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Characterisation of the production system of llamas and description of breeding strategies of smallholders in the Central Peruvian Andes

Master thesis

submitted by

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SUMMARY

Llamas are mainly reared in the Andean Highlands and played an essential role to develop civilisation in this region. Nevertheless little research has been done on Peruvian llamas. Therefore the aim of the study is to characterize the current llama production system as well as the applied breeding strategies in the study area of Pasco, Peru. The study area was divided into two zones where semi-structured interviews with a total number of 104 farmers were conducted.

In Pasco one of the tallest (height at withers) llama populations of Peru can be found and are mainly reared for meat production. In most cases the management of llamas is poor and can be described as low-input low–output system. The majority of the farmers do not own any pasture land by themselves and often communal land is used for keeping livestock.

Problems of overgrazing, unclear user rights and foreign animals are increased if fences are not available.

Main problems of llama keeping mentioned by farmers are a lack of available pasture, technical and management problems, external and internal parasites and the lack of good breeding animals. Although selection of llamas takes place, its frequency depends on the region as well as on the herd size. Most important selection criteria in llama males and females are size, conformation, coat colour and pedigree. Entire coloured animals especially in white, black or brown are favoured over multi-coloured ones.

The majority of the farmers recruit their llama males for breeding from their own herd or buy them whereas in females recruiting from their own herd is the most common practice. Renting, lending or interchange play a negligible role in both sexes.

Farmers mentioned a high occurrence of uncontrolled mating due to lack of knowledge, no separation of llamas by sex and the insufficient numbers of males to practice controlled mating. Inbreeding happens frequently as fences are lacking, as well as males are used for many years and are recruited from the same herd

Selling slaughtered llamas is more common than selling them alive. Principally farmers slaughter llamas for personal use or for market. Barter trading plays a minor role in this region. Generally llamas are slaughtered directly at home and slaughterhouses are rarely used. For personal use, predominantly males around two years of age are slaughtered. For market, mainly males around two years of age and old females at the end of their reproductive life are used.

The majority of the farmers want to increase their number of llamas in the future due the higher amount of meat they provide compared to alpacas and their strong resistance against diseases and environmental influences.

ZUSAMMENFASSUNG

Lamas waren unersetzliche Helfer bei der Besiedelung des peruanischen Hochlandes und werden in diesem Gebiet nach wie vor hauptsächlich gehalten. Forschungsarbeiten über peruanische Lamas gibt es nur sehr spärlich. Das spiegelt die wirtschaftlich untergeordnete Rolle der Lamas wider. Das Ziel der Arbeit ist die Charakterisierung des aktuellen Produktionssystems als auch der angewandten Züchtungsstrategien in der Region Pasco. Das Studiengebiet wurde in zwei Zonen unterteilt und semi-strukturierte Befragungen mit insgesamt 104 Landwirten wurden durchgeführt. Die Lamapopulation in der Region Pasco hat eine überdurchschnittliche Widerristhöhe und wird vornehmlich zur Fleischproduktion genutzt, da die Nutzung als Transportmittel nur mehr eine sehr untergeordnete Rolle spielt. Das aktuelle Produktionssystem kann als low-input low-output System beschrieben werden. Die Mehrheit der Landwirte besitzt keine eigenen Weideflächen, sondern kommunales Weideland wird für die Tierhaltung genutzt. Durch das oftmalige Fehlen von Zäunen zur Abgrenzung der jeweiligen Nutzflächen sind Probleme wie Überbeweidung, unklare Nutzungsrechte und Tiere von anderen Besitzern auf den Weideflächen sowie Raubtiere weit verbreitet. Als Hauptprobleme in der Lamahaltung werden von Landwirten die zu wenig verfügbaren Weideflächen, fachliche als auch Managementprobleme, externe und interne Parasitenbelastung als auch zu wenig gute Zuchttiere in der Herde genannt. Selektion von Zuchttieren wird in unterschiedlicher Intensität in den beiden Regionen durchgeführt und hängt auch zusätzlich von der Herdengröße ab. Die wichtigsten Selektionskriterien für beide Geschlechter sind die Körpergröße, Konformation, Farbe und Abstammung. Einfärbige Tiere werden grundsätzlich bevorzugt wobei die Farben weiß, schwarz und braun bei den Landwirten am beliebtesten sind. Landwirte remontieren vor allem Stuten aus der eigenen Nachzucht wobei zukünftige Deckhengste oftmals von der eigenen Herde abstammen als auch zugekauft werden. Mieten, Leihen oder ein Austausch von Zuchttieren spielt nur geringfügig eine Rolle. Durch das Wissensdefizit, die nicht vorhandene geschlechtliche Trennung innerhalb der Herde als auch die zu geringe Anzahl vorhandener Hengste, laut Landwirten, wird nur in den seltensten Fällen eine kontrollierte Paarung durchgeführt wobei auch die Inzuchtproblematik allgegenwärtig ist. Der Anteil von lebend verkauften Tieren ist gering, denn es wird vor allem Lamafleisch vermarktet. Grundsätzlich werden die Tiere für den Eigenverbrauch oder die Vermarktung am Betrieb selbst geschlachtet, wobei für den Eigenverbrauch vornehmlich junge Lamahengste (2 Jahre) genutzt werden. Für den Verkauf werden junge Lamahengste und alte Stuten genutzt.

Die Mehrheit der Lamahalter will ihre Lamaherde in der Zukunft vergrößern, da Lamas eine höhere Fleischausbeute durch ihr höheres Körpergewicht und eine hohe Resistenz gegen Krankheiten und ändernde Umwelteinflüsse, haben.

RESUMEN

Las llamas resultaron de gran ayuda a la hora de poblar el Altiplano peruano y gran parte de ellas sigue viviendo en esta zona. No existen muchos trabajos de investigación sobre las llamas, lo que viene a reflejar su escasa importancia económica. El objetivo de este trabajo es describir el actual sistema de producción y las técnicas de cría empleadas en la región de Pasco. El campo de estudio se ha dividido en dos zonas, en las que se realizaron encuestas semiestructuradas a un total de 104 campesinos. Las llamas de la región de Pasco poseen una altura de cruz superior a la media y se emplean predominantemente para la producción de carne, ya que su uso como medio de transporte ha ido perdiendo importancia con el tiempo. El sistema de producción actual puede describirse como un sistema de bajo uso de insumos y baja producción. La mayoría de los campesinos no posee pastizales propios, sino que utiliza pastizales comunales para que pasten sus rebaños de llamas. Estos pastizales comunales no suelen tener vallas que limiten los distintos pastos, por lo que suelen darse problemas tales como el exceso de pasto, derechos de usos pocos claros, presencia de animales de otros propietarios en los pastizales o presencia de animales depredadores. Para los campesinos, los problemas principales de la cría de llamas son los pocos pastizales disponibles, los problemas de gestión, la falta de conocimientos específicos, los parásitos internos y externos, así como la escasez de buenas llamas de cría en los rebaños. En las dos regiones, la selección de las llamas de cría se realiza a un distinto nivel de intensidad y depende del tamaño del rebaño. Los criterios de selección más importantes para los dos sexos de llamas son la altura, la forma, el color y el origen. Las llamas de un solo color suelen ser las preferidas y, entre ellas, las de color blanco, negro y marrón suelen ser las más preferidas entre los campesinos. Los campesinos suelen remontar, sobre todo, llamas hembra criadas por ellos mismos y los sementales suelen tomarlos de sus propios rebaños o comprarlos. Por lo tanto, el alquiler, el préstamo o el intercambio de animales de cría juega aquí un papel insignificante. La falta de conocimientos, el hecho de no separar a las llamas por su sexo dentro de los rebaños y el escaso número de sementales disponibles explican, según los campesinos, que el apareamiento controlado solo se haga en muy pocos casos y que el problema del apareamiento consanguíneo esté tan presente. El porcentaje de llamas vendidas vivas es muy escaso, ya que lo que más se comercializa es la carne de llama. Las llamas se suelen matar en la misma explotación familiar, ya sea para consumo propio o para venderlas. Para el consumo propio se suelen destinar generalmente machos jóvenes de 2 años y para la venta de carne se suelen utilizar machos jóvenes y hembras de mayor edad. La mayoría de los campesinos o ganaderos tiene previsto aumentar sus rebaños de llamas en el futuro, ya que las llamas tienen un mayor porcentaje de carne aprovechable gracias al mayor peso corporal y su alta resistencia frente a enfermedades y otras influencias medioambientales cambiantes.

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1 INTRODUCTION

The llama (*Lama glama*) is one of the two domesticated South American camelids. Llamas are mainly reared in the Andean Highlands (Fernandez-Baca 2005). The extreme environmental conditions in the Andes at altitude levels of around 4000 meters limit other forms of agriculture (Nürnberg 2005).

Llamas played an essential role in developing civilisation in the Andes (Gauly et al. 2011). During the first 100 years of Spanish colonisation in Peru, around 90% of the llama and alpaca population disappeared (Wheeler 1994). So did the profound knowledge of breeding strategies and herd management (Gauly et al. 2011).

The actual Peruvian llama population remains stable with around 1,000,000 heads over the recent years (Fernandez-Baca 2005). Nevertheless its number is smaller than sheep or alpaca populations, which are also reared in the Andes.

Llamas are well adapted to the climatic conditions of the Andes (Nürnberg 2005) and provide a variety of products and services such as meat, fibre, dung and transport (Wurzinger et al. 2005).

However, in most cases the management of llamas is poor and can be described as a low input-low output system. The main problems are the low reproduction rates, the high mortality of the offspring and nutritional deficiencies derived from inadequate pasture management which results in poor growth and deterioration of natural resources. Moreover, there are no selection programs for an improvement of economically important traits (e.g. carcass weight). Another particular problem is the high incidence of sarcocystis which affects the carcass quality and the public acceptance of llama meat. Producers also have great limitations with respect to the commercialisation of their products, due to insufficient organisation to act in collectives. Results of the limitations mentioned above are poor income, low profit, food insecurity and poverty of llama farmers in Peru (Fernandez-Baca 2005).

Due to their high adaptability to extreme weather conditions, better utilization of poor quality native grass, low water needs and higher resistance against diseases, llamas are an important genetic resource for the Andean population regarding climatic changes (Camino and Sumar 1992).

However, there is little research done in Peru on the production systems and management practices of smallholders. The aim of this study was to fill the knowledge gap by providing insights into the current situation of llama keepers in the Central Highlands of Peru and documenting the production system and breeding strategies.

1.1 Aim of thesis

The aim of this study is to characterise the current llama production systems and farmers' breeding strategies in the study area of Pasco. So far, little research has been done on Peruvian llamas. There are only few investigations about llama keeping, farmers' breeding strategies and animal preferences in Peru. Information on these points is essential in order to develop appropriate breeding strategies for farmers.

This research should close the information gap and should be used as a starting point for further research on Peruvian llamas. Based on the outcomes of this thesis, strategies for genetic improvement of llamas can be developed and implemented.

1.2 Research questions

Based on the aim of the study the following research questions were defined:

1) What are the current management practices of farmers in the area of Cerro de Pasco?
2) What breeding strategies do farmers use?
3) What are the selection criteria for breeding stock?
4) How does the herd size influence breeding and management decisions?

2 LITERATURE REVIEW

This chapter provides a brief overview of South American Camelids and deals with the most important topics regarding llama keeping and breeding in Peru.

2.1 Origin of South American Camelids

South American Camelids (SACs) belong to the family of “camelidae”. This family is divided into “Lamini” and “Camelini” - the camelids of the “new world” and the “old world”.
Both species originate from North America, but chose separate paths around 30-40 million years ago. The family of Camelini migrated to Asia and the family of Lamini to South America. There are two genera in the family of “Lamini”: the lama and the vicugna (Wheeler 1991).

There are four species of SACs. The Guanaco (Lama guanicoe) and the Vicuña (Vicugna vicugna), are wild species. Whereas the llama (Lama glama) and the alpaca (Vicugna pacos) are their domesticated relatives (Gauly et al. 2011).
Both genera, lama and vicugna, have the same chromosome set of 2n = 74. Crossings between the four SACs are possible, and all offsprings are fertile (Gauly et al. 2011).

2.2 Habitat of South American Camelids

SACs are distributed from 8 degrees latitude South (Calipuy guanaco reserve, Peru) to 55 degrees latitude south (Navarino Island, Chile) and live in altitudes up to 5,000 meters above sea level and more (Fernandez-Baca 1994).

The main natural habitat of SACs are the Andes which is a high mountain range along the western border of South America. Geological activity in the Andes formed a relatively flat plateau with occasional mountain chains averaging 6,000 masl and rising above this plateau. The actual habitat of SACs is the Puna. Puna refers to the intermediate zone of the Andes which ranges from 3,700 masl to 4,800 masl. It has a slightly hilly landscape which is characterised by bunch grasses and low herbs (Camino and Sumar 1992).

In the Puna two climatic seasons occur. The mild and rainy season from December to April forms the main growing period, with 80% of the rainfall occurring at that time of the year. May to November forms the cold and dry period when the remaining 20% of the precipitation falls in form of hail and snow. The annual precipitation is between 250mm and 900mm (Camino and Sumar 1992).

The daily variation of temperature is high and can vary by more than 30°C (Camino and Sumar 1992).
Due to climatic and geographic conditions and the low organic content of the soil, Andean vegetation is mainly grassland. Little or no agriculture can be found in this zone (Sumar and Camino 1992).

2.3 Domestication

The domestication of alpacas and llamas took place approx. 6000 years ago in the Puna of Peru. Llamas and alpacas were found everywhere in Peru including the coastal regions (Fernandez-Baca 2005).The oldest traceable centre of domestication is the Pampas region near lake Junin in the central Peruvian rangelands (Gauly et al. 2011).
In 1532 the Spanish conquerors brought their livestock and used pastures near the coast and in the Andean valleys, because their European livestock like sheep, cattle and horses could not cope with the high altitude (Wheeler 1988b, Flores 1982 in Wheeler 1991).
Therefore, the Spanish pushed llamas and alpacas up to more inhospitable regions, because they needed adequate pasture for their livestock. Due to their high adaptability, llamas and alpacas cope easily with the new circumstances (Fernandez-Baca 2005).

2.4 General biological characteristics of SAC

- The stomach of SACs has three compartments. Consequently the system of digestion is similar to ruminants. However, they are regarded as pseudo-ruminants. Their digestive system is more efficient at extracting protein and energy from poor-quality forages compared to the system used by ruminants (4 stomachs) (Sumar and Camino 1992).

- Camelids are bump-footed. This adaptation works like a sensitive cushion. Therefore, SACs are extremely step-safe and can cross dangerous mountainous areas. A positive side-effect is the prevention of soil compaction (Sumar and Camino 1992).

- SACs have an induced ovulation by mating. The pregnancy period is 345 days and birth takes place only on sunny days during full daylight. Unlike e.g. sheep or cattle, llamas do not dry their offspring by licking. Therefore favourable ambient temperatures are essential for the new born llamas. Probably, daylight parturition is an adaptation to avoid birthing during the cold night time temperatures of high altitude regions (Sumar and Camino 1992).

- Camelids have split upper lips so they can select leaves from horny parts of forages (Sumar and Camino 1992).

- Due to its elliptical shape, the haemoglobin of SACs has a high affinity to oxygen. Accordingly, the oxygen carrying capacity of the blood increases. SACs have a great number of tiny red blood cells (microcytosis) with elliptical shape. Microcytosis is an advantage at high altitudes in relation to an increased oxygenation rate in the red blood cells. It should be pointed out, however, that microcytosis is not a specific adaptation to high altitudes since it also occurs in low altitude desert camels in Africa (Sumar and Camino 1992).

- The fine and thick fibre of SACs protects against heat, intense solar radiation at high altitudes and temperatures below zero, which occur almost every night throughout the year (Sumar and Camino 1992).

- SACs have defined areas, called Latrines, where they urinate and defecate. Due to this behaviour, SACs have a lower risk for parasitic infestations, because parasitic cycles are interrupted (Sumar and Camino 1992).

- When threatened, SACs are apt to spit or kick. As a result, herding with dogs is not possible as SACs would attack the dogs (Sumar and Camino1992).

2.5 Species of SACs

There are four different species of SACs found, namely guanaco, vicuña, alpaca and llama. In the following, a brief description of each species is provided.

2.5.1 Guanaco (Lama guanicoe)

The guanaco is the tallest wild SAC and the ancestor of the domesticated llama (Wheeler 1995b).
Among the SACs, its distribution is the most widespread. The main populations are found in Argentina and Chile.
The coat colour of guanacos ranges from a reddish dark brown to a light brown or beige. Its maximum life expectation is 30 years (Wheeler 1995b).
The average weight of a guanaco is 120 kg and the average shoulder height is 110-115 cm (FAO 1996).

The main threat to guanacos is commercial hunting. Sheep farmers in Chile and Argentina defend their pastures against guanacos that compete with sheep over pastures and water. Moreover it is believed that guanacos transmit diseases (FAO 1997).

2.5.2 Vicuña (Vicugna vicugna)

The vicuña is the smallest species of the SACs and the ancestor of the alpaca (Kadwell et al. 2001).

In 1969, it was near to extinction. Since 1972, it has the status of an endangered species (Fernandez-Baca 2005).

The vicuña was hunted for its fine fleece, and is still famous for it. Peru, Bolivia, Argentina and Chile share the main vicuña populations of South America (Laker 2004).

The average shoulder height of a vicuña is 80-96 cm and its weight is between 35 and 55 kg (FAO 1996).

Vicuñas have a typical coat colour of cinnamon brown to beige. There are two types of vicuñas, one with white fibre on chest, belly and inner face of the flanks and one without (Wheeler 1991).

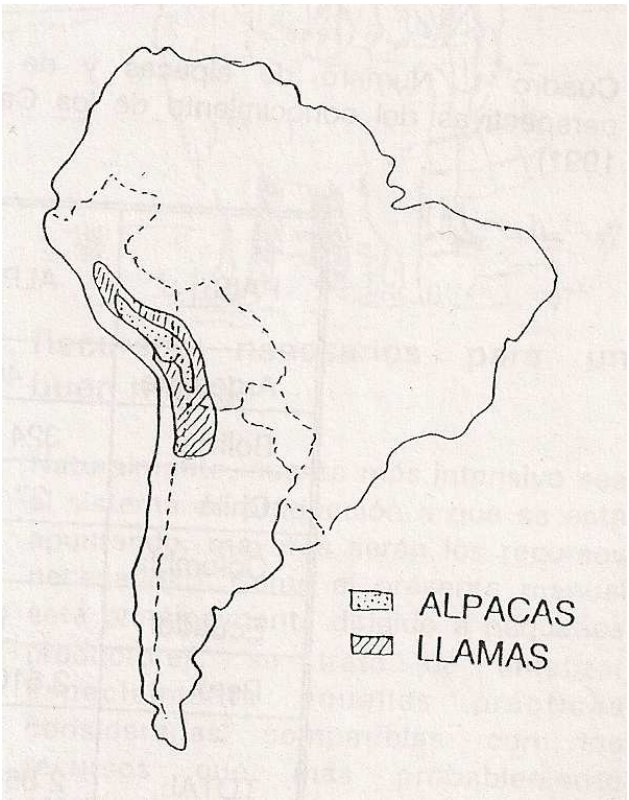

Figure 1: Distribution of llamas and alpacas in South America (Ponzoni 1996)

2.5.3 Alpaca (Vicugna paco)

Peru hosts the majority of the alpaca population in South America. Its fine fibre has a high value at the world market (Fernandez-Baca 2005).
Alpacas weigh 50 to 60 kg on average and their height at withers is between 80 and 90 cm (Sumar and Camino 1992). The colours of alpacas range from white to black with all possible shades (Wheeler 1995b).
There are two types of alpacas: Suri and Huacaya. They are distinguished primarily by their phenotypic characteristics. The Suri alpaca has long fibre skeins which hang down from the body. The Huacaya type has shorter fibre with a stronger crimp that makes the animal look more voluminous (Fernandez-Baca 2005).
90% of alpacas are Huacayas, because they are more resistant to the specific climatic conditions (Wheeler 1995b).
The world market has a huge demand for white alpaca fibre, which is the reason for the intense selection of white coloured animals, especially in Peru (Fernandez-Baca 2005, Fernandez-Baca 1994).

2.5.4 Llama (Lama glama)

The llama is the largest SAC (Fernandez-Baca 2005). Llamas weigh between 95 and 125 kg (Solis 2001). However, Paca (1977 in Wurzinger et al. 2005) pointed out that Peruvian llama males at the age of 5 can reach 152 kg of bodyweight and females 150 kg.

Llamas (and alpacas) do not show phenotypic uniformity. As a result, there are no breeds; instead, there are types (Wheeler et al. 1995a).
The types are distinguished by their fibre distribution on the body (Nürnberg 2005).
Nevertheless, the definition of the llama types varies regionally (Wheeler et al. 1995a).
The K'ara (or Pelada, K'cara) has no fibre on its face, neck or legs, only hair. It has a double-coat with short fine fibre and long coarse fibre (Chávez 1991, Sumar and Camino 1992). A clear differentiation between undercoat and outer coat is possible. The undercoat has a fine and short fibre with an average diameter of 25 microns, whereas the outer coat is a layer of thick, long and coarse fibre with an average diameter of 87 microns (Iñiguez et al. 1998, Sumar and Camino 1992). It has major body strength, higher bodyweight and less fibre than the Lanuda type (Fernandez-Baca 2005). The K'ara type represents 80% of the llama population in Peru and Bolivia and is mainly raised for meat production and transport (Sumar and Camino 1992, Nürnberg 2005).
The Lanuda (or Chaku, Tapada, Thampulli) type has a major amount of fibre all over the body, including extremities, neck and ears. It has a considerable amount of medium fine wool and

just a little bit of coarse fibre (Chávez 1991). This type is mainly used for fibre production (Nürnberg 2005).
Intermediates between K'ara and Lanuda exist. Generally, they show less coarse fibre than Peladas and have a regular amount of wool with acceptable fineness (Chávez 1991). It is considered that around 20% of the llama population in the Andes are intermediates (Sumar and Camino 1992).

