COMBATING DESERTIFICATION IN TURKMENISTAN ON THE GRASS ROOTS LEVEL EXAMPLE OF THE CENTRAL KARAKUM DESERT

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COMBATING DESERTIFICATION IN TURKMENISTAN ON THE GRASS ROOTS LEVEL EXAMPLE OF THE CENTRAL KARAKUM DESERT

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Acronyms and Abbreviations

ADB	Asian Development Bank
CIS	Commonwealth of Independent States
DAAD	Deutsche Academische Austauschdienst (German Service of Academic Exchange)
DRI	Desert Research Institute
ESCAP	Economic and Social Commission for Asia and Pacific
FSU	Former Soviet Union
GDP	Gross Domestic Product
GIS	Geographical Informational System
GL CRSP	Global Livestock Cooperation Research Support Program
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
IMF	International Monetary Fund
NAPCD	National Action Plan to Combat Desertification
NIDFF	National Institute of Desert, Flora and Fauna
ODI	Overseas Development Institute
PRA	Participatory Rural Appraisal
p/a	Peasant Association
TACIS	Technical Assistance to Commenwealth of Independent States
TSSR	Turkmen Soviet Social Republic
UN CCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
USAID	United States Agency for International Development
USSR	Union of Soviet Social Republics

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Preface

Considering the year 1996, when Turkmenistan joined the United Nations Convention to Combat Desertification, as a starting point in developing a new strategy of management of desert resources, the present thesis analyses the progress that has been made in this field. For the country where desert occupies more than 80 % of the total territory desertification control activities are important condition for ensuring safe livelihood of desert inhabitants, profitable and rational desert animal husbandry, and harmonious use of desert resources. The United Nations Convention identifies desertification as a complex problem with social, economic, and environmental components. Using an example of case study in the Central Karakum Desert of Turkmenistan this thesis describes the interconnection of the social, economic and environmental dimensions which are decisive for the development indicators of local communities. One should not understand desertification as a pure sand invasion processes, it encompasses much broader process of land degradation and occurs not only in desert areas but also within irrigation land and mountains. The consequences of desertification are as diverse as its causes; this paper describes both of them. It indicates the present status of desertification problem in the country using the existing scientific investigations of the National Institute of Deserts, Flora and Fauna of Turkmenistan. The perception of people identified as “affected” towards the desertification problem is revealed.

The question of changing socio-economic conditions of the country and the role of agricultural reforms in management of the desert resources is addressed in the thesis. Attention is given to methodological aspects with emphasis on innovative participatory approach in Turkmenistan. Participatory Rural Appraisal is a core methodological element in research and, simultaneously, is a subject of investigation. Desertification control activities initiated through participatory actions are in the focus of this research paper. Asset of knowledge and experience accumulated during several decades of intensive environmental study by foreign development agencies dictates a new strategy in the management of natural recourses. Holism and complexity of problems are opposed in the research to a specialisation and disciplinary approach. Geographical, botanical, historical, economic, and social elements are included in the research. Together they contribute to a puzzle of rural development in general and desertification problem in particular.

The thesis makes use of many-years experience of the National Institute of Deserts, Flora and Fauna of Turkmenistan in desertification control activities and worldwide experience of partic-

ipatory approach of German colleagues. The paper presents both quantitative and qualitative data on environmental, social, and economic situation in the research area. It also reveals certain limitation of participatory approach and the challenges which can be met on different levels of the society. The research suggests recommendations for development workers and policy makers on choosing an effective strategy in desertification control.

1 Introduction

1.1 Brief History of Research

The work on the Doctoral thesis started early in 1998, as the author was engaged in a Turkmen-German Technical Co-operation Project "Participatory Management of Pasture Resources in the Central Karakum" carried out by the Desert Research Institute in co-operation with the German Agency for Technical Co-operation (GTZ). By that time, the author worked at the Desert Research Institute (DRI)[1] in the Laboratory of Remote Sensing and Monitoring of Desertification after finishing the Faculty of Natural Sciences of Turkmen State University in 1996. In early spring 1998 a project team including the author made a first trip to the project area in the Central Karakum Desert, which has been chosen to test the participation of local people in the activities of desertification control. During the first appraisal mission together with German experts from the Consultative Agency GEOPLAN and Turkmen colleagues from the DRI, the author had her first experience in applying participatory tools. Later in 1998, the author was awarded with a Scholarship of German Academic Exchange Service (DAAD), giving the chance to prepare the scientific work with a partnership of Geographical Department of Cologne University in the framework of Sandwich-Program.

As the author decided to work on the Ph. D. thesis with the collaboration of German scientists, the idea of the subject of the thesis was already clear. The author wanted to analyse the first experience of testing popular participation in the field of desertification control in Turkmenistan. The issue of grass roots participation in solving the different environmental and social problems, the enabling and empowerment of local people has a long tradition in foreign academic institutions and development agencies. The countries of post-Soviet Asia remained a "white spot" on the map of people-oriented developing projects. This fact makes the work on the thesis more challenging and experimental because of the lack of related experience and publications in Turkmenistan and other Central Asian countries.

Sandwich Program of the DAAD involves the work in both the home country Turkmenistan and the country of the host University of Cologne, Germany. The choice of scientific supervisors from both countries was not casual. Prof. Dr. Agadjan Babaev, former Director of the DRI and present Head of the International Center of Aral Rescue, world-famous scientist in the field of desert studies, the author of large number of scientific publications and editor of the

1. Since February 1998 is a National Institute of Deserts, Flora and Fauna of the Ministry of Nature Protection of Turkmenistan

periodical journal “Problems of Desert Development” issued by the DRI. Prof. Dr. Bernd Wiese is a professor in the Geographical Institute of the University of Cologne and a scientist with long experience as consultant for development projects, the author of many publications on development in Africa.

The main objective and methods of work were defined and agreed with both scientific supervisors at the very beginning. The main objective remained intact throughout the research. In the course of the work on the thesis, some idea were reformulated and readjusted, the table of content underwent a number of alterations to reflect the concept of the thesisthe best way. Close study of foreign projects experiences, using PRA in environmental protection, negotiations with foreign colleagues who kindly shared their knowledge with the author, and author’s own experience, obtained during empirical investigations deepened the understanding of the subject.

The work on an absolutely new subject was not the only challenge for the author. It also opened up a new kind of work, communication and communication and strengthened the ability to integrate into new social and cultural settings, to liberalize views, and open new possibilities for future self-development.

In view of the temporary closing of the High Attestation Board of Turkmenistan, it was decided to submit the Doctoral thesis to Cologne University. After negotiations and numerous arrangements between DAAD, the Akademische Auslandsamt Köln, Mathematics-Natural Siences Faculty of Cologne University, the offcial consent from the Mathematics-Natural Siences Faculty to submit a thesis was obtained in 2001.

The work on this thesis could be generally split into two cycling phases: the phase of information collection, including field trips in the research area, interviews with representatives from various state organisations, discussions with colleagues from the NIDFF in Turkmenistan; and the phase of analysis, which occured in Germany, included analysis of obtained informations and work with literary sources on the experience of participatory approach. In total, the author spent 27 months in Turkmenistan and 22 months in Germany, working on the thesis.

As the language used during the course of the research varied from Russian and Turkmen in Turkmenistan to English and German in Germany, it was decided between the author and two of her supervisors as well as DAAD and Mathematics-Natural Siences Faculty of Cologne University to use the English language for the writing of the thesis.

1.2 New Methodological Concept

The concept of people/problem-oriented research started to develop in the early 1970s in foreign academic institutions as an alternative to the narrow conceptions of the traditional approach and underwent a long evolution and transformation. While the foreign scientists were applying the community-based approach, working directly with the people on the grass roots level, Soviet science kept adhering to the sectoral approach and rigid disciplinary division. Till present days, environmental sciences did not involve the holistic and interdisciplinary approach in their research practice. In Turkmenistan, like in other Central Asian republics, involvement of communities in the scientific investigations is a new working concept, which only recently found application in the few experimental researches.

Independent status of Turkmenistan dictated the new rules of integration in the international community. The country has to perform independently on the international scientific stage. Independent Turkmenistan has ratified a number of International Conventions. The most important of those for the Desert Research Institute were the United Nations Convention to Combat Desertification (CCD) and the Convention of Biological Diversity (1996). Joining the CCD has brought a possibility for Turkmenistan to become integrated into the world science as a newly independent state, to find new foreign partners and start new projects.

The CCD is a second attempt after the failure of the Plan of Actions in 1977, undertaken by decision-makers and scientists to solve the problem of desertification and poverty on the global level. Almost 10 years ago, in 1992, in Rio-de-Janeiro a new strategic approach emerged – enabling people, affected by natural and social problems, be involved in preparation and implementation of activities to solve these problems and thus influence the decision-making process. Earth Summit supported the approach of participation and stressed it as a core concept of the Convention to Combat Desertification, which has “breaks new ground by ensuring a bottom-up approach in international low” (Lean, G., 1995).

In 1996 after ratifying the CCD, a group of Turkmen scientists the from the DRI elaborated the National Action Program to Combat Desertification in Turkmenistan (NAPCD). The Program was developed on the agreement between the DRI and UNEP and was financially supported by UNEP. The NAPCD meets all the requirements of modern, ecologically sound and “sustainable” scientific work. It outlines the necessity of new approaches, the participation of non-governmental organizations, women’s organizations, young people and people who depend on the desert lands and their resources. Based on long years of experience, the scientists

gave an overview of the current situation of desertification in Turkmenistan, its natural and anthropogenic causes, the strategy of desertification control and proposed the solution measures for high priority ecological problems in the country.

The concept of the participatory approach has been tested in different developing countries for almost three last decades. It was enough time for creation a solid theoretic and practical basis of participatory approach. Therefore, saying "a new concept", the author means a novelty of the concept for Turkmenistan. Traditionally, only the scientists and politicians have rights for definition and management of environmental problems. For the scientists environmental problems are the subject of research on the local and regional level and for politicians they are the matters for developing of national laws and programs. The people, living in affected areas, are not involved in any level of environmental problems management. Therefore, definition of problems by the scientists and strategy to solve them chosen by the decision-makers do not always coincide with opinions and wishes of people affected by these problems. The novelty of the thesis is allowing people to express their own view on problems, which concern them. Participatory approach being, in essence, sociological methods, is a necessary and composite block in the structure of any development projects. The reality and problems of participation process will be examined in the chapter 2.

1.3 Objectives of the Thesis

As revealed in the title, the overall objective of this study is to find methods to combat desertification through the involvement of local communities. This goal has a double composition. First of all, to test the applicability of participatory tools under the socio-economic conditions and cultural traditions of Turkmenistan. This is the more technical part of the research. Secondly, to find a better strategy for combining desertification control activities with a participatory approach. The second part is represented by the analysis of participatory activities and the possibilities and constraints of a participatory approach in Turkmenistan. The new strategy will be applied within a peasant association, the Yerbent, which is located in the Central Karakum desert.

Combining methods from the social and natural sciences the thesis will try to reveal links between the specific ecological conditions of the research area and the way of life and the economy of its inhabitants. Through the attitudes and opinions of the local people, this research will bring to the open discussion the issue of the joint impact of ecological, socio-economic and cultural factors on the environment. The issue of the impact of the changing socio-economic conditions on the desert environment is also the focus of the thesis.

One of objectives of the thesis is to describe traditional methods of native desert dwellers for co-existing with the desert. This will be closely linked by considering the cultural and historical aspects under which the community of desert people has been formed. Using the methods of a participatory approach, this thesis will show the knowledge of local people of the terrain. This study will also reveal the many constraints to applying participatory methods in Turkmenistan. What are the priorities of desert inhabitants , do they coincide with the interests of scientists and decision-makers? All these questions are included in the thesis.

Formulating the objectives in a more specific way, they can be presented as the following:

- To test the applicability of participatory methods.
- To reveal the attitudes of the local people towards the environmental situation in the research area.
- To analyze the effects of the national policy of the country on the lives of desert inhabitants.
- To examine the historical and cultural preconditions and their influence on the modern lives of desert inhabitants.
- To formulate recommendations for a better strategy of desertification control at the grass roots level

1.4 Overview of the Thesis

The author has divided this study into seven chapters with each of the chapters corresponding to the different stages of research.

Chapter 1 “Introduction” contains information on the background of the research and its objectives. Chapter introduces readers to a conceptual of the research.

Chapter 2 “Methodology” explains the methodology used in the thesis. In analysing existing research, this Chapter discusses the advantages and shortcomings of participatory approach. Descriptions of the participatory tools used in the research is also given in this Chapter.

Chapter 3 “Economic Development and Environment” is aimed at revealing some of the broad socio-economic and socio-cultural settings, which are behind the problem of desertification in Turkmenistan. Economic and social marginalization is an attribute of the transitional process that has important impact on social groups and the livelihood of the people. Chapter 3 studies the evolution and transformation of the Turkmen rural desert society over the last two centuries.

Chapter 4 “The Impact and Consequences of Man and Nature on the Desertification Processes” contains the information on the geographic features and current socio-economic situation in the research area. This Chapter touches on the issue of demography and migration. This part of the thesis discusses the problem of the impact of economic activity on environment in the research area, and reveals the opinions of the local people concerning this problem. Chapter 4 analyses livestock husbandry and firewood collection as the major human cause of desertification in the desert area.

In Chapter 5 “Control of Sand Encroachment” readers can find a description of garden planting and stabilisation of moving sands carried out by a Turkmen-German Technical Co-operation Project. Together with technical information this Chapter also gives a closer look at the local people involved in the project’s activities.

Chapter 6 “Possibilities and Constrains of Mass Motivation and Participation” focuses on the applicability of participatory methods to the conditions of Turkmenistan. It shows the results of using different participatory tools in the research area. This Chapter reveals the area of risk for participatory activities and discusses the missing links between a relatively successful application of participatory tools and failure of realisation of participatory concept. This Chapter discusses a diversity of challenges and constraints for the applicability of participatory concept on the different administrational levels of society. A typology of participation accordingly to the definitions of scientists is also discussed in the Chapter 6.

Chapter 7 “Comparative Analysis: Experience of Turkmenistan, Mongolia and Israel in Combating Desertification” gives an analysis of the experience of desertification control the in Mongolia and Israel. Through a comparison of the environmental and socio-cultural settings of these countries, Chapter 7 highlights the specificity of the problems in Turkmenistan and identifies possible methods for an exchange of experiences.

Chapter 8 “Conclusions and Recommendations” summarises the author’s experiences of the applications of participatory concept to control desertification gained through her individual research and work with the Turkmen-German Technical Co-operation Project. This final Chapter gives general recommendations for better strategy to promote participation of grass roots level in desertification control activities in Turkmenistan.

1.5 Connection with a Project "Participatory Management of Natural Resources in the Three Pilot Areas in Turkmenistan"

The research is planned in co-ordination with the Turkmen-German Technical Co-operation Project "Participatory Management of Natural Resources in the Three Pilot Areas in Turkmenistan" (see Fig. 1 and Table 1). The project's overall goal is to improve the living conditions of the people in the research area. The long-term project's purpose was formulated as follows: in view of promoting the implementation of the UN Convention to Combat Desertification, the population as well as local decision-makers in the pilot areas have improved their self-help potential in a joint learning process of all actors and are now empowered to make use of it.

The project is based on working together with the families and local administration at the grass roots level. It is principally process oriented; its dynamic is determined by the people. This means that not only the results of the implemented resource management measures are important, but also the processes of sensabilisation, awareness creation, planning and management of the activities which lead to these results are important.

The project is a response to the UN Convention to Combat Desertification which was ratified by Turkmenistan in 1996 and therefore, the project is based on participation at the grass roots level. The Desert Research Institute of Turkmenistan was assigned as a direct executive body of the UN Convention. The scientists of the Desert Research Institute elaborated the National Actions Plan for Turkmenistan. The project started its activities in 1997 in the Central Karakum Desert and after three years of work extended its work to two more areas in Turkmenistan. The author of the thesis has worked with the project since the beginning of its planning and implementation.

Since the beginning of project, the German consultants have conducted seminars for the scientists of the Desert Institute on the common principles of participatory appraisal, project planning and gender approach. On-farm activities started in late 1998 after the team of Turkmen scientists together with their German colleagues conducted appraisal mission in Bahkardok village. Since then, the author started collecting data for this doctoral thesis. Besides carrying out regular project's activities, the author also planned and conducted supplementary research touching upon the different social and cultural aspects of the local people. While the Turkmen-German Co-operations project management had the task of giving technical and financial support thesis tries to have scientific insights of whole situation on the grass root level which has formed within the certain social, economical and cultural nexus. Both the Turkmen-German Technical Co-operation Project and this research paper have benefited from their mutual co-operation.

