The Handling of Livestock from Points of Origin in Provincial Peru to Slaughtering Centers in Lima

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SUMMARY

Sixteen trips were conducted aboard trucks that transport zebu cattle from the Province of Sullana (29 meters above sea level) in Northern Peru, to a slaughterhouse/meat-packing facility in the City of Lima. The purpose was to determine the cattle's weight loss during transport and define the actual conditions in which the cattle is handled. Each truck was weighed four times, before loading and after unloading. The average time taken for the 1069 Km trip was of 23 hours and 40 minutes, and the average weight loss was 7.442%. Additionally, two samplings were performed for each of four sites in Southern Peru, from where local crossbred cattle is transported to Lima. The following averages were obtained: For a distance of 1020 Km, from Arequipa (2378 m.a.s.l.) travel time was 29 hrs and 14 minutes and weight loss was 8.564%. For a distance of 922 Km, from Majes (880 m.a.s.l.), travel time was 23 hrs. and 20 minutes and weight loss was 7.328%. For a distance of 308 Km, from Ica (402 m.a.s.l.) travel time was 7 hrs. and 12 minutes and weight loss was 5.410%. Finally, for the distance of 1558 Km, from Ilave, Puno (3870 m.a.s.l.) travel time was 36 hrs. and 47 minutes and weight loss was 9.949%. In every case deficiencies in the handling of cattle were noted, as well as in the loading installations and trucks.

Key Words: Weight loss, cattle, zebu

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I. INTRODUCTION

The proper handling of livestock as it is shipped from ranching areas to slaughtering and distribution centers is an issue of considerable importance - not only from the point of view of animal welfare but also with regard to the quality and safety of the meat that reaches consumers. Nowadays, quality means more than simply assuring a food product is nutritious and tasteful. It also means that the product was produced with due regard to the animal's welfare. Some weight loss is to be expected when cattle are transported long distances. However, there are ways to reduce this weight loss. Since there was no information on Peru with regard to this issue, the present study was undertaken to obtain data on the handling of cattle from points of origin in the North and South of Peru to its unloading and subsequent processing at slaughterhouses in Lima.

This study makes a detailed analysis of all aspects of the shipment of livestock to the slaughterhouses, including the distances covered, time en route, rest periods, and food and water supply. It also calculates weight loss due to stress before, during and after transportation. By measuring the percentage weight loss en route, we can seek to mitigate the factors leading to this loss - thus assuring a higher-quality product and the ultimate welfare of the animals sent to slaughter.

II. HYPOTHESIS

The shipping and handling of livestock in Peru do not meet present standards, thus leading to excessive loss of weight and quality of animals slaughtered for human consumption.

III. PURPOSE

To undertake a detailed analysis of all aspects of livestock handling in Peru, from its points of origin in the provinces to its arrival and subsequent slaughter in Lima. It is hoped that current and reliable information will result in recommendations that may lead to improved yields. More specifically, this study proposes to determine the weight loss due to the transportation and handling of livestock.

IV. PROCEDURE

By weighing livestock at its point of origin - just prior to boarding - and again upon arrival at the slaughterhouses in Lima, the net weight loss is obtained. This net weight loss in turn enables us to calculate the decrease in carcass yields.

V. THEORETICAL FRAMEWORK

There is a certain inevitable weight loss associated with the shipping of livestock from ranching areas to slaughtering centers. Most of this loss is due to the elimination of excrement, urine and perspiration. However, when transportation and waiting are prolonged, there is also a loss of tissue which may lead to a reduced carcass weight. This latter type of loss is not always noticed, since it is not directly measurable. (Gallo 1997).

An animal's condition may change considerably within the short period between reaching the desired weight in the corral, and the time of slaughtering - whether herded to the slaughterhouse on foot or whether trucked there. In both cases, an animal loses weight and may suffer injuries. If trucked, livestock may asphyxiate due to poor ventilation. Animals may be mistreated in yet other ways. Not only is this inhumane, but it also reduces the quality of meat. (Lawrie R.A. 1977)

There is ample occasion for trauma during the transport and transfer of livestock. Injuries are classified according to their depth. Thus, first degree injuries only affect subcutaneous tissue, second degree injuries affect muscle tissue and third degree injuries affect subcutaneous, muscle and bone tissue. Carcasses with injured tissue yield lower-quality meat which must be sold at a discount, although no specific studies have been done to quantify the respective economic loss. (Gallo 1998)

Nonetheless, quality problems associated with injured livestock cause significant losses in the beef industry. These problems may be classified as occurring either before or after slaughter. In order to minimize losses occurring before slaughter, one may summarize the recommendations in two words: avoid stress. Livestock injuries caused by deficient facilities or mishandling result in bruised carcasses - a major problem, particularly in Latin American countries. (Velazco 2000)

The humane treatment of livestock, together with well -designed facilities, minimize stress levels, improve efficiency and maintain a good quality of meat. Mishandling and poorly designed installations affect both the animal's welfare and the quality of meat. Progressive supervisors recognize the importance of good handling practices. Constant supervision is needed to maintain high humanitarian standards. (Grandin 1993)

Stress is a physiological condition which arises when an animal's response to an environmental stimulus is extended beyond the tolerance level. The autonomous, sympathetic and parasympathetic nervous systems produce definite neurological and endocrine responses to the stimulus, through the activation of the corresponding neurons and nerve fibers. (Plumb 1994)

Stimuli, transmitted by the sympathetic nervous system, enable the organism to react to stress. Reactions normally include pupil dilation, an increase in heartbeat, blood pressure, respiration and perspiration, a decrease in gastrointestinal peristalsis, bladder relaxation, sphincter contraction and the secretion of adrenaline and noradrenaline by the medulla oblongata. (Chaffee and Little 1980).