The height at withers of llamas is 110-120 cm (Solis 2001). Cardozo and Choque (1987 in Wurzinger et al. 2005) reported different heights at withers with K'aras having a height at withers of 99 cm and Lanudas of 95 cm. In contrast, Parra (1999) and Sumar (1991) (in Wurzinger et al. 2005) reported similar heights at withers of K'aras and Lanudas. However, K'aras raised in Europe show a height at withers of 110-125 cm and Thampulis up to 120 cm (Hiendleder and Kessler 2002 in Wurzinger et al. 2005).

The Peruvian llama population amounts to approximately 1,082,213 heads (CONACS 2000 in Brack 2003). Peru has the second largest llama population in South America, with Bolivia ranking first (FAO 2005).

Table 1: Llama population in Peru (CONACS 2000 in Brack Egg 2003)

Department	Number of llamas
Ancash	1,566
Apurímac	30,115
Arequipa	101,927
Ayacucho	110,908
Cusco	178,000
Huancavelica	122,000
Huánuco	6,459
Junín	40,400
Lima	20,762
Pasco	43,132
Puno	409,630
Tacna	17,314
Total	1,082,213

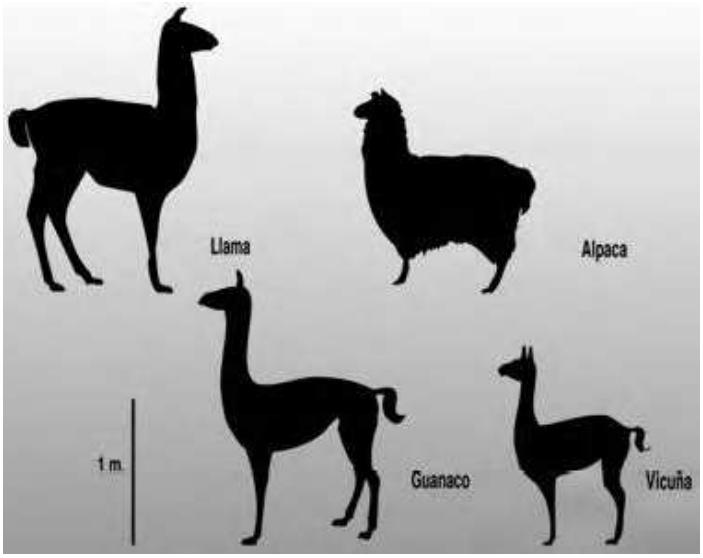

Figure 2: Silhouette of the four South American Camelids (Miller S. and Rottmann J. 1975)

2.6 Llama products

Animals of Andean smallholder communities contribute to the economic and social life of their owners. They provide a lot of products and uses like food, fibre, dung as fuel and fertilizer, means of transport, cultural use and capital functions (Sumar 1988, Flores and MacQuarrie 1995, Camino and Sumar 2000, Nürnberg 2005 in Markemann and Valle Zarate 2009).

2.6.1 Meat

Since prehistorical times, meat production and consumption has played an important role in Andean regions/ communities (Fernandez-Baca 2005).

Exact statistical numbers of llamas slaughtered per year do not exist. A high number of llamas is not slaughtered in a slaughterhouse. Therefore, they are not officially counted (Fernandez-Baca 2005).
10-15% of the Peruvian llama population is slaughtered annually. The majority of llamas destined for meat production are males of different age (Vilca 1991).
37% of the farmers slaughter males between 3 and 4 years for the market, 30% slaughter males more than 5 years for the market, 20% sell their young animals generally at hoof and 13% slaughter their old llama females (Iñiguez et al. 1997).

Meat composition and fattening

The meat composition of llamas is comparable with other herbivores like cattle. Nevertheless, llama meat has a lower cholesterol-content. The proportion of the components varies during aging (Vilca 1991). Meat of non-castrated males may have a more intense smell and taste (Fernandez-Baca 2005) compared to castrated llamas, the meat of which is also more tender (Alvarez 1986 in Vilca 1991).

Table 2: Meat composition of different livestock types

	Llama	Alpaca	Beef	Pork	Lamb	Chicken
Humidity (%)	73.9	73.6	71.5	70	73.0	75.0
Protein (%)	23.1	23.3	21.0	19.5	20.0	21.5
Fat (%)	0.5-3.5	0.5-1.1	4.8	10	5.5	4.7
Ash (%)	2.4	2.5	1.0	1.4	1.4	1.0
Cholesterol (mg/100g)	56.3	51.1	99.0	93.0	75	81.0

(Calle 1984, Cristofanelli et al. 2004, Cristofanelli 2005, Polidori et al. 2008, Polidori et al. 2007, Salva et al. 2009, Scherz and Senser 1989, Varnam and Sutherland 1995 in Gauly 2011)

Llamas increase body weight until 8 years of age and from 13 years on, body weight starts to decrease (Cardozo and Martinez 1981 in Vilca 1991). Nevertheless protein content reaches its maximum at four years of age and starts to decrease at an age of five years, whereas fat content increases (Vilca 1991). However, the average protein content of llama meat is 23.1 percent and fat percentage is 0.5-3.5 as given in Table 2 (Gauly 2011).

Up to 12 months of age, there is no significant difference between body weight in males and females. From 18 months onwards, males and castrates have higher body weights compared to females. There is no difference in body weight between non-castrated males and castrates (Vilca 1991).

Superior environment conditions as well as better technology in llama husbandry correlate with a higher body weight (Bryant et al. 1989, Bustinza et al. 1985 in Vilca 1991).

The dressing percentage of 57% is relatively high in llamas (Fernandez-Baca 2005).

Slaughter

There are two types of slaughtering: “saca mayor - main slaughtering” and “saca forzada - forced slaughtering” (Vilca 1991).

The main slaughtering season is between March and July. In this period, animals show the best body condition. It is the end of the wet season and the start of the dry season with poor pastures. In this period, supply is greater than demand. Superior animals are sold on hoof at a

higher price, whereas the rest is slaughtered and the meat sold as fresh or dried meat (Vilca 1991).
Forced slaughtering is practiced during the rest of the year when livestock farmers are confronted with family needs or social commitments (Vilca 1991) such as e.g. weddings, medical care, school fees or religious festivities (Camino and Sumar 1992).

Almost all farmers slaughter their animals at their farmyards under insecure low hygienic conditions (Vilca 1991).

Specific slaughterhouses for SACs do not exist in Peru. Therefore, slaughterhouses are used for all different species. Llamas and alpacas slaughtered in slaughterhouses are more likely to be found in regions with a high SAC population. Provinces like Puno, Huancavelica, Apurímac or Cuzco have the highest demand for SAC meat (Fernandez-Baca 2005). Hygienic conditions of Peruvian slaughterhouses vary from one place to another. However, they are generally acceptable and provide veterinary inspection services (Fernandez-Baca 2005).

Classification of carcass

Classification of carcass quality is important for determining the price of the meat. There are rules for classification of SAC carcasses. In Bolivia there are four general categories: extra, first, second and industrial. Nevertheless the main camelid slaughterhouses classify carcasses mainly by the level of sarcocystis infestation and to a lesser degree by weight. No attention is paid to factors like muscle formation and fat coverage (Condori et al. 2008).
Classification of carcasses usually does not take place and meat is sold only as fresh meat (Min. Agricultura Perú 1973 in Vilca 1991).

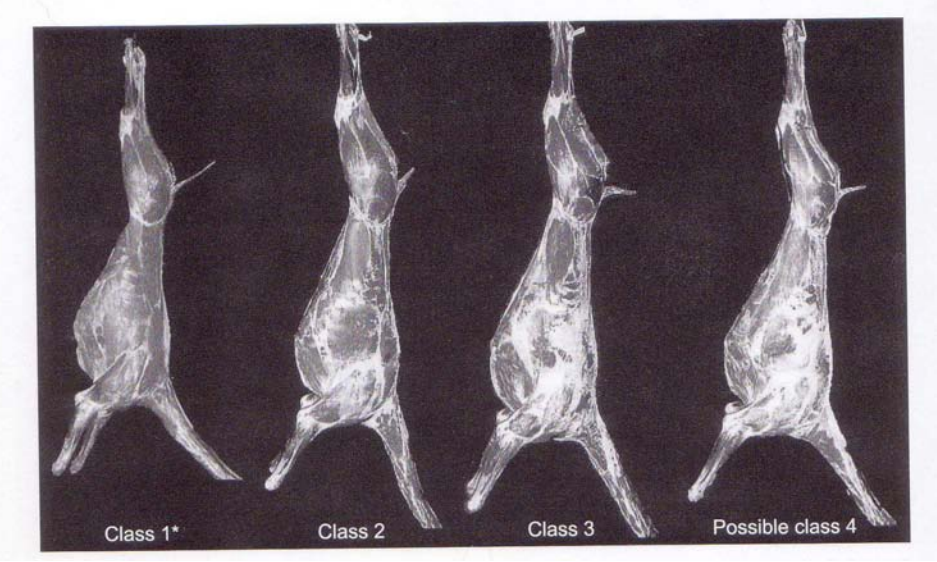

Figure 3: Carcass of llama classified by coverage of fat * carcass of alpaca (Condori et al. 2008)

Meat products

The following chapter describes commercialised products of llama meat.

Fresh meat

The consumption of fresh meat of SACs is limited in urban areas. It is more common in cities within the production zones of llamas and in sectors with a low monetary income. In general, the meat price for llama meat is half of the price for cattle or sheep (Fernandez-Baca 2005).

Dry meat

Dry meat, which is called charqui or chalona, is mainly produced by small-scale farmers. It is extraordinarily suitable for conservation, storage and transport (Vilca 1991).
Llama meat without bones is used for the production of charqui (Yépez 1988 in Vilca 1991). Llama meat including bones, sheep meat and condiments like paprika, vinegar and other spices is used for the production of chalona (Fernández 1970, Annick 1985 in Vilca 1991).
The yield of charqui is between 25-46% per kilo fresh meat (Vilca 1991).

Production takes place from May through August, the coldest and driest period of the year in the Andes (Jeri 1988 in Vilca 1991).
Technical steps to produce charqui are:

- Rolling out the meat
- Dredging the meat with granulated salt
- Natural drying

There is a huge variety of techniques. However, the most common process is salting, direct drying in the sun and safekeeping of the meat during night. The duration of drying ranges from 10 to 25 days (Vilca 1991).

83% of charqui is made of llama meat and only 17% of alpaca meat (Jeri 1988 in Vilca 1991). It is reported that farmers sometimes use meat of naturally deceased animals to produce dry meat (Sotomayor 1988; PAL 1988 in Vilca 1991).
Generally, the production of dried SAC meat is based on simple traditional technologies, resulting in poor quality (Jiménez 1988 in Vilca 1991). However, dried meat which is dedicated for high-end markets has a superior product quality (Vilca 1991).

Regarding charqui or chalona, approx. 30% is used for subsistence consumption and 70% for the domestic market (Vilca 1991).

Sausages

Processing sausages from SAC meat has not reached a huge dimension until now. Nevertheless, there is a potential for this kind of product. If animals with tender meat and high carcass qualities are used, there is a possibility for a huge market (Fernandez-Baca 2005).

Sarcocystosis

Sarcocystosis causes great economic damages to the commercialisation of SAC meat (Fernandez-Baca 2005). At present, no treatment is available for this disease (Sumar and Camino 1991.)

Sarcocystosis is caused by a coccidial protozoon (Sumar and Camino 1991). Three species of sarcocystis are known. However, llamas are only affected by sarcocystis aucheniae. It produces macroscopic cysts which grow in the musculature. Colloquially, it is called “triquina” or “arrocillo” (arroz = rice). It is a toxic zoonosis. If infected meat is ingested raw or insufficiently cooked, nauseas, diarrhoea, colic and ague may occur (Leguía 1991).

Sarcocystosis has an indirect life cycle of a predator-prey type. Dogs or wild carnivores are infected by feeding on raw meat. In their digestion system the cysts reproduce sexually and are excreted with the faeces as oocystes. Then SACs feed on forage or water contaminate with sarcocysts. It needs three generations of sarcocystes in a llama to affect the muscles. The first two generations affect the vasculature of almost all organs and then the third generation affects the musculature of llamas (Leguía 1991). For a better understanding, the life cycle of sarcocystosis is shown in the figure below.

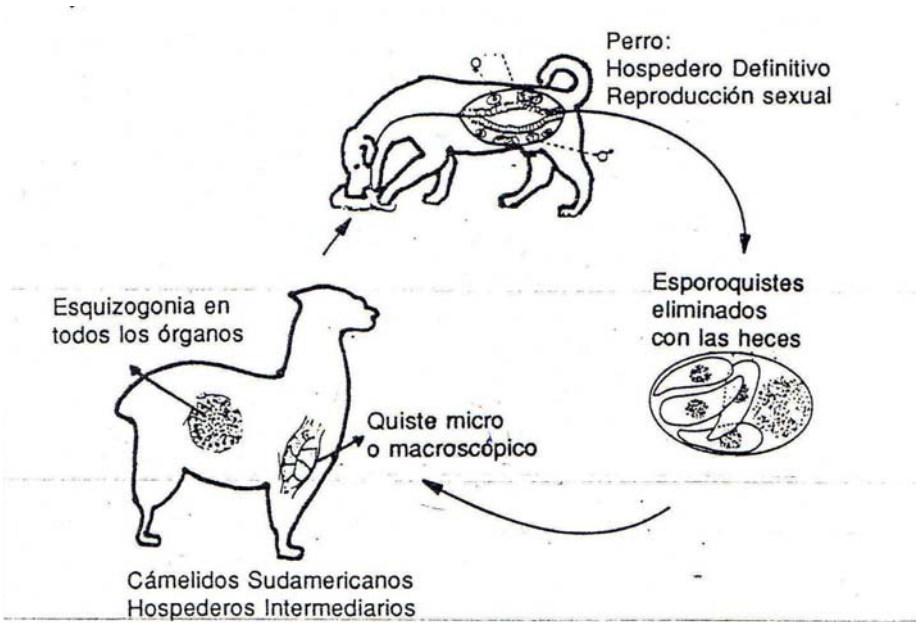

Figure 4: Life cycle of sarcocystosis (Leguía 1991)

In general, the incidence of sarcocystosis is lower in young animals. However, there are places, where farmers report a very low incidence of sarcocystosis and others where incidences are very high (Iñiguez et al. 1997).

Records of a Bolivian slaughterhouse, where all carcasses are examined by a veterinarian, show that approx. 90% of slaughtered llama carcasses had different levels of sarcocystes infestations (Iñiguez et al. 1997).

Meat markets

All llama farmers use parts of their slaughtered animals for subsistence consumption. The amount of commercialised llama meat varies in every region due to access to markets, level of commercial development and demand of the product (Iñiguez et al. 1997).

Slaughtering and selling of SAC meat is done under poor hygienic conditions and without any sanitary control (Ibarra et al. 1975; Alvarez 1986; Montoya 1988; Téllez 1988 in Vilca 1991). These are some of the factors accounting for the bad reputation, the low value and the limited consumption of llama meat (Vilca 1991).

There are several retail routes for selling llama meat directly. Usually, there are many intermediary traders between producer and consumer (Vilca 1991).
Llama meat prices are low and individual offers correspond with minor quantities. Therefore, farmers are not in a position to influence the meat price (PAL 1988 in Vilca 1991).

2.6.2 Fibre and Hide

It is a popular belief that llama fibre is coarse, stiff, bristly and only good enough for the production of woollen blankets or rugs. On the contrary, alpaca fibre is associated with fine, high quality products. Due to their double-coat, llamas have fine and coarse fibres. The fine fibre can be obtained after manual or mechanical dehairing. This process is routine in cashmere-production and in minor scale fibre production of camels and yaks (Delgado 2003).
Llama fibre is mainly used for internal use by llama farmers, for blanket production and, to a minor extent, for export (Solis 2001).
40% of the llama fibre is used for handicrafts and industry and 60% for auto-consumption (Fernandez-Baca 2005).

The average fibre diameter in Lanudas is 25.6-27.6 µm and in K'aras 29.2-30.7 µm (Chávez 1991).

The average fleece weight varies between 0.9 and 1.5 kg per animal/year (Delgado 2003).
The fleece colour and fibre quality of llamas shows no uniformity, as it has never been a breeding goal (Wheeler et al 1995a).

The skin of llamas has a very uneven structure. The back part is thick and tight in contrast to the skin of the side parts, belly and base of the neck, which is relatively thin. The surface of the skin is fine pored, but due to scars resulting from injuries, parasites or cuts during skin-removing the value of hides is fairly poor. Llama hides are thinner than cattle hides, but have huge tear strength (Gauly et al. 2011).

The hide of adult llamas is generally commercialized at trade fairs because of the fibre on the hide, the hide proper having almost no value (Ticona 1993).
Llama skin is often used to cover the floor in the farmers' houses. If the skin shows any defects, it is mostly burnt (Ticona 1993).

Hides of young animals are sold to tanneries on trade fairs. Major companies of leather and fur production require salted skins without any damage. Due to poor conservation, prices for such hides are low. They vary between 2 to 5 US$ per skin for tanning and 3 to 7 US$ for fur production, depending on size, quality and colour uniformity of the skins. Higher prices may be reached when farmers provide for appropriate conservation of the skins (Ticona 1993).

2.6.3 Transport

Llamas are efficient pack animals transporting food and trade goods for periods of several days to several months. Depending on the duration of the transports, group sizes range from 10 to 100 llamas (Iñiguez and Alem 1996 in Nürnberg 2005).
It is possible to handle a whole caravan with one or two persons. The animals are fed by natural fodder and wild grasses on their way, so there is no need to carry food for the animals (Sumar and Camino 1992).
The carrying capacity per animal amounts to 15-17% of its life weight, which corresponds to 20-25 kilos plus saddle weight (Gauly et al. 2011)
Llamas can walk 8-10 hours per day, covering a distance of +/- 20 km. In general, castrated llama males are used for transport. Males are castrated at the age of 3 and are used as pack animals for about 6-8 years (Iñiguez and Alem 1996 in Nürnberg 2005).
Llama caravans are used to carry non-perishables like grain, potatoes, fibre, handicrafts or preserved food. The mining industry used to be a major beneficiary for transporting minerals with llamas (Sumar and Camino 1992).

Transporting goods with llamas is a good energy-saving alternative to motor vehicles, especially on steep and winding roads. During the oil crisis in 1968 the fuel prices went up extremely and llama caravans were used in certain regions of the Andes and gained temporary popularity (Sumar and Camino 1992).

In Europe and the USA, llamas are used as pack animals for trekking tours, so as to contribute to sustainable tourism (Gauly et al. 2011).

2.6.4 Dung

Llama and alpaca dung is essentially used as fertilizers in agriculture or as fuel for cooking, especially because firewood is scarce in high altitudes and other sources of fuel are expensive (Camino and Sumar 1992).
The dung of SACs provides more heat per unit of dry-weight than sheep dung (Orlove 1980 in Nürnberg 2005).

Almost all crops in the highlands, mainly potato, depend on llama or alpaca manure. Due to the high altitudes, the dung decomposes slowly and therefore fertilizes the soil step-by-step (Camino and Sumar 1992).
Grazing animals disperse dung either directly on fallow land or the dung is collected manually and dispersed before ploughing (Novoa and Wilson 1992, Camino and Sumar 2000 in Nürnberg 2005).

2.6.5 Cultural use and capital reserve

SACs have always been important for religious festivals, sacrifices and social meetings. They serve as traditional symbols of wealth and communication between the spiritual world and humans (Sumar and Camino 1992).

Camelid lard plays an important role in religious rituals. The foetuses of camelids are used for fertility rites. Bezoars - stone formations in the SAC digestive system - are considered to be amulets with magical power (Sumar and Camino 1992).
It is believed that SACs are loans given from pachamama, the goddess Mother Earth, and that the future of human beings depends on a decent conservation of the herds. The SACs are said to originate from the underworld, emerging from water springs. According to widespread belief, the end of the world is near when alpacas diminish, they return to these sacred springs (Sumar and Camino 1992).

Llamas and alpacas are often seen as mobile rural capital which can be transformed into cash in times of need (Sumar and Camino 1992).

2.7 Production systems

At 3800-4000 masl llama and alpaca husbandry is combined with other livestock farming and agriculture. Above 4,000 masl SAC husbandry is predominant (Fernandez-Baca 2005).

Less than 1.5 million people in the high Andean region in Peru breed SACs. The main production areas of SACs include provinces where many families live in poverty (De Los Rios 2006 in Quispe et al. 2009).
Most farmers who keep llamas or alpacas live in extreme poverty. Their per capita income is one of the lowest in Peru (Fernandez-Baca 2005).

Table 3: Distribution of llamas and alpacas due to land size per farmer (Fernandez-Baca 2005 modified)

	Total	< 3 ha	3-10 ha	10-50 ha	> 50 ha
Llama (000)	977	405	175	159	238
Llama %		41.5	17.9	16.3	24.4
Alpaca (000)	2381	796	248	354	983
Alpaca %		33.4	10.4	14.9	41.3
Pastures (000)	15950	85	341	829	14695

76% of the Peruvian llama population is kept in agricultural property sizes of less than 50 ha. 41.5% of llamas are found in agricultural units of less than 3 ha and are kept on only 0.5% of the total available pasture. This fact implies that there is a high stocking rate per hectare. The consequences are overgrazing followed by erosion, degradation of land and insufficient availability of food, which gives rise to higher mortality rates of offspring and delay of growth. Final consequences are low productivity, low profitability and the risk of sustainability in this production system (Fernandez-Baca 2005).

