

**Regional differences by an analysis of main land
use/land cover and bioregional conditions in the Kyrgyz
part of the Pamir-Alai Transboundary Conservation
Area (PATCA)**

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Preface

Mountains as an important source of water, energy and biological diversity have been a fascination for many researchers, mountaineers, bikers, hikers and trekkers through the years. The Pamir Mountains is amongst the world's highest mountains and is located in Central Asia joining the Tian Shan Range on its eastern front. Largely falling within the Gorno-Badakshan Autonomous Oblast (GBO) of Tajikistan, it includes the Alai valley of Kyrgyzstan and the Hindu Kush Mountains along the Wakhan Corridor in Afghanistan and Pakistan.

Mountain areas development along this region is a goal of a European Union funded initiative the 'Pamir-Alai Transboundary Conservation Area (PATCA)', which hopes to legally establish a conservation site within a section of the transborder territory covering the Pamir-Alai between Kyrgyzstan and Tajikistan. Awareness and participation for this plight, however, has not involved a more effective and sustained effort at the stakeholder and community level. The existing PATCA consortium oversees and acts as a facilitator for the exchange of information to assist the accomplishment of PATCA goals and hence the legal adoption of a transboundary ecological unit in the area.

Projects such as the 'Pamir Strategy Project (PSP)' and 'UNU/UNEP/GEF Sustainable Land Management in the High Pamir and Pamir-Alai Mountains (PALM)' are carrying out multi-disciplinary research in this region, noting also a needed input from collaborative researchers and scientists on poorly researched aspects of resources, development potentials and conservation status in the area. The IYM Japanese National Committee has strong collaboration with the UNU/ UNEP/GEF PALM project and the Centre for Development and Environment (CDE) of the University of Bern, and Hokkaido University has been a strong collaborator in IYM activities.

I took the opportunity to participate in a study covering the proposed Pamir-Alai Transboundary Area (PATCA) due to my interest in natural borders, bioregions or those boundaries defined by the ecology of place (natural definition of borders) vs. that based largely on geopolitical reasons alone.

The research conducted in this relatively isolated part of the world was a very fascinating and instructive one, leaving warm impressions not only due to the beautiful scenery but also due to the hospitality of the local population. Now I am greatly thankful to all those that have contributed to the outcome of this thesis.

First and foremost I would like to thank my supervisor Prof. Teiji Watanabe for his support throughout my research. Maksart Anarbaev of the Center for Mountain Regions Development of the Kyrgyz Republic for logistic arrangement and for his valuable guidance during the time we spent at field. Thanks goes as well to the faculty members and students of the Course in Geoeology and Field Informatics whose assistance helped especially in the final realization of this thesis, especially to Mizuki Chiharu, Ukiana Megumu and Komatsu Tetsuya.

Finally I would like to mention that this thesis has been enabled by the large support of the Ministry of Education, Culture, Sports, Science and Technology.

Gaunavinaka, Leba

Abstract

The Alai valley, located in the southernmost area of the Kyrgyz Republic, is one of the least developed areas in the country. The valley floor ranges in altitudes from 2,240 m in the west (Karamyk) to 3,160 m in the east (Sary Tash). It falls within a currently proposed conservation territory termed the Pamir-Alai Transboundary Conservation Area (PATCA), which is a proposed establishment by the EU with Kyrgyzstan and Tajikistan to bring about conservation. PATCA is an interstate cooperation in resource monitoring and developments in the region, prompting a prospective reduction of damaging practices of intensified use of arable lands and declining key specie populations, a situation imminently following the collapse of the USSR and subsequent reversion to subsistence production in a period of political transformation and economic struggle. This study aims (1) to make an assessment of the land use/land cover across the valley and (2) analyze the distribution of vital resources and principal socio-economic conditions characterizing variations in the area. Field surveys were conducted in the autumn of 2008 and the summer of 2009. The questionnaire surveys were also conducted in both years: 354 and 468 respondents provided information about economy, industry, wildlife, nature conservation, and related aspects of resource usage.

The agricultural and pastoral sectors remain the key occupations, and the valley is suitable for grazing of sheep, goats, cows, yaks, and horses, livestock grazing being the largest industry in the area. Local variations based on biophysical and socio economic aspects differentially characterize the valley into three sections of the western, central and eastern Alai. The western Alai including the villages of Karamyk and Daroot Korgon yields a variety of agricultural products such as potatoes, cereals, peppers, carrots and fruits (apples, apricots and

berries). The central Alai with the villages of Jailma, Kashka Suu, Kara Kabak and Sary Mogol yields potatoes, barley and wheat. The eastern Alai with the villages of Taldy Suu and Sary Tash cannot grow agricultural products mainly due to severe climate. Potato cultivation is not sustainable although it has brought more income in the western and central Alai. Residents in the eastern Alai have to rely completely on food supply from outside (mostly from Osh). The questionnaire survey conducted in 2008 shows that more residents in the eastern Alai have negative perspectives on economy (43.9% of 105 respondents).

The interview survey conducted in 2008 and 2009 suggests that several wildlife species inhabit the Alai valley area such as ibex, lynx, bear, marmot, fox, although Marco Polo sheep is threatened by extinction. Such wildlife could be ecotourism resources and is important to conserve. The questionnaire survey in 2008 suggests that many residents favor development of ecotourism and the survey in 2009 shows that most positive responses for tourism development came from the central and eastern residents.

Ecotourism to be developed in this area should be connected to agriculture and grazing. Not only establishing ecotourism in the eastern and central Alai but also developing markets of agricultural products within the valley to serve both local residents and tourists, with supply of agricultural products from the western Alai to eastern and central Alai, would help augment sustainability in the entire Alai valley area. In this context, self-supporting efforts compatible with viable potentials suited for development and conservation in each locality can minimize the effects of existing pressure put on the natural resources of Alai valley today.

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Abbreviations

ACTED Agency for Technical Cooperation and Development

ARIS Community Development and Investment Agency of the Kyrgyz Republic

AKDN Aga Khan Development Network

AKF Aga Khan Foundation

CDE Centre for Development and Environment

FAO Food and Agriculture Organization

GBAO Gorno Badakhshan Autonomous Oblast

GEF Global Environment Facility

GIS Geographic Information System

YM2002 International Year of the Mountains

KG Republic of Kyrgyzstan

LUCC Land Use and Cover Change

NCCR North-South Programme

PALM Pamir Alai Land Management Project

PATCA Pamir Alai Transboundary Conservation Area

PSP Pamir Strategy Project

RS Remote Sensing

SDC Swiss Agency for Development and Cooperation

SAEPF State Agency of Environment Protection and Forestry under Government of the Kyrgyz Republic

TJ Republic of Tajikistan

UNU United Nations University

1. Introduction

1.1. Background

1.1.1. The Pamir-Alai Transboundary Conservation Area (PATCA)

The Kyrgyz Republic (hereafter referred to as Kyrgyzstan) and the Republic of Tajikistan are two of the Newly Independent States (NIS) of the former Soviet Union in Central Asia. Both largely mountainous with populations of 5.2 and 6.1 million (World Desk Reference, 2009) respectively, they are home to groups of mountain communities largely dependent on agricultural and pastoral sectors. Since the collapse of the USSR, these agricultural and pastoral activities have led to intensive land-use as people struggle to survive economically with the reversion to subsistence production, following a decrease in subsidies and state services and a general lack of alternative employments. This has resulted mostly in severe consequences for the ecosystems of this Central Asian region as land cover changes after independence occur alongside a time of difficult economic and political transformations (Kreutzmann, 2005).

In 2006 the European Union in collaboration with governments of both countries proposed to establish a conservation area between a transborder section of these two countries in an effort to help halt and lessen damages to the ecosystem. The conservation area should encompass the Tajik National Park (the largest in Central Asia) and the Alai valley. This initiative would also assist both countries adhere to requirements of ratified international conventions like the Biodiversity Convention as well as help their Biodiversity Action Plans and their National Environment Action Plans (NEAPs).



Figure 1.1: The Pamir-Alai Transboundary Conservation Area (PATCA) lies on the transborder of Northeastern Tajikistan and Southern Kyrgyzstan.

The Pamir-Alai Transboundary Conservation Area (PATCA) is the proposed conservation area on the transborder within the northern Pamirs (Figure 1.1). Located around $39^{\circ} 36' 45''$ N and $72^{\circ} 42' 12''$ E, the proposed area has a total land area of approximately 29,405 km²: 12,428 km² falls within Kyrgyzstan in the southernmost parts of the Osh province and 16,977 km² within Gorno Badakshan Autonomous Oblast (GBAO) of Tajikistan. Alai valley system occupies some 7,910 km² of Kyrgyz PATCA. The legal establishment of PATCA is to assist interstate cooperation efforts in the management and monitoring of natural resources across the border and help further their development plans in the territory. This study will consider PATCA extents in both countries but the focus will be on the land use/land cover of the Kyrgyz part of PATCA.

1.1.2. Natural Boundaries and Bioregions

Natural boundaries are simply boundaries that are not made by man. These would include rivers, mountain ridges or other natural features in the environment that borders and separates an area, distinguishing it from another. In the early 1970s, Peter Berg and Raymond Dasmann, credited for coining the term bioregion, developed works on this concept of natural boundaries (Thayer, 2003). Bioregions are natural boundaries commonly defined as areas sharing similar physical and environmental conditions; further the determination of these similarities should also emphasize local populations' knowledge and understanding of these variations. Similar physical and environmental features mean similar soil and terrain characteristics, similar climatic conditions and similar flora and fauna.

Assessing bioregions involves analyzing by modeling the interaction of biophysical conditions. Bioregions are smaller than ecoregions although they are often interchangeably used with ecoregions (Mc Ginnis, 1999). They zoom in to capture the local conditions of climate, soils, vegetation and flora and faunal communities. The ideal of bioregional environmentalism is to identify local ecological units that could plausibly be adopted as the scale for human administrative divisions of resource governance (Bailey, 2002; Brunckhorst and Rollings, 1999). It is concerned about the organization of society or re-habitation of place, within the ecological capacity of a natural region (Gary, 2007). Criteria for demarcating bioregion's main elements include the units used by the World Wide Fund for Nature (WWF, 2009) (Table 1.1). Biodiversity and natural boundaries ignore or transcend national and political boundaries, but are definitely

distinct assemblage of natural communities. Hence both should arguably be of a more relevant conservation planning unit.

Table 1.1: Bioregional demarcation criteria, adapted from the World Wide Fund for Nature's Conservation Science Program (2009).

Bioregional Units	
1	They share a large majority of their species
2	Share similar environmental conditions (elevation/climate/soil/vegetation)
3	Interact ecologically in ways that are critical to their long term persistence

1.1.3. Concept of land cover and land use

Land use and land cover can be indicators of ecosystem health, and also provides information on the extent of human communities' impact and conversion of their surrounding earth surface cover. When analyzing such changes, the term land-use and land-cover change (LULCC) is often used (Ellis, 2007), which is explained as the human modification of the earth's terrestrial surface. This combines the natural cover plus modifications rooted in human causes. Land cover encompasses the physical and biological cover over the surface of land, and includes elements as water bodies, vegetation, bare soil, and or artificial structures. Land use, often more complicated to define of the two encompasses human activities such as agriculture, forestry and building construction that alter land surface processes, affecting its' biochemistry, hydrology and biodiversity. Land cover often can be observed directly in the field and increasingly today, via remote sensing techniques. Observing land use requires a more

interdisciplinary approach, which can incorporate social scientific methods as interviews, to verify what is really occurring on the land along with observing what the land-cover interpretation indicates.

1.2. Statement of the problems and study objectives

The Pamir-Alai communities face difficult economic conditions due to their relative isolation and generally extreme climatic conditions. Intensified use of arable lands and increased hunting of wildlife for the sustenance of livelihood have often led to problematic consequences on the surrounding ecosystems and aggravate poverty and hardship. Fertility decline in arable lands and decrease in key species number, are of concern to any future development strategy. In order to effectively address the issue of conservation and to protect the ecological balances as to nurture an environment that would contribute to the health of its communities, it is important to assess the current status of dominant land use/land cover, distribution of vital resources, socio economic variations and biophysical conditions, and to observe how these links are interconnected and influence each other.

1.2.1. Objectives of the Study

The first objective of this study is to identify variations in the local environment as they pertain to landscape characteristics, elevation and climate, and the distribution of significant natural resources,

Secondly, to analyze a land use/land cover map as to model areal extent and distribution of land use/ land cover in the valley, and assess how their distribution

influence local communities' economic choices as well as shape their capacity to conserve the natural environment.

Thirdly, to propose how these characteristic variations lead to measures suitable for sustainable development and the mediation of conservation across Alai valley.

Particular objectives of the study are:

1. Identifying and reclassifying the land use / land cover of Kyrgyz PATCA,
2. Analyzing bioregional conditions,
3. Assessing variations over space, and,
4. Obtaining conclusions that can be a basis for action, that look into potentials of local community development and also ways of supporting community participation capacity towards environmental conservation.

1.2.2. Research questions and hypothesis

The research questions that this study is to address have the following four phases:

1. Can we identify variations in the local landscape from distinguished bioregional conditions across Alai valley?
2. How does land use/ land cover vary over the Kyrgyz PATCA landscape and how are these variations connected to its bioregional definition of place? How does the land use/ land cover shape people's choices.
3. What potentials and constraints are identifiable across the valley and what main resources are found to be of ecological or economic value?

2. Regional settings and ecosystem of the study area

2.1. Regional settings

The Pamir Mountains rises high between the steppes and valleys of Central Asia, and joins the Tian Shan stretching from the Northeast, the Karakoram and Kunlun Shan from Southeast and Hindukush from Southwest. The Alai valley lies between the Za-Alai Range and the Alai Range of Kyrgyzstan and can be described as an intermountain depression. Kyrgyzstan is made of eight administrative provinces (Figure 2.1) with a total area of 199, 900km² and the southernmost province is Osh wherein 12,428km² is within PATCA. The valley due to isolation from the main urban centers remains one of the least developed parts of Kyrgyzstan.

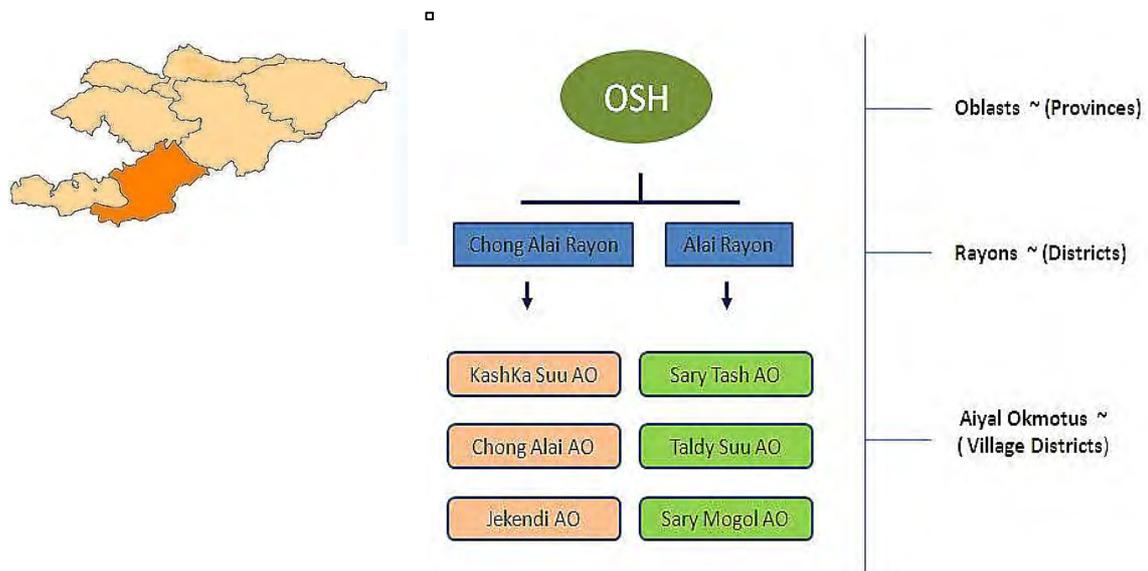


Figure 2.1: Administrative divisions of Kyrgyzstan. Osh highlighted in the inset map is the southernmost province of the republic.