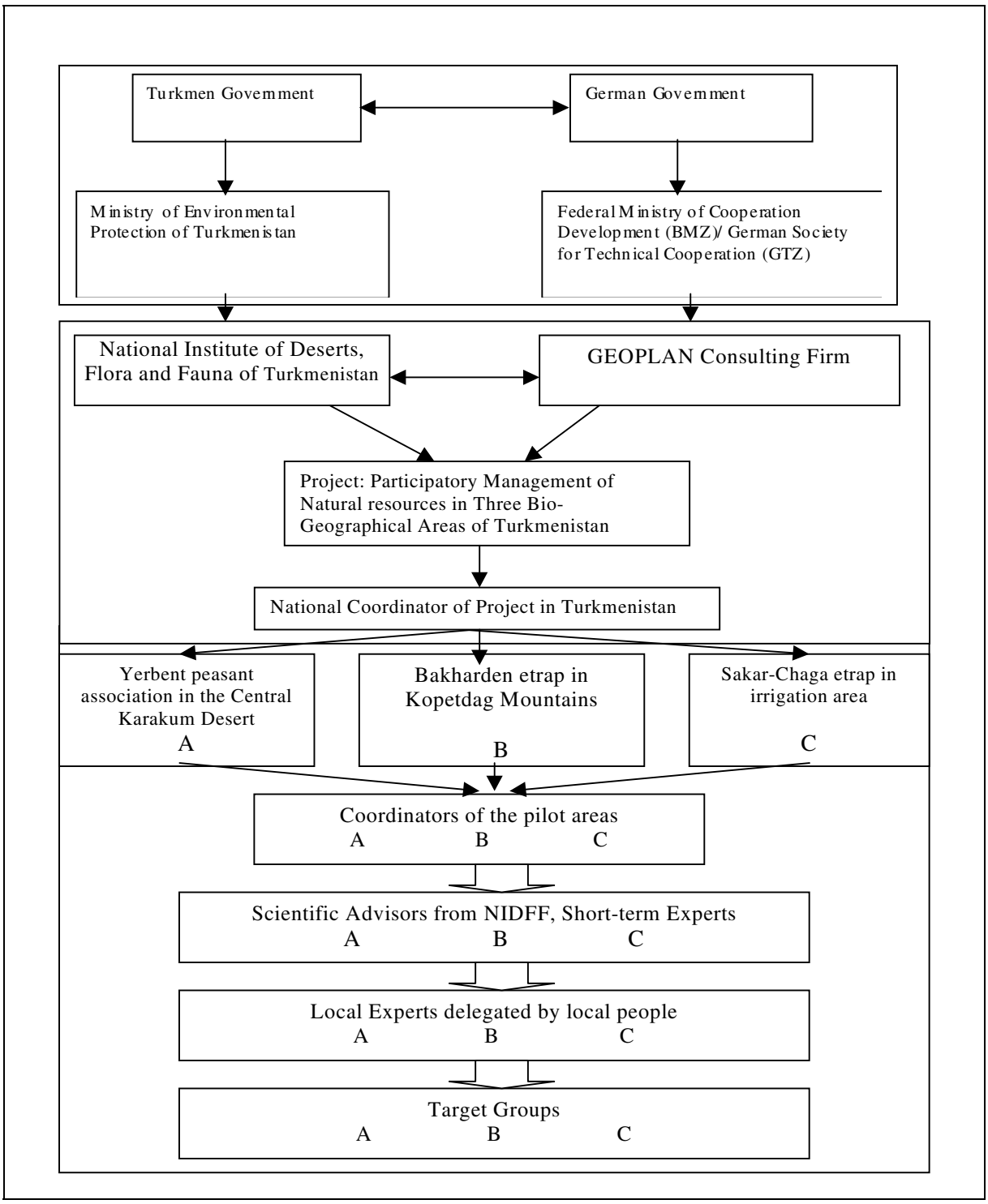


Figure 1: Administrational Structure of the Turkmen-German Technical Co-operation Project: Participatory management of natural resources in three bio-geographical areas of Turkmenistan

Composed by the author, 2001

Table 1: Comparison of Principal Objectives and Methodology of Doctoral Thesis and Cooperation Project

Objectives of Doctoral Thesis	Objectives of Cooperation Project
• Test participatory approach through the activities on desertification control • Recommend better strategy for desertification control on the grass roots level • To analysis effect of historical and cultural dimensions and modern national policy on behaviour of local people	• Improve living conditions of villagers • Control desertification processes
Methodological tools	
• Interviews, transects, observations • Geo-botanical survey • Historical and cultural survey	• Interviews, transects, observations • Seminars, meetings

Composed by the author, 2001

2 Methodology of Research

2.1 Overview of Participatory Methods

Participatory Rural Appraisal (PRA) originated in the early 1980-s when external practitioners first applied innovative approaches to development on the local level in rural areas of developing countries. Later, this approach was extended to urban development projects. The definition of PRA varies from author to author (Schönhuth, M., Kievelitz, U., 1994; Hagmann, J., 1997). The definition by Rietbergen-McCracken and Narayan (1998) is, in the author's opinion, one of the most comprehensive:

Participatory Rural Appraisal – an approach (and family of methodologies) for shared learning between local people and outsiders to enable development practitioners, government officials and local people to plan together appropriate interventions.

PRA evolved from a series of qualitative multidisciplinary approaches to learning about local level conditions and local people's perspectives including Rapid Rural Appraisal and Agro-ecosystem Analysis. The pioneers of PRA development have been non-governmental organisations and agricultural research agencies and in recent years the World Bank and other donors have begun to adopt PRA-type methods in their work.

With time, different scientists practicing innovative approach have introduced a broad spectrum of branches to participatory methods. All of them include four principal steps of participation:

- a participatory survey or appraisal of local conditions,
- enabling local people to plan curative strategy,
- implementation of the strategy,
- participatory analysis of the activities and assured follow-up of the project.

PRA began as an alternative methodological approach to a narrow disciplinary approach which dominated in the 1970s and 1980s. But lack of success in desertification control after the introduction of the Plan of Actions of the UN CCD in 1977 encouraged scientists to foster new approaches which involved community participation in the process of development.

PRA emphasises the revival of traditional knowledge about the rational use of natural resources. Participation which is oriented more toward the behaviors, attitudes and beliefs of the local people amplifies their confidence and empowers them to influence to decision-making

process (Slocum, Wichard, 1995). The whole implementation of the project activities is based on the willingness and ideas of the local people who directly involved in the project. External scientists take on the role of facilitators and the project itself provides logistics and financial expenses. Activities proposed and planned by the local people are implemented by them. The reassurance of the follow-up of the project is based on the idea if self-benefit of the local people. Hence, on the basis of long-term investigations, development in one particular area can be accomplished.

The general guidelines and project cycles are the same for different geographical and social background. In practice, the developing projects can face different conditions in a research area and therefore, have to be flexible and adapt to the local conditions. Hence, the process-oriented character is a core element in participatory processes.

2.2 Shortcomings of Participatory Methods

Having started in the early 1980-s Participatory Appraisal Methods have passed different stages of establishment, euphoria, experiments and adjustments. The 1990-s were marked by a stage of critical analysis of participatory methods. External practitioners and donors have come to understand that the concept of participation is not always a panacea from social and environmental problems and that as a method it has number of limitations and constraints, because the results of the process of participation are greatly influenced by individual biases and prejudices (Kumar, K., 1993).

One of the bottle-necks of the participatory method is the problem of communication, that is, to set the dialogue and gain the trust of the local people. This is a main challenge hidden in the concept of participation. Participation by its nature of voluntary activity is a complicated and fragile process. The emphasis is on “voluntary” because the activity dictated to the local people by outsiders will never assure the sustainability of these measures as well as their follow-up. Under certain conditions the different kinds of incentives could serve as a motivation for local participation.

The application of participatory methods should be considered carefully with respect to the cultural, historical and socio-economic background of the region it is being applied to. This creates certain limitations for the scientists and development projects. The planning of the project and the tools used vary from country to country. Participatory methods are always time-demanding. A participation process should not be considered as being only interviewing, drawing and singing. Sustainable participatory actions take a long time to be achieved, includ-

ing regular work of internal and external experts working on the different aspects of local life. In other words, participation promotes the readiness of the local people to solve their problems and the support of decision-makers in enabling the local people to do so. Therefore, any development project oriented toward participation should be reaffirmed by a follow-up.

As any middle and long-term activity project, oriented toward creating people's self-capacity, these projects need sufficient financial support. Participatory activities demand technical and logistical support and high mobilisation of mental resources. Whilst for a one-sided research a group of specialists from a narrow field of science is enough, for participatory methods a research group requires recruiting a wide range of multi-disciplinary specialists depending on the principle objectives of the project: anthropologists, sociologists, economists, geographers, physicians. Only with such a wide team of specialists can the problems of the region be fully embraced and understood. The findings to a great extent depend on the individual abilities of external experts to communicate, to listen to the people without imposing their opinions and to ask relevant questions to guide the course of the interview (Waters-Bayer, A., Bayer, W., 1995).

While keeping in mind both the advantages of participatory approach over the conventional researches and its disadvantages, the author will apply participatory methods in Turkmenistan. Next chapter will describe the tools of participatory methods that have been chosen accordingly from the variety of methods so as to take into consideration the historical-cultural and socio-economic background of Turkmenistan.

2.3 Tools of PRA Used by the Author

Participatory methods were applied in several villages within the research area. One of investigated village is a big most inhabited settlement with water and electricity available and with a location on the highway. Another small remote villages and settlements with worse infrastructure were chosen for comparison and better embracing situation in one farm association.

Interviews

Interview – the most popular tool – was used most intensively in the research. Interviewing has shown itself as a very appropriate way to communicate with deserters. The author was equipped with a first theoretical knowledge of interviewing during the workshop organised in the NIDFF by the German consultating firm GEOPLAN. The following fieldwork allowed to test obtained theoretical information on practical activities. Further on the author have extended knowledge and experience in interviewing during the next field trips and discussing the prob-

lems of this tool with the colleagues in Germany. Here should be noticed the lack of topically relevant indigenous research which the author could refer on.

Interviewing is the shortest way to obtain the information and people opinion and it proved to be one of the most useful tools of PRA with a local tradition. Inhabitants of desert who though, mostly literate possess stronger verbal culture and, so had not so much difficulties with interviewing (cf. Leyland, 1992b). Indeed, they prefer to explain the situation, which they are questioned about hesitating to draw or to use some other materials like stones and beans when they are offered or asked to use it. Interviewed people especially of older age and shepherds had ease explicitly express themselves orally. The interviews may have a form of personal stories when the researcher get a lot of information even that what he or she did not asked about, so it is a best way to get a people confidence and trust. With a help of participatory interview with key informants and small groups the general information of area, natural conditions, grazing system, resources use, problems, traditional knowledge can be obtained. Interviews were also used during the work with the representatives of the local administration and colleagues from the Desert Institute.

Interviewing may also have its weak points. It might happen that interview will become just a reflection of the interests of researchers, who want to get a confirmation of problems percepted by them. To avoid it researcher should be attentive to the story of people, not to miss the details, which on the face of it will seem not so important.

Transect Walk

In the study area of the Central Karakum transect walks were undertaken in order to identify different geographical and ecological features of the area, the types of people activities depending on these features, grazing roughs, the availability of water sources, the problems connected with this territory, the dynamics of recourses change, and the opportunities to improve the different parts of area. In this investigation there was almost homogeneous pastorals society which lives and works within homogeneous ecological zone and landscape. Besides, livestock breeding involves a big territory with long distance of migration roughs, therefore to use a vehicle for transect was reasonable though it was no longer *transect walk* rather *transect drive*. Setting up the transect allowed to get general information about desert vegetation and its role for local people and alteration of vegetation.

The transect should try to embrace as many as it can various social micro-zones including settlements, pastures, water points, irrigated areas, roads, pipe-lines. For the study area different objects influencing socio-economic situation are distinguished such as settlements, highway,

water pipe-line, irrigated lands, takyrs, soloncak and bare sand dunes. Therefor, the best way to cover all important social objects and ecological micro-zones, was a transect profile along and across the highway which runs through the Bakhardok village. Socio-ecological transect made together with local informants can be compared with transect of same route made by scientists. This allows comparing the opinions of "insiders" and "outsiders".

Diagramming

Diagrams showed itself as useful tool of participatory approach, which aims to obtain information of different ecological and socio-economical aspects of people life in visual form. This method does not require precise and accurate data, but common information, which helps to get an impression of aspects of people's activities which can be figured. It helps to reveal the interconnection between population activities in different social and ecological micro-zones and seasons of year. Recording the stories of local informants in the form of diagrams provides with demonstrative pictures, which can be subsequently used in the planning and monitoring of projects. The visual form of recording of information can help in revealing the concerns and problematic points. In present research the method of diagram was used to obtain the different kinds of information such as: seasonal calendar for shepherds and people who do not directly connected with shepherding treating their lands.

Mapping

Mapping is another visual tool of participatory methods, which was used in this research. Mapping as well as the diagram transfers the oral explanation to more expressive visual form. This tool is based on the knowledge of local people about the terrain where they live and work. For the shepherds this territory of knowing stretches for many kilometres of everyday routs of their animals including seasonal migration, places of seasonal camps, wells and other water points. In this investigation with help of mapping the plan of households, routes of animals' migration were composed.

Ranking

Ranking (problem ranking, preference ranking, wealth ranking) reveals the priority of problems and preferences of the population or in wealth ranking the local definition and indicators of poverty and stratification of the community by relative wealth.

Tool of ranking can be eased by visual-based techniques of drawing and any kinds of the diagrams. In the course of ranking it was noticed that local people hesitated to use visual techniques as well as during application of diagramming and mapping tools.

Historical and Cultural Analysis

Analysis of historical and cultural aspects can help to understand better behavior patterns and perception of local people, traditional knowledge in resource management, methods of co-existing with desert environment. The author supposes that cultural aspect one of the powerful factor influencing the people behavior. Taking into consideration cultural peculiarities the better methods of Participatory Approach can be chosen for study area. Historical and cultural information was obtained through the stories of deserters and existed literature sources.

Geographical Survey

To be introduce with the natural features of the research area the author conducted geographical survey, which is based partly on existing scientific findings, and own field survey. The geographical overview includes climatic data, the information of relief, soil, vegetation and water resources in the study area. To reveal the degree of pastures degradation in study area association ecological transects were conducted near the investigated settlements together with colleagues from the Desert Institute. The results of these transects gave the actual picture of degradation of pasture vegetation, showed the interconnection with degree of degradation and human settlements. But the ecological transect as well as pure geographical observation can not explain the causative linkage of the problem they reveal. But at the same time the social transects and observations carried out jointly with local informants may contain a personal biases depending on the choice of informants and many other factors influencing the reliability and validity of information and should be, thus, verified by scientific survey. The results and analysis of application of participatory tools are described in the Chapter 6.

3 Economic Development and Environment

Turkmenistan is situated in the westen part of the Central Asia between latitude 38°08' and 42°48' north and longitude 52°27' and 66°41' east. Turkmenistan, a former republic of the USSR, declared its independence on October 27, 1991 and is currently a Presidential Republic. With 488,100 km^2, it was the fourth largest republic of the former Soviet Union. But with the Karakum desert covering about 80 % of its area, the population of Turkmenistan is about 5 million. The average population density in Turkmenistan is 7.4 persons per km^2. The density decreases in the desert making 1 person per km^2. A significant part of the desert is not inhabited. Landlocked, Turkmenistan depends on its neighbors for access to international markets.

3.1 Socio-economical Transformation

Turkmenistan is largely desert with cattle and livestock breeding, intensive agriculture in irrigated areas and huge oil and gas reserves. Its economy remains dependant on central planning and state control, although its government has taken a number of significant steps towards a transition to a market economy.

Rural population prevails, making up 54.2 % of the country's total population. Rapid population growth (13.1 ‰) in Turkmenistan is caused by the high birth rate (18.5 ‰) (see Table 2).

Table 2: Demographic Indicators of Turkmenistan in Trend

	1995	1996	1997	1998	1999	2000
Square	491.2	491.2	491.2	491.2	491.2	491.2
Population	4,480.7	4,587.4	4,710.4	4,846.8	4,993.5	5,200.0
Density	9.1	9.3	9.6	9.9	10.2	10.2
Urban population	45.2	44.9	44.5	44.5	44.7	45.8
Rural population	54.8	55.1	55.5	55.5	55.3	54.2
Birth rate	28.3	24.2	21.6	20.8	18.5	18.5
Population growth	21.3	17.1	15.1	14.5	13.1	13.1
Mortality rate	7.0	7.0	6.5	6.3	5.4	5.4

Source: Human Development Report 2000. UNDP. Turkmenistan

Other indices of well-being are unfavourable. The country's infant mortality rate (38 ‰ in 1997) is the highest in the region, while life expectancy (65.4 years in 1997) is the lowest in the region. Male life expectancy is 57.29 years, a female life expectancy is 64.71 years. Unemployment among the youth is estimated at about 30 %. The literacy rate of the total population is 98 %, of which the male literacy rate is 99 % and the female literacy rate is 97 % (1989). The birth rate in Turkmenistan is closely linked with historical and cultural factors. The Turkmenistan tradition of having a large family still dominates rural society. The average rural family consists of 5–6 persons. The population is demographically quite young, with 40 % aged fourteen or younger and only 4 % aged over sixty-four.

Apart from the outflow of small numbers of Russians immediately following Turkmenistan's independence, neither out-migration nor in-migration is a significant factor for Turkmenistan's population. In 1992, there were 19,035 emigrants from Turkmenistan to the Russian Federation and 7,069 immigrants to Turkmenistan.

Turkmenistan hosted some 18,500 refugees and asylum seekers at the end of 1999. A large majority, 17,000, were Tajiks; another 1,500 were Afghans. The government recently recognised 375 Afghans as refugees. More than 2,300 refugees were repatriated from Turkmenistan in 1999, including some 2,200 Tajiks and a small number of Afghans and Azerbaijanis.

Turkmenistan has good potential for diversification into mineral resource-based industries, the economy is still predominantly agricultural. Agriculture, particularly cotton cultivation, accounts for nearly half of total employment. Gas, oil, gas derivatives and cotton account for almost all of the country's export revenue (Turkmenistan Country Report on Human Rights Practices, 1997).

In terms of social instability Turkmenistan has been relatively less affected by the breakdown of the Soviet Union than other republics. This factor is a good precondition for attraction of foreign investments in all spheres of the country's economy. But at the same time, compared to most of the CIS countries, economic reforms have been implemented very slowly in Turkmenistan. The state remains the dominant player in the economy. Price controls are still in place for many commodities and the public utilities. While import quotas have been eliminated and tariffs are not high, imports and exports are controlled through the State Commodity Exchange and other registration and licensing requirements. Foreign exchange is rationed and the parallel exchange rate is three times the official rate.

