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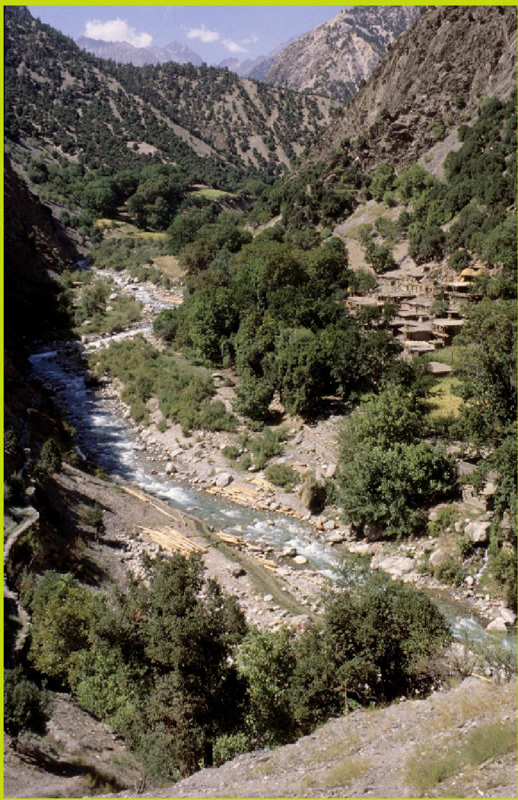

Decentralised Rural Electrification by Means of Collective Action

The Sustainability of Community-Managed Micro Hydels in Chitral, Pakistan

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Rumboor Village (Photo: Hermann Kreutzmann, September 1997)

Micro Hydel Signboard (Photo: Christian Maier, November 2005)

Micro Hydro Power Station (Source: AKRSP 2002: 25)

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Contents

1 Introduction

Currently, some 2.4 billion people in developing countries lack modern fuels for cooking and heating and 1.6 billion have, even one century after the invention of the tube light, no access to electricity.[1]

In spite of the fact that electricity supplies have been extended to more than 1.3 billion people in developing countries over the last 25 years, most of these connections have been in urban areas. Indeed, four out of five people without access to electricity live in rural areas in the developing world.[2] Due to an expected growth of the total population in developing countries of more than three billion in less than four decades, the problems of rural energy are likely to become more pressing than ever.[3]

Programmes for rural electrification, as the most prominent approach to rural energy development, are commonly embedded into rural development policies of developing countries. As in most cases national power utilities are entrusted with the task of rural electrification, these programmes are most often designed as centralised grid extension programmes. These are, however, expensive and, due to scattered villages in rural areas, do not always represent the least-cost solution for electrification.

Therefore decentralised electricity and generation through diesel generators or renewable energy (RE) can often be considered as more appropriate and cost-effective.[4] In comparison to fossil fuels, RE has significant environmental advantages and, noteworthy, the costs of many renewable technologies have come down significantly in the last decade.[5] Finally, many renewable energy appliances are small in scale and are therefore manageable for rural communities.

The key to success to these decentralised mini grids is the local institutional arrangement on who invests, develops, owns and operates the systems. For their ownership and management three different business models are possible:[6]

Public utilities are the most common model for rural electrification in developing countries and many of these companies provide mini grid services. The main advantages of this approach are the technical capabilities and financial resources of the utility companies and the easier possibility for the government to implement subsidy mechanisms. However, there are several disadvantages of the utility model for RE mini grid systems: First, due to the remoteness and the relatively low revenue generation, these systems are a low priority for the utility, often resulting in little attention to system maintenance and repair and therefore in a deterioration of the system reliability over time. Another disadvantage is that public utilities in many developing countries are often inefficient and driven by political agendas.[7]

Rural mini grid systems developed, owned and operated by the private sector have the advantage that, compared to public utilities, some of the political interferences can be

[1] UNESCAP 2005: 1;
[2] Saghir 2005: 9.
[3] World Bank 2004: 5.
[4] Meier 2001: 31f.
[5] World Bank 2004: 5.
[6] Additionally a fourth ‚hybrid model', namely the combination of above three models is possible (World Bank 2006).
[7] World Bank 2006.

eliminated. But despite the encouragement of private investment in the electricity industry, private companies have in most cases so far shown little interest in investing in rural areas, but instead preferred to concentrate on supplying industrial and urban customers.[1] A further limitation is the fact that private energy entrepreneurs are usually small and have only limited technical skills.[1]

The most common business model for developing renewable energy mini grid systems is community-based organisations.[2] Regarding the electrified village, such a community-managed project requires collective action – "voluntary action taken by a group to achieve common goals."[3] However, in contrast to a state-owned or private solution, electricity generated in that way has characteristics of common-pool resources (CPRs), whose utilisation would, according to Hardin's (1968) thesis, in the long term result in a "tragedy" due to over-exploitation by the users.

An example of a decentralised rural electrification project with community-managed electricity generation is the micro hydel[4] programme of the Aga Khan Rural Support Programme (AKRSP) in Chitral, the mountainous northernmost district of the North West Frontier Province (NWFP) in Pakistan.

On the one hand the success of this non-governmental organisation's micro hydel programme has been widely recognised: In 2004 AKRSP received the Ashden Award for Sustainable Energy[5] and in 2005 it was awarded with the Global Development Award for the most Innovative Development Project by the Global Development Network.[6]

On the other hand, however, there are concerns about the sustainability[7] of the micro hydels: These are expressed in an evaluation by the European Commission (EC) of AKRSP's infrastructure programme, which says that the "maintenance capacity might have increased, but remains relatively poor for certain types of infrastructure, such as [...] micro-hydels."[8] Furthermore, the Operations Evaluations Department (OED) of the World Bank states that for other infrastructure projects the "Sustainability is likely, but microhydels have some potential problems."[9] The arguments concentrate on lacking financial reserves of the communities; a representative and deeper research for further factors has not yet taken place.

In order to answer the question, what factors influence or even imperil the sustainability of community-managed micro hydels and to what extent Hardin's thesis applies to these projects, a three month research internship with AKRSP in Pakistan was carried out. One month was spent in its headquarters in Gilgit, in the Northern Areas, for the collection of secondary data, and two months in the Regional Office in Chitral. Thence

[1] World Bank 2004: 9.
[2] World Bank 2006.
[3] Meinzen-Dick & Di Gregorio 2004: 1.
[4] A micro hydel is hydro power installation with an electrical capacity of up to 100 kW.
[5] The Ashden Award promotes inspirational renewable energy projects for providing social and economic benefit to local communities and is handed over by Prince Charles (Ashden Awards 2006).
[6] The Global Development Award competition is the largest international contest for researchers on development (GDN 2006).
[7] At this point of time we can consider a micro hydel as 'sustainable', if it has got a high probability of smooth functionality until the end of its lifetime. For a more precise definition of 'sustainability' in the context of community-managed micro hydels refer to Section 3.3.
[8] EC 2003: 38.
[9] World Bank 2002: 29.

27 micro hydel projects were visited and interviews with persons involved in the management of the projects were conducted.[1]

The paper is divided into three parts. In the first part (Chapters 2-5), the technical (Chapter 2), theoretical (Chapter 3), local (Chapter 4) and programmatic (Chapter 5) conditions are explained, which build a basis for the second part (Chapters 6-8), the empirical analysis of the sustainability of community-managed micro hydels. The last part of the paper (Chapter 9) concludes the results.

2 Micro Hydro Power Technology

Harnessing hydro power on a small scale is one possible approach to the decentralised electrification of rural areas and nowadays a considerable number, yet with a still modest importance compared to big dams, of micro hydro power installations can be found in many parts of the world. In this context, attention has to be paid as there is no standardised definition of the different sizes of hydro power installations. The common ground for most definitions is that they are based on the capacity of the system.[2] In this paper the definition of the World Bank (2006) is used, that defines a micro power plant as an installation with a capacity between 5 kW and 100 kW. As there is no universally accepted definition, 'micro hydel' and 'micro hydro power' are used coequally in this paper. Furthermore, the expressions 'system / installation / scheme / plant' are defined as only looking at the physical constitution, while 'project' always includes the managing community.

Hydro electricity uses energy in falling water to spin a turbine to produce electricity. While there are various possibilities for the layout of a hydro power scheme,[3] micro hydels in developing countries are most often designed as 'run-of-river' schemes.[4] As seen in Figure 3 these projects have no storage reservoir. The water is either directly drawn from the stream or by using an intake structure and a small dam or weir, made of rocks to increase the water level. The water is then divided by the intake structure into the headrace or power canal. The headrace can be an open channel or a pipe. Thereupon the water enters the forebay, where sediments in the water settle before it enters

[1] This paper is based on the author's Master's Thesis handed in at the Friedrich–Alexander University Erlangen–Nürnberg in August 2006. It would not have been possible to conduct this study without the support of many persons, the author wants to thank: all interview partners during the field visits in Chitral, for their enormous patience in answering the countless questions and their overwhelming hospitability; Mr. Asif Ali Shah and Mr. Zahidullah Khan, M&E Officers, AKRSP Chitral, for translating all questions, their sensitivity in dealing with the respondents, and their friendly companionship; Mr. Babar Khan, Micro Hydel Engineer, AKRSP Chitral, for thoroughly explaining the technical issues of micro hydro power; Mr. Sadar Ayub, Area Manager Chitral, AKRSP Chitral, for providing comprehensive background information on AKRSP's micro hydel programme; Mr. Ehsan-ul-Haq, Manager M&E, AKRSP Chitral, for his support in the interpretation of the field data and his continuous encouragement; Mr. Abdul Malik, Programme Manager Resource Development/M&E, AKRSP, for the opportunity to conduct this study and his constructive criticism and guidance through the research work, and Mr. Prof. Dr. Hermann Kreutzmann, Director of the Centre of Developing Countries Research, Free University Berlin, for getting the internship into gear, his encouragement, and his support during the process of writing.

[2] Meier 2001: 49.

[3] The layout of a scheme is chiefly dependent on the <u>head</u> (actual height that the water drops), which is determined by the topography of the location. For possible layouts of micro hydels see Meier 2001: 50f.

[4] World Bank 2006.

the penstock. Most schemes generally have a spillway, to safely remove excess water. The penstock, most often steel-made, is a high pressure-pipe that conveys the water from the forebay to the turbine, placed inside the powerhouse. The spent water returns via a tailrace back to the river.[1]

Due to the non-existence of a reservoir, micro hydro technology "can be regarded as a technology with only minimal environmental impacts."[2]

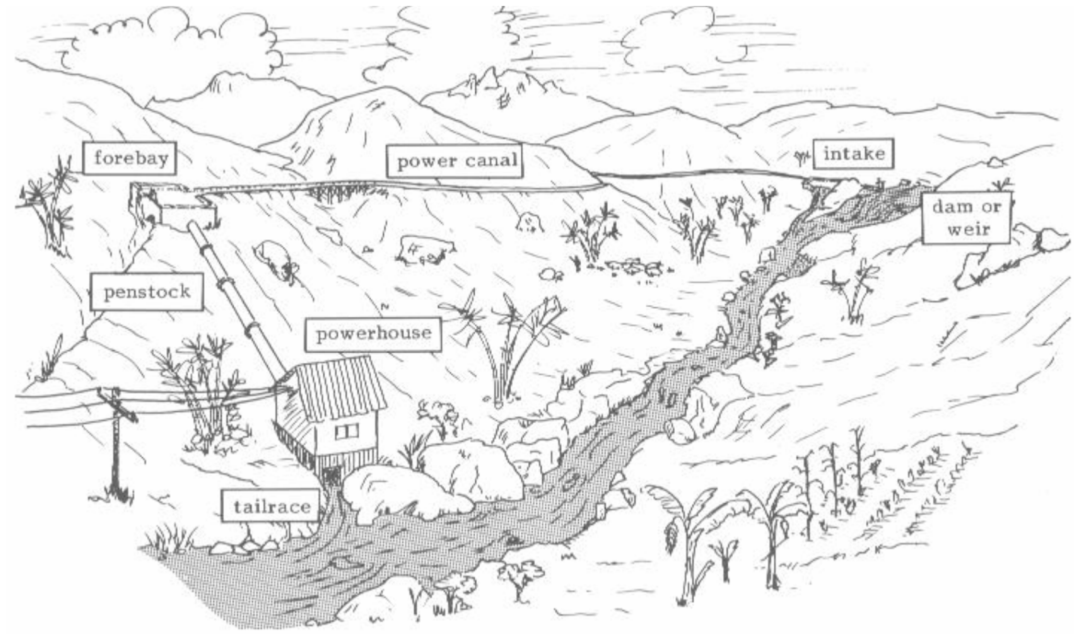

Figure 1: Basic Components of a Village Micro Hydro Power Scheme
Source: Greacen 2004: 12, after Inversin 1986.

Inside the powerhouse, water exits the penstock through a specially designed nozzle. By striking the turbine the energy from the falling water changes into rotational energy which, transferred by means of a belt, spins a generator that transforms the mechanical rotational energy into electrical energy.[3]

Any variation in the speed of the generator will result in frequency and, in spite the fact that most generators have some sort of voltage regulation, also in voltage. As these variations threaten the life of the consumers' electrical devices and also of the generator, the main principle is to keep the generator's speed constant, which is one of the most delicate issues in micro hydel operation.[4] Therefore three different options are possible:

(1) Flow Control Governor: Every time consumers switch on the lights or any kind of devices, the load on the generator increases, resulting in lower speed. This reduction in speed is sensed by a mechanical or electrical device that causes the governor to open the appropriate valve to admit more water to the turbine. Similarly, if appliances are

[1] Greacen 2004: 12.
[2] Meier 2001: 54.
[3] Greacen 2004: 13.
[4] Meier 2001: 60f.

switched off, the load on the generator decreases, and the generator senses a speed increase. Thereupon, the water flow through the turbine is reduced by closing the appropriate valves. In general, flow control governors are too expensive and difficult to maintain for micro hydels.[1]
(2) Load Control Governors control, as the name suggests, the load on the generator and not the flow through the machine. They are less complex and costly, although "it may be difficult to get them repaired if electronic components fail in the field."[2]
(3) Manual Control: Throughout the world, micro hydels are often manually controlled,[3] either using flow control or load control. Thereby the plant needs to be supervised by an operator who makes the necessary adjustments if the turbine speed changes. By observing the voltage and frequency meters at the panel board, the operator opens or closes a flow-regulating gate valve until the meters match the required level.[4]

The distribution system brings electricity from the generator to the end-users. The system consists of poles, wires and most often meters for measuring electricity consumption. If users are particular far from the generator, transformers are used to increase the voltage for transmission and to step it back for consumer use.[5]

The various parts of a micro hydel need to be maintained carefully: Regarding the water supply line, routine operations include the inspection of the channel, the forebay tank, and the removal of debris. Depending on the nature of the channel and the clearness of the water, the channel has to be cleaned one or more times per year.
Regarding the electro-mechanical equipment, moving parts have to be greased or lubricated regularly. Belt drives have to be maintained to keep the belt at the correct tension and free from grease. Special attention has to be paid to bearings which must run smoothly. In case of vibrations the operator should be capable of diagnosing the defective parts and conducting the necessary repairs so that further damage is prevented. In the case of manual control, uninterrupted attendance and observation by an operator during the process of operation is necessary. All transmission lines have to be checked regularly and if necessary cleared of tree branches as these cause earth faults and short circuits. In order to reduce downtimes, every micro hydel should have an inventory of appropriate spare parts and tools. In total, a considerable share of the revenues has to be spent on operation and maintenance of the system.[6]

[1] Meier 2001: 61.
[2] Meier 2001: 62.
[3] The same applies for AKRSP-assisted micro hydels in Chitral.
[4] Meier 2001: 63.
[5] Greacen 2004: 14.
[6] Meier 2001: 63f.

3 Common Property Perspective of Community-Managed Micro Hydels

3.1 Micro Hydro Power and the 'Tragedy of the Commons'

Where a micro hydel is managed by a community the success of the project is highly dependent on the collective action of the users. An important aspect thereby is that a communal micro hydro power plant has characteristics of a commons,[1] or in economic terms a common-pool resource (CPR). According to Ostrom (1999: 38), a CPR is a natural resource or a human-built facility that is characterised by two features: (1) It generates finite quantities of resource units, where one person's use subtracts the quantity of resource units available for others, and (2) the exclusion of potential beneficiaries is costly, yet not impossible. These characteristics also apply for a community-managed micro hydel. One the one hand, the quantity of electricity is limited by the capacity of the plant as well as the availability of water. On the other hand, once users are electrified, it is difficult and costly to restrict access to consumption of the resource. Anyone with an electricity outlet can plug in appliances and over-consumption by some can degrade the resource base for all.[2]

The result of these problems is, according to the conventional theory of CPRs, that the users of a micro hydel would not be able to manage the system over a longer period of time because they would be unable to overcome the temptation to pursue short-term, 'selfish' benefits: In his famous article "The Tragedy of the Commons", Hardin (1968) argues that common property will always be over-exploited and finally destroyed as the gain which users make through over-using will outweigh the loss they suffer as a result of this over-use. He uses an example of a herdsman, who keeps his cattle on a common pasture. With every cow the herdsman adds to his herd, he gains more than he loses: He is one cow richer, while the community as a whole bears the costs of the additional cow.[3]

In order to prevent this tragedy from happening, many economists and planners made recommendations that external authorities must impose a set of regulations on such a setting, either by privatising or nationalising the common property.[4] In the context of rural electrification through micro hydels, the conventional theory would therefore promote the 'public utility' or 'private company model'.

On the other hand, the "growing evidence from many studies of common-pool resources in the field [has] called for a serious re-thinking of the theoretical foundations for the analysis of common-pool resources."[5] As a result it has become accepted that neither the state nor the market always guarantee sustainable and effective utilisation of natu-

[1] The word ‚commons' refers to a shared area of land, by extension the term has also been applied to other resources to which a community has rights or access.
[2] Greacen 2004: 21. For a more detail description on CPR-characteristics of community-managed micro hydels refer to Section 3.2.
[3] The 'tragedy of the commons' has often been formalized as a collective 'prisoner's dilemma'. See Runge 1992.
[4] Ostrom 2000: 31.
[5] Ostrom 2000: 32.

ral resources. As seen in different cases,[1] communities have governed resources without state or market institutions for a long period of time with significant success.[2]
The reason for this success is the evolution of "adequate rules for resource utilisation"[2] or "decision-making arrangements that are well matched to the system's technical/physical characteristics."[3]

3.2 CPR-Characteristics of Community-Managed Micro Hydels

A framework developed by Oakerson (1990) suggests a useful guide to exploring characteristics of CPRs in general but also those of community-managed micro hydels. As can be seen in Figure 2, the frame distinguishes four sets of systematic related attributes: "(1) The physical attributes of the specific resource or facility and the technology used to appropriate its yield; (2) the decision-making arrangements (organizations and rules) that govern the relationships among users, as well as relevant others; (3) the mutual choices of strategies and consequent patterns of interaction among decision-makers; and (4) outcomes or consequences."[4]

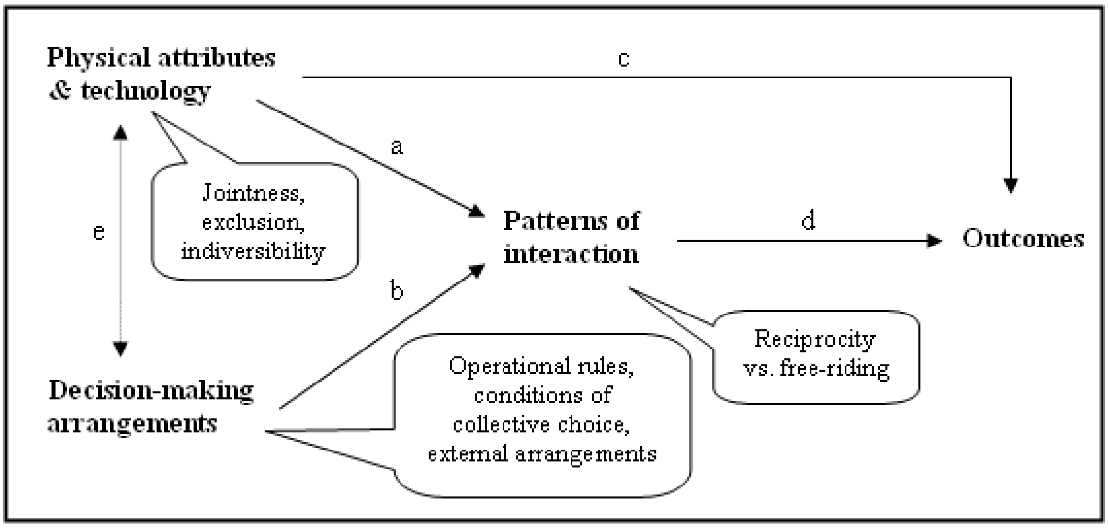

Figure 2: Framework for Analysing Common-Pool Resources
Source: Own presentation, based on Oakerson 1992: 53.

As "problems of the commons are rooted in constraints given in nature or inherent in available technology,"[6] in this model the physical attributes of the resource refer to three considerations:
First, the relative capacity of the resource base to provide benefit to multiple users at the same time without one interfering with another or diminishing the aggregate yield of the resource available to the group. This concern refers to the economic concept of jointness, which was originally introduced to define 'pure public goods'[5] and means that

[1] For instance see Schmidt 2004 & 2005.
[2] Schmidt 2004: 317.
[3] Oakerson 1992: 55.
[4] Oakerson 1992: 43.
[5] An example for a 'pure public good' might be a radio broadcast: Irrespective of the number of tuned-in listeners, the broadcast signal is not diminished. The opposite would be a 'private good', which an individual fully consumes, making it unavailable for others: After having eaten a loaf of bread, it is no longer available for others.

one person's use does not subtract from the use of others. In contrast, 'impure public goods' are those where jointness is limited by congestion. Beyond a certain threshold, additional consumption subtracts from the others' beneficial use.[1]
As outlined in the beginning of this chapter, community-managed micro hydels, like many CPRs, have characteristics of impure public goods. The electricity production is dependent on the amount of available water and the installed capacity of the machinery. If collective consumption is below this level, the system behaves like a pure public good and, due to the fact that electricity which is not used in a micro hydel system can be considered as wasted electricity, the marginal costs of consumption are zero. But if the consumption is above the threshold, the power quality for all users is degraded. The limited nature of the electricity production and the possibility for individual users to plug in large numbers of (energy-hungry) appliances, therefore leads to jointness problems.[2]

Second is the degree to which the commons permits the exclusion of individual users. The concept of 'exclusion', which was originally used by economists to differentiate between private and public goods, broadly refers to the ability to exclude access from any type of good, including the commons. The opposite of exclusion is complete openness, in which all users have unlimited access. "Although an organized commons need not be characterized by open access, the commons always has an access-control problem to some degree."[3]
In discussing CPR aspects of community-managed micro hydels it is useful to differentiate between two forms of exclusion: on the one hand related to the entrance of new users, on the other hand the level of consumption of existing users. In a community-owned micro hydro power system, the electricity is carried to individual households via a mini grid. Those who are not connected are excluded from the consumption. As long as illegitimate connections can be identified and removed, access is relatively easy to be controlled. Among those who are already connected, however, exclusion must be accomplished by restricted appliance use – as we will see later a more sensitive prospect.[4]

The third attribute of the commons is indivisibility: The degree to which the commons can be divided. Spatial divisibility and the establishment of boundaries is a key in the process of converting a commons into private property. CPRs have physical characteristics that inherently hamper physical partitioning or even make it impossible. In a micro hydro power system the electricity production takes place in one single powerhouse, making it impossible to divide the system. While the resource system is so subject to common utilisation, the resource units are not used commonly. Therefore improvements (e.g. as a result of maintenance work) of the system are available for every user at the same time, regardless of whether he contributed to the improvement, or not.[5]

[1] Oakerson 1992: 43f.
[2] Greacen 2004: 23f.
[3] Oakerson 1991: 44.
[4] Greacen 2004: 24.
[5] Ostrom 1999: 40.

The second set of attributes in the framework consists of decision-making arrangements – rules that structure individual and collective choices with respect to the commons as defined by the first set of attributes. Of interest here are the relationships of who has the authority to determine what in relation to whom. Decision-making arrangements can be sorted into three subsets: First are operational rules that serve to limit the users' behaviour in the interest of maintaining the commons, second are conditions of collective choice that describe how the group decides to modify operational rules and third are external arrangements – decision-structures outside the community that influence the use and organisation of the CPR.[1] The way decision-making arrangements in the context of community-managed micro hydels are organised and how successful they are is the objective of the empirical part of this paper and will be presented in Chapter 6.