2.2. Biophysical conditions

The Pamir-Alai is noted for its significant biodiversity. The Alai valley is generally characterized by an arid environment with variations relating to altitude. The high Pamirs presents a landscape of mountain lakes and snow and ice covered peaks. The Za-Alai Range (also known as Trans- Alai Range amongst westerners) of the Pamirs stretches over 200km in an east-west direction encompassing some glacialized peaks. The Alai Range borders the valley from the north and has maximum elevations of 5,500m, running approximately 350 km from northeast to southwest. The elongated Alai valley in between has an average altitude of 2,800m and a length of 180 km. The area is also known for a characteristically complex orographic massive with a long history of catastrophic natural hazards (Cunha, 1998). The topography of the area is complex and diverse (Badenkov, 1992), and through analysis with bioregional factors, we wish to capture some of this complexity and explain how it relates and influences the status of land uses and land cover in this region.

The climatic conditions are generally continental mountainous with a local variation of cold winters and cool summers (Khromova et al., 2006). Precipitation is of the highest during March and June. Air temperatures are high in July and August and lowest around peak winter months of December and February (Figure 2.2). The nearest weather stations within the area are located near Sary Tash and Daroot Korgon villages.

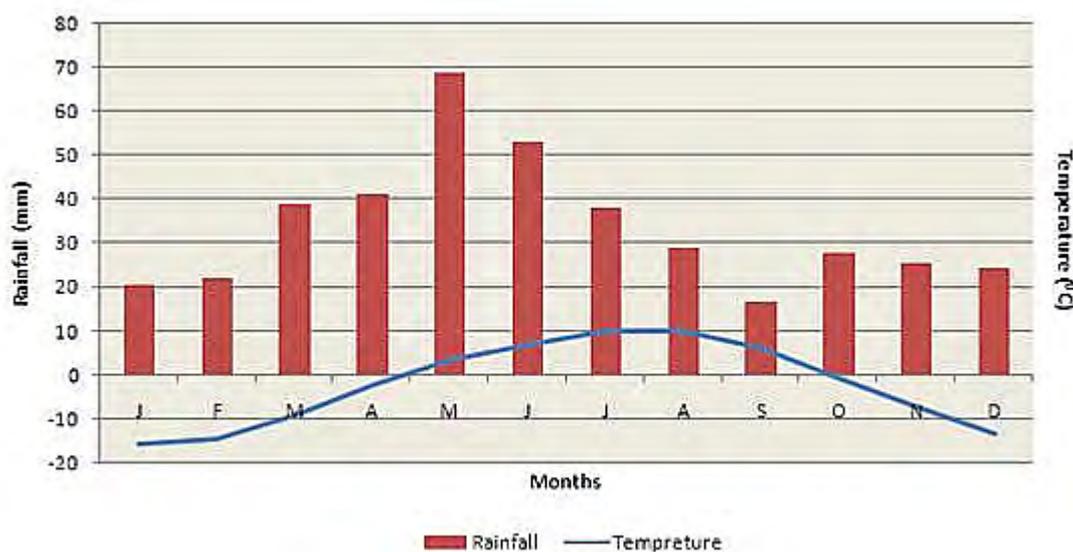


Figure 2.2: Mean average precipitation and air temperature for SaryTash: 1991-2000. Data source: Williams & Konovalov (2008).

Soil formation and vegetation growth are generally slow throughout the valley. Variations of vegetation growth can be attributed primarily to differences in altitude, precipitation, air temperature and cloud coverage. The area is considered a high mountain area averaging -8°C of mean annual air temperature (Cunha, 1998). According to the meteorological data taken at the state meteorological stations in Sary Tash (3,153m) and Daroot Korgon (2,470m), the average air temperatures in January are approximately -20°C in Sary Tash and -8°C in Daroot Korgon. Those in July are approximately 5°C in Sary Tash and 20°C in Daroot Korgon. Evaporation in the even higher surrounds such as the Alai Range and the Pamirs is at an average of 200 mm per annum, and in Alai valley 1,200 - 1,600 mm, usually exceed the average level of precipitation (CDE, 2005). Predominant winds are mountain and valley winds.

2.3. Socio – economic environment and history

Since the collapse of the USSR, there has been a general decline in public services as these countries struggle to make the transition into self-sufficient market economies. Ethnic tensions and political instability further aggravates the situation. Unstable working conditions in the urban centers and a general lack of alternative employments have lead many to live in rural areas and support their livelihoods through subsistence production or trade in livestock and agricultural products. This has brought pressure on the natural resources of rural areas due to intensive use (Breu, et. Al. 2003), and presents a challenge for the authorities and governing bodies on environmental management to preserve those areas considered to be biodiversity hotspots and essential to the sustenance of surrounding ecosystems and communities.

2.4. Aspects of land use in the area

Before the independence, there had been various kinds of help from the Soviet state in terms of public amenities, supplies and subsidies on local production. After the independence, residents have to find ways to generate income to support their livelihood given the sudden decline in economic benefits during the Soviet rule. Use of areas for livestock grazing intensified and/or expanded. Today the Alai valley floor is characterized by vast areas of pastures, being the most dominant land cover. Kyrgyz people are influenced by nomadic traditions, and have summer and winter pastures to alternate use on grazing grounds between seasons. Traditional rules determine the use of the pastures, and these are controlled by the local people. Sheep herding in mountain meadow (*jailoos*) remain the main source of income for most of the households across the valley, and where the land maybe arable enough, on agricultural crop production. Pastures are used most intensively during the short winter months. Other land uses

include coal mining activities, tourism and some fishery and trout breeding (Baird, 2008). Potential exists for gold and brennt mining as well, but more investigation on this potential is being assessed by the governmental authorities. The area remains a poorly researched region (AGRECO Consortium, 2007).

2.5. Flora

Generally the Alai valley has more vegetation than the Tajik side of the Pamirs, and this is mostly due to it receiving more rainfall. This comparative advantage, allows communities within the valley to grow at least certain crops without the need for the major irrigation system as is the case in Tajikistan. Still, dominant vegetation is limited to (1) high mountain conifers, (2) sparse growth of trees on the side of Alai range (mostly of juniper species (*Juniperus schugnanica*)), and (3) grasslands along the valley floor and mid-altitude meadows, and shrublands which include dwarf-shrub communities covering mountain slopes on both sides of the elongated valley. Of conservation significance is a shrub called teresken (*Eurotiaceratoides*). Known locally in Kyrgyz as *Shvak* and *Tsuthm* in Tajikistan, this has become a main energy resource in the valley (The Snow Leopard Conservancy, 2007). However, the collection of this shrub for fuel purpose, leads to loss of vegetation cover on an already arid environment and often causes desertification.

2.6. Fauna

The domesticated animals in the Alai valley include yaks, sheep, goats, camels, horses, and cattle. There are some bird species, insects species, a few reptilian lizards and wildlife including mammals such as Marco Polo sheep (*Ovis ammon polii*) a widely sort after trophy hunt, and endemic to the regions' corridor, Siberian ibex (*Capra ibex*

sibirica), snow leopard (*Uncia Uncia*), Asiatic lynx (*Lynx lynx*), brown bear (*Ursus actos isabellinus*), longtailed marmot (*Marmota caudata*), otter (*Lutra luta*) and wolf (*Canis lupus*) species (Izumiyama et al., 2009; Murray, 2007).

3. Methodology

3.1. Approach of PATCA

The initiative to establish a conservation transboundary area across Kyrgyzstan and Tajikistan (Figure. 3.1) to help conservation efforts and the assessment of development potentials that can help improve the state of the local economy.

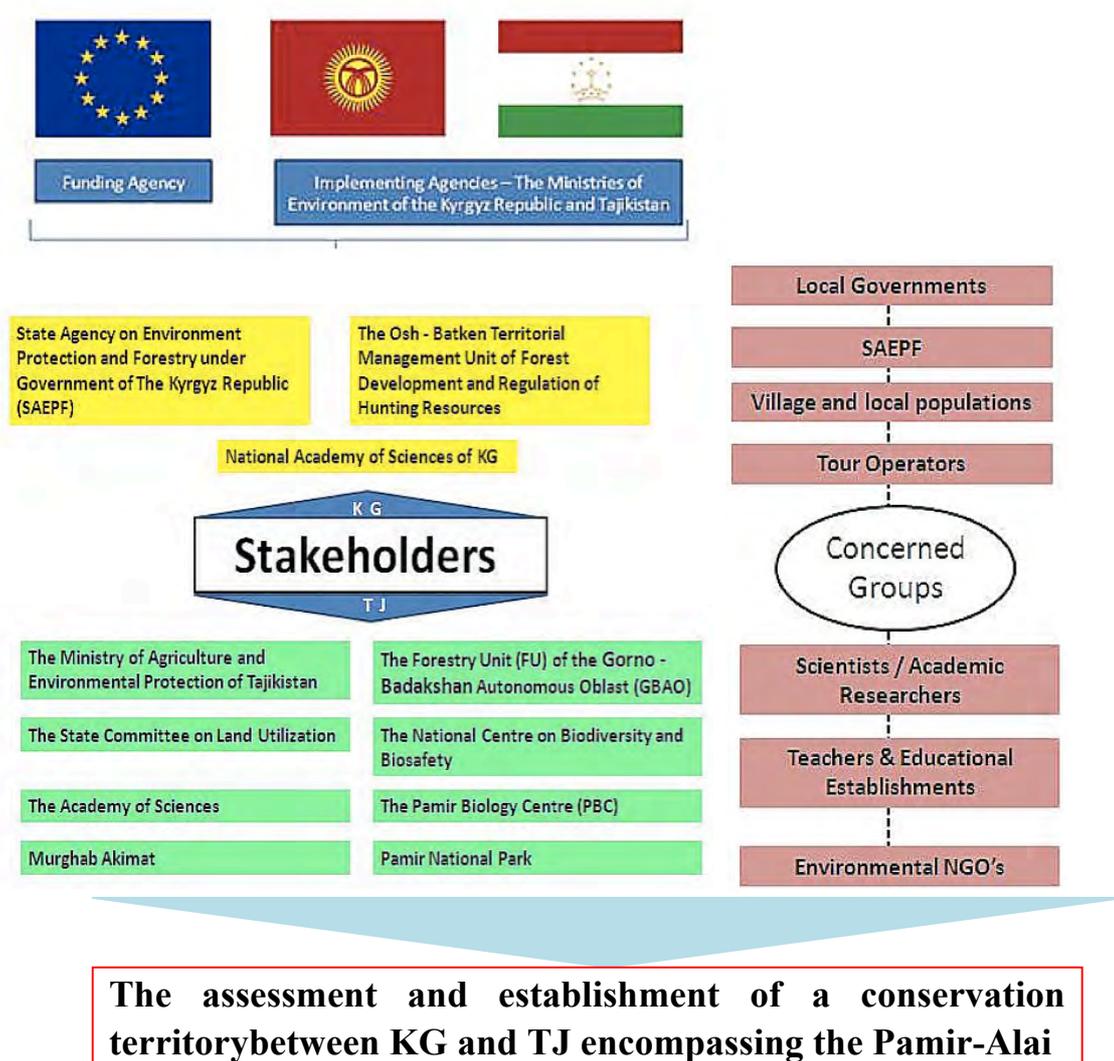


Figure 3.1: Stakeholders and Concerned groups in the establishment of the PATCA (prepared from AGRECO Consortium, 2007).

3.2. Approach of this Study

Bioregional definitions explain uniqueness of areas (Figure 3.2.) and in this study, characteristics of biophysical parameters (Figure 3.3) is described from the west to the eastern end of Alai valley to identify similarities and existing variance. Land-use/land-cover map analysis, field surveys and statistical data were used to describe the physical characteristics. Then questionnaire, interview and field survey data were used to describe bioregional conditions, obtaining information of Socio-economic, resource utilization, conservation and development potentials.