VI. MATERIALS AND METHODS

Between November, 1999 and March, 2000, information was collected at five points of departure of livestock in provincial Peru for slaughtering centers in Lima. The following devices were used: measuring tapes, thermometers, clocks and cameras. Also, truck scales were used for weighing cargo at the points of loading and unloading. The following elements were evaluated: load conditions, transportation and unloading of animals, duration of trip and distance traveled. Observers traveled on the same trucks as the livestock in order to record handling procedures en route. The following were determined: weight loss due to stress and/or mishandling, the presence of bruises and the corresponding loss in the value of carcasses and hides.

Trucks were weighed before and after loading cattle in the provinces, upon arrival in Lima and yet again after unloading (Appendices 1 to 5). Records were made of the number of animals in each lot, their breed, sex, age and type of feed (Appendix 12). Ramp characteristics were noted, as well as conditions in the trucks and herding procedures (Appendix 6). Provincial breeding centers were visited both in Northern and Southern Peru so as to ascertain the initial conditions of the livestock. Slaughtering procedures were also closely observed.

All livestock consisted of males between 2 and 2 _ years of age, on average. Each sample number itemized in the tables corresponds to a specific lot of livestock trucked from the provinces to a slaughterhouse in Lima. The trucks were identified with letters. In some cases trucks made more than a single trip.

A total of 24 trips were made. The first 16 departed from the Province of Sullana, in the North of Peru, where Brahman cattle are bred (Fig. 1). Trips 17 & 18 departed from Arequipa, 19 and 20 from Majes, 21 and 22 from Ica, and 23 and 24 from Puno. The weight loss of the livestock was calculated by subtracting the final weight, upon arrival at the slaughterhouse, from the initial weight at the point of departure.

WEIGHT LOSS = (Initial Weight) – (Final Weight)

The Initial weight (IW) was calculated by first weighing the empty truck, with bedding and food, and then once again after the truck had been loaded with cattle.

Weight of loaded truck (animals + food + bedding) - Weight of empty truck (with food + bedding)

INITIAL WEIGHT = The Final Weight (FW) was calculated by weighing the truck upon arrival at the slaughterhouse and then again once the livestock had been unloaded.

Weight of loaded truck (with animals + food + bedding + excrement + - Weight of empty truck (with food + bedding + excrement + urine)

FINAL WEIGHT = The initial and final weights of the livestock are given in Appendix 7. In no case were the animals given food or water during the trip. The food carried in the trucks (Fig. 37) was only used to feed livestock at the slaughterhouse.

The livestock density - defined as the area available to each animal during the trip - was established by dividing the loading area of the truck by the number of animals carried (Appendix 10).

The average weight of the live animals was calculated from their weights at the point of loading (Appendix 10). After slaughtering, the weight of the carcasses was obtained (Appendix 8)

Temperature and humidity were recorded at the time of loading (Appendix 9). Also, the geographical location of the various loading points is given (Appendix 11).

VII. RESULTS AND DISCUSSION

On the Sullana to Lima leg, a distance of 1,069 kilometers, the average time en route was 23 hours and 40 minutes and the average weight loss was 7.44% (Tables 1 & 6). On the Arequipa to Lima leg, a distance of 1,020 kilometers, average time en route was 29 hours and 14 minutes and the average weight loss was 8.56% (Tables 2 & 7). On the Majes to Lima leg, a distance of 922 kilometers, average time en route was 23 hours and 20 minutes and average weight loss was 7.33% (Tables 3 & 8). On the Ica to Lima leg, a distance of 308 kilometers, average time en route was seven hours and 12 minutes and average weight loss was 5.41% (Tables 4 & 9). On the Ilave to Lima leg, a distance of 1,558 kilometers, the average time en route was 36 hours and 47 minutes and the average weight loss was 9.95% (Tables 5 & 10).

Table 11 gives carcass yields, based on live weight at the point of origin (Yield A) and live weight at the slaughterhouse (Yield B). For Sullana, Yield A is 53.323% and Yield B is 57.609%. For Arequipa, Yield A is 49.261% and Yield B is 53.874%. For Majes, Yield A is 48.936% and Yield B is 52.801%. For Ica, Yield A is 52.486% and Yield B is 55.487%. For Ilave, Yield A is 49.568% and Yield B is 55.043%.

A study undertaken in 1995 by Gallo, *et al*, found an 8.25% drop in the weight of steers transported over the 950 kilometers from Osorno to Santiago in Chile - a 24-hour journey. The average carcass weight was 57.04% of the weight of the steers on arrival, and only 52.34% of their pre-journey weight (Gallo, 1997). These results seem to coincide with those of the Sullana to Lima leg - a journey of similar length. However, when compared to the results for the Majes to Lima leg, we find marked differences. This may be explained by the fact that our study includes only two such trips from Majes to Lima. The results are therefore less reliable than those obtained from a larger number of samples. Furthermore there are all sorts of variables that come into play, and which serve to complicate the analysis of the data. Among these are the breed of livestock, its sex, age, distance covered and time en route, food provided during the journey, the treatment given to the animals, their density in transit, the weather conditions, altitude, type of bedding provided, ventilation in the truck, road conditions and many others. All these serve to make each example an exclusive case study.

With regard to the treatment afforded the animals, the following comments are in order:

Livestock Management Prior to Loading

Livestock from outlying provinces, destined for slaughter in Lima, is first herded from the various corrals towards the loading dock. Several workers take part in this procedure, without inflicting any physical harm on the animals (Figs. 3 & 4). However, since animals from separate herds are placed together for the first time, fights occasionally break out - both before and during transport (Fig. 5). When the animals become exceptionally unruly en route, the vehicle is stopped and the offending animal is separated (Fig. 6), which results in lost time and even greater stress on the animals.