Given the physical and technical characteristics of the commons on the one hand (arrow a) and the decision-making arrangements available to govern its use on the other (arrow b), individuals make choices from which patterns of interaction emerge. The individual choices, which can be understood as a result of the comparison of the costs and benefits of alternative actions,[2] can be shaped in two ways: Either to cooperate and mutually contribute to one another's benefit through 'collective action', such as contributing to the maintenance of the micro hydel, or to free-ride and look only at one's own individual self-interest. If enough free-riding takes place, reciprocity is eroded and 'the tragedy of the commons' occurs.[3]

Finally, patterns of behaviour (arrow d) combined with the physical characteristics of the resource (arrow c) produce physical outcomes, in regards to a hydro power system a reliable and adequately powerful flow of electricity.

In summary, the common property perspective suggests looking for explanations of difficulties in the community management of micro hydro systems in "a mismatch between the technical and physical nature […] and the decision-making arrangements used to govern its use."[4] This relationship is described in the framework by the arrow e.

3.3 Implications on Research Questions

As we have seen, CPR theory suggests that a key determinate of successful community-managed micro hydels is the evolution of institutions[5] that are well matched to the system's characteristics. Thereby micro hydel systems are characterised by the need to regulate the consumption of electricity and the demand for operation and maintenance. Looking at the micro hydro power projects in the area of research with the theoretical background depicted above, the following questions arise:

- What kind of institutions can be found in the projects?

[1] Oakerson 1992: 46f.
[2] Ostrom 2000: 35.
[3] Oakerson 1992: 49f.
[4] Oakerson 1992: 55.
[5] Although Oakerson's definition of ‚decision-making arrangements' comprises "organisations and rules" (Oakerson 1992: 43), in the following the more common expression of North (1990: 3f) is used. He talks about 'institutions' that include both the governing rules for utilisation and the organisations which define, influence and control such rules.

- Do the institutions match to the systems' characteristics and, if not, what is the impact on the sustainability of the projects?

While basic attributes of micro hydel projects have been outlined, sustainability as the dependent variable has not yet been defined. In the framework used above, Oakerson (1992: 51) suggests that "patterns of interaction produce physical outputs." While at first glance these physical outputs can be considered as the quality and quantity of produced electricity, in this study the more universal, if difficult to quantify, term of 'sustainability' will be used. In the ex-post perspective the sustainability of a community-managed micro hydel can only have two values: Either the micro hydel is working (1) or it is abandoned (0). While the abandoned projects can solely be surveyed in regard to the reasons which lead to the abandonment (Chapter 8), the working ones might show certain variation of sustainability under an ex-ante perspective.
In Chapter 2 the demands for the operation and maintenance of a micro hydel have been outlined, which can be summarised as follows: Unskilled labour (a) for the operation and maintenance of civil engineering components, skilled labour (b) for the operation and maintenance of electrical and mechanical components, as well as financial resources (c). According to these demands that the operation and maintenance of a micro hydel make on a community, the project's sustainability is defined as comprising the following, overlapping criteria:[1]
(a) Social Sustainability: The community possesses the motivation to operate and maintain the micro hydel.
(b) Technical Sustainability: The community possesses the technical capacity to operate and maintain the micro hydel.
(c) Financial Sustainability: The community possesses enough funding for the operation and maintenance of the micro hydel.

One important aspect has to be kept in mind while analysing the institutional mechanisms applied in the micro hydro power projects in the area of research. Constructing a micro hydel in a remote and mountainous area of North Pakistan and thereupon transferring ownership to a local community does not symbolise the emergence of a new institution for the management of the scheme. On the contrary, the economical life in the area of research is characterised by a traditional, environmentally sensitive system of high mountain agriculture with irrigation as a key factor. For the maintenance of these systems, every village has its own traditional rules which have been developed over centuries[2] and are also likely to influence the management mechanisms regarding micro hydels.[3] Reflections on the role of these indigenous institutions, which will be described in the following chapter together with other influencing regional factors, play an important role in the current management mechanisms and therefore have to be part of this study.

[1] Due to the fact that micro hydels avoid detrimental environmental impacts, it is possible to refuse the utilisation of an ecological component in the definition of sustainability in the context of micro hydro power plants.
[2] Holdschlag 2000: 138f.
[3] Ostrom 2004: 3.

4 Local Setting: Chitral District

4.1 Overview

The area of research is Chitral, the northernmost district of the North West Frontier Province (NWFP) of Pakistan, bordering in the west with Afghanistan and in the east with the federally administered Northern Areas of Pakistan. The district, which can be divided into two subdivisions (Upper and Lower Chitral) covers a total area of 14,850 square kilometres.[1] It is bounded on the north-west by the Hindu Kush, on the north-east by the Karakorum and on the south by the Hindu Raj Range. A key feature of Chitral is its isolated location. The main entrance to the valley is Lowari Pass (3,118m) in the South, which is closed due to snow for about five to six months every winter, cutting the area off from the rest of Pakistan.

Figure 3:
Location of Chitral District within Pakistan and its Neighbouring Countries
Source: Marsden 2005: XV.

4.2 Natural Hazards

The Chitral valley and some 30 subsidiary valleys are drained by the Chitral River, which has different names along separate stretches, and its tributaries. Mean rainfall is approximately between 500 mm in Chitral Town and 650 mm in Drosh (Lower Chitral), occurring mainly in the spring and winter, while the summer and autumn are dry with monthly precipitation of 10-25 mm.[2] Not the direct rainfall, but rather melt water from snow and glaciers mainly controls the hydrological regime, especially of the main rivers. Their maximum discharges occur in summer and is twelve times more than in winter.[3] Therefore for people in Chitral water is the main natural risk factor, making water shortage a serious problem for most of them. In the harsh, dry and hot climate, water is not only of importance as drinking water, it is also the foundation of the agriculture,

[1] For a detailed map pf Chitral refer to Figure 7, p. 28.
[2] IUCN Pakistan n.d.b: 5.
[3] NWFP & IUCN Pakistan 2004: 8f.

which is still the most important employment sector. Furthermore, the seasonally fluctuating water supply can episodically vary extremely, too. Some valleys that receive sufficient amounts of water in 'normal' years suffer from grave shortages in dry periods.[1]

In contrast to the problem of droughts, large amounts of water in the alpine environment, which is characterised by high relief energy, can cause sudden gravitational mass movements, especially resulting from intense rain and snowmelt. Such processes, known as 'mountain hazards' imperil the assets and lives of the people in Chitral in the form of landslides, mudflows, avalanches and snowstorms but primary with high water and floods.[1]

4.3 Cultural Complexity

Before merging as a district into NWFP, the territory of Chitral was an independent monarchical state until the late nineteenth century, when the British negotiated a forced treaty with its hereditary ruler, the *Mehtar* (literally owner), under which Chitral become a semi-autonomous princely state within the Indian Empire. Chitral was fully incorporated into Pakistan and NWFP in 1969.[2]

Today Chitral, while comprising 20% of the area of NWFP, makes up with around 370,000 inhabitants only 2% of the province's population.[3] Close to 90% of Chitral's population resides in rural settlements, making Chitral the least urbanised province in Pakistan[4] with the district capital Chitral (Town) as the only urban settlement. Most people are living in joint family systems, comprising on average 10 persons per household.[5]

Compared to the rest of Pakistan, the people of Chitral are poor: The average per capita income stands at 11,090 Rupees (Rs.) (in 2001),[6] which is around half the average per capita income of Pakistan as a whole.[7] Many people try to escape the poverty through migration, making especially temporary/seasonal inter-regional migrant labour an important role in the society. Out-migration usually starts in autumn with the end of the agricultural season and ends in spring with the majority returning back to the places of origin. This has a strong impact on the family structures as the female members are left behind for months, having to manage the household affairs.[8]

The population of Chitral is characterised by a "great cultural and linguistic complexity"[9] and comprises a variety of ethnic groups with different languages, customs, production systems and know-hows. The majority of people belong to the Khow ethnic group and speak Khowar.[10] Pashto, the language of the Pashtuns has become the main

[1] Holdschlag & Fazlur-Rahman 2004: 2.
[2] Marsden 2005: 13.
[3] AKRSP Chitral 2004: 11.
[4] Holdschlag 2000: 133.
[5] GTZ 2005: 8f.
[6] By using the official exchange rate on 31/12/2001 of 0.0170 (Oanda.com 2006) this is equivalent to € 188.53 (ignoring Purchasing Power Parities (PPP) adjustment).
[7] NWFP & IUCN Pakistan 2004: 9.
[8] Holdschlag 2000: 147f.
[9] Marsden 2005: 24.
[10] Few people in Chitral actually write in Khowar, as most use Urdu, the national language of Pakistan for correspondence. Official business is conducted both in English and Urdu.

spoken language in the southern valleys of Chitral[1] where several settlements by Pashtun migrants can be found.[2] In total, more than ten languages are spoken inside Chitral.[3] The majority of the people in Chitral are Muslims (*umma*), with the exception of only around 2%[4] that comprise mainly the 3,000 non-Muslim Kalasha people[5], who have their own traditional beliefs.

Approximately 35% of the Muslim population of Chitral belong to the Islamic doctrinal tradition of Shi'a Ismai'li; the remaining 65% are Sunni.[6] The regional distribution of the different denominations in Chitral can be determined relatively precisely: Majority Sunnis are living in the Tehsils[7] of Drosh and Chitral as well as in Mulkoh and the southern parts of Turkoh.[8] While "the boundary between Ismai'li and Sunni Muslims has hardened significantly over the past twenty years,"[9] the extent of sectarian violence in Chitral "is [still] much rarer than what both many popular and academic commentators suggest is the norm elsewhere in Pakistan."[10] In Chitral the shape of Ismai'li identity has been powerfully formed by the wider geo-political context in which the region is situated: First of all, over the past thirty years Pakistan has experienced intermittent policies of state-led 'Islamisation', which has been formulated in response to calls for commitment made by Islamic political parties, many of whom have sought to impose Sunni legal codes and definitions of what it is to 'be Muslim' in Pakistan. Second, Ismai'lis in Chitral have felt threatened by hard-line Sunni-dominated governments in neighbouring Afghanistan, particular the Taliban.[11] The fact that the Taliban were mainly belonging to the Sunni Pashtun clans, resulted in solidarity of the Pasthun community and several fundamentalist mullahs exerted a strong influence on the Sunni communities.[12] Sunni women in Chitral strictly observe *purdah*[13] as do the women of the Ismai'li community, who are generally more liberal in their response to changes.[14]

Apart from ethno-linguistic and religious differentiation a further layer of different interests and power is formed by various clans. These different clans are associated with geographical areas; however, belonging to a special clan is not a visible differentiating characteristic of the Chitrali Khow populations. The Khow clans can be separated into two subgroups: Clans associated with the royal family and clans who are lower in status. Belongingness to a clan and solidarity between clan members still plays a major role in identity building and political life.[15]

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[1] A major reason therefore is the large numbers of Afghan refugees, who were mainly Pashtuns and settled since the early 1980s in the southern parts of the Chitral after the Soviet invasion of Afghanistan and the start of the Afghan war (Grevemeyer (n.d.): 8).
[2] Holdschlag 2005: 4.
[3] Haseroth 1996: 6.
[4] Holdschlag 2005: 2.
[5] Marshen 2005: 15.
[6] Holdschlag 2005: 2.
[7] Chital can be devided into six Tehsils, namely Mastuj, Turkoh, Mulkoh, Lutkoh, Drosh, and Chitral (Holdschlag 2005: 2, GoP 2006b: 1). Also refer to Figure 16, p. 59.
[8] The pattern of denominational distribution can be retraced to the regional missionary- and migration-history (Kreutzmann 1996: 252).
[9] Marsden 2005: 17.
[10] Marsden 2005: 196.
[11] Marsden 2005: 17f.
[12] GTZ 2005: 10.
[13] *Purdah* literally means ‚curtain', but also refers to a system of segregation of sexes mainly leading to the seclusion of women.
[14] Streefland et al. 1995: 17.
[15] GTZ 2005: 10.

4.4 Indigenous Resource Management

As stated above, the availability of water is a critical factor in Chitral, making irrigation the most important aspect of agriculture. Due to the importance of irrigation organisation and management,[1] which is necessary from the construction of a channel to a regular conveyance of water to the fields, Israr-ud-Din (1996: 20) labels Chitral a "hydraulic society". This management was traditionally accomplished through voluntary social organisation. As powerful princely rulers emerged in the area, they provided administrative, legal and financial support to many such cooperative endeavours. With the end of their rule, the system they fostered fell into disarray. Since then the building of new irrigation schemes as well as the development of other infrastructure projects and the creation of grassroots organisations for their maintenance was encouraged by non-governmental organisations (NGOs).[2] The importance of social organisation is not only reflected in the management systems of irrigation channels, but is also of significance for other assets and recourses.

The indigenous unit of social organisation is called *gram*. All farming and herding activities were organised by this unit as well as festivals and other events. In the social hierarchy, *gram* is smaller than a village and bigger than a household. The spirit behind this system is trust and mutual confidence, which is binding on every member of the system.[3] Therefore as "a social unit, gram had an important role in social services among the self reliant but independent people of the community in a traditional Chitrali village or valley."[4] Main services organised and facilitated by the *gram* include *mone,* which is a Khowar word for an indigenous system of providing social service by term. It is a form of collective responsibility of a whole *gram* to offer collective services on occasions like the maintenance of water channels, bridges and roads. Those that are not participating in, for example, the repair or maintenance of an irrigation channel are obliged to provide food for the workers.[5] *Mone* also applies to mutual agreement of individuals for particular farming activities. The system of the regular maintaining of water channels by collective efforts is called *mirzhoi*. For this purpose the *gram* hires the service of one or more persons who look after the channel. These persons are paid by the *gram* in a type of food grain at the harvest time in a certain quantity which is agreed upon by both parties.[6]

If and what parts of the system for resource management generally described above are or have been in use in a certain part of Chitral has to be answered in a very differentiated way. Apart from regionally differing socio-economic changes, it is important to note that "every village has got its own traditional and complex non-written rules."[7] According to Israr-ud-Din (2000: 71), the success of the respective institutions highly depends on the amount of time allowed for its development. Whether this amount of time was enough to adjust the indigenous institutions to the relatively new technology

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[1] See Kreutzmann 2000 for a comprehensive overview over irrigation and water management in the Inner Asian mountain barrier.
[2] NWFP & IUCN Pakistan 2004: 28f.
[3] IUCN Pakistan n.d.c: 5.
[4] IUCN Pakistan n.d.c: 6
[5] Israr-ud-Din 2000: 68.
[6] IUCN Pakistan n.d.c: 7f.
[7] Holdschlag 2000: 131.

of micro hydels and to develop new mechanisms will be examined in the further course of this study.

4.5 Electricity Supply

Apart from several independent power producers, electricity in Pakistan is produced by two integrated public sector power utilities, the Water and Power Development Authority (WAPDA) and the Karachi Electric Supply Corporation (KESC).[1] While KESC's engagement is limited to Karachi, WAPDA supplies power to the rest of Pakistan, including Chitral.[2] This happens in two ways: Firstly, a 33 kV transmission line connects Chitral Town to the national grid via the Lowari Pass. Secondly, WAPDA runs a 1 MW hydro power station in Chitral Town as well as some diesel generators.[3]

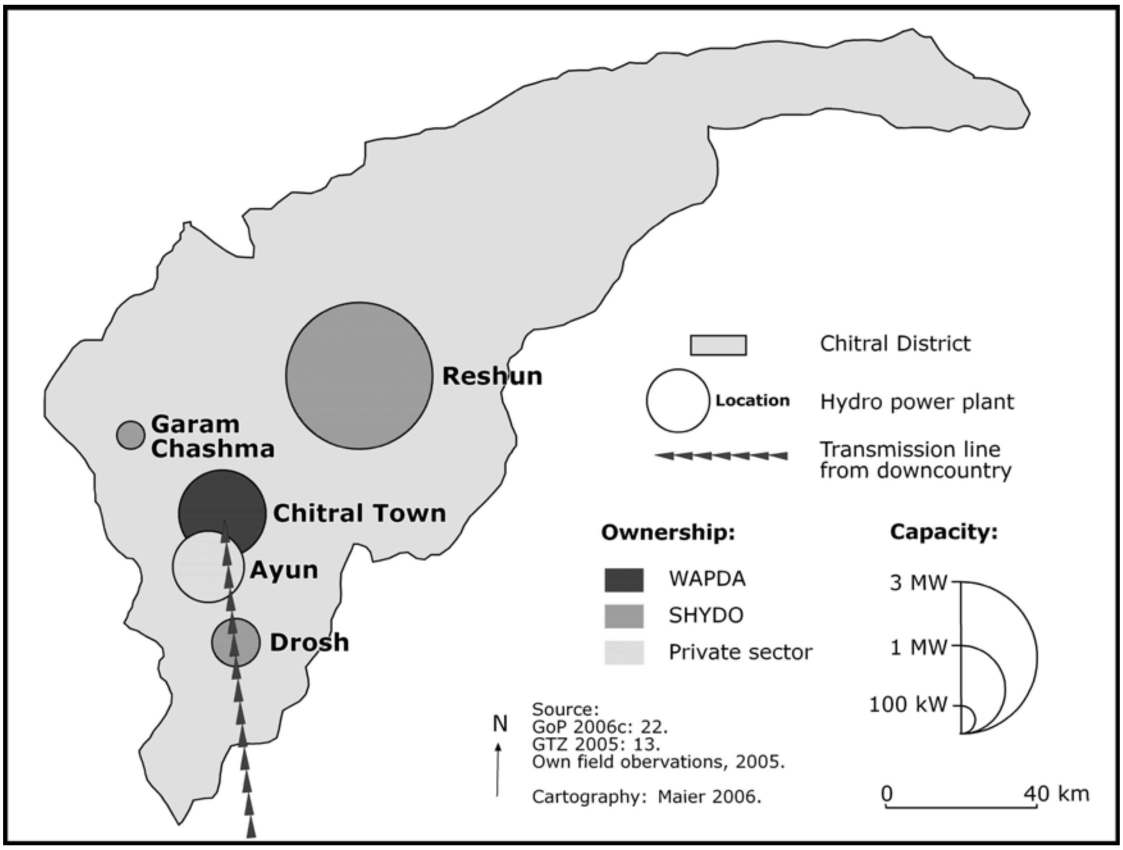


Figure 4: Public and Private Electricity Supply in Chitral
Source: Own presentation.[4]

A second energy actor in Chitral is the Sarhad Hydel Development Organisation (SHYDO). It was established in 1986 as a semi-autonomous body to carry out hydro power development in rural areas working in cooperation with the GTZ (‚Gesellschaft für technische Zusammenarbeit' – German Association for Technical Cooperation).[5] As shown in Figure

[1] Fraser 2005: 5.
[2] GoP 2006c: 10.
[3] Interview with Mr. Faroog, Head of WAPDA Chitral in December 2005.
[4] The figure neither shows the numerous community-owned micro hydels, nor electricity generation through diesel generators. It also does not include private power plants that are smaller than 50 kW or produce for own consumption only, like the hydel of the Hindukush Heights Hotel in Chitral Town.
[5] Speech of Mr. Ejaz Qureshi, Additional Chief Secretary of NWFP in GTZ 2000: 7.

4, it operates a 2.8 MW hydro power station at Reshun, about 60km north of Chitral Town, a 300 kW hydro power station ('Shishi') near Drosh in Lower Chiral, as well as a 100 kW station in Garam Chashma.[1]

A third actor in the electricity sector of Chitral is Mr. Mohammad Khan, a businessman living in Peshawar, who operates a 640 kW mini hydro power plant in Ayun. Although the main purpose of the plant is to provide electricity to his marble factory, around 2,500 households in the lower parts of Chitral receive power from it.[2]

The fourth actor comprises the several NGOs that have installed a considerable number of community-managed micro hydels. The Sarhad Rural Support Programme (SRSP) has built seven micro hydels, the Chitral Area Development Programme (CADP) 37 installations.[3] The Aga Khan Rural Support Programme (AKRSP) is with more than 150 installed micro hydro power plants[4] by far the most important non-governmental player, bringing electricity to "50 percent of the population of Chitral."[5] Also due to AKRSP's initiative, Chitral has got according to the World Bank (2002: 29) "the most schemes and the highest microhydel concentration in the world."

Nevertheless there "is scope in Chitral for many more such schemes."[6] For future hydro power generation WAPDA has identified a potential of 100 MW, while SHYDO has indicated a further potential of 190 MW.[7] This is needed badly: Only about 77% of all households in Chitral are electrified; the remaining 83,000 people do not have access to electric power supply at all,[8] and also those being electrified suffer, as we will see later, under the unreliability of the supply.

One main barrier to bringing electricity to all people in Chitral is of an institutional nature: The World Conservation Union (IUCN) Pakistan (n.d.a: 14) states that there "is no close coordination among different stakeholders of the energy sector, irrespective of GOs [Governmental Organisations] and NGOs. For example, in Chitral, WAPDA, SHYDO […] and AKRSP are working in the hydro electricity sector but they all lack coordination. They mostly do not understand one another's programme. Occasionally, these agencies start their work in the same areas without informing the others." And also according to GTZ (2005: II), the "rural decentralised power supply sector is not well structured" as there is among others "a lack of dialogue between potential energy developers and [the] government."

[1] GTZ 2005: 13.
[2] Interview with Mr. Mohammad Khan, December 2005.
[3] Interview with Mr. Babar Khan, AKRSP Micro Hydel Engineer, November 2005.
[4] AKRSP Chitral database.
[5] AKRSP Chitral 2004: 27.
[6] World Bank 2002: 109.
[7] NWFP & IUCN 2004: 26.
[8] GTZ 2005: 13.

5 Aga Khan Rural Support Programme (AKRSP) and its Micro Hydel Projects

5.1 AKRSP's Structure and Areas of Operation

The Aga Khan Rural Support Programme was founded in 1982 by the Aga Khan Foundation (AKF). This private, non-profitable organisation was established in 1967 by the Aga Khan, the spiritual leader of the Shi'a Ismai'li Muslims.[1] AKF is part of the Aga Khan Development Network (AKDN), which brings together a number of international development agencies, institutions and programmes that work primarily in the poorest parts of South and Central Asia, Africa and the Middle East. AKF, which both implements projects and provides grants, is non-denominational like all other AKDN agencies.[2]

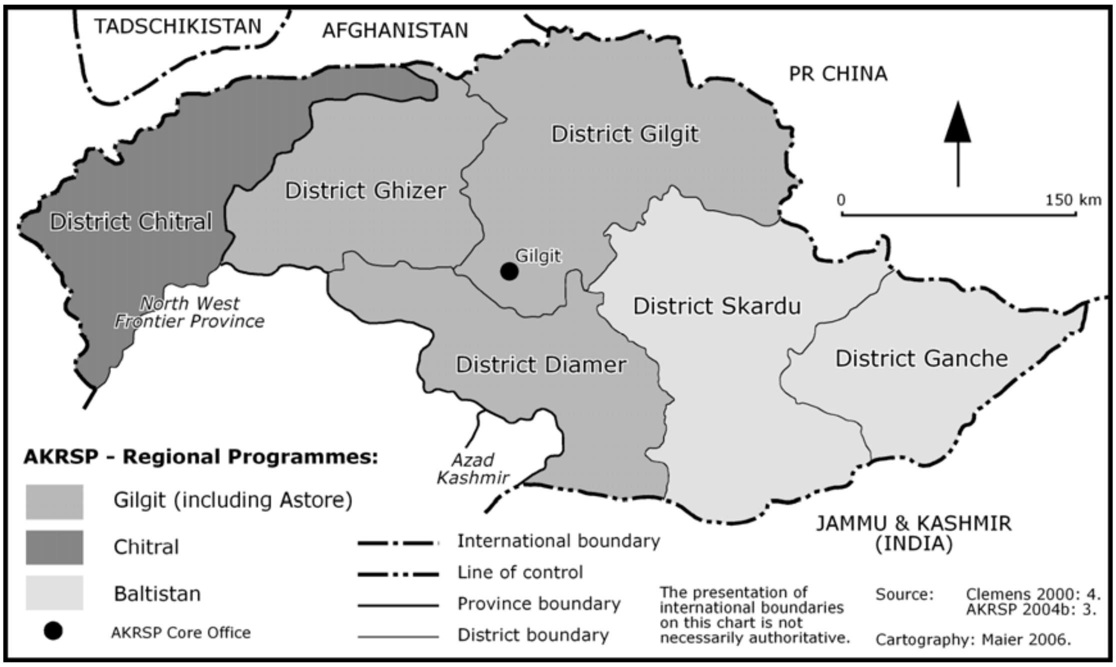


Figure 5: Aga Khan Rural Support Programme in Northern Pakistan
Source: Own presentation.