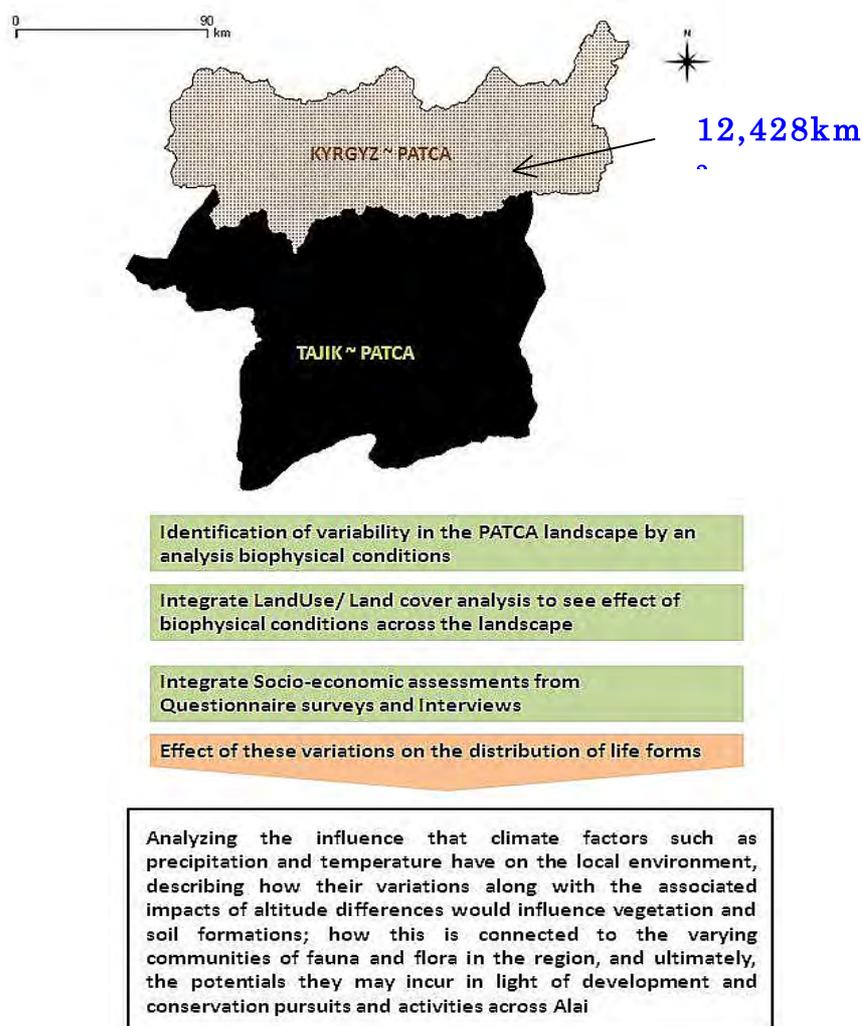


Figure 3.2: Concept of identifying similarities and variations in Kyrgyz PATCA

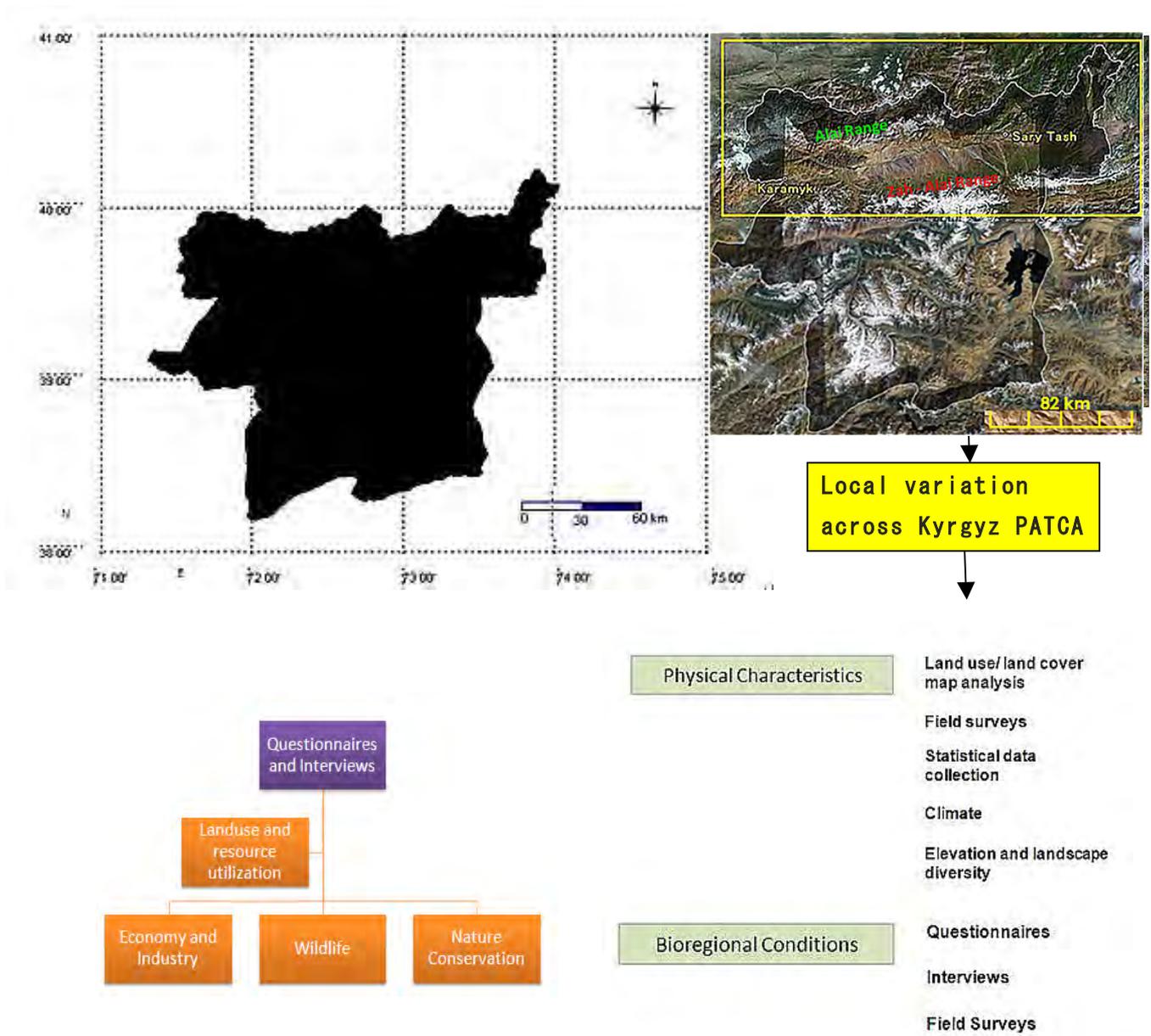


Figure 3.3: Overlay of bioregional parameters for the Kyrgyz part of PATCA.

3.2.1. Questionnaire and interview surveys

The 2008 questionnaire survey contained 16 questions. The questionnaire was first prepared in English and then translated into Kyrgyz with the help from the scientist of the National Center for Mountain Regions Development of Kyrgyzstan. A total of 514 translated questionnaire sheets were distributed across eight schools in the villages of Sary-Tash, Sary-Mogol, Kara-Kabak, Kashka-Suu, Jailma, Chon Alai and Alai Cyu. School children took the questionnaire sheets home to get them filled by their parents. I received 354 answer sheets but some of these were incomplete. Of the 354 respondents, 82 were public officers; 73, farmers / pastoral herders; 36, private-sector employees; 26, construction workers; 5 service personnel and 37 were engaged in other occupations. Further, 95 respondents did not give any answer. The percentages of male and female respondents were 71.4% and 28.6%, respectively. A significant percentage (47.2%) of the respondents were in their teens; this is because many students incorrectly filled-in their ages while questioning their parents. Further, 16.1% of the respondents were in their twenties; 17.7%, in their thirties; 13.0%, in their forties; 5.0%, in their fifties and 0.9% were aged sixty or above.

The 2009 questionnaire survey contained 31 questions. A total of 560 translated questionnaire sheets were distributed across eight schools in the villages of Sary-Tash, Taldy-Suu, Sary-Mogol, Kara-Kabak, KashKa-Suu, Kyzyl-Tuu, Daroot-Korgon and Karamyk. The questionnaires were handed out to locals, government officials and teachers and later picked up from their homes or offices. Some were handed out in person or via door to door and collected the same day. A total of 468 answer sheets were received. Of the 468 respondents, 359 were farmers/pastoral herders; 25, tourism operators or employees; 5, state employee only; 5, mining

employee; and 9 were engaged in other occupations. Also, 56 respondents did not give any answer. The percentages of male and female respondents was 69% and 31%, respectively. Nine percent of the respondents were under twenty years of age, 21.6 %, in their twenties; 22.6 %, in their thirties; 25.4 %, in their forties; 13.7%, in their fifties; and 7.7 % were aged sixty and above.

Interviews with local residents and local tourism-related individuals were conducted in 2008 mainly in Sary-Tash and Sary-Mogol, where there is some tourism activity. Additional interviews were conducted in some other villages as well. Interviews in 2009 were conducted in Sary-Tash, Sary-Mogol, KashKa-Suu, Kara-Kabak, Daroot Korgon and Karamyk.

3.2.2. Land use/land cover mapping

For the purpose of this study, a land-use/ land-cover map by Baird (2008) was adopted and was re-digitized into the working project. The vector layers for the adopted map were originally derived from satellite imagery (Landsat data) in 2004. This was reclassified into six main land-use types based on their commonly shared attributes. Each category was coded and combined with similar classes to obtain the reclassified groupings, which were then further analyzed with biophysical conditions by means of overlay analysis in GIS environment.

Datasets (vector shape files) covering the main roads, rivers, boundaries and distribution of four significant flora and ten key-specie mammals, in both countries were derived from the PATCA web portal (<http://patca.zerofive.co.uk/>) made by Baird (2008). A land use/land cover map initially interpreted from satellite imagery datasets for the CDE project was also published in a 2008 report by Baird for the PATCA

consortium. This was scanned and re-digitized in this study with their attributes, for geoprocessing analysis.

Base reference maps used are the 1:100,000 and 1:200,000 Russian topographic maps verified with Google Earth Map Data (2008-2009) with Transverse Mercator, Zone Gauss Kruger 13 (corresponding to UTM Zone 42-43N), Pulkovo 1942 datum, Kassevsky spheroid projection. This was analysed with the biophysical characteristics.

3.2.3. Analysis

The land use/land cover map re-digitized are then integrated with the socio-economic conditions by an assessment of data obtained from questionnaire survey and interviews which consider relationships, associations and trends across the valley relating to pastoral land-use and traditional means of monitoring the sustainability and use of grazing lands, agricultural production, cropland expansion and irrigation methods, sources of energy and fuel, infrastructures and settlement conditions and needs, in order to understand the causes relating to the land-use /land-cover types in this area.

Based on biophysical characteristics and the information assessed from these surveys, the Alai valley (Figure 3.4) can be categorized into three sections: (1) western Alai which includes the villages of Karamyk, Daroot Korgon and KyzylTuu; (2) central Alai encompassing the villages of Jailyma, KashKaSuu, Kara Kabak, and Sary Mogol, and (3) eastern Alai with Taldy Suu and Sary Tash.

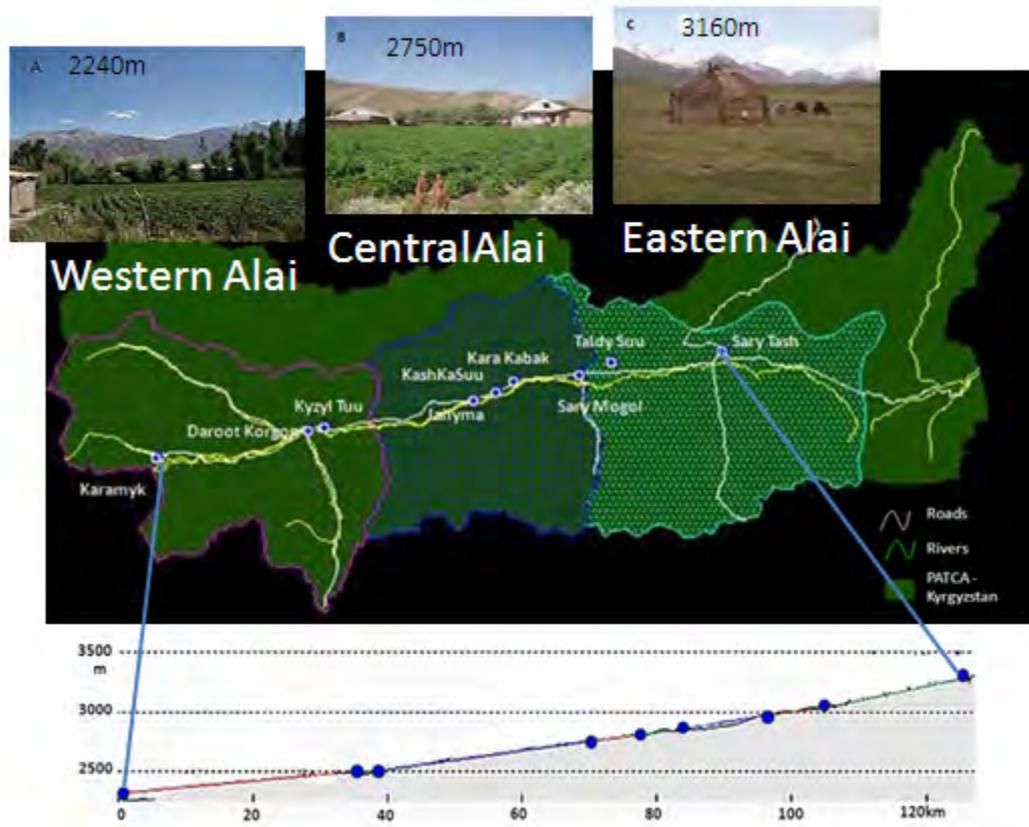


Figure 3.4: Three regional division across Alai valley with the surveyed settlements in 2008 and 2009.

4. Results

4.1. Questionnaire and interview surveys

4.1.1. Economic Occupation

Economic occupations are mainly pastoral herding and agricultural activities in the central and western areas. The eastern residents depend primarily on livestock breeding although recently there is supportive income from tourism and mining activities (Figure 4.1).

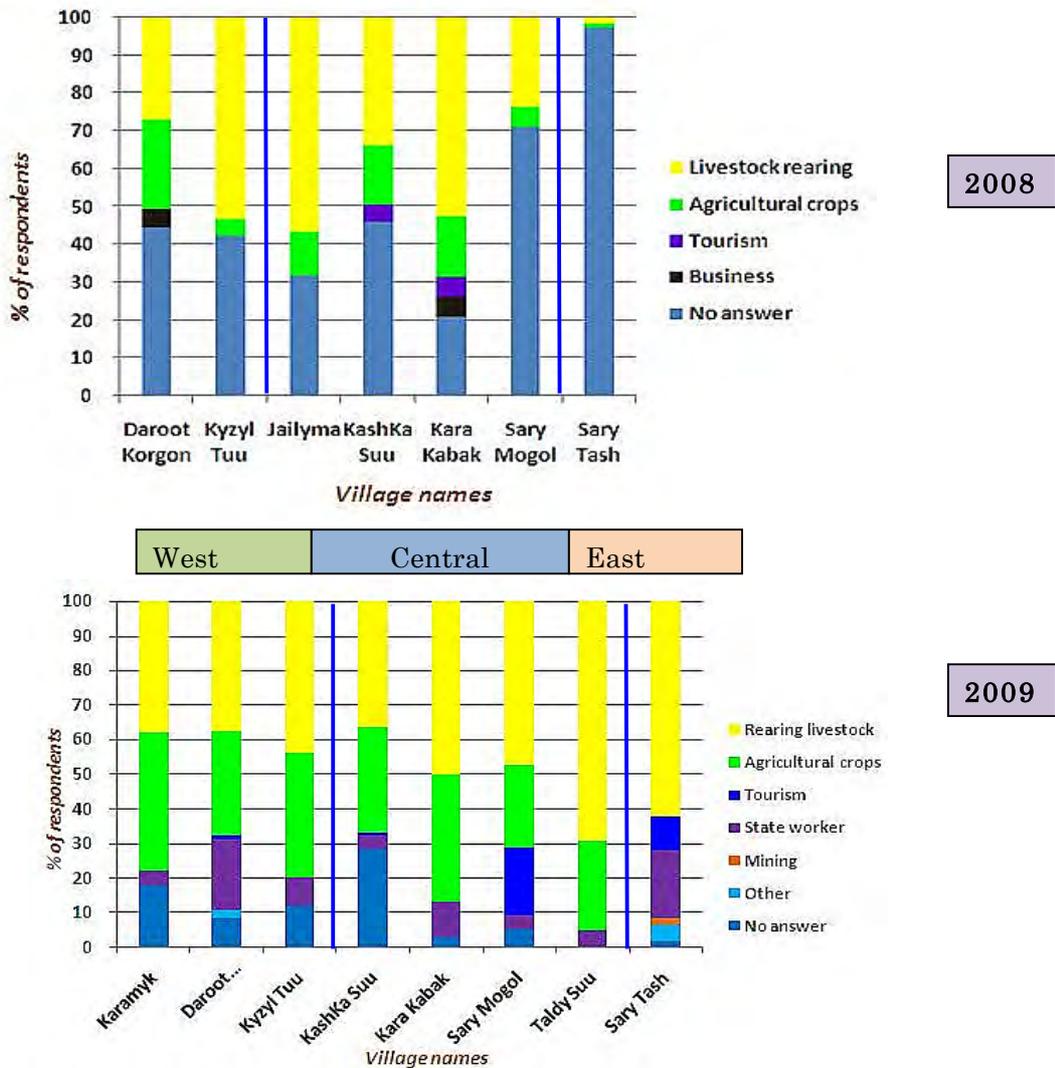


Figure 4.1: Livestock rearing, agricultural production remains the dominant household occupations in both 2008 and 2009 surveys.

4.1.2. Land use

Across the Alai valley, land use or the human modification of the land is largely for purposes of securing essential resources for food, energy and development. Land use is characterized by settlements, village gardens (areas around settlements allocated as croplands for potatoes and wheat, for example), mainly along central and western areas, grazing grounds on nearby meadows and on expanses along the valley floor to support livestock.

□

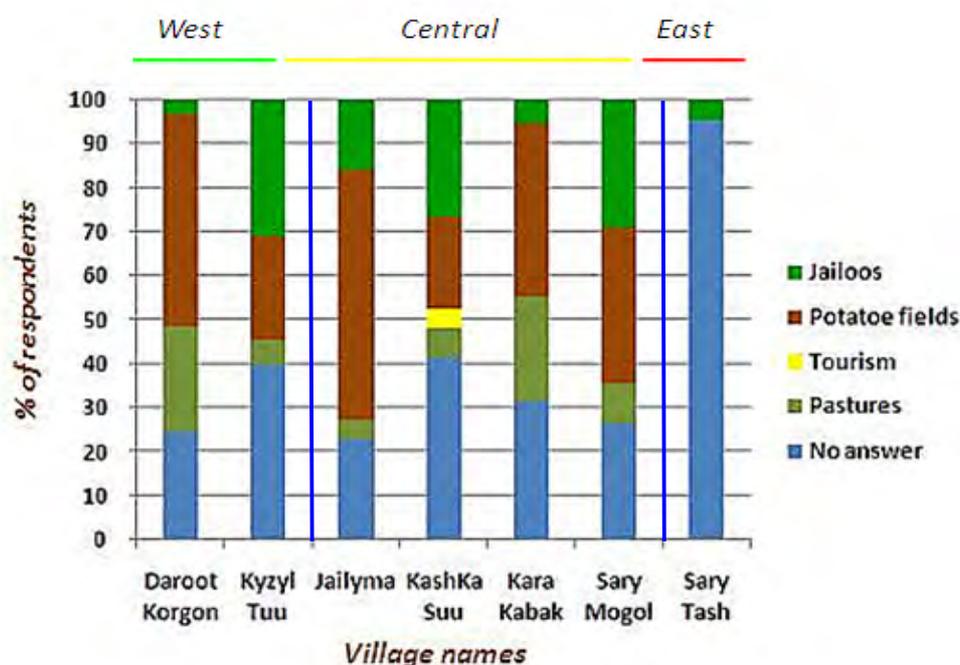


Figure 4.2: Activities that result in the main land-use types across the Alai valley

There are areas, mostly within central area, allocated to support tourism activities like trekking and places for yurt camps. Pasturelands include both (1) *jaiilos* (summer pastures) mostly located at the moderately high to very high altitudes, and (2) plains, the pasturelands along grass-covered steppes and valley floor.

