THE NEXUS OF SETTLEMENT DEVELOPMENT AND TODAY'S ENERGY USE IN SARY-MOGOL, ALAI VALLEY, KYRGYZSTAN

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With 7 figures, 2 tables, 6 photos and 1 supplement
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Summary: Based on a case study of Sary-Mogol, a rural settlement in the Alai Valley in Southern Kyrgyzstan, this paper investigates the relationship between settlement development, resulting in a three-period building structure, and today's domestic use of energy. The three-period building structure is considered to be a consequence of Soviet resettlement processes and post-Soviet developments such as migration and economic inequality. Until the 1940s, there were no permanent settlements in Sary-Mogol or in the surrounding areas. The settlement Sary-Mogol (3,000 m a.s.l.) was founded in 1946 as an enclave within the borders of the Kyrgyz Soviet Socialist Republic. Administratively, however, Sary Mogol belonged to the Tajik Soviet Socialist Republic, responsible for supplying the collective farms in the Eastern Pamirs (Murghab District, Gorno-Badakhshan Autonomous Region). The resettlement of predominantly Kyrgyz people from the Eastern Pamirs led to the start of the settlement construction. This paper examines the current domestic energy supply situation, which is part of multiple measures and strategies taken by the local population to meet the challenges of sustaining their livelihoods. Furthermore, a historical context since the establishment of the settlement will be given.

Zusammenfassung: Anhand des Fallbeispiels von Sary-Mogol, einer ländlichen Siedlung im Alaital im südlichen Kirgistan, wird der Zusammenhang zwischen der Siedlungsentwicklung, die eine Dreiperioden-Gebäudestruktur nach sich zog, und der heutigen häuslichen Nutzung von Energie aufgezeigt. Die Dreiperioden-Gebäudestruktur resultiert aus sowjetischen Umsiedlungsphasen und postsowjetischen Entwicklungen wie Migration und ökonomische Ungleichheit. Bis in die 1940er Jahre gab es keine permanenten Siedlungen in Sary-Mogol und Umgebung. Die Siedlung Sary-Mogol (3.000 m ü. NHN) wurde 1946 zur Versorgung der landwirtschaftlichen Kollektivbetriebe im Ostpamir (Murghab Distrikt, Autonome Provinz Berg-Badachschan) als Enklave in der Kirgisischen Sozialistischen Sowjetrepublik gegründet, gehörte aber administrativ zur Tadschikischen Sozialistischen Sowjetrepublik. Dazu wurden vorwiegend Kirgisinnen und Kirgisen aus dem Ostpamir umgesiedelt und der Siedlungsbau begann. Dieser Artikel beleuchtet die aktuelle häusliche Energieversorgung, die Teil der verschiedenen Strategien und Handlungen der lokalen Bevölkerung ist, den Herausforderungen der Lebensunterhaltssicherung zu begegnen, und stellt sie in einen historischen Kontext seit der Siedlungsgründung.

Keywords: Energy geography, human-environment interaction, Central Asia, Kyrgyzstan, high mountains, rural area, housing, coal mining

1 Introduction

This paper deals with the current domestic use of energy resources by households in the Alai Valley in Kyrgyzstan, their scarcity and availability and the historically changing supply of resources. The important role of energy resources and energy use within society, which have long been recognized by geographers and other social scientists, is still of central concern (Pasqualetti and Brown 2014). Energy geography continues to be a socially relevant research field (Solomon 2013). In the high mountains of Central Asia, particularly in different parts of the Pamir Mountains, research has been focusing on the nexus between land use and energy resources (cf. Droux and Hoeck 2004; Breu and Hurni 2005; Förster et al. 2011; Vanselov 2012; Kraudzun 2014; Kraudzun et al. 2014; Hohberg et al. 2015; Kreutzmann and Watanabe 2016). These studies provide valuable information about energy and resource use in the region. Other studies have investigated the energy efficiency and thermal insulation of houses, for instance in the Eastern Pamirs (cf. Wiedemann et al. 2012) and for rural settlements in Kyrgyzstan (Meessen et al. 2013). In both cases, the focus is on potentials and recommendations for the local population, mainly initiated by international development cooperation institutions.

The region has a long history of external interventions (Kreutzmann 2013a; 2013b; 2015). Concerning the analysis of the current situation the Soviet modernisation project is of crucial impor-

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tance; in particular, because of its forced sedentarisation of nomadic Kyrgyz pastoralists, resettlement, settlement construction and restructuring (collectivisation) of pasture utilisation and agriculture (cf. Popova 1994; Kreutzmann 2013c; 2015). In recent years, international development actors sought to improve the situation of energy supply in the high mountains of Central Asia, especially with regards to the acceptance of energy-efficient technologies (Kraudzun 2014, 550). Thus far, mainly wealthier households were able to afford investments in thermal insulation, therefore benefitting from these development projects (Wiedemann et al. 2012). Physical shortage or syndromes (e.g. the *teresken* syndrome) concerning natural resources are discussed (cf. Breckle and Wucherer 2006, 230; Kraudzun 2014; Kraudzun et al. 2014). They are being instrumentalized by state governments as well as international development actors and put on the development agenda.

In contrast, this paper focuses on existing strategies of the local population in Sary-Mogol[1)] and investigates how they cope with the challenges of energy and resource use. A special focus is on residential buildings, which play a significant role in the way people dealing with energy and resources. Therefore, this paper sets out to highlight the nexus between settlement development, which could be subdivided into a three-period building structure, and today´s energy resource use. The three-period building structure (1st period: 1946–1969, 2nd period: 1970–1991 and 3rd period: after 1991) in Sary-Mogol is considered as a result of Soviet resettlement processes and post-Soviet developments such as migration and economic inequality. Based on this, the central research question is as follows: How is settlement development (three-period building structure) interrelated with today's energy use in Sary-Mogol?

2 Vulnerability as agency and path dependence

A relevant approach, that the settlement development and the current energy use in Sary-Mogol are interrelated, is the analytical concept of a historical-genetic perspective, the approach of path dependence (Pierson 2004; Sydow et al. 2009; Schreyögg and Sydow 2010; Barnett et al. 2015). Sedentarisation and settlement construction, a legacy of Russian colonialism and the Soviet modernisation, continue to influence the people in the study area, particularly with regards to energy use and habitation. Previous decisions led to so-called path dependencies, which often limit or enable future economic and social developments of the households. The approach aims at explaining the current spatial structures and processes from a historical perspective. The appearance of the present settlement structure of Sary-Mogol is a result of its genesis. Thus, the recognition of historical developments is crucial for understanding the processes in Sary-Mogol.

The actor-oriented analytical concept by Bohle (2007) to frame social vulnerability as social practice and human agency is considered as applicable for this study. 'Livelihood' and 'vulnerability' approaches (Chambers 1989; DFID 1999; Villagrán de León 2006; Afifi and Jäger 2010), often criticised as depoliticising concepts, help to understand the side of the vulnerable and their actions in order to secure their livelihoods in risky environments. Nevertheless, they are often limited in terms of understanding the broader overarching political and economic framework (Neuburger 2013, 17). Hence, Bohle (2007, 9) integrates the analytic category 'arenas of vulnerability', "where conflicts over human livelihoods and securities" are negotiated. Arenas (environment, structures and processes) include threatened environments, politicised environments and/or violent environments. Looking at the actors "who have to live with vulnerability" is relevant within this approach, but it is equally important "to consider the actors who cause vulnerabilities" and who benefit from the situation (Bohle 2007, 15).