The decline of Gross Domestic Products is estimated at US$ 1,088 per capita in 1998 in contrast to US$ 2,797 per capita in 1989 (IMF, World Bank, 1998). Despite the steep decline in the GDP since independence, the extent of absolute poverty in Turkmenistan is small in comparison to many other countries in the region. Poverty in Turkmenistan was estimated at only 7 % in 1998 in terms of a purchasing power parity-based poverty line of US$ 2.15 per capita per day. But a large number of people live on the edge of poverty, provided by free or heavily subsidised water, energy, and other public utilities as well as basic foodstuffs.

Table 3: Turkmenistan Macroeconomic Activity. Real GDP per Capita

	1995	1996	1997	1998	1999
Real GDP (Millions of $US, 1995)	7,187	6,705	5,948	6,245	7,244
Total Population (Millions-Mid Year Average)	4,102	4,184	4,267	4,350	4,434
Real GDP Per Capita ($US Per Capita, 1995)	1,752	1,603	1,394	1,436	1,634

Sources: US CIA World Factbook, IMF World Outlook, US Census Bureau International Data Base

Turkmenistan inherited the system of state and collective farms from the Soviet Union, with its command structure of production quotas, fixed procurement prices, and soft budget constraints. The state still controls marketing and the distribution of agricultural produce through the Ministry of Trade in urban areas and the Co-operative Alliance in rural locales; the Ministry of Agriculture's Commercial Centre has a monopoly on cotton exports. Turkmenistan is highly dependent upon external sources for its agricultural inputs, the price of which has escalated more that those for agricultural products since independence.

Instead of restructuring the agricultural economy, the government's "New Countryside" policy envisions only limited privatisation of agricultural enterprises and expansion of grain

production to reduce dependence on imports. The development of transportation is critical to agricultural reforms in Turkmenistan.

One of the important steps in the socio-economic transformation of Turkmenistan was a decision by government not charge domestic users water, gas and electricity. Charges for water consumption in the agricultural sector are so small that they are not worth collecting. Low individual income charges for daily domestic facilities, such as water, gas and electricity, would be a heavy financial burden for many families. On the other hand, free and unlimited consumption of these resources does not encourage their rational use. While gas deposits are huge and electrical resources are renewable, the country badly lacks water resources. Turkmenistan, like the rest of Central Asia, suffers both from a shortage of water and wasteful water usage. Turkmenistan projections for its water needs are excessive and will create new water supply problems (Economist Intelligence Unit Limited, 1998). The water resources of Turkmenistan is formed mainly of agreed share of discharge of the rivers running over the territory of several countries and make up, presently, 24.6 km^3. Ninety-ninety-five percent of Turkmenistan's water resources is used for agriculture, and the rest is used in the domestic and industrial sectors. The main sources of water are four rivers, the Amudarya, Murgab, Tedjen and Atrek. The Amudarya River is the most important source of water in Turkmenistan. Within the boarders of Turkmenistan its water is distributed via the Karakum Canal with a length of 1,400 km. The competition among consumers of the limited water resources is high and will keep on growing. Forty-five percent of population in urban areas have access to safe water and only 18 % of population have access to safe water in rural areas.

The Government of Turkmenistan has undertaken a number of reforms in the industrial and agricultural sectors to help generate economic recovery and carry out the transfer to a market economy.

Reforms in Agriculture and Landuse System

Turkmenistan is a desert country where agricultural development is restricted by the water availability. Eighty-two percent of the country's land is suitable for agriculture (see Table 4). The majority of the agricultural lands consists of desert pastures and only 1.74 million hectares are irrigated. For the half of the population, which lives in rural areas, and engaged in agriculture, the agrarian policy plays an important role in state relations.

Ninety percent of the agricultural land are pasture areas. From 12 million hectares suitable for irrigation 2 million hectares are irrigated. *Irrigation farming* is the most labor-intensive but

Table 4: Landuse in Turkmenistan, 1995 (1,000 ha)

Total area	49,403.00
Total area suitable for agriculture	40,668.50
Irrigation land, among them:	1,744.20
In state sector	1,551.00
In private sector	108.30
Total area of pastures	38,890.80
Among them with water supply	25,148.40
Total population of the country	4,361.30
Among them rural population	2,380.10

Source: State committee on land resources and implementation of land reforms

at the same time lucrative branch of agriculture. Presently, the techniques of irrigation farming does not satisfy the requirements of the country that related to poor harvest and low incomes induced by various factors among which the most widespread is process of soil salinity.

The basis of *agrarian reforms* is the introduction of private land ownership. According to the Decree of the President of Turkmenistan from 1993, *"About the Rights of Ownership and Landuse in Turkmenistan"*, citizens can receive up to 50 hectare plot of land for private use. The land can be used for farming, gardening and building without the right to sell, exchange or give it to another person. By the year 1998, there were 200 thousand hectares of privately owned land. The next phase of *agrarian reforms* was the process of *reorganising of the rural institution***.** By the Resolution of 1994, state and collective farms (kolkhoz, sovkhoz) were transferred into *peasant associations* (p/a) with the following transfer of kolkhozes' and sovkhozes' lands to the p/a with the simultaneous introduction of the leasehold of state livestock on the long-term base (see also chapter 2.3). By the year 1997 1.398 thousand hectares out of 1.412 thousand hectares of arable lands were leased to the p/a. By the same time, 74 % of the livestock and 84 % of the cattle were leased. In 1992, the programmes "*10 Years of Prosperity"* and "*New Countryside"* were announced by the President of Turkmenistan. A national front for carrying out these programmes called "Milli galkynysh" (Movement for National Revival) is actively forming in rural areas. A set of measures is being adopted in order to assure the social well-being of the population.

But the process of ownership transfer is slow. The government is leasing out land to farmers with the possibility of transferring ownership once the farmer has established a good track record in farming. Moreover, with most marketing, distribution, and credit facilities largely available only to the state sector, private farmers are strongly dependant on the State whose investments remain significant for the two major crops-cotton and wheat. Despite some pri-

vileges adopted for farmers and livestock-breeders to help them in the first stage of transition to a market economy (farmers are exempt from value-added taxes and receive fringe benefits for purchasing fertilisers, seeds and using agricultural machinery) the real condition for transferring to a free market economy are still missing. The State maintains a monopoly on the purchasing of raw-cotton, wheat and wool. State orders regarding cotton and wheat production forces owners of private land plots to cultivate these two labor-consuming crops. Being the only purchaser, the State determines the prices for raw-cotton and wheat for farmers who often decide to give up with unprofitable business, because the expenses on improving soil fertility, the problems of obtaining timely agricultural machinery, and water provision are often not compensated for by prices paid by the state. In livestock husbandry, ownership of rural facilities such as wells and veterinary services are exclusively public.

Table 5: Production of Principal Agricultural Crops, 1992–94 (in thousands of tons)

Crop	1992	1993	1994
Wheat	368	502	1,063
Cottonseed	822	721	830
Cotton lint	390	402	403
Corn	147	202	252
Melons and squash	180	248	250
Tomatoes	133	150	200
Rice	64	88	149
Grapes	91	79	147
Barley	124	197	108
Onions	71	98	100

Source: Based on information from *The Europe World Year Book 1996,* 2, London, 1996, 3201.

In 1991, field and orchard crops accounted for 70.4 % of the value of agricultural sales prices (computed in 1983 prices), while livestock accounted for the remaining 29.6 %. Almost half the cultivated land was used for cotton, and 45 % of the land for grains and fodder crops. Livestock was mostly centred on sheep, especially for the production of Karakul wool. While the production of meat and milk in the 1986–91 period rose substantially (increases of 14,000 and 110,000 tons, respectively), the actual production in 1991 of 100,000 tons of meat and 458,000 tons of milk represented a decrease from 1990. Production of meat in 1992 declined by 21 % from that of 1991. Fishing, bee-keeping, and silk-rendering occupy small areas of the agricultural sector.

While small-scale privatisation of retail shops and catering establishments has been more or less completed, the privatisation of medium- and large-scale enterprises has stalled. The financial sector remains largely unreformed.

3.2 The Current State of Desertification Processes and the Methods Used to Combat it.

Deserts occupy 79 % (387,000 km^2) of the total area of Turkmenistan. According to the research conducted by the Desert Institute of Turkmenistan, 66.5 % of the country's territory is affected by processes of desertification with differing extents of severity (Babaev, Kharin, 1999). Data clearly shows that most of the desert territory in Turkmenistan is subjected to desertification processes.

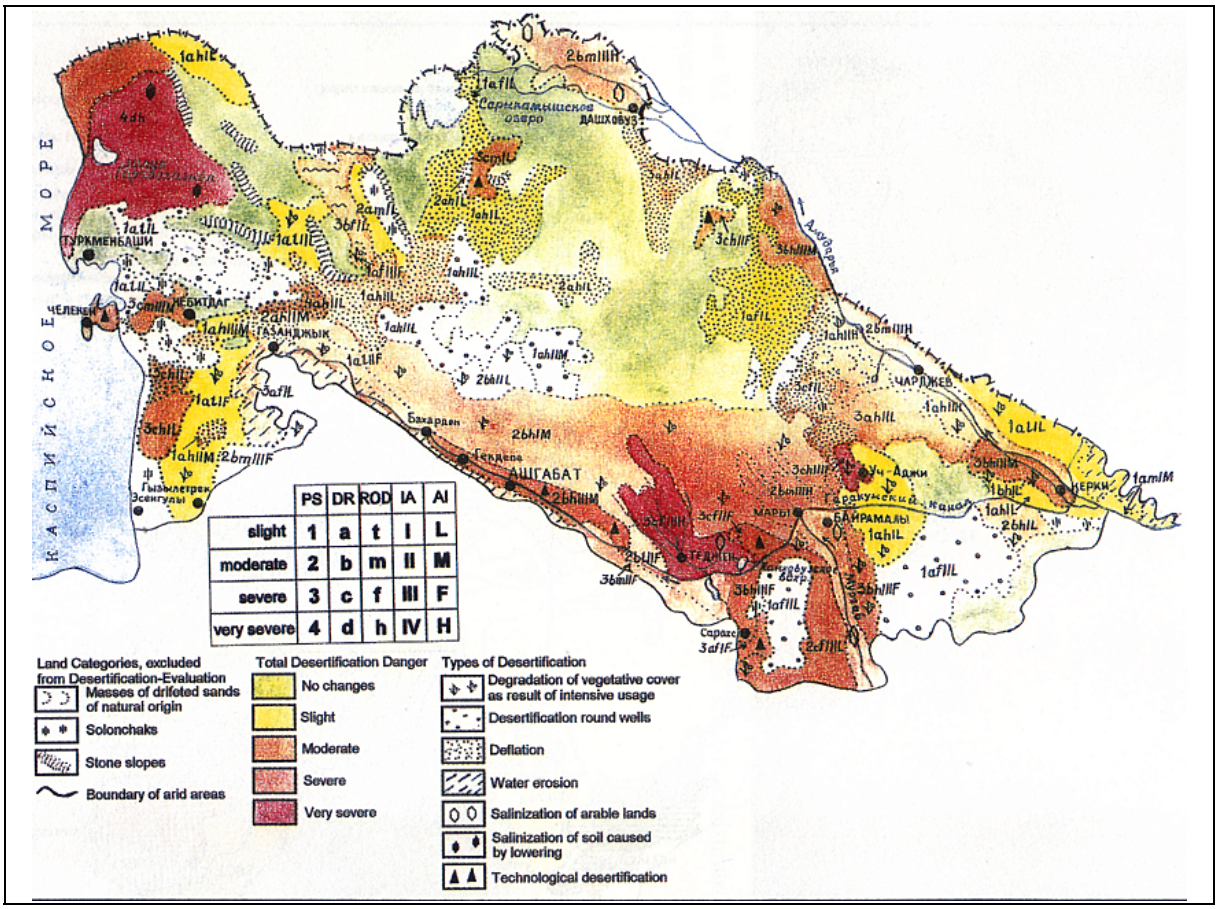


Figure 2: Anthropogenic Desertification in Turkmenistan
Source: Babayev, A., 1999, plate 8.2

According to the deflation rate, sandy deserts of Turkmenistan can be divided into 3 groups: slightly deflated (takes up more than 20 %), moderately deflated (about 70 %), and severely deflated (more than 10 %). The category of slightly deflated sandy desert includes hummock, ridge and other types of eolian relief, which are densely covered with grass, trees and shrubs. The category of moderately deflated sands includes areas partly covered by vegetation, while the remaining part is devoid of vegetation and has been affected by natural and human factors of desertification. The category of severely deflated sandy desert includes the typical barkhan sands with practically no vegetation. The area of such sands in Turkmenistan is 17 thousand hectares.

To depict the current situation of desertification in Turkmenistan, scientists of the Desert Research Institute elaborated on the classification of desertification processes to include types and classes (see Table 6). The estimated present state of desertification in Turkmenistan was based on space photographs, stationary observations, and the use of thematic maps and statistical materials gathered by the Desert Research Institute.

Table 6: Distribution of Areas of Degraded Lands in Turkmenistan (in km^2/%)

Type of degradation	Class of degradation			Total
	Slight	Moderate	High	
Lands Used or Potentially Suitable for Use				
Degradation of vegetative cover	323,442 66.2	43,680 10.0	400 0.1	357,522 75.3
Deflation	2,530 0.5	2,140 0.4	3,970 0.8	8,640 1.7
Water erosion	6,900 1.4	_	_	6,900 1.4
Salinization of irrigated lands	6,140 1.3	25,130 5.2	9,040 1.8	40,310 8.3
Salinization of soils caused by lowering of the Aral Sea level	_	_	15,015 3.0	15,015 3.0
Technogenic deserification	_	920 0.2	_	920 0.2
Swamping of pastures	_	5,360 1.1	1,620 0.4	6,930 1.5
Total	339,012 69.4	77,230 15.9	30,045 6.1	446,287 100
Lands Not Used or Extensively Used				
Drifting sands				13,894
Solonshaks				14,329
Territories close in conditions of utilization or reservation				9,220
Surface of water				4,370
Outcropping of native rock				–
Glaciers				–
Total				41,813
Grand total for Turkmenistan				488,100

Source: Babaev, A., 1996, pp. 227

According to the degree of degradation of ecosystems, three classes of desertification can be distinguished. The proposed concept of a background level of desertification signifies that the ecosystem is not harmed when no noticeable changes are observed in the productivity, in the

species composition of plants and animals, and in the functions of all the ecosystem's components. The background level was determined according to the state of the undisturbed ecosystems in the natural reservations (Babaev, 1996).

Table 6 shows types and classes of land degradation in Turkmenistan. The main causes of desertification in Turkmenistan besides climatic infavorability are overgrazing, cutting down of desert vegetation, inappropriate agricultural methods, and uncontrolled driving over the desert.

Causes of Desertification

Climatic features are an underlying factor of desertification in Turkmenistan. Droughts are, in essence, desertification catalysts. One has to distinguish between aridity and drought. Aridity is a constant characteristic of Turkmenistan's territory, while drought is a temporary phenomenon and generally accompanied by a sharp deficiency of precipitation (Babaev, 1996). Aridity is basically a comparison between water supply and water need (McGinnies, W., Goldman, B., 1986).

The following types of droughts are distinguished in Turkmenistan: meteorological, agricultural, soil drought, air drought and hydrological drought. Based on intensity, droughts are divided into five categories: weak, moderate, strong, very strong, and rigorous. Weak droughts are observed over the entire southern territory of the country. In the southeast of the country strong droughts may occur almost every year. In well-moistened regions (the Murgab oasis, the Amudarya River valley) the number of years with strong droughts is reduced by up to 20–27 %. In the less moistened Tedjen oasis and on the Kopet Dag foothill plain the repetition of strong droughts increases up to 60–80 %, while in the southeast of the country, strong droughts occur in 53–69 % of the years. The southeastern Karakum desert is singled out by its increased repetition of droughts. In an average a year, the number of days with a drought of all types exceeds 70 here. Towards the Central Karakum desert the number of days with a drought decreases to 30–50 days per year. In the northwest and west of Turkmenistan between 10 and 30 days of drought are registered every year (Babaev, 1996). Dry winds effect vegetation approximately the same way as droughts when the air is heated to 43 °C. This causes the active layer of the soil to dry up completely.

The most rigorous and intensive effect on the vegetation and the soil of desert pastures are the cutting of vegetation and overgrazing. Two factors are behind the problem of *cutting the desert plants*: the absence of a permanent gas supply in desert settlements and the absence of firewood for sale. Spaces that have been cleared are mainly located around villages, around

wells, and along railways and main roads. Stands of *Halloxylon persicum* have been reduced to 60 % of its former area. The same figures for stands of *Haloxylon aphyllum* total 68 %. Tugai forests have been destroyed by stubbing and by burning, these former lands are used for cultivation of cotton. Desert woodlands are mainly subjected to cutting. Apart from the trees and shrubs used for fuel, other species of vegetation were also cut out in a sand desert for various domestic purposes. Various species of *selin (S. Karelinii, S. pennata*) were especially intensively cut out. Having been one of the first plant used for fixing plants, *selin* was collected with its root system. Every year the upper part of *astragal (Astragalus sp*.) was cut for preparing sheaves where mulberry silkworms moths spin cocoons. All these tendencies underlie the development of deflation processes in the Karakum Desert.