4.1.3. Conservation

This study showed that most of the respondents were not aware (Figure. 4.3) of the proposed establishment. It is interesting that more residents in the central Alai tend not to know PATCA and the Sustainable Land Management in the High Pamir and Pamir-Alai Mountains (PALM) Project by GEF/UNEP/UNU (CDE, 2005; Hannam, 2006; Jansky and Pachova, 2006).

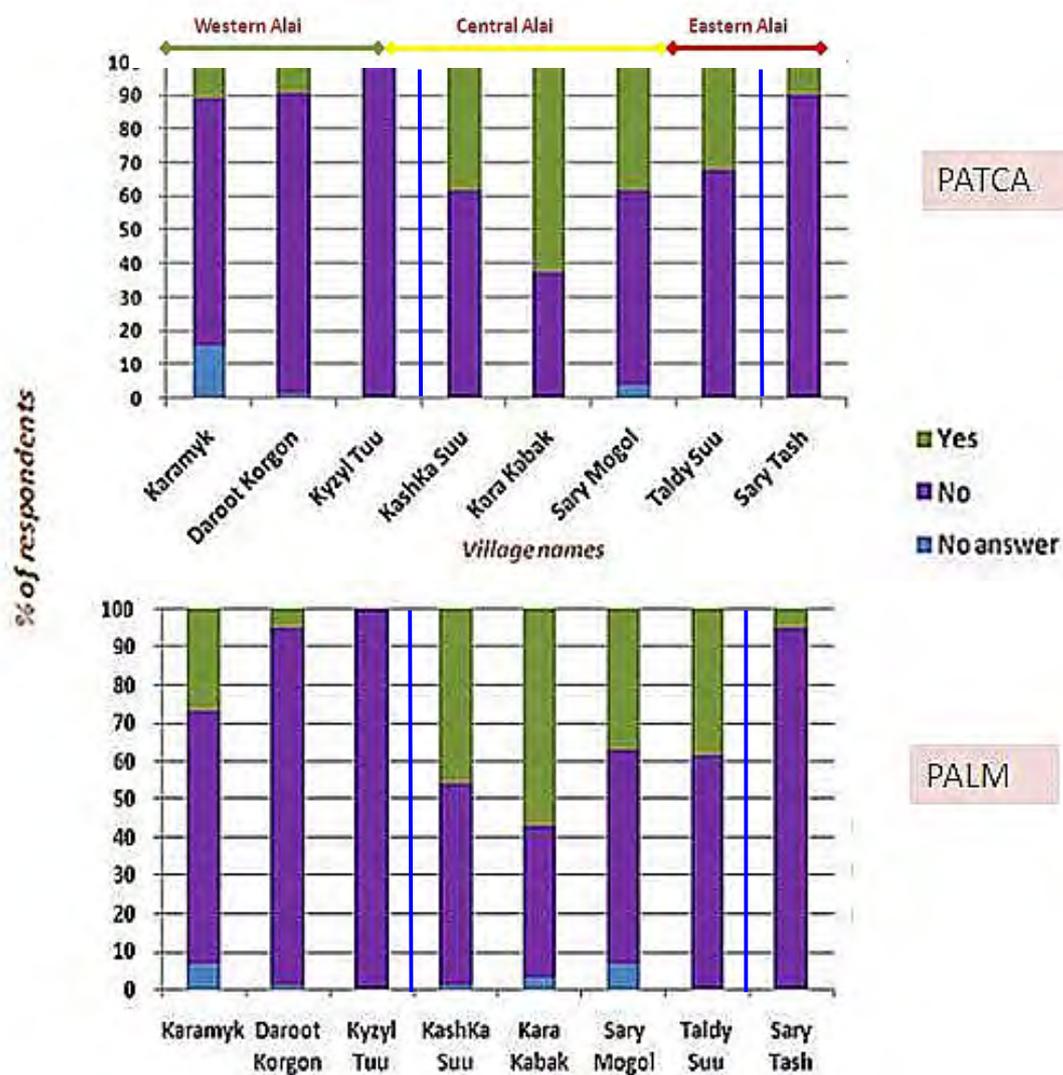


Figure 4.3: Responses to whether they know about the PATCA Project (top) and the Sustainable Land Management in the High Pamir and Pamir-Alai Mountains (PALM) Project by GEF/UNEP/UNU (bottom) in the area.

4.1.4. Livestock and livestock products

Livestock are reared in the form of transhumance, being mostly kept in stables near the villages in winter. Haymaking (cultivating grasslands for forage and livestock feed), is characteristic across the Alai valley. Sheep and goats make up for the highest numbers (Table 4.1), followed by cattle and horses. Yaks are also grazed but mostly in the central and eastern settlements due to their need to dwell and graze along higher altitudes. In the easternmost and of lower elevation side of the Alai (Karamyk village at 2240 m) there are no yaks

Table 4.1. Livestock counts in the Chon Alai Rayon (Data Source: Chon Alai Rayon Office; Darroot Korgon)

Year	1992	1997	2002	2007
Cows	7,179	8,161	12,043	12,529
Yaks	180	288	399	409
Horses	2,532	3,087	3,675	3,787
Sheep & goats	103,306	77,655	79,305	67,337

Livestock products are mostly for the provision of food (meat, butter, oil, yogurt, cheese, *kaimak*, fermented horse milk (*koumiss*), and eggs from chickens); transportation (camels, horses, and donkeys); clothing, household goods and traditional handicrafts (wool, leather).

4.1.5. Agriculture

Agricultural production is the second largest economic occupation in the Alai valley communities. Agricultural crops along the area are limited and vary. They are grown for both subsistence agriculture (mainly for food and forage, by smallholder farmers) and

commercial agriculture. Figure 4.4 shows the type of agricultural products that can typically be found in the three sections of the valley.

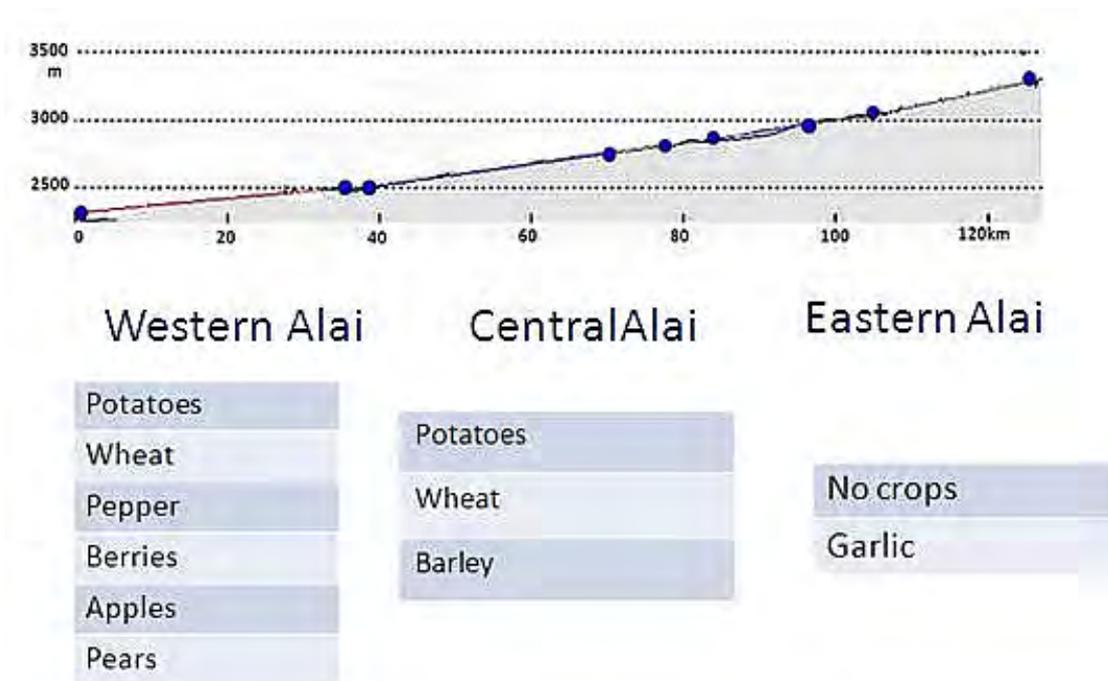


Figure 4.4: Main agricultural products grown across the Alai valley

4.1.6. Main environmental concerns

Main environmental concerns suggested by locals include problems of freshwater supply (Figure 4.5), poverty and related factors (as the lack of alternative incomes, natural resource scarcity especially vegetation in a very arid environment, difficult living conditions). River water provides the livestock and communities along the Alai valley their main source of drinking water. There are some village pipes (for example, in Kara Kabak) that channel water from the surrounding mountains to support village water supply.

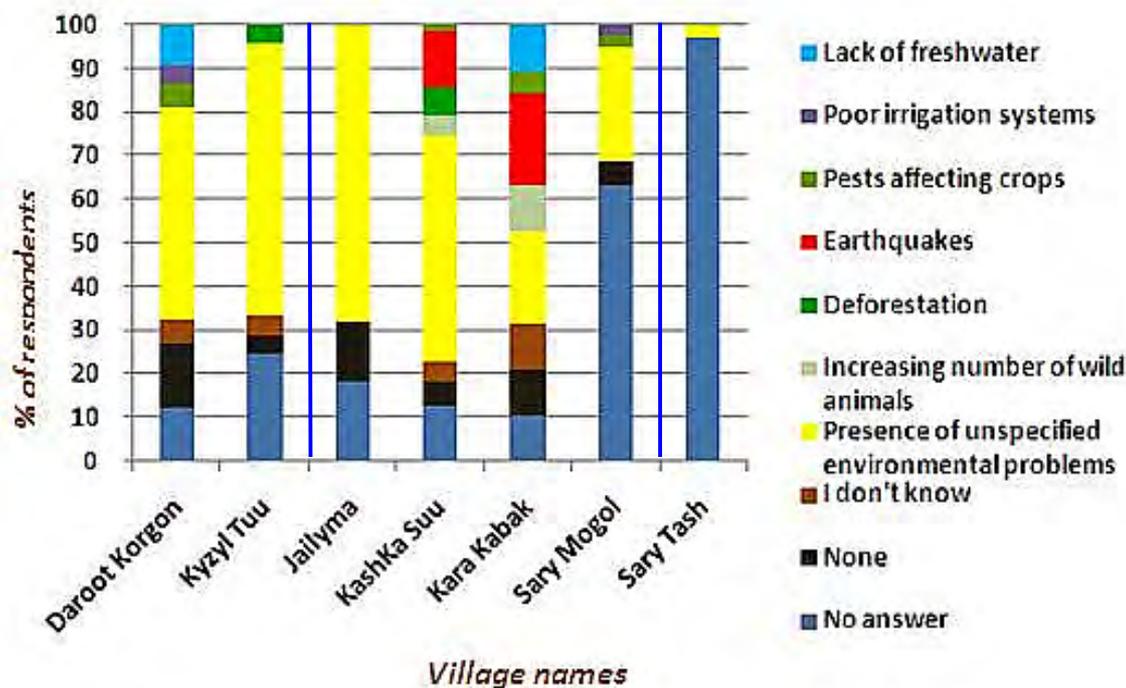


Figure 4.5: Main environmental concerns from questionnaire data in 2008.

Poor irrigation systems on arable lands, characteristic to some of the western and central settlements (Daroot Korgon (West) and Sary Mogol (Central)) further affect soil quality and capacity to sustain agriculture. The increasing number of wolves is common (Figure. 4.6) throughout the valley, and this can be attributed to a few interrelating factors. This presents a problem because it threatens livestock number (Figure 4.7).

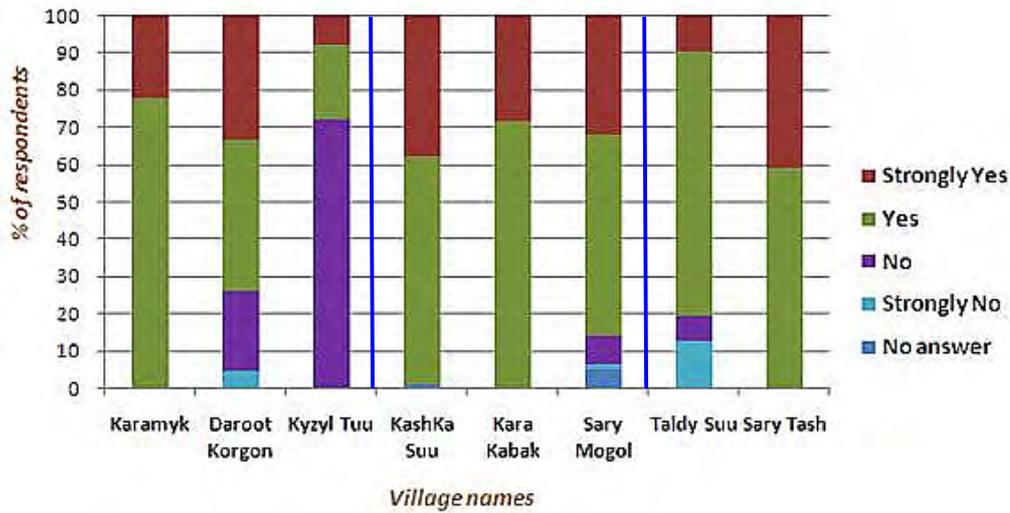


Figure 4.6: Responses to increasing wolf numbers between 1991 - 2009

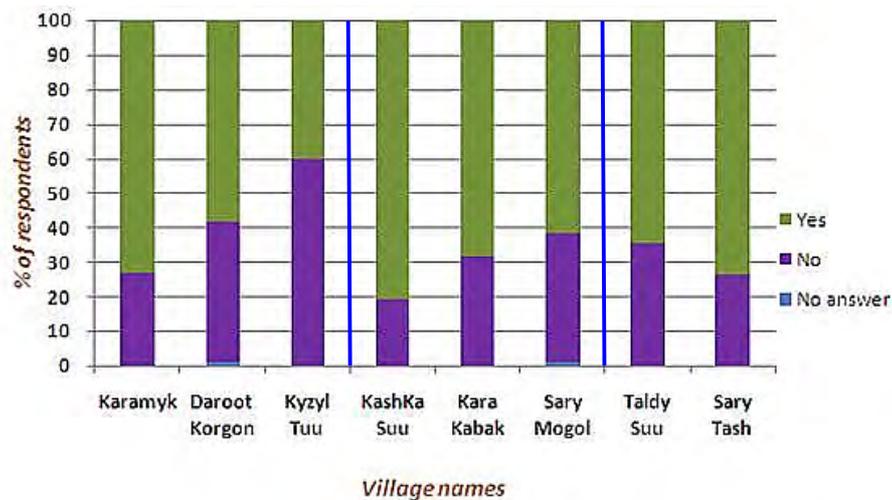


Figure 4.7: Percentages of residences that have experienced damages to their livestock by wolves between 1991 and 2009.

Natural hazards such as earthquakes also feature as a threat to security in the region (Figure 4.8). The occurrence of earthquakes can be attributed to the ongoing collision between the northwestern corner of the Indian indenter and Eurasia resulting in the closure of the intramontane Alai valley separating the Tian Shan and Pamir - Alai ranges (Strecker et al., 2003). Deforestation for expansion of pasturelands and

firewood (fuel/energy need) extraction attributes to the clearing of some coniferous woodlands (mainly *picea* species) along the Alai range.