AKRSP's engagement is not limited to Chitral: As seen in Figure 5, AKRSP's programme area comprises six districts in total, five in the federally administered Northern Areas and finally Chitral covering a population of around 1.3 million people in total.[3] AKRSP's headquarters ('Core Office') is situated in Gilgit, with one Regional Office in each of the programme areas, where Area Offices can additionally be found.

AKRSP, which employs around 230 staff members from all religious communities of the programme area, is funded by several international governments and their development agencies. As a major precondition for the financial support by several donors, AKRSP is not confined to the Ismai'li community but serves the entire population. The whole programme has been evaluated four times by the World Bank (1987, 1990, 1996, 2002) as an independent party which stated that the "achievements of AKRSP have been highly

[1] See Section 4.3.
[2] AKF 2004: 4f.
[3] AKRSP 2006.

satisfactory" with "remarkable results."[1] AKRSP's overall goal is the "reduction of poverty through sustainable improvements in livelihoods in the Northern Areas and Chitral."[2] In order to reach this goal, AKRSP works in four, closely bounded fields (Market-, Resource-, and Institutional-Development, Gender and Development).

5.2 Community Organisation and Productive Physical Infrastructure

The central focus of AKRSP's approach has always been the direct integration of the village population into the process of decision-making, planning and implementation of programme packages. Therefore, local self-help organisations – so-called 'Village Organisations' (VOs) – had to be established by the villagers themselves. As seen in Section 4.4, the indigenous unit of social organisation in Chitral is the *gram*. By the introduction of Village Organisations, AKRSP translated this "indigenous system into modern terms"[3] and aimed at filling at the local level the institutional vacuum, left behind after the abolition of the feudal rulers. Concerning AKRSP's model of development, VOs are both objective and instrument. The aim of the programme is the creation of self-sustaining institutions at village level to deal locally with the people's needs. To implement the programme inputs, the VOs participate in AKRSP packages.
The concept of VOs was later widened to 'Women Organisations' (WOs) and finally to the joining of several VOs and WOs into so called 'Clusters'. In Chitral, 1,345 organisations (VOs and WOs) have been set up by AKRSP in total, covering almost three-quarters of the rural households.[4]
Initially, the setting up of VOs and their later supervision was conducted by AKRSP's 'Social Organisers', while under the current strategy this task should be given to so-called Local Support Organisations (LSOs) which will act as formal intermediaries between VOs/WOs and various service providers.[5] With this strategic shift, some more changes affected the Village Organisations: While in the initial stage regular meetings of all VO members were obligatory, nowadays this procedure is up to each single organisation. The same applies for collective savings. Until 2002 AKRSP ran a highly successful micro finance programme under which all VO members had to save a certain amount of money. With the establishment of the autonomous First Micro Finance Bank Ltd. through AKRSP, many communities have given up these regular savings.

Closely linked with the establishment of VOs, WOs or Clusters is the provision of grants by AKRSP for improvements of the rural infrastructure. The purpose of these 'Productive Physical Infrastructure' (PPI) projects is the removal of local bottlenecks for increased production and economic development. Nevertheless, AKRSP never sees physical infrastructure development as an economic investment only, but its value is "also assessed against the criterion of its ability to promote collective action. In other words, AKRSP [...] [looks] at the interaction between community infrastructure development and social

[1] World Bank 2002: xiii.
[2] AKRSP 2001: 5.
[3] IUCN Pakistan (n.d.c): 6.
[4] AKRSP 2004a: 24.
[5] The service providers include AKRSP, the government, donors and other NGOs, as well as private sector entities.

organisation as a 'symbiotic relationship' where two processes reinforce each other."[1] As we have seen in Chapter 2, according to CPR theory the evolution of institutional mechanisms is the key factor for a sustainable utilisation of natural resources and, as shown for the example of micro hydels, also for sustaining collective action for the maintenance of commonly-owned infrastructure. On the other side, social organisation and the setting up of institutions requires motivation in terms of adequate benefits. These should derive from the PPIs, which AKRSP therefore uses as an 'entry point' to start and promote partnerships with the local communities. In shaping the 'Institution VO', the community is equipped with considerable freedom. Organisational instructions by AKRSP are limited to the selection of a VO president, representing the organisation outwardly, and a VO manager, being in charge of all internal affairs. The same applies for WOs and Clusters.

The type of PPI which AKRSP supports a community organisation with is always chosen by its members according to their needs. After more than twenty years of partnership between AKRSP and the rural communities in North Pakistan, in Chitral alone around 870 PPIs have been built. Apart from irrigation channels and roads, the most important infrastructure projects in Chitral are micro hydels with more than 150 schemes been built by AKRSP.[2] However, one should not overlook that approximately 30 these micro hydels have since been abandoned.[3]

5.3 Micro Hydel Programme

5.3.1 Community Involvement

The first step in the establishment of a micro hydro power project, as for most other PPIs, is always led by community demand with community representatives initially approaching AKRSP to explore the possibility of support. AKRSP then initiatives a three-stage 'dialogue process'. Therein great emphasis is put on ensuring that the community takes responsibility for the project.

During the 1st Dialogue, the AKRSP approach is explained to the community and the VO/WO/Cluster, if not already existing, is formed and a possible project is selected. In order to assess the feasibility of the PPI in the 2nd Dialogue, a technical and social survey of the proposed project is conducted and potential points of conflict are discussed with the community. During the 3rd Dialogue the Terms of Partnership (ToP) about the division of responsibilities between AKRSP and the community are drawn up and signed by AKRSP representatives and all members of the community organisation. This dialogue usually takes place in an open area with the majority of households to ensure the maximum possible participation and transparency.

[1] Malik et al. 2006: 111.
[2] AKRSP Chitral 2005: 8.
[3] Own estimation.

According to the **Terms of Partnership** the responsibilities of AKRSP are as follows:[1]
Provision of Non-Local Materials and Labour Costs: AKRSP only provides non-local material, e.g. mechanical and electrical equipment; the provision of local materials like the wooden poles or stones for the construction of the channel and powerhouse are to be supplied by the community. AKRSP meets the costs of skilled labour as well as a certain share of the costs of non-skilled labour. That means that all work on the micro hydel – especially the channel, where unskilled labour is required – is conducted by the VO members. AKRSP pays them for their work but with wages that are lower than the standard rate for unskilled labour. The difference is the community contribution to the project. Dependent on the negotiations with the community but also due to differing donor requirements, the communities contribute in this way between 10 to 50% of the total scheme costs. In some rare cases communities even make a cash contribution. In total, the average AKRSP grant per micro hydel project is about $ 10,600, equivalent to $ 150 per household.[2]
Limited Responsibility: AKRSP is not responsible for purchasing the land for the site of the project. It provides financial support only according to the agreement and will not increase or decrease it afterwards. AKRSP will not pay any emergency expenses (e.g. due to natural disasters) incurred during the construction of the project.
Right to Rescind: If the community breaks the agreement, then AKRSP has the right to withdraw its support during the construction of the project.

The community has the following responsibilities:
Project Identification: The community has to agree on a project on a need basis.
Provision of Local Materials and Labour (see above).
Provision of Project Site: The site identified for the project (powerhouse and channel) has to be provided by the community free of costs.
Conflict Resolution: The community has to solve all conflicts raised before, during or after the construction of the projects.
Financial Records: The community is obliged to maintain a record of all the expenses incurred in the project.
Maintenance of Project: The community has to complete the project in the estimated completion period (generally between three and six months) and ensure the maintenance of the project after the completion.
Formation of Committee: In order to monitor the construction of the project according to the given design, the community has to form a committee that is accountable to the VO. In practice, however, three committees are formed, namely a Financial Committee, accountable for keeping bills and receipts during the construction process, a Project Committee responsible for the construction process and an Electric Management Committee (EMC) responsible for all maintenance activities. The first two committees mentioned are generally dissolved after the completion of the construction.

[1] AKRSP Chitral micro hydel files. Documents are written in Urdu, kindly translated into English by Mr. Asif Ali Shah. The Terms of Partnership between AKRSP and the communities slightly vary with the course of time but also due to differing donor requirements.
[2] World Bank 2002: 109.

Maintenance Fund: In order to have sufficient financial liquidity in case of larger breakdowns, the community has to raise a Maintenance Fund.

If the ToP are agreed, a first share of the costs is released to the community and the implementation is initiated. With the fund provided by AKRSP, the villagers, under supervision of AKRSP, are required to purchase their own materials and equipment. This ensures that community representatives understand where equipment can be obtained in future.

5.3.2 Technology, Operation and Maintenance

All AKRSP-assisted hydro power schemes are run-of-the-water installations without dams. Due to the tradition of irrigation channel construction and water-powered milling in Chitral, the concept of power from water has readily been understood and accepted by the communities. The programme builds on this capacity by making use of locally available skills like traditional methods of intake and canal construction.
In order to enable the communities to maintain and operate the machinery as independently as possible, but also due to economic reasons the design of the micro hydels is quite simple: The vast majority of them are equipped with simple crossflow turbines and relatively cheap Chinese-made generators. Apart from this, all components are manufactured within Pakistan. Community-produced electricity can be easily distinguished from governmental or private power as those use steel poles, while in all AKRSP-assisted micro hydels the grid is made of locally available and easier and cheaper replaceable wooden poles. Almost no implemented schemes are provided with flow or load control governors and are therefore manually controlled by using flow control. The low population density and the desire to reach as many households as possible, often requires the use of long distribution lines that typically cost between 30 to 40% of the total scheme costs.[1] Nevertheless, the "average scheme costs are relatively low"[2] compared to other micro hydro hydels.

Due to the non-existence of coercive rules, each community establishes its own systems for operating and maintaining their hydro hydel. Advice is offered by AKRSP; however, the community will create their own specific institutional mechanisms. Decisions regarding the hydel are generally made by the Electric Management Committee (EMC). Identical in every project is the fact that one person (operator) is selected by the community to operate the machine. He received training from AKRSP and is now responsible for the community getting electricity. If he has technical questions, the operator refers to a manual, designed and handed over to him by AKRSP. AKRSP also provides him with refreshment trainings. For his work, the operator receives a monthly salary from the community, which is generally collected through the electricity bills. Also, sometimes paid by the community is a watchman, whose responsibility is the supervision of the channel. The amount of the salaries as well as the billing policy is decided by the community, which also has to ensure that enough money is available to cover the costs for regular maintenance as well as larger repairs. Spare parts and repairs are available from

[1] Simon 1998: 10f.
[2] Simon 1998: i.

one of the five micro hydel shops in Chitral Town, which were founded with support by AKRSP.

The rationale of the consequent involvement of the community in the design and construction and their obligation to establish their own management systems is to ensure that ownership is taken by the communities. To what extent this has really been successful, namely whether the community-set up institutions ensure a sustainable operation of the plants, will be discussed in Chapters 6-8.

5.3.3 Impacts

In order to understand the motivation of a community to operate and maintain a micro hydro power installation, following a brief review of some of the major impacts of the projects is given.[1]

(1) Economic Impact

Different case studies on AKRSP-assisted micro hydels suggest that all projects have a high degree of economic profitability: The Cost-Benefit-Analyses (CBA) show that the Internal Rate of Return (IRR)[2] in all observed projects achieves 20% and benefit-cost ratios range from 1.3 to 2.2 with an average discounted payback period of five years. Figure 6, though not representative but yet exemplary for many of AKRSP's micro hydel projects, shows the type of benefits as calculated for the CBAs.

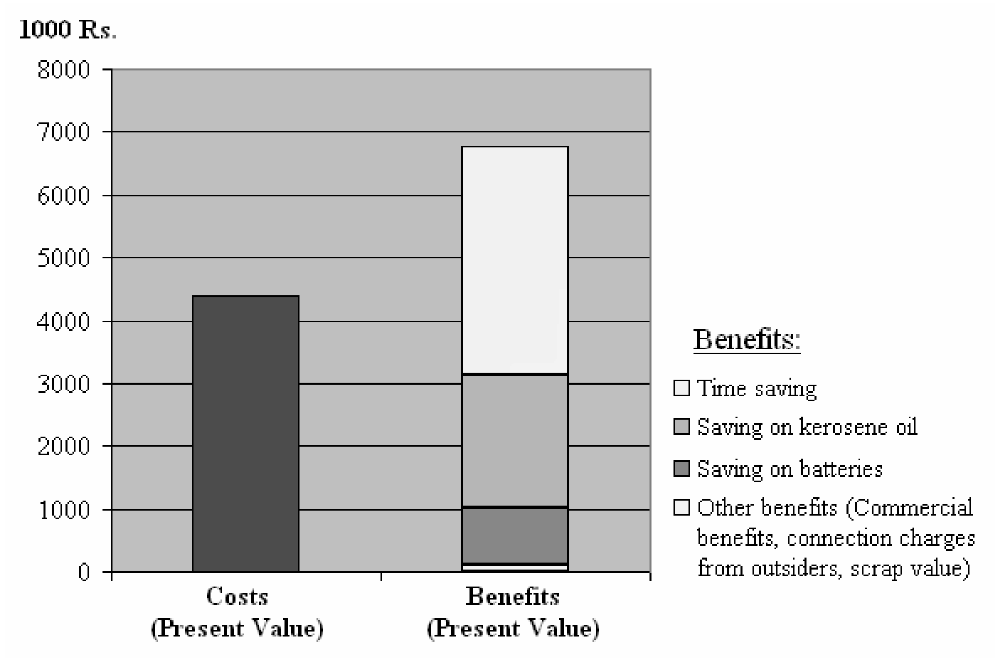


Figure 6: Weighted Average Cost-Benefit-Analysis of Three Sample Projects, 2000
Source: Own presentation and calculation, data taken from Effendi 2000a, b, c and AKRSP databases.[3]

[1]This section is based on the findings of six impact studies of AKRSP-assisted micro hydel projects (Anwar 2002, Kenward 2000, Hasnain 2000, Effendi 2000a, b, c) as well as three papers concluding the results of these studies (AKRSP 2000 & 2002, HTS Development 2002).
[2] The IRR is the discount rate that results in a net present value of zero for a series of future cash flows.
[3] The results of the CBAs of the micro hydel project of the community organisations Toque, Koragh and Izh were averaged according to their number of electrified households.

The main benefits are time savings and savings on batteries and kerosene oil, while commercial benefits together with the income through selling the electricity to non-VO members ('connection charges to outsiders') are relatively insignificant. In Chitral kerosene oil has traditionally mainly been used for lighting, but after having received a connection households switch to electricity for lighting. In rural Chitral fuel wood is the most important source of energy for cooking and heating; however, outlined in all the case studies is the fact that AKRSP's micro hydel programme had relatively limited impact on this pattern of consumption.[1] Without electricity communities tend to power their radios or tape recorders with batteries; by using electricity they are now able to reduce these expenditures. The decreased pollution through improperly disposed batteries adds to the economic benefits. The main financial benefit apart from saving money on kerosene and batteries is the saving of time, which mainly affects women and will be discussed later.[2]

The six impact studies suggest that income generation through electricity is very limited due to insufficient power. It is confined to women selling handicrafts that are produced in the evening enabled through improved lighting conditions and the saving of time. As a result of AKRSP's micro hydel programme a limited number of jobs have been created, namely the mentioned person(s) for the operation of the hydel, as well as the staff in the micro hydel shops.

(2) Social Impact

(a) Health-Related Benefits

The installation of micro hydro power schemes has resulted in households substituting kerosene for lighting purposes with electricity. Thereby the frequency of eye and respiratory irritation caused by the kerosene oil emitted fumes has fallen. Many villages highlight the importance of bright light in keeping their households clean; some report an improved ability to detect insects like scorpions and centipedes. Medical facilities are able to provide improved health care through the use of good lighting, as well as sophisticated electrical equipment and the possibility of refrigerating medicines. By using refrigeration at a family or communal level, stored food can be consumed in off-seasons or sold at higher prices and meat does not have to be consumed immediately after having been butchered.

(b) Education-Related Benefits

All case studies show a strong link between electrification and the positive impact on education. Opposed to kerosene lamps, the bright light provided through electricity creates an improved environment to study in, and the number of hours children are spending on homework has increased significantly and so have pass-rates.

Electricity makes the running costs of radios more affordable and by purchasing TVs and satellite dishes the micro hydels increase the communities' access to mass media and

[1] A more in-depth analysis of the attributes of the electricity produced by community projects will be given in Section 7.1.

[2] As for a CBA all benefits have to be quantified in terms of money, also time saving is calculated by multiplying gained free hours with an average hourly wage for unskilled labour. The conclusion that the saved time leads to an increased income can therefore not be drawn.

allow them a better understanding of the world as well as broader options for entertainment.
An impact of electrification that has been documented in all case studies is the change in sleeping patterns. After the construction of a micro hydro power plant, community members tend to go to bed later compared to the time when the village was in 'darkness'. While men use the time for socialising, women often undertake more work, e.g. making handicrafts. Comments of some village men even suggest that later bedtimes led to a certain degree of birth control. However, international experience shows "no evidence that rural electrification results in lower birth rates and assists controlling population growth."[1]

(c) Social Capital Development

As mentioned, AKRSP has never seen micro hydels as an economic investment only, but also as an incentive for social organisation. During the construction of the hydel the community has to meet and several decisions have to be made and implemented. The successful completion of the project therefore not only brings about direct economic and social benefits as outlined above; the community also feels a sense of pride in having contributed to the development of their village. As most impact studies show, this raised awareness and confidence in their abilities results in additional linkages with other sections of AKRSP, other AKDN institutions, different NGOs and government departments.
Nevertheless two questions arise: Firstly, is the developed social capital sufficient for setting up durable institutions of a sustainable long-term operation of the micro hydel years after the construction? Secondly, as all impact studies were conducted on working projects, which factors lead to an abandonment of the micro hydel, in spite of the developed social capital during the construction?

(3) Impact on Women

While all impact studies clearly show that women are affected by the electricity more intensively than men, the question whether their benefits increase accordingly, is answered quite differently. There is consensus that they derive from health- and education-related benefits in the same way that men do. Furthermore, the main economic benefit of the electrification as shown in the sample CBA in Figure 12, results from the saving of time, which more precisely is the time of women: Their workload is slightly decreased, as they do not have to prepare the evening meal with light from kerosene lights, clean the lanterns, wash clothes by hand or make butter and butter milk by traditional labour-intensive methods. On the other hand, the extra time in the evening resulting from the change of sleeping patterns is used by many women for making handicrafts and clothes. While in some villages the women are making income from such activities, which according to some authors may led to a rise of their status within the household,[2] others claim the additional evening work has further "strengthened their traditional roles."[3]

[1] Meier 2001: 46.
[2] AKRSP 2000: 15.
[3] AKRSP 2002: 27.

6 Methodology

The objective of the empirical part of this study is to provide an insight into the institutional arrangements set up by rural communities in North Pakistan for managing their micro hydels. Based on the technical, theoretical, local and programmatic foundation of community-managed micro hydels in Chitral, which have been covered in the previous parts of the study, the questions raised in Section 3.3 shall be answered.

Object of research were the village representatives involved in the management of the hydels. After interviews and discussions with various AKRSP staff and other key respondents, reviewing previous AKRSP studies about infrastructure projects and a pre-test, a questionnaire was developed. The interviews were conducted in a semi-structured way, often including discussions with groups of several community representatives. The field visits were facilitated by two Monitoring and Evaluation Officers, who translated all questions from English into Khowar, Urdu or Pashto. All answers were translated back into English. The possibility of lost information can therefore not be denied. In some villages the findings from the interviews were supplemented by participating observations while accompanying village representatives in activities like operating the machinery or participating in meetings of the Electric Management Committee.

In order to calculate an appropriate sample size the standard formula[1] was used, resulting in a sample size of 27 projects, which represent all AKRSP-assisted micro hydro power projects in Chitral. The sampled projects which are shown in Figure 7, were randomly selected. The ratio of abandoned to working micro hydels within the sample does therefore not equal that of the population.

After having finished the field visits, all data was put into spreadsheets. This gave rise to major contradictions in the field of the financial matters: In around 30% of the projects the development of the Maintenance Fund was not pursuable and in almost half of the projects the expected revenues were much lower than the actual figures given by the village representatives. Due to the frequency of these problems and the importance of financial outcomes in assessing the success of institutional mechanisms the decision was made to revisit the majority of projects. During these revisits no additional questions were added; the purpose was rather to clarify the above problems. In order to increase the reliability of information, two measures were taken: First of all, before restarting the field visits, all the information gained in the villages was compared with statements from AKRSP staff, who were asked regarding their experience while working with the communities, but also in their function as members or relatives of members of the respective communities. In a second step, it was attempted to extent the circle of interviewees and in spite of the partial unavailability of additional sources or the some-

[1] $n = (Z*S/P)^2$, where n is the sample size, Z the confidence interval (appropriate Z value), S the standard deviation and P the precision (in absolute terms). As sample frame the micro hydel-database provided by AKRSP Chitral was used, which, at the time of the calculation of the sample size, was 168. In order to asses the standard deviation, the variation of maintenance statuses between the micro hydro power projects was selected. Therefore AKRSP engineers were requested to estimate the degree of maintenance for a randomly selected sample of 30 micro hydel projects. According to these estimations the variance could be assessed with 1,586.81 resulting in a standard deviation of 39.83. A confidence level of 90% was considered as sufficient, resulting in $Z_{10\%} = 1.64$, the precision was chosen with 12.5.

times rather centralised responsibilities in 65% of the villages, different persons were interviewed compared to the first field visits.

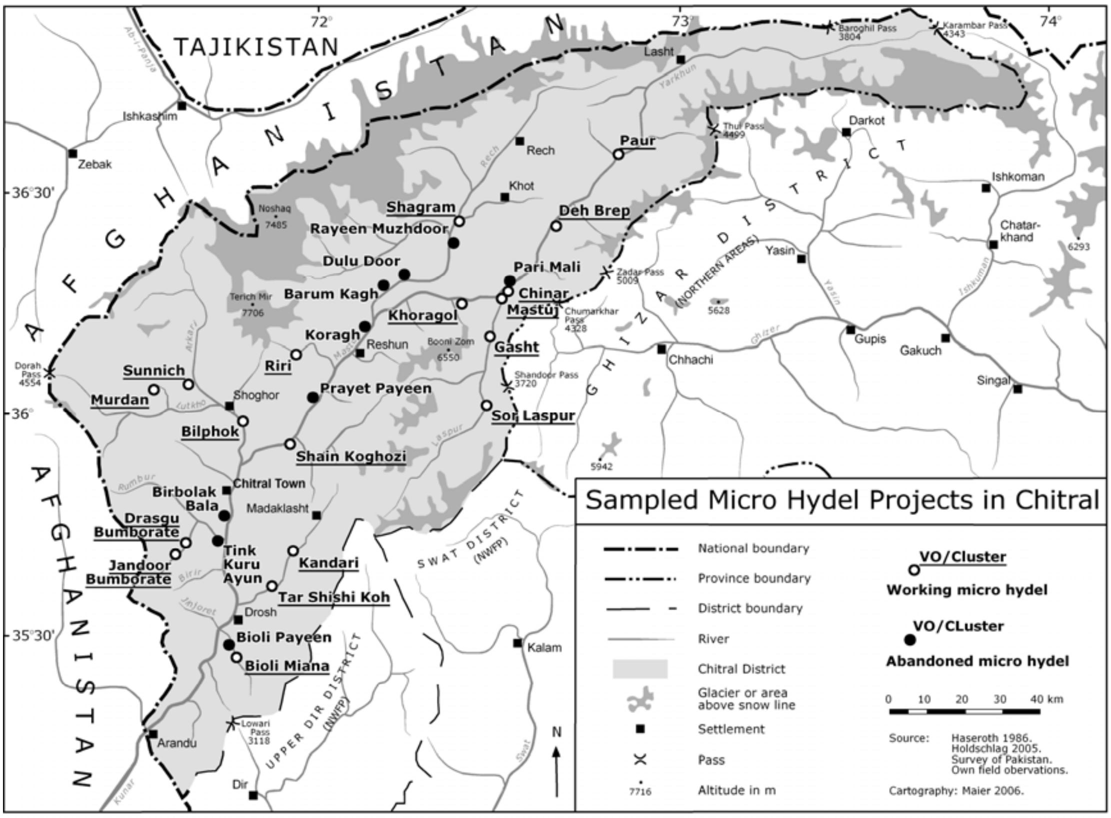


Figure 7: **Sampled Micro Hydel Projects in Chitral**
Source: Own presentation.

In total 85% of the communities were visited twice[1] and as a whole, members of the following positions presented in Figure 8 were interviewed. The figure shows in what share of the visited villages the respective positions were established to manage the project[2] and in how many percent of the projects members of the positions were interviewed.[3] In almost half of the projects, at least three different function-bearers were interviewed.