Overgrazing is another dominating factor of desertification in Turkmenistan. The sedentary way of life of the large farm centers, an unequal distribution of wells over the desert pastures, a lack of rural infrastructure such as roads and the poor condition of desert shepherd camps all inevitably lead to the high concentration of herds around the big settlements and the main roads. As a result the most intensive degradation is observed up to a distance of up to 1 km around the wells and the big villages, where the process of overgrazing is intensified by the collection of fuel wood.

Another harmful fact of favoring the advance of desertification processes is a change in the traditional structure of the herds, which were usually sheep and camels. They are best adapted to the local climatic and vegetative peculiarities of the Karakum desert. Sheep in the Karakum desert are mainly represented by two species, Astrakhan or Karakul, which are bred for their karakul pelts and Sardjy species, which are bred for meat. Sheep and camels are still the main desert domestic animals, but a drastically increasing number of goats and cows are the reason for concern. For instance, the number of cows on the state and private farms in Turkmenistan has increased from 331,000 heads in 1991 to 546 thousand heads in 1998 (Turkmen National Institute of Statistic, Report of 1998). Cows and especially goats have a more destructive affect on pasture vegetation due to their eating behavior than sheep and camels. It was also calculated that the number of sheep in Turkmenistan which can be kept under the condition of full pasture irrigation and usage, varies from 5.6 million to 11.4 million heads. 650,840 camels can be kept together with sheep on the all the year round pastures (Nikolaev V.N., Nikolaev V.V., 1999).

Another main type of desertification in the Karakum desert is a *water-logging* caused by inappropriate methods of irrigation. The water-logging of soils is mainly associated with a rising

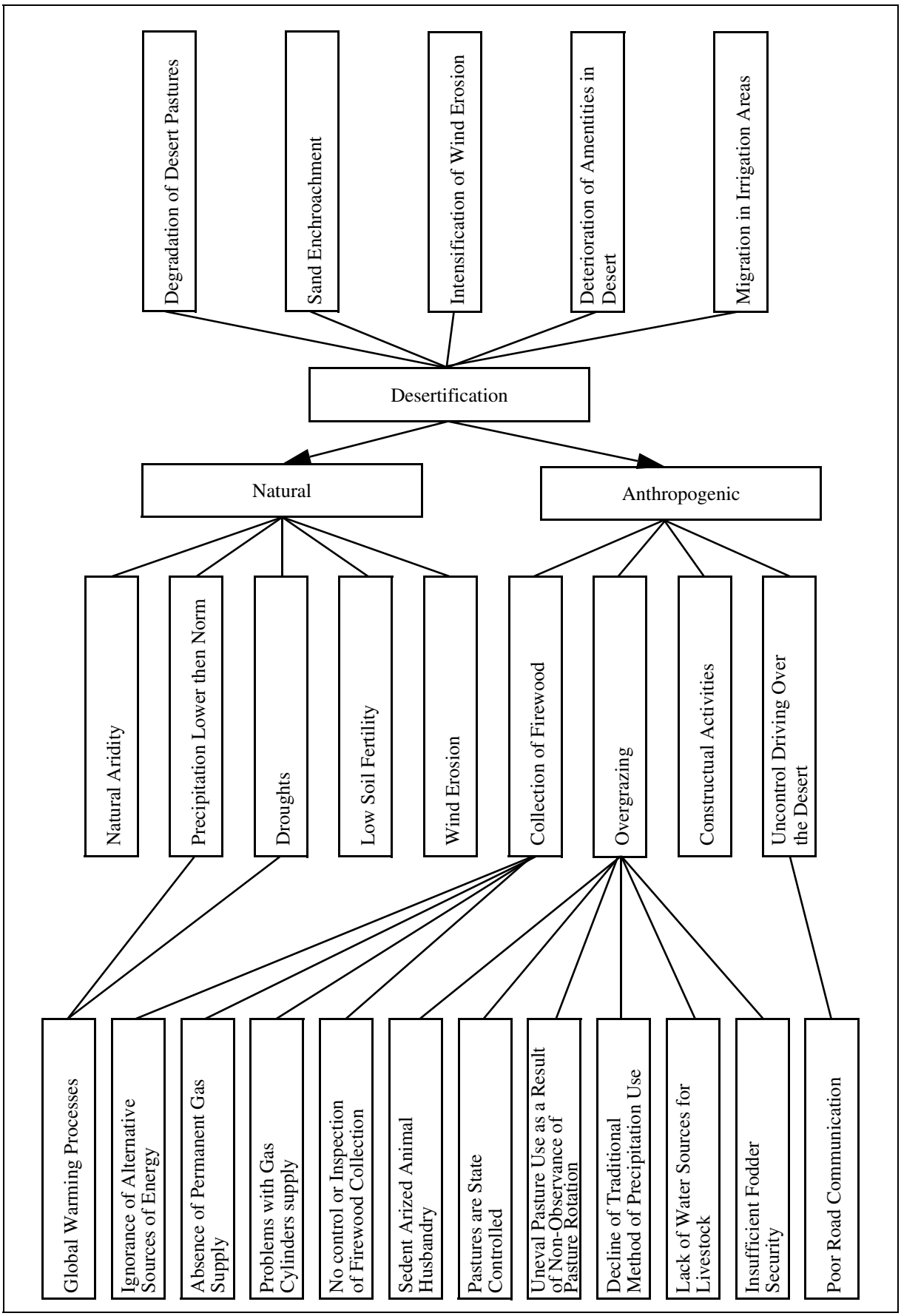


Figure 3: Problem Tree of Desertification on Example of the Central Karakum Desert
Composed by the author, 2000

of the ground water level (up to 1.0–1.5 m from the surface) due to poor drainage caused by filtration of water from the canals and irrigated fields. Waterlogged soils with a ground water depth under 2.0 m are not considered satisfactory from a reclamation viewpoint. The area of such lands in the country in 1992 was 610 thousand hectares (41.1 %) (NAPCD, 1996).

Uncontrolled driving over the desert territory is also a factor, which contributes to soil degradation. Besides the highway, which is the only paved road in the region of the Central Karakum, there are smaller side roads stretching to the remote villages and settlements. They are not all paved and therefore have no permanent route. Most drivers try to follow the tracks left by previous drivers, but in many cases this practice is not obeyed due to the lack of control and simply because the tracks become covered up by sand.

All above-mentioned factors of desertification in Turkmenistan, both climatic and human, are true for the area of the Central Karakum. A more detailed analysis of causes of desertification processes in the research area will be discussed in the Chapter 4.

Methods to Combat Desertification

Differences in general approaches to combat desertification in Turkmenistan are related mostly to the different political epochs. Generally, methods in controlling desertification in Turkmenistan can be divided into the three periods: *Pre-soviet, Soviet, and the Period of Independence.*

The first effort to investigate desert ecosystems within the territory of modern Turkmenistan dates back to the 19th century when a Trans-Caspian Railway was constructed. To protect the railway from the sand drifts, Russian scientist, V.Obruchev, was the first to recommend using the local desert vegetation to fixate the moving sands. Numerous expeditions were organized by the Russian Academy of Sciences in the late 19th and the yearly 20th centuries (Kalitin, 1883; Lessar, 1884; Natzkiy, 1916). The main objects of those field trips were the exploration of the southern frontiers of the Russian Empire, including mineral exploration. Together with geological prospecting work, Russian geologists conducted a geomorphological and geo-botanical description of the investigated terrain.

During the second half of the 19th century, Russia started the construction of the railway Krasnovodsk-Chardjou in the Trans-caspian region. Faced with the serious problems of drifting sands in 1910, the Russian Geographical Society set up the commission to study drifting sands and also recommended the establishment of a scientific station in the desert. In 1912 a desert

research station was founded in the South-eastern Karakum desert where an afforestation nursery was organized. In the period from 1912 to 1918 the station initiated the first meteorological observations in the Karakum desert and developed the n methods to protect the railway from sand drifts (Rakhmanov, J., Veyisov, S., 1999). The pre-Soviet period lasted from the late 19th century till 1924, the year Soviet Power was established on the territory of modern Turkmenistan.

Soviet Period of Desert Study

The second period is marked by the intensive development of a desert science. The fundamental research of the desert started with the founding of the Desert Research Institute in 1962 and was based on the knowledge and experience of the first Russian studies (Lopatin, G., 1930; Petrov, N., 1933; Korovin, E., 1934). The Institute was set up within the system of the Academy of Sciences of Turkmen Soviet Social Republic. The tasks of the Institute were to develop scientific and practical fundamentals for a comprehensive study and reclamation of desert lands.

During the period from 1978 to 1991 in the Soviet Union, within the framework of the international projects on controlling desertification, 53 measures were conducted, including 3 symposiums, 40 training courses, seminars, acquaintance trips, and 10 consultative, appraisal, and specialists meetings. The total number who participated in various undertakings exceeded 700 specialists from 81 countries, including about 150 from the countries.

During the decades of scientific investigations by the Desert Institute, the technology to combat desertification, which consisted of preventives and active measures were elaborated. The *preventive measures* included: prohibiting the cutting down of vegetation, limiting grazing on low-productive pastures, prohibiting the grazing up to five years on the improved pastures, the study of the potential of natural resources of each region of the country, and the ecological education of the population. The *active measures* included practical activities such as the protecting contractual objects from the sand drifts and deflation, the phyto-reclamation of sands, the planting of forests on the hillsides, the creation of protective tree plantations on irrigated lands, along canals and large irrigation ditches, the restoration of wood and shrub vegetation on sands, an increase in the capacity of pastures, and facilitation of the natural renewal of tugai forests, etc.

Five types of land use can be differentiated within the territory of Turkmenistan: urban, mining and industrial, irrigation-agricultural, desert pastures and mountain pasture territories. Whereby three levels of nature-protecting activities were then recommended by scientists: high, moderate, and low intensity. For the desert pasture territories, the intensity of the nature-

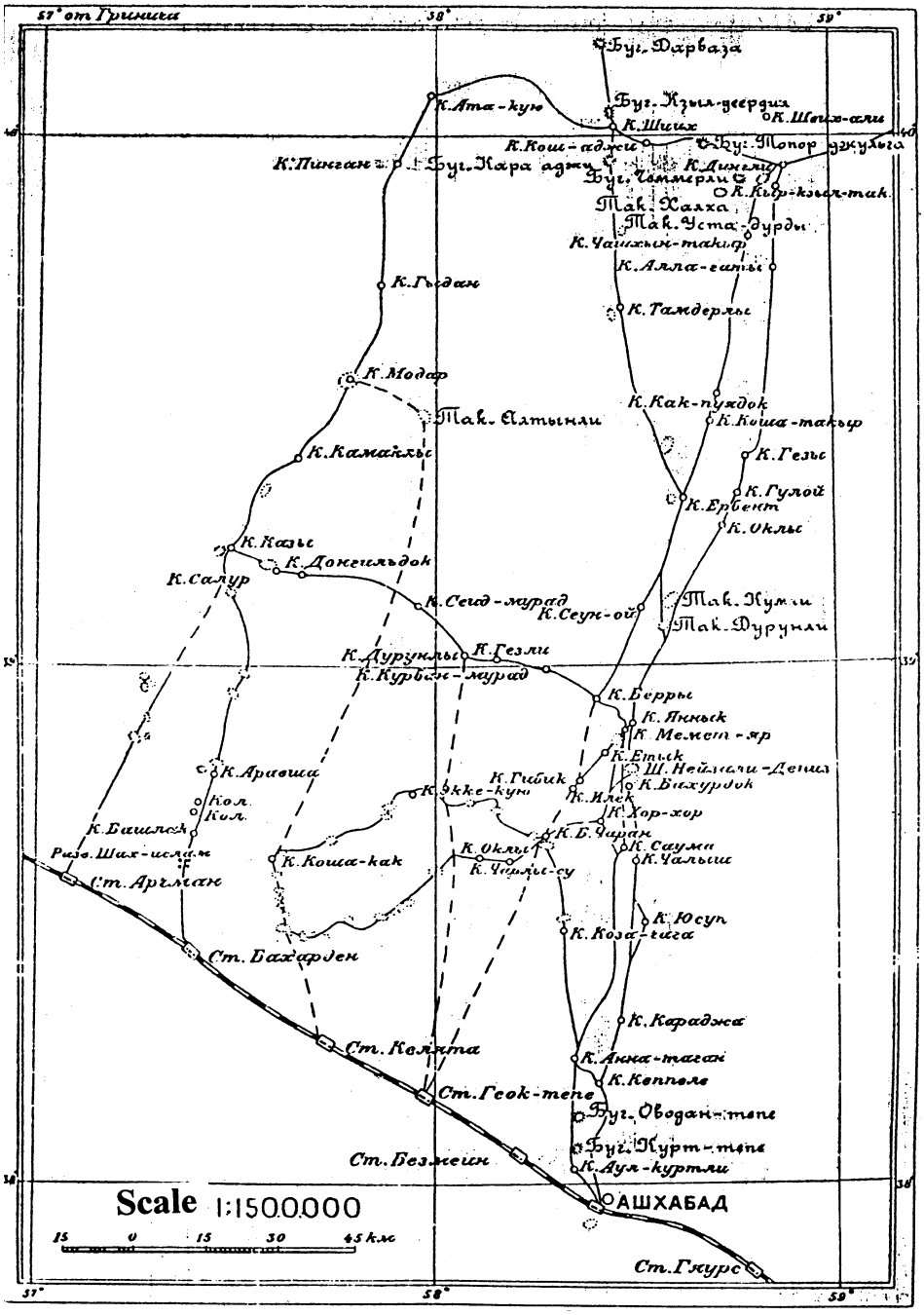


Figure 4: Map of Yerbent Region
Source: Lopatin, G.V., 1930

protecting activities would depend on the stability of the land system and the degree of anthropogenic degradation.

Scientists of the Desert Institute of Turkmenistan set up various monitoring methods and a prognostication system of desertification processes based on space photographs. Recent space information has been obtained from the ecological satellites “Cosmos-1906” and “Resurs-F”, which allowed Turkmen scientists to carry out comprehensive research of the dynamics of the

desertification processes. As desertification processes develop intensively, regular intervals between aerial/space surveys are very important. For regions with slowly developing desertification processes this interval is 10 to 15 years, in the regions where desertification activity has a moderate rate it is 5 or 10 years, and in the regions with very dynamic desertification processes surveys should be conducted every 3–5 years (Babaev, Kharin, 1999).

Turkmen Soviet scientists opted for strong support from the government and the maintenance of close connections to all Soviet scientific institutions. The study of the desert dealt with fundamental research and focused mainly on minimasing the effects of desertification rather than minimasing its causes. Preventive measures, though well-developed in theory and experimentally tested, were not put into further practice.

Post-Soviet Desert Science

The period of independence gained in 1991 is the third developmental phase of experience in the field of desert studies and desertification control. The scientific activities in the post-Soviet period are marked, first of all, by the collapse of previously existing connections with the former Soviet Union scientific institutions and the lack of state support. An important step in avoiding the isolation was the ratification by the Turkmen Government of the United Nations Convention to Combat Desertification. The same year, a State Commission on the Development of Conceptions and Strategies of Actions to Combat Desertification was established. The National Institute of Deserts, Flora and Fauna of the Ministry of Environmental Protection of Turkmenistan was entrusted to develop a National Action Program to Combat Desertification (1996). The overall objective of the National Action Program was to prevent and halt the processes of anthropogenic desertification and to restore the biological productivity of degraded lands. The National Action Program was created to comply with modern demands emphasizing the importance of an integrated participatory approach, which include co-operation between the "affected" local population and donor agencies. In 1997, the first version of the National Action Program was prepared and submitted to the Turkmen government as well as to the international organizations for consideration and realisation.

Since the mid-1990, when the National Institute of Deserts, Flora and Fauna started a Turkmen-German Technical Co-operation Project "Participatory Management of Natural Recourses in the Central Karakum", the main emphasis has been on an interdisciplinary approach to deal with desertification which maintained a strong co-operation with the people affected by this problem (see chapter 1.5).

According to the articles 4 “General obligations” and 5 “Obligations of affected countries” of the UN CCD, the countries signing the Convention must fulfil certain obligations and implement the main regulations of the Convention on national and regional levels. In March 1999, a State Commission on the Implementation of the Obligations of Turkmenistan arising from the UN Conventions and the UN Program on Environmental Protection was established by the Turkmen government. The UN Convention on Bio-diversity which is closely connected and has some common objectives and regulations with the UN CCD, was also ratified by the government and its National Action Program will be soon submitted for further consideration. The National Action Program to Combat Desertification is closely linked to national programs fostered by the President of Turkmenistan: “10 Years of Stability”, “New Village”, and the Resolution “On planting Trees and Gardens”, all of which are intended to solve social and ecological problems in the country.

Today, the control of desertification processes is complicated by some factors: the unsteady socio-economic development of the Central Asian countries, an inadequacy of the environmental legislation, an inadequate attention to ecological problems and the non-implementation of developed strategies and plans of action to combat desertification (Babaev, Kharin, 1999). Currently, the measures for deflation control are randomly implemented. They are largely only for the protection of industrial and irrigation facilities and only partially for the irrigated zone and distant-range pastures.

Unfortunately, during 1991–1992 in connection with the breaking up of the USSR and founding of the Commonwealth of Independent States, scientific activities of the NIDFF, the number of researches, projects, and survey establishments in the field of controlling desertification diminished substantially.

3.3 A Brief Overview of the Socio-economic Evolution of the Pastoral Society in what is today Turkmenistan.

Before proceeding to Chapter 4, “Introduction to the Research Area: the Central Karakum”, it will be useful to have a brief overview of the socio-economic evolution of the desert pastoral society in the territory of present-day Turkmenistan. This information will be helpful in gaining a better understanding of the dynamics and problems of the today’s pastoral society in Turkmenistan.