The livestock has water and concentrated feed available till the moment of boarding. Only in Sullana were there passageways leading to the loading dock - made from locally available woods known as *algarrobo* and *hualtaco* (Figure 2). However, the individual corrals are not connected directly to these passageways (Fig. 7). The livestock is thus forced to traverse an open area, where individual animals sometimes separate from the herd, stumble and hurt themselves (Figs. 8, 9 & 10). Once in the passageways, the animals are classified. Those over two years of age (Fig. 11) are marked with paint (Fig. 12). This classification also serves to identify what animals belongs to whom, when livestock belonging to different owners is shipped together. Although this is not always done, classification takes time and adds to animal stress - especially in the case of Brahman cattle, noted for their nervous disposition.

Livestock Management During Loading

None of the sites visited had boarding ramps. Rocks and soil had been piled so as to enable the livestock to climb up onto the loading dock (Fig. 13). In some cases - as in Arequipa - the animals were simply herded down the street towards a natural rise in the terrain (Fig. 14). Boarding was further complicated as night fell and adequate lighting was not available (Figs. 15 & 16).

In the majority of cases, such natural rises in terrain were not sufficient to reach the level of the flatbed, which was often some two feet higher (Fig. 17). Some animals were able to jump onto the truck without difficulty, while others shied away (Fig. 18).

Problems tended to arise upon loading the very last animals. The truck now being almost full, some animals refused to board. The workers would then resort to sticks and electric prods (Figs. 19 & 20). This was when the most blatant abuse tended to occur, as electric prods were applied to the eyes or anus (Figs. 21 & 22). Electric prods should never be applied to sensitive areas such as eyes, ears, nose or anus (Grandin, 1988). It should be pointed out, however, that these procedures were not acts of wanton cruelty but simply ignorance on the part of the livestock handlers.

The construction of adequate ramps is of paramount importance in avoiding the above loading problems, together with injuries to animals that fall while trying to jump aboard the vehicle (Figs. 23, 24, 25 & 26), upon disembarking (Fig. 27) or when transiting the boarding area (Fig. 28). This leads to lost time - perhaps as much as 50 minutes - especially when an animal refuses to jump aboard in spite of being jabbed with an electric prod. In such cases additional workers are called upon to tow the animal with a rope (Fig. 29). Once the truck is loaded to capacity, the gate is shut (Fig. 30). There is no control over the number of animals jammed into each vehicle, resulting in severe overloading and consequent stress (Appendix 10).

In the other places visited, there were neither ramps nor adequate passageways for assuring the proper boarding of livestock into the trucks. Although the livestock was more docile than the Brahmans loaded at Sullana, individual animals occasionally broke loose, sometimes jumping the low fences of the flatbed trailers (Figs. 31 & 32). Livestock fairs (Fig. 33) are a frequent attraction in Ilave, in the Province of Puno. However, their loading areas are entirely inadequate (Fig. 34). Especially during the rainy season - from December to March - falls are a frequent problem (Figs. 35 & 36) as the livestock tends to slip in the deep mud. There is a pressing need for ramps and non-slip surfaces. The flatbed should be cushioned with straw rather than soil, which tends to aggravate the above problems.

In Sullana, wet sawdust is used to line the flatbeds (Fig. 37), this being the most readily available material. In Majes (Fig. 38), sand and other materials are used (Appendix 12).

Except in Sullana, where livestock is sent untethered because of its more gentle disposition, in the other places studied the animals are generally tied by the head to the fencing of the truck (Figs. 38 & 40). In general they are not arranged alternately, head to rump. This adds to the discomfort of some of the animals (Figs. 41 & 42). Untethered animals are usually transported in trucks without separators, which are recommended so as to keep the herd orderly (Fikuart 1996).

Livestock Management During Transport

Most of the trucks - simple flatbeds with fencing - are inappropriate for transporting livestock. Moreover, they rarely have adequate ventilation, the openings being above the level of the heads of the livestock (Appendix 6). This causes labored breathing for some animals, especially when the vehicle is forced to stop (Fig. 43). This is a frequent occurrence during the voyage from Sullana, a situation aggravated by the high temperatures en route.

Among the problems encountered was one in which a truck also transported tricycle wheel rims (Fig. 44). The cargo of wheel rims broke loose during the voyage, causing stress to the animals and additional delays (Figs. 45 & 46).

Trucks were weighed both before and after taking on their load of livestock (Figs. 47 & 48).

There were no additional problems encountered with animals being transported from the southern regions of the country. There were no undue delays, despite the fact that some animals had to endure journeys of over 36 hours - especially those being shipped from Ilave (Figs. 49 & 50) - with the exception of the accident described in Appendix 13.

The basic problems encountered were with livestock transported from Sullana. There were continually cases of animals falling - requiring anywhere from 18 to 22 additional stops along the way in order to help the fallen animals to a standing position. Depending on the severity of the fall, it is easier to raise an animal from a sitting position (Fig. 51 & 52) than from a prone position (Figs. 53 & 54). The fallen animals can be trampled by the others (Figs. 52 & 53), and may also have difficulty breathing (Fig. 56). Every stop made to help fallen livestock took from 15 to 30 minutes. These stops would be made throughout the journey, at whatever hour of the day or night (Figs. 55, 56 & 57).

