
Introduction of corralones, (semi-roofed shelters) and veterinary pharmacies in order to protect livestock (Llama camelids) and reduce mortality due to extreme events in the Bolivian Altiplano (High Andean Plateau).

SUMMARY:

In the highlands of Bolivia, recurrent cold waves and related extreme events severely increase the mortality rate of camelids, which represent a main source of livelihood for the local population.

This technology describes the introduction of *Corralones* or semi-roofed shelters aimed at protecting livestock from extreme weather and climate events, in the Bolivian eco-region of the Altiplano (High Andean Plateau) as a means to enhance the resilience of livestock (Llama camelids) in the face of snow, frost and hailstorms, in addition to the introduction of veterinary pharmacies, in order to provide livestock with the necessary treatments to cope with prolonged frost and snow periods.

In farms affected by frost and snow, this good practice contributed to reduce livestock mortality, bringing 18% higher net benefits compared to the local practice, as well as increasing livestock production in the face of extreme events.

KEYWORDS:

[Livestock](#) [1]

CATEGORY:

[Climate change and disaster risk reduction](#) [2]

[Livestock production](#) [3]

COUNTRIES:

Bolivia

DESCRIPTION:

Description of the application of the technology/practice

1. Corralones (semi-roofed shelters)

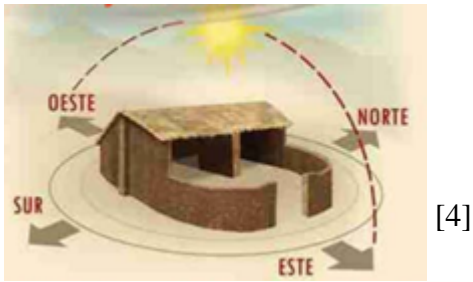
1.1 Location

The *corralones* are the most necessary during winter and summer, in consideration to this they should preferentially be located close to the areas where the llamas spend most time, which might be different according to the season. When possible, two *corralones* would be ideal.

1.2 Orientation considerations

1.2.1 Sun

The entrance of the *corralón* should face the sunrise (east) in order to warm up and disinfect the shelter.



[4]

Photo 1. Orientation in relation to the sun

1.2.2 Wind direction

The back of the *corralón* should face the direction from where the strongest and most frequent winds blow.



[5]

Photo 2. Orientation in relation to the wind

1.2.3 Topography

When built on a slope, the *corralón* entrance should be oriented facing down the slope, and a water-diversion canal should be dug in the upper side, at the back of the *corralón*.



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Photo 3. Orientation in relation to the topography

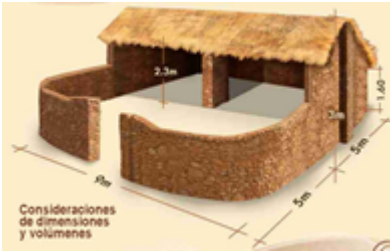
1.3 Dimensions and volumes

1.3.1 Size of the herd

The dimension of the *corralón* is directly correlated to the size of the herd, with a ratio of 1.5 m^2 per adult llama. It is advisable to also consider the amount of pregnant female and baby llamas.

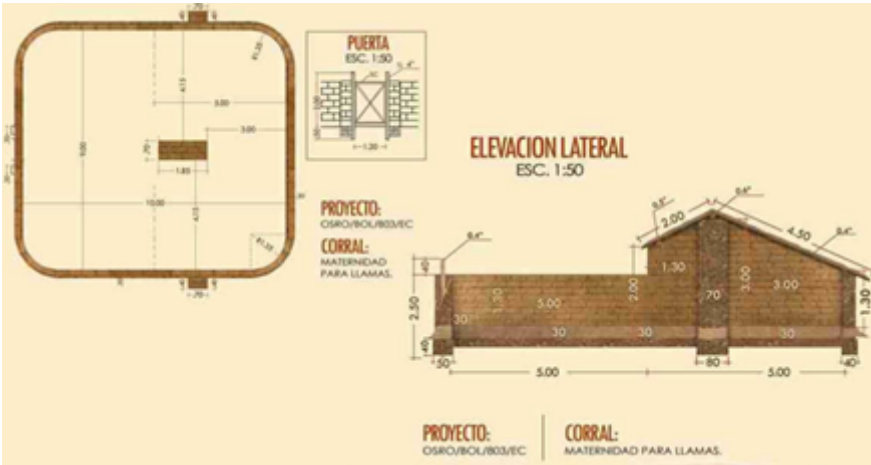
1.3.2 Size of the shelter

A shelter of $9 \times 5 \text{ m}$. is enough to fit 30 adult llamas, covering a surface of 45 m^2 .