Beginning in the 1st millennium BC despite prosperous agricultural settlements at oases, nomadic animal husbandry was the prevailing economic activity in Turkmenistan. The nomadic

economy was based on large-scale livestock-breeding throughout all of central Eurasia. There is little information available on the organizational structure of the Turkmen nomadic society prior to the 19th century, "but there does appear to have been a tight hierarchical structure, with several clan-tribal sub-divisions" (Akiner, Sh., *et.al*, 1998, p. 44). The nomads interacted with settled agriculturists through trade but sometimes also through political and military alliances.

Throughout the centuries desert nomads adjusted themselves to the severe desert conditions. They had significant knowledge of their environment, and could find water in places where it could not be expected; they ploughed small plots with limited water application and even without water (Babayev, A., Arnagedyev, A., 1999). The herds were composed of camels and sheep, the animals which are best suited to the hot climate, saline water, and to the biological cycles of vegetation. Different kinds of animal production were widely used by the nomads making their life nearly self-sufficient. Sheep were bred for meat; sheep wool was used for making felts, sacks, ropes, and many other things; sheep skin was used for making fur-coats, fur caps and footwear. Camels were very important for the nomads: besides meat, wool and skin, they provided their owners with milk, which has a medicinal value and is indispensable in hot weather. Camels were also used as working animals. All of the above mentioned skills and handworks are still preserved among modern livestock-breeders.

In the late 19th to early 20th centuries, three main social groups could be distinguished in the desert areas of the country: prosperous livestock-owners and religious authorities, a middle-class and poor peasants. Prior to the revolution of 1917, there was no strict pastures borders among the villages. The wells in the desert were considered as a property, construction of which was affordable only for the rich owners.

In the time of nomads and semi-nomads up to 1930s, the animals grazed in the desert on the seasonal pastures under the constant care of their owners or hired shepherds. The nomadic livestock-breeders of the Karakum desert pursued a meridian-type migration with radial grazing *(from the center of a well)*.

The nomads and semi-nomads resettled their families and herds three times per year: in the summer, the winter and the spring. The pastures were always located around wells. The issue of ownership and the use of pastures was complex. According to stories told by local people that although there were no specific limitations on the use of pastures, in practice, the rich livestock-breeders used the best pastures. However, there was certain plots of constant pastures for every settlement or small clan.

It is known that prosperous livestock-breeders grazed their herds themselves or with the help of hired shepherds. Less well-off peasants gathered their animals in one herd. They could herd themselves or hire other shepherds. In the latter, the one who had more animals in the flock herded it longer than other shepherds. Among the such group of the livestock-breeders, a leader was chosen. The leader was usually the one with the biggest number of animals. He had to deal with the problems of resettlements, payment and getting supplies for the hired shepherds.

In the late 19th century, the Russian Empire extended its borders to Central Asia. However, the colonial Russian regime did not interfere much with the indigenous economy in its southern provinces. The Russian explorers were searching for something that was of no interest for the native people: gas, oil and sulphur. Starting in the late 19th century, a number of expeditions were organised by the Russian Academy of Science (Kozlovskiy, 1930). Thanks to this, the first scientific materials about Turkmenistan terrain, which date back to the late 19th and early 20th centuries are available (see Fig. 4). That was, however, not the only advantage of the Russian presence on the territory of present-day Turkmenistan. The Russian military was of great help in defending the Turkmenistan borders from Iranian and Afghanistan invasions. In the early 20th century, many Russian settlements emerged on the territory of present-day Turkmenistan. This was the first wave of Russian migration to Turkmenistan.

The transfer to a sedentary life-style began with the establishment of the Soviet regime in 1917 through its process of collectivisation and the establishment of *kolkhozes* (collective farm) and *sovkhozes* (soviet farm). The process of collectivisation was accompanied by the forced transfer of all livestock to state farms. At the beginning of the collectivisation processes in the 1930, desert areas with nomads made up about ¾ of the entire country's territory and were inhabited by only 145–150 thousand of them. Owing to the remoteness and isolation of the nomadic tribes away from the inhabited oases, the way of life of the nomads remained intact after the establishment of the Soviet regime. The constant mobility of nomadic tribes made it difficult to conduct registration of desert population. Nomadic livestock-breeding was considered by the Soviet government as an obsolete economical process and the nomads themselves were treated as an illiterate folk with the lack of class consciousness. At the same time, the obligatory census of the desert population and the overall campaign against illiteracy took place. The ensuing sedentary life greatly changed the habits of the desert inhabitants. People were forced to resettle from their nomadic dwellings, *yurta,* to clay houses. The emergence of the infrastructure tempted people to stay at newly created farms. Thus, the process of collecting

formerly spread out desert inhabitants and their herds into permanent settlements took place over the whole territory of the Karakum desert.

During the period of civil hostilities in the early years of the establishment of the Turkmen Soviet Republic (1924–1926) the number of livestock dropped sharply and barely amounted 45–50 % of the livestock population of the pre-Soviet period. Ninety percent of marketed production was carried out by private traders, which at that time were considered as a serious hindrance to the development of the livestock sector in the Soviet republic by the new regime.

With the beginning of the Second World War, the process of collectivisation was suspended. After the war, the second wave of collectivisation began under the Stalin regime. In the late 1950s and early 1960s, the process of collectivisation among the desert nomads was completed. In the course of time, as power of the Soviet regime in the Turkmen Republic became stronger and more advanced livestock-breeding as a traditional way of economy gave the way to agriculture with cotton as a monoculture based on artificial irrigation. During the seven decades of the Soviet period, traditional practices and the knowledge of migratory pasture management and an "entire way of life – a way of relating to the environment" were lost (Akiner, Sh., *et.al*, 1988, p. 54)

A new spiral in the evolution of the pastoral society in Turkmenistan started independence gained in 1991. By Presidential Decree in 1994 kolkhozes and sovkhozes were replaced by so called *peasant associations*. The plots of land, livestock, property of all kinds, and monetary funds previously belonging to kolkhozes and sovkhozes were transferred to the newly established peasant associations. The bigger part of state-owned livestock were given to individuals as long-term leases (see chapter 4.2.1). After the abolishment of the state farm system in 1994, grazing management did not experience many changes. Nowadays, feeling more independent under the leasing conditions and at the same time with the weakened state support to the livestock sector, there is a growing tendency among the shepherds to rely more on their own professional skills and experience. Some shepherd families have started to practise longer migrations with their herds, spending almost the whole year on the pastures (see chapter 4.2.1).

Thus, two very opposite transformations in the pastoral society have taken place over the last century – first, the collectivisation of livestock with the prohibition of private property in the early 20th century and second, the decollectivisation of livestock with the development of the private sector since 1991. Nowadays, the process of reformation in the agricultural sector in Turkmenistan is still continuing and the bases for related legislation has not yet been settled.

4 Natural and Human Implact on Desertification and its Consequences

4.1 Frame-conditions of Research Area: the Central Karakum Desert

4.1.1 Introduction to Research Area

For testing participatory approach in controlling desertification processes in Turkmenistan a peasant association (p/a) Yerbent was chosen in the Central Karakum. The peasant association locates to the north of Ashgabat from 80th km of the Ashgabat-Dashoguz highway. Main volume of the research activities was conducted in Bakhardok village, the administrational center of p/a. Other villages within the borders of p/a – Yarma, Chalysh, Mamed-Yar, Sovma – have been also involved in the research for supplementary information.

Photo 1: View of Central Part of Bakhardok Village
Village with gardens is sinking in sand dunes
Photo taken by the author, 1999.

Reasons of Choice

The choice of study area depends on several of circumstances:

- The area of p/a Yerbent has terrain, soil and vegetation cover typical for sandy desert zone.
- Traditional occupation of inhabitants is livestock-breeding combined with irrigation farming.
- Different kinds of ecological stresses peculiar to the desert conditions can be observed in the study area (degradation of vegetation, soil erosion, shifting sands).
- Availability of piped water for irrigation gives the possibility to test fostering of planting skills of local population.

- The highway Ashgabat-Dashaguz runs across the territory of Yerbent p/a and offers transport communication with the settlements and facilitates the visits of the study area as often as needed.

Location

The territory of the p/a is located in the middle part of the Central Karakum by two areas with different squares. The first main massive is spread from south to north by belt of 180 km length, approximately 45 km breadth covering the area of 8,100 km^2. The second massive locates in the northern part of the Central Karakum near the first massive and occupies 870 km^2. The total area of p/a is about 9,000 km^2, including pastures (95 %), irrigated lands for fodder storage, wheat, grainyards, vegetables for the own needs of p/a.

Administration Division

The Yerbent p/a is comprised of five farms with farms' centers: Bakhardok, Mamed-Yar, Yerbent, Bory, Dingly. Each central farm village is surrounded by a number of smaller villages inhabited by shepherd families with both private and state owned livestock.

The center of the p/a, Bakhardok village, is located 90 km north of Ashgabat along the Ashgabat-Dashoguz highway. The village is populated by 2,032 inhabitants or 368 families (Data 1997).

Population and Migration

Total population of Yerbent p/a is 8,046 according to the 1998 census (Table 7). Within the desert population is spread unequally. People tend to accumulate in those places where they can obtain better life facilities. These are the main factors of attraction – favour of natural conditions, infrastructural facilities and employment opportunity. Big villages and settlements in the Central Karakum locate on the main road Ashgabat-Dashoguz. These villages with water and electricity supply attract people from remote settlements. Bakhardok village, besides of the facilities mentioned above, has the biggest school in the region, a hospital and a shop, which also motivates people from the smaller settlements to change their place of living. The road facilitates communication with other cities and provides an easier access to the market in the capital to deliver animal production. Young generation of deserters try to grab any real possibility to move to the capital or other cities in the oases. The chances are constrained by many barriers to migrate, mainly the difficulties to find job and accommodation in the new social setting. In the area of the Central Karakum the process of migration usually happens in the fol-

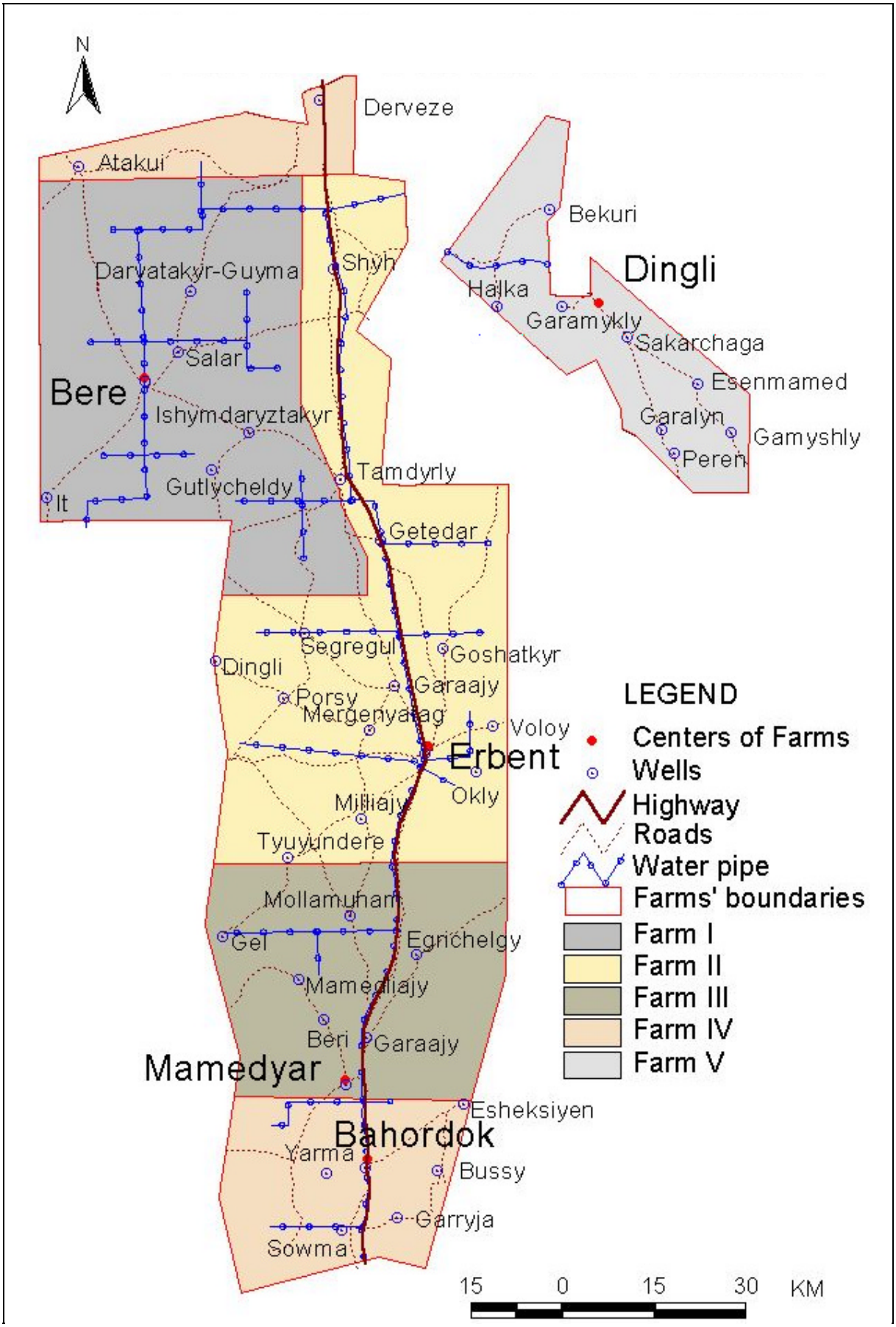


Figure 5: Administrational Devision of Yerbent Peasant Association
Source: Results of GIS, NIDFF, 1999

lowing direction: marginal desert land – bigger central desert villages – desert villages with irrigated areas – city, to say shorter, southward of the central part of the desert.

Table 7: Population of the Largest Villages and Settlements in Yerbent Peasant Association (state on 06.01.98)

Village	Number of families	Population
Bokhardok	368	2,032
Chalysh	71	436
Mamed-Yar	142	721
Sovma	28	156
Yarma	10	44
Charyp	45	236
Bussy	33	149
Eshekshen	10	81

Source: Statistic of Administration of Yerbent Peasant Association, unpublished.

Unfortunately, no research on the specific issue of migration caused by deterioration of environment has not been carried out in Turkmenistan up to now. From the interviews with the local people one can assume that the dominating reason for people to migrate is rather socio-economic factors than the ecological ones.

There is also an opposite process when some people from the oases come to the desert. These are women who got married and followed their husbands. Teachers and physicians who were appointed to work in the desert areas also contribute to the in-flow migration in the area. But in-flow process is insignificantly small.

Education Availability

There are several schools in Yerbent p/a, both primary and secondary. Secondary schools are located in the large villages and the farms' centers. Till 1998, a boarding secondary school in Bakhardok village provided education for children of the central and neighbouring villages and settlements. Today, due to the lack of finance boarding facility is closed. This presented causes and inconvenience to those who live far from Bakhardok village. Closing of the boarding school along with the weakening of school attendance control, as well as lack of teaching materials decreased the quality of education in the region. Many cases were observed when children of school age did not attend school because of the long distances, the absence of transportation, financial problems or the need of domestic help.

Transportation

The highway crossing Turkmenistan from south to north makes communication with the desert settlements much easier. The buses ply through the Bakhardok village in both directions. The other smaller roads within the village are not of good quality and at some places covered by sands. The highway provides better access to the food market for the village inhabitants. The trade trucks passing through the p/a from northern oasis of Turkmenistan to Ashgabat's markets stop in the roadside villages. The villagers can buy the products, which they do not produce or produce insufficiently such as fruits and vegetables. The price of these products is about 30–40 % lower than on Ashgabat's markets. There is also an opposite process along the highway. The inhabitants of the villages sell animal production. In many cases, trading of goods happens by barter.

Water Supply

Prior to the installation of the water pipe in 1979, the inhabitants of Yerbent p/a used water brought from the capital, water from well and collected precipitation. Since the Soviet time fresh water has been brought to the desert settlements by trucks. Till present time people are buying drinking water, 4–5 tons of which costs them about 80,000 manat[1] depending also on the distance of delivery. This fresh water is kept in the underground cement tanks, which are available in every household.

After the construction of water pipe the inhabitants of Yerbent p/a started to get free water. The 178 km long water pipe brings its water from Karakum Canal, which, in turn, takes water from Amudarya River. Along with pipe a purifying construction was build to clean the muddy canal water. But even after purification the quality of piped water is not good enough for drinking purpose and is used for irrigation and livestock watering. Some parts of the pipe are not isolated and locate above the ground level, making water warm in summer and cold in winter. So, shepherds who uses the piped water complain about its quality and blame it for sheep diseases and bad quality of wool.

Water supply was also intended to irrigate approximately 900 ha of fields in p/a Yerbent for fodder storage for farm's livestock. Before reaching p/a the water pipe passes through many private state farming lands. The uncontrolled water diversion from the pipe are occurs in many parts. From originally planned discharge of 600–700 l/sec there are only 200–250 l/sec are

1. Manat is the local currency, exchange rate in June 2000 was US$ 1 = 15,000 manat. Due to high inflation exchange rate is always raising, which affects the prices. 80,000 manat is the price of delivery to Bakhardok village; to remote settlements surrounded by sand dunes, price is much higher.

Photo 2: Water Well in Mamed-Yar Village
Fetching of water is usual duty of the women.
Photo taken by the author, 1998

reaching the territory of Yerbent p/a, which makes the supply such an area with water impossible. In fact, there are about 400 ha are cultivating now by tenants. Lack of water in the pipe is explained by wear and tear of pipe, diminishing water charge in Karakum Canal[1] and uncontrolled using of water from pipe along its route.