The decision to revisit the micro hydels turned out to be extremely valuable. Not only could the problems regarding the financial matters be solved, but it also allowed access to difficulties the communities have to deal with, which had not fully been covered yet. One of the reasons for the divergence between the calculated and the actually collected revenues was founded by the difference between the resolutions passed by the communities in the beginning of the project and its practical implementation, which often only came to light in the second interview. Apart from the thereby discovered existence of sometimes considerable amounts of dues, the mistiness regarding the financial matters was furthermore caused by the complexity and variety of financial mechanisms including varying labels for same accounts. Differing comprehensions of the number of electrified households added to the confusion.

[1] All working micro hydels were revisited and with the exception of four projects also all abandoned ones.
[2] For a detailed discussion on the different positions refer to Section 7.2.2.
[3] In cases where several persons obtain one position (possible in all positions except president and manager) one interviewed function-bearer represents the entire respective position of the village.

Finally, a further important reason of receiving aberrant information from different interview partners is founded in the relationship between the communities, the key respondents and the interviewer: Although the vast majority of interviewees showed enormous patience and enthusiasm in participating in the survey, the given information turned out to be not always correct. One explanation is founded in the responsibility the village representatives feel towards their communities: Questions regarding the efficiency of institutional arrangements were at the same time to a certain degree always targeting their competence as function-bearers in managing the project. Problems arising due to inferior institutional mechanisms sometimes seemed to be considered as a result of their own shortcomings, resulting in prettifying certain realities like the financial performance. Occasionally another fact added to this phenomenon: In remote valleys where no AKRSP staff had been for a longer period of time, being interviewed by a foreigner apparently made some respondents proud. Additionally, some interview partners seemed to hope for the allocation of funds, although the purpose of the visit was always announced by the interpreters at the beginning of each interview.
The consequence was an occasional presentation of their own achievements in a favourable light and the withholding of problems and conflicts. As a result of the cross-checking of the information after the first round of interviews and as well as during the revisits, these problems could be eliminated.

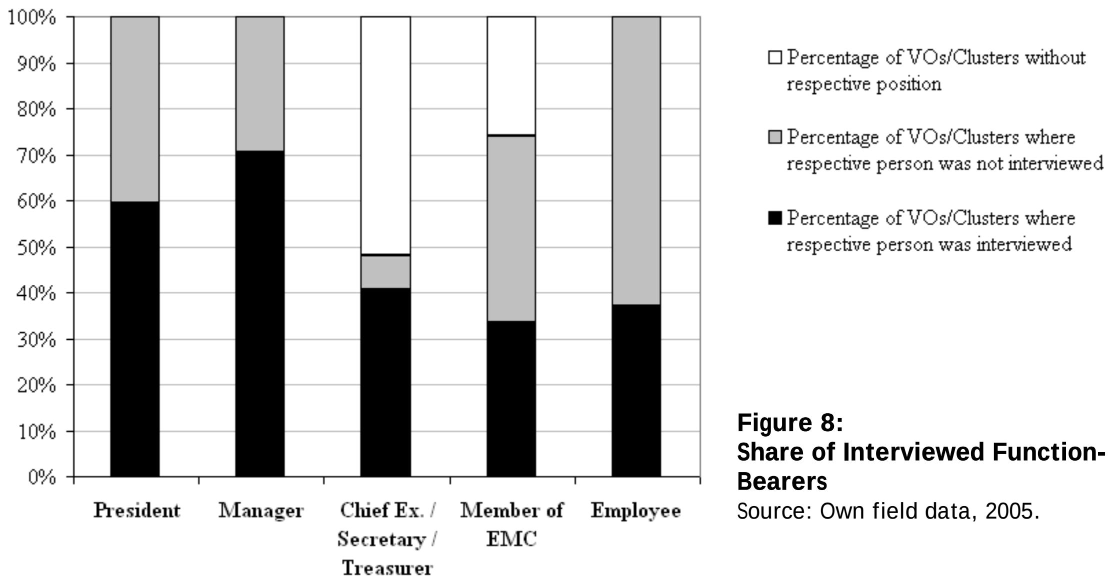


Figure 8:
Share of Interviewed Function-Bearers
Source: Own field data, 2005.

The empirical findings are presented as follows: Chapter 7 only concentrates on working micro hydels, trying to describe and analyse institutional mechanisms and their contribution to the sustainability of the projects as defined in Section 3.3. While this analysis provides an understanding of institutional constraints imperilling the sustainability of the projects, it is not possible to make statements on their actual implications. This can only be done when looking at the reasons which caused an abandonment of a scheme which will be done in Chapter 8. Central arguments raised in both parts of the chapter are illustrated by embedded boxes, presenting example substantial features of selected projects.

7 Working Micro Hydels

7.1 Attributes of the Electricity

7.1.1 Community Electricity

The overall basic prerequisite for motivating a community to set up institutions for the maintenance of a micro hydel is an equivalent benefit for its members gained through the electricity. Generally speaking, the question is whether "individuals [are] getting a reasonable and fair return on their contribution to a collective undertaking that regulates behaviour?"[1]

The impact of electricity from AKRSP-assisted micro hydels on the local communities has briefly been discussed in Section 5.3.3. However, it has to be noted that great variations in the availability of electricity across the different projects are prevailing: fewer than half of the electrified households use electric butter churners and less than 10% use washing machines, fans, TVs or PCs. Irons, fridges and juicers can only be found in around 10% of the villages.[2]

While most often several factors at once influence the purchase of appliances, the main reason for not using particular appliances goes back to the character of the electricity: As mentioned in Section 5.3.2, AKRSP hydels are not equipped with flow or load control governors, resulting in the risk of damage for the generator in the event of fluctuating loads, which are caused by appliances like irons, washing machines and water heating rods, among others. Together with the overall low capacity, in around 70% of the projects all appliances apart from tube lights, butter churners, radio tape recorders and TVs are completely banned by the community. In all communities the use of washing machines is restricted to certain hours and in the vast majority of VOs/Clusters the use of bulbs, despite being cheaper to purchase, is banned. Only more expensive tube lights are allowed due to their lower demand of electricity. The reason for these measures is on the one side to prevent the generator from being damaged through fluctuation loads, on the other hand to not further diminish the already modest amount of available electricity. In order to take care of the machine and due to the consumption pattern which focuses on lighting, in most villages the micro hydels operate only during the night time.

In summary, two statements can be made:

First, electricity is scarce in all communities. Therein lies an important reason for setting up institutions for the sustainable use of the resource: "If resource units are relatively abundant [...], there are few reasons for appropriators to invest costly time and efforts in organising. [...] Self-organisation is likely to occur only after appropriators observe substantial scarcity."[3] In spite of this scarcity, electricity, even if only used for lighting, provides the households due to various multiplier effects with enormous benefits as described in Section 5.3.3.

[1] Oakerson 1992: 52.

[2] Own filed data, 2005. n = 18 communities comprising 1,933 households. The data was not gained through a household survey but interviews of village representatives (Section 6) responsible for charging fees for the use of different appliances.

[3] Ostrom 2000: 36.

Secondly, there are variations of available electricity between different villages. In some communities the micro hydels provide quite bright light and at least the possibility to use some other appliances; in others the electricity is hardly enough for dim light. However, the use of appliances and the resulting benefits are dependent not only on the available electricity. For the consumption pattern of the two communities with the highest and lowest observed kW-per-household ratio, see Boxes 1 and 2.

Box 1: Benefiting from High Capacity – VO Tar Shishi Koh

VO Tar Shishi Koh comprises only 17 households that benefit from a 50 kW micro hydel (for the explanation of this ratio, refer to Box 5, p. 42). As a result of the relatively high capacity of the hydel, the use of bulbs is allowed and all households own radios, fans, butter churners and irons. Half of the households use the electricity for washing machines. This pattern of consumption makes it necessary to operate the machine around the clock, with a two hour break twice a week to give the machine a rest. Due to the good availability of fuel wood nobody makes use of electric heaters or water heating rods. Although the electricity would be more than sufficient, nobody in the village owns a TV or PC.

Interviewees: President, operator.

One may suppose that greater benefits due to a broader spectrum of used appliances results in a higher motivation to maintain a project and therefore a decreased vulnerability compared to installations that only bring light. This hypothesis could neither be approved nor rejected. On the one hand, a community that uses the electricity only for lighting purposes may feel less motivation to sustain their hydro power scheme due to an easier possibility of substituting the electricity with lamps compared to a community that operates TVs and washing machines, which cannot be operated with kerosene oil. On the other hand it is exactly the scarcity that requires a high degree of self-organisation and the setting up of institutional rules (see Box 2). On basis of the collected data, little evidence could be found that micro hydels that provide relatively low power are more vulnerable than ‘stronger’ schemes. The observations were moreover that the requirements of efficient institutions for regulating the use of electricity often also come with a general high degree of social organisation.

Box 2: Coping with Low Capacity – Cluster Drasgru Bomborate

While in most of the visited micro hydels the capacity is enough to provide light for all consumers at the same time, the extreme low capacity of the micro hydel owned by the Cluster ‘Drasgru Bomborate’ forces the management to implement a quite sophisticated power management:
Some 201 households are electrified by a 24 kW generator – in other words all appliances apart from washing machines, butter churners and radios are not possible to be operated or are banned. Although every household can install as many tube lights as it likes, it is only allowed to lighten one at a time. But even then the management has to apply load shedding, which means that out of the three faces, in a two-hourly rotation only two of them are under power at any one time. As the capacity is not yet enough to run the villagers’ washing machines, the micro hydel, which generally runs only from 5 pm to 8 am, operates for 24 hours three day a week. In that case, for one day each, during daytime all power is given to one face while the remaining two are off.

Interviewee: Manager.

However, the transition between resource scarcity and a condition where “the resource is already substantially destroyed [and] the high costs of organizing […] [do]not generate substantial benefits”[1] any more is often fluent.

[1] Ostrom 2000: 36.

7.1.2 Electricity by Alternative Providers

All the arguments stated above assume that, analogous to the CBA presented in Section 5.3.3, the only possible substitute for electricity provided by the micro hydels would be kerosene oil or batteries.[1] While this was true in the initial stage of the programme, nowadays it applies only to some projects: Around one-third of the communities that operate micro hydels are now connected to one of the electricity providers presented in Section 4.5.[2] In these villages a small minority of people have disconnected themselves from the community-owned hydel while other parts of the village use both sources parallel: These 'double-connected' households generally utilise the alternative electricity source but in cases of downtime they switch to the electricity of their micro hydel, which they normally pay regular fees for.

The reason why both systems, community and 'alternative' electricity, can exist side by side is the distinctive advantages of each system. In spite of the different sources of the alternative electricity,[3] the communities' assessment of its quality compared to that produced themselves was quite similar:

Alternative Electricity Source	
Advantage	**Disadvantage**
+ Higher capacity + 24h availability + No requirement of maintenance (+ Possibility of illegal utilisation)	- Higher costs - Unreliability - No relaxation in case of financial difficulties

Table 1:
Appraisal of Alternative Electricity Sources in Comparison to Community Electricity
Source: Own field data, 2005.[4]

The main advantage of 'alternative' electricity is its higher capacity, as there are generally no restrictions on the use of certain appliances and, in contrast to the community-managed power, it is available throughout the day. As the 'alternative' electricity is an external utility, consumers are not obliged to contribute anything else than the payment, compared to a communal project where the community is responsible for the entire maintenance. A final advantage of electricity from non-communal sources is the possibility of illegal utilisation. Although this argument was (understandably) seldom explicitly mentioned by community members and denied by the all responsible officials, the fact that "due to weak grid infrastructure and substantial theft of electricity, losses from the transmission and distribution network totalled [in Pakistan] some 30% in 2003/04"[5] indicates at least the possibility of its validity. While manipulating the meter

[1] As the electricity is not used for heating, the availability of fire wood as an alternative energy source can be ignored.
[2] Own field data, 2005. n = 18.
3 The visited communities received, if connected to an alternative provider, electricity either from the SHYDO hydro power plants in Reshun or Garam Chashma or from the private mini hydel in Ayun (see Figure 4, p. 17).
[4] n = 25. The arguments are sorted according to their frequency in being quoted by the interviewed community representatives. The argument being in brackets was seldom explicitly mentioned.
[5] AEDB & GTZ 2005: 1.

or bribing the meter reader seems to be less common in rural areas, in several villages people have given connections to their neighbours to save the connection charges. This does not imply that communal projects do not suffer from illegal utilisation. As we will see later, in that case illegality in electricity utilisation as a form of freeriding applies rather for banned appliances. Taking illegal connections is virtually impossible due to the relatively low size of community-managed projects and social control mechanisms within the villages.

In spite of these advantages, many households in the visited villages have not taken the 'alternative' electricity. While in some cases the reason is the too great distance between their houses and the grid, the electricity has a number of disadvantages on principal.

First of all the costs are generally higher compared to the communal electricity. Due to differences in the available electrical power as well as the billing system the price level between both community and 'alternative' electricity can not be easily compared, but the high connection charge in particular is often a (too) high financial obstacle for many households. An indicator for the equally high operational costs is the fact, that in spite of the purchasing of electric heaters and water heating rods by 'double-electrified' users, these appliances are only used for a few hours a day or in the guest-houses. No single household was found where fuel wood is no longer the major source of energy for cooking and heating any more.

Apart from the high costs, the reliability of the electricity alternatives is their main disadvantage: "The transmission line [connecting Chitral Town to the national grid] remained broken through out the winter months since the time it was commissioned in the mid 1990s"[1] and also all villages, regardless the energy provider they were connected to, complained of a huge lack of reliability in the electricity supply. Apart from power failures lasting up to several weeks, the electricity supply is also characterised by regular downtimes in the range of hours. The reasons for the unreliability are apart from shorter downtimes due to maintenance work, the difficult terrain and the danger of natural hazards like landslides, mudflows, avalanches and snowstorms (Section 4.2), but also the "weak grid infrastructure"[2] – or more precisely its limited adaptation to the natural conditions. Especially the steel poles often seem to be unable to withstand snowfall in the way the wooden poles used by communities do.

In Section 2.2 three different business models for decentralised rural electrification were presented. In the context of the local conditions of Chitral in terms of reliability of supply, the community-based approach shows clear advantages over the public or private solution. This can be explained by three different facts:

The first reason, already mentioned, is the better adaptation to local conditions of community projects by using local materials in the form of wooden poles. Secondly, the community systems are generally smaller in size. This means relatively small grids compared to the private and public providers, making the system physically less vulnerable.

[1] GTZ 2005: 13.

[2] AEDB & GTZ 2005: 1.

Thirdly, and most important, the repair mechanisms work far better in community-managed projects compared to public and private utilities. Without exception, all 'double-connected' villages reported that in cases of breakdowns of both systems (e.g. as a result of snowstorms), the functionality of the community system was restored in a shorter time due to the collective action of the community members .
On the one hand this can again be explained by the smaller size of the community systems, making the obtainment of information about the system's status easier and enabling a faster repair due to shorter distances.
On the other hand the motivation and coordination of the work force is likely to be considerably better in community-managed projects compared to public or private ones. This phenomenon can be explained by the economic 'principal-agent theory',[1] which treats difficulties that arise under the conditions of asymmetric information when a principal hires an agent. According to the theory, the principal uses the agent to pursue his own objectives. He expects the agent to support not his own aims, but those of him (the principal's). However, the principal can hardly observe the engagement of the agent, who can therefore use this information asymmetry for his own action. In the event of a damage of a private or governmental grid, the company's manager (principal) orders his employees (agents) to repair the system. Those are paid according to the time they spend on their work, while the quality of their work (also due to the large distances in Chitral) is hardly (and only at great costs) to be observed by the employer. Therefore their motivation might differ from that of the community members: Principal and agent are the same persons as every electrified household at the same time also contributes to the maintenance work. Instead of an indirect benefit through a salary, the community members directly profit from their work through the revival of their electric supply. As they receive this benefit only in the event of success (reinstallation of the grid), their motivation should be considerably higher compared to that of the employee.
Mentioned by quite a number of respondents was the further disadvantage that, in contrast to communal providers, in the event of financial difficulties no relaxation is granted by governmental or private providers. In comparison, communities are much more flexible and tolerant in dealing with financial difficulties of their members, with all accompanying problems (Section 7.4.3).

The intervention of alternative electricity providers and the fact that both systems are used parallel gives rise to two possible conclusions: Under the prevailing conditions …
(1) …electricity alternatives are a useful supplement to community-managed micro hydels as both systems complement each other, or…
(2) …the availability of electrical alternatives is a major threat to the sustainability of a community-managed micro hydel, as sooner or later the community will give up its plant.To discover which of these is true, the reasons behind abandoned projects have to be examined, which will be done in Chapter 8.

[1] Jensen & Meckling 1976.

7.2 Electric Management Committee

7.2.1 Responsibilities

In our definition, ‘institution’ comprises the governing rules as well as the organisation that defines and controls them. In the context of community-managed micro hydels in Chitral, this organisation is the respective Electric Management Committee (EMC) of each village. Its members are selected by the community organisation and after the completion of the construction the EMC is the responsible authority for managing the project. In summary, the EMC has to organise the work of the employees[1] and to pool the resources that are necessary to maintain the micro hydel and that are provided by the community members. These recourses are on the one hand, like in all other PPIs, human resources in the form of unskilled labour but on the other hand a quite considerable amount of financial resources and skilled labour. These inputs are at the same time the demands a micro hydel system makes on a sustainable operation.

Stakeholder	**Community**		**Employees**
Inputs by Stakeholder (Demand of micro hydel system)	Financial Resources	Human Resources	
		Unskilled Labour	Unskilled and Skilled Labour
Main Responsibilities of EMC	- Setting of tariff system - Collection, administration and utilisation of funds - Definement and realisation of sanctions	- Acquisition and organisation of manpower - Definement and realisation of sanctions	- Selection - Supervision - Payment
Sustainability-Components as defined in Section 3.3	Financial Sustainability	Social Sustainability	Technical Sustainability

Table 2: Responsibilities of Electric Management Committees
Source: Own presentation.

Table 2 shows the main responsibilities of an EMC according to the inputs of the community stakeholders and the corresponding sustainability components as defined in Section 3.3. Regarding the responsibilities, it has to be noted that the division of responsibilities between the EMC and the remaining community members varies between the villages, as the latter participate in the decision-making processes to differing degrees. In particular, the setting of the tariff system and the selection of the employees is seldom solely decided by the EMC. Also other rules like the sanction systems are often fixed in so-called ‘resolutions’ in the initial stage of a project by the entire community organisation. However, a later change of the rules can quite possibly be conducted without consultation of the consumers and the interpretation and realisation of the rules is most often solely carried out by the EMC.

[1] In our definition, the employees responsible for the operation the scheme are not included in the ‚Electric Management Committee’, yet they often also control institutional rules and are sometimes involved in the decision-making processes. However, as they in contrast to the members of the EMC and all other members of the community receive a salary, their endeavours can by definition not be considered as part of a collective action.

Roughly speaking, the EMC has to acquire and coordinate the resources provided by the community and the staff and has to define and realise penalisation measures in the event of freeriding. Nobody in the EMC is compensated for this effort. The total spectrum of responsibilities will be explicitly examined in the later outline of the study: The pooling of human resources provided by the community in terms of unskilled labour in Section 7.3, and that of skilled (operator) and unskilled (watchman) labour provided by the employees in Section 7.5, after the description of financial processes in Section 7.4. An important responsibility, derived from the characteristics of micro hydel systems disregarded in Table 2 as it can hardly be assigned to the division of resources provided by the stakeholders, is the supervision of banned appliances, which will be analysed in Section 7.4.1.

Before taking a closer look at the decision-making processes in the EMC, the connection between the stakeholders' inputs and the already defined sustainability of the projects (Section 3.3) has to be established. Keeping the overlap between the three components in mind, the quality of what financial resources are pooled determines the financial sustainability of a project, the competence and motivation of the staff (or more precisely that of the operator) targets the technical sustainability, and the extent of motivation of the community for communal work will decide whether the project is socially sustainable.

7.2.2 Classification

To solve the tasks briefly described above, the members of the EMC are provided with different duties and responsibilities. In general, four different function-bearers can be distinguished, who generally hold at least one monthly meeting. The following outline of the function-bearers' duties is based on the distribution of responsibilities in the majority of villages, keeping in mind the existence of a considerable number of different cases.

As stated in Section 5.2, the only organisational prerequisite of AKRSP for the establishment of a community organisation is the selection of a president and a manager. Those mostly keep their position in the EMC.
In many villages the <u>president</u> is not involved in the routine day-to-day business, but only in special cases. His signature is necessary for making use of the Maintenance Fund and he is responsible for keeping records of its balance. As well as being a member of the EMC, he also represents the committee beyond the village.
In most EMCs the actual head is the <u>manager</u>. He calls and leads the meetings of the committee, issues penalties against freeriders, coordinates the collection of the fees and pays the employees. He furthermore organises the community work as well as possible larger technical repairs on the machinery. Together with the president, he is the under-signer of all Maintenance Fund transactions.
In around 50% of the EMCs another leading position exists, which has different names (e.g. <u>chief executive, secretary, treasurer</u>) as well as different functions, all related to the financial management of the project. While in some villages this function-bearer is

responsible for the management of the revenues, too, or surveys and audits the financial process, in others he only keeps the records.
In around 75% of the EMCs the monthly fees are not collected by the heads of the committees or the employees solely. This task is taken over by members of the EMC, who are generally responsible for a fixed area. In monthly meetings they hand over the money to the manager, who then releases the salary for the employees and settles the expenditures for the regular maintenance. Together with the heads of the EMC, the members are responsible to supervise the employees as well as the use of banned appliances and to decide on sanctions.

All stated positions – and this is the only common characteristic in all visited villages – are solely staffed by men. In contrast to this, the exact distribution of responsibilities varies as do the sizes of the EMC. While in some villages all responsibility lies in a few hands, other communities have entrusted a large group of persons with the management of the micro hydel. As demonstrated in Figure 18, the EMCs can be clustered into three groups according to their size.

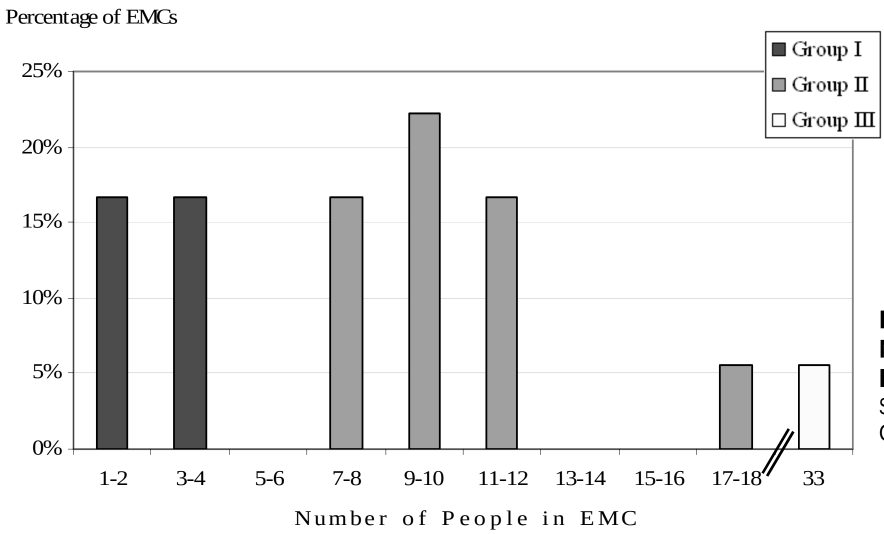


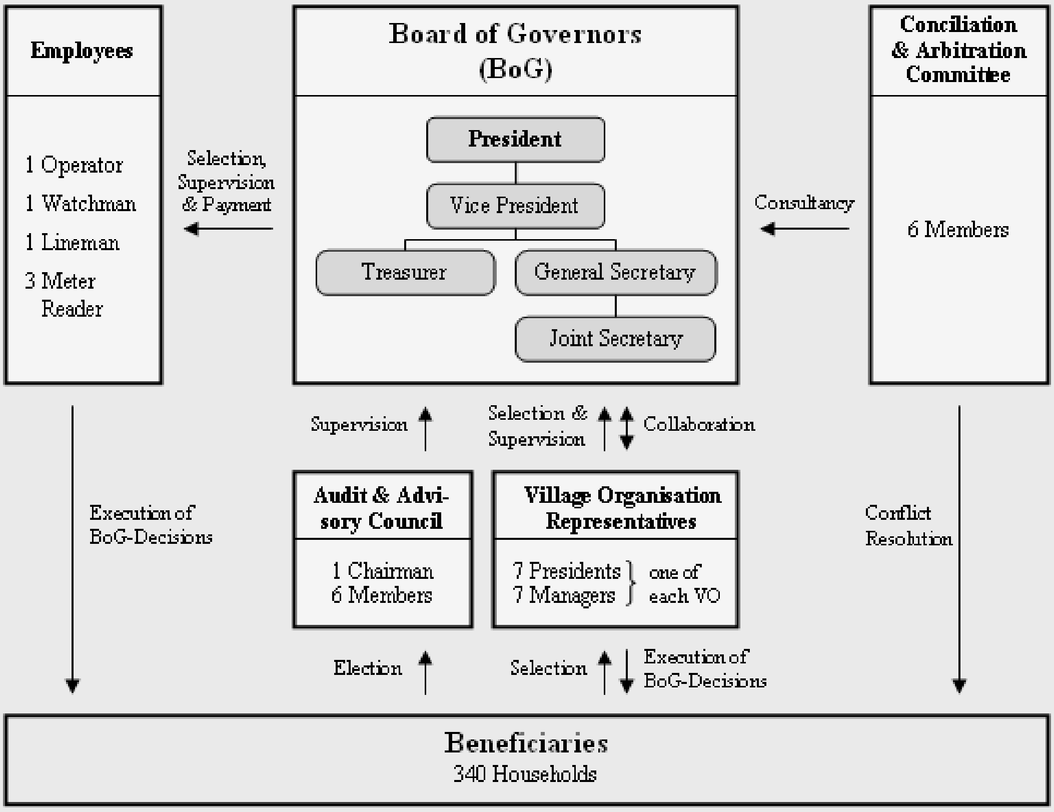
Figure 9:
Number of People Involved in EMCs
Source:
Own field data, 2005.[1]

The first group is composed of committees that are rather personalised and only comprise up to four persons being responsible for managing the micro hydel; Group II integrates all EMCs containing between five and 18 persons, while the third group is explained by the visit of only one outstanding community organisation, whose organisational set-up is without comparison. The management system of this village (Shagram) is separately described in Box 3, p. 38f. As shown in the following, each of these groups represents a certain type of organisation, with Shagram as a third, non-representative type.[2]

[1] n = 18.
[2] Shagram has to be treated differently from other community organisations as it has firstly by far the most people involved in the EMC, secondly by far the most employees and thirdly a unique billing system (Section 7.4.1).