A survey in 1982 detected that 90% of the Peruvian llama population is owned by “rural communities”, “parcialidades” and smallholders. 6% are owned by medium scale farms and only 4% are found in agricultural cooperatives and agricultural enterprises (Bustinza 1990 in Guadalupe 1994). However, there is no exact data available on land size of small-scale, medium-scale farms and cooperatives.

2.7.1 Communities and Smallholders

Llamas are mainly kept in one herd without any separation of species, breed or sex.
Herds are often mixed with alpacas, sheep and cattle. In most cases no precaution for disease-control exists. Moreover, unlike well managed farms, a calendar for defined livestock work, like shearing, antiparasitic treatment and pasture management does not exist (Fernandez-Baca 2005).

In Peru more than 90% of the land which is owned by communities is native rangeland (Gilles and Jamtgaard 1988 in Mocaër 2006).
The land is the property of the communities and the animals are owned privately. There is a tendency to own more animals than the capacity of the pasture tolerates. Consequences are overgrazing and degradation of land (Fernandez-Baca 2005).

The state guarantees the right of land property for communities. Communities have the autonomy for the use and free disposal of their lands (Montúfar 2002). The community is responsible for the management of the land and the natural resources (Quezada 2003 in Mocaër 2006). In most cases farmers can only lease land from the communities.
Due to the effect that the land is owned by communities, farmers are not encouraged to put capital into their business (Recharte et al. 2003).

2.7.2 Medium scale farms

In this sector, farmers have an entrepreneurial approach. They practice livestock management and provide acceptable sanitary practices. In most cases these farmers are progressive, invest in new technology and are hungry for knowledge. Their production performance is above average (Fernandez-Baca 2005).

2.7.3 Agricultural cooperatives and enterprises

Generally spoken, cooperatives and enterprises have the same technological level as medium scale farms. Animal classification due to age and sex, and sometimes type too, exists. They follow a work-calendar throughout the year and have more developed handling practices like mechanical shearing, rotational pasture management and controlled mating. For the commercialisation of SAC products, this sector has better possibilities for negotiations due to its higher production volume. It has the major potential for producing quality meat for internal and external markets (Fernandez-Baca 2005).

2.8 Llama Herd Management

Llamas and alpacas are an essential part of the traditional Andean management system. The llama is important for many farmers in the high Andean regions, although its full production potential is not utilized (Iñiguez et al. 1997 in Nürnberg 2005). Due to traditional management, which is not based on advanced techniques, production performance is low (León-Velarde et al. 2000 in Nürnberg 2005). The extreme environmental conditions are the most important limiting factor of production (Novoa and Wilson 1992 in Nürnberg 2005).

The following chapter provides an overview of the general llama herd management in South America.

2.8.1 Herding and herd structure

In production systems where llamas have no importance as pack-animals anymore, llama males, breeding females and young llamas are often kept in one single flock (Iñiguez et al. 1997 in Nürnberg 2005). Nevertheless, systems exist where males are kept separate at remote locations and are taken back to females for mating from January to March (Rodriguez and Quispe 2007 in Quispe 2009).
Depending on the available land and time of farmers, livestock is kept separately by species. Otherwise, llamas and alpacas are kept together (Llanque 1993 in Nürnberg 2005) but mixed herds of llamas and sheep have been reported by Panama 1995 and Marca 1996, too (in Nürnberg 2005).

Llamas are fed exclusively on natural pasture. Native plants are well adapted to the extreme climatic conditions of the high Andes. However, the production potential of the pasture is low and during the dry season food shortage may occur in terms of quantity and quality (Alzérreca 1992 in Nürnberg 2005).
An extensive rotational pasture system is practiced where llamas range freely on native grassland (Delgado 2003). Markemann and Valle Zarate (2009) report that llamas are rarely herded in contrast to sheep. They graze freely during the day and return instinctively to their corals at night.

During the cold and dry Andean winter herders take their animals to watered pastures called bofedales. During the rainy season when other grassland is abundant and productive, bofedales are not used (Camino and Sumar 1992, Delgado 2003).
At night, flocks are kept in roofless corals. In the early morning, the animals are released for grazing (Camino and Sumar 1992).

Until the 1960s, a high rate of up to 50 % of males in the herd was observed due to the great importance of castrated llamas as pack animals.
In general, a herd includes 50 % females, 20% offspring and yearlings and 30% males and castrates. A low number of adult females, and consequently, a small proportion of foals was observed by Rodríguez and Cardozo (1989) in Bolivia. Moreover, farmers often keep infertile females in the herd as well (Nürnberg 2005).

2.8.2 Water supply

The wet season, which lasts for 3-4 months, is the natural limiting factor for the water supply of peasant families and livestock. During the dry season, natural water sources decline drastically and sometimes cease to exist. Consequently, animals need to cross large distances to search for water. Therefore, their production capacity decreases because energy is wasted on movement (Flores and Egoávil 2006).

2.8.3 Reproductive performance of llamas

According to Novoa (1986) the female productive life is between 10 and 12 years. Nevertheless, Nuevo-Freire (1994 in Graziotti et al. 2001 in Markemann and Valle Zarate 2009) report a productive life of 8 to 10 years.

A young llama female should weigh at least 60% of its adult weight at first mating. If the weight of 70 kg is reached at one year's age, there is no need to wait any longer for mating. Poor nutritional and sanitary conditions result in a delay of puberty, which, in turn, postpones the age of reproduction (Ponzoni 1996).
In the harsh Andean environment, the general practice is to start using female llamas and alpacas as breeding animals at the age of two. On adequate pasture, the age at first mating could be decreased to one year (Bryant et al. 1989).
On average, every farmer owns 30 females but only 60% are in reproductive age. Embryonic losses and abortion are high in llamas (Wurzinger et al. 2008). Novoa (1991 in Wurzinger et al. 2008) suppose that embryonic losses and abortions of 19 % are common.

Males start producing fertile semen at one year of age. However, at this age males have a natural foreskin adhesion, which keeps 90% of males from copulating. 70% of males at the age of two are able to mate because their penis is already released (Sumar 1996, Ponzoni 1996). At the age of 3, nearly 100% have no foreskin adhesion (Ponzoni 1996). The general practice is to use males for reproduction at 3 years of age (Sumar 1985a in Sumar 1996). If males are supposed to be used earlier, special attention should be paid to the absence of foreskin adhesion (Ponzoni 1996).

A healthy male is able to copulate with 5 to 6 females per day. It is recommended to have 6-10% males of the number of females. If breeding males are handled well they can be used for 4 years, but measures should be taken to avoid inbreeding (Ponzoni 1996).
The average productive life of breeding males is 3.7 years but ranges from 1 to 10 years (Markemann and Valle Zarate 2009).

2.8.4 Mating systems

Mating systems used by llama farmers are explained in the following chapter.

Continuous mating

One or two llama males are kept with all females all year round in the herd. Males which are not destined for mating are castrated, sold or slaughtered. Those selected for mating stay in the herd as males for reproduction. This method is frequently used in “comunidades campesinas” communities with a small herd size (Ponzoni 1996).

The main advantage of this method is its simplicity. It requires only little organisational efforts and labour. However this method also has a lot of disadvantages (Ponzoni 1996):

- Males may mate young receptive females which have not yet reached their minimum weight to ensure an unproblematic gestation (Ponzoni 1996).
- Females which recently gave birth show the male that they are receptive again. Nevertheless, females are not receptive until 10 to 12 days after giving birth. If mating occurs before that time, it may interfere the recovery process of the females’ uterus (Ponzoni 1996, Smith et al. 1994 in Gauly et al. 2011).
- Sexual interest of aggressive males during birth may lead to shocks for the newborn animals and their mothers (Ponzoni 1996).

Birth rates of llamas per year are between 40 and 50% at the continuous mating system (Ponzoni 1996).

Individually controlled mating

This method brings a female together with a male in an appropriate site for mating. It implicates that males and females are separated during the remaining time and come into contact with each other just for mating. It allows the farmer to keep reproductive records of every female and to plan births. Losses and inefficiencies can be detected as well as the approximate due day (Ponzoni 1996).

This system of mating reaches birth rates per year between 70 to 85% (Ponzoni 1996).

Controlled on field

A group of females is brought together with one or more males on a suitable grazing site. Males and females can interact naturally. Males mate females at their most receptive moment. Consequently, unlike individually controlled matings, there is less forced mating of submissive but not receptive females. The advantage of this method is that the animals do not have to be individually handled. However, it is not possible to keep records which female has been mated by which male (Ponzoni 1996).

A rotation of males is practiced to avoid a sexual disinterest which is observed when males are permanently exposed to females (Ponzoni 1996). In this system birth rates of 60 to 80% can be reached (Ponzoni 1996).

2.8.5 Weaning

Most farmers do not favour artificial weaning. Offspring remain with their mothers until they reject them. Sometimes a mother can be seen with her newly born offspring and the last year's offspring, both still suckling. This leads to a poor development of the newly born animal and a low reproductive performance of the female. For good herd management, weaning is essential. Young llamas can be weaned at 6 months. Mothers then have enough time to recover before the next birth takes place (Ponzoni 1996).

2.8.6 Breeding

A way to improve animal production in developing countries is breeding. It makes sense to adjust breeding strategies to actual situations and adapt breeding programmes to environmental conditions (Valle 1995 in Nürnberg 2005).

Selection of llamas

According to Iñiguez et al. (1997) and Rodríguez and Cardozo (1989), llama keeping smallholders generally do not practice breeding or selective mating.
In contrast, Nürnberg (2005) notes that the main selection criteria of Bolivian llama farmers in the Ayopaya region are: fibre quality and colour uniformity, body conformation and body condition, mating behaviour and health. Male llamas for breeding are selected by the criteria mentioned above. Males with genetic defects like blue eyes (sarco) or short ears are excluded. Farmers usually replace breeding males within their own herd (Nürnberg 2005).

Rojas (1995 in Nürnberg 2005) stated that libido, body condition, fibre parameters, absence of genetic defects and a different fleece colour which makes it easier to recognize offspring of breeding males, are selection criteria for llama farmers in Bolivia.
In llamas, a single-coloured fleece is preferred over spotted ones. Only in few cases specific colours are preferred (Markemann 2009).
Delgado (2003) found out that approximately 78% of llamas have a uniform colour and 22% are spotted.

Table 4: Coat colours and their percentage in the two types of Peruvian llamas (Camino and Sumar 1992)

Types	Kara	Chaku
Colour		
Brown	24	28
Black	1	3
White	32	38
Grey	9.5	8.5
Roan	---	---
Multi-coloured	33.5	22.5
	100	100

The overall preference are single-coloured animals. However some individuals or individual groups prefer spotted llamas (Markemann 2009).

Nürnberg (2005) pointed out that nearly no selection takes place in females although farmers have selection criteria for females but do not seem to apply them (Nürnberg 2005).
Due to the retention of the herd size and the lack of knowledge about appropriate female selection criteria, selection within females is generally not applied (Markemann and Valle Zarate 2009).
Panama 1995 and Rojas 1995 (in Nürnberg 2005) pointed out that the selection criteria for females are mainly size and fleece-colour.

In general, reasons for culling females are age, sterility and meat demand for home consumption (Markemann and Valle Zarate 2009).
Females older than 6 years are culled but if e.g. mortality rates are high, few or even no breeding females are slaughtered (Panama 1995 and Rojas 1995 in Nürnberg 2005).

2.8.7 Diseases

Bolivian llama keepers suffer great losses through endo- and ectoparasitic diseases (Colque 1995, Medrano 1995, Panamá 1995, Rodríguez et al. 1996, Iñiguez et al. 1997 in Nürnberg 2005).

Mites, lice and ticks are the most common ectoparasites (Colque 1995, Medrano 1995), whereas mites are the most common cause of death in camelids (UNEPCA et al 1999).

Mites occur in great numbers during the rainy season with higher temperatures and humidity (Leguía 1999 in Nürnberg 2005). Lice occur throughout the year, but affect llamas particularly during the dry period when animals show inferior resistance against pathogens due to limited food availability (Alandia 2003).

Endoparasitic diseases which occur in camelids are Coccidiosis, Sarcocystis (see chapter Meat), Toxoplasmosis and gastroinestinal parasitosis (Grock et al. 1990, Fowler 1996, Leguía 1999 in Nürnberg 2005). Diarrhoea may be a sign of diverse gastrointestinal parasites, but laboratory tests are necessary for detection, which are not usual in the Bolivian production system (Alandia 2003 in Nürnberg 2005).

Alandia (2003) reported that diarrhoea was the most serious health problem affecting Bolivian camelid herds, followed by mites, lice, sarcocystosis and worms in the internal organs.

In general, smallholders practice no prophylactic parasite control. Preventive application measures are much more common in alpacas than in llama and focus mainly on ectoparasitic control (Alandia 2003). If treated, commercial drugs, anti-parasite baths or traditional medicine are used. Moreover, instead of the entire herd, only single animals are treated against parasites. Infections in foals and yearlings are high. Institutions that focus on camelids try to improve health control, but the lack of veterinarians in camelid keeping regions entails deficits in disease management (Bilbao 1994, Rodríguez 1994, Panamá 1995, Rojas 1995, Iñiguez et al. 1997 in Nürnberg 2005).

3 Materials and Methods

This chapter provides information on the study area, the data collection and survey approach.

3.1 Study area

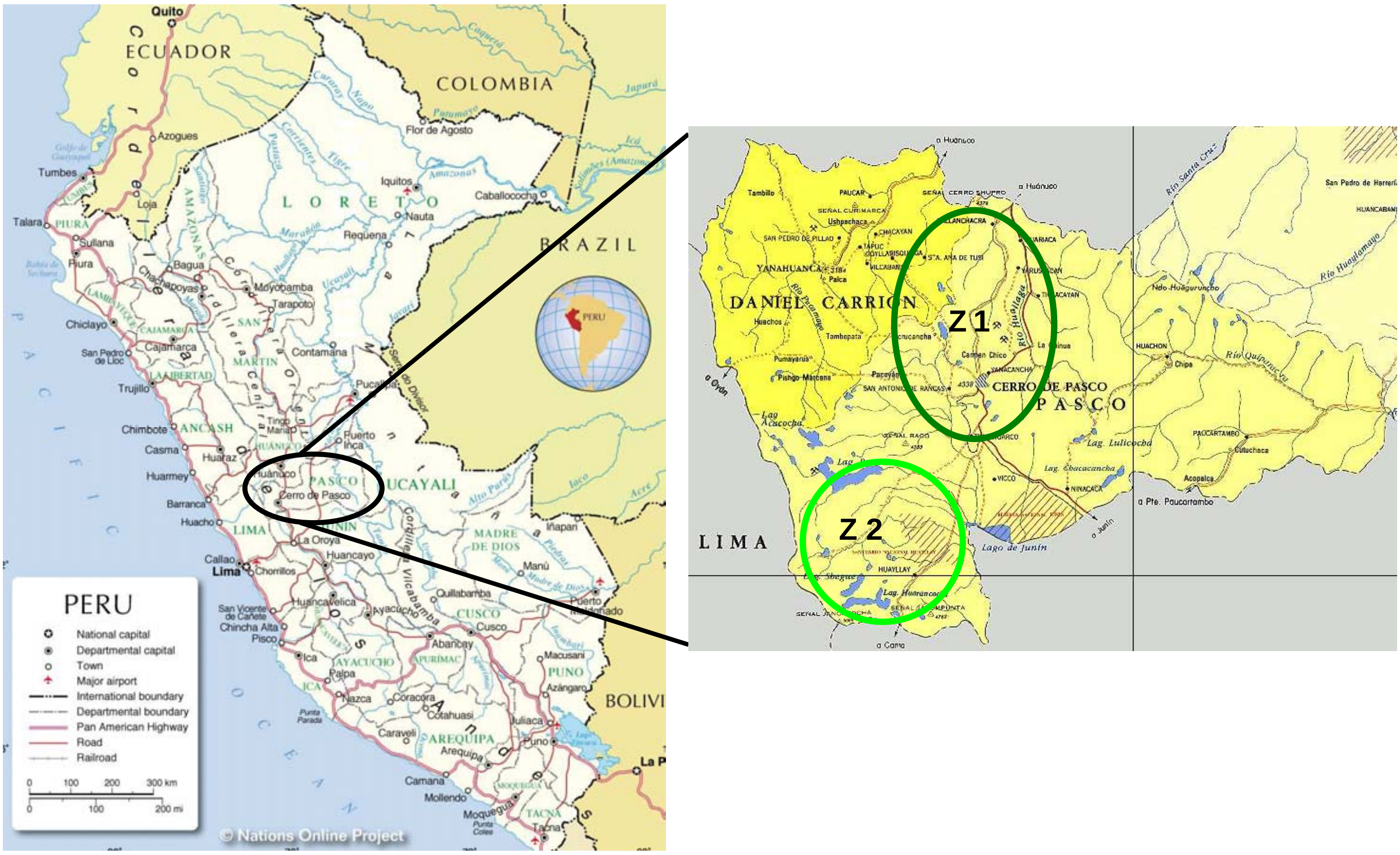

Figure 5: Map of Peru and location of study area (UN Cartographic Section 2004, Map Peru 2012)

Data collection was carried out in the province of Pasco, which is located in the central Andes of Peru, from 1st of June to 28th of August 2011.

The department of Pasco is divided into three provinces and 28 districts (Flores and Egoávil 2006). The three provinces are Oxapampa, Daniel Carrion and Pasco. The districts of Pasco and Daniel Carrion are located in the Puna zone which is characterized by scarce vegetation and absence of trees (Vega 2007).

The department of Pasco extends over an area of 25,320km² and has 241,000 inhabitants.

Its capital Cerro de Pasco has 72,100 inhabitants and is located at 4,338 meters above sea level (Flores and Egoávil 2006). It is one of the highest cities in the world (Quispe 1987).

Pasco is one of the most important mining regions in Peru. Mainly lead, silver, carbon and zinc are extracted (Flores and Egoávil 2006).

The average annual precipitation is 930mm (Quispe 1987). Nevertheless, Vega (2007) mentioned an average precipitation of 1182.7mm.

The distribution of precipitation in Cerro de Pasco is figured below.

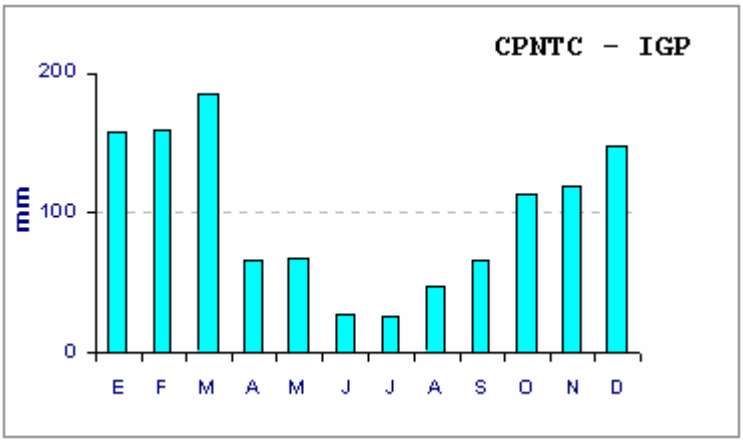

Figure 6: Average multi-annual precipitation, monthly accumulated 1961-1980 (CPNTC 2012)

The average maximum temperature is 12.4°C, whereas the average lowest temperature is 0.6°C throughout the year (Vega 2007). During day and night great oscillations occur throughout the year, which can be seen in figure 7 (Quispe 1987).

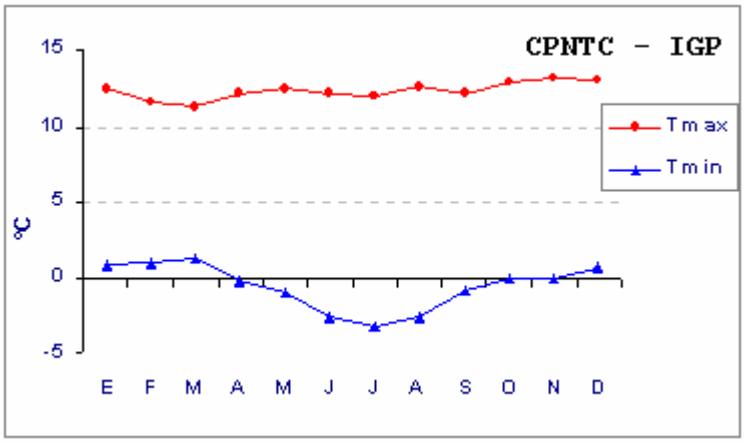

Figure 7: Multi-annual average minimum and maximum temperatures in Cerro de Pasco 1961-1980 (CPNTC 2012)

Ethnic groups in the department of Pasco are the Asháninkas, Tyrolean settlers, Amueshas and others (Flores and Egoávil 2006).

The general life expectancy in Peru is 72.5 years (INEI 2009), whereas in Pasco the average life expectancy is 71.2 years (INEI-DTDES 2004).

Illiteracy rate in rural areas like Pasco is 25%, whereas in urban Peru the illiteracy amount to only 5.9% (INEI 2002).

In 1996, 47.2% of children under the age of 5 showed delayed growth in Pasco, whereas tendency decreases. Nevertheless, this value is among the highest in Peru (FAO 2000).

The survey was carried out in the districts of Simon Bolivar, Santa Ana de Tusi and Huayllay, which are located in the provinces of Daniel Carrion and Pasco.