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Photo 4. Corralón dimensions

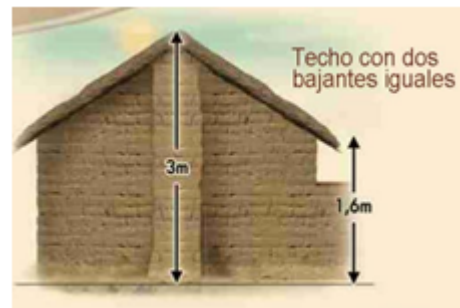


[8]

Photo 5. Construction design

1.3.3 Roof design

The roof of the shelter could be of one or two gabled roofs. When designing the roof, considerations on the maximum high of llamas (1.70 cm) should be taken, being recommended to have a maximum high of 3 m.



[9]

Photo 6. Ceiling design

1.3.4 Size of the patio

As a general rule, the area of the patio is the same as the area of the shelter, but may vary according to the availability of space.

1.3.5 Shape of the patio

The shape can be circular, rectangular or squared. Although it is recommended for the patio to have a rounded shape, in order to facilitate cleaning as well as to facilitate the movement of the llamas and a safe management.



Photo 7. Patio design

1.4 Materials

1.4.1 Floor

It is recommended to have soil as a floor.

1.4.2 Walls

It is recommended to use local materials, such as rocks, adobe, etc.

1.4.3 Roof

The roof may vary in thickness, and may be composed by one material or by the combination of different materials, such as straws, roof tiles, bamboos, mud, plastic membranes, weaved wires, etc.

The cost (in Boliviano) for the construction of the roof are:

Material	Units	Quantity	Price per Unit (Bs)	Total (Bs)
Wooden logs 2" x 2m	piece	8	5	40
Wooden logs 3" x 2m	piece	11	7	77
Wooden logs 4" x 4.5m	piece	11	25	275
Wooden logs 5" x 5m	piece	2	30	60
Wooden logs 6" x 5m	piece	2	30	60
Chajallo	moorage	10	25	250
Nails 4"	kg	2	15	30
Nails 6"	kg	2	15	30
Nails 1.5"	kg	2	15	30
Wire	kg	4	16	64
Galvanised wire	kg	2	17	34
Rope (plastic)	m	30	2.5	75
Geomembrane	m2	70	10	700
Sub-total with Geomembrane				1725
Sub-total without Geomembrane				1025

Other required material (usually this material does not imply and

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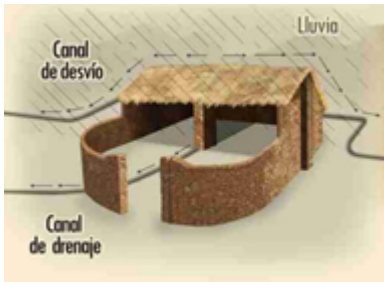
1.5 Complementary Infrastructure

1.5.1 Water-diversion canal

In laden terrains a construction of a water-diversion canal in the upper side of the *corralón* is needed to deviate rain water.

1.5.2 Draining canal

To drain out the urine and any rain water that filters into the *corralón*, in order to maintain it dry.



[12]

Photo 8. Water-diversion and draining canal

1.5.3 Dung deposit

In order to maintain clean the *corralón*, while facilitating the production of manure.



[13]

Photo 9. Dung deposit

1.6 Maintenance

- In-depth cleaning of the corralones should be done twice a year.
- The roof should be checked every year prior to the commencement of the rain season.
- Shelter and canals should be cleared regularly.

2. Veterinary Pharmacies

In addition to shelters, veterinary pharmacies located at the municipalities were introduced in order provide livestock with the necessary treatments to cope with prolonged frost and snow periods.

Farmers in this way were provided with easy access to veterinary pharmacies, supplied (dewormers and multivitamins) by the municipalities before and after (possible) extreme weather events and low temperature seasons, in order to guarantee the access to the dewormers and multivitamins, being those the most requested medications.

2.1 Deworming and Multivitamins

During crisis periods, camelids usually experience a high level of stress, both nutritional and physiological, compromising the balance of their

vital functions, their pastoral ethological behavior, their immunological levels and reproductive functions among others.

This situation is worsened by the parasitic state of the animals. Depending on the level of parasitic infestation, cleaning and disinfection of the parasitic population can be applied in order to secure that it is the animal that benefits from a subsequent vitamin, mineral, energetic and protein doage and not the parasites.

It is advisable to consider a complete deworming of endo and ecto parasites. This can be done in two ways: (1) through oral dosage of a product based on levamisole agents or similar and (2) through a subcutaneous parenteral injection (i.e. under the skin elsewhere in the body than the mouth and alimentary canal of the animal) of a product based on the enzyme principles of ivermectin. The latter can be accompanied by a fat-soluble vitamin complex containing vitamins A, B, C, D and K.

