

# Herd Management and Livestock Productivity of Altai Mountain of Mongolia

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**Abstract:** It is well known that in Mongolia the livestock sector is a source of livelihood for nearly half of the national population, especially since the political and economic changes in the early 1990s strongly affected the lives of rural people. This thesis analyses, in a localized context, the current rural development, the economic settings and political measures that affect the traditional extensive livestock husbandry system and its importance for rural livelihoods. Possibilities to improve the current livestock management and thus herders' livelihoods in an environmentally, economically and socially sustainable manner are discussed at a regional scale.

**Keywords:** Herd Management, Livestock, Productivity, Altai Mountain, Mongolia.

## I. INTRODUCTION

Livestock husbandry is well known as essential source of food, income and other functions (providing manure, power and financial instruments) worldwide (Li et al., 2007). Nowadays the development direction of livestock systems are being shifted to more sustainable ways where the domestic livestock can behave naturally (Frewer et al., 2005), in order to produce healthier and safe organic food for the rapidly raising world population (The World Bank, 2008). The present study was carried out in the transhumant livestock husbandry system in Mongolia where the above mentioned development principles exist together with site-specific advantages and restrictions. Mongolia is a landlocked country in Central Asia covering 150 million hectares of area and hosting 3 million people; 99.5% of the country's total territory is used for pasture with a carrying capacity of approximately

75 million sheep units of livestock per year (FAOSTAT, 2014). Consequently, the livestock husbandry is the most significant subsector that produces 88% of total agricultural products (20% of GDP), around 10% of the country's export income, directly employs 35% of total work force and contributes to alternative income generation of half of the country's population (NSOM, 2014). Therefore this study deals with current livestock husbandry and pasture management and their contribution to livelihoods of pastoralists at herder households' level.

## II. LITERATURE REVIEW

### A. The present livestock management

Most of the global livestock population is kept in developing countries (Upton, 2004), where it serves as an important source of especially rural populations' economic activities and subsistence by supplying income and livelihoods (Herrero et al., 2013). The majority of the respective herbivorous animals are kept under different forms of (agro-) pastoralism (Blench, 2001). Mongolia is one of most livestock-dependent developing countries in the world (Suttie et al., 2005), with almost half of its population directly depending on transhumant livestock husbandry (NSOM, 2014). The livestock husbandry

itself relies on native pasture vegetation as the basic source of feed for all types of herbivores throughout the year. Across the country, livestock owners or (hired) herders move their animals between four main seasonal pastures that are used for spring, summer, autumn and winter grazing.

### B. Environmental challenges

Depending on their agro-ecological settings, different regions of the world are dominated by either nomadic or transhumant pastoralist systems, transhumant or sedentary agro-pastoralist systems or sedentary mixed systems (Alexandre and Mondonnet, 2005) – mainly depending on the length of the growing period. According to these authors, Mongolia covers the arid and semi-arid temperate zone with a growing period ranging from 60 to 180 days (Johnson et al., 2006; Li et al., 2007). The main environmental challenges are strongly related to its continental climate conditions such as highly variable temperature and precipitation. Figure 1.2 shows a long dry season and short more humid conditions during the cold winter season, which is environmentally the most difficult period for grazing livestock. The Altai Mountain and Gobi-desert zones are more suitable to rear small ruminants, camel and yak, while the Khangai-Khentii Mountain and the steppe zones are well suited for sheep, cattle and horse. The main strategies of Mongolian herders to cope with these rough and / or highly unpredictable environmental variables have been and still are seasonal herd movements and hay preparation for the winter season (Fernandez-Gimenez, 2002).

### C. Socioeconomic challenges and opportunities

The socio-economic challenges to implement sustainable development strategies for Mongolia's grazing-based livestock husbandry are the lack of clearly defined and widely accepted official regulation of pasture use and the weak implementation of pasture management, poor market opportunities and irregular social and health care services to herder households in remote areas (Asian Development Bank, 2013). The number of herding households almost tripled from 1990 to 2014 (NSOM, 2014) with no formal limitation on animal numbers, and most herder families increasingly spent more time around water points, settlements such as soum centres, roads and seasonal camps (Ykhanbai et al., 2004). The reduced distances of transhumance movements and declining mobility pattern (Mearns, 2004; Janzen, 2005; Lkhagvadorj et al., 2013b) seem to be explained rather by institutional weaknesses than by environmental changes (Undargaa and McCarthy, 2016). The present Mongolian land law (provision 52; adopted in 2002) permits local governments to regulate pasture stocking rates, seasonal herd movements, and design reserve pastures for emergency cases; yet this law is not sufficiently implemented (Fernandez-Gimenez and Batbuyan, 2004; Munkhnasan, 2010). At the same time, another very useful informal traditional institution of pasture management is the *neg nutgiikhan* or *khot ail*, which is a small group of herder

households who often camp together and pool their livestock to share labour.