3 The Sary-Mogol Microcosm – settlement development and energy use

By means of the case study of Sary-Mogol, specific research questions will be discussed by using the aforementioned concepts. Firstly, the impact of political and economic transformations concerning settlement development and energy use in Sary-Mogol will be discussed from a historical perspective. Based on the framing in the historical setting contemporary questions linking socio-economic aspects with energy use issues placed in Sary-Mogol will be addressed. Thus, the interrelationship between settlement development and current utilisation of energy resources will be illustrated and interpreted.

[1)] The material presented in this paper was conducted in two field trips to the Alai Valley, Southern Kyrgyzstan (August–September 2012 and July 2014).

3.1 Methods

Findings are based on 57 semi-structured household interviews and 25 qualitative interviews with local experts. The latter include interviews with the head of the settlement administration, pastoralists, livestock owners, crop farmers, coal miners, coal collectors, house constructors, carpenters, mud brick layers, retailers and traders. During the field trips participant observations, energy use calendars and mappings were also carried out. In addition, 13 narrative biographical interviews were conducted with elderly people. These provided important information for the energy and resource situation as well as for the political and socio-economic conditions and developments of the past decades. All interviews were conducted with the help of a translator.

3.2 Sary-Mogol – settlement development and transformations

3.2.1 Study area

The research area of this study includes the rural settlement of Sary-Mogol and its surroundings, located in the Alai Valley in the south of the Kyrgyz Republic (Fig. 1). The Alai Valley is located

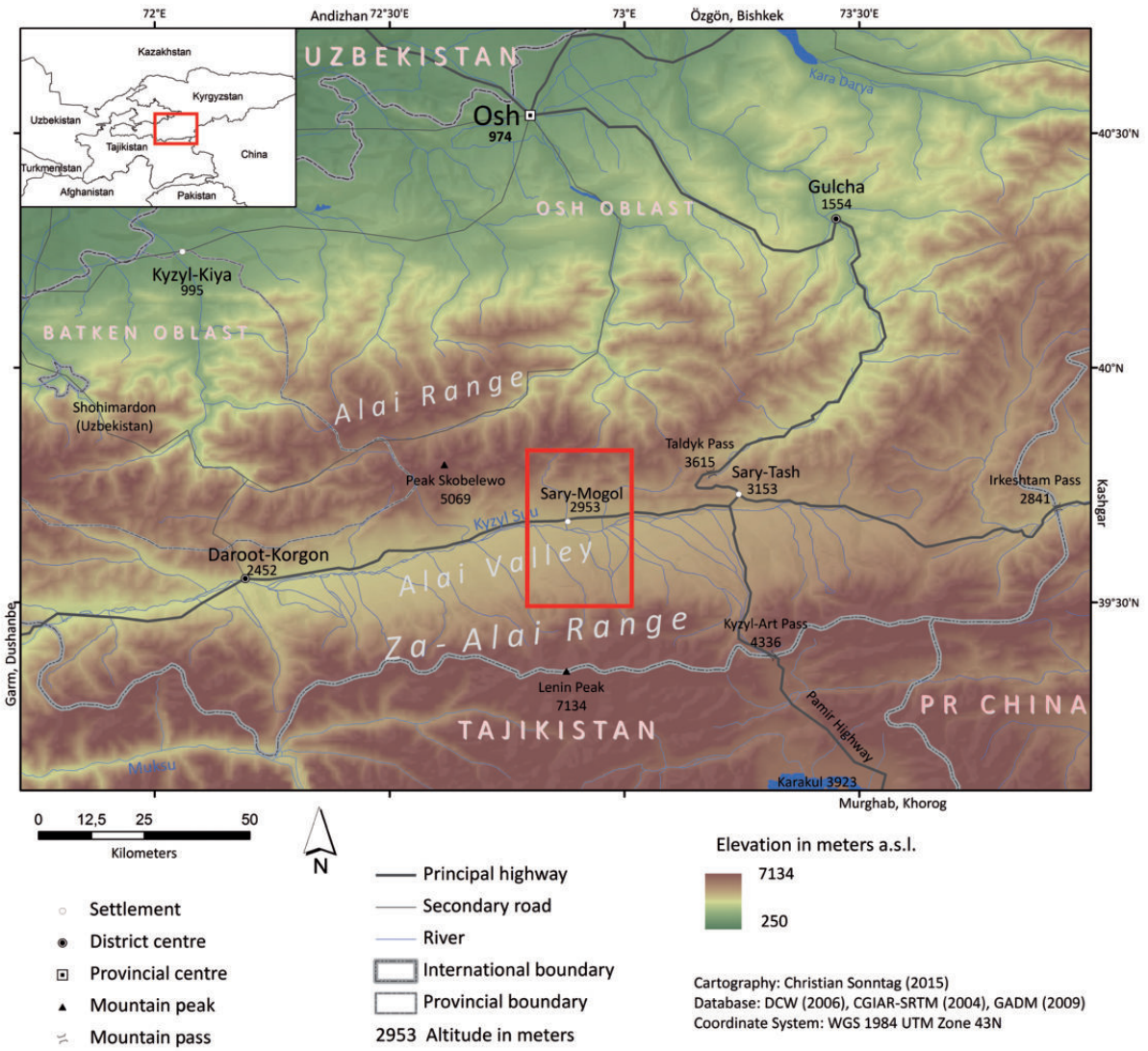

Fig. 1: Location of the research area in the Alai Valley in Southern Kyrgyzstan

between the high mountain ranges of Alai and Za-Alai, as part of the Pamirs. Administratively, Sary-Mogol is part of the Alai District, with its centre Gulcha (population: 11,700). The Alai District is in turn part of the Osh province, with its capital Osh city (population: 258,100; National Statistical Committee of the Kyrgyz Republic 2009, 42–43). Osh city is the centre of the South Kyrgyzstan region in terms of administration, trade, markets, education and traffic. Hence, it is of crucial importance as central place for the people in the study area.

Sary-Mogol was founded in 1946 as an enclave due to the need for fodder supply for collective farms in the Eastern Pamirs (Murghab District, Gorno-Badakhshan Autonomous Region) (Kreutzmann 2003, 224). The enclave was founded within the borders of the Kyrgyz Soviet Socialist Republic but belonged administratively to the Tajik Soviet Socialist Republic. Mainly ethnic Kyrgyz were resettled from the Eastern Pamirs to Sary-Mogol. The total leased area of the supply point Sary-Mogol was 61,764 ha (Ayil Ökmötü Sary-Mogol 2010; see Fig. 3). Overall, there were 1,900 ha of arable land and 28,200 ha of pastures (ibid.). The community remained an enclave of the Republic of Tajikistan until 2002, when it had to be returned to the Kyrgyz Republic. The residents could choose whether they wanted to take up Kyrgyz or Tajik citizenship (Kreutzmann 2011, 188). The vast majority opted for changing their citizenship and became Kyrgyz citizens (ibid.). Two major transformations in the 20th century impacted tremendously on the life of the people in the region (cf. Abazov 2004). First, the October Revolution of 1917 and the subsequent establishment of the Soviet Union in 1922 transformed the region profoundly. This was followed by collectivisation and sedentarisation campaigns in the 1930s. The forced sedentarisation and the resettlement of large populations in the region had already begun in Tsarist Russia (Popova 1994, 69), however, until the 1940s there were no permanent settlements in Sary-Mogol or in the surrounding areas (Photo 1).