These sanitary activities are carried out following a sanitary schedule.

Ivermectin is an internal and external antiparasitic vitaminized with vitamins A, D and E whose composition is the following:

Ivermectin	1 g.
Vitamine A (palmitato)	8.85 g (150.000 U/ml).
Vitamine D3	0.06 g (22.500 U/ml).
Vitamine E	1.5 (15 Mg/Ml).
Excipientes c.s.p.	100 ml

The parasites that Ivermectin eliminates in cattle are:

- Gastrointestinal parasites: Cooperia onchophora (adults and L4); Cooperia punctata (adults and L 4); Cooperia spp (adults and L3); Haermonchus placel (adults, L3 and L4); Nematodirus helvetianus (adults); Nematodirus Spathiger (adults); Ostertogia ostertagi (adults, L3 and L4, including inhibited larvae).
- Pulmonary parasites: Dictyocaulus viviparus (adults, L4 and inhibited states).
- External parasites: Sum Psoroptes ovis (syn. Psoroptes communis var bovis); Sarcoptes scobieii var bovis'; Chorioptes bovis'. Sucking lice: Haematopinus eurysternus; Linognathus vituli; Solenopotes capillatus Ura: Dermatobia homninis; Hypoderma bovis; Hypoderm lineatum.

Ivermectin helps in the control of chewing lice Damalinia bovis. Other parasites where Ivermectin has shown activity are Parafilaria bovicola (adults); Thelazia spp (adults); Chrisomyia ezziana.

- Vitamin A, essential for growth and development, also has a protective and regenerative action of epithelia and mucous membranes.
- Vitamin D, anti-rickety, favors the absorption and fixation of calcium and phosphorus in the bones regulating the metabolism.
- Vitamin E, has a dilating action on trophic arterioles, on the hepatic parenchyma and on the myotonic musculature, it also intervenes in the enzymatic systems of protein metabolism.

In the case of mineralization, it is recommended to inject a mineral complex containing Sodium Glycerophosphate, Calcium Hypophosphite, Calcium Chloride, Magnesium Chloride, Copper Chloride, Cobalt Chloride, Manganese Chloride, Zinc Sulphate, Ammonia Ferric Citrate, Potassium Iodide and Sodium Selenate.

Minerals are used in bovine and porcine cattle for the prevention and treatment of mineral nutritional deficiencies, as a restorative of the general condition and as a nutritional factor in weaning, lactation, growth and fattening.

Functions of essential minerals are:

- Sodium: Regulation of the acidity and alkalinity of body fluids. Digestion.
- Phosphorus: Once inoculated subcutaneously, is absorbed through the blood to be distributed in the body. It participates in the chemical reactions characteristic of muscle contraction. It is eliminated by digestive route / milk.
- Calcium: In ruminants calcium is absorbed according to the needs of the organism after parenteral administration. Young animals have higher requirements to grow, the amount of calcium retention has direct relation to the administered amount, adults retain only enough calcium to cover restoration needs and the rest is eliminated by excretion in urine and intestine. Calcium retention increases in periods of high demand such as gestation and lactation.
- Copper: Copper enters as a carrier in the blood, appearing in both erythrocytes and serum. The liver removes most of the copper from the blood, although other soft tissues also store some copper. The liver excretes copper with bile, although reabsorption occurs in the intestine. Copper can cross the placenta and be stored in the fetal liver.
- Cobalt: It is stored only in limited quantities and not in all tissues. In adult ruminants its only function is in the rumen and therefore must be there permanently. Cobalt reaches the digestive system through the bile and then produces cabalamin.
- Zinc: Deficiency causes growth deficiency, anorexia, rough and brittle hair with loss of hair and accumulation of dry, hard and brittle skin mainly in the hindquarters.
- Iron: Once inoculated subcutaneously it is absorbed by the bloodstream and intervenes in hematopoiesis as a component of hemoglobin and a small part of myoglobin and in certain enzymes involved in the use of oxygen.
- Potassium: Potassium deficiencies cause nervous disorders, respiratory failure, muscle damage, slow reflexes. Potassium intervenes together with sodium in the regulation of the body's energy expenditure and normalizes the heart rate, promotes healthy skin and stimulates the kidneys to remove toxic waste from the body.