The study area was divided into two zones. Zone 1 consists of the districts of Simon Bolivar and Santa Ana de Tusi. Zone 2 consists of the district of Huayllay.
In Zone 1, farmers of the following villages participated in the survey: San Pedro de Racco, Ucrucancha, Quiulacocha, Santa Ana de Tusi, Tunacancha, Racracancha, Sacrafamilia. In Zone 2 farmers of the villages Canchacucho, San Carlos, Andacancha, Leonpata, La Cruzada, Condorcayan and Huarimarcan participated in the survey.

Nearly all villages were accessible by car. Due to the increase in mining activities, roads had been built. The main “public” transport vehicles are mini-buses and “taxis”.

3.2 Data collection and survey methodology

In total, 104 households were interviewed. The survey was conducted in the Spanish language.
In Zone 1, 66 households were interviewed; Zone 2 involved 38 households. Due to the greater extension and the higher population density of the villages in Zone 1, more interviews were carried out. In Zone 2, only 38 interviews were carried out due to the smaller village sizes and the generally smaller study area.

Table 5: Number of interviews in villages

Zone	Village	No. of farmers		Total
1	San Pedro de Racco	17	66	104
	Santa Ana de Tusi	12		
	Racracancha	10		
	Tunacancha	5		
	Rancas	10		
	Ucrucancha	4		
	Sacrafamilia	4		
	Quiulacocha	4		
2	Condorcoyan	4	38	
	San Carlos	7		
	Leonpata	4		
	Andacancha	6		
	La Cruzada	6		
	Canchacucho	5		
	Huarimarcan	6		

A questionnaire including open and closed questions was used for data collection. Selection criterion for eligible households was a number of more than 3 llamas. Interviewees were randomly selected in the villages.

Figure 8: Interview in San Pedro de Racco © B. Wolfinger

To obtain information from the respondents about their llama keeping management, the questionnaire (see Annex) was based on the following: general information and socioeconomic aspects, production systems, pasture and herd management, animal health, characteristics of llama breeding, selection criteria for male and female llamas, use of males in the herd, meat and fibre production, products and markets and support from external organisations.

Before starting the interviews in the study area, two villages (Huayllay and San Pedro de Racco) of the study region were visited together with the supervisors Dr. Wurzinger (BOKU) and Gutierrez Reynoso, PhD (UNALM). A meeting took place and farmers were informed about the aim of the study, the general structure of the questionnaire and the interviewer was introduced.

Interviews were primarily conducted outside, occasionally indoor. On average, an interview took 40 minutes, depending on the age and talkativeness of the respondent.

After completing data collection, a feedback seminar was held in San Pedro de Racco to present preliminary results of the survey. The main problems in llama keeping and breeding were presented to the farmers participating in the survey.

3.3 Data analysis

The data obtained was coded and entered into Microsoft Excel 2003 and analysed by using SAS 9.2 (SAS 2008).

SAS 9.2 was used to calculate descriptive statistics. Standard deviations, means and frequency distributions were calculated. Chi-square tests were applied to compare findings of the two different zones. A p-Value of 0.05 was used as the level of significance. Herd classes were formed as presented in Table 6 to investigate differences in management practices across different herd sizes.

Table 6: Herd classes

Herd classes	1	2	3
Number of llamas	3 - 38	39 – 79	≥80

4 RESULTS

The following part provides the results of the thesis.

4.1 General Information and socioeconomic aspects

This chapter provides a general overview of the farmers' livelihood and some key information on socioeconomic aspects.

In the majority of cases men are family heads (81.82% in Z1, 76.32% in Z2) with an average age of more than 51 years (Z1: 51.4 years ± 13.97, Z2: 56.94 years ± 13.07).

Most of the interviewed farmers are married (68.18% in Z1, 57.89% in Z2). The other interview partners are either widowed (15.15% in Z1, 13.16% in Z2), cohabitate (9.09% in Z1, 13.16% in Z2) or are single (7.58% in Z1, 13.16% in Z2). Only one interviewee in Zone 1 stated to be divorced. When llama keepers are married or cohabitate it is common that men are the head of the households.

The majority of farmers in the study areas have completed either primary or secondary school. In the present study illiteracy is mainly restricted to old women.

Table 7: Education level of household head

	Illiterate	Primary school	Secondary school	Higher education
Z1 (n=66)	10.61%	30.30%	42.42%	16.67%
Z2 (n=38)	5.26%	44.74%	39.47%	10.53%

The education level positively correlates with the herd size. Higher education indicates larger flocks. 90.91% (54.55% higher education, 36.36% secondary school) of farmers who keep more than 79 llamas have advanced education.

Reason of llama keeping

All interviewed farmers stated that meat is the main motivation for keeping llamas.
In Z1, meat production reached 78.79% of the frequency ranking 1st. In Z2, only 36.84% ranked meat first, whereas other important reasons were savings (31.58%) and tradition (30.3%). Nevertheless, 55.26% of the farmers in Z2 mentioned meat on 2nd place at the rank order. Significant differences between study sites occurred regarding the ranking of meat, fibre and savings. Llama fibre has a low market value and, therefore, only 30.3% in Z1 and

38.5% in Z2 keep llamas for their fibre. Fibre was basically ranked on 2nd place in Z1 and on 3rd place in Z2.

The location and accessibility of the villages is crucial if llamas are still used for transport. 21.21% of farmers in Z1 and 7.89% of farmers in Zone 2 keep llamas as pack animals. The value of llamas as means of transport is significantly lower in Z2.

Keeping llamas as an asset which allows them to transform them into cash in times of need is not common in Z1 as compared to Z2. Hides, transport and dung are of minor importance regarding the rank order. Herd classes do not influence the reasons for llama keeping. Llama husbandry for traditional purposes like keeping llamas for cultural use or because llamas have always been part of their livestock and daily life, occurs significantly more frequently in Z2 (Z2 81.57%, Z1 30.3%). Regarding the ranking below, tradition as a reason for llama keeping was significantly ranked more frequent on first place in Z2 (Z2 26.32%, Z1 9.09%).

The general disadvantage of rankings is that farmers have to rank motives according to their importance. However, this does not mean that other motives mentioned are negligible or farmers do not value the products provided by llamas.

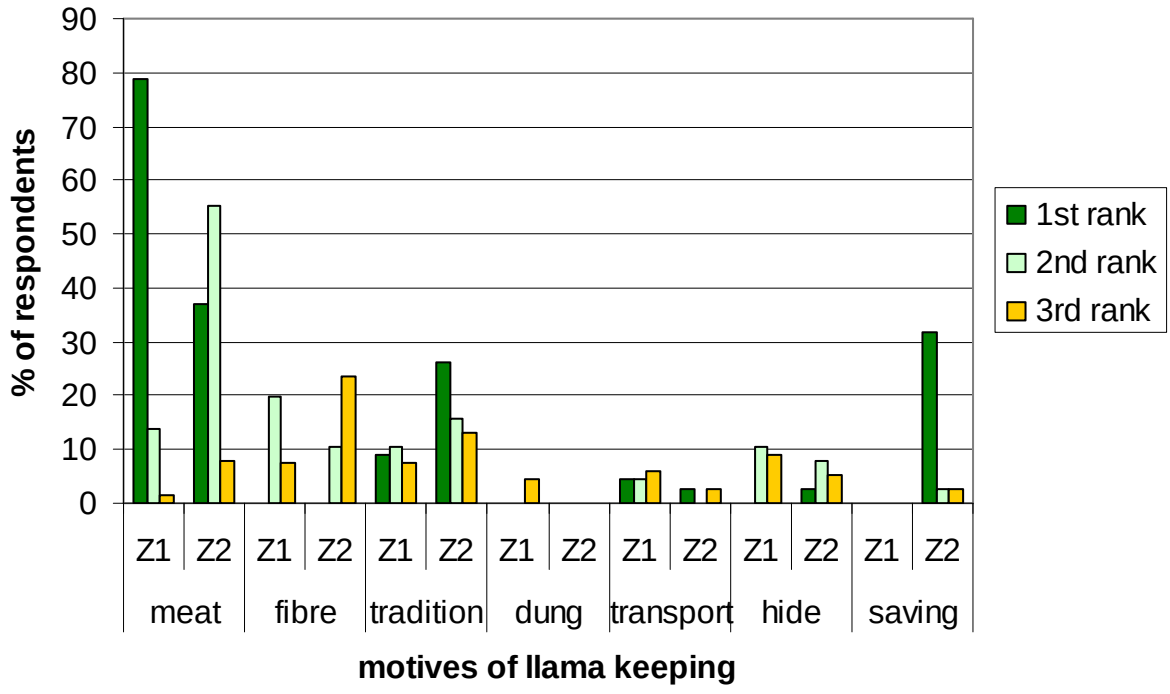

Figure 9: Ranking of motives for llama keeping

Main source of income

Animal husbandry is part of every peasant's income.

The importance of principal activities varies significantly between the two study sites.

Mining as part of their income has a significantly higher priority in Z2 as compared to Z1 (Z2=21.05%, Z1=3.03%). Generally spoken, mining plays a bigger role in Huayllay (Z2) where significantly more people work for mining companies.

The rank order in the figure below demonstrates that significantly more people in Z1 mentioned livestock keeping as their principal activity.

The capital of Huayllay offers more attractive job alternatives than the visited villages in Z1. Because of this llama keepers work significantly more often as shopkeepers, freelancers, workers, traders, professors, community presidents or professionals in Z2 (36.84% in Z2, 18.18% in Z1).

Crop production was found only in one specific village (Santa Ana de Tusi) in Z1. It seems that the micro climatic conditions in other villages are less favourable to practice crop farming.

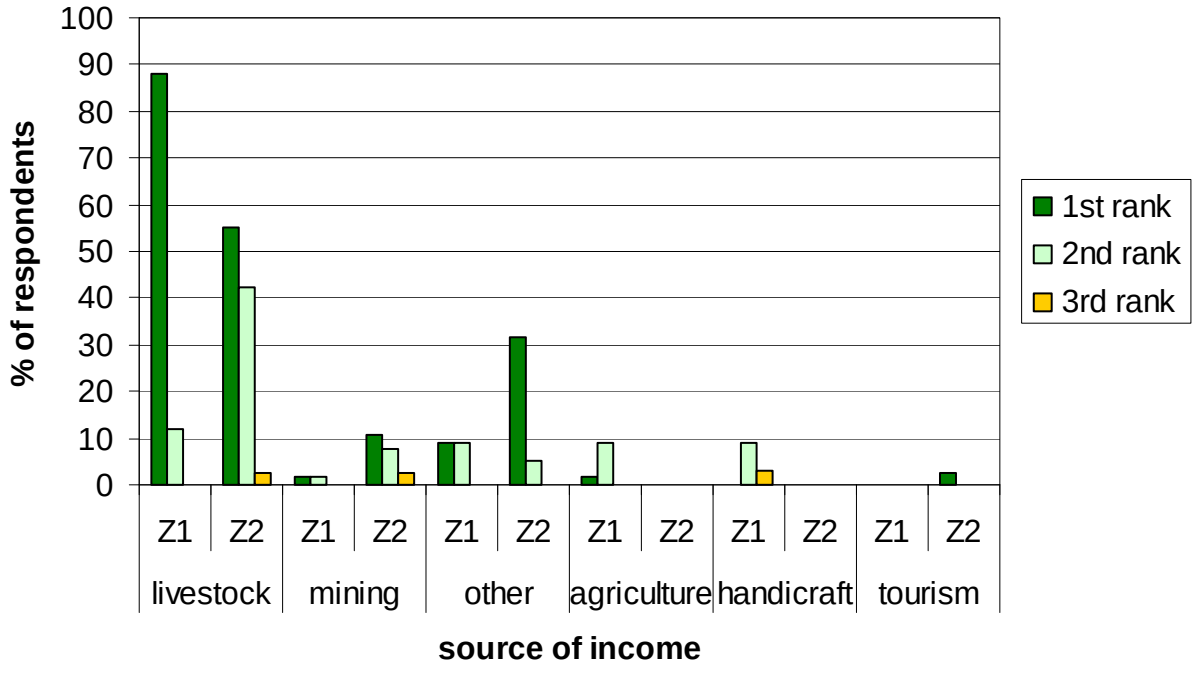

Figure 10: Ranking of sources of income

Figure 10 illustrates the importance of different sectors for llama keepers. Altogether, agriculture, handicrafts and tourism are of minor importance as source of income for the farmers interviewed.

Herd sizes

An average farmer in Z1 owns 45 llamas, 68 alpacas, 95 sheep and 4 cattle, whereas an average farmer in Z2 keeps only 34 llamas, 31 alpacas, 84 sheep and no cattle. The composition of flock kept per farmer has a wide range (see table 8). The study areas do not influence the number of llamas kept per farmer. Nevertheless, the number of alpacas per farmer show significant differences between study areas and herd classes. The number of sheep is significantly varying between herd classes and the amount of cattle per farmer is significantly higher in Zone 1. Other animals like horses, guinea pigs, poultry, rabbits, goats or pigs are kept by farmers to a minor extent.

Table 8: Herd composition in both study regions (figures are number of animals)

	Region					
	Z1			Z2		
	Mean ± SD	Minimum	Maximum	Mean ± SD	Minimum	Maximum
Llamas	45 ± 44.33	4	289	34 ± 22.03	4	100
Alpacas	68 ± 66.18	0	300	31 ± 43.42	0	180
Sheep	95 ± 77.16	0	320	84 ± 63.31	0	221
Cattle	4 ± 7.52	0	30	0 ± 1.62	0	10

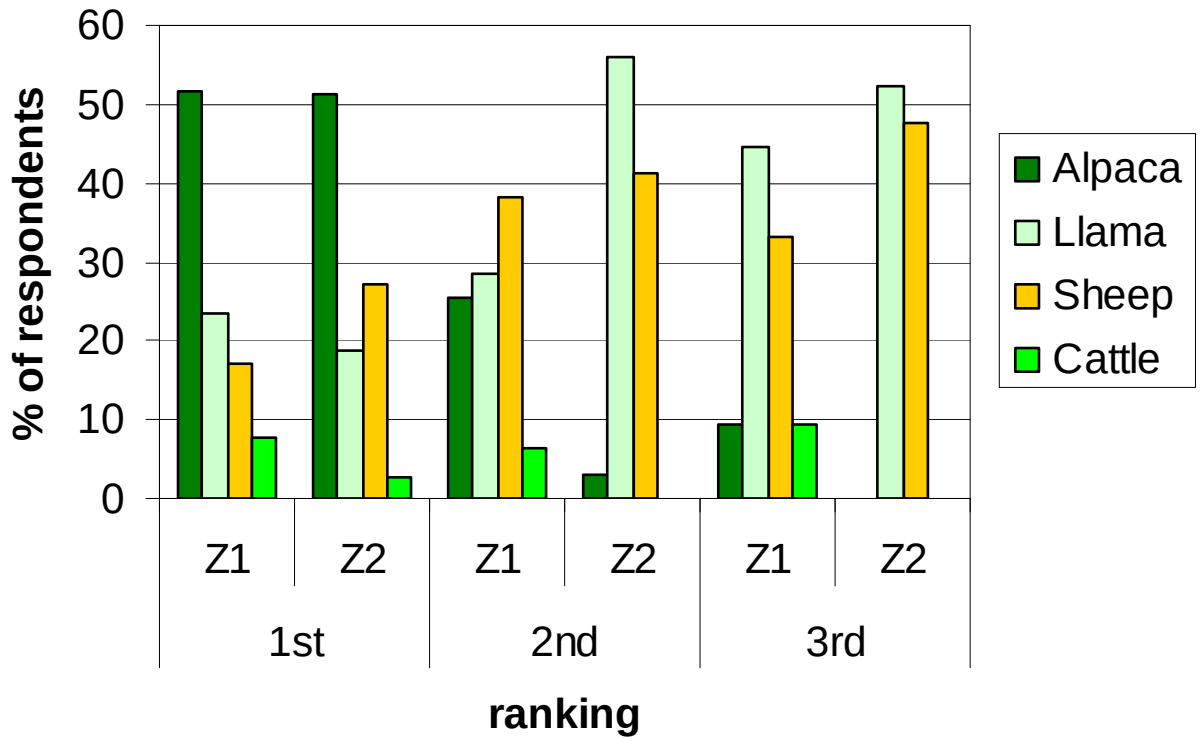

Figure 11: Ranking of animals which provide highest income

The rank order in figure 11 shows that in comparison to alpaca, llamas, sheep and cattle are of minor importance in terms of income. Significant differences were observed between the two study sites with respect to the ranking of the second most important animal. Llamas were mentioned more frequent as 2nd most important animals in Z2 as compared to Z1. Ranking was not influenced by the herd size. Due to their fibre alpacas provide the highest income for farmers (51.56% in Z1, 51.35% in Z2).

For the last five years period, the tendency of the livestock population shows no significant variance between the study sites. The llama population of farmers in Z1 either increased (34.85%), was stable (37.88%) or decreased (27.27%) over the past five years. In Z2, 42.11% of the respondents decreased their number of llamas within the last five years and 28.95% mentioned that their llama herd either increased or is still stable. No clear trend of the llama population in Z1 is identifiable, whereas in Z2 a tendency towards a decline of number of llamas was observed.
In alpacas an upwards trend in the number of animals can be seen in both zones. Sheep numbers remained generally stable in both study areas (Z1 50.82%, Z2 45.71%).

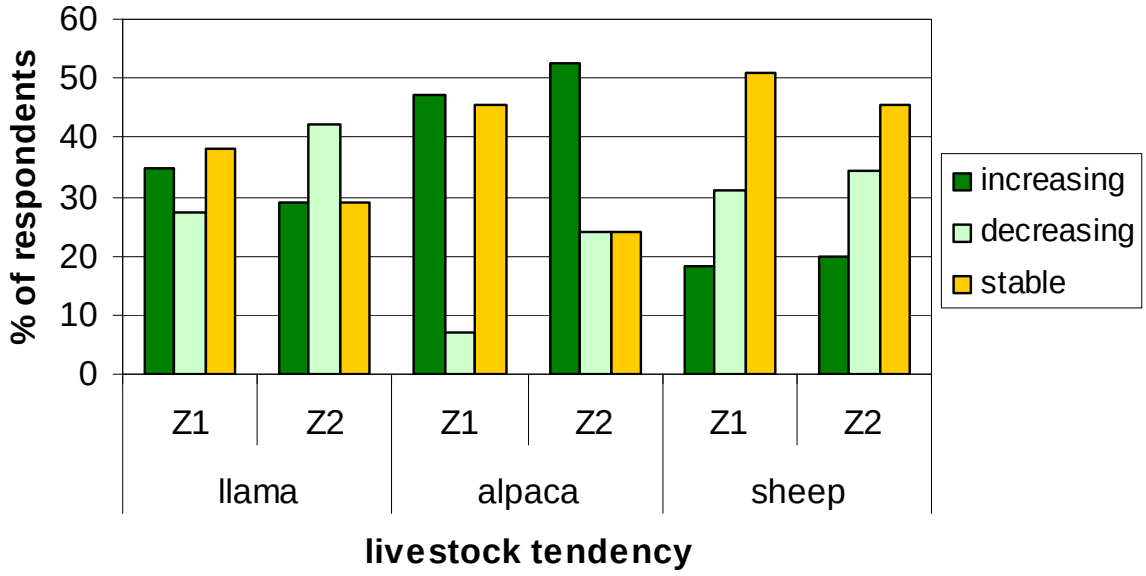

Figure 12: Tendency of herd sizes in the last 5 years

Herd classes have a significant influence on the decision of farmers to either increase, decrease or keep the herd size stable.
Farmers in herd classes 2 or 3 principally increased their llama herds (herd class 2=44.12%, herd class 3=63.64%) over the past five years. Although 27.27% decreased their llama herd in

herd class 3 and 26.47% in herd class 2. In contrast, 37.29% of farmers with a small llama population (herd class 1) decreased their herd and 42.37% of farmers had a stable llama population over the past five years.

The reason for a decline of llamas most frequently mentioned in both study sites is related to economic aspects (e.g. selling animals for family needs). Further reasons referred to are management problems of llama herds, problems with guarding, lack of llamas in number and quality, low productive and overgrazed pastures, lack of land to support an increased number of livestock and diseases responsible for high mortality rates.

In Zone 1, the decline in llama population is basically associated with economic issues. In Zone 2, the reasons most frequently mentioned are economic issues and the lack of knowledge of llama management.

Llama herds increased within the last 5 years due to better management, better guarding, more offspring, small number of slaughtered animals, animals bought-in, higher profitability of llamas and better production possibilities.

The reasons for a stable population are identical with those responsible for the decline of llamas.

4.2 Production and management system

This chapter supplies information about the principal llama herd and pasture management practices and the problems farmers are faced with.

Pasture management

To use communal land for livestock keeping is common. Therefore, 92.42% of the farmers in Z1 and 97.37% in Z2 do not own any pasture land. On average, people use 72.39 hectares (± 53.13 range: 3-244) in Z1 and 49.5 ha (± 74.09 range: 4-250) in Z2. These results should be dealt with carefully as they are not accurate and provide only a rough appraisal. Farmers are often not familiar with the concept of “hectares” or have no information about the actual size of the land they use.

It is common practice in both study regions (Zone 1: 72.73%, Z2: 55.26%) that farmers divide their pasture into a number of plots (pasture plots are defined areas per farmer where they are allowed to graze their animals). Herd size shows no influence on the occurrence of pasture plots (herd class 1 = 63%, herd class 2= 74%, herd class 3= 64%). The remaining farmers use available communal pasture without any boundaries to keep their livestock.

66.67% of the respondents in Z1 graze their llamas on fenced plots. Compared to Z1, significantly less people in Z2 (2.63%) have fences for pasture management.