Box 3: Sophisticated Institutional Mechanisms – Cluster Shagram

Outstanding from all other visited EMCs are the institutional mechanisms in Shagram, where two 50 kW generators provide electricity to 340 households:



Source: Own field visits, 2005.

The micro hydel project in Shagram was initiated by a Cluster consisting of seven Village Organisations, each represented by one president and one manager. These 14 people select, or if there is no consensus, elect five member for the Board of Governors (BoG), the main body for managing all processes related to the hydro power project and a unique arrangement in all visited projects.
The Board of Governors, which holds weekly meetings, is lead by a president, who when absent is represented by his vice. He is in charge of the treasurer and the joint secretary, who acts for the general secretary in case of his absence.
The treasurer is responsible for all cash transactions with the bank. Together with the general secretary he is the signatory of the Billing Account, where all Surplus Revenues, i.e. the revenues after deduction of the salaries for the employees, are deposited. For expenditures of the Maintenance Fund, the signature of the president is additionally necessary. All money transactions above Rs. 2,000 have to be permitted by all members of the BoG.
The BoG acts as the direct employer of the staff, decides about the salaries and, if necessary, hires or releases employees. The electricity fees are collected by three meter readers, who also carry out measures against defaulters decided by the BoG. After not having paid for three months without convincing explanation, the president hands over an authorisation letter to the meter reader who then disconnects the respective household.

The maintenance work on the channel is coordinated by the president of the BoG. He selects the responsible VO(s) and informs its representatives about the requirements of labour, who then select workers. People not participating in the work without reason are charged by their VO representatives, who hand over the money to the BoG.
Every three months all transactions of the BoG are audited by the village representatives, although those often join regular meetings of the BoG, too. Once a year, all beneficiaries households have the possibility to check the work of the BoG, via an Audit & Advisory Council, which is elected by vote by all households for a period of three years. Together with the BoG, it is the second arrangement not existing in any other village.

Arising problems between the BoG and the community, like questions on the amount of connection charges for newly-built houses or conflicts in the event of a break of the channel are solved by the Conciliation & Arbitration Committee. Its six members are dominate people of the village that act as arbitrators (Urdu: '*salis*') in conflicts not only restricted to occurrences related to the hydro power project.

What are the reasons that in Shagram people have developed this sophisticated and successful institutional system, although AKRSP's requisition was, as in all other projects, limited to the selection of a president and manager? On the one hand all factors that determine the organisational configurations in other hydro power projects also apply in Shagram. It is a Cluster level project and of all visited micro hydro power schemes, the largest in terms of capacity as well as in the number of electrified households. On the other hand the existence of a considerable number of truly dedicated and respected activists was obvious in Shagram.

Interviewees: President, treasurer, general secretary, two VO managers.

Looking at the large variance of people constituting the different types the following question arises: What are the characteristics of these types and what are the influencing factors for the establishment of the respective organisational structures?

Organisational Type		**I**	**II**	**III (Shagram)**
Number of people in EMC		**1-4**	**5-18**	**33**
Characteristics	Probability of existence of specific positions for fee collection	0.17	1	0.00
	Probability of existence of specific position for financial management	0.34	0.91	1
Influencing Factors	Average number of electrified households	41	147	340
	Share of projects initiated on Cluster level	17%	73%	100%
	Share of projects with more than 95% Sunni beneficiaries	83%	0%	0%

Table 3: Organisational Types
Source: Own field data, 2005.[1]

Taking a look at the first characteristic listed in Table 3, the main reason for the different sizes of EMCs becomes obvious as Type I organisations comprise members for the collection of the fees only in 17% of the projects, compared to EMCs of Type II where this position can be found in all cases.[2] A similar picture exists when looking at the financial positions described above, which can be found in organisations of Type I with a probability of only 0.34 compared to EMCs of Type II where the probability is 0.91.

Type I therefore represents organisations with lean management and seemingly relatively low community participation, while Type II stands for more complex organisational systems where all four different function-bearers stated above can be found and which are apparently characterised by broader consumer participation in the decision-making process.

[1] n = 18.
[2] As shown in Box 3, in Shagram paid meter readers for collecting the fees are employed, who due to their status of employees are not added to the EMC.

As we can see in Table 3, organisations of Type I manage projects with on average 41 benefiting households compared to an average 147 households managed by Type II organisations. This fact put the considerations about community participation into perspective as the relative participation in terms of the number of benefiting households in proportion to the number of members in EMC adapts in all Types. Furthermore it becomes obvious that those positions (members for fee collection, financial positions) differing Type I from Type II have primarily been established to cope with the demands of larger projects with regards to the number of households fees have to be collected from and the larger scale of financial transactions.

An important fact when talking about community participation in the management of a micro hydel project is that the decision-making process is, with variations between the villages, seldom a democratic one. Most decisions are strongly influenced by kin relations, clan structures and power configurations (Section 4.2). "What appears as full-scale collective action is usually reflecting inequalities in influence and power, with stronger families dominating."[1] That does not mean that all decisions are always made by the most influential members of the community having been selected at the initial stage of a project: As Box 4 shows, there are cases where community members are quite capable of changing leading positions in the event of dissatisfaction.

Box 4: Replacing the Leading Positions – Cluster Sor Laspur

In order to examine the institutional processes in Sor Laspur, the EMC's president and manager were interviewed during the Mastuj Multi Stakeholder Development Forum. During the revisit three weeks later, the two were not in charge anymore. In a meeting of the whole Cluster, it was decided to replace them with two new people. The community justified this step with the dissatisfaction about their performance in organising repairs and checking the use of banned appliances. The remaining nine members of the EMC were not changed.

Interviewees: Presidents, managers, two members of the EMC.

A further factor that determines the characteristics of the different organisational types, indirectly linked to the fist argument, can be identified: Projects initiated by VOs have the tendency of a lower number of people being involved in the EMCs than projects at Cluster level, where members of each involved VO can often be found as representatives of their Village Organisation in the EMCs. Indeed, only 29% of the micro hydels managed by Type I organisations were initiated by a Cluster, compared to 70% of those with Type II EMCs.

A final influencing factor to the organisational structure within the villages is quite notable. As seen in Table 3, 83% of the projects managed by less than five persons are characterised by electrified households of which at least 95% belong to the Sunni sect. Micro hydels being managed by more than seven persons always electrify communities with at least six percent beneficiaries belonging to other sects or religions. According to the denominational differentiation in Chitral, those are mainly Ismai'lis (Section 4.2).[2]

[1] Wood & Shakil 2003: 19.
[2] An exception is the micro hydels of VO Jandoor Bumborate and Cluster Drasgru Bumborate with 50% and 10% Kalasha beneficiaries, respectively. The remaining households belong to the Sunni sect.

While the threshold value (95%) is admittedly chosen quite arbitrarily, this finding nonetheless demonstrates a correlation between the sectarian setting and the organisation structure. This fact can be explained as follows. Especially in the initial stage, in spite of its non-denominational status, AKRSP, as founded by the spiritual leader of the Ismai'lis and financed among others by western donors, faced considerable acceptance problems within the Sunni and especially Pashtun community due to the influence of some fundamentalist mullahs (Section 4.2). Villages with a large share of Ismai'li households were mostly very willing to set up VOs and later on join them to Clusters, compared to Sunni dominated communities where often only single families approached AKRSP and the formation of larger Clusters only seldom took place. The results are prevalently smaller micro hydro power projects in the southern, Sunni-dominated part of Chitral with an additional strong Pashtun influence.
The sectarian and cultural conditions consequently firstly determine the size of the projects as well as the type of community organisation (VO or Cluster), which then has the impact outlined above on the organisational structure of the EMCs. An example of these religiously-motivated or at least -justified conflicts accompanying the construction of a micro hydel as well as the later development of the conflict is given in Box 5, p. 42.

Regarding the sustainability of the micro hydels, one final question arises: What are the implications of the different organisational types on the sustainability of the project? While the answer will mainly be dependent on how the respective EMC is able to enforce its rules and to pool the necessary resources, two statements can be made right now:
First, the acceptance problems of AKRSP mentioned above have, in spite of existing tensions between Sunnis and Ismai'lis (Section 4.2), mostly settled down in the meanwhile, making micro hydels managed by EMC organisations of Type I therefore no more vulnerable per se than those of Type II organisations.
Secondly, however, within Type I organisation systems, individual micro hydels can be considered as being less sustainable than others. This refers to systems where one or two persons are managing all processes. If responsibilities rest on many shoulders, a person who leaves can more easily be replaced by an already informed and familiarised successor than in a situation where all know-how is monopolised by one single person. At the same time, due to a lack of control mechanisms the danger of revenue evasion threatening the financial sustainability of the whole project is considerably larger in centralised than in diversified systems with implemented supervision mechanisms. The reason for the existence of such centralised systems, described in Box 6, p. 43, is often founded on conflicts within the community, something that is discussed in the following section.

7.2.3 Conflicts

In many of the visited projects, tensions between community members and smouldering conflicts could be observed.

As the conflicts can be founded by a mismatch of the institutional arrangements and the system's characteristics and therefore be directly related to the management of the micro hydel, they can also be caused by anyway existing heterogeneities within the village. This differentiation is often not easy: In many cases where conflicts seem to be directly related to a project (see Box 6, p. 43), the existence of deeper-rooted and more complex tensions and conflicts traceable to certain heterogeneities within the community and underlying the visible disputes can be considered to be likely. In that context it has to be noted that institutional arrangements for managing micro hydels are interrelated with other village institutions for regulating the utilisation of other resources as well as being embedded into a complex social network.

As described in Section 4.2, Chitral's society is characterised by a substantial scope of cultural, religious and linguistic diversity with quite a certain conflict potential. The existence of differing education levels, the belonging to different casts, diverse migration patterns, as well as divergent extents of reliance on farming all add the possibility of finding a high degree of heterogeneity within a villages. All these heterogeneities provide the potential for conflicts within the community, which might also affect the sustainability of the micro hydel projects.

Box 5:
Electricity and Religion – VO Tar Shishi Koh

When Mr. Javed Ahmad applied to AKRSP for the support of the construction of a micro hydel, all 45 households of his village were supporting him. They formed the Village Organisation 'Tar Shishi Koh' and everyone participated in the construction of the project. When the generator was ready to be installed, the local mullah put pressure on the people not to accept the electricity and threatened to never visiting their houses for religious ceremonies any more. As a result, only four households completed the work and took benefit from the micro hydel. Thereupon parts of the other households tried, incited by the mullah, to sabotage the project. The electrified members of the community had to clean the channel during nighttimes, equipped with Kalashnikovs. Nevertheless, it did not take long until the channel was destroyed and only thanks to the intervention of AKRSP and the police was the situation finally settled.

Now 20 households receive electricity, although according to the EMC and its three members the remaining 25 households would also have the possibility to benefit from the hydel. However, these households are not living in the darkness: They receive power from a micro hydro project built by CADP. Although financed, like AKRSP, predominantly by international donors, they consider its electricity to be *halam*. Yet in comparison to the AKRSP Hydel, the capacity of the CADP one is substantial lower. As the electric wires of both micro hydels are fixed on the same poles, it was more than once that Mr. Javed Ahmad has discovered secretly attached connections between the two wires.

Interviewees:
Manager, operator, AKRSP Area Manager Chitral

That is the reason why "many scholars [...] presume [...] that homogeneity is needed to initiate and sustain self-governance."[1] To what extent heterogeneities finally influence the sustainability of community-managed micro hydels is a task this study can not tackle. In the period of time each village was visited it was hardly possible to observe

[1] Ostrom 2000: 44.

the large diversity of possible dimensions of heterogeneity within the communities. Furthermore, the effect of heterogeneity on collective action belongs to the "many unresolved theoretical issues [that] still exist about the self-governance of common-pool resources."[1] For example, several villages that appeared very well organised and reported few problems regarding the operation and maintenance of their micro hydel mentioned as a reason for their success the belongingness of all members of the community to the same cast. On the other side, villages with a great heterogeneity of casts were not inevitably facing more problems.

Box 6: Electricity and Personal Jealousy – VO Khoragol

A well organised VO constructed its micro hydel without the occurrence of any major conflict; the problems within VO Khoragol started when its village Sonoghor was connected to the SHYDO hydel in Reshun. Out of 45 electrified households, 15 took the connection from this provider additionally to the community electricity. Their willingness to pay the fees and to contribute in the communal work faded away; finally disputes within the community erupted and the EMC broke off. Some of those households that receive both AKRSP as well as the 'alternative' electricity find themselves in a quandary:

On the one hand they do not want to contribute to the continuance of the AKRSP-assisted hydel and support the anyway disliked operator, who additionally benefits from the electricity as he is the owner of a shop for electrical appliances. On the other hand they do not have the power to accomplish an universal closure of the hydro power scheme.

Finally, they are still dependent on the community-owned micro hydel. The electricity from Reshun turned out to be rather unreliable with sometimes long-lasting downtimes. Having guests in their dark houses watching the neighbours receiving electricity from the community-owned project would hurt their pride. For a few of them the solution seems to lie in sabotaging the project. By causing faults with *sitar* (four-stringed Chitral instrument) strings, thrown over the electric wires, they try to coerce the operator to finally close the micro hydel.

The operator himself is, with occasional consultation with the president, solely managing the whole project. As another side of the story, after deducting the expenditures for regular maintenance from the revenues, he puts all money as a salary into his own pocket.

Interviewees: Operator, community member, former AKRSP Social Organisor.

According to Ostrom (2000: 45), heterogeneity is "not a variable with a uniform effect on the likelihood of organising and sustaining self-governing enterprises." The main question is rather, whether the members of a community "share a common understanding of their situation"[2] and "design institutions that cope effectively with heterogeneities."[3]

This will also be the guiding principle in the following course of the study: According to the definition of the dimension of heterogeneity, each community is heterogeneous by various kinds and different degrees which all set the potential basis for possible conflicts. The key for a sustainable operation and maintenance of a project is however the establishment of institutions that function in spite of these heterogeneities and conflict potentials. However, micro hydel projects in communities where large-scale conflicts have already erupted (see Box 6) should definitely be considered as more vulnerable than those being managed by a community that is able to suppress conflict potentials.

[1] Ostrom 2000: 43.
[2] Ostrom 2000: 44.
[3] Ostrom 2000: 45.

7.3 Communal Work

While the consumers of electricity produced by a community-managed micro hydel are not obliged to contribute anything more than their electricity fees to the day-to-day operation of the project, this changes with regard to the long-term maintenance. Therefore the collective work of all community members is required. This input of unskilled labour mainly attributes to the channel and to a minor degree to the grid network. Founded by the characteristics of a micro hydel system, two means of maintenance can be distinguished:[1]

(1) Regular Maintenance: Regarding the channel, regular maintenance work of all community members is necessary, with different degrees of frequency between the villages. The work mainly comprises the removal of sediments from the channel that are brought with the river, especially in spring. The amount of time that is necessary for this task varies widely between different villages from one or two days per year up to several weeks. This variation is very much dependent on whether the water flow through the channel is drawn off from a river or a spring, whether the channel is cemented or not, and how long the channel is. In some villages the consumers are furthermore required to once a year cut the branches of the trees to prevent them from touching the electric wires.

(2) Emergency Maintenance: In Section 4.2 the reasons for the high risk of mountain hazards in Chitral were described. Those hazards also threaten the intactness of micro hydels and require the community to provide institutional mechanisms that guarantee the repair of the damages. On average, each village has an annual probability of 0.61 of the channel being severely damaged, causing the micro hydel to stand still for an average of eight days per year.[2] The natural hazards either occur in the spring or summer in the form of floods, landslides or mudflows or in the winter as avalanches and snowstorms. The latter often additionally cause the poles to break, which then have to be reerected by means of the collective action of all community members.

As mentioned, the duty of the Electric Management Committee is to organise the maintenance work as well as to enforce rules for preventing freeriding.

Regarding the organisation in projects initiated by VOs, the coordination efforts are comparatively small as only relatively few households are involved in the maintenance process. In Cluster level projects, different types of rules for the coordination have emerged. The most common is that the involved VOs are obliged to provide labour for the regular maintenance of the whole channel in daily shifts, but also systems where each VO is fully responsible for a certain fixed section of the channel (whose distribution is sometimes decided by a draw) can be found. In the case of emergency maintenance, generally all benefiting households have to provide labour at once.

[1] With regards to the civil engineering components and the grid network, the difference between regular and emergency maintenance is defined by the fact that the former is required at least once every year and at a foreseeable point of time.

[2] Own field data, 2005. n = 18. The calculations are based on the damage-history of the projects from October 2002 to November 2005. Similar to the variations in the requirements for regular maintenance work, the frequency of natural hazards destroying the channel varies between the different villages from once in a year to once every three years, causing stand-stills between a couple of days and several months.

In order to ensure sustainable collective action, freeriding has to be prevented. In general each household has to send one male member to the maintenance work. To ensure that all households meet this obligation, a system of sanctions which comes to use in case of disregarding has to be developed. As Figure 10 shows, in different communities different penalisation systems can be found.

In the majority of villages, a household of which no member participates in the communal work has to provide refreshments to the people working on the channel. In some cases this penalty is due only in cases where the household does not attend the work without notice, in others it is obliged to contribute the fee in any case of absence. It is so the exact application to the indigenous *mone* system (Section 4.4), which is ideally adaptable to the new technology of micro hydro power, as the requirements of maintaining an irrigation channel hardly differ of those of a micro hydel channel.

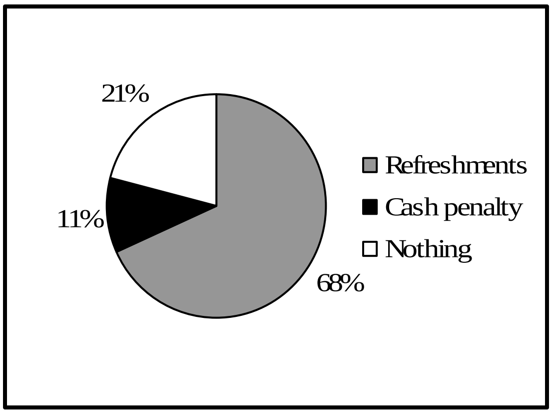


Figure 10:
Penalisation Systems for Freeriding in Communal Work According to Frequency of Occurrence
Source: Own field data, 2005.[1]

However, in 11% of the visited villages a penalty in the form of cash has to be paid.[2] In these communities the cash penalty is a fee rather than a sanction measure. The reasons are traced back to the changing socio-economic livelihoods of households in Chitral. Migration to Chitral Town or downcountry is an important strategy of surviving in Chital, leaving female household members behind for several months. However, the management of (natural) resources requiring the labour in-put of the community comes along with the prerequisite of the availability of a certain number of (male) members. Therefore the changing socio-economic conditions with an increasing number of people working in the off-farm sector away from their villages constitute a certain threat to these management mechanisms. Community organisations like VO Shain Koghozi, where according to its manager almost 50% of the members are not working within the village, try to counteract this threat: If all male members of a household are working outside the village the households pays a certain fee as compensation. However, this system, even if providing an additional source of funds for the projects, is, as with other sanction systems, highly dependent on the actual enforcement of the rules. Furthermore it has to be noted that a lot of communities where many members are working outside the village have not applied this system. For instance in Paur, Gasht, or Sor Laspur, although being strongly affected by out-migration process, penalties in the form of refreshments are charged.

[1] n = 18. In many villages also a penalty in kind of 'refreshments' is collected in cash from what food for the workers is bought. 'Cash penalty' refers to a penalty that is not used for buying food but put into an account used for expenditures on the micro hydel project.
[2] See footmark 1.

If in the above two groups the penalty (either in food or cash) is not paid, many villages use the measure of disconnecting the respective household for a certain amount of time.

A final group of villages finally does not apply any sanctions at all. Within this group it is important to differentiate: On the one hand it comprises VOs that are relatively small in size with all members belonging to the same cast. Due to the strong cohesion between the members, imposing sanctions is considered as being not required. On the other hand are villages like Khoragol, where as a result of profound conflicts sanctions are anyway not possible and the EMC can hardly find anyone to help maintain the channel (see Box 6, p. 43).

The reflections above lead to the following key question: Are the institutional rules designed to mobilise communal work fitting to the requirements of the regular and emergency maintenance of a micro hydel and are there differences between sanctions according to their contribution to the (social) sustainability of the projects? Before trying to answer these questions, three important statements about the sanction mechanisms described above have to be made.
Firstly, it is extremely difficult to measure the exact application of different sanctions between the villages. During the first interview, most communities reported quite severe penalisation mechanisms, which during the revisits turned out to have often never been applied. This fact can have two possible if contrary explanations: Either the EMC is too weak to implement the sanctions, or the high quality of collective action does not require any in the first place.
Secondly, these sanction mechanisms are unlikely to be implemented in all cases and to all members equally. For instance in some villages a small number of households are free from any contribution to the maintenance work, either because its members are too old or the household is female-headed. Furthermore, during the revisits of the projects it came to light that in the majority of villages freeriders exist that never take part in the communal work and that also never pay any penalty. Those are mostly persons who are respected due to their religious or social status within the community. While the members of the EMC often complain about this behaviour on the quiet, nobody has yet had the courage to take action against it.
Thirdly, the selection of a certain sanction mechanism, regardless of when and to what extent it is applied, is always influenced by several factors. An influencing factor is on the one hand the physical setting of the project (e.g. the general risk of natural hazards and the physical vulnerability of the project deduced for instance from the length of the channel), and on the other hand also the social setting (e.g. the size, heterogeneity and socio-economic background of the community).

Based on these three findings, the conclusion about the effectiveness of certain sanctions can be drawn that apparently no one particular sanction mechanisms is superior to another, as its selection is largely dependent on the circumstances of the whole project. Furthermore, the actual enforcement of the rules by a respected EMC seems to be considerably more important for the success of collective action than the mere existence of a certain penalty.

Regarding the general effectiveness of the community-designed institutions to pool human resources, it can be said that these are generally working quite well. Of course, in many villages freeriding occurs in spite of the institutions but as it takes place only on a relatively small scale and as it is tolerated by the remaining households it does not imperil the sustainability of the projects. Apart from villages where general conflicts threaten the entire project, the institutions for mobilising communal work are therefore working quite well. One might argue that the efficiency of communal work as an element of collective action necessary for sustaining a micro hydel project is, in comparison to financial mechanisms for example, more difficult to be operationalised and measured. To some extent this is true; on the other side also those interviewees freely admitting problems regarding the financial system or conflicts within the community stated that in comparison to all problems they face, the mobilisation of the communal work functions quite well. Even through deeper questioning about the history of breakdowns, very few delays came to light that would indicate time lags as a result of a slow and difficult mobilisation process. Furthermore, after the impact of natural hazards the functionality of community-managed electricity systems turned out to be restored considerably faster than those of other providers (Section 7.1.2).