2.2 Costs

Input	Cost (Bs)
Mineral salts + Vaccine - <u>Rabia</u> - Bs/unit	1.5
Mineral salts + Vaccine - <u>Brucellosis</u> - Bs/unit	1.5
<u>Dewormer VIRBAC</u> - Bs/l	175
<u>Dewormer TRIPLEX</u> - Bs/l	175

[14]

3. Benefits

The farmers found that their livelihood practices are now safer in the face of extreme events. The practice contributed to avoid livestock losses and increased livestock production.

The veterinary pharmacies have allowed farmers to apply vitamins in during frost, helping the animals to cope with the extreme weather periods.

Increased access to treatment through the veterinary pharmacies helped reduce the mortality rate. However, it is not possible to disentangle the benefits of veterinary pharmacies from the benefits of corralones.

In addition, the functioning of the veterinary pharmacies, allowed the increase of vaccination and deworming campaigns provided by the ? *Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria?* (SENASAG).

3.1 Economic

Cost-Benefit Analyses (CBA) were conducted based on quantitative data collected during the 2016 winter period. The net benefits obtained from raising camelids with *corralones* and veterinary pharmacies were compared to the net benefits of raising camelids without *corralones* and veterinary pharmacies. The costs and benefits were calculated based on the average herd size in the monitored farms (i.e. 85 llamas).

The CBA calculates the cumulative net benefits obtained by an average farm over a period of 11 years (10 percent discount rate is applied to express the future value of costs and benefits in present terms), as well as the benefit-cost ratio (BCR), which is the ratio between total discounted benefits and total discounted costs over the appraisal period.

Figure 1 provides an overview of the outcome of the CBA. In particular, it shows that:

- The good practice brings 17 percent higher net benefits as compared to the usual practice.
- The BCR of the good practice (2.98) is higher than the BCR of the local practice (2.4), meaning that the good practice brings greater benefits relative to costs, as compared to the usual practice.

The assessment was conducted in farms that were affected by frost during the monitoring period. Benefits considered include the value of sold camelid meat and wool, and the live weight value of camelids sold. The introduction of shelters to protect camelids from frost, combined with the increased access to treatments following the establishment of veterinary pharmacies, significantly reduced the mortality rate of camelids. On the other hand, the increase in benefits was partially outweighed by the capital costs of building shelters, as well as the costs of travelling to the veterinary pharmacies located in the municipalities.

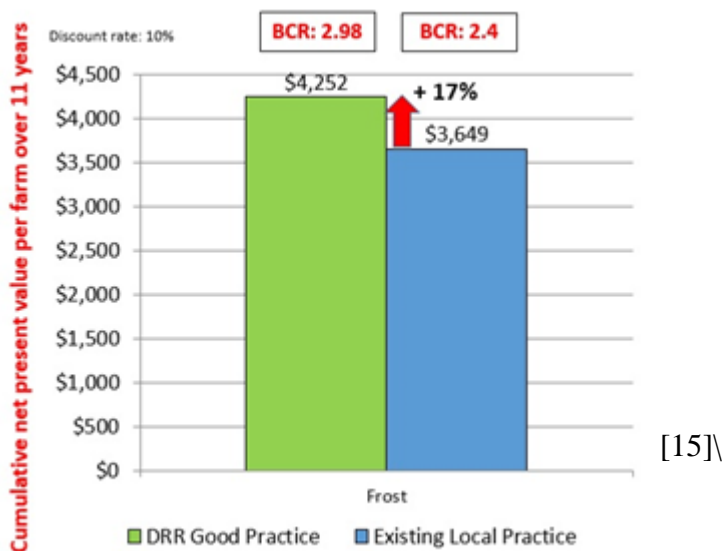


Figure 1. Cumulative Net Benefits and Benefit Cost Ratio of DRR Good Practice and Existing Local Practice

3.2. Environmental

Further analysis is required in order to assess potential environmental co-benefits of this good practice.

4. Difficulties and/or limitations

(a) Farmers cannot afford to build new *corralones* unless they receive additional support from the municipality.

(b) High costs of travelling to the municipality, in order to attend the veterinary pharmacies, located in the municipalities.

FURTHER READING:

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http://teca.fao.org/sites/default/files/technology_files/Cobertizoparall... [16]

FAO Bolivia.(2012).Pericias Contribuyentes a Mitigar los Efectos de las Olas Frías y Tormentas de Nieve en Favor de la Ganadería Alto Andina.https://issuu.com/ucerbolivia/docs/libro_et_pagina [17]

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[FAO Bolivia](#) [18]

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[12] <http://teca.fao.org/sites/default/files/Photo%208.Water-diversion%20and%20draining%20canal.png>

[13] <http://teca.fao.org/sites/default/files/Photo%209.Dung%20deposit%20.png>

[14] http://teca.fao.org/sites/default/files/Costs_0.PNG

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