The dissolution of the Soviet Union and the entailing independence of the Central Asian states in the early 1990s represented the second significant transformation in the 20th century. In addition to this, living conditions in this enclave rendered the situation more challenging for people in Sary-Mogol, particularly with regards to securing their livelihoods.

Photo 1: Alai Valley in 1928, view from the Alai to the Za-Alai Mountains with Lenin Peak (Photo: Finsterwalder 1928 in Rickmer-Rickmers 1930, 40; Copyright by Bibliographisches Institut GmbH, Berlin)

3.2.2 Settlement development

The aforementioned sedentarisation and resettlement of people from the Pamirs to Sary-Mogol forced by Soviet rulers is apparent when looking at areas of parental origin of household heads; hence the history of the settlement can be recognised. Almost ninety percent of them were born in different areas of Murghab District (Gorno-Badakhshan Autonomous Region), such as Murghab, Karakul, Rangkul and Aksu. This indicates the historical connection between the Sary-Mogol population and their relatives and networks in the Eastern Pamirs, which play a significant role in every sphere of daily life, including economic exchange relations until today. The resettlement and migration to Sary-Mogol happened continuously since 1946 and is still ongoing. This fact can be substantiated with data. The population increased from 4,000 in 2012 to 4,600 in 2014, with most people coming from Murghab (Ayil Ökmötü Sary-Mogol 2014).

The present settlement structure of Sary-Mogol is a result of its genesis. The settlement development of Sary-Mogol can be traced back to the date of construction of the first buildings (Fig. 2). When the first workers of different collective farms from the Eastern Pamirs were resettled in the 1940s, they started living in yurts on the eastern shore of Suu Sary-Mogol. A strip of land near the river was assigned for each collective farm to build the first stables and dwellings for the workers and their families. Before the land use planning was intensified in the second period, the settlement structure in the first period (1946–1969) is signified by its irregularity.

In 1970, the second settlement period (1970–1991) began as part of modernisation processes in the Soviet Union. In the course of history, new dwellings and other buildings were built at the eastern edge of the village. In this period, some buildings for livestock breeding and dwellings for workers were also built west of Suu Sary-Mogol in Burgan-Suu, which has historically never been part of Sary-Mogol. This area was territory of the Kyrgyz Soviet Socialist Republic. Today, Burgan-Suu is part of Kashka-Suu settlement of Chong Alai District, Kyrgyz Republic.

Political and economic developments after the dissolution of the Soviet Union are diverse and recognisable in the settlement structure (third period after 1991). On the one hand, many governmental buildings, which were constructed until 1991 and located in the area of the first and second settlement period gradually decayed (Fig. 2). Furthermore, some people left Sary-Mogol after 1991 and moved to Osh, Bishkek as well as back to Murghab or abroad. On the other hand, there was and there still is an ongoing post-Soviet migration to Sary-Mogol. Besides that, many new houses were built in the east of Sary-Mogol or were under construction at the time of research, especially in the so-called area of Aktilek. Due to the poor supply situation immediately after independence in 1991, construction activity was initially quite scarce. When Sary-Mogol became part of the Kyrgyz Republic in 2002, however, construction activities began to increase. Due to increasing wealth gaps between households as well as lack of materials, quality and size of buildings differed profoundly.

3.2.3 The transformation of energy and resource use

At the beginning of the settlement (1940s and early 1950s), similarly to pre-Soviet times, the people of Sary-Mogol were mainly using dried dung as well as rare woody plants as their main energy resources. In the following years, the supply of fuel and other essential goods (e.g. fodder and construction materials) was ensured and heavily subsidised by the Soviet Union. The high altitude location of Sary-Mogol (approximately 3,000 m a.s.l.) further demonstrates the importance of supply with energy and agricultural products. In particular, the supply of coal for heating and cooking in long winters was (and still is) of crucial importance to the population. Over a period of seven months the mean air temperature is below freezing point (Miehe et al. 2001). The absolute minimum in winter reaches -35 °C to -40 °C. The vegetation period is short and the cultivation of crops has always been challenging. Regular deliveries of coal to Sary-Mogol began from 1961, when unsustainable extraction of woody *teresken* (dwarf shrub) as fuel in the Eastern Pamirs (Gorno-Badakhshan Autonomous Region) was banned by the central committee of the Communist Party (Kraudzun et al. 2014, 53). By the early 1970s, a power supply system was constructed for the Alai Valley. Nevertheless, shortages and supply problems concerning energy, fuels and other resources continued during the Soviet era, especially in the 1980s.

As a corollary of the economic collapse after the dissolution of the Soviet Union, the supply system for coal and other fuel deliveries collapsed. Furthermore, conflicts over territory and resourc-