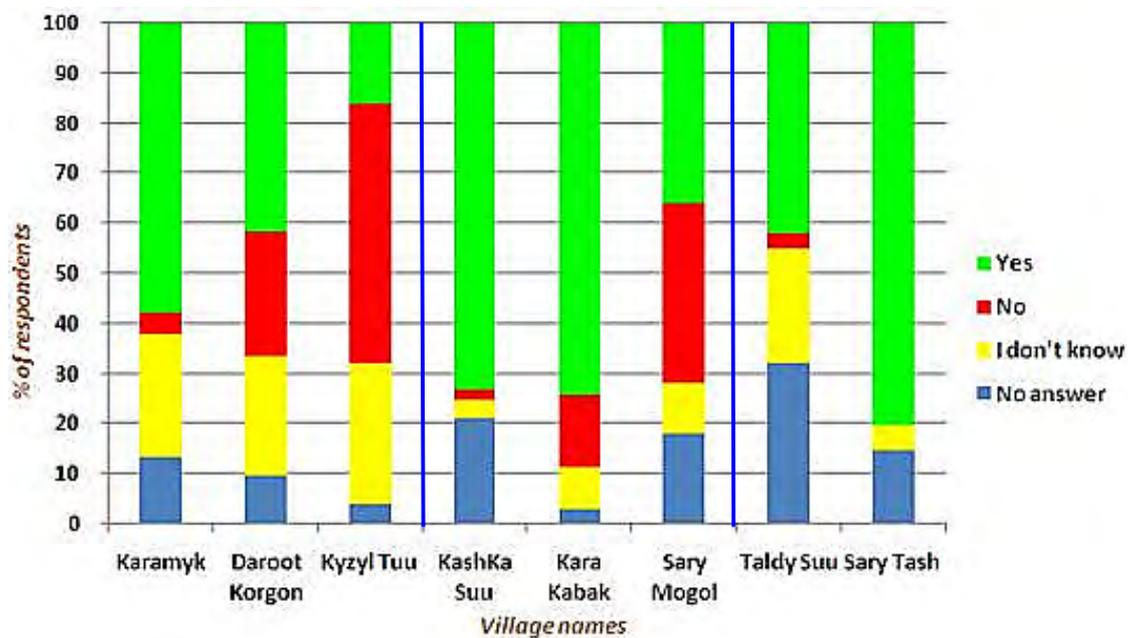


Figure 4.8: Percentages of respondents that have experienced earthquakes in the settlements.

4.1.7. Main potentials for economic development

Main potentials for economic development as indicated by the respondents rest mainly on the improvement of Alai valley's agricultural industry including the marketing of their cash crops and livestock products, development in the tourism industry, and investments in some alternative ways that could support and generate supplementing incomes. To manifest these potentials, it is vital to improve the road conditions (Figure 4.9) linking the valley to the main market center (Osh city), improving these roads would be a costly undertaking and financial backing or aid is needed. Other supportive factors include improving education and the facilitation of better credit terms.

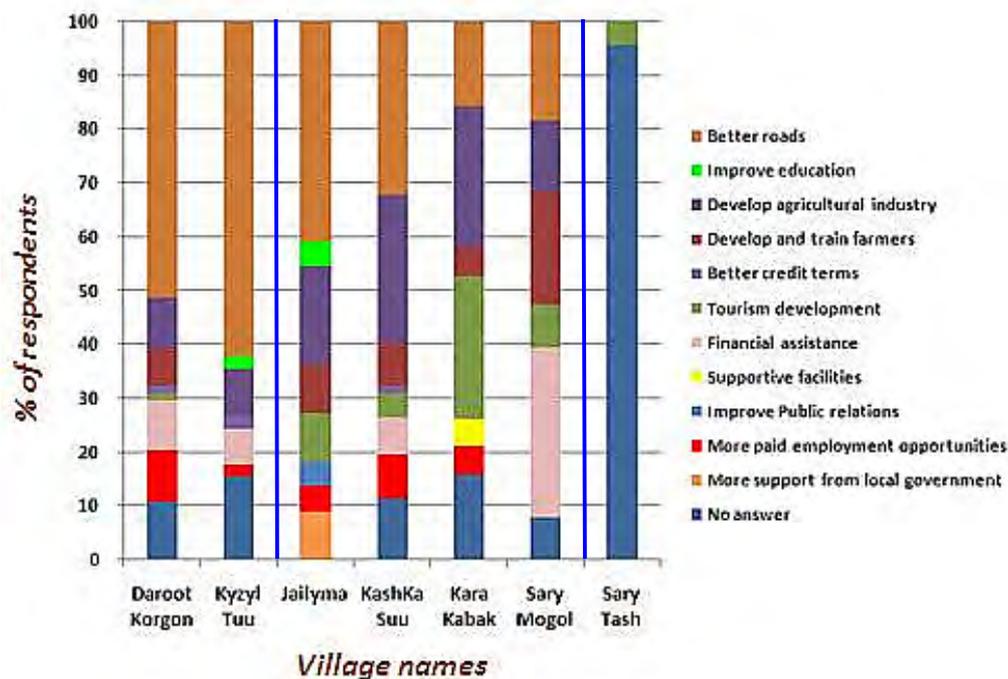


Figure 4.9: Factors that can support potentials for economic developments

Tourism

Figure 4.10 shows that potential for tourism development has high percentage of the respondents in the eastern Alai of Sary Tash and Taldy Suu and in the eastern edge of the central Alai (Sary Mogol). Settlements of Sary Tash depend on livestock trading and some businesses (like restaurants and cafes) for income generation. Due to its strategic location on a road junction connecting the Pamir Highway that runs into Tajikistan, with the road into the Alai valley, and the road to Nura village, closer to the Chinese border southeastward, and with the main road from Osh city, it is an ideal location for business and trading of goods from all the connecting places. There are two home stays (homestays) and two family-run yurts in Sary Tash (Watanabe et al., 2009). In Sary Mogol, there are three home stays including a Community-Based Tourism (CBT) guesthouse that offer meals, tours and trekking activities to tourists heading to Mount Lenin Base Camp and its surrounding areas, or just passing through.

Tourism development in the valley is relatively new but if implemented and organized better can become a good source of alternative income.

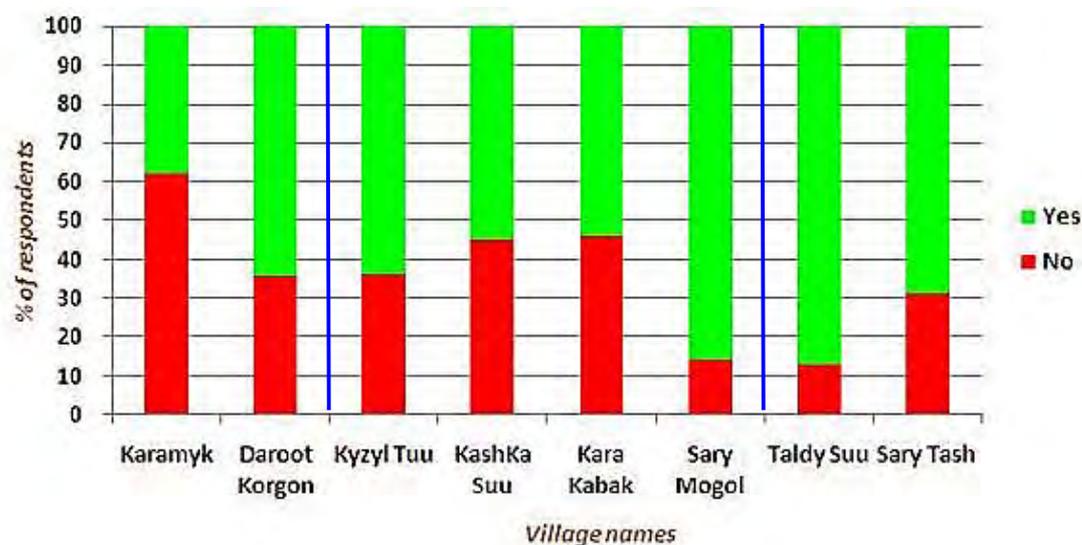


Figure 4.10: Perception on whether Community-Based Tourism has potential in developing their settlements

Wool Processing

Wool processing currently carried out in the households from Sary Tash to Karamyk, (Figure 4.11), provides mostly for making carpets and clothes. There is sufficient surplus wool available and this can be marketed to outside centers if a wool processing plant or market is well established to facilitate this. Skin processing for leather production presents an alternative as well.

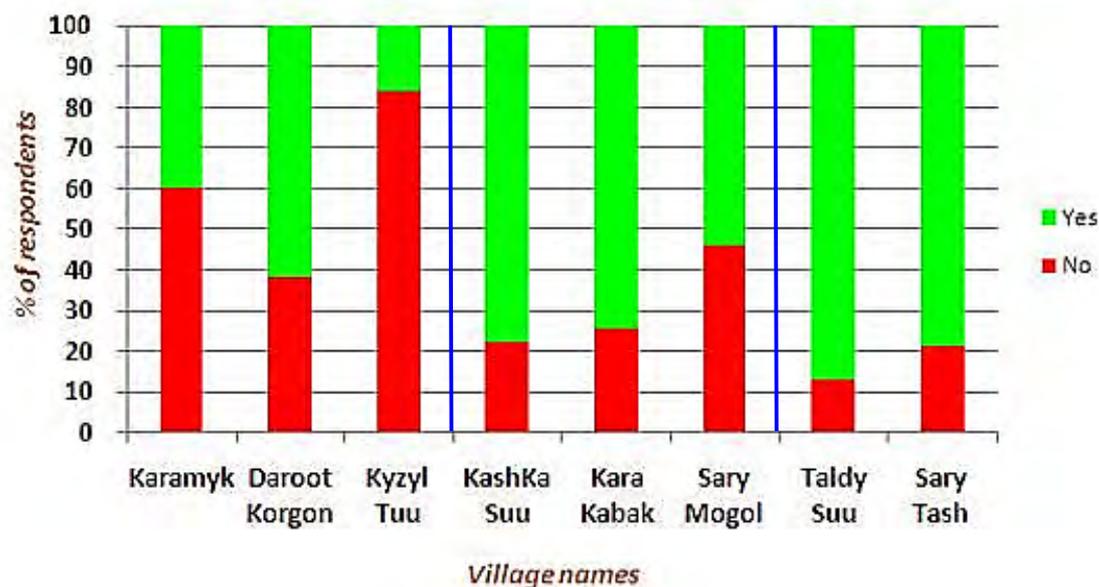


Figure 4.11: Perception on whether wool processing has potential in developing their settlements

Milk Processing

Development of a milk processing plant in the area holds potential to help generate income for Alai valley residents. Highest percentages of responses came from the eastern Alai and this could be attributed to their high dependence on livestock products to generate some alternative income, and they are at the edge of the valley on the way to Osh. Local people can not keep milk for long in the valley (Doempke, 2008); hence, it is more often used instead to produce butter and *kurut* (a hard and sour cheese that can be stored for longer periods). According to a PATCA project survey in the area (Doempke, 2008), there exists a potentially good market to sell such milk in Osh, because there is a demand in Osh province given that they cannot produce sufficient amounts of milk in good quality and often depend on milk imported from Bishkek.

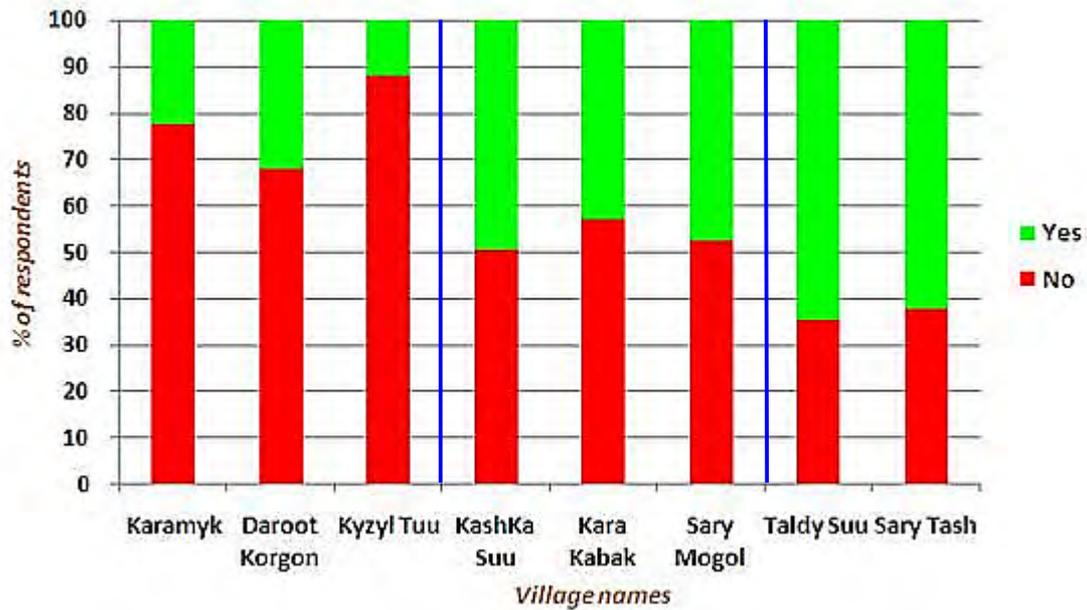


Figure 4.11: Perception on whether Milk processing has potential in developing their settlements.

Gold, coal and salt minings

Gold, coal and salt are mined in the valley (Figure 4.13). There is widespread potential for coal mining. Even though a current gold mine is located in the east, there is a higher percentage of respondents from western residents in support of gold mining potential in their settlements (Figure 4.14), and interviews with residents gave an indication that there are surveyed areas with potential for gold excavation in the area, but are currently not explored yet. Coal mining has widespread support (Figure 4.15) and a number of locals are employed in the two existing mines. Higher percentages of responses in Daroot Korgon and Kyzyl Tuu for Salt quarrying (Figure 4.16) could be due to the fact that a ground salt quarry has been existing from the Soviet time in Daroot Korgon (Altyn Dara Salt quarry) (Figure 4.13). It provides no packaging plant but can be used by locals.



Figure 4.13: Location of the gold, coal and salt mines in the Alai valley.