Fallen animals were brought to their feet by different means:

a. Electric prod: Although this was a fast way to get animals back on their feet, some excesses were committed - as when the prod was applied to the anus. Because of its high cost, very few trucks come equipped with a prod. It is recommended, though - as long as it is used properly (Figs. 58, 59 & 60).

b. Hook: Trucks not carrying an electric prod usually had a long pole with a stout metal hook on one end. The handler would try to hook the tail of the fallen animal in order to force it to its feet (Figs. 61 & 62). Sometimes, however, the animal's tail is not readily accessible by the handler. At such times the handler must enter the flatbed and manually hook the animal's tail - thus placing himself at considerable risk of injury (Fig. 63).

c. Gasoline: When the above methods prove inadequate the driver and his helper often sprinkle gasoline in the fallen animal's snout or ears. The animal reacts violently, coming to its feet immediately (Fig. 64). This method - known to cattle ranchers - is considered necessary in extreme cases. They feel it is far better than having the fallen animal trampled underfoot by the rest of the herd - something which fortunately did not happen in any of the cases studied.

During the voyage, the livestock was often exposed to inclement weather - rain in Ilave, high temperatures in Sullanan and Ica - the exception being those few trucks with roofs and adequate ventilation. Fortunately for the animals, most of the roads over which they are transported are in fairly good condition. In fact, most of the journeys monitored by the present study were over paved highways - except in Majes (Fig. 65) and Sullana (Fig. 66), where there were some 10 and 2 kilometers, respectively, of gravel roads.

Livestock Management During Unloading

Trucks were weighed upon arrival at the slaughterhouse and immediately after unloading (Fig. 67) - although only for the purposes of the present study. Normally, trucks are not weighed. The ramps in the slaughterhouses (Figs. 68 & 69) appear to fulfill their function, allowing the livestock to disembark uneventfully (Figs. 70 & 71). They could, however, be redesigned in accordance with the recommendations of experts in these matters. The redesign would include a level area at the very top of the ramp so that the livestock could exit the vehicle before starting to descend. The ramp itself would have a maximum inclination of 20 degrees. Anything steeper increases the likelihood of falls (Grandin 1993).

Livestock transported from Sullana often arrived exhausted from their journey, and remained prostrate until forced to disembark (Figs. 72, 73 & 74).

Disembarked animals were then led through a passageway (Fig. 75) to a corral. The animals would immediately drink water and then lie down to rest (Fig. 76).

Livestock Management Prior to Slaughter

Once at the slaughterhouse the livestock is given unlimited water. Animals arriving from Sullana are fed concentrate while those arriving from points south are given dry forage. In all the slaughterhouses visited the animals are fed until moments before butchering. This has the inconvenience of not permitting proper elimination from the digestive tract. Upon evisceration, there is a greater risk of contamination with fecal matter (Gallo, 1998). Although there was no evidence of contamination of carcasses following evisceration, it is recommended that food intake be restricted to 12 hours prior to butchering. Animals were kept at the slaughterhouse from 12 to 24 hours before butchering - with the exception of a herd brought in from Sullana, which was kept a full 48 hours.

The herding of livestock along the passageways took place without undue difficulty. It was observed that when the walls of the passageways were not solid, enabling the animals to peer through holes in the fencing (Figs. 77 & 78), they tended to stop in their tracks whenever they saw people nearby. It is therefore advisable that passageways have solid walls (Grandin, 1993). Electric prods were sometimes used, but not excessively (Figs. 77 & 79). Before entering the slaughtering pen, the animals pass through a bath or shower. Besides removing dirt, the cold water encourages peripheral vasoconstriction and therefore a more complete bloodletting of the carcass (Fig. 80).

Livestock Management during Slaughter

All animals arriving from Sullana were taken to a modern slaughterhouse with refrigerated facilities. There, butchering was accomplished with humane devices, such as the captive-bolt pistol (Fig. 81) which dispatches the animal prior to bloodletting. Nonetheless, the majority of animals arriving from points south are still taken to slaughterhouses that employ the so-called Spanish pike (Figs. 82 & 83). This is not only a potentially cruel method, but also much less effective than the captive-bolt pistol. Studies comparing the captive-bolt pistol to the Spanish pike indicate that the former permits far better bloodletting - essential for a high-quality carcass (Gallo 1998). Furthermore, up to three animals at a time are introduced into the slaughtering pen (Figs. 84, 85 & 86). Only three of Lima's seven slaughterhouses use a captive-bolt pistol for slaughtering livestock. Yet another deficiency observed was the practice of skinning carcasses on the floor, then throwing them onto metal racks (Fig. 87). Besides contributing to the possible contamination of carcasses, they cannot be bled properly in that position.

Although it does not form part of the present study, Appendix 13 describes the operations of a rural slaughterhouse.

Loss of Value of Carcasses

It is difficult to quantify the weight loss of carcasses due to the prolonged transportation of live animals to the slaughterhouse. One would have to do a study with numerous animals of the same breed and of similar weight. Furthermore, one would have to compare the weights of carcasses issuing from local slaughterhouses with those issuing from slaughterhouses that butcher cattle brought in from distant points - after trips of over 24 hours. Although not easily quantifiable, this loss nonetheless exists. When animals are denied food and water for 12 hours prior to slaughter, one knows that the weight loss is simply the weight of the urine and excrement. On the other hand, there is the weight loss due to the actual loss of tissue during prolonged journeys, and which directly affects the weight of the resultant carcass (Grandin, 1998).

There are no standard prices in the Peruvian market and carcasses are usually quoted individually. At the present time a kilo of prime carcass costs between seven and 8.20 soles (US$2.00 - US$2.34). This is what the rancher loses for each one-kilo weight loss due to prolonged transport to market. Then there are the losses due to injuries. The present study encountered numerous cases of superficial bruising, involving only subcutaneous tissue. Such bruises do not affect the value of the carcass since the superficial parts are removed during dressing (Figs. 88 & 89). When the injuries involve muscle, however, the presence of a hematoma will affect the value of the entire carcass. In such cases, the losses may reach one or 1.20 soles per kilo. Three such lesions were found in the carcasses of animals originating in the south (Figs. 90 to 93). Since the carcasses had an average weight of 267 kilos, the total loss of value per carcass was somewhere between 267 and 320 soles (US$76 - US$91).