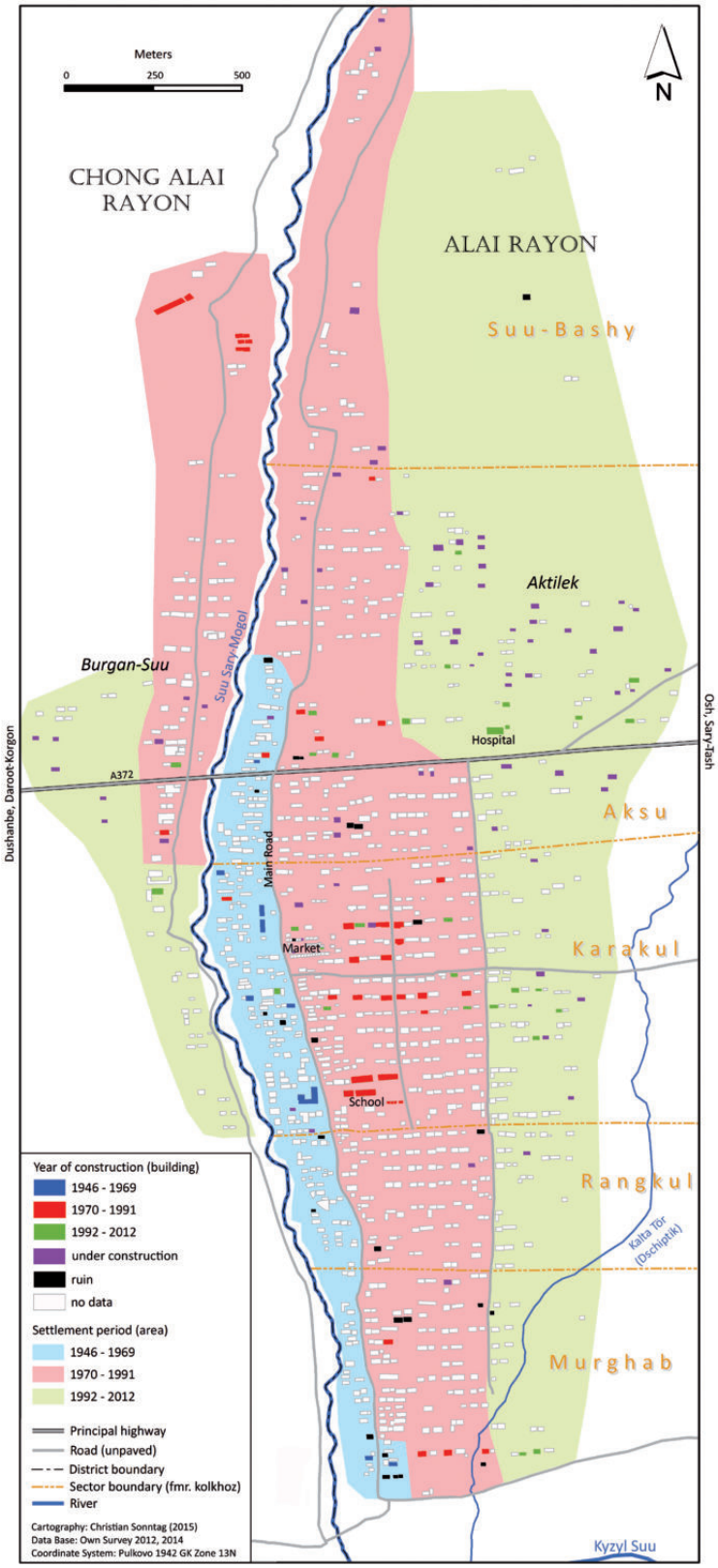

Fig. 2: Settlement development in Sary-Mogol and Burgan-Suu

Remarks on figure 2:
Areas of settlement periods have been determined based on the year of construction of buildings in combination with information from expert interviews. According to statements from expert interviews only the part between Suu Sary-Mogol and the north-south main road, which runs through the entire settlement, was built before 1970. Another road to the east provided an important demarcation too. Only a small number of exceptions do not fit into the pattern. Of course, new buildings were built later in older areas due to usual settlement activities transforming the structures. Regarding this house classification based on three settlement periods it has to be mentioned, that houses are constantly being repaired and renovated. This grouping is a simplified situation of reality and therefore an overview of the three-period building structure. The aim is to understand the valid trends, strategies and behaviour patterns of people in terms of their energy and resource use.

es evolved. The local economy in Sary-Mogol was marked by subsistence and unemployment and new borders affected pastoralism, the dominant way of land utilisation and the basis of local livelihoods until today. While the government in Bishkek promoted the liberalisation and privatisation of goods as well as agricultural land in cooperation with European advisors, Tajikistan was threatened to be torn apart by civil strife. Many places similar to Sary-Mogol showed a very bad supply situation concerning food, fodder and fuels in the 1990s (cf. STEIMANN 2011). Coal was initially absent. Therefore, people were forced to develop new survival and coping strategies and to adapt existing ones, in order to make a living. Often proven strategies of the ancestors were used (for example the increasing use of manure). Private companies started to extract larger amounts of coal about seven kilometres north of Sary-Mogol since 1996. The presence of coal improved the supply with the main fuel of households in Sary-Mogol to the present day. There are currently two relevant coal mines (Fig. 3), of which the southern mine of 'Oshprim' is larger and economically exploited. The northern one is now abandoned, but continues to be important for the local population, which will be discussed at a later stage in this paper.

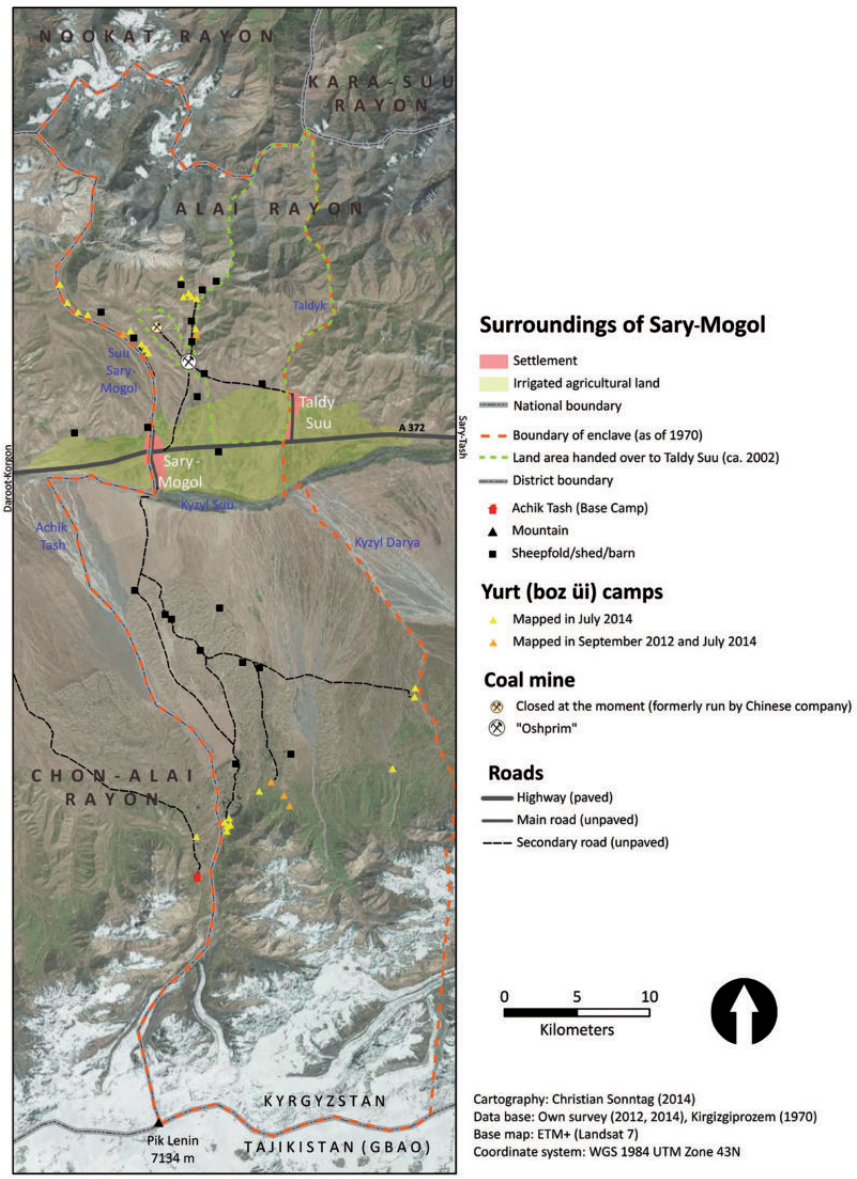

Fig. 3: Surrounding areas of Sary-Mogol

3.3 The current situation in Sary-Mogol

3.3.1 Vulnerabilities and making a living in Sary-Mogol

There is a precarious socio-economic situation in most households in Sary-Mogol, with its 4,600 inhabitants (Ayil Ökmötü Sary-Mogol 2014). Approximately every second surveyed household has both, a monetary income below the international poverty line[2] and not enough livestock to earn an income. According to Steimann (2011), households in Kyrgyzstan need more than 50 small livestock units[3] in order to being actually able to earn income from livestock breeding. Most of the other households in Sary-Mogol are only slightly better off. Subsistence economy is very important for households in Sary-Mogol. Only very few households own large herds of livestock, which is considered to be a strong economic position. The main pillar for the livelihoods in most households (80 percent of interviewed households) continues to be livestock breeding. Between May and September households graze their animals on pastures south and north of Sary-Mogol (Fig. 3) (cf. Shirasaka et al. 2016). A single income per household often does not suffice. Therefore, a diversification of livelihood strategies is taking place. Today, labour migration is an essential element of these strategies, with popular destinations being Osh, Bishkek or Russia. Nearly every household owns a small irrigated garden plot, where they grow potatoes and barley for sale, subsistence and barter (see supplement). Summer pastures, larger irrigated cultivation areas, and hay meadows are located outside of the settlement (see supplement). These summer pastures, cultivation areas and hay meadows are unequally distributed among households.