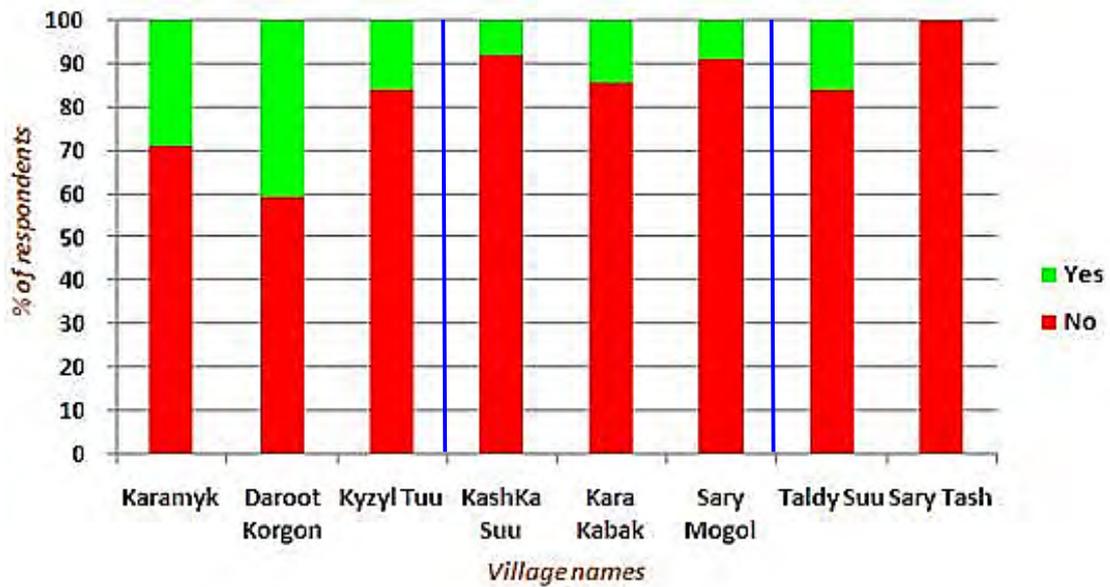


Figure 4.14: Perception on whether gold mining has potential in developing their settlements

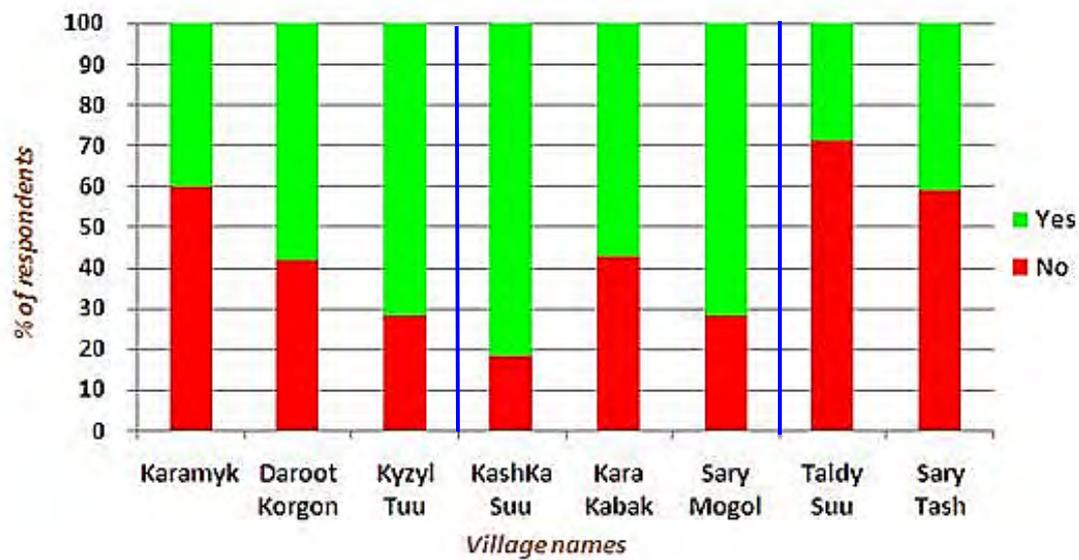


Figure 4.15: Perception on whether coal mining has potential in developing their settlements

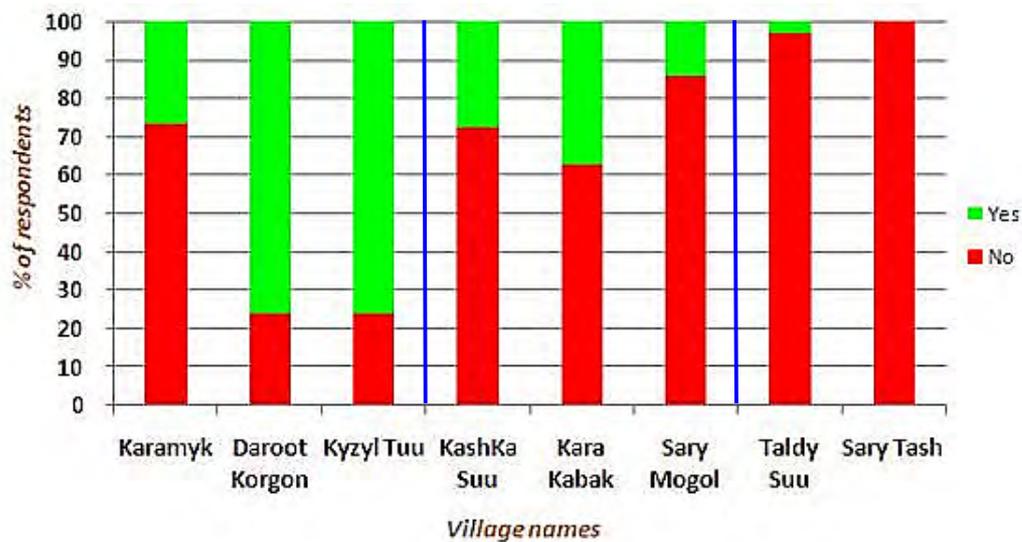


Figure 4.16: Perception on whether salt mining has potential in developing their settlements.

Arts and Crafts Market

Figure 4.17 shows that the central Alai has higher percentage of respondents in agreement that hosting arts and crafts markets in their settlements would be a positive undertaking. This is due partly to their central location and proximity to tourist centres,

such as closeness to treks to Mount Lenin Base Camps. Arts and crafts include traditional items of dresses, hats, coats, thick and long woolen socks, colourful carpets, bags, bracelets and beads.

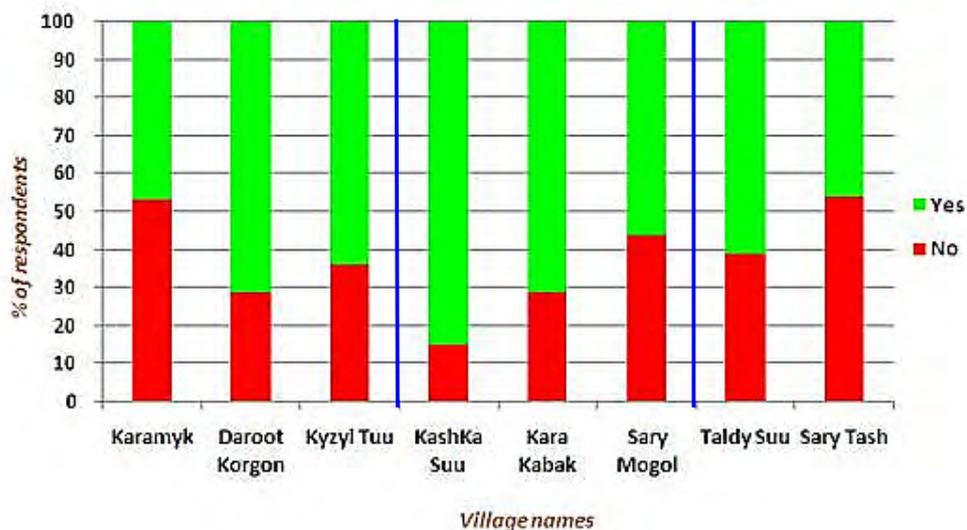


Figure 4.17: Perception on whether an arts and crafts market has potential in developing their settlements.

Fruits and Vegetables

Mostly cultivated in the westernmost end of the valley and none at all in the east (Figure 4.18): these include apples, pears, berries and apricots (Figure 4.19)



Figure 4.18: Fruits and vegetables that only grow in western Alai (Karamyk)

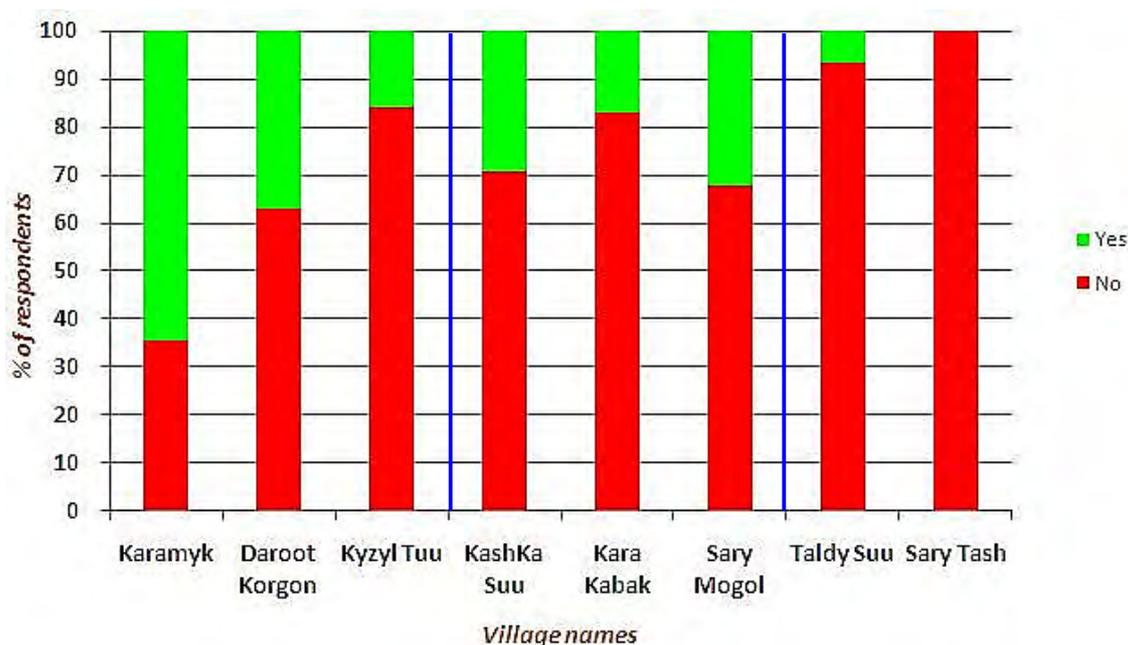


Figure 4.19: Perception on whether developing a fruits and vegetables market has potential to develop their settlements.

Most positive responses came from western Alai where the only fruit trees of Alai valley are dominantly present. Those that do not consider this as much of a plausible option, indicate that although they can market this resource to support their community, and assist in the trade and redistribution or resale of fruits and vegetables from western Alai, the difficult road conditions is the big limitation to the realization of this potential.

Cultivation of Medicinal herbs

Some shrub species are cultivated for their medicinal quality. This include the seabuckthorn berries (*Hippophae zhannoides*), which are of better quality than when grown in many other areas of Kyrgyzstan. This species thrives in drought like environments. Local residents view potential in development of medicinal herbs, especially in the western and central Alai (Figure 4.19).

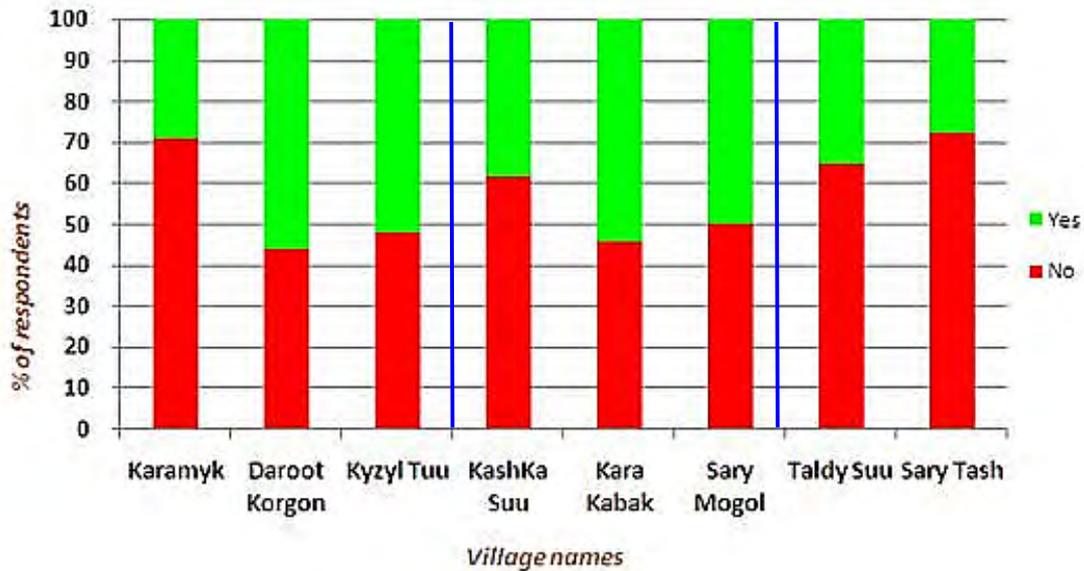


Figure 4.19: Perception on whether the cultivation of medicinal herbs has potential in developing their settlements.

Fish breeding

This has potential largely in the central Alai such as Kashka Suu village. Rivers in the Alai Range support fish species as *Ferrel*, and this is also found along most rivers running on the south-facing slopes of the Alai Range, especially the Dara River near Daroot Korgon and Kyzyl Tuu as well as in the rivers near Karamyk. Reflecting the distribution, the respondents from all villages have positive perception on the fish breeding in future (Figure 4.20).

Fish breeding is supported in Daroot Korgon, and the residents want to extend this along the Kyzyl Suu River and more in the surrounding mountains from the Alai Range. The villages of Kashka Suu and Kara Kabak show great interests in attracting international investment on the fish breeding.

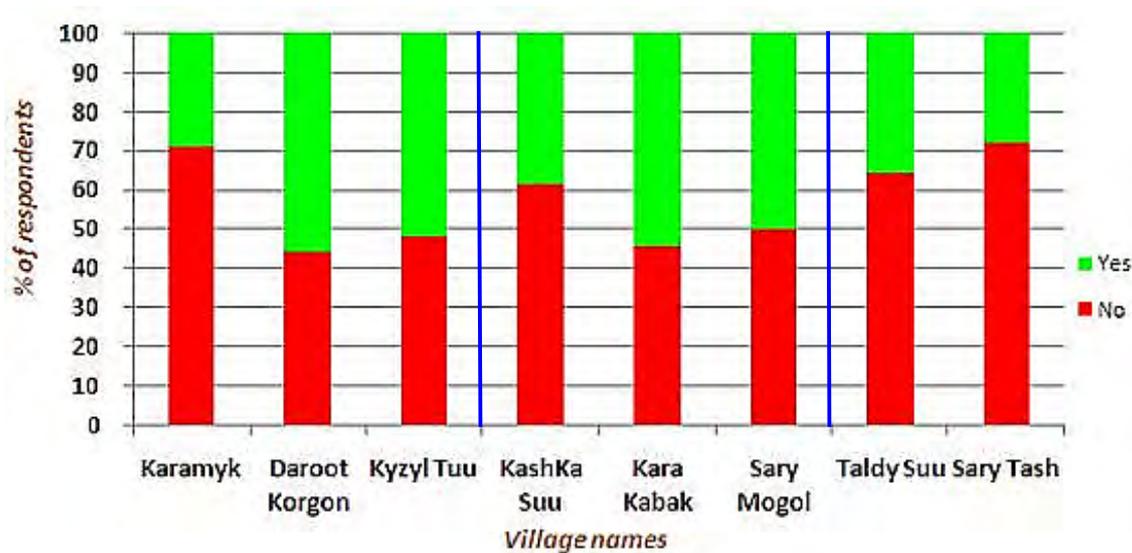


Figure 4.20: Perception on whether fish breeding has potential in developing their settlements.

The eastern Alai has potential to develop markets for fish breeding and tourism development. The central Alai needs more vegetables and crop yields, wool and milk processing facilities, and tourism development. The western Alai also needs more vegetable and crop yields but also particularly markets to support fruit production. Development of gold and salt mining is also suitable for western Alai. Road improvement, development of medicinal herbs and fish breeding are also needs shared by the central and western Alai areas.

4.2. Land use and land cover

4.2.1. Land use and land cover mapping

A land use/ land cover map by Baird (2008) with fifteen initial categories was re-digitized for my analysis of land use/ land cover in this study.