#### ***D. An assessment of pastoral livelihood strategies***

Mongolia is one of the few truly pastoral countries in the world (Suttie, 2005) with a 2000 to 3000 years old nomadic tradition (Rudaya et al., 2008). Although nowadays, mining contributes considerably to the country's economic growth (Suzuki, 2013), livestock husbandry has been, and still is, an important sector for Mongolia's economy and employment (Batima et al., 2005). The National Statistical Office of Mongolia reported that at the end of 2013 the agricultural sector contributed 15% to the national gross domestic product, which is equivalent to 7% of the country's total export income (Komiyama et al., 2013). Of this fifteen percent, 80% are derived from the livestock sector (NSOM, 2013). In addition, the livelihoods of approximately 1.5 million rural dwellers directly and indirectly depend on animal husbandry (Fernandez-Gimenez, 2002), which is almost half of Mongolia's population. By the end of 2012, 160,000 out of 208,000 livestock keeping households in Mongolia were characterized as true herder households whose livelihoods directly depended on animal husbandry; each herder household has on average four family members (NSOM, 2013). The Mongolian Altai Mountains serve as the drainage divide for the rivers emptying into the Arctic Ocean Basin and the closed basins of Central Asia (Rudaya et al., 2008). The Bulgan River is one of these water bodies originating at the southern slopes of the Mongolian Altai and feeding into one of the inner Central Asian basins, the Ulungur Lake in China (Johnson et al., 2006). In Mongolia, the river flows through two different Bulgan counties, one located in Khovd province and one located in Bayan-Olgii province, and forms the Bulgan River Valley where it is joined by numerous medium- and small-size streams.

### **III. METHODOLOGY**

The present study was carried out in two administrative units along the Bulgan River, namely in Bulgan county (Bulgan county, belonging to Khovd province) and in the Sonkhel administrative subunit (belonging to the other Bulgan county, located in Bayan-Olgii province; Figure 2.1). The study region is located at the interface of the Mongolian Altai Mountains and the Dzungarian Basin (Grubov et al., 2001), in a steppe and semi-desert ecosystem characterized by long and cold winters, dry and hot summers, low precipitation (rainfall and snow) and high temperature fluctuations (Batima et al., 2005). The average amount of precipitation is higher upstream, in the mountainous locations, and decreases towards the southern part of the Bulgan River Valley. Annual air temperature averaged 2°C over the last past 50 years at Bulgan county centre; however, average annual temperatures have increased by 1.4°C over the same period of time (Gomboluudev and Davaanyam, 2012). The year can be divided in two main seasons, namely the rainy and warm season and the dry and cold season. The first season comprises spring and summer, from May to early October.

#### ***A. Data Collection***

In a 5 km radius around each of the six weather stations installed within the framework of the WATERCOPE project ([www.watercope.org](http://www.watercope.org)) all households encountered were approached for their participation in the survey. Mostly with the male household head or in very few cases with his wife, were conducted in 225 households on the basis of a pre-tested semi-structured questionnaire. The interviews took place between May and September 2012 and covered questions

related to the socio-economic characteristics of the household (size, age, gender structure, education level of household head, and employment status of family members), cropping activities (field sizes and locations, crops grown, cropland management, and product marketing), and livestock activities (herd composition and size, feeding management, products harvested, and marketing strategies). The education level of the household head was classified into six different groups (illiterate, primary, middle and high school, technical academy, university). Sheep and goats were addressed as small ruminants, whereas cattle, horses, camels and yak were defined as large animals. All animal numbers were also converted into sheep units (SU; Annex 2.1). Herd mobility was assessed by asking for the approximate distance in kilometers between seasonal pastures. The cash income from livestock husbandry was estimated based on sales of live animals, raw cashmere wool, sheep and camel wool, as well as animal skins. Self-consumption of products such as meat, milk, cereals, tubers and vegetables, was not addressed in the questionnaire.

#### ***B. Statistical Analysis***

Data was analysed with the Statistical Package for Social Sciences SPSS-PC Version 20.0 (IBM Corp, 2011). Twenty-nine initial variables were selected based on their competence to clarify the livelihood of pastoral families (Annex 2.2). Households of similar livelihood strategies were identified by subjecting the initial 29 variables to a Categorical Principal Component Analysis (CATPCA), in order to explore variable importance and interdependencies (Dossa et al., 2011). The main advantage of CATPCA is the simultaneous consideration of multiple categorical and continuous variables in one analysis and the ability to determine nonlinear relationships between variables. For the selection of the most important explanatory variables, a component loading >0.5 was set and assigned variables were retained for subsequent two-step-cluster analysis. The number of fixed clusters was determined based on the Bayesian information criterion (BIC).