Since 1996, several private companies started to mine coal in Sary-Mogol. Initially these were Kyrgyz companies, later also international companies from China and Australia. Therefore, completely different stakeholders came into the arena in comparison to the Soviet time and the first years after independence. The coal mine 'Oshprim' plays a crucial double role within the settlement (and thus for other settlements within the Alai Valley). On the one hand, the coal mining company creates jobs for 300 people of which approximately 100 are from Sary-Mogol, and supplies local population with comparatively cheap coal. On the other hand, the coal mine represents a significant alteration for the socio-economic situation. Many residents will leave if the coal mine closes. This fact was confirmed by many interviewees. Furthermore, the coal mine is characterised by profit-oriented exploitation of the workers and poor working conditions. The situation in Sary-Mogol has similarities to cases in other rural areas in Kyrgyzstan affected by mining. Steimann (2011) examines such a conflict situation between mining companies and the local population in a case study in Jergetal, Naryn province. Steimann (2011, 81) exposes, that "the appearance of the mining company has fundamentally altered the local economy, not only by creating new livelihood opportunities for the local population, but also by causing new conflict lines to appear at local level." The complex situation in Sary-Mogol also demonstrates both sides.

3.3.2 Energy use in Sary-Mogol

A crucial part of the livelihood security for households in Sary-Mogol is the supply of energy for heating, cooking, lighting and electrical devices. Residents in Sary-Mogol use coal, *kuik*[4], diesel and electricity[5]. Coal is the main fuel due to the higher heat value in comparison to *kuik*. Households were able to provide exact information about the amount of used energy resources (Tab. 1, Fig. 5). All of the investigated households use coal as fuel and 96 percent utilise *kuik* as fuel for heating, cooking and baking in variable amounts.

According to statements of the interviewed households, two-thirds of them spend more than 10 percent of their disposable monetary income on energy costs, excluding transport fuels. However, according to an indicator of 'energy poverty', this means that two-thirds of households in Sary-Mogol are affected by energy poverty (cf. Robić et al. 2010, 1). These energy costs, in contrast to the amount of energy, are often only approximate num-

[2] The international poverty line (purchasing power parity) of 1.25 PPP$/capita/day for the Kyrgyz Republic leads to 1,429 KGS/capita/month in 2012 (cf. Ravallion et al. 2008, 36). 48 percent of the studied households have financial means below that threshold.

[3] One small livestock unit is equal to 1 sheep/goat, 0.2 cattle/yak or 0.16 horse (cf. Steimann 2011, 84; Kraudzun and Kreczi 2012, 10).

[4] Cut pieces of livestock droppings mixed with bedding straw from stables, which is afterwards stacked to dry in the sun.

[5] Electricity in Sary-Mogol is obtained from a power grid. Small solar panels and batteries are used in yurts on the pastures.

bers, based on both, estimation and calculation. Table 1 shows the averaged energy costs per household and year for the energy used. Costs in this table are simplified, calculated with the average prices for energy in Sary-Mogol. Not considered is the fact that households also collect coal, use own *kuik* and/or barter coal and *kuik* against each other and with other goods. Hence, coal is by far the largest share of energy costs (about two-thirds) for households. *Kuik*, diesel and electricity follow (Tab. 1). The burden of expenditure on energy is evident if compared with the average monthly salary of a teacher of 7,958 KGS or an average monthly pension of 3,674 KGS in Sary-Mogol.

When households have a shortage of coal or cannot afford to buy it, collecting of coal remains from the mining dump on the southern mine 'Oshprim' (Photo 2) and screening of coal residues from the smaller abandoned mine (Photo 3), are often practised coping strategies. This work is physically demanding, often dangerous due to falling objects and exhausting in winter. According to my interlocutors, every one in five households collects coal or screens coal residues. Observations and expert interviews suggest a higher share. People collect coal remains from the mining dump of the southern mine without pay for their own needs or for a later sale to generate income. For filling up a 50 kg sack by screening coal residues from the closed mine, people have to pay a charge of 30 KGS to the owner of the mine. Coal is also obtained through barter. Some households exchange the surplus of hay, barley or potatoes for coal. This is the case especially when people are employed in the coal mine where they can get cheaper coal and barter it for other much needed goods. Consumed *kuik* originates mainly from own livestock. This is the case in 62 percent of studied households using *kuik* as fuel. 27 percent need to buy *kuik*. Other households obtain *kuik* via barter or within their social network. The relevance of self-supply is confirmed by the relation between *kuik* consumption and livestock possession (own survey 2012). The more livestock the households own, the more *kuik* is produced and consumed.

Tab. 1: Simplified averaged energy amounts and costs per household and year (in KGS)

Product	Amount	Costs
Coal	7.2 t	18,125
Kuik	2.7 t	4,239
Diesel/petrol*	60 l	2,640
Electricity	3,021 kWh	2,115
Total expenditure		**27,119**

* only 50 percent use diesel/petrol regularly to ignite
(own survey 2012, 2014, N=54; 1 Euro≙58 KGS)

3.3.3 Interrelation between three-period building structure and today's energy use

Corresponding to the mentioned settlement history of Sary-Mogol, a three-period building structure in terms of construction methods, size, appearance and functionality evolved. However, it is to ask which interrelation can be observed between this three-period building structure and the today´s use of energy of households living in these houses.

Photo 2: Coal mine 'Oshprim' north of Sary-Mogol (Photo: C. Sonntag, 25 July 2014)

Photo 3: Screening of coal residues (Photo: C. Sonntag, 19 August 2012)

The spatial distribution of studied households in terms of their annual coal consumption shows remarkable aspects relating to the settlement periods (Fig. 4).

Households living in houses built before 1970 consume small (>3–6 tons) to moderate (>6–9 tons) amounts of coal, in comparison to the rest of households.

Almost all households with large (>9–12 tons) to very large (>12–15 tons) coal consumption out of all the interviewed households live in houses of the middle settlement period in Sary-Mogol (1970–1991). Although there are big differences in that area, in which households with small to moderate coal consumption exist, too. This is partly due to the recent renovation of some houses (built 1970–1991) with energy-efficient materials, if the corresponding households can afford it. Furthermore, smaller and/or energy-efficient houses have also been built after 1991 in the area of the second settlement period.

Coal consumption in the area of recent residential development (after 1991) is usually small apart from a few rather large amounts. Only small and medium-sized heated living areas (winter rooms) were present in the studied households in the oldest settlement area, which is more energy-efficient than heating large rooms and demonstrates the correlation with the aforementioned coal consumption. Differences of houses (size, construction, materials) located in the area of the second and third settlement period are larger, which correlates with bigger differences of fuel consumption within these areas (Fig. 5). The fact, that households living in houses with larger areas to be heated use more energy and have higher costs, is largely independent from the socio-economic situation of the households and the number of household members. These results will now be examined and interpreted in greater detail (Fig. 5, Tab. 2).