When the lesions involve bone, such as fractured ribs, the value of a carcass is reduced by two to 2.50 soles per kilo. Had there been such fractures present, the value of the carcasses would have decreased by some 534 to 668 soles (US$152 to US$191).

In none of the cases observed were carcasses, viscera or other animal parts confiscated.

Loss in the Value of Hides

With regard to the value of their hides, livestock from the south is quoted higher than livestock from Sullana. This is due to the fact that the livestock in Sullana is mostly Brahman. This breed is brought from Ecuador for fattening in Sullana. It is often affected by parasites such as *Dermatobia hominis* - known locally as *tupe*. This condition is characterized by superficial boils (Fig. 94). These boils make holes in the animal's hide, and it takes just one hole to lessen the value of the entire hide. Furthermore, the animals exhibit numerous brands (Figs. 95 & 96) that also serve to deface the hide and lessen its value. These losses have been estimated at 0.50 to 0.90 soles per kilo of hide - depending on the agreement reached by rancher and purchaser. This led to a standard quotation being agreed upon for the hides of Sullana livestock - 1.30 soles per kilo - regardless of condition. Since the average weight of a Brahman hide is 45 kilograms, the loss due to damaged hides is equivalent to some 31.50 soles (US$9).

VIII. CONCLUSIONS AND RECOMMENDATIONS

1. The livestock market is marked by its informality. Cattle is transported using whatever vehicles are available without regard to the welfare of the animals.
2. Improvements in the facilities, such as the construction of adequate ramps, corridors and anti-slip surfaces, should be seen as a sensible investment. Besides being both necessary and useful, such measures provide immediate and tangible benefits.
3. Livestock fairs should have scales for weighing incoming animals. Throughout the country livestock is sold according to the general appearance of the animal, a method that often works against the rancher. In Ilave, for example, there was much interest in acquiring a scale. The cattle of the local ranchers is often sold to intermediaries at prices that do not reflect the true value of the livestock.
4. The use of the so-called Spanish pike for slaughtering livestock should be discontinued. It is a cruel device, and also serves to diminish the value of the carcass - as explained earlier.
5. Slaughterhouses not meeting certain minimum requirements should be closed. Such facilities are at odds with the humane treatment of animals, and also produce poor-quality meat. It has also been observed that animals are sometimes subjected to needless cruelty at livestock fairs. This situation could be easily corrected through the construction of adequate facilities (Appendix 13).
6. Trucks used for the transportation of livestock must meet certain minimum requirements with regard to ventilation and materials used to line the flatbed. Also, animals should be separated during transport.
7. The weight loss of carcasses due to prolonged transportation of live animals from distant points brings up the question of establishing slaughterhouses with refrigerated facilities within the cattle ranching regions themselves. Those ranchers consulted for the present study were in favor of establishing such facilities locally. Although necessary, such facilities are costly and investors would face substantial risks. Refrigerated trucks would also be necessary for the subsequent transportation of carcasses. The economic benefits, however, could be considerable.

    a) Ranchers would benefit, since a refrigerated truck could transport a far greater number of carcasses than live animals. Furthermore, refrigerated trucks would serve to attenuate price fluctuations in fruits and vegetables, which at present can reach fifty percent.
    b) Weight loss due to the prolonged transport of live animals would be eliminated entirely - together with losses due to injuries suffered by animals during transport.
    c) Regional slaughterhouses with refrigerated facilities would obviously enjoy a large captive market in their respective regions.
    d) Regional development and decentralization would be promoted as job opportunities opened up in outlying areas. Both direct and indirect employment would be enhanced - through the preparation and sale of meat products, viscera, hides, transportation in appropriate vehicles, etc.

e) Obviously, the above benefits would be offset by specific losses - for the central slaughterhouses in Lima, for example, as well as for the present truckers of livestock. Nonetheless, the potential benefits - in the form of higher-quality meat, higher yields from ranching activities and higher regional employment - far outweigh these specific losses. There are valid and clear-cut reasons for pursuing these benefits.

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Table 1: Percentage Weight Loss of Livestock Loaded in Sullana and Transported to Lima

Sample No.	No. of Animals	Weight at Departure (kg)	Weight at Arrival (kg)	Weight Loss (kg)	% Weight Loss
1	22	11020	10230	790	7.169
2	20	12690	11780	910	7.171
3	21	12000	11060	940	7.833
4	21	12500	11490	1010	8.080
5	21	11180	10330	850	7.603
6	20	12000	11240	760	60333
7	23	10680	9860	820	7.678
8	22	11090	10310	780	7.033
9	22	10350	9630	720	6.957
10	22	11650	10770	880	7.554
11	19	11630	10730	900	7.739
12	20	12330	11260	1070	8.678
13	22	10890	10070	820	7.530
14	20	11760	10920	840	7.143
15	21	1162	10820	800	6.885
16	22	10940	10100	840	7.678

Average Weight Loss: 7.442%

Table 2: Percentage Weight Loss of Livestock Loaded in Arequipa and Transported to Lima

Sample No.	No. of Animals	Weight at Departure (kg)	Weight at Arrival (kg)	Weight Loss (kg)	% Weight Loss
17	15	6510	5950	560	8.602
18	21	9150	8370	780	8.525

Average Weight Loss: 8.564%

Table 3: Percentage Weight Loss of Livestock Loaded in Majes-Arequipa and Transported to Lima

Sample No.	No. of Animals	Weight at Departure (kg)	Weight at Arrival (kg)	Weight Loss (kg)	% Weight Loss
19	17	6320	5840	480	7.595
20	18	7790	7240	550	7.060

Average Weight Loss: 7.328%

Table 4: Percentage Weight Loss of Livestock Loaded in Ica and Transported to Lima

