Introduction of livestock refuge mounds, in combination with deworming and preventive vitaminization and mineralization for cattle raising in the Bolivian Amazonia

SUMMARY:

This technology describes the introduction of livestock refuge mounds in the sub-Amazonian eco-region of Bolivia (Department of Beni) as a good practice to increase the resilience of cattle raisers to recurrent floods. Livestock refuge mounds are small mounds covering an area of about 0.5-1 ha, and they provide shelter for people, livestock and agricultural products during floods. In addition, animal treatments such as deworming and preventive vitaminization and mineralization were introduced or improved in the targeted communities in order to further reduce animal mortality in both normal and hazard conditions.

This technology briefly introduces the concepts of livestock refuge mounds, deworming and preventive vitaminization and mineralization and presents a cost-benefit analysis of the combination of the 3 good practices compared to normal practices.

KEYWORDS:
Livestock [1]

CATEGORY:
Climate change and disaster risk reduction [2]
Livestock production [3]

COUNTRIES:
Bolivia

DESCRIPTION:

1. Description of the technology

This technology describes the introduction of livestock refuge mounds in the sub-Amazonian eco-region of Bolivia (Department of Beni) as a good practice to increase the resilience of cattle raisers to recurrent floods as well as to ensure water availability in the canals during dry spells.

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2. Livestock refuge

Livestock refuge mounds are man-made soil mounds. They have a size of 0.5 to 1 ha in surface, and 1.80 m to 2.20 m in height. Livestock refuge mounds are used to protect livestock and safeguard agricultural products in times of flooding.

The main objective of livestock refuge mounds is to face flood events, but they have also proved suitable for confronting dry spells and droughts. The peripheral canal that surrounds livestock refuge mounds has a storage capacity of about 13,000 m$^3$ of water. In times of drought the channel is used to supply water to livestock. In addition, the channel allows to generate complementary feeding strategies; horticultural production and fish farming.

Illustration 1. Refuge mound during flood

Illustration 2: Construction of refuge mounds

The components of the refuge mounds are:

- A shelter area of 5,000 m$^2$ with a height of 1.8 m.
- Water storage ring surrounding the mound of 7,200 m$^3$
- Perennial forage production area of 8,000 m$^2$
- Sowing of 4,000 m$^2$ of winter forage (maize, fodder or forage sorghum).
- Plantation of 1,000 m$^2$ of ?Camerún Panameño? forage (3,000 - 3,500 kg of mature vegetative seeds per hectare).
- Micro irrigation system with water pump.
- Cattle chute for livestock health management, to facilitate vaccination, deworming and vitaminization and mineratization.
- Hayloft for forage storage.
During the dry season the refuge mounds are used for the production of forage to feed the cattle. The forage species are Tangola (*Brachiaria sp, B. mutica x B. tanner*) and Camerún Panameño or liso (*Pennisetum purpureum*).

(a) **Tangola**

The Tangola (*Brachiaria sp, B. mutica x B. tanner*) and Camerún Panameño or liso (*Pennisetum purpureum*) are the two species that best adapt to the conditions of droughts and floods in Bolivia.

According to Hinojosa and Repes (2009) tangola is a perennial grass, with hollow and creeping stems. It reaches 2 m long and 1.2 m high, with nodes every 7 cm, where new sprouts grow. It is adapted to tropical, humid climates and waterlogged soils. Being not demanding in soils, it supports overgrazing, is tolerant to burning, and grows very well in semi-heights and shallows. The sowing of tangola allows to ensure the availability of fodder to feed livestock in conditions not suitable for many other forage species. The propagation is carried out by vegetative route since its seed is not viable, using about 3,000 to 3,500 kg of mature vegetative seed/plant parts for the planting of one hectare. Yields depend on climatic conditions, ranging from 9 - 11 t dry matter (DM)/ha/year. Among its nutritional characteristics, it has between 7 and 9.0 % of protein, depending on the fertility of the soil and the physiological state of the plant.

Tangola is used in direct grazing and if the terrain conditions are uniform, it is used for hay or silage. The harvest of the vegetative seed is realized with machete or brushcutters when the grass is ripe and has a height of between 40 and 50 centimeters. The cut should be made 10 or 15 centimeters from the ground, to ensure regrowth after 45 to 50 days.