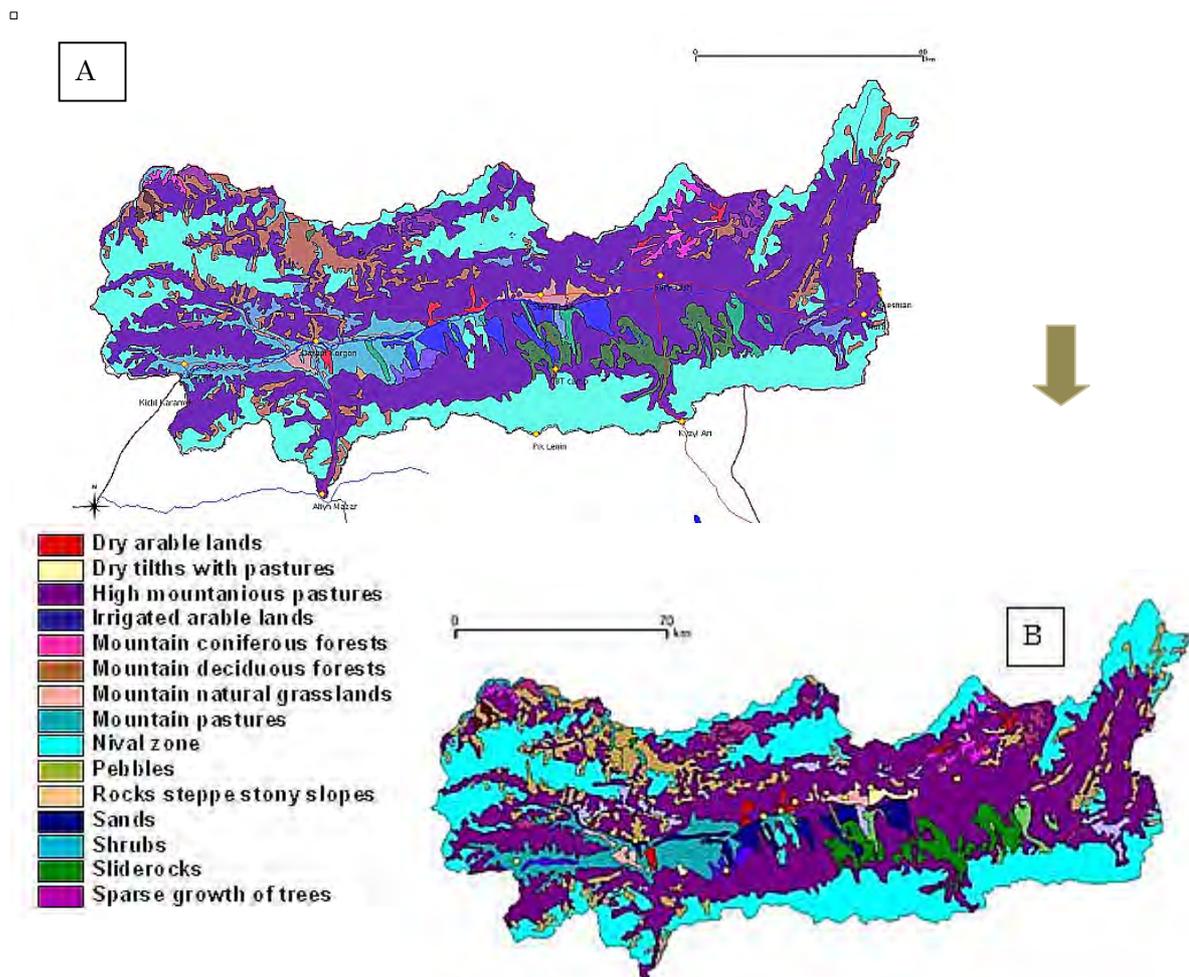


Figure 4.21: Land-use/ Land-cover map from CDE datasets published by Baird (2008) (A), and re-digitized into this study (B).

From this was analyzed the vertical zonation and distribution of land use/land cover within Alai valley's natural boundary. The diagram on Figure 4.22: shows the results of this analysis. Valley bottom altitude goes from lower to higher when we

move from western Alai to eastern Alai. The categories are distributed from being vertically closer to the settlements (valley bottom) to far away (higher ground).

	Western Alai	Central Alai	Eastern Alai	
Far away Higher ↑ Distance from villages ↓ Altitude ↓ Close Lower		Bedrock, snow & ice	Bedrock, snow & ice	
			High mountain pasture	High mountain pasture
		Bedrock, snow & ice	Dry arable land	Stony steppe
		High mountain pasture	Mountain natural grassland	Coniferous forests (north)
		Sparse trees (northern peaks)	Sand	Pebbles
		Stony steppe	Irrigated arable land	Slide rocks (southern peaks)
		Shrub land (S-facing slope)	Mountain pasture	
		Dry arable land		
		Mountain natural grassland		
		Sand		
		Irrigated arable land		
		Mountain pasture		
Valley bottom altitude	Lower ←————→ Higher			
Landscape characteristics	Diverse landscape, wider valley ←————→ Simple landscape, narrow valley			

Figure 4.22: Results of the land use/ land cover map analysis, with categories adopted from Baird (2008).

From this analysis, it is notable that western Alai is made up of a more diverse landscape compared to central and eastern Alai with relatively simpler landscapes. This diversity in the landscape however presents some categories that are too small to analyze area wise. Sparse trees for example accounts to 0.003% of total area. It deemed useful to combine similar classes so I reclassified the categories into six main classes (Figure 4.23) composing of (1) Agricultural lands (2) High mountain pastures (3) Forests (4) Mountain pastures (5) Bare ground (6) Alpine zone.

4.2.2. Land cover distribution

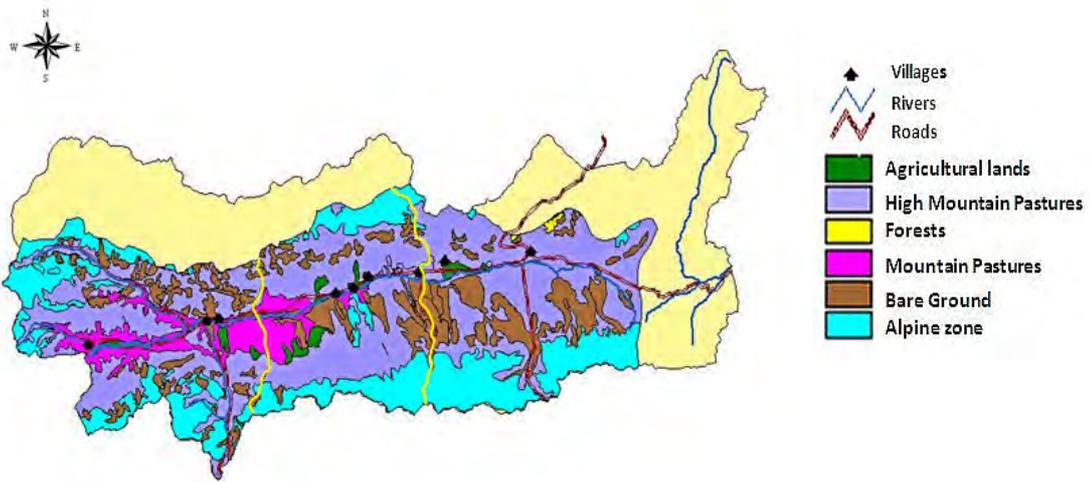


Figure 4.23: Six main land use/land cover classes in the three regions of Alai valley.

Then from the reclassified map, the area distribution of each category was calculated (Figure 4.24). You have the altitude zonation of the categories going from valley bottom to higher ground when moving longitudinally from western, central to eastern Alai.

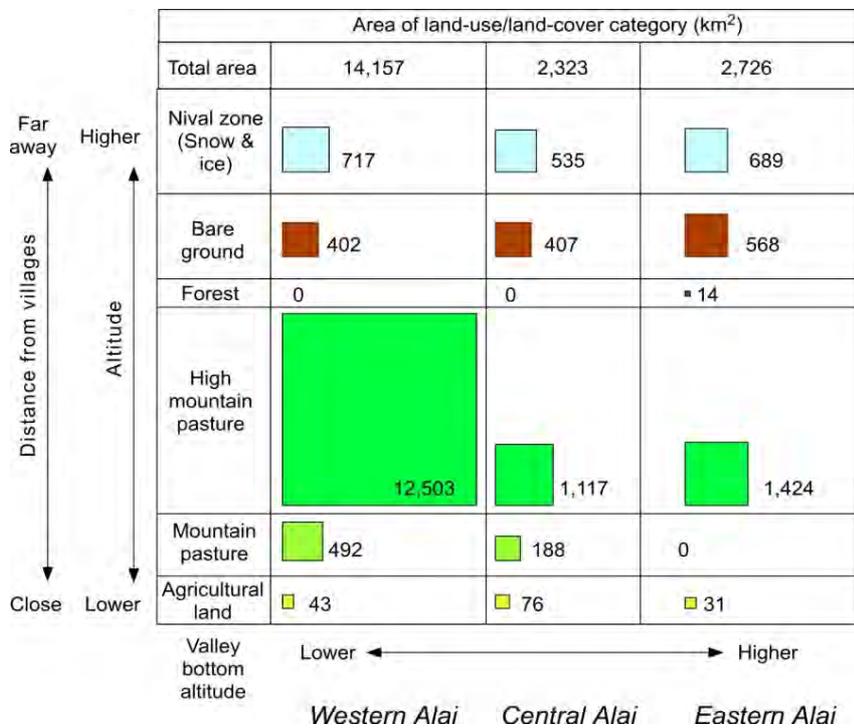


Figure 4.24: Area of each land use/ land cover in the three Alai regions

Analysis of the areal distribution shows that High mountain pastures makes up for the majority of the land cover in western Alai, which is also the section of the valley with the largest total area. Agricultural land is limited throughout the valley and there no forests in western and central Alai with almost none in eastern Alai. The next diagram (Figure 4.25) shows the calculated percentage of each land use/ land cover class per the area distribution as summarized earlier in figure 4.24.

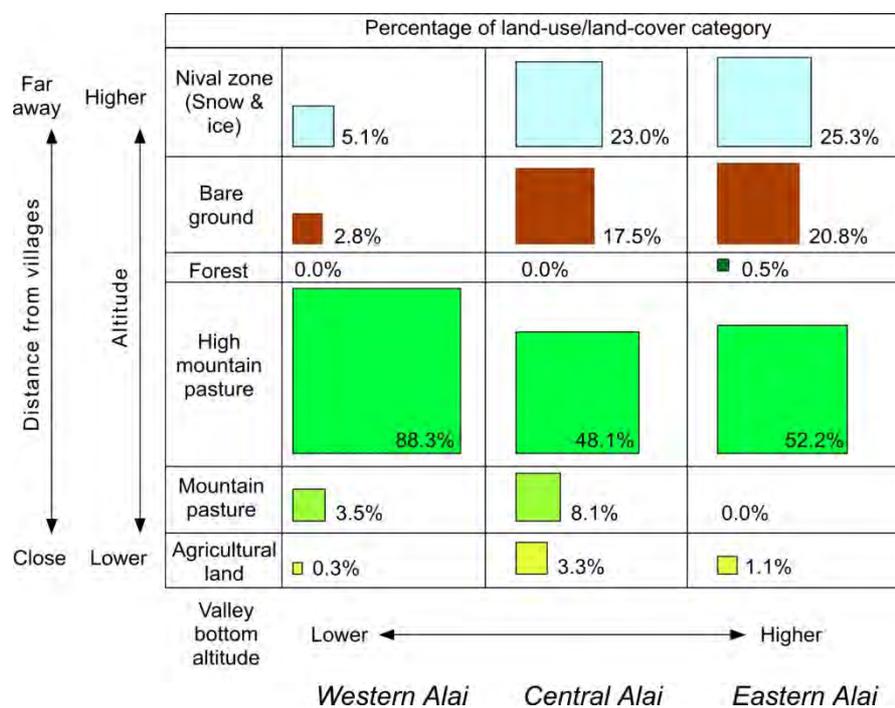


Figure 4.25: Percentage of the land use/ land cover categories in the three Alai regions

This diagram again shows the large areal expanses of High mountain pastures, and limited agricultural land. For central and eastern Alai, there are higher proportions of nival and bare ground. This makes up for an approximate 40% of their total land area (deeming it unusable for agricultural and grazing activities). Land use thus intensifies with limited usable land. However, these nival zone and bare ground areas still presents scenic landscapes, which can be explored for ecotourism purposes. Hence,

there is the need for careful and proper land-use strategy to maximize their economic situation through sustainable means.

Table 4.2: Characteristics of the land use/land cover in the three Alai regions

	Western Alai	Central Alai	Eastern Alai	Characteristics
Non-usable land	1,119 km ² (7.9%)	942 km ² (40.5%)	1,257 km ² (46.1%)	>40% in C. & E. Alai
Forests	0 km ² (0.0%)	0 km ² (0.0%)	14 km ² (0.5%)	Almost no forests
Pastures	12,995 km ² (91.8%)	1,305 km ² (56.2%)	1,424 km ² (52.3%)	Major land use/land cover; smaller toward E.
Agricultural land	43 km ² (0.3%)	76 km ² (3.3%)	31 km ² (1.1%)	Extremely limited
Total	14,157 km ² (100.0%)	2,323 km ² (100.0%)	2,726 km ² (100.0%)	

This Table 4.2 summarizes the main characteristics from western, central and eastern Alai regions, summing up how agricultural land is extremely limited across the entire valley, with pastureland being the major land use/land cover, even though still smaller towards eastern Alai. There are almost no forests, even though interviews conducted with the locals indicate there were more forests around 5 to 10 years ago than exists today. This is mostly because of the extraction of timber for firewood and building materials in an already harsh climate where trees take longer to grow.

5. Discussion

5.1. Regional differences identified by the questionnaire, interview and field surveys

Figure 5.1 summarizes the regional differences identified by the questionnaire, interview and field surveys conducted in 2008 and 2009.

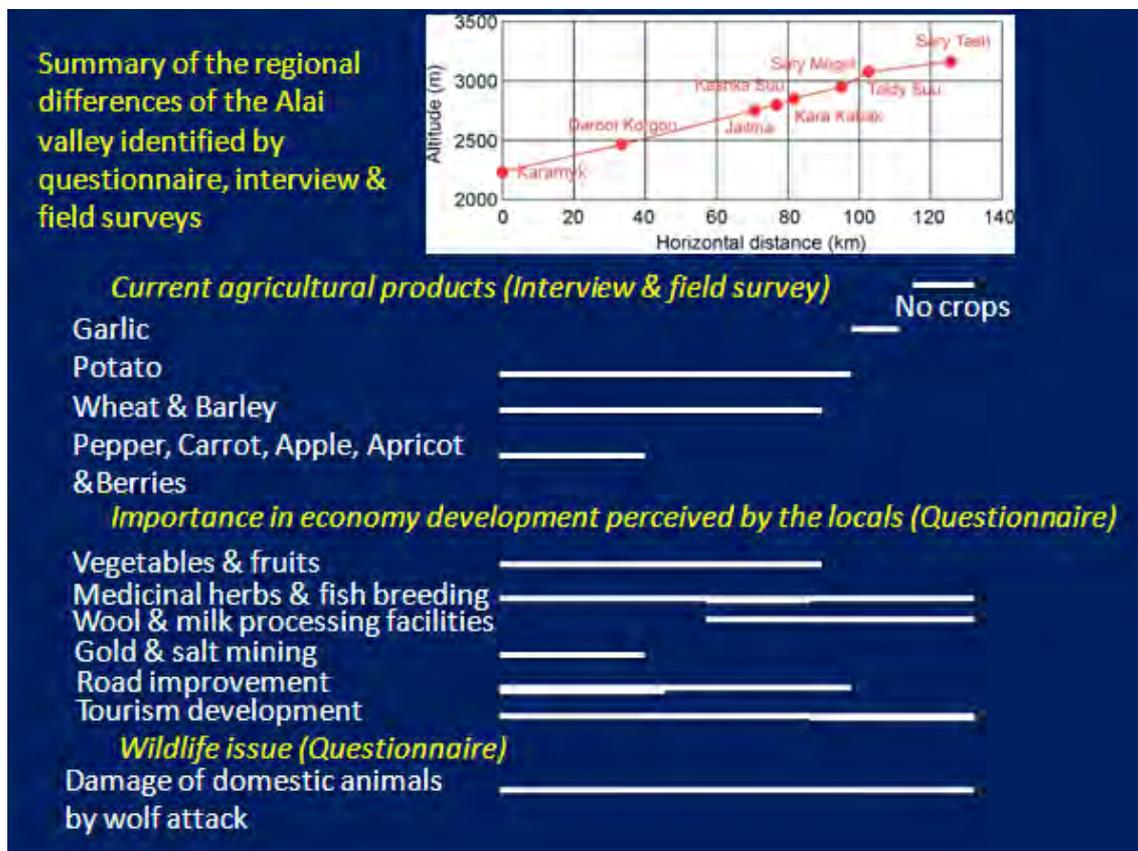


Figure 5.1: Summary of the regional differences identified by the questionnaire, interview and field surveys.