Due to high mineralisation, water from wells can not be used for drinking and irrigation, although there are a few deep wells with water suitable for these purposes. The pastures are not sufficiently provided with fresh water wells. After the breakdown of the former system of collective farms the maintenance of wells is more and more becoming a problem of shepherds themselves. Since the ancient time fresh water in the desert was first condition for the emergence of human settlements. All desert settlements appeared around the wells or the traditional water catchment area. Desert inhabitants treated water as the biggest treasure and tried to obtain and store it by different methods. Fresh water, which costs so dear for the inhabitants of the desert has been used rationally and for the priority needs.

Traditional Methods of Water Supply

An old method of collection and storage of water on the base of precipitation use is still been practised in a few settlements and some parts of desert pastures. During the rainfall season precipitation is collected on the large flat and slightly declined area of takyr soil. Dense and firm

1. Karakum Canal is the biggest canal taking water from Amudarya River, which feeds Aral Sea. Ability to handle water in Karakum Canal is reducing year by year due to insufficient management and maintenance.

structure of clay soil prevents water from infiltration. If the amount of precipitation reaches at least 6mm it creates water flow that goes to the an artificial pool (*oi*) and further to the underground reservoir (*sardob*). Sometimes rain water collected in the pool passes the sand stratum and creates a lens of fresh water. The volume of water collected in this way depends on the amount of rain and the size of the water catchment area. It is used for animal and human consumption (Kunin, 1959).

This way to obtain water has a number of constrains which, apparently, caused the decay of this method. Low precipitation is a natural limitation for this method. As a precipitation variability in the Karakum desert is 25–30 %, the sufficient amount of rain is not guaranteed. Besides, the surface of water catchment area must be kept clean. Any object, stone or dung, will lead to sand deposition with the consequent appearing of vegetation and can break the surface of takyr. The area should also be protected from passing herds and vehicles. Another reason for refuse of the traditional method of water collection is the emerge of the alternative water supply. In the settlements where water pipe has brought constant water there is no longer need in using takyr water.

4.1.2 Natural Preconditions of Desertification

The Karakum sand desert occupies a giant territory of 360,000 km^2 between the Uzboi in the west, the Amudarya River in the east, the Kopetdag and Paropamiz mountains in the south, and Kwarazm (or Khiva) Oasis in the north. The region is an immense undrained basin with parts below sea level. Very young dry land areas are encountered, formed as the result of drying up of lake basins and the drop in the level of the Caspian Sea. This vast territory is divided into Trans-Unguz and Lowland Karakum: the latter, in turn, is divided into the Central Karakum and the Southeast Karakum.

Relief

The Central Karakum lies northward from the sub-mountain plain of Kopetdag. Its absolute elevations vary from 20 m in the west to 200 m in the east. Sand ridges appear immediately northward from the submontane plain and often contain hard clay takyrs in the interridge depressions. Especially stable is the takyrs belt in the central and western parts, which streatches from 30 to 80 km east-west. Separating takyrs surface, sand ridges can rise to 15–20 m, and sometimes can be more than 10 km long. Takyrs are of great importance in the desert since they function as water catchment area. Wells and settlements are often located next to takyrs in the Karakum desert.

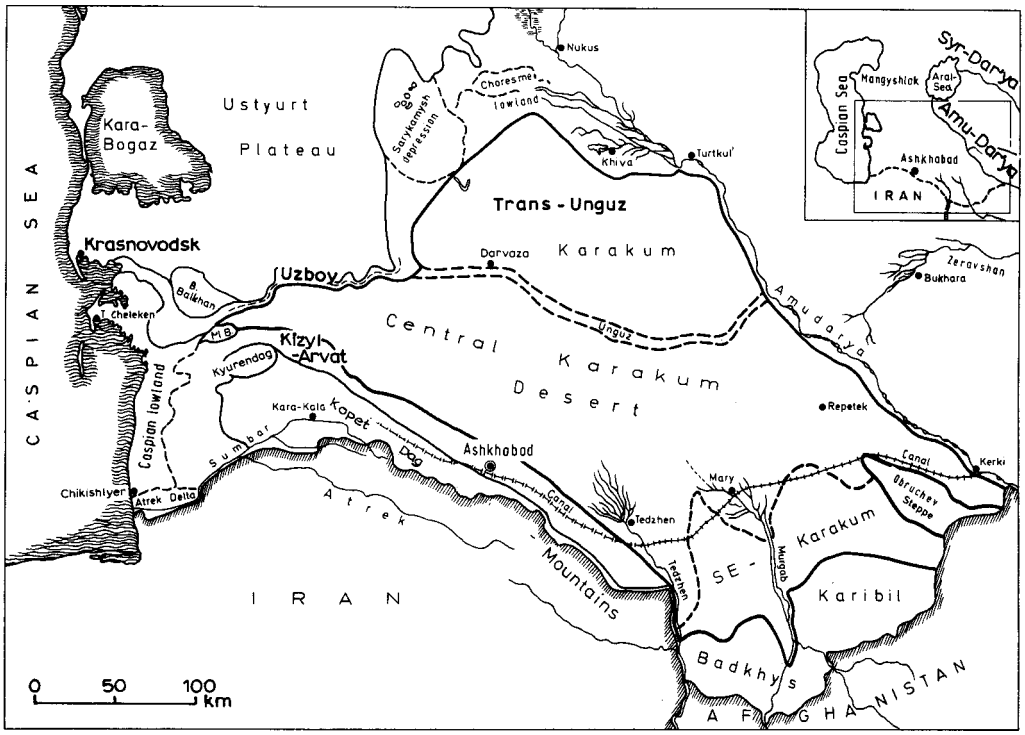


Figure 6: Southern Turan Part with the Sandy Karakum Desert
Source: Walter, H. and Breckle, S.-W., 1986, p. 233

In the southern part of the Central Karakum, a latitudinal belt of solonchaks (shors) stretches from east to west with a width from 10 to 40–45 km. The depth of solonchak, which is usually from 8 to 15 m, can reach at the some places to 40 m. Northward from the solonchal belt, sand area reappears and stretches to the ancient dry river bed of Unguz. Here ridges are low, dense, and separated by interridge depressions, creating a ridge-depression relief. Many depressions are occupied by takyrs. Primary ridges in the Karakum Desert have usually meridional or submeridional directions.

Temperature Regime

The features of atmospheric circulation, the intensive solar radiation, the southern continental location of the country, the nature of underlying surface and the remoteness from ocean determine the climatic peculiarities of the Central Karakum. The territory inland desert is characterised by high daily and seasonal fluctuation of air temperature. The average annual mean of air temperature of the over the territory of the Central Karakum varies from +14,8 °C in the north (Darvaza), and increase southward reaching +15,8 °C in the central part (Bakhardok, Yerbent). The absolute maximum of air temperature varies from +25 to +40 °C in cold season and +41 to +47 °C in warm season. The coldest months are December and January when the minimum temperature can reach −26 to −30 °C. The absolute minimum of air temperature ranges from −4 to −30 °C in October–April and −4 to −16 °C in May–September. The ampli-

tude of daily temperature fluctuation exceeds 31 °C. The absolute amplitude of annual temperature fluctuation exceeds 80 °C.

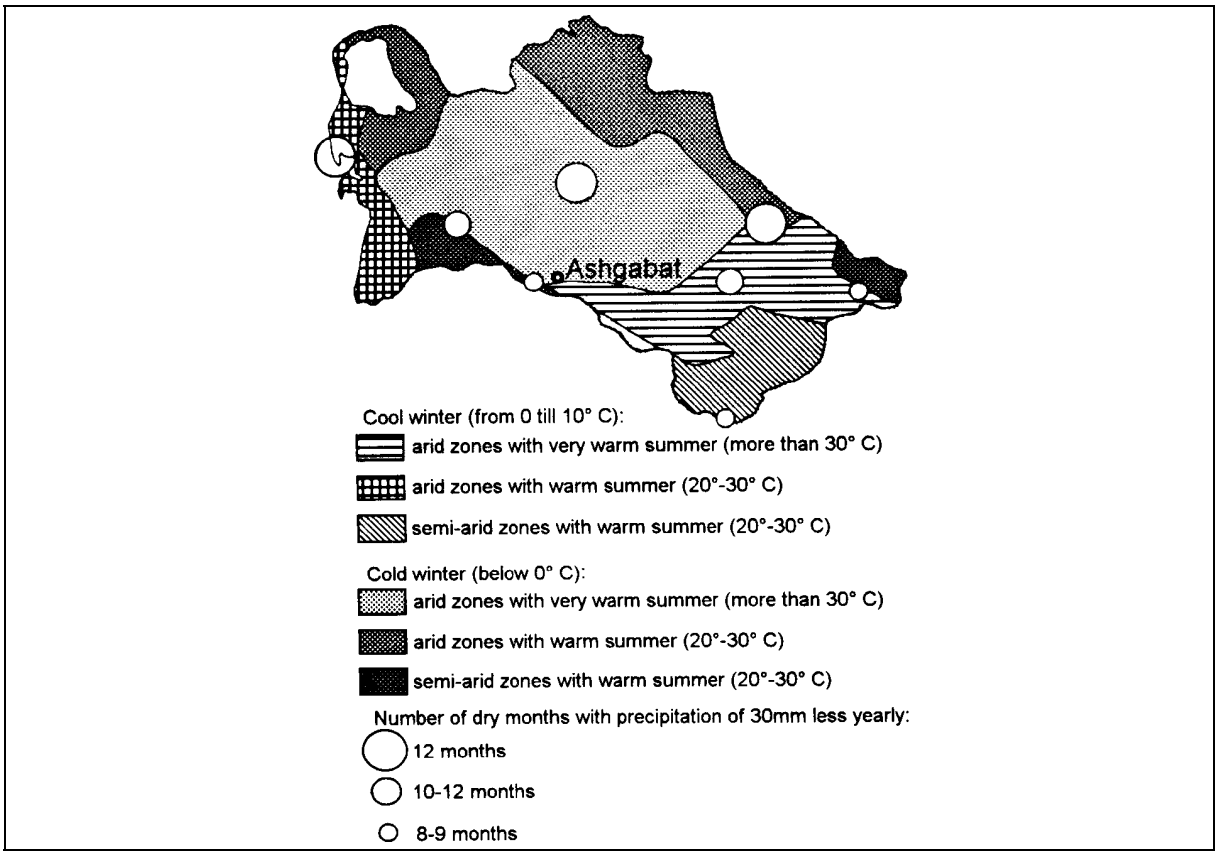


Figure 7: Fragment of the "Map of World Distribution of Arid Regions".
Source: "Desert Problems and Desertification in Central Asia", Babayev A.G., 1999 p. 92

Due to the dry climate of Karakum, almost all incoming solar radiation is spent on soil warming; therefore, soil temperature during the warm period is high everywhere. The average monthly soil temperature in July varies from 32–38^{o}C and, in some days, can reach a maximum of 76 °C–78 °C. The average annual temperature of soil surface varies from 18 °C to 20 °C in the Central Karakum. The sum of temperatures varies from 4,900 °C to 6,900 °C, both at the soil surface and at a depth of 20 cm.

Another characteristic of the Karakum desert is the long duration of solar radiance, which makes up in average 2,800–3,100 hours yearly. In January the duration of solar radiance is 100–150 hours and in July is 320–400 hours what is 80–93 % of maximum possible duration (Mukhamedov, G. ,1979).

Precipitation Regime

According to the level of annual precipitation territory of the Central Karakum belongs to the region with precipitation from 110 to 150 mm. Rainfalls affect the formation of sand relief and

diminish its transportation. The dry warm period and damp cold period are sharply distinguished in the Central Karakum. Major part of precipitation falls during the second half of winter and first part of spring. The minimum of rainfall is in July-August. In the Central Karakum 15–20 % of precipitation is falling in solid form and 60–70 % in liquid form, mixed form makes up 15–20 %. The blanket of snow in the Central Karakum is unstable; during winter it can accumulate and melt several times which helps the accumulation of humidity in soil for better development of ephemeral vegetation later in spring. The rate of humidity in autumn is an favourable factor for development of vegetation.

Apart from the uneven distribution of the precipitation during the year, the climate is characterised by an exceedingly great variability in different years. The annual mean of atmospheric precipitation fluctuates in the Central Karakum from 24 mm to 564 mm. There are years with very little precipitation and the years when almost whole annual amount of rain falls in one month. The highest daily maximum is 124 mm. The number of days with considerable precipitation (10 mm during 12 hours) varies from 2 to 6. Notwithstanding its scarce occurrence, rainfall in a short time may cause water erosion and destructive mud flood.

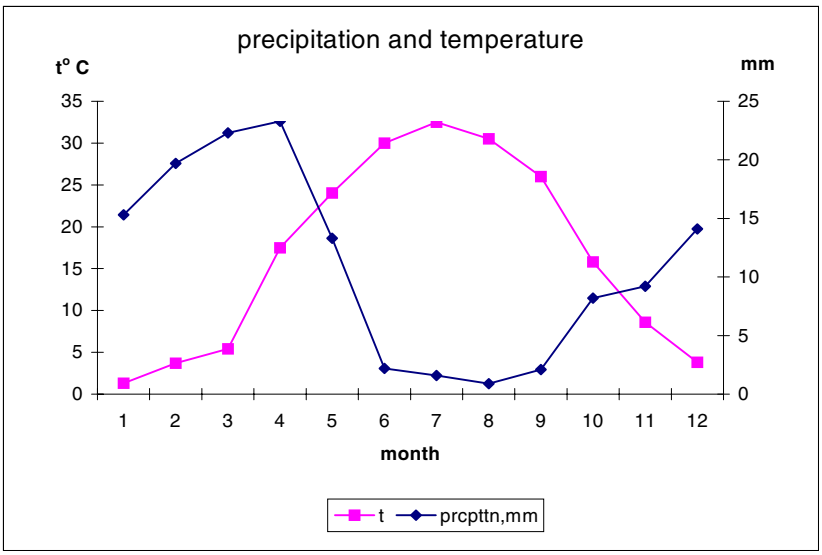


Figure 8: Annual Distribution of Temperature and Precipitation in the Central Karakum.
Based on the 50 Years Observation (1945–1995). In the Central Karakum summer is the longest season (more than 150 days) when temperature reaches its highest grades and precipitation its lowest. Only 4 % of annual precipitation falls in June-August period when average monthly air temperature raises up to 46–48 °C during the daylight hours.
Composed by the author, 2000

High air temperature and scarce precipitation in the region cause the dryness of air. In summer the relative air humidity raising up to 22–25 % and in the hottest days it makes only 2–3 %. In winter the average relative monthly humidity of air is comparatively high – 75–78 %. High

air temperature in the Central Karakum causes evaporation rate of 2,115 mm which is 20 times exceeds the mean of rainfall in this region (Arnageldiev A., 1979). Such climatic conditions underlie the high degree of aridity of the region. The aridity coefficient varies from 2 to 7 which makes the region severely proned to the processes of desertification (Babaev A., 1996).

Circulation factors and geographical peculiarities of the terrain determine the wind regime in the Central Karakum. The territory of the Central Karakum is open from all sides except for south, that is why north-eastern anticyclones are dominating during cold season and western and north-western cyclones prevail during warm season. Their mutual interaction changes in different parts of the Central Karakum under the affect of Kopetdag mountains in the south. As the result, by annual repetition, the north-eastern winds are dominating in the southern and central part and north-western are dominating in the southern part of the region.

The winds with low and moderate velocity (0–5 m/sec) are prevailing in the Central Karakum. Repetition of these winds is 75–85 % of possible velocity. The difference between seasonal wind velocity is clearly recorded. The highest average monthly velocity is typical for winter and especially in spring (Mukhammedov, G., 1979). In the Central Karakum during one year in average 5–10 days with strong winds (velocity more than 15 m/sec) are to be observed.