(b) **Camerún panameño**

According to Hinojosa and Repes (2009) grasses of the *Pennisetum purpureum* type are generally known as Elefant grass, and represent a high yield of fodder, since they adapt to a great variety of soils and tolerate drought.

It is a perennial, tall, erect species that forms tillers, with sturdy stems that reach up to about 4.5 meters in height, is tolerant to droughts, but not floods, so it must be planted on high ground with good drainage.

It has high yield of forage, but its nutritive value begins to descend as the grass is maturing. The cutting should be done at about 10 centimeters from the soil, and to be fertilized with at least twice a year, preferably after any cut during the dry season.

The reproduction of the Camerún Panameño grass is carried out by the vegetative route; by cuttings or bearings of stem, which must be matured to guarantee a good germination. For the planting of one hectare, 3 tons of seed are necessary. The best sowing time is during the rainy season.

Sowing can be done in different ways; V-shaped or with a distance between furrows of 1 meter and 0.5 meters between plant and plant. It can also be planted in furrows with a distance of 1 meter between furrows to a depth of 5 centimeters. When the vegetative material cannot be planted immediately it can be conserved for some days as long as it is kept under shade and with adequate humidity.

Camerún Panameño grass presents an annual production of 14.68 tonnes of green matter per hectare per year (t DM/ha/year) and 21.80 tonnes of dry matter per hectare per year (t DM/ha/year), in 4 or 5 cuts. Camerún Panameño grass has an average content of 18.55% dry matter, with a protein content of 11.42%, being this grass the most productive with respect to the Camerún Verde, Camerún morado and Moralfalfo varieties. In addition to the acceptable nutritional content, it presents good palatability for livestock and has the advantage of having no hair on the stems and leaves thus facilitating its manual handling.

It is important to remember that in times of drought and flood food is scarce and in many cases the cattle consumes fodder that it normally rejects (semipalatables) for being highly lignified. In order to store forage on the mound for drought and flood times a hayloft is also built.

A cattle chute is also built at the refuge mounds to facilitate the application of vaccines, dewormers, vitamins and minerals; all activities that are important from the point of view of disease prevention and animal health preparation for a future event of drought or flood.

2.2 **Socio-economic benefits of livestock refuge mounds**

Livestock refuge mounds allow to:

- The refuge mounds as described above have a capacity for up to 800 heads of dairy cattle which can be fed during the flood season.
• The peripheral canal that surrounds livestock refuge mounds has a storage capacity of about 13,000 m$^3$ of water. In times of drought the channel is used to supply water to livestock, with a ratio of 20 liters per head, for 90 days, representing 800 m$^3$, leaving 400 m$^3$ for forage watering.
• The channel allows to generate complementary feeding strategies; horticultural production and fish farming.

2.3 Cost

<table>
<thead>
<tr>
<th>Activity</th>
<th>Unit</th>
<th>Price per unit (Bs)</th>
<th>N. of units</th>
<th>Total cost (Bs) in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land preparation by tractors for building the refuge mound</td>
<td>Hours</td>
<td>250</td>
<td>4</td>
<td>1000</td>
</tr>
<tr>
<td>Land preparation after building of the mound for sowing forage</td>
<td>Man days</td>
<td>50</td>
<td>20</td>
<td>1000</td>
</tr>
</tbody>
</table>

2.4 Side effects

No side effects were identified regarding the use of refuge mounds.

2.5 Major barriers

• Farmers cannot afford to build new refuge mounds unless they receive additional financial support from the municipality.

2.6 General recommendations

• Conduct training in production management and maintenance of the livestock refuge mounds to beneficiary communities.
• Develop a maintenance plan of the mound at community level.
• Strengthen community capacities for the construction and maintenance of livestock refuge mounds.
  Involvement of the community is crucial for the successful establishment and maintenance of livestock refuge mounds.
• Build the mounds close to the communities.

2.7 Synergies with other good practices

• Vitaminization, mineralization and deworming

3. Deworming and preventive vitaminization and mineralization

During crisis periods, cattle usually experiences 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 disorders among others.

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

It is advisable to consider a complete deworming of endo and ecto parasites. This can be done in two ways:

(a) Through oral dosage of a product based on levamisole agents or similar.