Sample No.	No. of Animals	Weight at Departure (kg)	Weight at Arrival (kg)	Weight Loss (kg)	% Weight Loss
21	15	8822	8340	482	5.464
22	18	9260	8764	496	5.356

Average Weight Loss: 5.410%

Table 5: Percentage Weight Loss of Livestock Loaded in Ilave-Puno and Transported to Lima

Sample No.	No. of Animals	Weight at Departure (kg)	Weight at Arrival (kg)	Weight Loss (kg)	% Weight Loss
23	20	9490	8570	920	9.694
24	20	9310	8360	950	10.204

Average Weight Loss: 9.949%

Table 6: Travel Times for Livestock Loaded in Sullana and Transported to Lima

Sample No.	No. of Animals	Truck	Departure	Arrival	Time *en route*	Loading Time
1	22	A	10:40	08:05	21h. 25 min.	50 min.
2	20	B	11:23	11:35	24h. 12 min.	24 min.
3	21	C	12:30	12:40	24h. 10 min.	47 min.
4	21	D	12:50	12:50	24h. 00 min.	15 min.
5	21	A	09:35	06:30	20h. 55 min.	22 min.
6	20	B	10:12	09:20	23h. 08 min.	14 min.
7	23	C	10:25	09:22	22h. 57 min.	11 min.
8	22	E	10:55	11:01	24h. 06 min.	28 min.
9	22	F	09:00	10:10	25h. 10 min.	18 min.
10	22	R	09:37	10:55	25h. 18 min.	08 min.
11	19	C	10:25	11:10	24h. 45 min.	20 min.
12	20	B	11:10	12:52	25h. 42 min.	30 min.
13	22	A	09:20	06:50	21h. 30 min.	28 min.
14	20	B	11:50	12:05	24h. 15 min.	35 min.
15	21	G	12:42	12:44	24h. 02 min.	42 min.
16	22	C	13:10	13:05	23h. 05 min.	25 min.

Average time *en route*: 23 hours, 40 minutes, covering a distance of 1,069 kilometers.

Loading Time: Taken from the time the first animal boards to the time the last animal boards and the gates are closed (Fig. 30). (Animals are in corridors, waiting to board.)

Table 7: Travel Times for Livestock Loaded in Arequipa and Transported to Lima

Sample No.	No. of Animals	Truck	Departure	Arrival	Time *en route*	Loading Time
17	15	H[3]	20:10	01:30	29h. 20 min.	40 min.
18	21	H	18:15	23:05	28h. 50 min.	48 min.

Average time *en route*: 29 hours, 14 minutes, covering a distance of 1,020 kilometers.

Table 8: Travel Times for Livestock Loaded in Majes-Arequipa and Transported to Lima

Sample No.	No. of Animals	Truck	Departure	Arrival	Time *en route*	Loading Time
19	17	I	08:00	07:25	23h. 25 min.	35 min.
20	18	I	08:35	07:50	23h. 15 min.	44 min.

Average time *en route*: 23 hours, 20 minutes, covering a distance of 922 kilometers.

Table 9: Travel Times for Livestock Loaded in Ica and Transported to Lima

Sample No.	No. of Animals	Truck	Departure	Arrival	Time *en route*	Loading Time
21	15	K	11:15	18:34	07h. 19 min.	55 min.
22	18	J	10:20	17:25	07h. 05 min.	60 min.

Average time *en route*: 7 hours, 12 minutes, covering a distance of 308 kilometers.

Table 10: Travel Times for Livestock Loaded in Ilave-Puno and Transported to Lima

Sample No.	No. of Animals	Truck	Departure	Arrival	Time *en route*	Loading Time
23	20	L	13:15	02:00	36h. 45 min.	42 min.
24	20	M	13:30	02:20	36h. 50 min.	30 min.

Average time *en route*: 36 hours, 47 minutes, covering a distance of 1,558 kilometers.

Table 11: Percentage Yield of Carcasses:

Weight of Carcasses / Weight of Livestock at Point of Departure (Yield A)
Weight of Carcasses / Weight of Livestock at Time of Slaughter (Yield B)

Average Weight Loss (kg) and % Weight Loss of all Livestock Transported to Lima

Sample No.	No. of Animals	Yield A (%)	Yield B (%)	Average Weight Loss (kg)	Percentage Weight Loss
1	22	52.868	56.950	35.909	7.169
2	20	54.460	58.667	45.500	7.171
3	21	53.533	58.083	44.762	7.833
4	21	50.984	55.466	48.095	8.080
5	21	53.649	58.064	40.476	7.603
6	20	55.425	59.173	38.000	6.333
7	23	52.444	56.805	35.652	7.678
8	22	53.309	57.342	35.455	7.033
9	22	54.155	58.204	32.727	6.957
10	22	51.983	56.230	40.000	7.554
11	19	53.869	58.388	47.368	7.739
12	20	53.179	58.233	53.500	8.678
13	22	53.517	57.875	37.273	7.530
14	20	53.759	57.894	42.000	7.143
15	21	52.676	56.571	38.095	6.885
16	22	53.364	57.802	38.182	7.678
17	15	49.078	53.697	37.333	8.602
18	21	49.443	54.050	37.143	8.525
19	17	48.038	51.986	28.235	7.595
20	18	49.833	53.619	30.556	7.060
21	15	52.800	55.851	32.133	5.464
22	18	52.171	55.123	27.556	5.356
23	20	50.232	55.624	46.000	9.694
24	20	48.904	54.462	47.500	10.204