60.61% of the interviewees in Z1 have additional divisions or fenced paddocks for a rotational pasture system or for splitting animals (e.g. females with offspring grazing in one division; males, breeding males and yearlings in another one). On average, in Z1 farmers have 2.5 divisions (± 2.4 range: 0-10) and in Z2 0.1 divisions (± 0.648 range: 0-4).

Figure 13: Example of a division in San Pedro de Racco © B.Wolfinger

94.74% of llama keepers in Z2 have no management plan for their pastures. Farmers in Z1 practice significantly more (40.91%) pasture management.

28.13% respondents in Z1 and 39.47% respondents in Z2 pay for the use of communal pasture and local government decides if payment takes place. On average, the annual amounts paid come to 124.8 Nuevo Soles = 36.52 EUR (± 287.4 25-1200NSol) (Currency Calculator: Volksbank) in Z1 and 89.35 Nuevo Soles = 26.15 EUR (± 123.49 10-483NSol) in Zone 2. The amount paid for the use of pasture also depends on the local village government. Farmers either pay per hectare of land used or per animal grazed on the pasture. The amount paid per animal depends on the type of animal (e.g. farmers pay less for sheep than for llamas).

Main problems of pastures

Water is crucial for livestock keeping. Therefore, 65.15% of the llama keepers in Z1 and 68.42% in Z2 stated that the absence of water reservoirs is a problem concerning their pasture management and further livestock keeping. The lack of water, mainly during the dry season is a problem for over 73% of the farmers (73% in Z1; 73.69% in Z2).

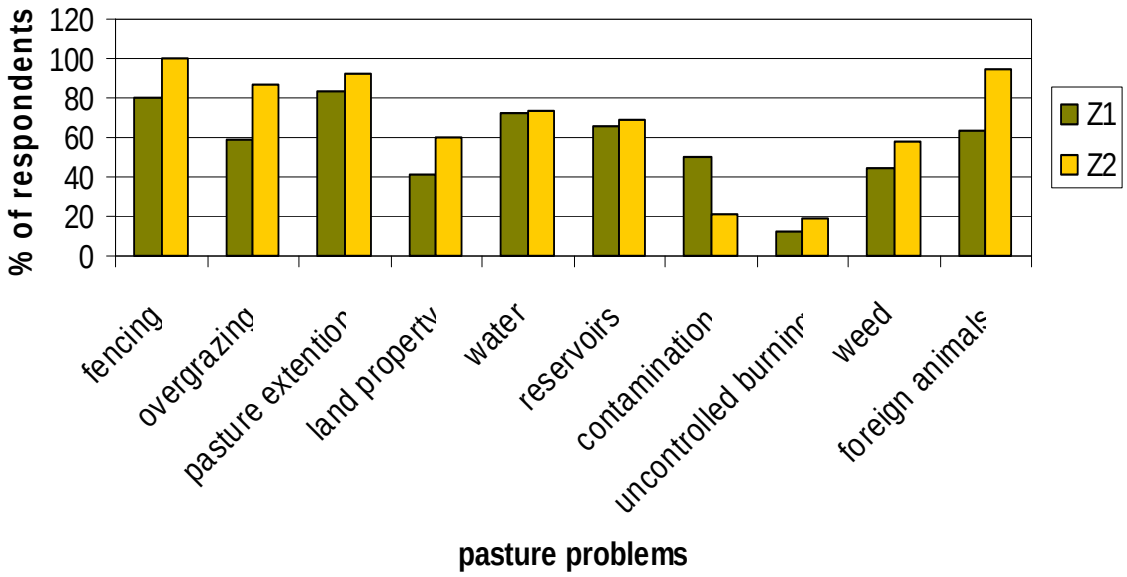

Figure 14: Main difficulties in pasture management

The lack of fencing is one of the principal difficulties for llama keepers in both study sites. No distinction was made between farmers who are not allowed by the government to build fences and those who are not able to finance it.

The invasion of weeds as problem of pasture management was mentioned by 57.89% of the interviewed farmers in Z2 and 43.94% in Z1.

Another problematic issue is the contamination of pastures by the mining industry. 50% of the farmers in Z1 and 21.05% in Z2 pointed out that contamination of their pastures is a problem.

Z2 had more problems due to unclear user rights of the used pastures than Z1 (40.91% Z1, 60.53% Z2). Nevertheless, no significant differences occurred. Uncontrolled burning is a minor problem for farmers (Z1 12.12%, Z2 18.42%).

Figure 15: Free ranging llamas in Canchacucho © B. Wolfinger

The herd size has a significant influence on pasture extension. Those farmers who own larger livestock numbers have significantly fewer problems with land shortage (HN1=84.75%, HN2=97.06%, HN3= 63.64%). The problems of overgrazing, fencing and free-range carnivores (e.g. pumas, foxes, wild dogs) are significantly lower in Z1.

Water

The most common source of water for livestock in Zone 1 are lagoons (50% Z1, 23.68% Z2). In Z2 water springs have significantly more importance as source of water (84.21%) than in Z1 (50%). More than 1/3 of the interviewed farmers mentioned to use rivers for water supply (Z1=33.3%, Z2= 36.84%). Water holes and water canals are negligible.
68.18% of the interviewees in Z1 and 76.32% in Z2 have access to clean water for their llamas, even during dry season. The remaining 31.82% in Z1 and 23.68% in Z2, respectively, stated that available water for llamas is muddy during dry season. Nearly all farmers have clean water supply during the wet season in Pasco (95.45% Z1, 94.74% Z2). The main problem is not quality aspects but rather the availability of water during dry season.

Llama herd structure

In each herd one can usually find all three types of llamas. Herds in Zone 1 are composed on average by 13 newborns, 8 yearlings, 21 adult females, 3 males and 1 castrate.
In Zone 2 the herd structure is composed of 5 newborns, 6 yearlings, 16 adult females, 3 males and 2 castrates.
The herd class influences the number of intermediates over all age and sex levels significantly.
Table 9 below shows that peladas are more frequently used for breeding in Z1 as compared to Z2. In Z2 people own a lower amount of animals per farmer and breed more often with intermediates.
The amount of pelada foals and females is significantly influenced by the study area and the herd size. The number of pelada yearlings and males is significantly dependent on the herd size.

The data collected is only a snapshot because farmers were only interviewed once. No development throughout the year or over years was made. Therefore fluctuation depending on diseases, negative environmental influences or selling of animals for financial reasons was not determined.

Table 9: Herd structure (figures are number of animals)

		Z1			Z2		
Llama types		Mean ± SD	Minimum	Maximum	Mean ± SD	Minimum	Maximum
	Offspring	6 ± 13.1	0	89	3 ± 3.31	0	12
	Yearling	3 ± 5.42	0	30	5 ± 7.49	0	35
intermediates	Female	8 ± 17.06	0	120	11 ± 14.76	0	65
	Male	1 ± 3.86	0	30	3 ± 4.76	0	25
	Castrates	1 ± 3.86	0	25	2 ± 5.0	0	20
	Offspring	2 ± 4.67	0	25	1 ± 5.82	0	35
	Yearling	1 ± 2.38	0	10	0 ± 1.58	0	7
lanuda	Female	4 ± 6.97	0	30	2 ± 5.12	0	23
	Male	1 ± 3.88	0	30	0 ± 0.72	0	4
	Castrates	0 ± 2.12	0	16	0 ± 0.81	0	5
	Offspring	5 ± 8.50	0	40	1 ± 2.91	0	10
	Yearling	4 ± 6.20	0	30	1 ± 3.79	0	15
pelada	Female	11 ± 18.85	0	120	3 ± 7.35	0	39
	Male	1 ± 2.26	0	15	0 ± 0.77	0	4
	Castrates	0 ± 2.24	0	16	0 ± 0.68	0	3

Herd management

Differences between the two study sites regarding the separation of llamas by sex and the separation of offspring after weaning are significant. In Z1, 75.76% of the farmers keep their entire llama herd together. In Z1 25.76% of the farmers keep males and females separated and 27.27% stated to separate offspring after weaning. On the contrary, in Z2 100% of the farmers keep their entire llama herd together without any separation.

The herd size has a significant influence on the separation of males and females (herd class 1=8.47%, herd class 2=29.41%, herd class 3=18.18%). In herds of 39 to 79 llamas (herd class 2) farmers separate llamas significantly more frequently than in herd class 3 (>80 llamas) and herd class 1 (<39).

At night, most farmers keep llamas in resting areas (roofless corals) (83.33% in Z1 and 92.11% in Z2) to protect livestock from predators. Approximately 1/3 of the respondents (36.36% in Z1, 31.43% in Z2) mix llamas with other livestock in resting areas. In both study sites it is common to mix llamas with alpacas during the night (45% Z1, 72.73% Z2). Farmers in Z1 mix llamas with sheep, too (25% Z1, 0% Z2). 20% of the interviewed farmers in Z1 and 27.27% in Z2 keep llamas, alpacas and sheep together during the night. 10% of the farmers in Z1 stated to keep their entire livestock in one resting area.

Figure 16: Alpacas returning in their corral © B. Wolfinger

Common diseases and veterinary service

External parasites like lice, scabies and ticks are the most common diseases in llamas (Z1 45.38%, Z2 52.56%). Another very common disease is liver fluke (Fasciola hepatica). In Z1 23.84% and in Z2 24.37% of the farmers stated that liver fluke occurs regularly in their livestock. Sarcocystosis was referred to as a common disease in llamas by 11.54% of the interviewed farmers in Z1 and 5.12% in Z2, respectively. This low infestation rate is due to the fact, that the issue of diseases referred to living animals. In most cases, sarcocystosis is diagnosed not earlier than when the animals are slaughtered. Other diseases the interviewees mentioned are internal parasites like tapeworms or screwworms, infections like septicaemia, bronchopneumonia or diarrhoea, nematodiases like lung worms, round worms or strongyles (stomach worm, thread-necked strongyle). However, all diseases listed above were mentioned by less than 10% of the farmers in every study area.

Veterinary services in the study areas are usually available, but the majority of farmers (84.85%) in Z1 treat their animals themselves, whereas in Z2 only 26.32% of all interviewees stated to practice self-medication and self-diagnosing. In Z2 it is common to call on a store or market for veterinary services (55.26% Z2, 7.58 Z1).

Support from veterinarians is not common in either of the study sites. Nevertheless it is significantly more frequent in Z2 (18.42%, Z1 7.58%).

The herd size influences the use of veterinary assistance. Receiving help from a shop or market is significantly more common in herd class 1 (33.9%) and herd class 3 (36.36%),

respectively, as compared to herd class 2 (5.88%). Nevertheless, treating animals by themselves is the method farmers usually apply (herd class 1=52.44%, herd class 2=82.35, herd class 3=63.64%). The number of farmers who themselves diagnose and treat their animals is significantly higher in herd class 2.

Weaning

60% of interviewed llama keepers in Z1 and 100% in Z2 do not wean their llama offspring. Only 40% of respondents practice weaning, whereas 10.77% wean between 6-7 months of age. 16.92% wean between 8 and 10 months, 7.69% wean at 10 to 12 months and 4.62% wean between 4 and 6 months. Llama farmers with larger herd sizes practice weaning between 6-7 months of age of the offspring to a considerably larger extent (herd class 3=36.36%) than farmers with smaller herds (herd class 1=3.57%, herd class 2=2.94%). Farmers in herd classes 1 and 2 usually wean between 8 and 10 moths (HN1= 8.93, HN2= 17.65).

Main problems of llama keeping

Lack of pasture is the main problem of llama keeping (Z1=72.31%, in Z2= 73.68%). At the same time, 64.62% of the farmers in Z1 and 76.32% in Z2 mentioned to have technical and management problems in keeping their llama herds. External parasites were mentioned to be a problem by 69.23% of the respondents in Z1 and 60.53% in Z2. Internal parasites are less problematic in Z1 than in Z2 (Z1 44.63%, 68.42% Z2).

Farmers mentioned the lack of good breeding llamas more frequently in Z1 (significant) (56.92%) than in Z2 (36.84%). Other problems mentioned by farmers were genetic defects (Z1 30.77%, Z2 26.32%), infectious diseases (Z1 32.32%, Z2 21.05%), fertility problems (Z1 36.92%, Z2 28.95%) and administrative and managerial problems (Z1 29.23%, Z2 23.68%). Figure 17 below shows that the lack of pasture is the most serious problem for farmers in both study sites.

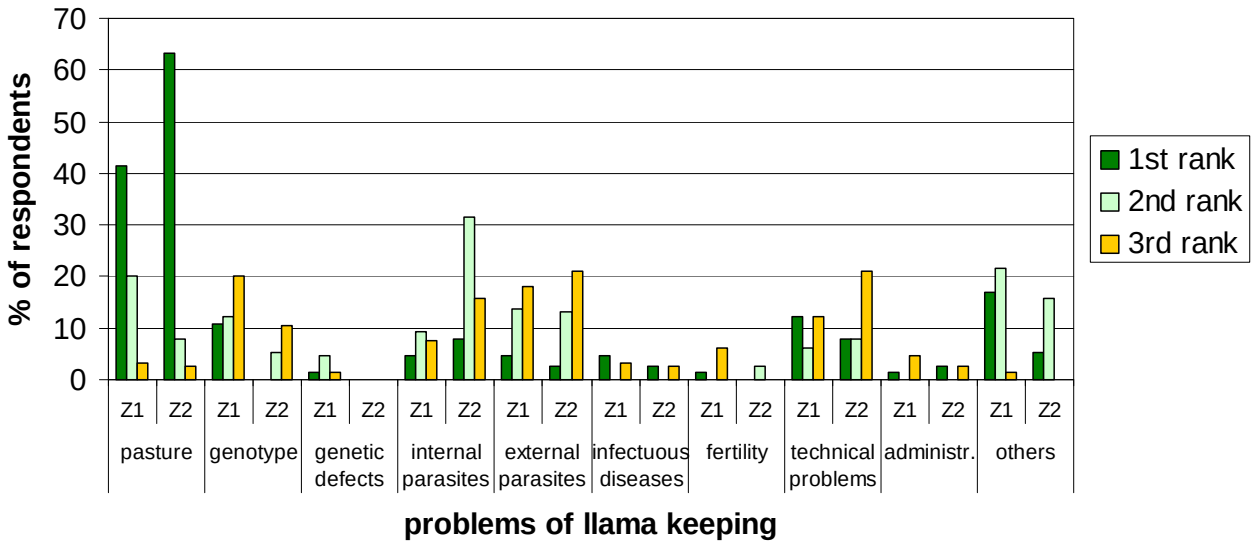

Figure 17: Problems in llama keeping

Castration

In Z1 castration of llamas is not very common (67.69%). In Z2 the opposite was observed, because 63.10% of farmers stated to castrate males. Main reasons for castrating llama males are birth control (Z1 15.38%, Z2 13.16%) and the calmer temperament of castrated males (to avoid injuries through fighting), which was more often referred to in Z2 (55.26%, Z1 15.38%).
Common statements for refraining from castration are: animals are sold on market before reproductive age is reached; better growth rate when not castrated; castration of males is not customary; farmers have not enough experience and knowledge to castrate males.
In Z1 most frequent reasons for not castrating males were the selling of llama males (36.36%) and the lack of knowledge (9.09%). In Z2 the lack of knowledge (7.89%) and unfamiliarity with castration (10.53%) were commonly mentioned as reasons for refraining from this practice.

4.3 Breeding

Breeding strategies, selection criteria of farmers, use of males, reproduction management, inbreeding and the origin of breeding llamas are described in this following chapter.

Selection

Farmers in Z1 practice significantly more selection in llamas (56.06% males, 56.92% females) than those in Z2 (34.21% males and females, respectively) for breeding purposes. The herd size influences the decision of selection. With an increased number of llamas, farmers practice significantly more often selection of males and females.

Table 10: Practice of selection in males and females

Herd classes	Selection of male % of respondents	Selection of female % of respondents
1 (n=59)	32.20	37.29
2 (n=34)	64.71	63.64
3 (n=11)	81.82	63.64

The slightly higher selection rate of females in herd class 1 is due to the fact that not every farmer owns a male for breeding. Therefore, farmers only practice selection in their females.

The average age at selection is 15 months in Z1 (male 14.78 ± 6.97 range: 1-24, female 14.81 ± 7.64 range: 1-36) and 18 months in Z2 (male 18 ±7.86 range: 8-30, female 18.25 ±7.7 range: 8-30). No significant differences were observed between the two study sites.

The method most frequently used is a selection of llamas according to the farmers' own criteria (93.85% Z1, 100% Z2). Only few farmers use selection criteria established by CONACS (consejo nacional de camelidos sudamericanos). Criteria of CONACS are more common and used more frequently in alpacas than in llamas.

Table 11: Selection criteria for males and females

Criteria		Males		Females	
		% of respondents	p-Value	% of respondents	p-Value
Size	Z1	93.94	0.0014	66.15	0.0173
	Z2	71.05		42.11	
Conformation	Z1	77.27	0.004	55.38	0.0093
	Z2	50		28.95	
Colour	Z1	56.06	0.007	44.62	0.0029
	Z2	28.95		15.79	
Temperament	Z1	10.61		12.31	0.0243
	Z2	2.63	n.s	0	
Growth rate	Z1	13.64		4.62	n.s
	Z2	10.53		0	
Fibre	Z1	22.73	n.s	12.31	n.s
	Z2	18.42		7.89	
Libido	Z1	18.18	n.s	---	--
	Z2	10.53		---	--
Walk long distances	Z1	3.03	n.s	3.08	n.s
	Z2	7.89		0	
Pedigree	Z1	56.06	0.007	35.38	.0.0675
	Z2	28.95		18.42	
Others, male/ female without genetic defects	Z1	6.06		10.77	
	Z2	7.89	n.s	23.60	n.s

The most important selection criteria for males and females are body size, conformation, colour and pedigree. Information on pedigree does not mean that farmers have written information about the ancestors of each individual animal. This only means that farmers can identify the dam and in some rare cases the sire of their llamas. Farmers in Z2 quoted all other criteria for selection rarely. The criterion of growth rate in males gains considerable importance with increased numbers of llamas (herd class 1 =5.08% herd class 2=20.59% herd class 3=23.08%).

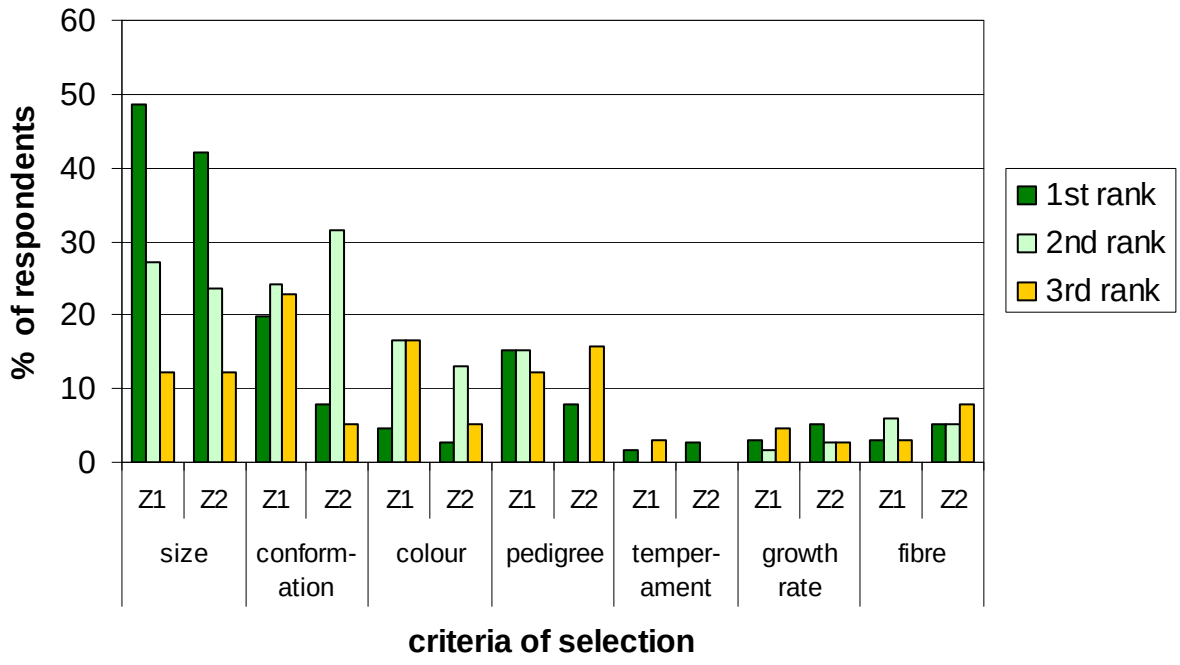

Figure 18: Selection criteria for males

Other criteria like the ability to walk long distances, growth rate or fibre quality are negligible and not included in figure 18 due to the low values.

Figure 19: Winning llama male at the animal show in Ninacaca © B. Wolfinger

The main difference between the selection of males and females is the absence of genetic defects, which favours females over males.