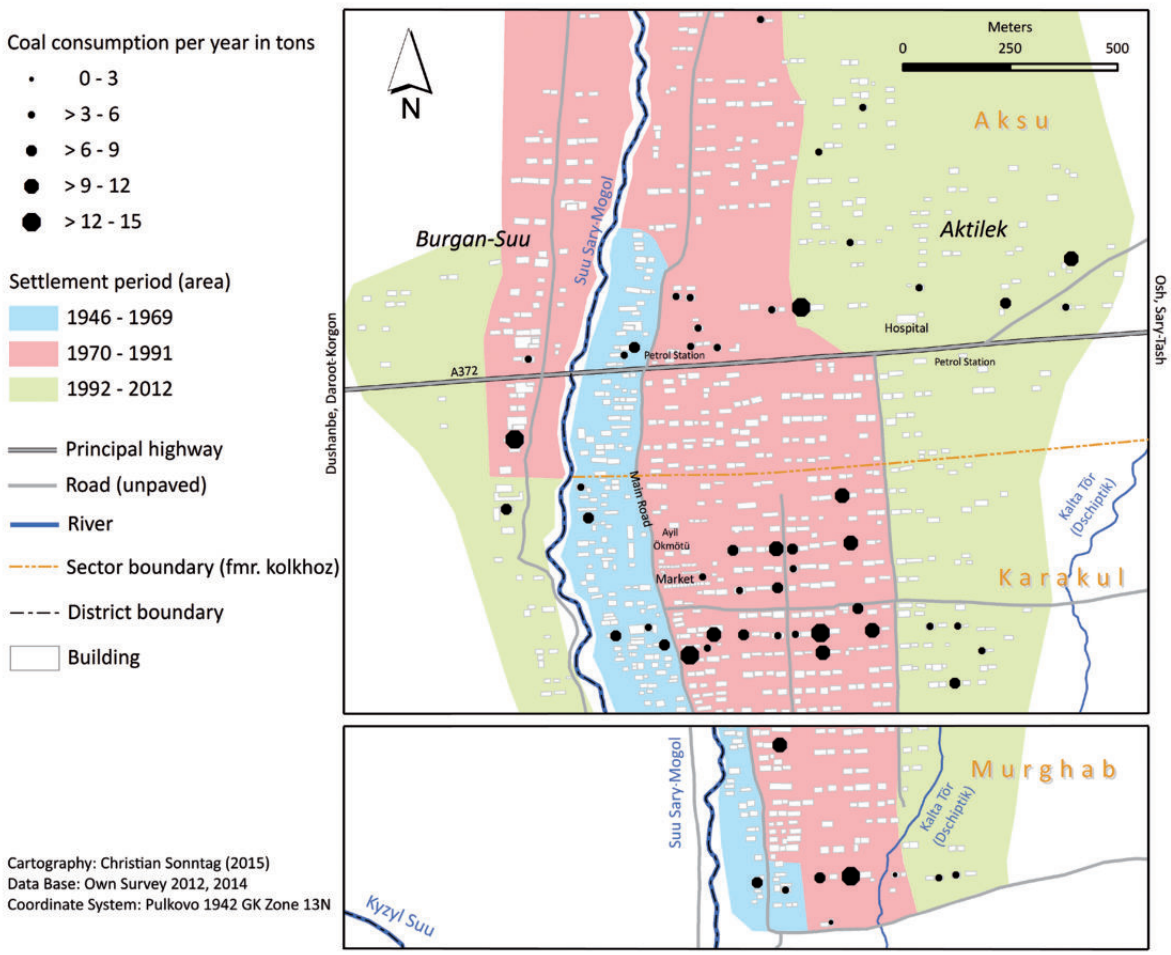

Fig. 4: Spatial distribution of coal consumption per household in Sary-Mogol (map sections with studied households, own survey 2012, N=57)

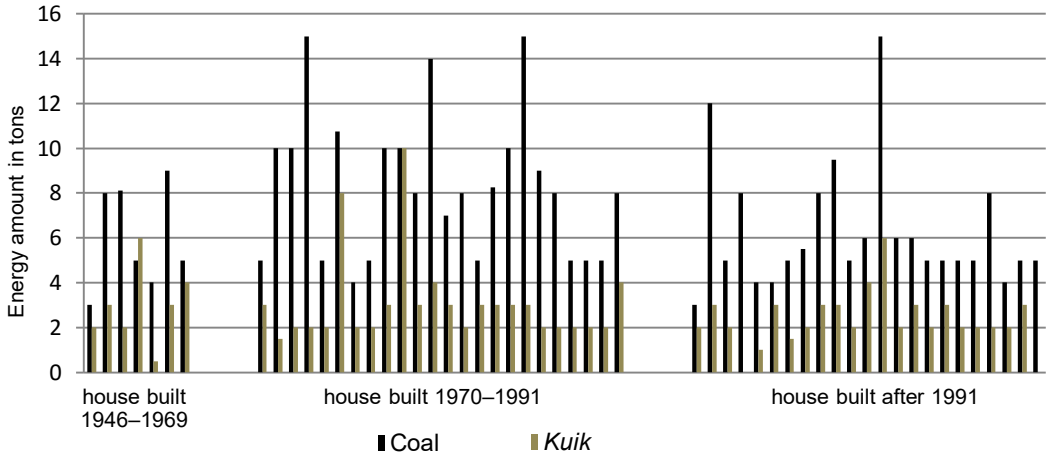

Fig. 5: Current annual consumption (in tons) of coal and *kuik* for every individual household, ordered regarding settlement periods (own survey 2012, N=54)

The floor plans (Figs. 6 and 7) illustrate the differences of the buildings from the first and second settlement period. These representative houses for the respective period show differences concerning number of rooms, house area, number of windows, window area and winter room area. Houses built in the first period are small to medium-sized, low buildings (Fig. 6). Furthermore, they have small heated areas for the winter period (31.6 m² on average). In cold months, all family members live together in these winter rooms, which are similar in all households in Sary-Mogol today and in past decades. Houses have only a few, small windows, which are wooden and often consist of two glass panes. All these aspects make houses built in that period relatively energy-efficient (Tab. 2). The scarcity of financial resources and building materials also contributed to the construction of small and therefore energy-efficient houses at the time of construction. This is confirmed by low to medium-sized energy consumption of coal and *kuik* (Fig. 5) and lower total energy costs of households living in these houses in comparison to households living in houses built between 1970 and 1991.

Dwellings built in the second construction period are on average the largest in terms of ground area and number of rooms (Fig. 7, Photo 4). The total area and number of windows as well as size and number of winter rooms are also larger (Tab. 2). Households living today in these dwellings use considerably higher quantities of fuel (coal, *kuik*) for heating and cooking and have higher energy costs than households living in houses, which were built in other settlement periods (Tab. 2). These houses were built in a time when supply of energy resources and energy saving were not of concern neither for the people in power nor for the locals. Many elderly interviewees confirmed the wasteful use of energy resources and construction materials in that time. Another reason for the construction of larger houses during that time might have been a larger number of family members per household. However, the author did not receive any evidence or any statements of the residents in this regard. Today, households often use

Tab. 2: Compilation of data concerning housing and energy, ordered by settlement periods in Sary-Mogol (own survey 2012, N=54)

Year of house construction*	Area of house [m²]	Number of rooms	Area of winter rooms [m²]	Number of winter rooms	Window area [m²]	Today's coal consumption [t]	Today's *kuik* consumption [t]
1946–1969 (N=7)	89.0	3.4	31.6	1.6	4.4	6.9	2.9
1970–1991 (N=25)	97.8	4.1	42.4	2.0	7.1	7.9	3.0
after 1991 (N=22)	83.5	3.9	29.7	1.5	6.9	6.4	2.3

* This representation relates solely to the year of construction of the houses. Buildings, which differ concerning year of construction from previously designated settlement areas, were assigned to the correct corresponding settlement period.