Appendix 1: Loads (kg) Carried by Trucks from Sullana-Piura to Lima

Sample No.	No. of Animals	Sullana-Piura Loaded	Sullana-Piura Empty	Lima Loaded	Lima Empty
1	22	24,930	13,910	24,310	14,080
2	20	24,820	12.130	24,160	12,380
3	21	24,900	12,900	24,200	13,140
4	21	25,390	12,890	24,700	13,210
5	21	25,090	13,910	24,530	14,200
6	20	24,100	12,100	23,520	12,280
7	23	23,540	12,860	22,980	13,120
8	22	25,020	13,930	24,480	14,170
9	22	23,310	12,960	22,890	13,260
10	22	25,360	13,710	24,760	13,990
11	19	24,160	12,530	23,530	12,800
12	20	24,800	12,470	24,300	13,040
13	22	24,400	13,510	23,860	13,790
14	20	23,430	11,670	22,840	11,920
15	21	23,400	11,780	22,670	11,850
16	22	23,430	12,490	22,810	12,710

Appendix 2: Loads (kg) Carried by Trucks from Arequipa to Lima

Sample No.	No. of Animals	Arequipa Loaded	Arequipa Empty	Lima Loaded	Lima Empty
17	15	18,680	12,170	18,260	12,310
18	21	21,100	11,950	20,540	12,170

Appendix 3: Loads (kg) Carried by Trucks from Majes-Arequipa to Lima

Sample No.	No. of Animals	Majes-Arequipa Loaded	Majes-Arequipa Empty	Lima Loaded	Lima Empty
19	17	17,440	11,120	16,730	10,890
20	18	18,970	11,180	18,640	11,400

Appendix 4: Loads (kg) Carried by Trucks from Ica to Lima

Sample No.	No. of Animals	Ica Loaded	Ica Empty	Lima Loaded	Lima Empty
21	15	17,861	9,039	17,530	9,190
22	18	17,910	8,650	17,606	8,842

Appendix 5: Loads (kg) Carried by Trucks from Ilave-Puno to Lima

Sample No.	No. of Animals	Ilave-Puno		Lima	
		Loaded	Empty	Loaded	Empty
23	20	21,770	12,280	21,100	12,530
24	20	21,500	12,190	20,820	12,460

Appendix 6 : Specifications of Trucks Carrying Livestock

Truck	Length (meters)	Width (meters)	Height [1]	Ventilation Height [2]	Area (square meters)
A	8.40	2.37	2.07	1.44	19.908
B	8.57	2.43	2.11	1.65	20.825
C	8.39	2.38	1.96	1.66	19.968
D	8.40	2.39	1.98	1.65	20.076
E	8.35	2.40	2.03	1.67	20.040
F	8.10	2.38	2.05	1.66	19.278
G	8.36	2.39	2.01	1.65	19.980
H	8.12	2.52	1.85	1.48	20.462
H[3]	5.85	2.52	1.85	1.48	14.742
I	8.10	2.42	1.98	1.64	19.602
J	7.75	2.44	1.89	1.57	18.910
K	7.92	2.49	1.92	1.62	19.721
L	8.41	2.50	2.10	1.67	21.025
M	8.36	2.48	2.00	1.65	20.734

(1) Height, in meters, from the floor of the flatbed to the upper edge of the fencing.
(2) Height, in meters, from the floor of the flatbed to the first ventilation opening.
(3) This is the same H truck, after having separated part of its flatbed for a different type of cargo.

Appendix 7 : Percentage Yield of Carcasses:

Weight of Carcasses / Weight of Livestock at Point of Departure (Yield A)
Weight of Carcasses / Weight of Livestock at Time of Slaughter (Yield B)
Weight of Livestock at Point of Departure & Upon Arrival in Lima

Sample No.	No. of Animals	Yield A (%)	Yield B (%)	Weight at Departure (kg)	Weight at Arrival (kg)
1	22	52.868	56.950	11020	10230
2	20	54.460	58.667	12690	11780
3	21	53.533	58.083	12000	11060
4	21	50.984	55.466	12500	11490
5	21	53.649	58.064	11180	11330
6	20	55.425	59.173	12000	11240
7	23	52.444	56.805	10680	9860
8	22	53.309	57.342	11090	10310
9	22	54.155	58.204	10350	9630
10	22	51.983	56.230	11650	10770
11	19	53.869	58.388	11630	10730
12	20	53.179	58.233	12330	11260
13	22	53.517	57.875	10890	10070
14	20	53.759	57.894	11760	10920
15	21	52.676	56.571	11620	10820
16	22	53.364	57.802	10940	10100
17	15	49.078	53.697	6510	5950
18	21	49.443	54.050	9150	8370
19	17	48.038	51.986	6320	5840
20	18	49.833	53.619	7790	7240
21	15	52.800	55.851	8822	8340
22	18	52.171	55.123	9260	8764
23	20	50.232	55.624	9490	8570
24	20	48.904	54.462	9310	8360

Appendix 8

Total and Average Weights of Carcasses

Sample No.	No. of Animals	Total Weight (kg)	Average Weight (kg)
1	22	5,826	264.82
2	20	6,911	345.55
3	21	6,424	305.90
4	21	6,373	303.48
5	21	5,998	285.62
6	20	6,651	332.55
7	23	5,601	243.52
8	22	5,912	268.73
9	22	5,605	254.77
10	22	6,056	275.27
11	19	6,265	329.74
12	20	6,557	327.85
13	22	5,828	264.91
14	20	6,322	316.10
15	21	6,121	291.48
16	22	5,838	265.36
17	15	3,195	213.00
18	21	4,524	215.43
19	17	3,036	178.59
20	18	3,882	215.67
21	15	4,658	310.53
22	18	4,831	268.39
23	20	4,767	238.35
24	20	4,553	227.65