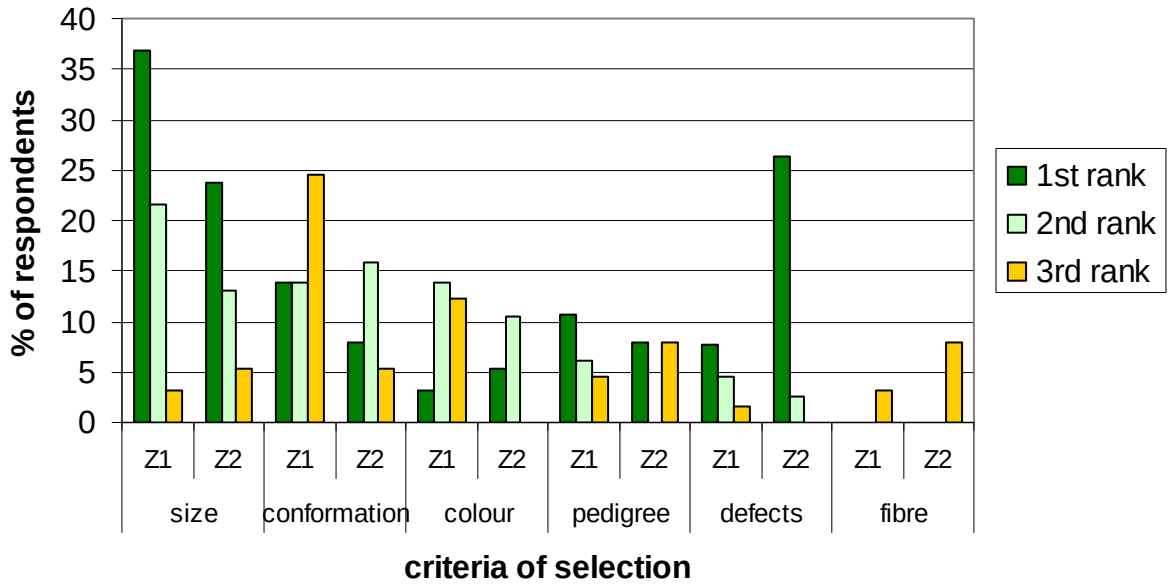

Figure 20: Selection criteria for females

Colour is one of the most important selection criteria in males and females.

Accordingly, the colours in llamas mostly preferred by farmers in Z1 are white (22 people), black (20 people), coloured (13 people) and lead coloured (12 people). Colour ranking in Z2 is white (12 people), brown (10 people) and black (6 people). Interviewed farmers mentioned

multi coloured (36 in Z1, 9 in Z2) animals as the most undesirable ones. However, not every farmer was able to give an undesired or desired colour in llamas.

The most common criterion for culling breeding females is the age. 84.62% of the farmers in Z1 and 86.84% in Z2 stated to cull a breeding female because of her advanced age. Another reason for rejecting a breeding female are fertility problems (46.15% Z1, 52.63% Z2). Breeding females with bad maternal characteristics are rejected by farmers significantly more often in Z1 (44.62% Z1, 18.42% Z2), so are breeding females with diseases (35.38% Z1, 13.16% Z2). Abortion as criterion for culling was mentioned by 23.08% of the farmers in Z1 and by 7.89% in Z2. The herd size does not influence the reasons for culling females.

Best llamas in herd

Farmers were asked if they have a best breeding male in their herd and further to describe the attributes why this male is the best.
Most farmers pointed out that their best breeding male has a good body conformation, high body weight and body size as compared to the rest of the herd.
The statements given by farmers correspond with the selection criteria for males.
In Z1 46.51% and in Z2 75% of the farmers stated that their best breeding male comes from their own herd. This fact differs significantly between study sites.

Most farmers in Z1 (80.4%) are able to mention their two best females of the herd. In contrast, in Z2 only 44.74% of the farmers could specify their best females. This means that remaining persons judge all llama females equally.
Overall reasons for the best female are size (24 respondents in Z1, 6 in Z2), good conformation (Z1 12), bearing good offspring (Z1 14) and having a short interval between births (Z2 3). An additional criterion was non or low rate of abortions.

Male and female offspring of one of the best llama females is kept to a high extend by farmers themselves. Nevertheless male offspring is sold more frequently than female offspring. The obtained data shows no significant differences between study sites or herd classes.

Table 12: Sale of males and females out of best breeding females

		% of respondents
Keep females	Z1	84.91
	Z2	70.59
Keep males	Z1	58.49
	Z2	52.94
Sell females	Z1	13.21
	Z2	17.65
Sell males	Z1	41.51
	Z2	29.41

Origins of males and females for breeding

Farmers were asked about the origin of their breeding animals.

The majority (95.45% in Z1, 100% in Z2) of llama keepers recruit llama females for breeding from their own herd, which means that farmers usually do not buy, rent, lend or interchange females.

Interchanging of livestock means that, for example, one farmer lends his breeding male to another farmer and, in return, receives another male.

Buying breeding females was only mentioned by 15.38% of the farmers in Z1. Other possibilities like renting, interchanging or lending of breeding females were mentioned only by a few farmers.

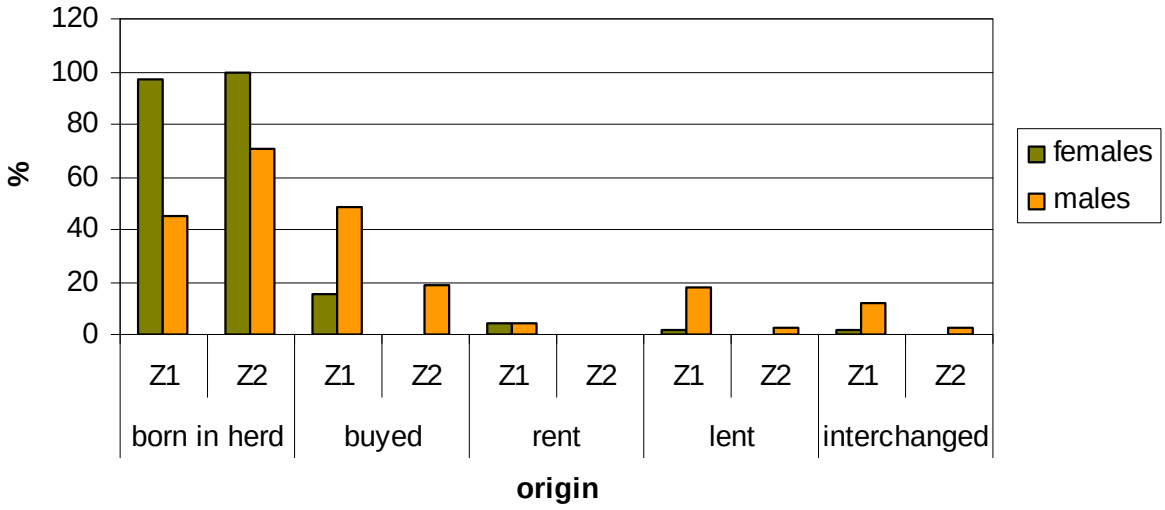

Figure 21: Origins of breeding males and females

In Z1 the most common origins of breeding males is buying and recruiting from their own herd. Lending, interchanging and renting plays a minor role only. In Z1 less than 20% of the farmers said they would interchange, lend or rent breeding males.

Significant differences between the two study sites were observed. In Z2 farmers obtain breeding males usually from their own herd and, compared to Z1, less farmers buy breeding males. Renting, lending and interchanging of breeding males is negligible in Z2.
It was observed that most interchange activity of breeding males takes place in herd class 2. 17.65% (near significance 0.064) of the farmers stated to practice interchange of breeding males (herd class 1: 5.08%, herd class 3: 0%).

Table 13: Origins of breeding males and females (figures are % of respondents)

Origin	Zone	Male	Female	P-Value
Own herd	Z1	45.45*	95.45	0.012
	Z2	71.05	100	
purchase	Z1	48.48*	15.38*	0.002/ 0.014
	Z2	18.42	0	
Lending	Z1	18.18*	1.58	0.021
	Z2	2.63	0	
Renting	Z1	4.55	5.52	n.s
	Z2	0	0	
Interchange	Z1	12.12	1.54	n.s
	Z2	2.63	0	

***= significant**

Most farmers keep their best breeding llamas and do not sell them (68.18% in Z1, 63.16% in Z2). Nevertheless, the remaining farmers mentioned economic reasons (Z1=7 respondents, Z2=4 respondents) and meat production (Z1=6 respondents, Z2=8 respondents) as reasons for selling the best llamas.

Reproductive management

An average farmer in Z1 owns 1.51 males (SD ±1.24, range: 0 - 5); a farmer in Z2 has 2.31 males (SD ±2.47 range: 0 - 10) for mating. The number of males increases with the herd size. Significant differences between zones and herd classes were observed.

Table 14: Number of breeding males in herd

Herd class	Mean ± SD (nr. of animals)	Minimum (nr. of animals)	Maximum (nr. of animals)
1 (n=59)	1.47±1.41	0	6
2 (n=34)	2.0±1.96	0	10
3 (n=11)	3.0±2.72	0	10

The average time span llama males are used for breeding is 3.62 years (SD ± 2.16 range: 1-15) in Z1 and 4.81 years (SD ± 2.76 range: 2-15) in Z2, respectively. The study sites show a significant difference with respect to the duration of the useful life.
Most farmers use one male for their entire number of females because generally they do not estimate how many males they need. The specifications how many females a single male can serve, ranged from 1 to 100, whereas the quantity of 10 (Z1=8 respondents, Z2=2 respondents) was stated most frequently. Independent of the herd size, farmers did not estimate how many males they need for mating.

Uncontrolled mating occurs in 83.08% of the farmers' llama herds in Z1 and 97.37% in Z2. A significant difference between the two zones was observed.
Main reasons for uncontrolled mating are: all llamas are kept together (Z1= 83.08%, Z2= 92.11%); lack of knowledge (Z1= 20%, Z2= 68.42% - significant) and insufficient number of males (Z1=26.15%, Z2= 31.58%). Other reasons mentioned were lack of fencing, lack of time and no interest, which, however, is negligible.
The remaining farmers (11 people in Z1, 1 farmer in Z2) practice controlled mating. The methods used are controlled individually (3.08% in Z1 and 2.63% in Z2) and controlled mating on field (13.85% in Z1).

Usually, farmers have no system of mating (92.31%Z1, 100% Z2) because males randomly mate females in the herd. Nevertheless, 5 farmers answered to have a mating system. One farmer mentioned to mate the best with the best, three farmers stated that llamas are mated by phenotypes and one farmer answered that he mates his llamas by colour.

Figure 22: Male randomly mating a female © C. Mendoza

Reproduction

Farmers stated that the average age at first mating in males is 26.3 months (± 8.28 range: 12-60) in Z1 and 27.3 months (± 9.43 range: 8-48) in Z2. On average, females in Z1 are 22.8 months (±5.59 range: 12-36) old and 24.8 months (± 7.34 range: 12-36) in Z2.

Most births occur in January (45 people Z1, 19 people Z2), February (45 people Z1, 23 people Z2) and March (40 people Z1, 21 people Z2) in both zones.

The average reproductive life of a female in Z1 is 8.34 years (± 2.38 range: 4-15) where she gives birth to 5.76 offspring (± 2.107 range: 3-12). In Z2 the average reproductive life of a female is lower (not significantly) with 7.97 years (± 3.069 range: 4-20) and 5.20 offspring (±1.83 range: 3-10).

Inbreeding

In Z1 39.06% of the farmers allow their breeding male to mate his mother and 43.75% of the farmers allow the male to mate his sister or daughter. In contrast, in Z2 80% of the farmers allow their breeding male to mate his mother, sister or daughter, which is a significant difference between study sites.

Reasons mentioned in both study sites why farmers allow this practice are lack of fences, lack of males and the fact that all llamas are kept together. Moreover, there is a significantly higher number of farmers in Z2 (36.84% Z2, in Z1 9.09%) who mentioned the lack of fences as main reason.

The remaining farmers do not allow the male to mate his relatives. The main reason mentioned was the awareness of potential problems of inbreeding, with 48.48% in Z1 and 10.53%, respectively. Other reasons why males do not mate close relatives are: no males in herd, castration, recently bought llamas, no relatives in the herd and slaughtered males which are born in the herd. The differences between the two study sites are highly significant.

4.4 Products, markets and help from external organisations

This chapter provides the obtained results regarding llama products, their sales channels and external support for llama farmers.

Meat production

Most farmers slaughter llamas for personal meat consumption (90.91% Z1, 84.21% Z2).
Regarding slaughtering of llamas for market, a significant difference between the two study sites was observed (93.94% Z1, 73.68% Z2).
Barter trading plays a minor role (3.03% in Z1, 10.53% in Z2) for llama farmers in the study areas. Nevertheless, is has a greater importance in Z2. Farmers in herd classes 2 and 3, respectively, sell animals more frequently (herd class 2= 97.06%, herd class 3= 90.91%) as compared to herd class 1 (79.66%).

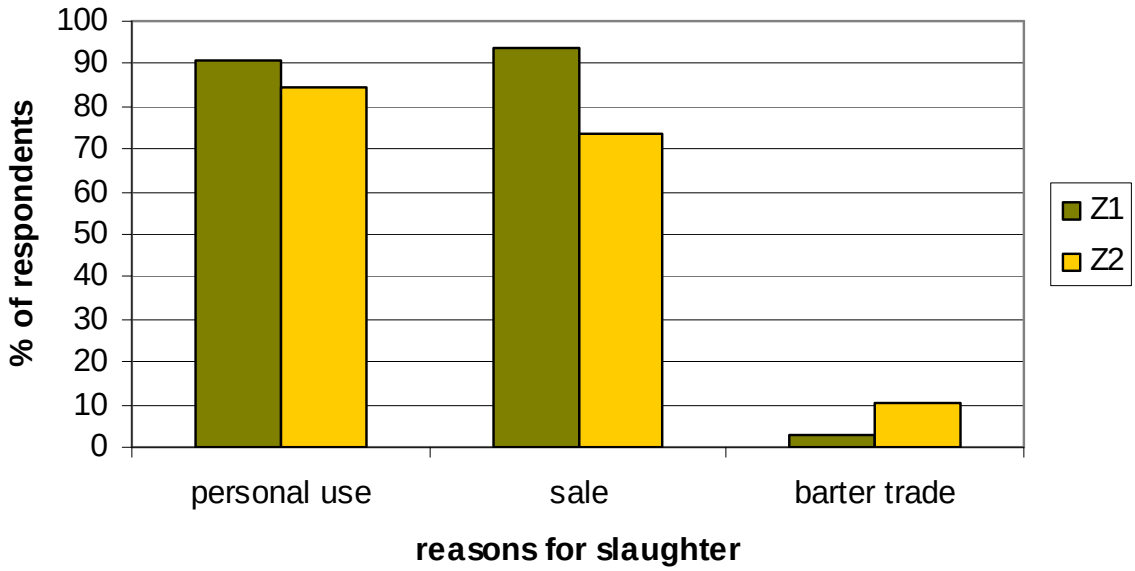

Figure 23: Reasons for slaughtering llamas

The majority of the farmers in Z1 use males younger than 2 years of age for personal consumption whereas in Z2 usually males younger than 2 and older than 2 years of age are used.
For commercialisation of meat in Z1 generally males younger than 2 years and females of more than 2 years (which are mainly old females at the end of their reproductive time) are used. People in Z2 trade meat usually from males of more than 2 years of age and females of more than 2 years (at their end of reproductive time).

Table 15: Animals slaughtered for personal use or sale (figures are % of respondents)

		Males <2	Males >2	Females<2	Females >2(old)	Castrates
Personal use	Z1	69.70*	24.24*	21.21	30.30	18.18
	Z2	42.11	44.74	15.79	26.32	21.05
sale	Z1	57.58*	40.91	13.64	62.12*	24.24
	Z2	21.05	52.63	13.16	42.11	18.42

***=significant difference between zones is shown**

It is common to slaughter animals directly on the field or near the house (87.88% in Z1, 89.47% in Z2). Only 5 persons (7.58%) in Z1 slaughter their livestock in a slaughterhouse. The remaining persons do not slaughter their animals, but sell them alive.

The number of llamas destined for meat is significantly higher in Z1 as compared to Z2. On average, 10 llamas are slaughtered or sold per farmer and year (± 9.76 range: 1-60) in Z1, whereas in Z2 only 6 llamas are slaughtered or sold per farmer and year (±6.78 range: 0-40). The number of llamas destined for meat considerably depends on the herd size. It is plausible that a larger herd provides more animals for slaughtering (herd class 1=4.38 ± 4.08 range: 0-25, herd class 2=9.47 ± 6.78 range: 0-40, herd class 3=24.9 ± 15.98 range: 6-60). In Zone 1 80.3% of the respondents sell their llamas as meat and 42.42% alive. In Z2 the tendency is similar whereas 63.16% sell their animals as meat and 36.84% sell them alive.

Fattening

49.23% of the farmers in Z1 do not fatten llamas in order to gain more meat and weight, whereas in Z2 68.42% of the farmers stated to practice fattening.
However, it has not been specified which form of fattening is performed by farmers.
Llamas fattened in Z1 are predominantly males younger than two years of age (36.92%), males older than 2 years and old females at the end of reproductive age (each 24.62%). In Z2 farmers fatten males older than 2 years of age, males and females younger than two years of age (each 23.68%). There are no significant differences between zones and herd sizes concerning the choice of farmers to fatten llamas or not.

Meat products

Products made from llama meat are mainly fresh meat and charqui (fresh meat accounting for 95.24% in Z1 and 87.88% in Z2; charqui accounting for 68.25% in Z1 and 87.88% in Z2). Regarding charqui production there was a significant difference between the two study sites. Sausages or other meat products are not relevant as there are no facilities for further processing.

Commercialisation of meat, hide and live animals

In Z1 81.82% of the farmers and 50% of the farmers in Z2 sell meat. Thus, a significant difference between the two zones was observed.

Meat is mainly commercialised between April and July (56%in Z1 55, 63.16% in Z2). All other farmers sell meat all year round depending on their economic needs. In Z1 68.18% of the farmers and 31.58% in Z2 sell their meat to intermediates. Intermediates in Z1 are generally locals or people from at least the same region, in contrast to Z2 where all intermediates are locals. Only 9 farmers (13.64%) in Z1 and 7 farmers (18.42%) in Z2 sell their meat locally to shops or markets.

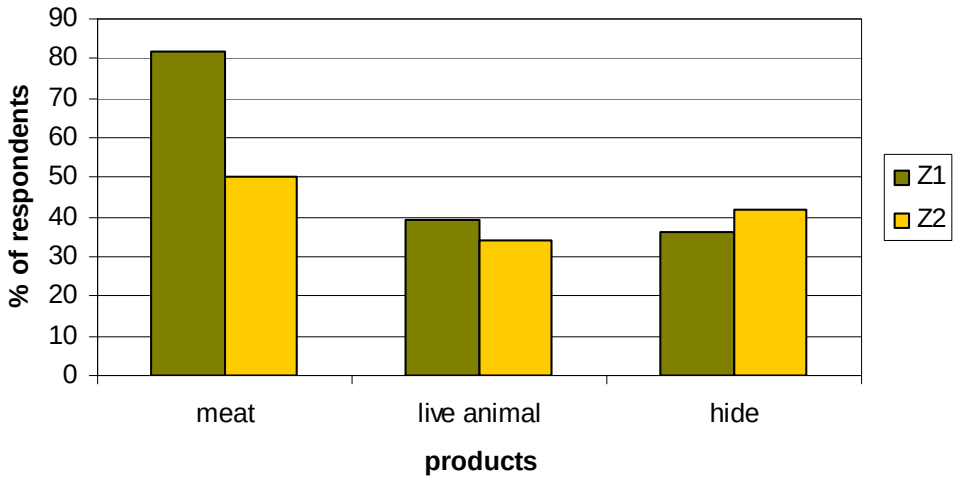

Figure 24: Commercialised products

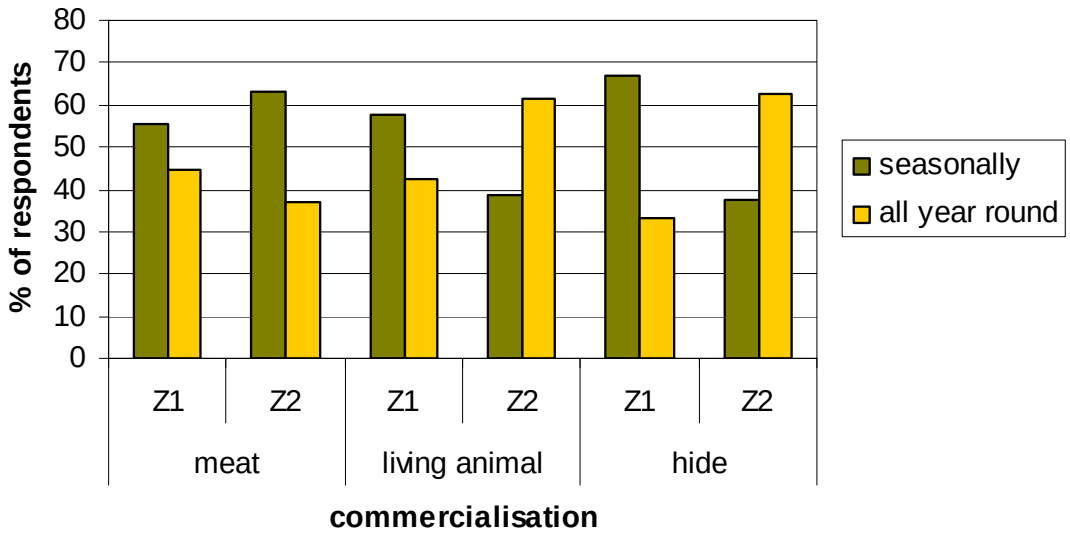

Figure 25: Time of commercialisation

Marketing of living lamas (Z1= 39.39%, Z2= 34.21%) is not as common as selling meat. Farmers sell living llamas mainly to intermediates (100% in Z1, 92.3% in Z2) and only one person stated to sell living animals locally (7.7% in Z2).

On average, 9.84 animals (± 9.27 range: 1-40) are sold for 204.25 Nuevo Soles (± 72.61 range: 115-420) = 59.9 EUR per animal in Z1. The price is significantly lower in Z2, where an average of 3.84 (± 3.30 range: 2-13) animals are sold for 143.3 Nuevo soles (± 28.39 range: 80-180) = 42.09 EUR.