One reason for the relatively successful institutional mechanisms for ensuring communal work is explained by the fact that the demand for collective action for managing natural resource systems has always been an important aspect of Chitral's society (Section 4.4). In many ways the requirements in terms of labour input resemble those for irrigation systems maintained by communities in almost all parts of Chitral. To some extent, changing socio-economic conditions are challenging these collective maintenance systems; nevertheless, some villages have tried to implement countermeasures. However, if more and more people elect the way to pay a fee instead of contributing labour to a project, two possible scenarios arise: Either the system will still be collectively managed with the difference that the inputs provided by the community are substituted (capital against labour) according to the individual availability and that additional paid staff are possibly employed for the work. Or the people contributing labour will start using the fees as their own wage while the remaining households will gradually be relieved from responsibilities and as well as their right to say, eroding the concept of collective action and moving towards a market-based solution.

7.4 Financial Mechanisms

7.4.1 Billing Policy

Apart from the characteristic of a micro hydel that it has to be maintained by means of human resources, the system furthermore requires a considerable amount of financial resources which the community members have to afford. A major part of the money is collected through electricity fees, which are mainly used for paying the wages of the staff as well as for expenditures on the regular maintenance of the machinery. While the exact utilisation of the funds provided by the community will be discussed in detail in the following two sections, the fee-collection systems in the different villages can be differentiated into four different billing policies:

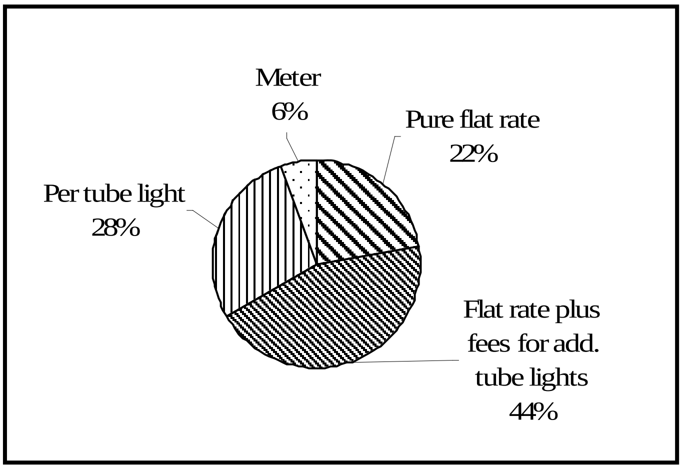


Figure 11:
Different Billing Systems According to Frequency of Occurrence
Source: Own field data, 2005.[1]

As can be seen in Figure 11, in only 6% of the micro hydel projects are the fees charged according to the actual consumption by using meters. Only the community in Shagram (see Box 3, p. 38f) decided, advised by AKRSP, to buy and install meters. All other communities are using different kinds of billing policies. The most common practice is to charge a flat rate for every household irrespective of the number of tube lights used by the household ('pure flat rate') or with extra charges for additional lights above a certain threshold of tube lights already included in the flat rate. In 28% of the projects the monthly fee is calculated by multiplying the number of used lights with a certain fee. As can be seen, the main element of most billing systems is the number of tube lights a household uses. While lighting is still the most important utilisation in many villages, other electrical appliances are also used (Section 7.1.1). Although most villages established in the initial stage of the project a catalogue of monthly fees for each electrical device, there are actually, apart from TVs in some villages, generally no charges for other appliances.

The amount of the flat rate, the number of tube lights included in it as well as the fees for (additional) tube lights vary significantly across different projects. Figure 12 provides an overview of the theoretic monthly fees households with different numbers of tube lights (up to four) have to pay as well as the mean monthly fee charged across all

[1] n = 18.

AKRSP-assisted micro hydel projects. As can be seen, there is a considerable variation in the costs for each tube light. A factor that influences this pattern is the size of the projects which causes households of very small projects to pay higher prices to enable the accumulation of a sufficient amount of revenues to pay the staff. For each different number of tube lights (1-4), among the four most expensive communities are three VOs where less than 50 household are electrified. In Tar Shihi Koh, with only 17 electrified households, a monthly flat rate of Rs. 100 (approx. € 1.39) is charged, which approaches a monthly fee that could be expected from a private or public provider. However, the amount of electricity provided by this community-managed micro hydel is almost equal to that of an alternative provider, too (see Box 1, p. 31 and Box 5, p. 42).

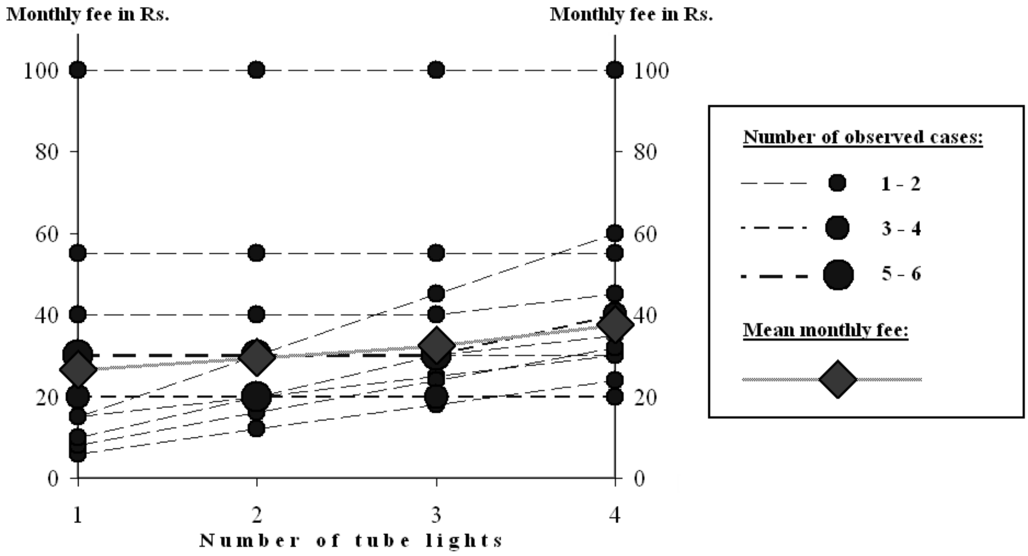


Figure 12: Monthly Electricity Fees for Different Numbers of Tube Lights
Source: Own field data, 2005.[1]

In addition to the connection for households, many villages also provide electricity to shops, which are generally charged via a special flat rate. The few consumers using the electricity in a productive way are most often charged different, but mostly with slightly higher tariffs. Mosques, jamaat-khanas,[2] schools and police stations are generally free from any charge.

Figure 12 suggests that there is a certain increase in the mean monthly fee charge across the different projects from Rs. 27 for one tube light to Rs. 38 for four. However, after checking the financial records every EMC keeps, it became obvious that often only few households of a village are actually paying different fees from the average. The reason is that only a few households charged with a 'flat rate plus additional tube lights' billing system excel the number of tube lights already included in the flat rate. Together with the fact that additional charges for other appliances could, with the occasional exception of TVs, not be enforced by the EMCs in the majority of villages, in

[1] n = 17. The figure does not include fees charged by using electricity meters. The mean monthly fee was calculated by dividing the accumulated fees charged for a certain number of tube lights in the different communities through the number of communities, irrespective of the number of paying households.

[2] A jamaat-khana is a place of prayer for Ismai'lis.

most communities the actual billing policy is a flat rate for most consumers, not resembling the actual consumption of electricity.
This billing policy has three important consequences:

(1) In contrast to a per-unit billing system, there is little incentive for saving energy. Tube lights are generally never switched off, further diminishing the already scarce electricity.

(2) In many cases there is no redistribution between wealthier households having more rooms and tube lights as well as using electrical appliances like radios, washing machines and electric butter churners compared to relatively poor households with one or two tube lights and no additional electric appliances. However, this argument has to be put into perspective as in every village a substantial number of ultra-poor households (up to 15% of the total number of electrified households) is free from any cost. While this fact shows the establishment of an institutional arrangement that anticipates and ex ante prevents freeriding, it furthermore demonstrates the strong cohesion within a community.

(3) As already mentioned several times, due to the low capacity of the micro hydels and the prerequisite of keeping the load on the generator as constant as possible, the use of certain appliances is often forbidden. In regard to a flat rate billing policy, the ability of the EMCs to control such bans is more than questionable as the use of these appliances, although being forbidden, is without any additional cost for the user. While by being charged according to the consumption by means of meters, the illegal use of for instance an iron would mean extra costs for a household, the inducement not to use it is relatively low under the current billing policy.
The effect of a low incentive for reciprocity is reinforced by the difficulty of obtaining information about freeriding due to two reasons:
(a) As we have seen in Section 7.1.2, around one-third of the villages with AKRSP-assisted micro hydels are now also connected to an alternative provider and parts of these villages use both sources of electricity in parallel. In most villages these 'double-electrified' households are not able to use both sources at the same time. Due to the lower capacity of the communal electricity, households, depending on the village, relatively seldom switch to it to save the meter-measured fees of the 'alternative' electricity, as the light is dimmer and, for example, heating water would take far longer. The main problem starts during downtimes of the alternative provider. Due to that higher capacity, the 'double-electrified' households own all the appliances that are banned for the use with the micro hydels. Compared to 'single-electrified' households for whom the possession of these appliances is generally forbidden, they have the right to own them. As information about the (long-term) ownership of an appliance is more easily obtainable than about the (short-term) utilisation, villages that are electrified by two providers face exceptional problems in regulating the use of banned appliances. The EMC of Cluster Chinar has in response developed an interesting countermeasure, presented in Box 7.
(b) As learned from the analysis of impact studies of micro hydels in Chitral, the main beneficiaries of electricity are women (Section 5.3.3). Butter churners, washing ma-

chines and especially the often banned appliances irons and water heating rods are mainly used solely by women. However, of all visited communities, in no EMC (totally comprising 163 people) is one single woman a member. Under the condition of a broad observation of *purda,* the fact that men try to control the utilisation of certain appliances used by the women of other households does not appear to be an effective mechanism. The scope of this problem may vary with the size of the villages as well as the relations between the households and the denominational setting.

By concluding the statements made above, it becomes obvious that the current billing policies are with the exception of meters quite problematic. While the prevalent systems have the advantage that no meters have to be installed, they offer no incentive to obey the restrictions on certain appliances. Their users – analogous to Hardin's herdsman – gain the benefit from the appliances while all others have to bear the costs in terms of a lower capacity and an increased risk for the generator. The institutions regulating this behaviour have to cope with difficulties in obtaining information due to technical and religious restrictions.

Box 7: Coping with the Illegal Utilisation of Banned Appliances – Cluster Chinar

The general existing problem of the utilisation of banned appliances is increased in Chinar, where out of 142 electrified households, 45 additionally receive electricity from SHYDO. These households use water heating rods, irons and heaters, appliances whose utilisation is strictly forbidden on the communal electricity. While the 'double-electrified' households can not use both kinds of electricity at the same time, some of them occasionally switch to the community one, in order to save the (meter-measured) fees for the SHYDO electricity. In the event of its downtime everyone uses the electricity produced by the micro hydel. In order to impede the 'double-connected' households from powering their appliances with the communal electricity and thus preventing the generator from burning through a fourth time as well as to keep the available amount of electricity at an acceptable level, the EMC has developed a well-thought out mechanism:
The grid of the micro hydel is divided into three faces, each electrifying different areas of the village. By observing the voltage and frequency meters, the operator in the powerhouse can detect a misuse and assign it to one of the three faces. In this case he is advised to switch the face off and instantly on for three times. This signal is on the one hand a warning to the misuser that he has been detected. On the other hand the members of the community living in the affected part of the village are alert and leave their houses to detect the freerider.

Interviewees: President, manager, chief executive, operator.

To cope with this situation in the short term, a vigilant operator (Section 7.5) who prevents the generator from burning through is necessary; in the long term, and especially for new micro hydro power projects, meters should be installed. Some community organisations meanwhile have concrete plans to install meters or have already started to collect money.

7.4.2 Financial Complexity

In most villages the monthly electricity fees are collected by the members of the EMC, in some, mainly those managed by Type I EMCs, this job is carried out by the operator, in others the community members themselves have to come to the house of the manager to deliver the money. In all communities managed by organisations of Type II (and

III), the EMC meets on a certain day per month where all members hand in the collected money. These funds are required for three kinds of expenditures:[1]

(1) Salaries: Each community employs at least one person for the operation of the micro hydel. As this assignment is a full-time job he receives a monthly salary. Depending on the number of employees and their wages, a village has to provide between Rs. 750 and Rs. 9,000 in funds every month.[2]

(2) Regular Maintenance: As shown in Chapter 2, the maintenance of the electro-mechanical equipment needs a considerable amount of funds for purchasing, among others, grease, belts and bearings. With considerable variations between different villages, a community has to spend on average around Rs. 540 per month,[2] dependent among other things on the age of the equipment and quality of the construction.

(3) Emergency Maintenance: In the event of a breakdown of the micro hydel, financial reserves need to be available to afford the necessary repairs, especially for the electrical and mechanical equipment. In more than 20% of the villages a major breakdown of the electro-mechanical equipment happens at least once a year. Half of the breakdowns in the last three years were caused by a burn-through of the generator, which is responsible for almost two-thirds of all electro-mechanical breakdowns.[3] Keeping the variations between the villages in mind, each community spends on average an additional amount of Rs. 3,500 per year on emergency maintenance.[1]

In order to bear these three sources of expenditures, in principal each community member has to contribute financial resources in two ways:

(1) Every household has to afford the monthly electricity fees, which represent the Monthly Revenues of the project:

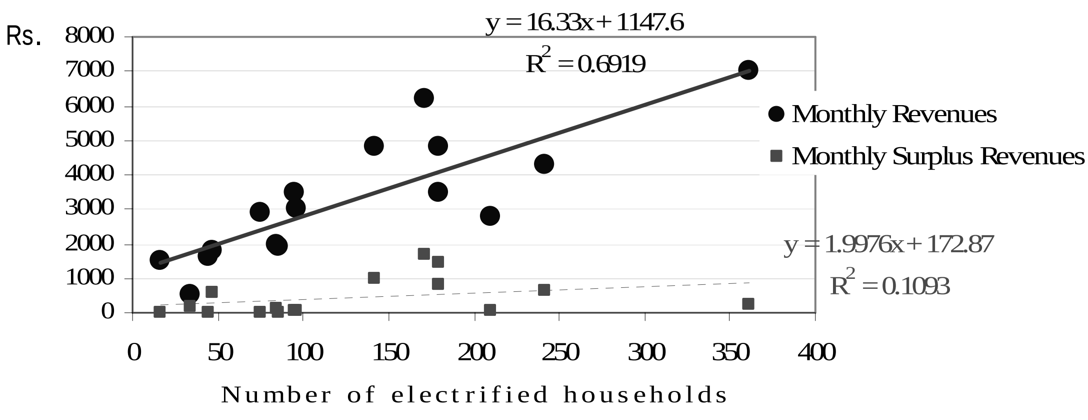


Figure 13:
Collected Monthly (Surplus) Revenues Dependent on the Number of Electrified Households
Source: Own field data, 2005.[4]

[1] In regard to the electro-mechanical equipment, the difference between regular and emergency maintenance is defined by the fact that the former is practicable during daytime without interrupting the night-time energy supply.
[2] Own field data, 2005. n = 18.
[3] n = 18. The calculations are based on the damage-history of the projects from October 2002 to November 2005.
[4] n = 16. The revenues are equivalent to the monthly accumulated average fees actually collected by the EMCs, not the expected ones (see Figure 15, p. 56). For VO Khandari and Cluster Deh Brep no reliable and consistent data was available.

Although we have seen that households in very small villages often have to pay a higher price for the electricity, Figure 13 illustrates that there exits a correlation between the total amount of monthly collected revenues and the number of electrified households. This correlation diminished when looking at the Surplus Revenues, namely the revenues after deducting the expenditure for salaries and regular maintenance. A coefficient of determination (R^2) of 0.1093 indicated that other factors determine the Surplus Revenues. However, it has to be noted that the Surplus Revenues themselves reflect the financial profitability of a project only to a limited degree. Firstly, electricity fees are not the only source of income; secondly, in the Surplus Revenues the expenditures for emergency maintenance are not yet included. These are however subject to immense fluctuations, requiring the search for another quantity for the financial success of micro hydel projects.

(2) Apart from the monthly electricity fees, in the initial stage each household has to pay a connection charge (between Rs. 500 and 1,000) which will provide the basis for the Maintenance Fund as agreed in the Terms of Partnership (ToP).

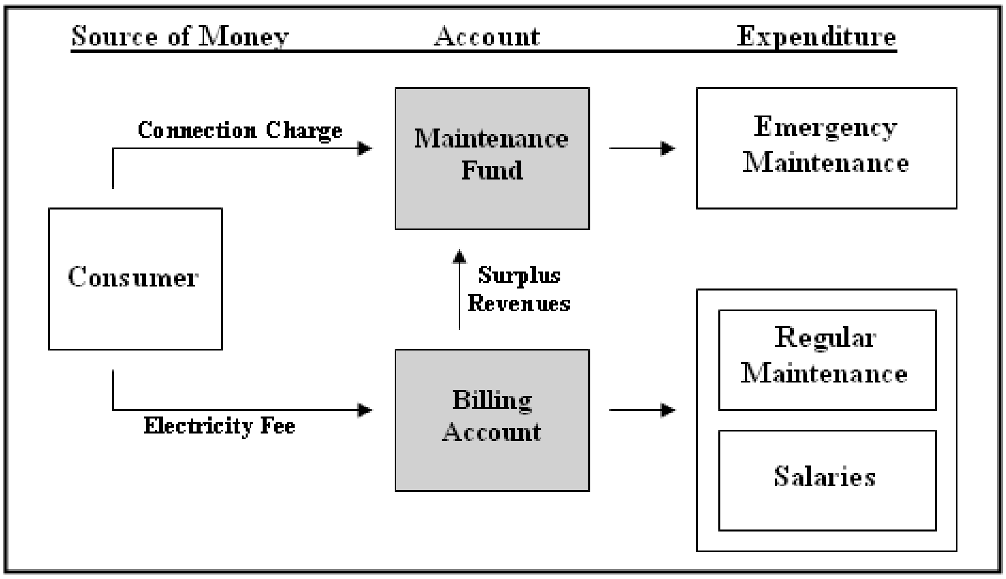


Figure 14: Exemplary Financial Mechanisms in Community-Managed Micro Hydels
Source: Own presentation.

As shown in Figure 14, in an example village the revenues collected through the fees are put into a billing account from which the salaries and the expenditures on regular maintenance are paid. The remaining Surplus Revenues are deposited into the Maintenance Fund, which is used in the event of emergency maintenance. According to that model, the development of the Maintenance Fund would represent the financial success of the project as its increase would be the result of incomes excelling the expenditures. However, on the ground this model experiences grave modifications in every village, complicating any statement about the financial success of different projects:

- In spite of the conditions of the ToP, 22% of the villages have not established a Maintenance Fund.[1] The reason will be explained in Section 7.4.4.

[1] Own field data, 2005. n = 18.

- In many villages the expenditures for regular maintenance are not bore by the Maintenance Fund but by direct cash contributions from the households (Section 7.4.4).
- Several villages keep no bank account at all. In these villages (mainly managed by Type I EMCs), one person keeps all money in cash.
- In some villages the funds placed in the Maintenance Fund are fixed for a certain amount of time, enabling growths due to interest.
- In communities where both accounts have been established, the frequency of depositing revenues into the Billing Account or Surplus Revenues into the Maintenance Fund varies from once in a month via once Surplus Revenues are available to never.
- While in some projects all consumers pay the connection charge prior to the start of the construction, in many others instalments are still going on years after the completion of the project, making a comparison of the development of the Maintenance Fund between different villages futile.
- As seen in Section 7.3, some EMCs charge cash penalties for not participating in communal work. This type of penalty is sometimes also charged against misusers of banned appliances and defaulters, providing an additional source of income.

These distinctions in the financial mechanisms between different communities led to the insight that while a decrease in the Maintenance Fund indicates low financial profitability, (due to insufficient revenues or major expenditures) the reverse can not be drawn: An increase of the Maintenance Fund is not an indicator of high Surplus Revenues. The additional fact that the quality of the financial records varies considerably between different villages made it necessary to conduct a thorough survey of the financial mechanisms of every village.

7.4.3 Financial Profitability

By analysing and comparing the various financial systems in the different villages, it came to light that no single community was found where the accumulated funds comprising a Maintenance Fund and/or a Billing Account grew without the addition of later added connection charges or through interest. No community is making any significant profit from their micro hydel projects.[1] They are able to finance the expenditures for operation and regular maintenance mostly through revenues, but sometimes also by using cash penalties and connection charges. In contrast, emergency expenditures are seldom paid from revenues, but from one-time charges of the households, either through connection charges (Maintenance Fund) or through ad hoc levies (Section 7.4.4).

Furthermore, and most importantly, the communities do not pool enough financial resources for covering the depreciation on the equipment.[2] For the non-existing financial profitability of the projects, two explanations are possible: (1) Either the majority of

[1] This result corresponds with an evaluation conducted by the World Bank (2002: 111) that states that “cost recovery is just sufficient to cover routine O[peration] & M[aintenance].”

[2] This section only focuses on the income regularly deriving from the projects as a result of the communities’ established institutional arrangements. Maintenance Funds, as they are a prerequisite for obtaining a project, are not taken into account.

benefiting households are not provided with sufficient financial resources to afford higher electricity fees or (2) the communities are not willing to pay higher prices and the EMCs are not able to get them passed.

(1) On the one hand the community members may not be able to cover higher fees. With variations between villages and households this may be true to some extent; on the other hand one has to take the actual opportunity costs into account. The CBAs, illustrated in summary in Figure 6, p. 24, were calculated on prices from the year 2000. Due to the increase of fossil fuel prices this situation has changed dramatically: At the time of the field visits the price of one litre of kerosene oil in Chitral was Rs. 45 compared to Rs. 13 in 2000.[1] Using a carefully estimated monthly consumption of 10 litres per household,[2] a family would have to spend on average Rs. 450 per month for lighting their house. By comparing this figure with an average monthly electricity fee of Rs. 38 for four tube lights (see Figure 12, p. 49) the large amount of saved money becomes obvious, particularly as in this sample calculation opportunity costs through saved expenditures on batteries have not been taken into consideration, let alone the various non-monetary benefits of electricity. The argument that a number of households hesitate to take a connection of an alternative provider due to the higher costs seems to be more likely rooted in the high connection charge than in the amount of the monthly fees. However, these reflections do not suggest that the majority of households would actually be capable of bearing higher costs, especially as the productive use of the electricity is more than limited. Without differentiated data about the actual (cash) income situation, no well-founded statement can be made if, where, and to what extent an increase of electricity fees up to a profitable level would be possible.

(2) The figures used in Figure 13, p. 52 represent the average monthly revenues the communities stated they collect. By checking them with the information given by the interviewees about the billing system, the actual revenues turned out to be considerably less than the expected ones. The reason for these differences is manifested in the sometimes large amount of outstanding debts, listed for each project in Figure 15.
On the one hand this figure shows the existence of big outstanding debts in several villages. The 'front runner' in terms of total debts as well as regarding the dues per households is Mastuj. On average, in this Cluster every household has a debt of Rs. 380 with an electricity fee of Rs. 10 per tube light; the total outstanding debts amount to Rs. 65,000. Taking the fact in consideration that the EMC averagely collects Rs. 6,200 per month, it means that the total revenues of the whole village for several months are missing. As seen in Figure 26, this situation is not an isolated case but can be found in quite a considerable number of the micro hydel projects. The fact that all these communities obviously face a problem in recovering the existing fees questions the realisability of even higher prices for the electricity.

[1] Own field data, 2005, AKRSP 2000: 11. Included in this price hike is a general rise in price level amounting 27% from 2000 to 2005 (own calculation, based on the Consumer Price Indices of GoP 2006a: 119).

[2] According to various impact studies, prior to the construction of a micro hydel in different villages, between 9 (Effendi 2000a), 14 (AKRSP 2000), 15 (Effendi 2000c) and 27 (Effendi 2000b) litres of kerosene oil per month and household were consumed. In our calculation the demand for kerosene is assumed to be perfectly inelastic.

On the other hand the figure does however also indicate that by far not all communities have problems in recovering the electricity fees: In an approximately equal number of villages no household (HH) has got dues.