(b) 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.
is an internal and external antiparasitic vitaminized with vitamins A, D and E whose composition is the following:

<table>
<thead>
<tr>
<th>vitamin</th>
<th>1 µg</th>
</tr>
</thead>
<tbody>
<tr>
<td>vitamin A (palmitate)</td>
<td>3.85 g (150,000 U/mL)</td>
</tr>
<tr>
<td>vitamin D3</td>
<td>0.06 g (22,500 U/mL)</td>
</tr>
<tr>
<td>vitamin E</td>
<td>1.5 mg (15 mg/L)</td>
</tr>
<tr>
<td>Excipients c.s.p.</td>
<td>100 ml</td>
</tr>
</tbody>
</table>

The parasite that Ivermectin eliminates in cattle are:

- **Gastrointestinal parasites**: Cooperia onchophora (adults and L4); Cooperia punctata (adults and L4); Cooperia spp (adults and L3); Haemonchus placei (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 scobiei var bovis'; Chorioptes bovis'. Sucking lice: Haematopinus eurysternus; Linognathus vituli; Solenopotes capillatus Ura: Dermatobia homninis; Hypoderma bovis; Hypoderma 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.

**3.1 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.

### 3.2 Socio economic benefits of deworming and preventive vitaminization and mineralization

- Provision of vitamins, minerals and deworming treatment helped to reduce the mortality rate.

### 3.3 Cost

<table>
<thead>
<tr>
<th>Input</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral salts + Vaccine - Rabies</td>
<td>1.5 Bs/animal</td>
</tr>
<tr>
<td>Mineral salts + Vaccine - Brucellosis - Dewormer</td>
<td>1.5 Bs/animal</td>
</tr>
<tr>
<td></td>
<td>175 Bs/l</td>
</tr>
</tbody>
</table>

[8]

### 3.4 Side effects

- No side effects were identified.

### 3.5 Major Baerriers

- High costs of travelling to the municipality, in order to get vaccinations, dewormers, vitamins and minerals.

### 3.6 Synergies with other good practices

- Refuge mounds
- Corralones

### 4. Benefits

Provision of vitamins, minerals and deworming treatment helps cattle to be more resilient and to take better advantage of the nutrients consumed by being free of parasites.

### 4.1 Cost-benefit anaylsis

Cost-Benefit Analyses were conducted based on quantitative data collected during the monitoring period in 2016. The CBA calculates the cumulative net benefits obtained from an average livestock raising community over a period of 11 years (10 percent discount rate), as well as the benefit-cost ratio (BCR), which is the ratio between total discounted benefits and total discounted costs over the appraisal period.
Data collected from good practice farms that built the refuge mounds, supplied vitamins and minerals to their cattle and dewormed the animals were compared with data collected from neighboring farms where the refuge mounds had not been built yet, and where cattle was not dewormed and did not receive vitamins and minerals. The costs and benefits were calculated based on the average number of cattle in the monitored communities (i.e. 139 cows). Results show that, even when no hazards occur, cumulative net benefits from the good practice are about 132 percent higher than the benefits of the traditional practice (appraisal period: 11 years). Accounted benefits include the value of cattle meat and skin sold, as well as the value of live cattle sold.

The BCR of the good practice is 5.51, as compared to 1.48 for the existing local practice, meaning that the good practice brings greater benefits relative to costs, as compared to the usual practice. Given that the mounds were not used during the monitored period, the higher performance of the good practice is mainly attributable to the introduction of deworming and preventive vitaminization and mineralization of cattle, which reduced mortality and improved animal productivity. However, the costs of constructing the mounds is included in the BCR. Therefore, it is expected that in case of floods the net benefits would be much greater.

![Figure 1. Cumulative Net Benefits and Benefit Cost Ratio of DRR Good Practice and Existing Local Practice($ per average herd size)](image_url)

4.2 Added benefits

Even in the absence of hazards, feeding vitamins to animals and deworming them, contributed to reduce livestock mortality, bringing 132% higher net benefits than producing livestock without any additional vitamin and dewormer application. Accounted benefits include the value of cattle meat and skin sold, as well as the value of live cattle sold.

4.3 Avoided losses

The hazard scenario could not be analysed yet, as none of the communities was affected by floods during the monitored period.
4.4 Co-benefits

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

FURTHER READING:


SOURCE(S):

FAO Bolivia [12]

Country:
Bolivia


Links:
[10] https://issuu.com/ucerbolivia/docs/libro_et_pagina