57.69% of the farmers in Z1 and 38.46% in Z2 sell living animals seasonally from April to July. The remaining people sell their llamas all year round. Concerning the time of commercialisation, a significant difference between the study areas was observed, because in Z1 marketing takes place significantly more often seasonally than in Z2, where marketing takes place mostly all year round.

Intermediates who buy living animals are locals or are at least from the same region in Z1. In Z2 all intermediates are locals.

In Z1 36.36 % and in Z2 42.11% of the farmers commercialise llama hides. In Z1 farmers sell an average of 8 (± 8.12 range: 1-35) hides of young animals and 6 (± 4.78 range: 1-20) hides of adults for 8.27 (± 7.25 range: 1-30) Nuevo soles= 2.57 EUR. In comparison to Z1, farmers in Z2 sell 4.5 (± 5.11 range: 1-20) young llama hides and 3.47 (± 1.92 range: 1-7) hides of adult animals at a price of 7.42 (± 5.38 range: 1-20) Nuevo soles= 2.31 EUR. The number of hides of young llamas is significantly different between study sites. To a greater extent, hides are bought by intermediates. In Z1 the intermediate traders are regional and intermediates in Z2 are mainly locals, which significantly differs between the two study areas.

Shearing

68.18% of the interviewed farmers in Z1 and 57.89% in Z2 shear their llamas. Most of the farmers shear their llamas randomly (84.44% in Z1, 95.45% in Z2). A significant difference occurs regarding herd sizes and the decision to shear all llamas. Farmers having a small number of llamas shear all llamas at fairly regular intervals (21.62%). In herd classes 2 and 3, nobody stated to shear their llamas with certain regularity.

External support

The majority of the respondents have not received any type of assistance (75% in Z1, 77% in Z2).

Only few respondents have received some sort of training in livestock keeping so far (25.76% Z1, 23.68% Z2). In Z1 and Z2 assistance mainly involved producing charqui, pasture management, handicrafts, general management of SACs and reproduction management. However, the focus has mainly laid on alpacas.

External organisations

Help from external organisations is not common in either of the two study sites (100% Z2, 90.91% Z1). The remaining 9.09 % of farmers in Z1 received help from the NGO Fodesa. These respondents where mainly located in the village Tunacancha where Fodesa cooperates with farmers.

For a future improvement of llama breeding, most respondents have to use their own capital (81.82% Z1, 92.11% Z2). The local and regional government, loans, donations and NGOs do not play a noteworthy role in llama rearing.

Future

In both study sites the majority of the farmers intend to increase their llama herd in the future. Reasons most frequently mentioned in Z1 are: llamas have more meat than alpacas; are more resistant against diseases and environmental difficulties; llamas are profitable. In Z2 reasons mentioned are: llamas produce more meat, better management in the future, profitability and economic income. The rest of the people in Z1 who do not want to increase their number of llamas in the future stated the following: they want to improve the quality instead of increasing the quantity of llamas; no land/pastures available; llamas have no economic value. In Z2 the reasons for not increasing the number of llamas in the future are as follows: lack of land/pasture; llamas have no economic value. Herd sizes do not influence the decision on whether to increase llama herds or not.

Figure 26: Llamas in Santa Ana de Tusi © B. Wolfinger

5 DISCUSSION

All data collected are perceptions obtained from farmers and no crosschecking of data could be realized. E.g. Data about herd sizes, breeding practices could not be verified. Therefore, this data has to be handled with caution. Nevertheless, it points out the current management system as well as the perception of llama keepers about their problems in the study area.

General information and socioeconomic aspects

Generally, men are head of households. Throughout all interviews with women, the impression arises, that these women had less knowledge about their livestock than men because it was difficult to get answers. Women often responded that their husbands would be able to answer the questions more precisely.
On the contrary, Guadalupe (1994) stated that women have the knowledge and responsibility for the family's livestock and they also select the animals for slaughtering.
Caro (1992 in Nürnberg 2005) describes a gender specific division of responsibilities in households in the southern Altiplano. Men generally take over the tasks of agriculture and work abroad, whereas women are responsible for the livestock.

According to Guadalupe (1994), the illiteracy rate of males amounts to 45.65% and that of females to 65%, respectively, in Pasco and Daniel A. Carrion.
During this survey, most farmers stated that they had at least attended primary school. Only a few persons were illiterate.
The data of Guadalupe (1994) does not correspond with the data collected in the subject survey. The time span between the two periods of data collection is 18 years. Heads of households changed and modernisation regarding new media (like radio, TV and computers) took place.

54.55% of farmers who keep more than 79 llamas have an advanced level of education (higher than secondary school). A significant difference concerning main source of income of higher educated people was expected but not observed. It was expected that, unlike farmers with a low level of education, higher educated farmers have other main sources of income apart from livestock keeping. A significant difference between Z1 and Z2, where a larger number of persons found a job outside the farm, was observed. Furthermore, it also depends on the location, if farmers have other income opportunities than livestock keeping. If possible, farmers often use the chance to earn an income apart from livestock keeping, which was observed in the ranking of main source of income (Fig. 10).

The reason most frequently mentioned for keeping llamas is meat production. It is the only product of considerable value and demand on the Peruvian market. Nürnberg (2005) mentioned that in Bolivia llamas are primarily used for the transport of goods. However, their dung, meat and fibre are used as well.
The use of llamas for transport was rarely observed and is no longer relevant.
Llama fibre is sold to traders at a very low price. Guadalupe (1994) mentioned that traders exert downward pressure on llama fibre prices arguing that this product does not serve for the textile-industry and is regarded as waste material, which is totally untrue. Furthermore Guadalupe (1994) stated that fibre quality of intermediates, peladas and lanudas is generally lower than that of alpacas representing the most important livestock in the central Peruvian rangelands.
Keeping llamas out of tradition and as savings has a higher importance in Z2 than in Z1. Eventually, due to other work opportunities in Z2, llamas are kept more often for traditional purposes and food security than for the processing of meat or fibre. Peru has a relatively instable currency, and, therefore, people might prefer owning animals rather than saving money at a bank.

In Z1 livestock plays a major role as source of monetary income, which is illustrated by a higher number of alpacas, as compared to Z2, because alpacas provide the highest monetary income for farmers. Sheep were ranked more frequently as 2nd most important animal in Z1, whereas in Z2 llamas were ranked on 2nd place. This significant difference allows for no interpretation as in either of the two study areas sheep are slaughtered regularly to cover the families' meat requirements, and their wool is sold as well. Nevertheless sheep are more care intensive than llamas and at farms with additional income sources, the amount of workload, easy handling and the cultural value is eventually more important.

The number of alpacas and sheep varies significantly between herd classes, which means that larger farms generally own larger livestock herds. The number of alpacas kept per farmer is varying between the study sites. This is probably due to the different working opportunities and that llamas are less work intensive than alpacas.

Most farmers in both study sites increased their number of alpacas within the last five years because they provide the highest monetary income.
No clear trend of an increased number of llamas was observed in Z1, whereas in Z2 a tendency towards a decrease of llama stock occurred. This result does not match with the ranking of farmers' most important livestock in Z2. For traditional reasons, farmers give priority to llama keeping over sheep farming.

Nevertheless, Nürnberg (2005) mentioned that 55% of the respondents in the Ayopaya region in Bolivia increased their llama herd, 28% had a stable population and only 17% decreased the llama numbers. These values do not correspond with the values of the subject survey and are not comparable, because Bolivia has a larger llama population and these animals are also used for fibre production and alpacas play a minor role there.

Farmers with large herd sizes generally increased their number of livestock. It is obvious that financial bottlenecks occur more frequently at subsistence farmers due to the lower amount of livestock and limited sale opportunities. A decline in the number of llamas might be stopped if the price of llama meat increases. The actual meat price is very low and, therefore, farmers often sell llama meat as alpaca meat. Alpaca meat achieves higher prices on the market and customers are not in a position to distinguish the differences.

Production and management system

In Z1 significantly more farmers practice pasture management. Nevertheless, it has not been specified what kind of management strategies farmers realize. Therefore, the term "management" may range from using fences up to pasture cultivation. In general the absence of fences implicates in most cases that farmers do not practice pasture management. The lack of fencing occurred to be the most common problem for farmers especially in Z2. Also, problems with uncontrolled user rights mainly occur at farms with insufficient or no fencing at all. All in all, fencing seems to be essential for minimizing management problems.

Farmers stated that higher mortality rates and genetic defects sometimes occur due to contaminated pasture (contaminated from mining activities). However, this fact could not be verified in the framework of this data collection.
Pasture extension is a bigger problem in small scale farms with an amount of livestock lower than that of larger farms.
Subsistence farmers striving to make a living are limited in terms of amount of animals and availability of pasture. Fernandez-Baca (2005) stated that farmer with less available land, especially small-scale farmers, have higher stocking rates.
Water quality seems to be unproblematic, whereas the availability of water is an issue as the lack of water was mentioned in almost every interview. This fact corresponds with the findings of Flores and Egoávil (2006), that during the dry season water sources decline drastically. Water quality was not tested. Therefore the results reflect the farmers' opinions only. No ranking of the problems with pasture management took place. Therefore, one cannot say which problems farmers consider to be most serious. Anyway, all problems mentioned by farmers (Fig. 14) have a huge influence on the productivity of livestock in the study areas.

For the record of herd sizes and llama types farmers were asked to classify their llama herd into intermediates, lanudas and peladas. Most farmers had problems to distinguish between different llama types and age classes like e.g. foals, young or adult llamas. Therefore the values of the average herd structure and herd composition are only approximate values. Nürnberg (2005) had the same impression in Bolivia, that farmers not always had an exact overview of the structure of their llama herds.
In Z1 more farmers own pelada type llamas and less intermediate animals than farmers in Z2. In the author's opinion more farmers in Z1 try to select in terms of a meat based pelada type. The lanuda type occurred less frequently in both zones compared to intermediates and peladas. In Z2 respondents eventually care less about llama types and selection or have no opportunities to get good breeding stock. This might explain the higher amount of intermediates occurring in Z2. In Z2 one might get the impression that farmers generally do not care much about their llamas. 100 % of the interviewed farmers in Z2 keep their llamas together without any separation, which also might be as well a reason for the higher amount of intermediates.

If the complete llama herd is kept together, weaning of foals is unlikely and did actually not occur in the study sites. Weaning is more likely if males and females are separated. A separation of the llama stock is considerably more common in herd class 2 than in the other classes. According to Fernandez-Baca 2005 this might be due to the fact that medium scale farmers are progressive, invest in new technology and are eager to learn. It is possible that their herd size is large enough to practice separation and weaning efficiently and at the same time small enough to have an overview of the herd.
In Z1 40% of the interviewed farmers wean their llama offspring, whereas in Z2 nobody practices weaning. According to Ponzoni (1996), most farmers do not favour artificial weaning. A weaning age between 8-10 months is common. In general, farmers with larger herd sizes wean earlier, that is at 6-7 months. It is possible that farmers with lager herds eventually know the benefits of earlier weaning like better recovery of female, better body condition and earlier reception, which also corresponds as well with the statement of Fernandez-Baca (2005) regarding medium scale farms. The nonexistent weaning in Z2 corresponds with the fact that farmers have no fencing and no separation by sex or age classes.
Guadalupe (1994) referred to the lack of manpower, corals or pastures and technical ignorance as reasons why farmers do not wean their llama offspring.

Approximately 1/3 of the respondents in both study sites stated to mix llamas with other livestock in their resting areas. This practice of mixing llamas with alpacas increases the probability of crossings between them. The so-called huarizos are unwanted as their fibre has

poor quality. The number of huarizos within the herd was neither collected nor mentioned by farmers. One explanation for this could be that farmers counted them as alpacas.

Common diseases in llamas are lice, scabies (mites), ticks and liver fluke. Most farmers treat animals by themselves, although vet services are available in most cases. Treating the animals themselves is definitely cheaper and farmers possible do not value llamas enough to call on veterinary services. Another assumption is that farmers presume that due to the high resistance of llamas against diseases, they can cope with certain diseases without any medication.
Guadalupe (1994) also stated that medical treatment is deficient and traditional practices are used. Without any planned controls of the dosage, anti parasitic baths, therapies and the awareness of farmers about the importance of animal health, diseases will recur which negatively impinges on livestock production.
Better observation and treatment would help to reduce animal losses.
Nürnberg (2005) stated that in Bolivian llamas the most common diseases are diarrhoea, mange, fever, lice and ticks in this order. These results are partly similar, but show that different problems occur in llama populations. However, Colque (1995) and Medrano (1995) stated that mites, lice and ticks were mentioned as the most common ectoparasites by llama farmers, which corresponds with the findings of this study.

The castration of llama males is more frequently realized in Z2. One would expect that this initial situation provides better conditions for breeding a pure llama type. However, the number of males in the herd that were castrated per year was not an issue. Possibly, that only spirited or aggressive males are castrated and docile ones are spared, because birth control is not the main reason for castration. One might get the impression that the frequency of castration depends on the location of the farms.
Guadalupe (1994) mentioned that the castration of pelada males is common because they are intended to be pack animals and castrated males are more docile and less obstinate.
The role of llamas as pack animals is negligible in most villages, whereas the reason of castration is the better temperament and easier handling of castrated males.

Breeding

Selection criteria in males and females are nearly similar. Ranked by their importance, body size, conformation, colour and pedigree are the main selection criteria. Additionally, the absence of genetic defects is a selection criterion in female llamas.
Markemann and Valle Zarate (2009) described body conformation, fibre, testicle conformation, fleece colour, height at withers and healthiness as the most important selection criteria in llama males with declining importance in the order mentioned. In llama females, body

conformation, fibre, fleece colour and height at withers are the selection criteria most important in Bolivian llamas in the Ayopaya region.
Nürnberg (2005) characterised the fibre quality, conformation, body size, mating ability and healthiness (without genetic defects) as the selection parameters for Bolivian farmers in the same region. Panama (1995) and Rojas (1995) stated that body size and fleece colour are used as the main selection criteria for llama females.
Clear differences exist between the selection criteria of Bolivian and Peruvian farmers in the respective study areas. Fibre quality is of high importance in Bolivia, unlike Peru where body size is most important. These results reflect the different use of llamas in different locations.
The coat colour of llamas is an issue when farmers select animals. However, it should play a minor role when selecting pelada type llamas, as colour, colour uniformity and fibre quality are not essential when selecting pelada type llamas. In contrast, in lanuda type llamas, fibre quality and colour uniformity are important traits to consider.

It is assumed that the “ability to walk long distances” was important for farmers in former times. Nowadays, this trait is negligible as most villages in the study region can be accessed by road.
The characteristic “without any genetic defects” in llama females was mainly documented in Z2. This might be due to the low selection intensity and, consequently, the higher inbreeding in Z2, which might result in increased obvious genetic deformations.
The absence of genetic defects does not really have a greater importance in females. The absence of genetic defects is important in selecting breeding males too, as it was observed by Nürnberg (2005). Very likely, this is even more important because, in general no males would be used for breeding if they had obvious genetic defects. Therefore, other selection criteria are more important.
The trait “growth rate” gains more importance with an increased herd size of farmers. This might be explained by the higher production and selection intensity as compared to small scale farmers. There might even be better recording for further selection steps at farm with larger llama herds.

White and black are the coat colours mostly preferred in llamas. This might be due to the fact that white fibre, like most alpaca fibre, has a higher value on the fibre market.
The most undesired fibre colour of llamas is multicoloured. Reasons for this may be attributed to the low price of multicoloured fibre and the additional work sorting the different colours. Farmers definitely select with the aim of breeding single coloured animals, as stated by Markemann (2009).
Guadalupe (1994) mentioned that the great amount of multicoloured animals is due to the lack of genetic improvement, selection and inbreeding problems.

Reasons for culling breeding females are age, sterility, bad maternal attributes, diseases and abortions. Age was most frequently mentioned as a reason for culling as this is easier for farmers to recall. This response also included sometimes that older animals also tend to have more fertility problems.

Diseases might be a reason for culling breeding females, because medication is too expensive and the sick females are not worth being treated. By applying this criterion of culling sick breeding females, farmers, eventually and unknowingly, select towards disease resistant animals. Markemann and Valle Zarate (2009) mentioned age, sterility and meat demand for home consumption as reasons why Bolivian farmers cull females. However, females normally stay in the herd until they die or are culled because of diseases.

The issues “age” and “sterility” correspond to Markemann and Valle Zarates’ (2009) reasons for culling breeding females.

Renting, lending or interchanging of females and males has a minor importance for farmers. An explanation for the low importance can be the higher risk of injuries, diseases and maltreatment by bringing new animals into a herd. However, the most probable reason for the low exchange of breeding animals is that farmers do not expect any advantages. In contrast, they presume a higher workload is involved.

Breeding females mainly originate from the farmer’s own herd. A clear difference was observed between the two study areas concerning the origin of breeding males. In Z2 farmers mainly select breeding males from their own herd which corresponds with the findings of Nürnberg (2005) Certainly, this fact is a main reason for inbreeding problems. Eventually, farmers pay more attention to genetic defects through the increased occurrence of such disorders than farmers in Z1. Nevertheless, due to lack of fencing, other males owned by neighbouring farmers can easily mate females which reduces the possible risk of inbreeding.

In Ayopaya, Bolivia, Markemann and Valle Zarate (2009) observed that 76% of the interviewed farmers replace breeding males within their herd, 14% buy males and 11% use males from relatives or neighbours. These results correspond to the values of Z2 (see table 13).

The majority of farmers practice uncontrolled mating. Due to the fact that males often escape, it is not possible to assure any pedigree. This indicates that llama breeding is not a focal issue in farm management.

According to Markemann and Valle Zarate (2009) random interchange of llama males counteracts inbreeding but interferes with breeding organisation, selection and the collection of pedigree information.

The lack of fencing and the low number of males were mentioned as reasons for not separating males from the rest of the herd. Eventually these reasons serve as excuse for the high degree of relation. It is cheaper and less labour-intensive to replace males from the own herd than buying or changing breeding animals to avoid inbreeding to a certain extent. In Z2 most farmers do not attach great importance on breeding practices.

Some farmers stated to practice “controlled mating” (it is practiced by farmers to a very small extent, only). Some answers were not consistent because in a next step farmers stated that their llamas mate randomly. Maybe some farmers did not understand the question or were unwilling to tell the truth.
Usually, farmers have no mating system and their males mate females randomly.

Interchange activity was observed most frequently in herd class 2. Farmers in herd class 2 increase their llama herds, practice more separation of males and females and wean significantly more often. This leads to the assumption that these farmers practice more advanced llama management than the other herd classes.

In Z2 more inbreeding was observed. People use their breeding males significantly longer (4.81 years in Z2, 3.62 years in Z1). Nevertheless, in both study sites there are farmers who use their males for breeding as long as possible.
The data collected by Markemann and Valle Zarate (2009) shows that a replacement of breeding males is done every 3.7 years on average. However, they also stated that some farmers use their breeding males as long as possible in the herd. The values are comparable to the replacement interval of Z1. On the other hand Nürnberg (2005) mentioned an average useful life of llama males of 5.5 years which is comparable to Z2. The observed female average reproductive life of 8 years is within range of the data provided by Nuevo-Freire (1994) of 8-10 years.

The collected average number of males does not implicate that all males are used for breeding at the moment. There is the possibility that farmers included young llama males for future breeding. Furthermore, farmers are generally not aware of the prepuce adhesion in llama males, which is an issue when starting reproduction. Therefore, it is possible that farmers do not know if a young breeding male is ready for mating or not. Guadalupe (1994) mentioned the lack of knowledge of the llama male reproduction system, especially the prepuce adhesion, as problem of llama farmers.

Apart from the average age, the minimum and maximum age of males and females at first mating were additional issues of research. In most cases it was not possible to get a clear and

realistic answer. It appeared, that the questions of minimum and maximum age were too challenging. Farmers did not keep records, as they obviously did not deal with their llamas extensively. Unrealistic data was excluded. Nevertheless, it shows that some farmers have no exact knowledge of their llama stock.

Products, markets and external support

Meat production

It is obvious that farmers in herd class 1 sell significantly less animals than farmers of herd classes 2 and 3, respectively. They own a smaller amount of animals and, therefore, sell fewer animals. It is likely that small scale farmers need a comparatively higher amount of their livestock for their own consumption than farmers with a higher number of livestock.

Concerning the slaughtering of llamas for personal use, sale or barter trade it has not been specified how much older males “older than 2 years” are. Nevertheless, the majority of farmers gave a slaughtering age of around 3 years.

Five farmers stated to slaughter their llamas in a slaughterhouse. All other farmers slaughter their livestock at their farm. It was not specified whether these farmers really slaughter their livestock in a slaughterhouse or only have a special place (e.g. room) for slaughtering.

Meat products

Generally, processed llama meat products are irrelevant for farmers. Facilities for producing high quality meat are not available. Furthermore a national market for fresh and processed llama meat would have to be established to provide a reasonable income for farmers.

The values of Fig. 23 concerning the reasons for slaughtering do not correspond with the data given in Fig. 24. Inconsistency between answers in figure 23 and figure 24 can be observed. Figure 24 seems more reliable because farmers had to give further information about marketing meat. For example those who stated to sell meat but did not respond to sell any llamas where classified as farmers who do not sell meat. In Z1 a rate higher than 100% was determined (around 80% sell meat and 40% live animals) which means that around 20% of the farmers sell both live animals and meat. It was not possible to confirm whether llamas sold as meat really had a worse body condition than animals sold alive, as it was referred to by Vilca 1991 in chapter 3.6.

According to Nürnberg (2005) llamas are mainly marketed as live animals and meat is predominantly used for self-consumption. On average, 1.7 llamas were marketed per household and 100% of the live animals were marketed through intermediates in the Ayopaya

region, Bolivia (Nürnberg 2005). This result cannot be confirmed because in the study sites in Peru the market for llama meat is more important than that for live animals. The different use of llamas may be the reason for the varying ways of commercializing.