#### ***C. Household and Herd Characteristics***

The 225 households interviewed in the six study locations represented 13% of all households in both provinces; the households belonged either to the Uriankhai, Torguud, or Kazakh ethnic group (Table 2.4). Most Torguud were encountered in Bulgan-soum, Bulgan-gol and Bayan-gol, while a mixture of ethnicities inhabited the Sonkhel Lake area. Nonetheless, there was no clear relation between ethnic group and cluster. The average size across all households was 5.1 family members, with an average of three adults potentially contributing to the household's daily work. Across all locations the average age of the household head ranged from 43 to 50 years, and most household heads (97.3%) were literate. Most households (92%) managed livestock for self-consumption and to earn cash, the main species being cattle and goats (each kept in 94% of the livestock managing households). Only 8% of the households did not manage any livestock. Calculation of livestock species richness and diversity allowed for further insights into the composition of livestock herds in the study region (Table 2.5). The highest species richness was found in Kheltgiikhad, while the lowest one was found in Bulgan-soum. In contrast, livestock diversity was highest in Turgen, but lowest in Bayan-gol. The latter location also exhibited the lowest evenness value, whereas for Turgen and Bulgan-soum the highest values were calculated. Species accumulation curves, saturated at two levels of richness, depended on whether five or six animal species were kept in a location. The Shannon diversity accumulation showed more variability in the

diversity distribution, potentially ranging from 0.71 (Bayan-gol) to 1.18 (Sonkhel Lake.)

#### IV. DISCUSSION

Grazing-based and mixed crop-livestock production are the typical and predominant land use systems of Mongolia (Carlos and Henning, 1995; Andrew et al., 2009). Therefore, it is not surprising that the families settling along the Bulgan River Valley were classified into three different pastoral (cL) and agro-pastoral livelihood clusters (cLscC, scLsC) with only 17 out of 225 household being pure agriculturalists (cC). Even though the majority (92%) of the interviewed households kept livestock, most (70%) of them also cultivated crops and indicates that crop farming is the second pillar of livelihood. This is similar to other counties within Khovd province that are located along the Buyant River Valley (Janzen and Hartwig, 2006). However, crop farming is less prominent in other regions of Mongolia, as only river valleys offer the opportunity to cultivate irrigated vegetables, cereals and some fruit trees. The four livelihood clusters determined along the Bulgan River Valley differed from each other in their socio-economic characteristics, herd size, cropland surface, combination of livestock and cropping, as well as market orientation. The livelihood strategy of cluster cL was solely based on livestock and characterised by extensive herd movements between autumn and winter pasture areas in the Dzungarian desert and spring and summer pasture areas in the Altai mountain region. The opposite was true for the livelihood strategy of cluster cC, which relied entirely on field cropping, leading to a sedentary lifestyle (needed for the sowing, weeding and watering of the crop fields) and very low herd mobility in cases of cC households keeping animals. Even though households in clusters cLscC and scLsC were similarly involved in livestock keeping and cropping, they clearly differed in herd size, crop area, production orientation, cash income, and the extent of long distance livestock movements. Accounting for valuable assets, total number of livestock and cash income from livestock sales plus cash income from crops sales, the best-off households were in cluster cLscC and the poorest were in clusters cC and scLsC. However, according to Johnson et al. (2006), the average herd size of 157 SU across the studied households is not sufficient to support a family's livelihood.

#### CONCLUSION

The herder families along the Bulgan River Valley have to cope with poor living conditions and practice traditional livestock husbandry and small-sized cropping. Their income sources cannot be diversified due to the lack of livestock and agricultural market possibilities in this remote rural area. Herd management is partly carried-out by inexperienced herders and is becoming more sedentary with shortened migration distances between pastures. This pattern seems likely to continue throughout the near future and will most likely result in the decrease of the number of herder families and in the degradation of pastures along the lower part of Bulgan River Valley. Therefore herder households should be supported by local and central governments with improved pasture utilization regulations and more sustainable market opportunities for livestock products, in order to diversify and sustain their income opportunities. Due to this, livestock keepers are very interested in increasing cashmere goat numbers in order to secure their cash income, which is clearly demonstrated by the official livelihood statistics for the county of Bulgan (Figure 1.1 and 2.3) and by the findings of Johnson (2009) for desert and desert steppe regions of Mongolia. Field

cropping activities (clusters cLscC, ScLsC and Cc) were more frequently found in Bulgan-soum, Turgen, and Bayan-gol than at Sonkhel Lake, Bulgan-gol and Kheltgiikhad. This is due to the fact that the these three locations are more suitable for cultivating vegetables and cereals thanks to their wide and flat plains and deep soils as compared to the narrow and rocky valleys of Kheltgiikhad and the harsh high altitude conditions of Sonkhel Lake. The reasons for the absence of farming activities at Bulgan-gol are the lack of infrastructure and its location in a nature reserve close to the Sino-Mongolian border. Across seasons and clusters, the vegetation of natural pastures was the most important feeding resource for all livestock species. This finding is consistent with Bat-Oyun et al. (2010) who reported that pastures are the major food source for livestock in Mongolia. Therefore, herders' feeding strategies can be differentiated between two main seasons (Gendaram, 2009); in the rainy and warm season, animals can ingest enough good quality fodder to build up body fat reserves (especially fat rump sheep, camels, and yak) for coping with the harsh dry and cold season. Although pasture land is government property, herders are allowed to use it freely. Their seasonal mobility is influenced by weather and environmental conditions.

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