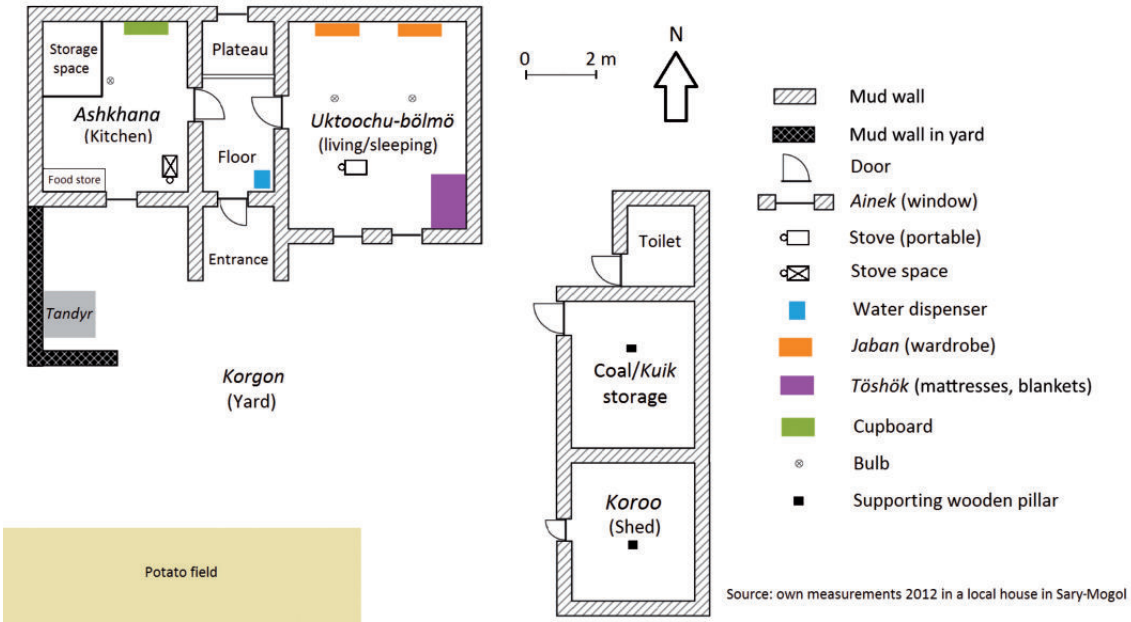

Fig. 6: Plan of local homestead built in 1947 in Sary-Mogol

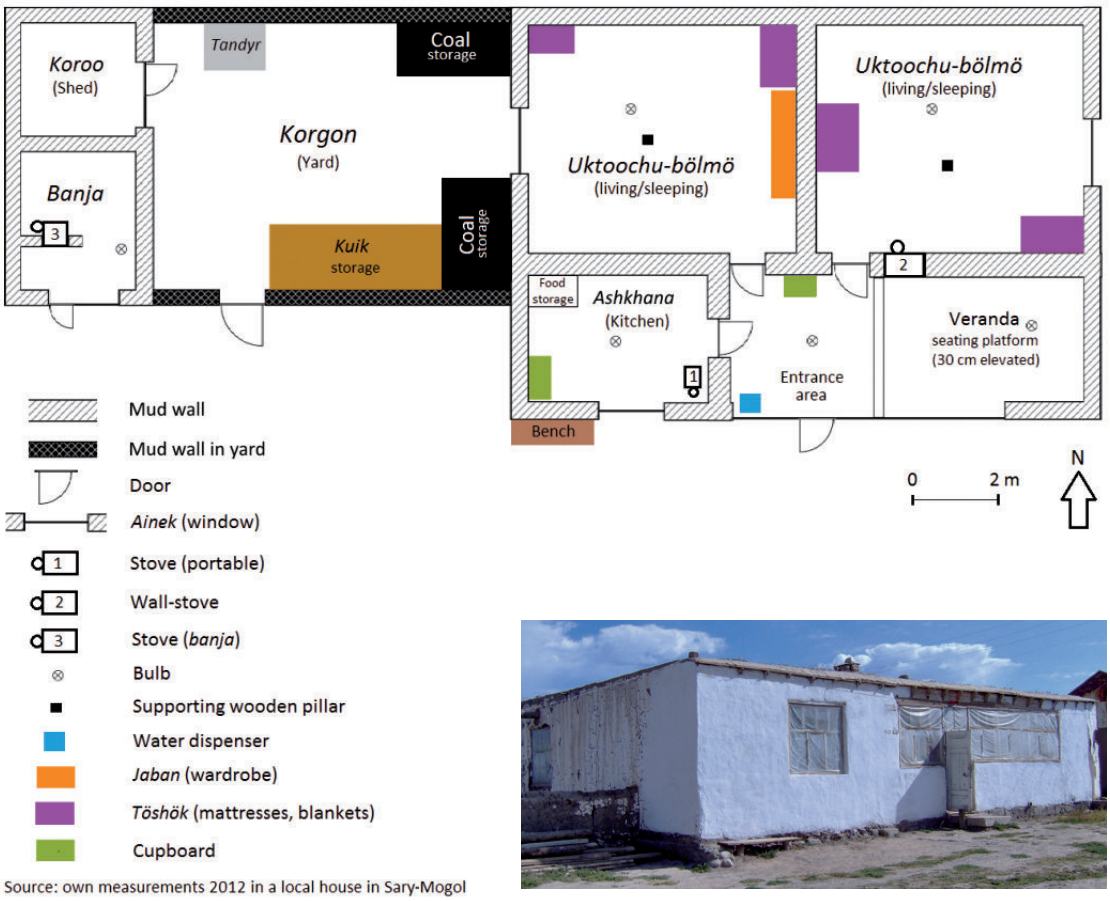

Fig. 7: Local homestead built in 1980 in Sary-Mogol

Photo 4: Local homestead built in 1980 in Sary-Mogol (Photo: C. Sonntag, 18 August 2012)

the kitchen (*ashkhana*) as a winter room, instead of one of the large rooms (Fig. 7). The kitchens are often small, have only few windows which are covered for insulation purposes with plastic foil and therefore much more efficient to heat. This is a commonly described strategy by studied households and this is another reason for the mentioned big deviation of fuel consumption and size of heated winter rooms among houses of the second settlement period.

There are various differences visible in Sary-Mogol in terms of building structures of the third period after independence. This is caused by several factors like migration dynamics, increasing wealth disparities and availability of new construction materials.

On the one hand, there are small mud brick buildings (*kysh*) already constructed or under construction, which form the majority of houses built after 1991. These houses are built predominantly with locally available materials, have basic facilities and are similar to buildings from the first settlement period in regards to appearance and function (Photo 5). Mainly households with lower or limited income and resource access inhabit theses houses. A low consumption of resources is generally of major importance. On the other hand, there is a small group of larger houses among the settlement period after 1991 (Photo 6). Mud bricks are still the preferred option to construct buildings, which have a good heat storage, according to interview statements. Houses are often built by using other energy-efficient but cost-intensive materials (e.g. double glazing/insulated glazing, doors, insulating materials), imported mostly from China/Xinjiang and bought at the Osh markets. With the help of various strategies, such as construction of small houses with small winter rooms or the use of new materials, people try to build energy-efficient dwellings. The possible options depend very much on the income situation of the households. On average, houses built after 1991 in Sary-Mogol are the smallest in terms of ground area and heated room area and these households consume the lowest amount of energy fuels (Tab. 2). They spent significantly less money on energy compared to households living in houses built in the other settlement periods.