The selling of live animals between April and July corresponds with the findings of Vilca (1991) (see chapter 3.6).

In Z2 commercialisation through local intermediates takes place significantly more often. This might be due to the fact that the village Huayllay has urban infrastructures. This involves better opportunities to transport goods to the capital Cerro de Pasco where local demand for products is higher.

Shearing

Farmers with small herd sizes may have limited access to capital and fewer opportunities to sell stock. Llamas of small-scale farmers are sheared at fairly regular intervals. Fibre is a low value product, but for subsistence farmers money earned with llama fibre does represent a source of monetary income in times of need. If a llama produces good fibre quality, the material it is often sold as alpaca fibre or used for handicraft products that are sold as alpaca products, because llama fibre has more colour variation than alpacas which are predominantly white. Nürnberg (2005) also stated that llamas are sheared as short-term source of income, depending on family needs.

External support and organisations

The majority of farmers has no external support. People who stated to get support in terms of trainings in livestock keeping were not asked to specify whether this kind of support involved specific training courses or e.g. only an information event. This data shows that little attention from the government or other supporting organisation has been put on llama production. There is more support for farmers rearing alpacas as these animals also provide more income for farmers.

6 CONCLUSIONS

Farmers in Pasco keep llamas in a low input-low output system. Little investments are done regarding livestock or pasture improvement. The pasture quality is poor, especially during the dry season where water is not sufficiently available for livestock either. This results in a poor growth of animals which are fed by grazing.

Compared to other livestock, llamas are very work extensive. The uncomplicated handling and keeping still grants them a place in the actual livestock production system of the Andean peasants although their market value is low compared to other livestock. The meat of llamas is the only product with a certain value for traders. The main reasons for keeping llamas are their meat for self-sustenance and livestock sales. However, no strict market oriented production was found and only surplus animals or/and meat are sold. Llama fibre is predominantly used for personal requirements due to the extremely low value on the market.

No one of the participating farmers was specialized in llama keeping. All farmers owned additional livestock in combination with llamas, whereas most farmers keep a higher number of alpacas and sheep compared to llamas. Those mixed herds are considered important for risk spreading.

Farmers pay little attention to proper breeding techniques. Therefore, it may not be useful and practical to establish pure breeding programs without paying attention to the other problems farmers have to struggle with. Pasture and herd management seemed to be of greater importance than the (genetic) quality of the animals kept. Nevertheless most farmers have selection criteria for llama males and females. Most important traits for farmers are body size, conformation, colour and pedigree (in terms of knowing at least one parent). Nevertheless a combination of an improvement of pasture, herd and breeding management as well additionally an implementation of breeding programs would help farmers to sustain their livelihoods.

However, there is little risk that llamas will extinct if no breeding management is done. Less genetic improvement and a decline in the genetic variety are expected. Llamas will still play a role in the future of the high Andean production system to reduce the possible risks of raising only a single species in this harsh environment.

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8 ANNEX

Questionnaire:

Encuesta: Numero Fecha:

INFORMACIÓN GENERAL Y ASPECTOS SOCIOECONOMICOS

1. **Cual es tu Nombre**:_____
Sexo: M☐ H☐
Tu Edad: _____

2. **Quien es el Jefe de tu hogar y que relacion tienen**:_____

Sexo: M ☐ H ☐

Edad del jefe de tu hogar: _____ años

3. **Cual es el estado civil del jefe de familia**

Conviviente ☐
Casado ☐
Divorciado ☐
Viudo ☐
Soltero ☐

4. **cual es el Nivel educativo del jefe de familia:**

No tuvo educacion escolar ☐
Lee y escribe ☐
Grado: Primaria ☐
Secundaria ☐
Estudios superiores ☐
Asiste a programas de alfabetizacion ☐

5. **Personas que viven en tu casa; numero, edad y sexo:**

Niños: m ≤ 11 años: ____jóvenes: m: 12-18___ adultos: m >18 años: ____
h ≤ 11 años: ____ h: 12-18 ___ h > 18 años: ____

6. **Cuál es tu principal actividad económica (fuente de ingresos)**

Marcar (Ranking from 1-3, 1=most important)

Ganadería ☐___
Agricultura ☐___
Artesanía ☐___
Minería ☐___
Turismo ☐___
Otros _____

7. **Cuantas especies de animales crías:**

|numero|

a) Llamas: ____
Alpacas: ____
Ovinos: _____
Vacunos: _____
Otros:_____

b) Cual de ellos te da más plata?
1ero:_____
2do:_____
3ero: _____

8. **cual es la Tendencia de tu población de animales en los últimos 5** años**:**

	Ascendente	Descendente	Estable	Causa
Llama	☐	☐	☐	_____
Alpaca	☐	☐	☐	_____
Ovinos	☐	☐	☐	_____
Vacunos	☐	☐	☐	_____

PRODUCCIÓN Y SISTEMA DE GERENCIA

9. **Cuantas llamas tienes (en grupos de edades):**

	Llamas		
	Lanuda (chaku)	Pelada (kjara)	Intermedio
Cria			
Tuis			
Hembras			
Machos			
Capones			

10. **Piensas aumentar tu numero de llamas?**

S ☐ N ☐

No, porque_____

Sí, porque_____

11. **Porque motivo crias llamas y** Marcar (Ranking from 1-3, 1=most important)**:**

Carne ☐
Fibra ☐
Ceremonia ☐
Estiercol ☐
Transporte ☐
Piel ☐
Ahorro ☐
Otros:_____

ALIMENTACIÓN Y PASTOREO

12. Que Extensión de pastos dedicas a la crianza de tus llamas:

_____ Has.para llamas
Propiedad: propio ☐
Comuna ☐
alquilado ☐
otro ☐ _____
_____Has. total

13. Cual es tu Método de pastoreo:

	Estacion humeda	estacion seca
Pastoreo libre	☐	☐
Con pastor	☐	☐
Pastoreo mixto	☐	☐
Otros_____	☐	☐

14. Duración del pastoreo durante la estación húmeda:

En la mañana desde_____hasta_____horas
En las tardes desde _____hasta_____horas

15. Duración del pastoreo durante la estación seca:

En la mañana desde _____hasta _____horas
En la tarde desde _____hasta _____horas

16. Cuentas con canchas de pastoreo? Si ☐ No ☐

17. ¿Cómo usas las canchas de pastoreo asignadas a llamas?

Cancha	Superficie Has	Época	Tipo de pastizales	Condiciòn	Tendencia +/-	Clase de Ganado(llama, ovino,…)

Condicion: Excelente, Bueno, regular, pobre, muy pobre

¿Qué tipo de pastizales posees destinadas para pastoreo?

Pajonales (ichu, paja,festuca, calamagrostis, stipa, etc.) ☐
Césped de Puna (aciachne ó pacu pacu, mula pilli, warako,pulla pulla,china etc.)☐
Bofedal (sora, tullupasto, pilli,q´ollo,miski pilli, etc.) ☐
Tolares (Festuca dolichophylla ó chilligua, etc.) ☐
Totorales y Juncales (totorilla, matara, junco, etc.) ☐
Otros: _____

18. ¿Cuáles son las principales dificultades en el manejo de tus pastos?

ninguna ☐
Falta de cercos ☐
Sobrepastoreo ☐
Poca extensión de pastos ☐
Problemas de tenencia de tierras ☐
Ausencia de fuentes de agua ☐
Falta de reservorios y represas ☐
Contaminación ☐
Quema no controlada ☐
Invasión de malezas ☐
Daño de animales ajenos ☐

19. ¿Cuentas con plan de manejo y conservación de pastos? ☐ SI ☐ NO

20. ¿**Cuentas con cercos perimétricos**?
SI ☐ NO ☐

21. ¿Cuentas con divisiones o potreros cercados?
SI ☐ NO ☐ Cuantos:_____

22. ¿Pagas por el uso del pastizal comunal ? ☐ SI ☐ NO

23. Si respondió SI ¿Cuánto pagas por especie al año en nuevos soles?

Vacunos	
Ovinos	
Alpacas	
Llamas	
Caballos ó burros	
Otros	

SUMINISTRO DE AGUA

24. Cuentas con fuentes de agua?

No cuenta ☐
Lagunas ☐
Ríos ☐
Puquiales ☐
Ojos de agua ☐
Canales ☐
Otros ☐

25. **Como es la calidad del agua para tus llamas?:**

	Estación seca	Estación Húmeda
Limpia	☐	☐
Lodosa	☐	☐
Mal olor	☐	☐
Otros _____	☐	☐

26. **Distancia para el punto de agua mas cercano al dormidero de tus llamas?**

a casa ☐
< 1 km ☐
1-5 km ☐
6-10 km ☐
> 10 km ☐

27. **Frecuencia de racionamiento de agua para tus llamas adultas :**

	Estación seca	Estación húmeda
Siempre disponible	☐	☐
Una vez por dia	☐	☐
Una vez cada dos días	☐	☐
Otro:_____	☐	☐

MANEJO

28. **Comó manejas tu rebaño?**

Machos y hembras separados ☐
Crías separadas después del destete ☐
Todas las clases están juntas ☐
Otros_____ ☐

29. **Tienes dormidero para tus llamas?** Si ☐ No☐

30. **Son tus llamas mezcladas con otros animales en el dormidero?**
S ☐ N ☐
Sí, cual animales?_____

SANIDAD

31. **Cuentas con Acceso a servicios de veterinaria:**

Veterinario privado ☐
Tienda o mercado ☐
Otros:_____ ☐

32. **Distancia más cercana a un veterinario desde el lugar donde crias tus llamas:**

< 1 km ☐
1-5 km ☐
6-10 km ☐
>10 km ☐

33. **Cuáles son las enfermedades mas comunes en tus llamas?**

Tipo de enfermedad	Síntoma	epoca	edad del grupo susceptible	rank

USO DEL MACHO COMO REPRODUCTOR

34. **Cuantos llamas machos tienes para empadre?** _____
35. **Como calculas cuantos machos nececitas para empadre?**

_____

36. **Cuantos años promedio un llama macho es utilizado en tu rebaño?**
_____ años

37. **Haces un manejo especial para tus llamas macho?** S ☐ N ☐

38. **Cuando Si- que tipo de manejo?** _____

39. **Origen de tus llamas para la reproduccion**

	M	H
Nacido en tu rebaño	☐	☐
Comprado	☐	☐
Alquilado	☐	☐
Prestamo	☐	☐
Intercambio	☐	☐
otro:_____	☐	☐

40. **De donde compras los reproductores(machos y hembras) en los últimos 5 años? Numero total de: H____ M_____**

Nombre del vendedor de las llamas	**Procedencia de llamas**	**Cantidad**	**Sexo**	**lugar de compra**	**precio**

41. **De donde alquilas los llamas reproductores (hembras y machos) en los últimos 5 años? Numero total de: H____ M_____**

Nombre del que alquila	**procedencia**	**Cantidad**	**Sexo**	**Precio**

42. De donde te has prestado los reproductores llamas machos en los últimos 5 años?

Nombre	Cantidad	Procedencia

43. Con quien has intercambiado los reproductores llamas machos en los últimos 5 años?

Nombre	Cantidad	Procedencia

¿Por qué buscas llamas machos de otros rebaños?

_____

44. ¿Alquilas/vendes/prestas/regalas tus llamas machos a otros rebaños?
alquilas☐
vendes☐
prestas☐
regalas☐
No. ¿Por qué?:_____
Si. ¿Porque?:_____

45. Vendes tu mejores hembras ó machos? S ☐ N ☐

46. Si. ¿Por qué? →¿A quién? (Ej. Familia, campesinos del pueblo, amigos, etc.)

_____

47. ¿Realizan ferias ganaderas en tu comunidad? SI ☐ NO ☐
que opinion tienes:_____

_____

48. ¿Consideras importante tu participación en ferias ganaderas?

SI ☐ NO ☐

49. Que aspecto consideras más importante de la realización de ferias ganaderas:

☐ Lugar de aprendizaje
☐ Observación y comparación de animales
☐ Aprendizaje sobre criterios físicos que caracterizan los buenos ejemplares
☐ Intercambio de opiniones
☐ Venta de animales
☐ Todos los anteriores
☐ Otros:_____

50. ¿Qué instituciones realizan las ferias ganaderas?

_____

SELECCION

51. Practicas selección en:

Machos S ☐ N ☐
Hembras S ☐ N ☐

52. A que Edad seleccionas tus llamas?

Macho _____ meses
Hembra _____meses

53. cuales son tus Criterios de selección para tus llamas macho:

	marcar | rank
Tamaño	☐__
Conformacion	☐__
Color	☐__
Temperamento	☐__
Velocidad de crecimiento	☐__
Fibra	☐__
Libido	☐__
Capacidad de caminar distancias amplias	☐__
Pedigree	☐__
Otros_____	☐__

Lista de colores preferidos: 1._____ 2._____ 3._____
Lista de colores indeseables: 1._____ 2._____ 3._____

54. Criterios de selección para tus llamas hembras jovenes(reemplazo de llamas hembras viejas):

	marcar | rank
Tamaño	☐__
Conformacion	☐__
Color	☐__
Capacidad de caminar amplias distancias	☐__
Temperamento	☐__
Velocidad de crecimiento	☐__
Pedigree	☐__
Fibra	☐__
Otras_____	☐__

55. Criterios de selección para saca/descarte de tus llamas madres?:

Fertilidad ☐
Aborto ☐
Mala madre ☐
Enfermedad ☐
Otros_____ ☐

56. Cuáles son los métodos de selección de llamas que utitizas?

Observación visual – criterio propio ☐ criterio CONACS ☐
Otros ☐ _____

57. tu empadre es:
controlado ☐ no controlado ☐

58. Cuando no es controlado, cual es la razón?

Llamas pastan en conjunto ☐
Falta de conocimiento ☐
Insuficiente numero de machos ☐
Otros_____ ☐

59. Cuando es controlado, que método utilizas?

Controlado individualmente ☐
Amarrado (hembras con patas amarradas) ☐
empadre controlado a campo(un grupo de hembras con un macho)☐
Otros_____☐

60. Permites que tu llama macho monte a su...

	Si	**No**	**Porque**
Madre	☐	☐	_____
Hija	☐	☐	_____
Hermana	☐	☐	_____

61. Permites que tu llama macho monte a otras llamas hembras además de las tuyas?

S ☐ Porque_____
N ☐ Porque _____

62. En qué fechas realizas el empadre?

Enero a marzo ☐
abril a diciembre ☐
todo el año ☐

63. Cuál es el esquema de apareamiento que utilizas?

Lo mejor con lo mejor ☐
Al azar (sin control) ☐
Por razas ☐
Otros.... ☐

64. En qué edad realizas el deteste?

Seis a siete meses ☐
Ocho a diez meses ☐
Die diez a doce meses ☐
Otros..... ☐

65. Cuáles son las pricipales dificultades en la crianza de tus llamas?(rank 1-3)

	Markar	Ranking (1-3) 1=most important
Falta de Pastos		
Genotipo		
Defectos congénitos		
Enfermedades parasitarias internas		
Enfermedades parasitarias externas		
Enfermedades infecciosas		
Problemas fertilidad		
Dificultades técnicas ó problemas de manejo		
Problemas administrativos dirigenciales		
Otros		

CASTRACIÓN

66. Castras tus llamas machos?
S ☐ N ☐

67. Cuando si, por que?

Control de la cría ☐
Mejorar el engorde ☐
Mejor temperamento ☐
Mejor precio ☐
Otro_____ ☐

68. Cuando no, por que? _____

69. A que edad los castras ?

☐ < 12 meses
☐ 12-16 meses
☐ >16 meses → especificar_____

70. Que metodo usas para castrar?

Especificar_____

PRODUCCION DE CARNE

71. Practicas el engorde de tus llamas?

S ☐ N ☐

72. Si → que animales engordas?

☐machos > 2 años
☐hembras > 2 años
☐machos < 2 años
☐hembras <2 años
☐capones
☐hembras viejas_____ años
☐machos viejos _____años

73. Cuántas de tus llamas destinas para carne cada año? _____
Venta en pie ☐
Venta en carne ☐

74. Con qué proposito beneficias tus llamas?

Uso personal ☐
Venta ☐
Cambio ☐
Otros_____ ☐

75. Que tipo de llamas beneficias para uso personal?

Machos <2 años ☐
Machos >2 años ☐
Hembras <2 años ☐
Hembras >2 años ☐
Capones ☐
Otro_____ ☐

76. Que tipo de llamas beneficias para vender?

Machos <2 años ☐
Machos >2 años ☐
Hembras <2 años ☐
Hembras >2 años ☐
Capones ☐
Otro_____ ☐

77. Que clases de productos produces con carne de tus llamas?

Charqui ☐
Embutidos ☐
Carne fresco ☐
Otros ☐

78. Donde beneficias tus llamas?

En campo ☐
Matadero ☐
Otro_____

CARACTERISTICAS DE PRODUCCIÓN

79. Edad promedio al primer empadre

Macho _____meses
Hembra_____meses

80. Edad a la primera parición

Promedio edad _____meses
Máxima edad _____meses
Mínima edad _____meses

81. Intervalo de parición?

Promedio _____meses
Maximo _____meses
Minimo _____meses

82. Determinas la edad de tus llamas machos para la primera monta?

S ☐ N ☐ Porque:_____

83. Promedio de vida reproductiva de tus llamas hembras (años)_____

84. Numero de pariciones durante la vida reproductiva de tu llama hembra_____

85. La mayoría de los pariciones de tus llamas ocurren en

Enero	☐	abril	☐	julio	☐	octubre	☐
Febrero	☐	mayo	☐	agosto	☐	noviembre	☐
Marzo	☐	junio	☐	septiembre	☐	diciembre	☐

ESQUILA

86. realizas esquila de tus llamas? S ☐ N ☐

87. Esquilas todas tus llamas? S ☐ N ☐

88. Época en que esquilas tus llamas_____

89. Color de fibra que prefieres? 1_____2_____3_____
Por que?_____

90. Color de fibra que menos prefieres? 1_____2_____
Por que?_____

COMERCIALIZACION

91. como es la Comercialización de Carne de tus llamas?

Mes de comercialización(de 1 a 12 meses)	
Cantidad de llamas beneficiadas por anho	
Precio por Kilo en nuevos soles	
Comprador (Intermediario 1, Fabrica 2, Venta local 3)	
Procedencia del comprador (Local 1, regional 2, nacional 3, internacional 4)	

92. ¿como es la Comercialización de tus llamas en pie para carne?

Mes de comercialización (de 1 a 12 meses)	
Cantidad de animales vendidos en pie por anho	
Precio por kilo de peso vivos en nuevos soles	
Comprador (Intermediario 1, Fabrica 2, Venta local 3)	
Procedencia del comprador(Local 1, regional 2, Nacional 3, internacional 4)	

93. ¿Comercializas pieles?

Mes de comercialización (de 1 a 12 meses)	
N° de pieles de Adultos	
N° de pieles de jóvenes	
Precio por unidad en nuevos soles	
Comprador (Intermediario 1, Fabrica 2, Venta local 3)	
Procedencia del comprador(Local 1, regional 2, Nacional 3, internacional 4)	

94. Mano de obra

	Familia: >15 a | <15 a		Trabajador:	Al partir:
	M| H	M|H	M|H	M|H
Compra de llamas	☐☐	☐☐	☐☐	☐☐
Venta de llamas	☐☐	☐☐	☐☐	☐☐
Vigilancia	☐☐	☐☐	☐☐	☐☐
Cría	☐☐	☐☐	☐☐	☐☐
Cuidado de animales enfermos	☐☐	☐☐	☐☐	☐☐
Pastoreo	☐☐	☐☐	☐☐	☐☐
Esquila	☐☐	☐☐	☐☐	☐☐
Producion de carne	☐☐	☐☐	☐☐	☐☐
Artesanía (fibra, piel...)	☐☐	☐☐	☐☐	☐☐
Otros _____	☐☐	☐☐	☐☐	☐☐

95. ¿A Qué fuentes de financiamiento tienes la posibilidad de acceder para mejorar la crianza de tus llamas? (señale en orden de importancia 1=mas importante)

Gobierno local	
Gobierno regional	
Capital propio	
Prestamos financieros	
Donaciones	
ONGs	
Otros	

CAPACITACION

Esta sección se refiere al entrenamiento que han recibido los productores anteriormente, ya sea en cursos, talleres, asistencia técnica institucional y otros que les haya permitido generar destrezas o mejorar sus capacidades y conocimientos en las aéreas de infraestructura , manejo, transformación y comercialización.

96. Has recibido algún tipo de capacitación en:

Artesanía ☐
Embutidos ☐
Charqui ☐
Cuero ☐
Fibra ☐
Operación y mantenimiento de sistemas mejorados de fuentes de agua ☐
Manejo de forraje de corte ☐
Reproducción ☐
Selección ☐
Praderas ☐
Alimentación ☐
Sanidad ☐
Otros:_____

97. Cuentas con apoyo de alguna organización que esté vinculada a la actividad llamera o transformación de productos?

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98. Cual es tu mejor macho? Nombre_____
Edad____ Nacido en tu rebanho?_____
Porque?_____

100. Describes cuales son tus 2 mejores hembras?
Nombre1_____ Edad____ Porque?_____
Nombre2_____ Edad____ Porque?_____

101. Cuantas crias ha tenido tus mejores 2 llamas hembras en su vida?
Hembra 1_____ Hembra 2_____

102. Que pasa con las crias de las mejores llamas hembras?
_____

103. Han tenido tus 2 mejores llamas hembras un aborto?
Hembra1_____ Hembra2_____

104. Hay abortos un problema en tu rebanho?_____