Appendix 9

Temperature and Relative Humidity at Point of Departure

Sample No.	No. of Animals	Temperature (Degrees C.)	Relative Humidity (%)	Max. Altitude *en route* (meters above sea level)
1	22	23	23	200
2	20	24	23	200
3	21	27	22	200
4	21	29	22	200
5	21	30	28	200
6	20	32	29	200
7	23	32	29	200
8	22	32	29	200
9	22	28	31	200
10	22	29	32	200
11	19	29	32	200
12	20	30	32	200
13	22	36	44	200
14	20	35	43	200
15	21	36	44	200
16	22	36	44	200
17	15	10	46	2378
18	21	11	42	2378
19	17	23	52	880
20	18	28	38	880
21	15	28	53	402
22	18	34	36	402
23	20	22	42	4755
24	20	22	42	4755

Appendix 10

Average Weight of Livestock at Point of Departure and Loading Density of Animals in Trucks

Sample No.	No. of Animals	Weight at Departure	Truck	Cargo Area (m^2)	Area (m^2) Per Animal
1	22	500.909	A	19.908	0.905
2	20	634.500	B	20.825	1.041
3	21	571.429	C	19.968	0.951
4	21	595.238	D	20.076	0.956
5	21	532.381	A	19.908	0.948
6	20	600.000	B	20.825	1.041
7	23	464.348	C	19.968	0.868
8	22	504.091	E	20.040	0.911
9	22	470.455	F	19.278	0.876
10	22	529.545	E	20.040	0.911
11	19	612.105	C	19.968	1.051
12	20	616.500	B	20.825	1.041
13	22	495.000	A	19.908	0.905
14	20	588.000	B	20.825	1.041
15	21	553.333	G	19.980	0.951
16	22	497.273	C	19.968	09.08
17	15	434.000	H^3	14.742	0.983
18	21	435.714	H	20.462	0.974
19	17	371.765	I	19.602	1.153
20	18	432.778	I	19.602	1.089
21	15	588.133	K	19.721	1.315
22	18	514.444	J	18.910	1.051
23	20	474.500	L	21.025	1.051
24	20	465.500	M	20.734	1.037

Appendix 11

Geographic Location of Points of Departure & Distances to Lima

Point of Departure	West Longitude	South Latitude	Altitude (meters above sea level)	Distance to Lima (kilometers)
Sullana	80° 38'	04° 52'	29	1,029
Arequipa	71° 33'	16° 33'	2,378	1,020
Majes	72° 12'	16° 21'	880	922
Ica	75° 44'	14° 06'	402	308
Ilave	69° 47'	16° 05'	3,870	1,558

Lima itself is located at 76° 53' West Longitude and 12° 15' South Latitude. It is at 203 meters above sea level.

Appendix 12

Type of Livestock, Trucks and Bedding Materials

Point of Departure	Breed of Livestock	Breeding Methods	Sex	Average Age	Truck Type	Type of Bedding
Sullana	Brahman	Intensive	Male	2 - 2 1/2 years	Wooden stakes	Sawdust
Arequipa	Holstein and mongrel	Intensive	Male	2 - 2 1/2 years	Wooden stakes	Soil & guano
Majes	Holstein and mongrel	Mixed	Male	2 - 2 1/2 years	Wooden stakes	Sand
Ica	Brown Swiss and mongrel	Intensive	Male	2 - 2 1/2 years	Wooden stakes	Sand & soil
Puno	Brown Swiss and mongrel	Mixed	Male	2 - 2 1/2 years	Wooden stakes	Sand & soil

Appendix 13

Additional Observations:

Inadequate Slaughterhouses

While the present study was being undertaken, the authors had the opportunity to inspect one of the rural slaughterhouses operating deep within the country's interior. The rudimentary conditions under which livestock was slaughtered were much in evidence. There was only a single pulley with which to hoist the hooked carcasses. Since there were no overhead rails for moving carcasses from one point to another, they were skinned on the floor - with the attendant risk of contamination (Figs. 97 & 98). There was no high-pressure water available. Viscera were dropped on the floor and axes were used for chopping the carcasses into two halves (Figs. 99 & 100).

While inspecting the facilities, we witnessed the impromptu butchering of an animal. It was forced to jump from the truck onto the ground, and it was butchered right on the spot (Figs. 101 & 102). The slaughterhouse in question has no pen for butchering animals, so the procedure is performed on the floor (Figs. 103 & 104).

The Sale of Goats at a Livestock Fair

At some livestock fairs animals are unnecessarily mistreated because of the inadequate facilities available. In Figure 105, we see animals lying on the ground - seemingly dead but in fact alive. All four legs of the animals are tied, since corrals are unavailable.

Regarding the Conduct of Truckers

While monitoring the transport of livestock from the country's southern region, we witnessed an accident on the road from Ilave to Lima. The truck carrying the livestock collided violently with a pick-up, pushing it off the road. Fortunately there were no fatalities. However, this highlights the special responsibilities of those assigned to transport livestock. In this particular case, the driver was intoxicated. The animals were unloaded and continued on their journey several days later. This case was eliminated from the present study.

Glossary

"Butchery"	A slaughterhouse.
Carcass	A butchered animal, with the skin, viscera and extremities removed (head, legs and tail). In the case of pigs, the skin is left on. The carcass is then split into two halves.
Confiscation	Animals or animal parts that - upon inspection - are adjudged unacceptable for human consumption and are removed from market.
Intensive Breeding	Livestock bred within stables and fed specially balanced diets to maximize growth.
Mixed Breeding	Similar to the above, except that the livestock is also let out of the stables to graze (as in extensive breeding).
Refrigerated Slaughterhouse	Slaughterhouse with refrigerated facilities for storing meat. Industrial refrigerated slaughterhouses also have facilities for processing meat products and organic residues.
Slaughterhouse	Facilities used for slaughtering livestock. The term is generally used to include slaughterhouses with refrigerated facilities.