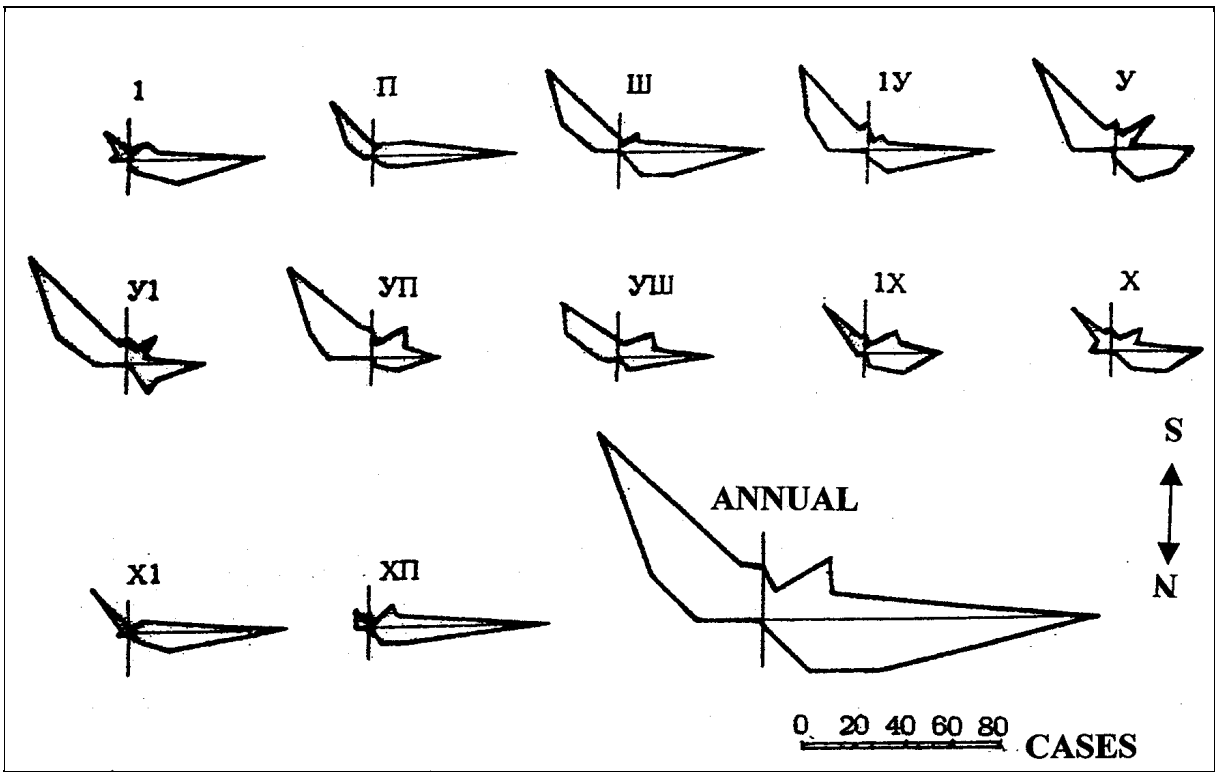


Figure 9: Average Monthly and Average Annual Rose of Active Wind Based on the Data of Meteorological Station Bakhardok (1951–1972)
Source: Arnageldyev, A., 1979, p. 44

Bakhardok meteorological station indicates that eastern winds prevail from October till March. The main part of annual amount of precipitation (124 mm) falls in this period when the sand become moisturised and less active. The average velocity of eastern winds during the period of 22 years (1951–1972) is 5.4 m/sec and 6.3 m/sec for the western winds (Arnageldiev, A., 1979). In April direction of winter winds changes for summer direction. In the period from May till August when the sands are dry and active wind blows from west and north.

Water Regime

The Central Karakum is distinguished by extreme water deficiency: there is no surface water in the Central Karakum, but this part of the desert is rich in underground waters. They spread throughout the desert and form a united hydrological water table called "Karakum flow" (Kunin, V., 1959). Depending on the altitude of terrain, its geological structure and types of relief, underground waters are spread on the largest part of the desert at the depth of 10–25 m. In solonchak depressions underground water can be found at the depth of 0.4–1 m depending on the season. Underground waters of the Karakum desert is formed mainly by the in-filtration of water from Amu-Darya river and blind deltas of Murgab and Tedjen rivers in the eastern part of the desert. At the less extent, underground water is supplied from Kopet-Dag mountains and Karakum Canal in the south part of the desert. Besides, underground water is fed by the run-off infiltration from takyr surfaces and precipitation through the barkhan sands. When the fresh water percolates to the level of saline water, part of fresh water mixes with saline underground water. In the Central Karakum this natural phenomenon has been known and used by the desert inhabitants as an alternative water source for a long time (see chapter 4.1.1).

The degree of mineralisation of underground water increases from south to north: in the south where underground water is diluted by fresh water of the Karakum Canal, northwards mineralization is growing and reaches up to 40 gr/l.

Underground water of the Central Karakum flows with little inclination to north-west and west of the country. This underground stream flows under the depressions of the Central Karakum where the level of underground water rises reaching the surface and increasing transpiration, so forming solonchaks. In the depressions of the Central Karakum, root systems of many plants can reach the underground water and rely on it. However, the biggest part of the region has a very deep level of underground water which is inaccessible for plants. The main source of moisture of root system is moisture horizon appeared in sands as a consequence of precipitation or condensation of dew at a depth of 60–80 cm.

Soils

The research area belongs to the zone of deserts. According to a frequently used soil classification, there are grey-brown, desert, sand, takyr-like and takyrs soils. The interzonal soils of halomorphic series are represented by typical, takyr-like, and hydromorphic, solonchaks, and crustal soils. Soils of sand desert are composed of medium and fine-textured nonsaline sands and are used for pastures. The natural fertility is low, and the humus content is up 0.5 %.

The takyr-like and takyrs soils extend throughout the ancient alluvial delta and proluvial foothill plains with scarce. Takyr-like soils build up from comparatively young stratified loam and clay deposits varying in their salt content, and with ground water at a deep level. Takyrs have a clear polygonal patter and are formed of saline clay deposits. In their profile, a dense cellular crust is singled out separated by fissures. The area of takyrs appear to be ideal for irrigation, but their high salinity and very low permeability make it difficult to farm successfully (McGinnies W., Goldman B., 1986).

Solonchak soils formed by salt deposition, by the ancient alluvial basins or by prolonged irrigation with inadequate leaching, may be found throughout the Central Karakum.

Vegetation Cover

Climatic characteristics of the Central Karakum together with the soils patterns create specific vegetation cover. Vegetation cover of the region is composed of drought resistant species. The number of species in the research area is not rich because of lack of precipitation, drying up of soil, air droughts and extremely high summer temperatures. Sandy soil extremely heated during the summer affects the climate and causes specific microclimatic conditions.

Detailed description of geo-botanical survey of the Central Karakum was conducted by the Turkmen scientists and published in the book “Vegetation of the Central Karakum and its productivity” (Nechayeva, 1970). According to this survey, the three main vegetation associations can be distinguished in the Central Karakum. They are vegetation of large sandy ridges, vegetation of shallow hilly sand, and vegetation of takyr surface.

Regarding the climatic factors and the methods of adaptations to severe arid condition of the desert, plant communities develop variously. Vegetative period occurs in different time of the year. Desert vegetation is the main sand fixing component and thus the main factor of relief development. Among the plant communities in the Central Karakum Halaxylon persicum (white saxaul) is a plant suitable for fixing desert sands; it is also valuable as wood, food and

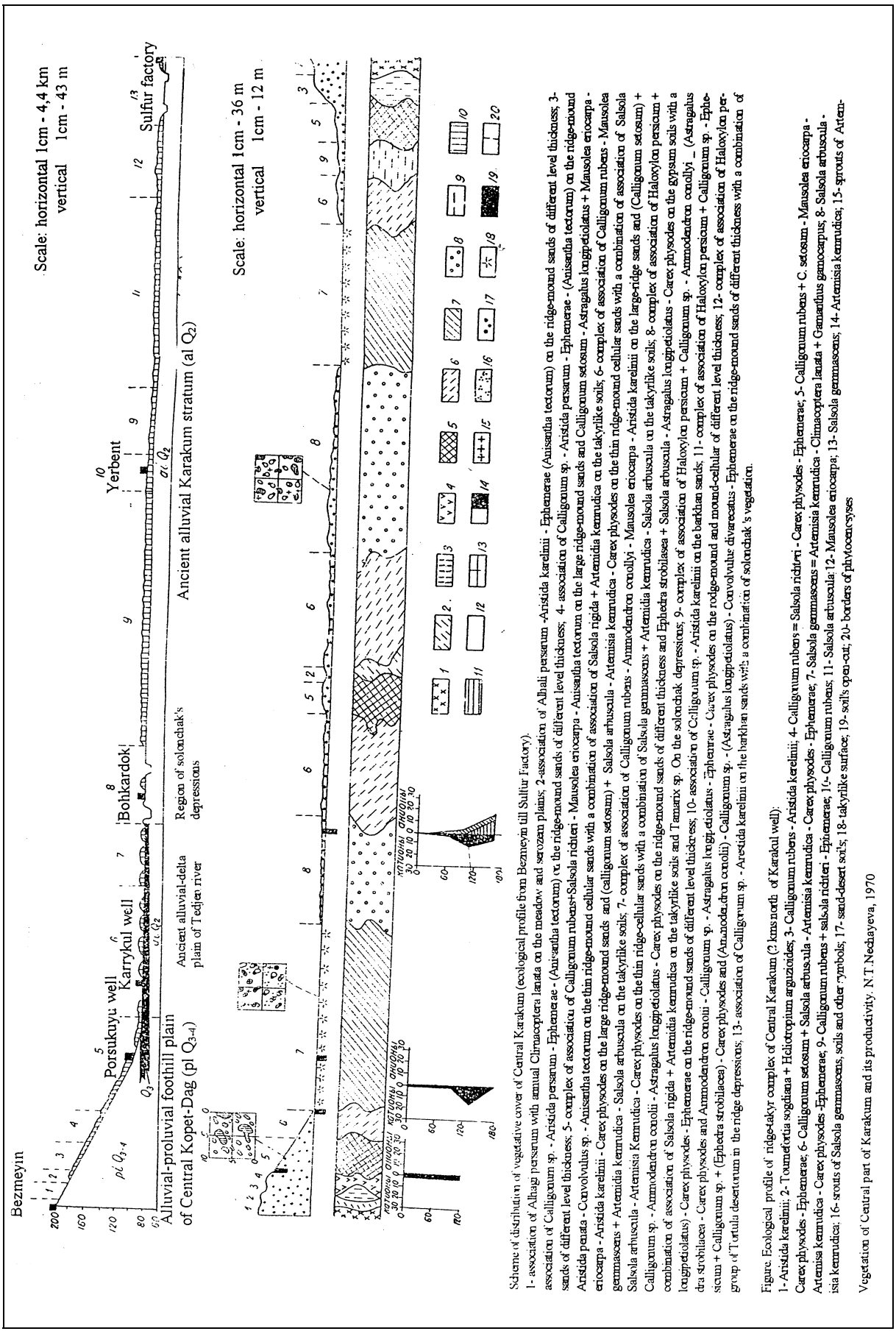
Table 8: List of the most Widespread Desert Vegetation Species in the Central Karakum

Latin name	Turkmen name	Russian name
Trees		
Ammodendron conolii	Suzen	Sandy acacia
Shrubs and undershrubs		
Haloxylon persicum	Sazak	White saxaul
Haloxylon aphyllum (ammodendron)	Odjar	Black saxaul
Salsola richteri	Cherkez	Solyanka richtera
Callegonum setosum	Chakysh	Kandym zhetinistyi
Ephedra strobilacea Bunge	Bordjak	Khvoinik shishkonosnyi
Astragalus longipetiolatus	Potlak	Astragal dlinnochereshkovyi
Sasola arbuscula	Boyalych	Solyanka derevzividnaya
Salsola gemmascens	Tetyr	Solyanka pochechkonosnaya
Salsola sclerantha	Shora	Solyanka hryazhezvetnaya
Mausolea persicum	Bozagan siza	Mavzolea volosistoplodnaya
Tamarix karelini	Yilgyn	Grebenzhik karelini
Calligonum rebens	Kandym	Kandym krasneyuzhyi
Calligonum arborescens	Akkandym	Kandym drevovidnyi
Artemisia kemrudica	Yovshan	Polyn kemrudskaya
Perennial grasses		
Argusia sogdiana	Gunneyik	Argusia sogdiyskaya
Heliotropium argusioides	Ashygozhy	Geliotrop argusievidnyi
Alhagi persarum	Yandak	Camel thorn
Ephemeroid species		
Carex phisodes	Ilak	Osoka vsdutaya
Ephemera species		
Stipagrostis karelinii	Erkek selin	
Stipagrostis penata	Urkochi selin	
Ferula litvinoviana	Chemuch	Ferula litvinova
Climacoptera lanata	Gushgezi, balyk goezi	Klimakoptera sherstistaya
Bromus tectorum	Epelek	Koster krovelnyi
Meniocus linifolius		Ploskoplodnik lnolistnyi
Erodium cicutarium		
Arnebia decumbens	Chekeneylik	Arnebiya prostertaya

Source: Nechayeva, N., 1970, pp. 237–244

shade for animals. The black saxual thickets (Halaxylon aphyllum) prefers mainly depressed forms of the relief where the sands have finer grains and are quite saline.

Variety of vegetation in the Central Karakum Desert is presented in Table 8.



Scheme of distribution of vegetative cover of Central Karakum (ecological profile from Bezmeyin till Sulfur Factory).

1- association of Alhagi persarum with annual Chrisocoptera lanata on the meadow and serozem plains; 2-association of Alhali persarum -Aristida karelinii - Ephemerae (Anisantha tectorum) on the ridge-mound sands of different level thickness; 3-association of Calligonum sp. - Aristida persarum - Ephemerae - (Anisantha tectorum) on the ridge-mound sands of different level thickness; 5- complex of association of Calligonum rubens+Salsola richteri - Mausolea eriocarpa - Anisantha tectorum on the large ridge-mound sands and Calligonum setosum - Astragalus longipetiolatus + Mausolea eriocarpa - Aristida pennata - Convolvulus sp. - Anisantha tectorum on the thin ridge-mound cellular sands with a combination of association of Salsola rigida + Artemidia kemrudica on the takyrlike soils; 6- complex of association of Calligonum rubens - Mausolea eriocarpa - Aristida karelinii - Carex physodes on the large ridge-mound sands and (calligonum setosum) + Salsola arbuscula - Artemisia kemrudica - Carex physodes on the thin ridge-mound cellular sands with a combination of association of Salsola arbuscula - Artemisia Kemrudica - Carex physodes on the thin ridge-cellular sands with a combination of Salsola gemmascens + Artemidia kemrudica - Astragalus longipetiolatus - Carex physodes on the ridge-mound sands of different thickness and Ephedra strobilasea + Salsola arbuscula - Astragalus longipetiolatus - Carex physodes - Ephemerae on the ridge-mound sands of different level thickness; 10- association of Calligonum sp. - Aristida karelinii on the barkhan sands; 11- complex of association of Haloxylon persicum + Calligonum sp. - Ephedra strobilacea - Carex physodes and Ammodendron conolii - Calligonum sp. - Astragalus longipetiolatus - Ephemerae - Carex physodes on the ridge-mound and mound-cellular of different level thickness; 12- complex of association of Haloxylon persicum + Calligonum sp. + (Ephedra strobilacea) - Carex physodes and (Ammodendron conolii) - Calligonum sp. - (Astragalus longipetiolatus) - Convolvulus divaricatus - Ephemerae on the ridge-mound sands of different thickness with a combination of group of Tortula desertorum in the ridge depressions; 13- association of Calligonum sp. - Arestida karelinii on the barkhan sands with a combination of solonchak's vegetation.

Figure. Ecological profile of ridge-takyr complex of Central Karakum (2 kms north of Karakul well):
1- Aristida karelinii; 2- Tournefortia sogdiana + Heliotropium arguzioides; 3- Calligonum rubens - Aristida karelinii; 4- Calligonum rubens = Salsola richteri - Carex physodes - Ephemerae; 5- Calligonum rubens + C. setosum - Mausolea eriocarpa - Artemisia kemrudica - Carex physodes -Ephemerae; 6- Calligonum setosum + Salsola arbuscula - Artemisia kemrudica - Carex physodes - Ephemerae; 7- Salsola gemmascens = Artemisia kemrudica - Climacoptera lanata + Gamanthus gamocarpus; 8- Salsola arbuscula - Artemisia kemrudica; 9- Calligonum rubens + salsola richteri - Ephemerae; 10- Salsola arbuscula; 11- Salsola arbuscula; 12- Mausolea eriocarpa; 13- Salsola gemmascens; 14- Artemisia kemrudica; 15- sprouts of Artemisia kemrudica; 16- sprouts of Salsola gemmascens; soils and other symbols; 17- sand-desert soils; 18- takyrlike surface; 19- soil's open-cut; 20- borders of phytocenoses

Vegetation of Central part of Karakum and its productivity. N.T.Nechayeva, 1970

Figure 10: Scheme of Vegetative Cover of the Central Karakum

Source: Nechayeva, N., 1970

4.1.3 Climate Change Scenarios for Turkmenistan

The information presented in this chapter relies on the data of the First National Report on Framework Convention on Climate Change in Turkmenistan (1999).

The surface and atmospheric air temperature was considered as the main climatic characteristics of the database of meteorological stations distributed evenly on the territory of Turkmenistan. These meteorological stations possess a sufficiently long monitoring database. The monitoring data of two periods of three decades each (1931–1960 and 1961–1990) together with the data of recent years (up to1997 inclusively) were used for the evaluation of the change of meteorological parameters.

The comparison of annual mean of air temperature (AT) of the period 1961–1990 with previous decades 1931–1960 shows that the later period became warmer, particularly in the northern part of the country where the AT rose on average by 0.6 °C. In the western part of Turkmenistan the warming made up to 0.3 °C, in the foothill areas and the eastern part the warming is 0.2 °C. The analysis of 65 years data of mean of AT in Turkmenistan indicates the tendency of slightly increasing mean of seasonal and annual AT over the period of 1931–1995.

The analysis of repetitions and continuity of the periods with AT of 40 °C and higher was conducted on the database of three MS (Gyzylarvat, Takhtabazar and Ashgabad) over the period of 1931–1995. As a result of the analysis, it was concluded that the number of days with the AT of 40 °C and higher has been increasing since 1983. It should be pointed out that during the period of 1931–1974 the case when AT of 40 °C and higher holding more than 15 days in July was observed once; during the period of 1975–1997 such cases occurred 9 times, whereas during the period of 1995–1997 such cases happened three years successively.

In comparison with the 1931–1960-period the amount of atmospheric precipitation (AP) during the period of 1961–1990 has increased in winter season mainly in the northern and eastern parts of the country and Kopetdag foothill areas. In spring season the amount of AP has decreased on the whole territory of the country. In summer AP are very scarce and are mainly observed in the eastern part and Kopetdag foothill areas. In the northern and western parts of the country some meteorological stations recorded the increasing of AP and some of them recorded the decreasing of AP. The amount of autumn precipitation has decreased allover the territory of Turkmenistan. In comparison with preceding thirty years (1931–1960) annual mean of AP of many years has increased during the period 1961–1990.