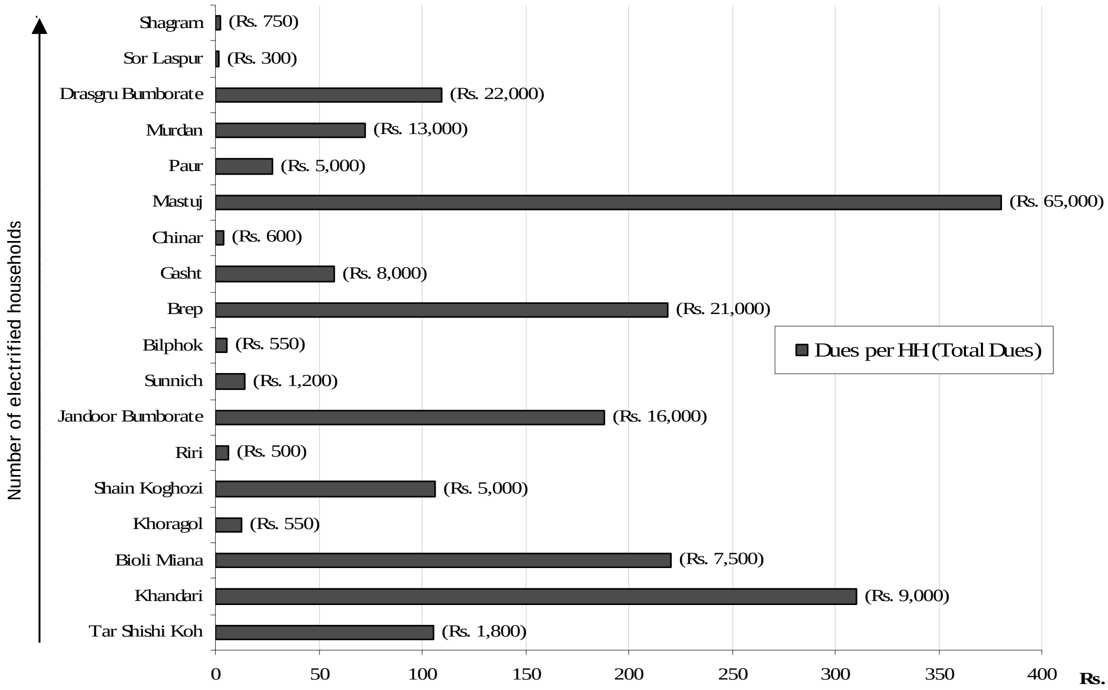


Figure 15: Outstanding Debts
Source: Own field data, 2005.

The question itself suggests why in some communities the institution for acquiring financial resources in the form of electricity fees seems to work quite well, whereas in others apparently a large number of freeriders exit. This study can not provide an explanation applying to all communities, but some tendencies can be identified:

In many communities with large outstanding debts, this fact was often justified by the respondents with the effects of migration. The women of a household who are left behind for several months by the male members of the family for working in downcountry do generally not pay the fees until the return of the men. As the case for the supervision of restrictions on electrical appliances, the involvement of women would, apart from representing an enhanced empowerment in general, possibly solve this problem. However, this explanation does not explain the cleared outstanding debts in villages, also strongly affected by out-migration processes.

Some theorists would suppose that large amounts of dues as an outcome of shortcomings in institutional arrangements for enabling collective action (payment) would more probably be found in large villages than in smaller ones. This argument is based on Olson's (1965) work, who argues that the size of a group is negatively related to solving collective action problems. Figure 15 shows the outstanding debts of communities which are sorted according to the number of electrified households and, as can easily be observed, such a supposed correlation does not exist. While on the one hand there may be the effect that households in larger projects comprising several villages are more reluctant to pay their fees due to an increased non-committal, on the other hand village representatives in many small communities reported that due to the close kin relationships it is hard for them to push their relatives to pay the fees. In any case, regarding the prevalent study, the size of the group does not have a uniform effect on the quality of the collective action.

In order to prevent freeriding in terms of defaulting, every community has developed its own system of sanctions, mostly including the elements of late fees and then disconnection. As for the different penalisation systems implemented to ensure communal work (Section 7.3), equal problems also apply in the context of billing.[1] In general, the strict implementation by the EMC seems to be more effective than the sole existence of a sanctions system (see Box 8). One explanation for low dues therefore applying in at least some villages, is the existence of a firm and respected EMC. On the one hand it prevents the occurrence of large-scale freeriding which has the effect that at some point in time, almost nobody is paying anymore (see Box 11, p. 69). On the other hand it stops the amount of dues for each household exceeding an amount that the household is not able to clear any more. In Mastuj, people fulfilling their payment obligations are now only able to pay back parts of their dues.

Box 8: Clearing Outstanding Debts – Cluster Sor Laspur

Prior to the change of the president and the manager of the Electric Management Committee in Sor Laspur (see Box 4, p. 40), the total dues of all community members exceeded Rs. 28,000. The first step of the newly selected function-bearers was to collect all outstanding debts, resulting in almost cleared dues.

Interviewees: President (new), manager (new), community member.

In summary, no factor that influences the dues that applies to all villages can be identified; however, it has to be noted that also villages suffering from low payment morality have so far managed to finance all expenses. Nevertheless, their problems in recovering the fees makes the claiming of higher charges, which would then cover the depreciation of the installation, rather unrealistic. In this context it should be remembered that communities with no outstanding debts also pool too few financial resources in the long term.

One reason for the relatively too low charges (and also a further explanation for high dues) is the effect that paying electricity fees is, from a short-term perspective, only to some extent necessary for keeping the project running: The staff need to be paid on a monthly basis, whereas the remaining expenditures can under good circumstances be relatively low for a certain amount of time. While an input of human resources is especially in case of emergency maintenance easily communicable, as the effect of this endeavour is immediately visible, regularly paying electricity fees is, apart from the fund for the staff and the expenses for regular maintenance, an insurance against future emergencies, which occurrence is uncertain and unpredictable. While this situa-

[1] Comparable to the sanction policies which should ensure communal work, some sanctions (late fees), although included in the resolution passed by the communities in the initial stage of the projects, are rarely realized in any project. Furthermore in most communities there a limited number of freeriders exist, in the sense that these people have never paid any fee.

tion still challenges the recovery of fees in many villages, charging even higher fees for creating a fund for the replacement of the existing machinery appears improbable.
Linked to this argument is the fact that providing labour to sustain a resource system is deeply rooted in indigenous institutions for resource management, compared to a scenario with obliged regular cash payments for replacing costly technical parts of a project after the end of their lifetimes. Already in the existing situation, many village representatives stated considerable problems in convincing the community members that although all of them have worked in the construction of the hydel, and although the village is now the owner of the project, they still have to pay monthly fees.
These arguments are ideally illustrated by the example of VO Khandari, which is outlined in Box 9, where the 'new' mechanism of charging electricity fees exists side by side with the indigenous *mirzhoi* system, presented in Section 4.4.

Box 9: Financing the Operation and Maintenance of a Micro Hydel – VO Khandari

In VO Khandari, the contribution of the 29 electrified households to the operation and maintenance of their micro hydel occurs, apart from the collaboration in communal work, in two ways: In order to compensate the operator for his duty, every household is obliged to hand him over 20 kg of maize every year. For covering the expenditures for regular maintenance on the machinery, every household has furthermore to pay electricity fees of Rs. 6 per tube light and month. At the time of the visits (November 2005) with the exception of two households all community members had delivered the maize. Regarding the money, in 2005 with few exceptions so far no household has paid any fee. In 2004 only half of the households had paid the electricity charges.
In Spring 2003 the generator broke, causing a financial damage of Rs. 6,500. At that time the operator, who is solely managing all financial processes, had Rs. 3,000 of revenues in his hand. As the community has no Maintenance Fund, the remaining money was lent from a man within the village. It took almost one year to collect enough fees to pay off the credit.

Interviewees: Manager, operator, two community members.

One last, and probably the most important, reason that the communities charge insufficient fees for replacing larger parts of the installation is the fact that the communities have up until now relied on the support of AKRSP. By having a 'backup solution' for the replacement of large parts of the project, EMCs have little incentive for pushing high fees, that will possibly never be required.[1]

In our definition, a financially sustainable micro hydro power project would require the managing community to possess "enough funding for the operation and the maintenance of the micro hydel."[2] This definition is deliberately vague. Assuming an endless time horizon, financial sustainability would require the project to pool enough funds derived from its benefits (electricity) to sustain it after the end of its lifetime. Using this definition and disregarding one-time charges for a Maintenance Fund, none of the micro hydels is financially sustainable. Assuming however the time horizon to finish with the end of the project's lifetime, all visited micro hydels that are running sustainably. The assessment of different gradations of sustainability requires – due to the complexity and diversity of different financial systems – an in-depth study of each pro-

[1] To what extent AKRSP's financial injections may with regard to a mainly as well subsidized electricity supply by alternative providers be appropriate will not be further discussed within this study.
[2] Section 3.3.

ject. The crucial point in any case is that in the event of damage to the machinery, the community is provided with sufficient funds for financing the repair process. Therefore the communities are obliged to establish a Maintenance Fund. How the communities who have not installed such a fund do cope with the challenge of suddenly occurring high costs will be outlined in the next section.

7.4.4 Maintenance Fund

Although included in the ToP, in 22% of the villages no Maintenance Fund was established.[1] Figure 16 illustrates the different amounts of Maintenance Funds, as well as the denominational differentiation in Chitral. To illustrate the connections it also includes projects that are now abandoned.

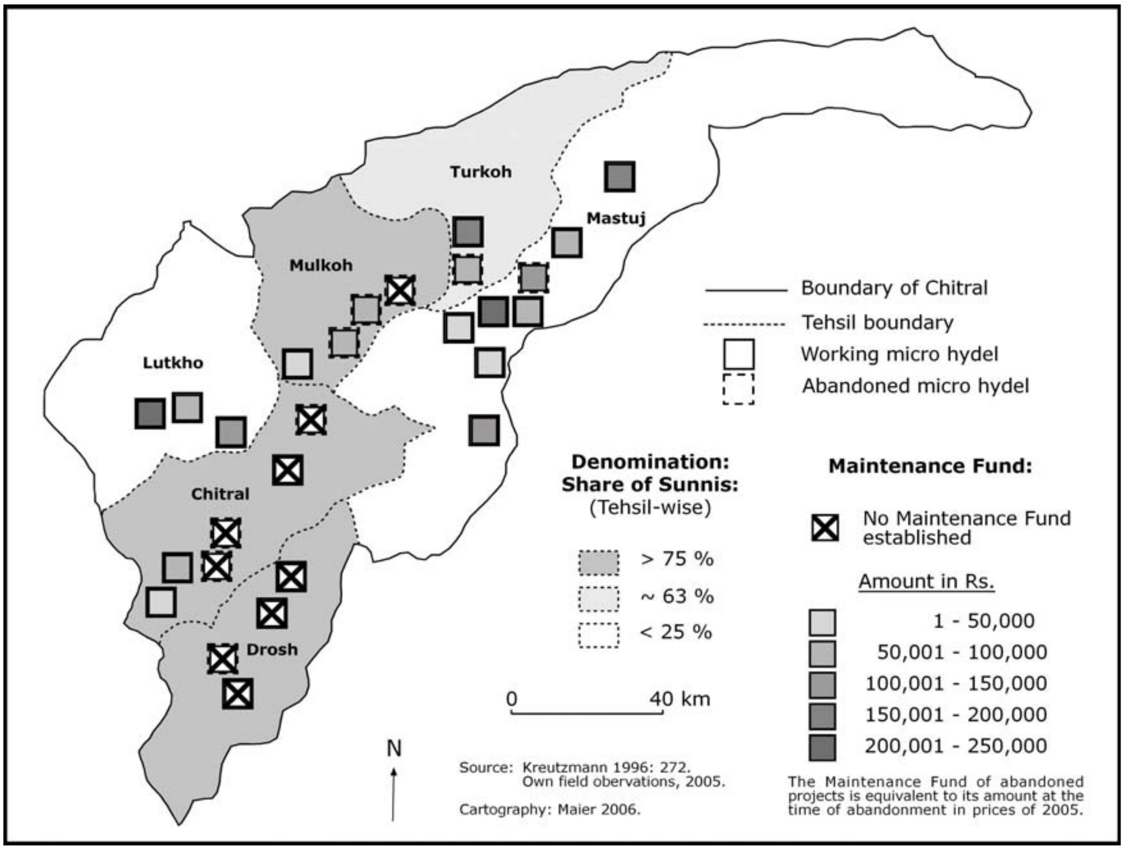


Figure 16: Maintenance Funds of Sampled Micro Hydel Projects
Source: Own presentation.

The figure can of course be challenged as the denominational differentiation at Tehsil-level is too rough and the concentration on the Sunni sect presents a simplification of a more complex context as ethnic-linguistic facts, for example, are disregarded. However, the figure clearly indicates a correlation between areas with a high Sunni share and whether a Maintenance Fund has been established or not. All communities without a Maintenance Fund are located in tehsils with a Sunni share of more than 75%. Apart from the two visited micro hydels managed by Kalasha people, no project in Chitral and Drosh was found with a Maintenance Fund. One reason for this correspondence is the

[1] Own field data, 2005. n = 18.

already mentioned fact of acceptance problems of AKRSP by many Sunni- and Pashtun-dominated villages. In order to establish a relationship with these villages, which often opposed AKRSP, and to connect them with the outside world through electricity-powered telecommunication appliances, concessions on the condition of the ToP were made and from the obligation to establish a Maintenance Fund, demanding a relatively large payment of each household, was dissociated. The fact that saving is a religious legitimated objective for Ismai'lis[1] added to the easier promotion of Maintenance Funds in their villages.

As can also be seen from Figure 16, the amount of Maintenance Funds varies considerably. However, as shown in the previous section, without analysing the whole financial system of each community, the size of the Maintenance Fund says little about the financial profitability of the projects. Furthermore it has to be noted that its establishment and also its initial size was required by, and negotiated with, AKRSP as a prerequisite for obtaining the project. In contrast to the other financial mechanisms, it is therefore not a community-made institutional arrangement.

What is then the impact of a Maintenance Fund on the financial sustainability of the projects? It is obvious that communities having established a large Maintenance Fund have advantages: In the event of a larger repair, funding is readily available and in some isolated cases the Maintenance Fund is even enough for a future replacement of electro-mechanical parts. However, judging these projects financially more sustainable than those with no Maintenance Fund, would require the latter to evidently face more problems in financing repairs. This assumption could not be approved. The reason is that communities with no Maintenance Fund have different characteristics to the other villages. As stated above, the existence of a Maintenance Fund is strongly influenced by the denominational setting. Section 7.2.2 showed that this fact also indirectly influences the size of the projects, as religious motivated tensions and reservations against AKRSP have hindered the motivation and cooperation of communities for obtaining larger projects.

Establishment of Maintenance Fund		**No**	**Yes**
Characteristics	Average no. of electrified households	32	150
	Probability of being managed by EMC of Type I	1	0.07

Table 4:
Community Characteristics Dependent on the Existence of a Maintenance Fund
Source: Own field data, 2005.[2]

As shown in Table 4, communities having installed a Maintenance Fund electrify on average 150 households, whereas those without the fund comprise on average 32 household.[3] In correlation to the findings of Section 7.2.2, communities without Maintenance Funds are always managed by Type I EMCs, compared to those without a Maintenance

[1] Schönherr 1992: 29f.
[2] n = 18.
[3] All sampled projects without Maintenance Funds electrify fewer households than those with Maintenance Funds.

Fund, which predominantly have Type II EMCs. In the event of an emergency, the required money is either taken as a credit and paid back later on (see Box 9, p. 58) or collected through ad hoc levies. In that case only in very rare situations does every household pay the same amount of money; instead the people contribute according to their financial capacity. In the visited communities, these procedure have so far worked quite well, due to relatively small numbers of electrified households and therefore relatively low organisational efforts. Apart from time lags between the occurrence of the damage and the allocation of funds, micro hydels managed by communities with no Maintenance Fund can on the basis of the collected empirical data not be considered being financially less sustainable per se than projects where such fund exits, due to their special conditions.

This result is strengthened by the findings presented in Figure 17. One might suppose that communities with a Maintenance Fund rely on this kind of funding in the event of emergency maintenance. However, this applies only to around three-quarters of the expenditures. These have indeed been financed by making use of the Maintenance Fund or the Surplus Revenues, or, in cases where the money has not yet been deposited into the Maintenance Fund, the Billing Account. But in spite of the existence of a Maintenance Fund, around one-quarter of all expenditures for major repairs of the scheme is financed by ad hoc levies of all electrified households. In none of these cases was the balance of the Maintenance Fund too low to bear the costs. Reasons given by the members of the EMCs for this procedure were the following: In many cases of ad hoc levies, the damaged occurred to the channel and the community argued that they want to use the Maintenance Fund only in regard to the electro-mechanical equipment. Some village representatives argued furthermore that they want to save the funds in the Maintenance Fund. The argument often went into the direction of keeping a saving for larger damages, but some people also stated that by means of a high Maintenances Fund they would impress AKRSP and thereby hopefully obtain further funding.

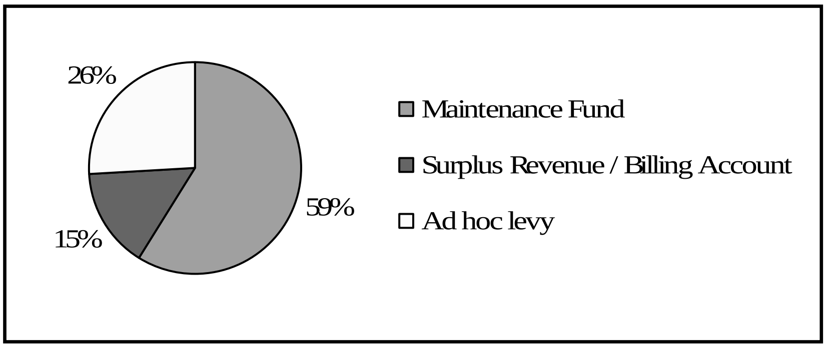


Figure 17: Source of Money for Expenditures on Emergency Maintenance in VOs/Clusters Keeping a Maintenance Fund
Source: Own field data. 2005.[1]

This finding shows that the externally implemented institutional arrangement of establishing a Maintenance Fund is in many cases not a decisive factor for the sustainability of the micro hydel.

[1] n = 14. The figure is based on all expenditures for emergency maintenance in the different micro hydel projects from October 2002 to November 2005.

7.5 Operation

In every community a certain number of people are employed by the EMC. In general, these male employees that are selected by the community or the EMC can be divided into four categories with regard to their duties:

(1) Operator: Every village employs one operator. As mentioned in Section 5.3.2, he received training from AKRSP and is now responsible for all technical processes, which includes the supervision of the machinery during the operation, the realisation of regular maintenance works and the connection of newly electrified households. In many villages with Type I EMCs he is furthermore often involved in the fee collection or is even solely responsible for all financial processes. On average, an operator earns Rs. 1,400 per month, varying between the villages from Rs. 400 to Rs. 2,500.[1]

(2) Watchman: Some 60% of the VOs/Clusters employ a watchman (Urdu: '*chowkidar*'). In the remaining 40% his duties are additionally fulfilled by the operator. While the operators' job is related to the electro-mechanical parts of the scheme, the watchmen's responsibility is, analogous to the indigenous *mirzhoi* system (Section 4.4), the channel. Daily he has to observe the channel to remove obstacles as well as to detect possible breaks. The watchman furthermore has to clean to forebay tank and release the water into the penstock pipe. In some villages it is necessary that the watchman together with the operator prevents the channel from freezing during the winter. Watchmen have an average monthly salary of Rs. 1,100.[2]

(3) Lineman: A minority of villages with a relatively large number of households additionally employ a lineman for maintaining the transmission lines and providing electrical connections.

(4) Meter Readers are only found in villages using meters (Shagram), where they are responsible for collecting the fees.

As linemen and meter readers are relatively rare positions in the projects, the following text will concentrate on operators and watchmen only.

As stated in the pervious parts of the study, the vigilance of the operator is of crucial importance in the AKRSP-assisted hydro power projects. Due to the non-existence of flow or load control governors, the operator has to control the flow of the water manually to keep the generator's speed constant. His permanent observation of the frequency and voltage meters is especially important as, due to a non-consumption-based billing policy, the compliance with restrictions on appliances that are energy-hungry and characterised by shifting electricity demands is not encouraged and the bans are difficult to be effectively controlled (Section 7.4.1). The operator is therefore obliged to remain the whole night inside the powerhouse, checking the meters on the panel board, the intensity of the lights and the sound of the machine to be able to immediately adjust the flow of water. However, as seen in Section 7.4.2, burn-outs of generators represent with almost two-thirds the largest share to all breakdowns of the electro-mechanical equipment. According to the AKRSP engineers, the vast majority of

[1] Own filed data, 2005. n = 18.
[2] Own field data, 2005. n = 12.

these repairs could be avoided by a careful supervision of the system by the operators.[1] This statement was confirmed by several village representatives, who claimed the operator was responsible for damages to the generator as he was not present in the powerhouse at the time of a breakdown. Especially in villages with large distances between the houses of the community members and the powerhouse, the supervision of the operator is difficult.

A similar situation applies to watchmen. Hindering a channel from breaking requires its continuous supervision by the watchman. However, in several villages they were accused of being responsible for breaks due to their carelessness.

The general satisfaction of members of the EMC with the performance of the staff is illustrated in Figure 18. We see that the members of the EMCs are generally more satisfied with the work of the operators, whose performance in almost one-quarter of the villages was rated as excellent.

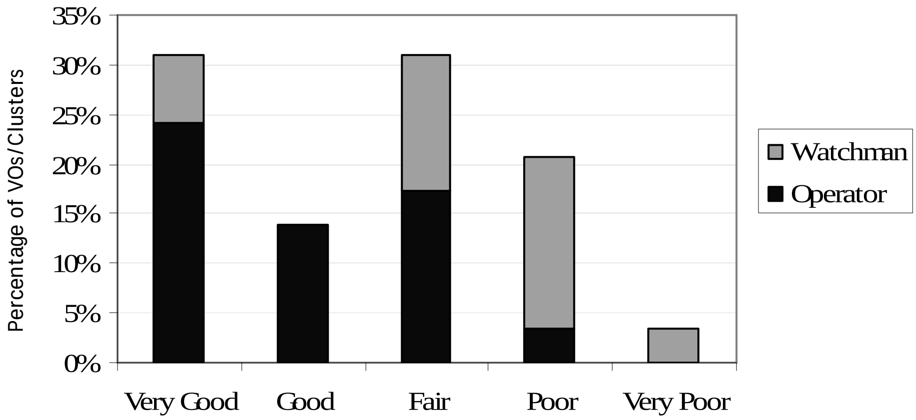


Figure 18:
Assessment by Function-Bearers of the EMCs of Their Staff's Performance
Source: Own field data, 2005.[2]

However, it is also evident that in almost one quarter of the projects the EMCs claimes the staff's performance is 'poor' or 'very poor'. This raises the question if in these village measures are taken to change the situation and possibly sack staff.

To answer this question, an important finding of this study has to be included. When asking about the reasons that led to the selection of a particular person for the job, the following fact come to light: As shown in Figure 19, in around three-quarters of all cases the operator was employed because he is the owner of the site where the powerhouse is constructed and the watchman obtained his job due to owning the land that the micro hydel channel is flowing through.

This procedure can be explained as follows: In the majority of cases where the land owner does not donate his land for the project or where it is not in possession of the

[1] Interview Mr. Babar, AKRSP Micro Hydel Engineer, November 2005.
[2] n = 17. The assessments were conducted by all interviewed function-bearers of the EMCs. It has to be noted that in villages where only one person was interviewed the assessment represents a single opinion only, while in all other cases the average of all individual statements was used, weighting each assessment equally.

community,[1] the landowner is compensated by the community through an 'employment contract'.
On the one hand this procedure has some advantages. With regards to the operator it is ensured that he often lives close to the powerhouse; with regards to the watchman the advantage can be seen in the fact that in the event of a break in the channel it is first his land that is flooded.

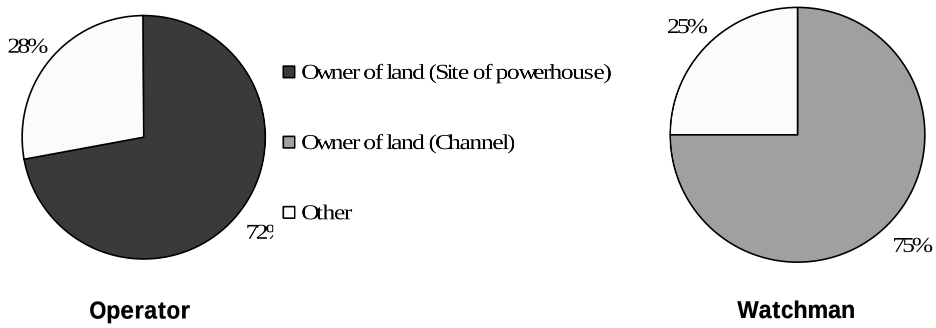


Figure 19: Decisive Reasons for Staff's Employment
Source: Own field data, 2005.[2]

On the other hand however, this institutional arrangement brings a grave potential problem. All staff that have property rights on the project have a monopoly on its position. Although around one quarter of the operators and watchmen perform their duty in an unsatisfactory way in the eyes of the EMC, they yet can not be sacked as they claim their jobs as a compensation for their land. Therein raises the situation that in villages where the staff have no property rights related to the scheme, in almost every second case it has been changed by the community due to dissatisfaction, compared to the remaining 75% of communities where with one exception (resignation) a change in staff has never happened.[3] Several community organisations (e.g. Riri, Shain Koghozi, Chinar) are in the dilemma that the employees' performance is very poor and the EMC is not able to sack them as wanted. In these communities, discussions and negotiations are focused on collecting money so that the community can buy the land and end the monopoly situation of the staff.

