Notes
0	6	0	-6	1.000	-6	
1	0	0	0	1.021	0	Assume not laying until 9 months old
2	0	0	0	1.042	0	
3	0	0	0	1.064	0	
4	0	0	0	1.086	0	
5	0	0	0	1.109	0	
6	0	0	0	1.132	0	
7	0	0	0	1.155	0	
8	0	0	0	1.179	0	
9	0	33	33	1.204	27	Benefit is the opportunity cost of not selling the eggs if they're consumed or receiving income if eggs are sold
10	0	33	33	1.229	27	Average 65 eggs per year according to stakeholder interviews. So approx 5.5 eggs per month - though they tend to only lay for part of the year. Eggs sell for approximately 6rp per egg
11	0	33	33	1.255	26	
12	0	33	33	1.281	26	
13	0	33	33	1.307	25	
14	0	33	33	1.335	25	
15	0	33	33	1.362	24	
16	0	33	33	1.391	24	
17	0	33	33	1.420	23	
18	0	33	33	1.449	23	
19	0	33	33	1.480	22	
20	0	33	33	1.510	22	
21	0	33	33	1.542	21	
22	0	33	33	1.574	21	
23	0	33	33	1.607	21	
24	0	33	33	1.640	20	

Estimated NPV (INR)
371

Table 8: Discount cash flow valuation of a cross-breed (croiler) reared for meat (INR)

Note: These models weren't used in the estimates for the Dhemaji STR. We only included averages for local chickens. We include these in the appendices for the sake of any future research.

Monthly discount rate: 0.021

	Time (months)	Cost (INR)	Benefit (INR)	Net Benefit (INR)	Discount Factor	Discounted Net Benefit (INR)	Notes
	0	35	0	-35	1.000	-35	Higher cost to acquire a x-breed chick. 30-35rp reported by Atul Burogohain.
	1	45	0	-45	1.021	-44	X-breeds require supplemental feed. Chickens generally convert protein at a rate of 3:1 so we assume that the amount of feed is roughly three times the final body weight, divided equally over the four months. We assume they get 20% of their feed from foraging and unpriced sources (rice meal). We use a price of 30rp per kg, based on reported prices per 50kg bag of between 1000-2000rp. See below.
	2	45	0	-45	1.042	-43	
	3	45	0	-45	1.064	-42	
Low	4	45	325	280	1.086	258	Price Low: 130rp, Mid: 180rp and High: 200rp per chicken. Low based on 130rp for a 2.5kg chicken, Mid on 180 for a 2.5kg chicken and high based on 200 for a 3kg chicken. Some people reported higher prices for local chickens. Reportedly sell at around 2.5-3kg afteraround 4 months.
Medium			450	405	1.086	373	
High			600	555	1.086	511	

Assumptions	
Price of feed (INR)	30
Final weight (kg)	2.5
Total Qty of feed (assume 80% from purchased and 20% from on-site foraging)	6
Qty of supplementary feed per month	1.5

Estimated NPV (INR)	
Low	93
Medium	208
High	346

Table 9: Discount cash flow valuation of a cross-breed chicken kept for eggs (INR)

Monthly discount rate: 0.021

Time (months)	Cost (INR)	Benefit (INR)	Net Benefit (INR)	Discount Factor	Discounted Net Benefit (INR)	Notes
0	35	0	-35	1.000	-35	Higher cost to acquire a x-breed chick. 30-35rp reported by Atul Burogohain.
1	37.5	0	-37.5	1.021	-37	Assume not laying until 6 months old. But feeding with supplemental feed at rate of 1kg per animal per month (20rp per kg). This is a guess as we don't know optimum or average rates of feed.
2	37.5	0	-37.5	1.042	-36	
3	37.5	0	-37.5	1.064	-35	
4	37.5	0	-37.5	1.086	-35	
5	37.5	0	-37.5	1.109	-34	
6	37.5	66	28.5	1.132	25	
7	37.5	66	28.5	1.155	25	
8	37.5	66	28.5	1.179	24	
9	37.5	66	28.5	1.204	24	Benefit is the opportunity cost of not selling the eggs if they're consumed or receiving income if eggs are sold
10	37.5	66	28.5	1.229	23	Average 135 eggs per year according to stakeholder interviews. So approx 11 eggs per month - though they tend to only lay for part of the year. Eggs sell for approximately 6rp per egg. Assume three years productiviity.
11	37.5	66	28.5	1.255	23	
12	37.5	66	28.5	1.281	22	
13	37.5	66	28.5	1.307	22	
14	37.5	66	28.5	1.335	21	
15	37.5	66	28.5	1.362	21	
16	37.5	66	28.5	1.391	20	
17	37.5	66	28.5	1.420	20	
18	37.5	66	28.5	1.449	20	
19	37.5	66	28.5	1.480	19	
20	37.5	66	28.5	1.510	19	
21	37.5	66	28.5	1.542	18	
22	37.5	66	28.5	1.574	18	
23	37.5	66	28.5	1.607	18	
24	37.5	66	28.5	1.640	17	

Estimated NPV (INR)	Assumptions	
189	Price of feed per kg	30
	Final weight	2.5
	Qty of feed per month (layers) 50% bodyweight	1.25
	Cost of supplementary feed per month	37.5

Table 10: Discount cash flow valuation of a pig reared for meat (INR)

Monthly discount rate: 0.021

	Time (months)	Cost (INR)	Benefit (INR)	Net Benefit (INR)	Discount Factor	Discounted Net Benefit (INR)	Notes
	0	900	0	-900	1.000	-900	
	0	1500	0	-1500	1.000	-1500	Cost of buying 2 month old piglet
	1	420		-420	1.021	-411	Pig feed (rice meal) at 21kg per week and 5rp per kg.
	2	420	0	-420	1.042	-403	Low: 8000rp, Mid: 10000rp and High: 12000rp per pig depending on size. Reportedly sell at around 80-90kg for 120rp per kg liveweight and 150rp per kg deadweight.
	3	420	0	-420	1.064	-395	
	4	420	0	-420	1.086	-387	
	5	420	0	-420	1.109	-379	
	6	420	0	-420	1.132	-371	
	7	420	0	-420	1.155	-364	
	8	420	0	-420	1.179	-356	
Low	9		7000	7000	1.204	5814	Some interviewees reported selling their pigs after 9 months, some reported selling them after 18 months. Ones selling earlier fed extra feed to the pigs, which would allow for faster fattening and sale.
High			8000	8000	1.204	6645	
	10			0	1.229	0	
	11			0	1.255	0	
	12			0	1.281	0	
	13			0	1.307	0	
	14			0	1.335	0	
	15			0	1.362	0	
	16			0	1.391	0	
	17			0	1.420	0	
Low	18		8000	8000	1.449	5520	Note: owner who kept pigs for 18 months didn't report buying them feed, this explains the longer time to gain weight for sale.
Medium			10000	10000	1.449	6899	
High			12000	12000	1.449	8279	

Estimated NPV (INR)		
Low	1249	If sold after 9 months (with feed)
High	2079	
Low	5999	If sold after 18 months (no feed)
High	7379	