According to my interlocutors, the vast majority of respondents had knowledge and showed awareness about insulation and energy efficiency, regardless of whether they live in a new or old house. 85 percent of households realised at least one, often more than one of the diverse activities or strategies to save energy or to improve energy efficiency. Methods include: plastic foil outside of windows, insulated glazing, new doors, new stoves, energy-efficient house construction methods, and efficient use of energy. Moreover, many households had ideas and plans to improve their energy consumption situation, which have not been realised yet, mainly due to insufficient economic means and limited access to resources.

4 Discussion

The supply with basic needs, energy and resources is highly relevant to the people living in Sary-Mogol, within the high mountain area of the Alai Valley and its challenging conditions. This relevance has been present since people started living in that area and they are used to manage the challenges. However, frame conditions were transformed several times in the 20th century and influenced the way of living dramatically.

The analysis has shown that the majority of households in Sary-Mogol can be described as economically poor, which is interrelated to a high risk exposure, vulnerability and endangerment of livelihood security. Households in Sary-Mogol spend a high share of their total expenditures on energy resources, despite the fact that coal per se is available

Photo 5: House built in 2010 (56 m² living area) (Photo: C. Sonntag, 23 August 2012)

Photo 6: House under construction (117 m² living area) (Photo: C. Sonntag, 11 September 2012)

and relatively cheap, in comparison to other regions of Kyrgyzstan. Especially for the poor households in Sary-Mogol, the supply with energy is a heavy burden. They are often vulnerable to external influences (e.g. price trends) and stressors or shocks (e.g. death of family member, loss of livestock), primarily because of a lack of economically relevant resources or available savings. Moreover, poor households usually have no money for new windows and energy-efficient building materials. Thus, they need more energy resources to get houses warm. In extreme situations, they do not have sufficient fuels to heat their houses. It does not require more detailed description of what it means to have not enough fuel materials during periods of up to -40 °C.

Nevertheless, vulnerable people are not merely victims within that problematic situation, but rather they find ways and they struggle every day to secure their livelihood (cf. Bohle 2007). As presented in this study, local people show awareness of the problematic situations and have developed and adapted manifold livelihood activities and coping strategies (e.g. collecting coal, increased use of manure, energy saving strategies, energy-efficient house construction). They are dealing with vulnerability and especially with energy and resource issues within the realms of their capabilities and possibilities, but often limited due to economic reasons. Social networks are an important part of the often limited coping strategies of the poorest households.

Next to vulnerable households there are also a few winning actors in Sary-Mogol, who profit from the vulnerability of poor households. Statements by interviewees in Sary-Mogol showed, that socio-economic disparities are everything but not a new phenomenon and already existed in the Soviet Union. The present rural elites and networks, which are legacies from the Soviet Union, played an important role in the unequal distribution of production goods, of livestock but also of political influence after the dissolution of the Soviet Union (Steimann 2011). For example, some households in Sary-Mogol were able to acquire large herds of livestock, which manifests their strong economic position within the settlement until today. At present, these legacies are one reason for the political dimension of the vulnerability of many households, due to low participation in decision-making at the village level and little impact on higher levels (district, province, state). Other profiteers of the vulnerability of poor households are the owner and representatives of the coal mine, who can employ the workers to poor working conditions and dismiss them at any time. However, there are hardly any similar paid labour opportunities in Sary-Mogol. Soviet legacies and as a consequence economic and political power asymmetries are reasons for the observed unevenly distributed ownership, wealth and thus also access to energy, natural resources and construction materials. However, in order to analyse these complex issues it needs further studies, directing the focus on inequality and power relations.

Following the concept of path dependence, various decisions of the past have direct impact on the households living in Sary-Mogol today. The relationship between settlement development and present-day energy use, which is the focus of this article, is an evidence for that. Many households today have to deal with the inefficient houses built in the second settlement period because they can neither afford to build a new house nor equip the old house with adequate insulation. This applies especially to the most vulnerable households with only few livestock and a low income. Vulnerable households build small houses as efficiently as possible if they have the money to construct a new dwelling. Wealthier households can build new houses according to their own taste and rely on costly energy-saving materials.

5 Conclusion

An important element regarding energy resources and use is the 'house', the primary place of domestic energy resource consumption. With the help of a historical-genetic perspective, valuable results of the present spatial structures and processes have been generated and are evaluated regarding current energy and resource use. Housing and energy use of many households in Sary-Mogol today are still influenced and limited by decisions and legacies from Soviet times, which led to path dependencies. This is especially true for those households who are economically poor and therefore more vulnerable. There are three periods of settlement construction and inherent areas in Sary-Mogol, corresponding to these periods energy and resource use has also changed, e.g. in relation to the amount of fuel material. The three-period building structure results from Soviet resettlement processes and post-Soviet developments like migration as well as inequality in access to wealth and resources. These aspects have strong, visible influence on contemporary life and especially on the use of energy.

With the help of the case study, the interrelation of settlement development and the everyday strategies of energy use of households living in Sary-

Mogol were analysed. The study provides important insights for future initiatives, research and development projects regarding energy use and housing, also to other settlements of post-Soviet Central Asia. Furthermore, the study provides a basis for potential practical applications concerning energy justice and efficiency in peripheral high mountain regions.

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Sary Mogol - Habitation and Land Use

Chong Alai Rayon

Alai Rayon

Pastures

• 3019

SUU-BASHY

Coal mines

Aktilek

Burgan-Suu

Suu Sary Mogol

Osh
Sary Tash

A372

• 2953

Daroot Korgon

AKSU

Main Road

Centre

Bazaar

Kalta Tor (Dschiptik)

KARAKUL

RANGKUL

MURGHAB

Kyzyl Suu

Suu Sary Mogol

• 2903

Tulpar Köl,
Pastures

Kyzyl Suu

Buildings

- House under construction
- Flat-roofed building
- Pitched-roofed building
- Yurt (boz üi)
- Stable / shed under construction
- Flat-roofed stable / shed
- Pitched-roofed stable / shed
- Public building
- Shop
- Chaikhana (teahouse)
- Unoccupied building
- Ruin

Facilities / Infrastructure

- Mosque
- Muslim cemetery
- School
- Kindergarten
- Hospital
- ① Administrative office
- ② Militsiya
- ③ Bank
- ④ Pharmacy
- ⑤ Shop for tools /metal
- ⑥ Photocopy shop
- ⑦ Dentist
- ⑧ Sports ground
- Petrol station
- Bus / private taxi stop
- Library
- Livestock market
- Weir
- Main power grid

General information

- Highway (paved)
- Main road (unpaved)
- Secondary road (unpaved)
- Road under construction
- Bridge
- Footbridge
- • 2953 Altitude in meters a.s.l.
- District boundary

Watercourses

- River
- Main channel
- Secondary channel

Land use

- Barley
- Potato
- Meadow
- Esparcet
- Cultivable land within the settlement area
- Garlic
- Pasture
- Cultivable land beyond the settlement area
- Fodder crops (barley, esparcet, lucerne, meadow)
- River bed
- Settlement area

KARAKUL Former Kolkhoz (sector)

N

0 75 150 300

Meters

Cartography: Christian Sonntag (2015)
Data Base: Own Survey 2012, 2014
Coordinate System: Pulkovo 1942 GK Zone 13N