[1] About 95% of all households in Chitral own their land. Pastures are mostly owned by the village, with each households having grazing rights (GTZ 2005: 25).
[2] n = 18.
[3] Own field data, 2005. n = 18.

7.6 Synopsis

In the first part of the empirical part of the study, the different institutional mechanisms applied in community-managed micro hydels were analysed with regard to their contribution to the projects' sustainability. The basic prerequisite for establishing these mechanisms is the electricity provided by the hydro power scheme. The benefit of electricity is valued very highly by the consumers although, with variations between the villages, it is characterised by a considerable scarcity, requiring rules that govern its use. Unless the resource base is substantially destroyed, no empirical evidence was found that relatively low per household electric capacity comes with a decreased social sustainability derived from reduced motivation to maintain the project. Whether this statement also applies to communities that are additionally connected to an alternative electricity provider will be outlined in the next chapter. In these projects, households use both sources of electricity parallel as those have complementary characteristics. Comparing the reliability of both types of providers, it becomes obvious that community-managed projects have clear potential advantages compared to private or state-run approaches.

The organisations in communal micro hydel projects in Chitral that define and control the rules necessary for sustaining the projects are the Electric Management Committees (EMCs). With varying degrees of community involvement, the main responsibilities of the EMCs are the acquisition, pooling and coordination of resources provided by the community and the employees, as well as the supervision of institutionalised rules. According to the number of people involved in the committees, the EMCs can be classified into two groups, each representing an organisational type with different characteristics. However, the division does not reflect different degrees of community participation in the decision-making process; instead the two types are determined by community characteristics, including the denominational setting. Therefore no organisational type can be judged of having an evident impact on the sustainability of a project, with the exception of centralised systems involving one or two persons only. These are often a result of conflicts, either founded by institutional shortcomings or by heterogeneities within the village. While this study could not prove heterogeneity on its own to have a uniform effect on the quality of community institutions and therefore on the sustainability of the micro hydels, already erupted conflicts have to be regarded as a major risk factor.

In all visited projects the consumers have to contribute their labour to the maintenance of the hydels. To ensure this form of collective action, the communities have developed several coordination structures and different penalisations systems. The latter are with certain digressions also applied to ensure payment morality and the compliance with restrictions on electrical consumption patterns. However, with regards to the sustainability of the projects, the strict application of the different sanction systems by a respected EMC seems to be more decisive than their mere existence. With the exception of general conflicts threatening the entire project, the institutional mechanisms for communal work are functioning quite well, resulting in a general high social sustainability. Arguments can be found in the fact that communal work is deeply rooted in indigenous resource management systems as well as in the fact that the success of communal work is immediately visible. Nevertheless, changing socio-economic conditions may imperil the collective management mechanisms.

Apart from manpower, the households are obliged to pay monthly electricity bills. The most commonly applied billing systems are flat rates, with often no extra charges for additional appliances. According to CPR theory, difficulties in the utilisation of a common-pool resource arise due a mismatch of the resource's characteristics and the institutions that govern its use. With regards to the community-managed micro hydels, the billing policy presents an indisputable mismatch. The micro hydels are characterised by low intensity of electricity and a lack of flow and load control governors, which are required for keeping the generators' speed at a constant level. A billing policy of flat rates however provides little incentive for saving electricity and obeying bans on forbidden appliances. This mismatch between the technical characteristics of the resource and the governing rules is widened even further by religious and cultural constraints hindering an improved supervision of banned appliances through women as well as by a situation where households receiving electricity from two providers can evade the restrictions. The result is a further decrease of available electricity and the requirement of a vigilant and motivated operator. A recruitment policy however that brings along a monopoly position for the staff leads to further risks of generators burn-outs.

Regarding the price of energy, in very small projects the people have to bear higher costs for the electricity; nevertheless, the amount of total collected revenues rises with the number of electrified households. However, the sizes of the projects have neither a uniform effect on the profitability nor on the payment morality. Taking the great diversity of financial mechanisms in different projects into account, the communities have not established institutions to pool enough financial resources for covering the depreciation of the equipment. The reasons may lie in lacking financial capacities of the majority of households, which in comparison to the opportunity costs of electricity seems to be a questionable suggestion. On the contrary, large amounts of debts resulting from migration patterns, an inconsequent enforcement of sanctions, difficulties in communicating the necessity of regular fees for creating reserves, and the availability of external financial injections, rather generally question the possibility of financial profitability in community-managed projects. From this point of view, no micro hydel is financially sustainable. However, by focusing on the given projects' lifetimes, the fact that all communities have somehow managed to pool enough financial resources to conduct all repairs twists this assumption round. The externally implemented institutional arrangement of collecting connection charges for a Maintenance Fund facilitates the funding of breakdowns, although it is in many cases not a deciding factor for sustaining a project.

Issues regarding the final impact of the problems outlined above, that are most often derived from a mismatch between the characteristics and demands of micro hydels and the institutional arrangements, on the sustainability of projects resulting in the abandonment of a scheme, will be discussed in the next chapter.

8 Abandoned Micro Hydels

The fact that approximately 20% of all AKRSP-assisted micro hydels in Chitral are not in operation anymore[1] raises questions about the reasons and the fundamental differences between them and those plants that are still used by the communities. Comparing abandoned micro hydels with those that are in operation, it is noticeable that the projects in both groups resemble each other very much.

Condition of Micro Hydel		In Operation	Abandoned
Characteristics	Average no. of electrified households	101	93
	Probability of being managed by Type I EMC	0.33	0.33
	Average performance of staff (1-very poor, …, 5-very good)	3.48	3.85
	Probability of at least one employee having property rights on the scheme	0.71	0.67
	Probability of establishment of Maintenance Fund	0.78	0.29

Table 5:
Selection of Characteristics of Operating and Abandoned Micro Hydel Projects
Source: Own field data, 2005.[2]

These features for instance involve (as shown in Table 5) the number of electrified households, the organisational type, the performance of the staff and their property rights, which show no statistical significant differences between working and abandoned projects.[3] Furthermore, in both groups religious motivated conflicts occasionally characterise(d) the initial stage of the projects, both report problems in controlling restrictions on consumption patterns, both sometimes have (/had) a small number of permanent and tolerated freeriders within their villages, in both groups there exist(ed) cases with problematic bill recovering and in both burn-outs of the generator are (/were) not uncommon.

The only, if weak, statistically significant difference between both groups is the existence of a Maintenance Fund,[4] with abandoned projects less likely to have established one.[5] During the analysis of micro hydels in operation, it was stated that the establishment of a Maintenance Fund is in many cases not of crucial importance, proved by the fact that a considerable number of small communities have been managing the hydro power plant successfully without having the fund and also those with it often use other sources of funds. This statement is not challenged by the quantitative findings above, as by analysing the qualitative information about the reasons that led to the abandon-

[1] Own estimation.
[2] n = 27. The performance of the staff is calculated on the basis of the assessments of function-bearers of the EMC, (see footmark 2, p. 63) only taking operators and watchmen into account.
[3] The described variables differ between working and abandoned projects with significant levels (asymptotic 2-tailed significance in Pearson's chi-square test) of more than 0.288.
[4] Additionally financial features can not be compared as in many abandoned projects, due to the long period of time passed, no reliable information was obtainable.
[5] Abandoned and working micro hydels differ in the existence of a Maintenance Fund at a significance level (asymptotic 2-tailed significance in Pearson's chi-square test) of 0.083.

ment it is found that the existence of this fund would not have prevented the micro hydel from being abandoned in any community.
The main reasons named by the communities that led to the abandonment, the analysis of the lifespan of the projects and the availability of 'alternative' electricity are summarised in Table 6.

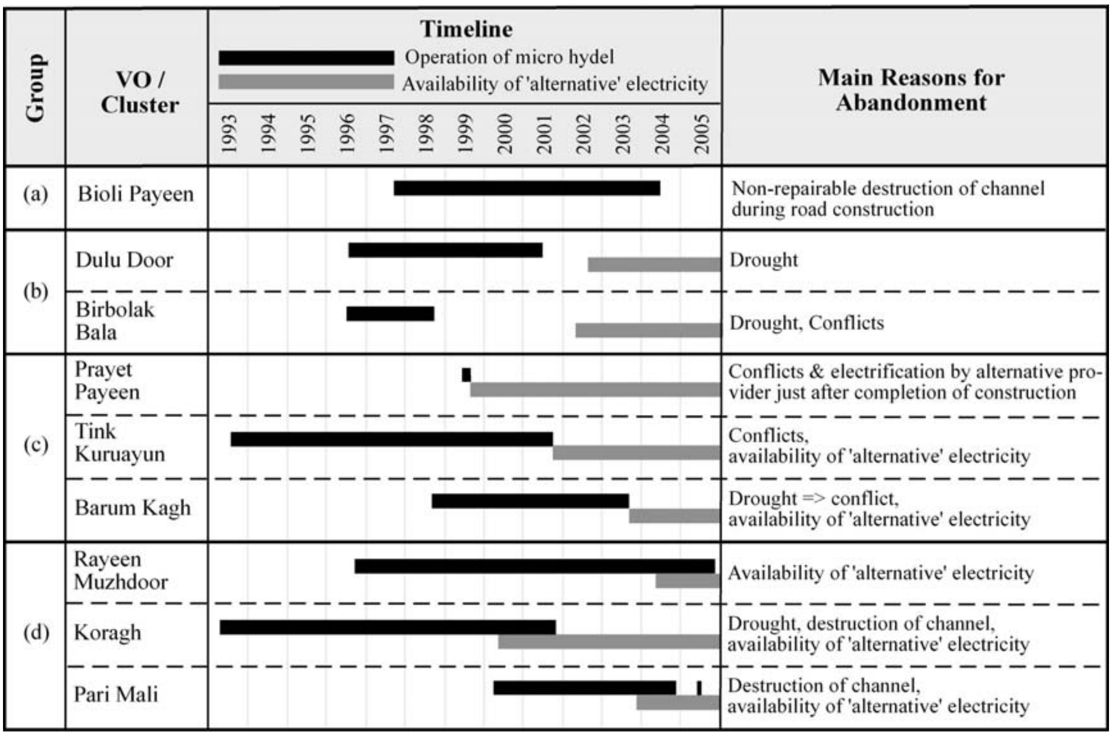


Table 6: Lifelines of Abandoned Micro Hydels
Source: Own field data, 2005.[1]

In spite of the similarities between working and abandoned micro hydels, one feature differentiates both groups significantly and that is the existence of external factors most often either through natural hazards (1) or derived from the availability of 'alternative' electricity (2).

(1) As we have seen in the previous part of the study, micro hydels in Chitral are strongly physically vulnerable to natural hazards destroying the channel and the grid. But as shown in Section 4.2, water is a major risk factor in another way too, making droughts a serious problem in Chitral. Almost half of the abandoned micro hydels visited were affected by long-lasting severe water shortages in a way that, in the end, electricity was only available by load shedding, if at all.
As stated in Section 7.1.1, the transition from resource scarcity to a situation where the resource base is substantially destroyed is fluent. In this case, for example due to a drought, the light is getting dimmer and dimmer and the benefits for the households diminish, resulting in a deceased willingness to bear the costs for self-organising. Depending on the strength of the institution within the village, either the community will

[1] The lifelines of the availability of 'alternative' electricity only take the connection into consideration; downtimes are not considered.

use the micro hydel for a period of time and then commonly agree to stop the operation as it is not feasible any more, or conflicts will arise.

(2) However, as can be seen in Table 6, linked to the occurrence of droughts is often the availability of 'alternative' electricity. While around one-third of the communities operating a micro hydel are connected to another provider, in almost all abandoned projects electricity is available. Taking a look at the lifetimes in connection with the availability of 'alternative' electricity, the projects can be divided into the four groups (a) to (d).

(a) The VO in the first group is the only visited project where the community members are now living in the darkness; thereby the intervention of an alternative electricity supplier was not involved in the process of abandonment. The same applies for droughts; however, another external factor caused the abandonment – namely the non-repairable destruction of the channel during a road construction (see Box 10).

Box 10:
Improving a Road and Destroying the Channel – VO Bioli Payeen

When the Government improved and widened the road in Bioli Payeen, the channel was damaged in way which makes it – according to the village representatives – impossible to be repaired. The community was compensated for the destruction and now waits for the electrification by SHYDO, who has already erected the poles.

Interviewees:
Manager, operator, member of EMC.

(b) The second group comprises communities that are now electrified by alternative providers. However, as the villages had to live in darkness for a certain amount of time the electricity alternatives did not play a role in the abandonment. The reason for stopping the operation of the hydro power schemes was a severe shortage of water, making lighting without additionally using kerosene impossible. The existence of general conflicts, whose impact on the sustainability of the projects has already been identified in Section 7.2.3, further facilitated the decision to close the micro hydel.

(c) In the third group, the abandonment of the community-managed micro hydro power plants directly passed into an electric connection from other providers. Like in the previous group, the projects were heavily affected by droughts diminishing the benefits, and/or by general conflicts increasing the costs for self-organising. Nevertheless, in

Box 11: Conflicts and the Coming up of a Way Out – VO Tink Kuruayun

After the completion of the micro hydel in 1995, the management of the project worked quite well for the next five years: People paid their bills regularly and no larger repairs were necessary. In 1999 a major conflict within the village arose: On the one side the two households that own the land of the powerhouse and the channel which they had provided the community without compensation and on the other side the manager and other members of the EMC. The exact reasons of the conflict, which had the result that people even today do not talk with each other could not be clarified as both interviewed conflict parties had their own version of the story. The result of the conflict, derived from personal jealousies and inter-cast tensions, was that the management of the micro hydel changed and from 1999 on the two households with the property rights managed all affairs. Their performance can be seen in the amount of debts. At the time of the change they had Rs. 3,600; two years later the total outstanding debts of the consumer excelled Rs. 22,000. Fewer and fewer people paid their bills, also because the construction of the private mini hydro power plant in Ayun was in progress. When the community was electrified by that electricity, people did not hesitate to close their hydel.

Interviewees: Manager, landowner, operator, member of EMC.

contrast to the previous group, the relation between cost and benefits seemed to be worthwhile for the communities to operate the project. However, at the point of time an exit option for this unfavourable ratio was available in the form of electricity supply of an external provider, the community commonly opted for it and ended the project.
Noticeable is the case of VO Prayet Payeen, as its micro hydel was abandoned after having been operated for just three months. This case impressively demonstrates an unfavourable allocation of resources derived from a lack of coordination and dialogue between the different actors in the energy sector of Chitral, outlined in Section 4.5.
(d) The last group comprises communities that used the micro hydel electricity parallel with that of other providers for a certain amount of time until the VO/Cluster finally decided to stop the operation of the scheme. These communities have therefore been in a comparable situation that around 30% of the working projects are currently in, namely the simultaneous availability of electricity from the community-managed micro hydels and from other providers (Section 7.1.2). Figure 20 compares the ratios of 'single- and 'double-connected' users in working and abandoned micro hydro power projects at the time of abandonment.

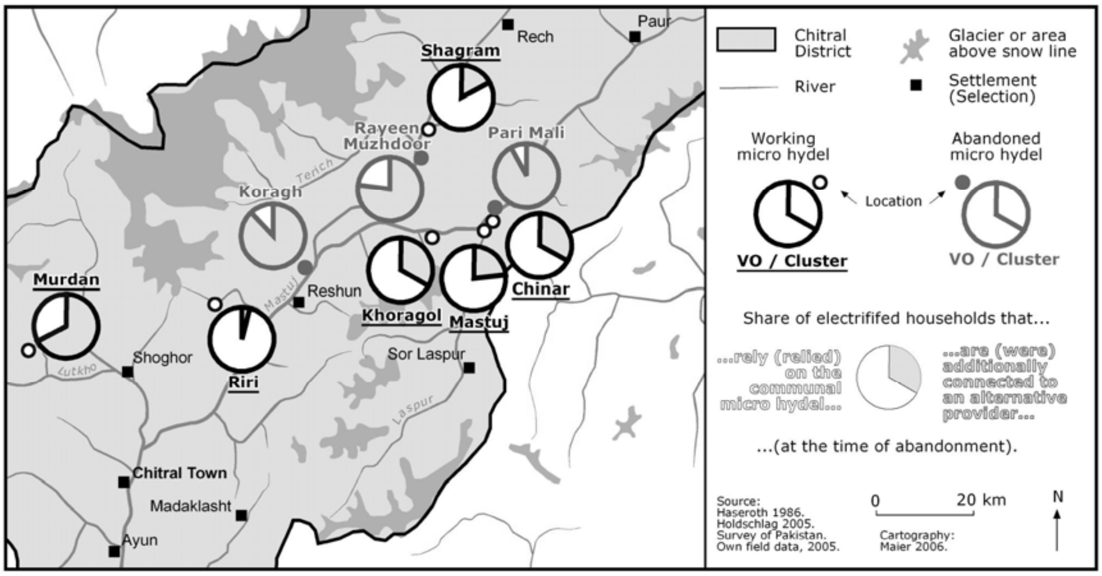


Figure 20: Sampled 'Double-Connected' Community Organisations
Source: Own presentation.

As seen from Figure 20, in all abandoned projects at the time of abandonment more households were using two sources of electricity compared to those relying on the communal micro hydel. In all working projects 'double-electrified' households are in a minority, with the exception of Cluster Murdan, where the 'alternative' electricity is characterised by an extraordinary level of unreliability.[1] This finding does not suggest that a majority of households that receive electricity from two providers is necessary to shut down a micro hydel, as the facts presented above (group (c)) have indicated that micro hydro power plants are also abandoned by communities when alternatives are only in sight. However, in cases where the micro hydro electricity is, either due its high

[1] Two-thirds of the micro hydel electricity consumers in Murdan are additionally connected to the hydro power scheme in Garam Chashma (see Figure 4, p. 17), which in 2005 provided electricity for less than three weeks (Own field data, 2005; Interviewees: President, manager, secretary, member of EMC).

power or the alternative's low quality, a true alternative, a majority of double-electrified households seems to be necessary for the abandonment.

Thereby the question raised at the end of the Section 7.1.2 about the impact of electricity alternatives on the sustainability of the projects can be answered. In the majority of visited communities the availability of electricity alternatives was the main reason that led to the abandonment. Unless the majority of households decide to keep the micro hydel as the only source of electricity, the project will be given up.
Projects that are 'double-electrified' are thereby especially vulnerable. Further external factors like natural hazards in the form of droughts destroying the resource base and diminishing the benefits deriving from the projects will cause more and more people to opt for additionally supplies. At a certain point of time the costly maintenance of regulating institutions will not be supported by the majority of consumers and the whole project will be stopped.

The consequence is that the respective communities have to cope with the unreliability of the 'alternative' supply.

Box 12: Abandonment in Stages – VO Pari Mali

In November 2003, VO Pari Mali was connected to the SHYDO hydro power plant in Reshun and the majority of the community members took a connection. Both systems were used parallel until November 2004, when the VO finally decided to close the micro hydel and use it as a 'spare' plant. In April 2005, a downtime lasting one month prompted the community to again take the micro hydel into operation and bridge the power failure. After the electricity supply from SHYDO was reinstalled, in July 2005, a flood destroyed the channel of the once-again not operating micro hydel. As at this moment no direct dependency on the project existed, the repair of the channel – which would last several weeks – was not taken up. During the next power failure the community will therefore not be able to fall back on their micro hydel.

Interviewees: President, manager.

VO Pari Mali has tried to cope with this dilemma by declaring their micro hydro power installation a 'spare hydel', which means that it will only be brought into operation in cases of longer downtimes of the alternative provider (see Box 12). Nevertheless, this example demonstrates that while the latter strategy can work quite well under 'normal conditions', in case a major input from the community is required to preserve the standby mode of the 'spare hydel', the community is not easily motivated, especially if the 'alternative' electricity has been relatively constant recently. Therefore the success of the intention of VO Rayeen Muzdoor, which is planning the same, should not be regarded too optimistically in the long term: Taking the micro hydel into operation, finding a temporarily operator and charging consumers is more easily organised than long-lasting repairs in anticipation of a possible future requirement.

Concluding the observations of abandoned micro hydels, it becomes obvious that in the end no project was given up without the intervention of an external electricity provider or other effects from outside, either in the form of droughts or human impacts both taking away the possibility of generating a sufficient amount of electricity.

9 Conclusion

By applying Hardin's thesis to community-managed micro hydels, rural decentralised electrification by means of collective action would fail in the long term as consumers would act selfishly and not jointly operate and maintain the system in a sustainable manner. As seen in the case of hydro power projects in Chitral, communities however are able to set up institutions that govern the use and ensure the maintenance of the plants and that in many ways function better than state- or private-based models. However, all projects suffer from similar problems, derived from a mismatch between the institutions and the characteristics and demands of the system. The billing policies seldom differentiate between different levels of electricity consumption, which results together with other reasons in poor control mechanisms of banned appliances, the project are running unprofitably with too little revenue generated to cover the depreciation and the personnel employment processes are problematic as they often prevent the communities from sacking staff.
However, by analysing the reasons that lead to the abandonment of projects, it becomes obvious that the accruing of external factors like natural hazards destroying the complete resource base or exit-options through electricity supplies from alternative providers are necessary for a community to shut down the project. The fact that the problems outlined above are on their own not enough to imperil the sustainability of the projects shows the success of the programme and proves that decentralised rural electrification by means of collective action is a worthwhile and feasible approach.

Community-managed micro hydel projects in Chitral can roughly be clustered into two types. Type I represents relatively small projects, managed by a few people, not having established a Maintenance Fund, and mostly located in Sunni-dominated areas. Type II projects have a larger share of other denominations, a relatively high number of electrified households, more sophisticated rules and organisation structures, higher revenues and a Maintenance Fund. Nevertheless, as seen in many examples, within these groups a wide variation of institutions exits. These institutions were established to govern the use of the micro hydels as appropriate to their characteristics.
As stated in the Oakerson framework, this refers to the technical and physical nature of the micro hydels. Different installations differ in terms of the available electricity, the quality of the construction, the equipment's age, the risk of natural hazards, the size of the scheme in terms of the length of the channel and the extent of the grid, the quality and quantity of the water, the used equipment and its age and many others factors. All these factors have different impacts in influencing the benefit the community gains from the projects as well as the costs it has to bear for the operation and maintenance.
However, a project is not only characterised by differing technical and physical attributes, it is furthermore embedded into a unique social setting. Differences in the number of electrified households, distinctive religious and ethnic-linguistic settings, different numbers of clans with varying relationships, socio-economic heterogeneities, personal jealousies and conflict potentials make different demands on the regulating institutions.

As the institutions are set up by the community to cope with the demands of the projects, the variation in communal and physical characteristics is reflected in the variation of institutions.

Thereby emerges an important consequence for future attempts at decentralised rural electrification by means of collective action. In spite of the shortcomings outlined above, it is of essential importance to enable communities to set up their own institutions instead of imposing external blueprints of how the project should be managed. Uniform institutional instructions would not match to the varying characteristics of the project and therefore barely be accepted by the communities.

However, this is only one side of the coin. Successful decentralised electrification by means of collective action is not only about allowing communities to set up their own institutions, it is furthermore about enabling them to do so. This requires three conditions:

Firstly, the communities need to take ownership of the projects even before construction by involving them in the planning process, by precisely imparting the exact divisions of responsibilities and by demanding their contribution to the construction.

Secondly it means scaling down the technology of hydro power to a level that villages can deal with, by using locally manufactured parts, establishing repair facilities and providing thorough and repeated trainings but also through regular consultation and technical support.

Finally, enabling villages to establish institutions requires endeavours for guarding the community institutions from imperilling external factors occurring from either natural hazards destroying the resource base or exit-options resulting from the connection to alternative providers. Solutions can on the one hand be provided by comprehensive technical feasibility surveys, on the other hand seen through an improved communication with other actors in the energy sector and the seeking of an integrated energy policy for rural development at the regional and national level.

In compliance with these prerequisites, the approach of decentralised rural electrification by means of collective action can make a considerable contribution to solving the developing world’s energy problems.

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