5.2. Regional differences identified by the land-use and land-cover map analysis and field survey

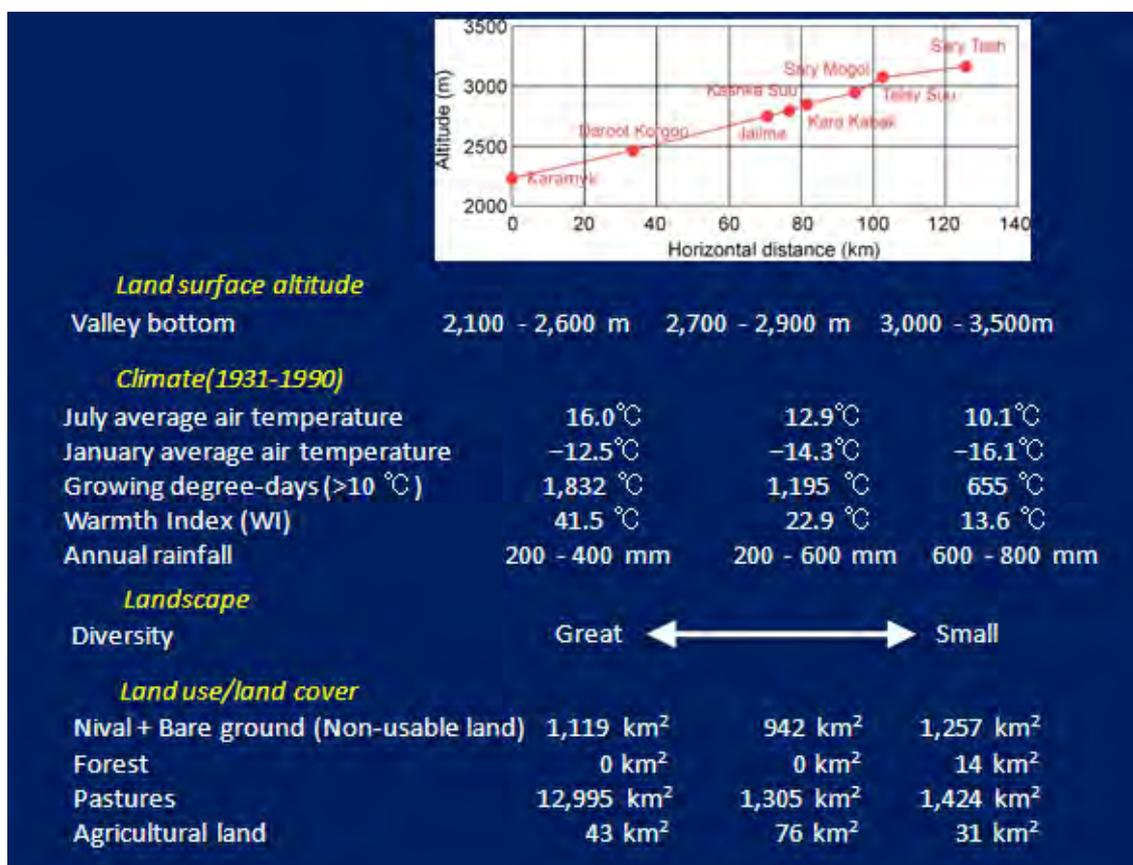


Figure 5.2 : Current conditions of the Alai valley identified by land-use/land-cover map analysis, climate data analysis and field surveys

A summary of the climatic variations in the three sections of Alai valley with July average temperatures corresponding to summer months and January's average air temperatures to winter months (Figure 5.2). Also calculated are the Growing Degree Days (GDD) which gives the mean monthly air temperature more than 10°C, usually taken as an indicator for vegetation, crops and forest growth. The Warmth Index (WI) giving the mean air temperature less than 5°C, usually a more specific indicator was

also calculated and it varies from 41.5°C in the west, declining to 13.6°C in the eastern Alai. These indicators showed that eastern Alai corresponds to Tundra climate and vegetation while the central and western Alai environments correspond to the Siberian Tuiga type of climate and vegetation environment.

Baird (2008) had shown three significant flora communities though in the Alai valley: *Pulsatilla iskandera*, *Artemisia persica*, and *Hippophae rhamnoides* (Figure 5.3). Among these species, sallow thorn (*Hippophae rhamnoides*) is a willow-like shrub with an approximate 2.5 m in average height, having narrow silvery leaves on the underside, with tiny orange-yellow fruits usually found in mountainous areas of Asia and Europe (Encyclopedia Britannica, 2009) the plant is often used for its fruits and as some ornamental shrubbery. Within the Kyrgyz PATCA it is dominant along the east and western Alai. Boiss (*Artemisia Persica*) is a rare species that can grow on rocky slopes and sandy beaches altitude ranges of 2900 - 4000 m, with slightly alkaline loamy soil, and preferring a warm sunny dry environment. The plant is usually drought tolerant on light sandy, medium loamy and heavy clay soils. Therefore, it can thrive in the areas of well-drained soil and nutritionally poor soils, acid, neutral and basic alkaline. It is often found in semi-shade, light woodland areas and areas with no shade. Its flowers are hermaphrodite and spread via insect pollination. *Artemisia* species is often taken as an indicator of overgrazing (Baird, 2008) and this is common in the eastern Alai as well as the south-facing slopes of the Alai to the east of Sary Tash. Because of its relatively higher elevation and difficult biophysical conditions for vegetation growth, pressure on grazing land in this section could be attributing to the presence of *Artemisia* here.

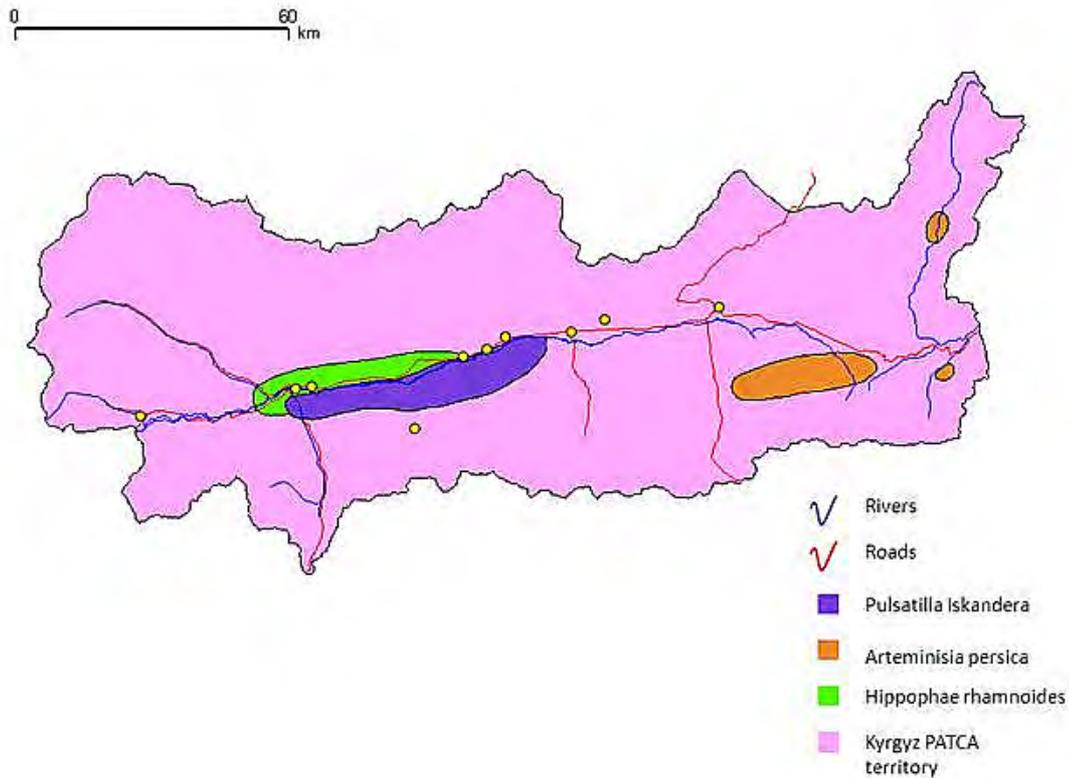


Figure 5.3: Three important flora communities in the Alai valley, adopted from Baird (2008).

5.3. Conservation and economy issues: potential to developing ecotourism and local market system

The difficult road conditions are considered the greatest hindrance to development and its improvement can facilitate development efforts. Improving the agricultural industry and the training of farmers, promotion of tourism, financial backing and better credit terms are seen as supportive factors to economic development. Supportive facilities and infrastructure in schools, and settlement centers are also important in attracting investments into the area that could help generate more economic developments in the region. Awareness and improvement in public relations is also important as well as improving local market to support local production. For example crops that is limited or

cannot be cultivated at all in the east (in Sary Tash and Taldy Suu) are available in the western and central Alai, yet residences of these areas prefer to sell their products directly in Osh because of a lack of proper marketing to facilitate this trade locally.

Due to the area's strategic location along one of Central Asia's main water towers, it is important to preserve the biodiversity of the area, to study and to monitor land use because the intensification of anthropogenic activities in this area easily affects the health of surrounding ecosystems and regulatory services such as water purification, and elements related to pollution control. Overgrazing, depletion of limited woodlands, increased consumption of teresken shrubs eventually impede on the health of the ecosystems of the valley and the surrounding Pamirs, and the conditions and well-being of biodiversity supporting ecosystem services. These interlink with and impacts the provision and supply of food, fiber, freshwater, and medicinal plants that sustain communities.

However, the effective establishment of PATCA encompassing the study area depends in large on the residents' collaboration to bring weight on the implementation of the conservation and sustainable development goals. The selected villages surveyed were interviewed on their opinions and awareness regarding PATCA and PALM activities and goals in the region. This study showed that most of the respondents were not aware (Figure 4.3) of the proposed establishment. To effectively involve the local people in a decision that impacts their very lifestyles and livelihoods, it is vital to create more awareness first on the importance of their surrounding biodiversity. Village meetings to be encouraged in every village possible, as directed by the Aiyal Okmotu administrative officers, with directions from the state ministries in Bishkek and Osh. This would mean more active collaboration between the state authorities and the

authorities in the localities.

Next and more complex to address, is the issue of monitoring the proposed conservation site. As poaching and the hunting of large mammals as Marco Polo sheep (*Ovis ammon polii*) would need financial backing to support effective monitoring, the locals if explained on the severity of the consequences on biodiversity overconsumption or exploitation might willingly engage in activities that can help protect their natural environment without the need for much monitoring by the state authorities.

This, however, also means the promotion of alternative income generating activities. Increased awareness and more training of locals in these directions can help manifest this goal. Fundamental financial support and encouraging policies is needed from the state and outside communities to back this.

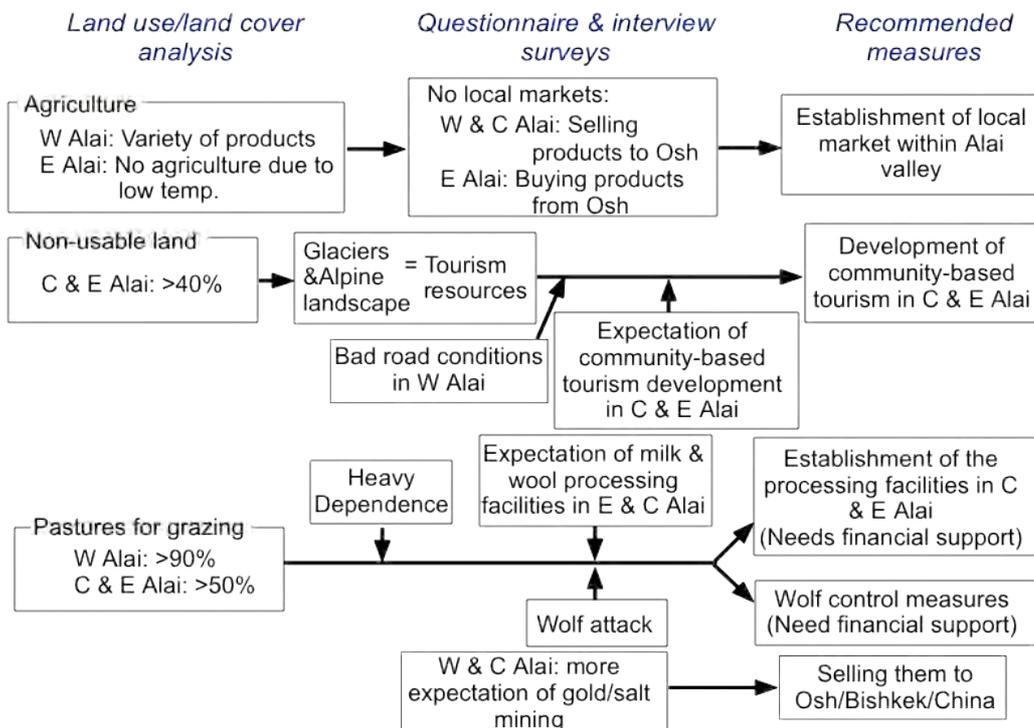


Figure 5.4: Summary of the recommended measures that can be deduced from the analysis.

6. Conclusions

The objective was to assess environmental conditions shaping variations across Alai valley as interpreted and deduced from a land use/land cover analysis, along with analysis from the questionnaires, interviews, field surveys and statistical data collection. Then interpret how these characteristic variations within Alai valley shapes the residences' basic economic choices and capacity to explore income generating options or to collaboratively participate in any planned conservation management in the area.

The resulting conclusions are:

1. Land use/land cover is characterized by: (1.) Pastures (>90%) in western Alai; (>50%) in central and eastern Alai. (2.) Non usable land (>40%) in Central and Eastern Alai, but this can be a good ecotourism resource.
2. Livestock: which is the primary industry across the valley, now suffers from wolf attacks, which needs control in the entire valley. More wolves are attacking domestic animals since independence. This is because local residents face great difficulties in controlling the wolves without any budget. Sustaining livestock which from past to present remains the most reliable source of food security for these mountain communities to secure their livelihoods is important, and now even so is the need to find ways to do this with limited effect on the ecosystems that support it, or through provision of alternatives that could help lessen the impacts on the natural environment. Also, the interview survey conducted in 2008 and 2009 suggests that several wildlife species inhabit the Alai valley area such as ibex, lynx, bear, marmot, fox, although Marco Polo sheep is threatened

by extinction.

3. Agriculture production: mainly in western and central Alai, and none in eastern Alai, hence their heavy dependence on livestock and alternative income generation. Agricultural products from western and central alai are mainly sold directly to Osh. To minimize money leakage, Alai residents should establish local market within the valley. Developing local markets of agricultural products would help augment sustainability in the entire Alai valley area and be a self supporting effort.
5. Community-based tourism (ecotourism) development is suggested in central and eastern Alai. The promotion of Community Based Tourism (CBT) to support economic needs is well received in the central and eastern villages, particularly Sary Mogol and Sary Tash. Sary Mogol's location with the presence of a CBT office and guesthouse in the settlement, providing trekking activities to surrounding areas of the high peaks such as Mount Lenin is a reason for this large support. Sary Tash, 280 km from Osh city and at a strategic junction, can help inject development to its surrounding areas. Convenient for tourism development, this would also be helpful to the village residents who do not have the option of cultivating croplands as do their lower altitude neighboring settlements. The questionnaire survey in 2008 suggests that many residents favor development of ecotourism because of their scenic surrounds. Ecotourism to be developed in this area should be connected to agriculture and grazing.
6. Bioregional analysis: suggests self-reliance in economic development although current situations in Alai valley show that local residents/communities rely

heavily on outside supports. If outside support could contribute by majorly improving current road conditions, it should greatly assist community based approaches in exploring sustainable alternatives and manifest the recommendations of this study. This may also contribute to further investigation of the resources under pressure and discussion of which remediation strategy is suitable for which region, across the Alai valley.

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