In average, during the period 1931–1995 the sum of total annual AP has slightly increased on the whole territory of Turkmenistan; among the seasons winter is more pronounced.

A definition of possible scenarios of climate change on the territory of Turkmenistan was done by the method of Intergovernmental Group of Experts on Climate Change. The definition was based on models of general circulation of atmosphere and oceans, namely:

- GISS – balanced model of Goddard Institute of Space Stidies of USA
- CCC – balanced model of Canadian Climate Center
- UK89 – balanced model of Meteorological Survey of United Kingdom
- GFDL – balanced model of the Laboratory of Geophysical Fluid Dynamics Laboratory of University of Prinston, USA
- GFDL-T – unbalanced model of the Laboratory of Geophysical Fluid Dynamics Laboratory of University of Prinston, USA

The real climate database of 1961–1990 was used for the calculation of the climate change model. By the calculation of the scientists concentration of CO_2 in the atmosphere will double by the mid or end of the 21st century. This fact will affect climate in Turkmenistan by increasing annual and seasonal mean of AT.

Analysis of all models used for investigation of the main climatic parameters in Turkmenistan shows the following results:

- The model CCC predicts the maximum warming. According to this scenario, by the time of doubling of CO_2, increasing of average annual AT in Turkmenistan is expected to make up 6.1 °C and AP will decrease by 15 %. The maximum rise of the AT will fall on the winter period and increasing of AP will happen in spring.
- The minimum warming is given in the scenario of GDFL model. According to this scenario increasing of average annual AT will be 4.2 °C and annual sum of AP will be without change (0.0 %).
- Another scenarios predicts the increase of average annual AT on 4.6–5.5 °C with decrease of AP on 17–56 %.
- The seasonal change of average surface AT is predicted to be the following: CCC model shows the maximum warming in winter, UK89 model presents maximum warming in summer, GISS model in autumn, GFDL-T – in winter period and GFDL – in summer period.

Table 9: Change of Average Annual AT (ΔT) and Annual Sum of AP (ΔR) on the Territory of Turkmenistan (data 1961–1990)

General Atmospheric Circulation Model	ΔT, C	ΔR,%
GISS	4.6	–56
GFDL	4.2	0.0
UK89	5.5	–17
CCC	6.1	–15
GFDL-T	4.8	– 4.4

Source: National Report on Frame Convention on Climate Change, 1999.

Increasing evaporation and moisture deficiency caused by climate change will affect physiological need of vegetation in water. On the base of climatic parameters used, the annual sum of evaporation will increase by 760 mm (48 %). With probable moisture deficiency exceeding the actual one by 1.4–1.6 times during vegetative period the productivity of agricultural sector will be affected.

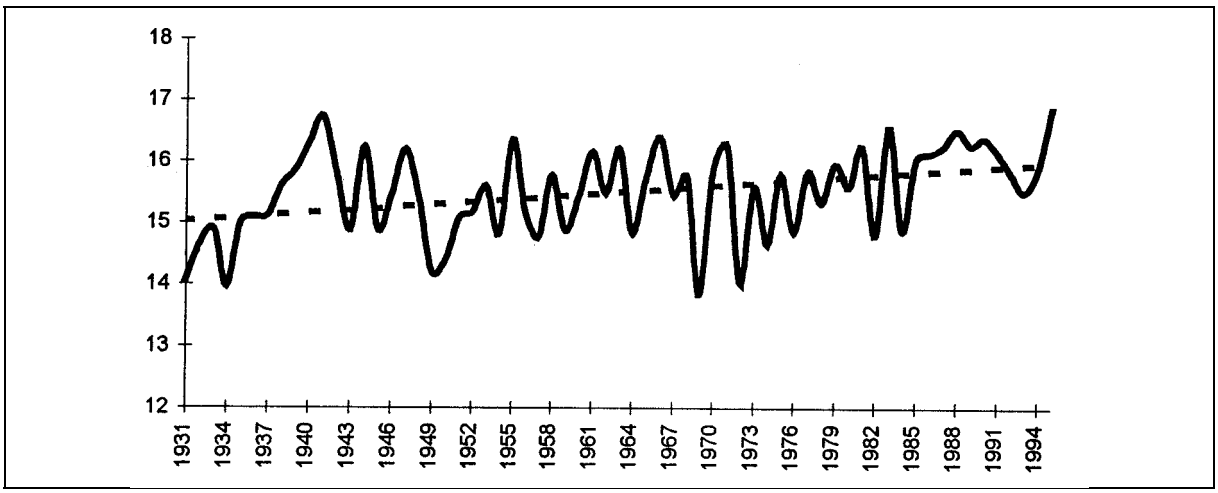


Figure 11: Time Dependence and Linear Trend of Annual Average Air Temperature Averaged for Territory of Turkmenistan (1931–1995)
Source: National Report on Frame Convention on Climate Change, 1999.

The assessment of climate change and its influence on pastures vulnerability shows that pastures productivity will reduce in the future. Despite of high adaptation capacity of vegetation to dry and hot weather conditions, there are 1–2 years out of 10 years when desert drought causes reduction of pasture productivity. The criterion of soil drought is the reduction of soil moisture up to 4mm in the layer of 0–20 cm.

For prognostication analysis, the totals of annual precipitation and moisture deficiency in April were used. The analysis of these parameters indicates that, in comparison to the actual annual totals of precipitation, the predicted annual totals of precipitation in autumn-spring period (September–May) will decrease in:

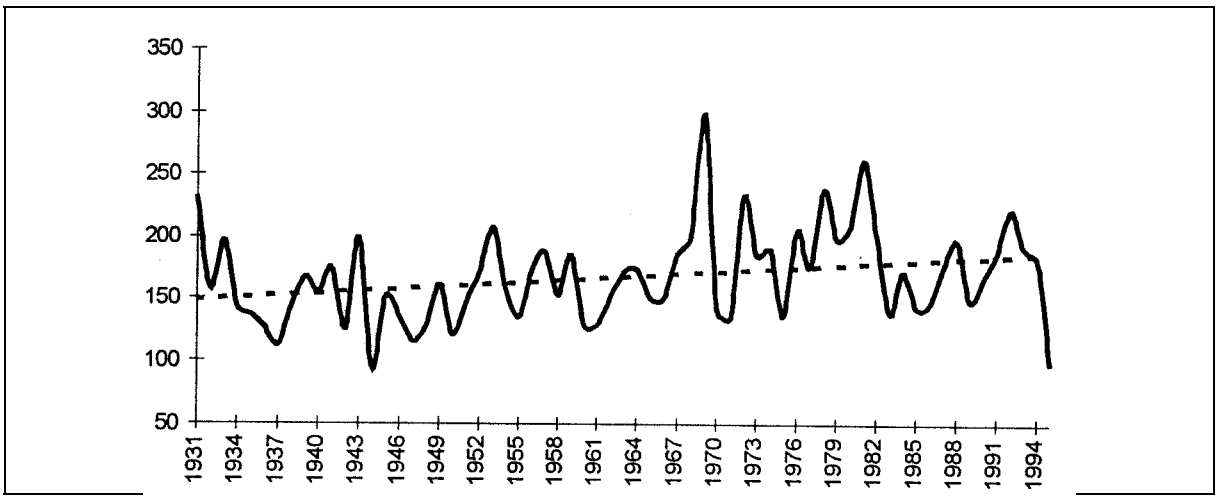


Figure 12: Time Dependence and Linear Trend of Annual Average Sum of Precipitation Averaged for Territory of Turkmenistan (1931–1995)
Source: National Report on Frame Convention on Climate Change, 1999.

- Balkan Region by 45 mm/year
- Akhal Region by 60 mm/year
- Mary Region by 14 mm/year
- Lebap Region by 49 mm/year
- Dashoguz Region by 16 mm/year

Generally, during the vegetative period, moisture deficiency may increase in

- Balkan Region by 7.8 %
- Akhal Region by 11.7 %
- Mary Region by 14.4 %
- Lebap Region by 10.4 %
- Dashoguz Region by 8.8 %

The analysis of results of the estimation shows that according to the scenario of UK89 model, pasture productivity may be reduced by 10–15 %. Nevertheless, it is possible to control pastures productivity taking rehabilitation measures to conserve pasture vegetation and to maintain pasture carrying capacity. This allows us to conclude that with adequate conservation measures the desert livestock-breeding sector will not be negatively affected by climate change.

Over a decade (1986–1995) sheep population in Turkmenistan varied from 4,816 thousand heads to 6,574.2 thousand heads (average was 5,708.5 thousand heads). There are certain ap-

prehensions that the increase of temperature may negatively affect animal health (meat, wool, lambing rate) with consequent reduction of their productivity. According to the estimation of scientists the yield of lamb may decrease by 5–25 % and the yield of wool may decrease by 10–20 %.

Considering all said above, one can conclude, that according to the four worldwide models of climate change increase of AT and moisture deficiency is projected for Turkmenistan. Productivity of vegetation of desert pastures in the forthcoming years will be undoubtedly threatened. Therefore, development and implementation of conservation measures in agriculture will request certain investments.

The on-going Project of Global Livestock CRSP in Turkmenistan, aiming at modelling of carbon dioxide flux on the pastures and the rural survey of human welfare and the production systems, concludes that recent market changes and privatisation caused imbalances and dramatic reductions in agricultural stocks, production and productivity in Central Asian Republics. Sustainability of extensive production and human nutrition welfare were negatively affected. Central Asian pastures may constitute a significant part of the "missing sink" that attenuates the increase in atmospheric carbon dioxide (Annual Report GL CRSP, 1999). Therefore, being a consequence of climatic variations and human impact pasture degradation itself contributes to further climate change.

4.2 Identification of Problems and Strategies

4.2.1 Livestock Grazing, its Impact on Desertification Processes and Opinion of the Shepherds

The main occupation of the Karakum desert inhabitants is a migratory livestock breeding. Livestock breeding is the main source of income for the local people, and at the same time, the desert dwellers main and the oldest way of co-existing with the desert environment. The sandy part of the Karakum desert presents suitable desert pastures for year-round grazing of sheep, goats and camels. Based on observations carried out by the Desert Research Institute, the use of the pastures and the value of forage change with the seasons (Table 10). Turkmenistan's pastures make up about 38.7 million hectares. Among them, 28 million hectares belong to the Karakum desert. Livestock raising in Turkmenistan plays a major role in supplying food for domestic consumption as well as supplying national market with meat, wool and dairy products.

Because of the location of the pastures of shepherds' tribes, Astrakhan Sheep-Breeding sovkhoz[1] Yerbent was founded in 1941 by the Turkmen Soviet administration to supply the

Table 10: Utilization of Pastures According to Seasons

Pastures	Spring	Summer	Fall	Winter
Sandy desert	S	M	M	W
Clay desert	N	N	M	W
Gypsum desert	N	N	M	N
Submontane desert	S	M	M	W
W – weak, S – strong, M – moderate, n – not in use				

Source: TACIS Report, 1990, p. 11, unpublished

military on the front with meat during the Second World War. A redistribution of the pastures in Turkmenistan together with their inventory took place in 1979. The redistribution did not touch the Ashgabad Region which includes Yerbent sovkhoz. Therefore, the distribution of pasture plots in Yerbent peasant association is the same as on the day of its foundation in 1941 (see Fig. 13).

The territory of the peasant association comprises pastures suitable the all year-round grazing of small stock and camels except in years of drought. Traditionally, livestock grazing in the Central Karakum was fully dependent on rainfall. Its amount was decisive for the biomass and digestible proteins of the pasture vegetation. With the emergence of the sovkhoz and kolkhoz systems, the loss of animals during years of low yield and drought was minimized by the storage of extra fodder by the local administration. The climatic peculiarities of the Karakum desert cause of the irregularities in available forage base. It can be assumed that within a ten years period, three of the years will provide sufficient natural pasture forage, four of the years will provide a moderate crop with three of the years yielding an insufficient forage base (Nikolaev, V., 1982).

After the 1991independence when the former collective farm system was transformed into a new model of peasant associations (see chapter 2.3), the process of leasing state animals to the private shepherds started in the newly established peasant associations. Presently, there are three forms of livestock ownership in Turkmenistan – state/public animals, leased animals on a long-term basis, and private ownership.

Leasing is executed on the basis of a contract between the head of the peasant association on the one side and the leaseholder on the other. The leaseholder can either be an individual or a group of individuals. In the latter case, the leading shepherd has to be chosen. All leased property remains the property of the peasant association. A special account book is opened for the lease-

1. Sovkhoz is shortening from *sovetskoye khozaystvo* (Soviet farm)

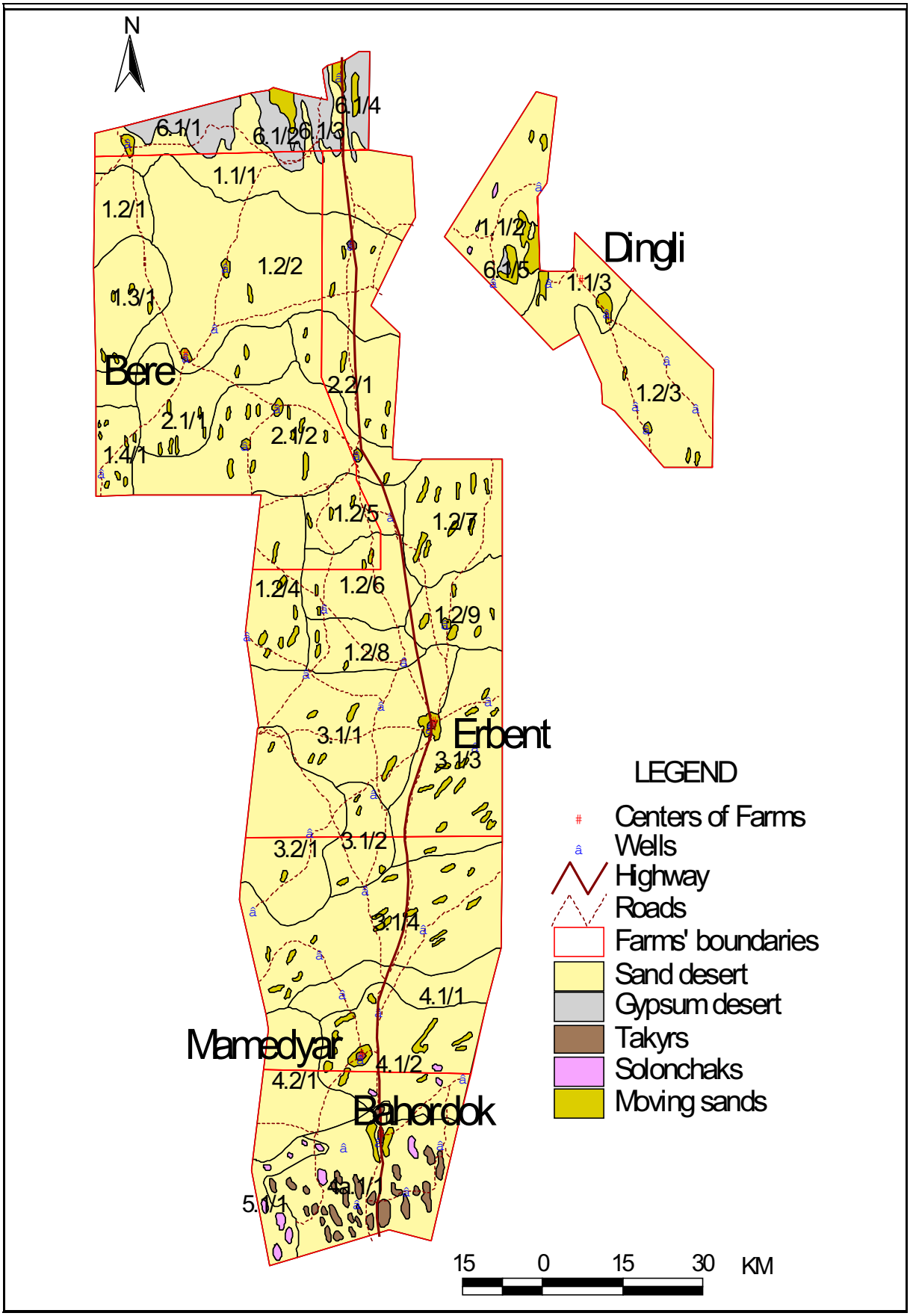


Figure 13: Types of Pastures of Yerbent Peasant Association
Source: Results of GIS, NIDFF, 1999

holder. The administration of the peasant association is obliged to supply the shepherds, who work under the lease agreement, with all necessary farming equipment. The association is also obliged to sell fodder for the leased livestock at a prime cost. The shepherd, in turn, is obliged to maintain the initial number of animals in his herd. Otherwise, he has to compensate the loss of leased animals with his own animals or the equivalent amount of money. He also has to deliver an agreed upon amount of wool, which depends on the age of the sheep, maintain the optimal weight of the animals. The shepherd is given in advance monthly payment by the administration of the peasant association, which based on the number and specie of animals.

In the case of Yerbent peasant association, a shepherd brigade (group of tenants) receives 80 % of the total annual production of their flock, while 20 % is given to the peasant association (1997). The lease contract requires that each shepherd give up 90 lambs from 100 Karakul ewes. Any extra offspring belongs to the shepherd. If a shepherd does not meet the target he has to make up the difference from his private herd. In 1998 the average lambing percentage was 92 %, and in 1997 it was 90.8 % (Wright, 1998). The shepherds under lease contract can work in both collective and individual brigades. The difference between these two forms is that under the collective lease there is one supervisor for 20 shepherd brigades, who takes the records of all expenses and inputs received by each brigade during the year. Every half year he reports to the administration on behalf of the shepherds. The shepherd working under individual lease must keep his own record of expenses and meet with the administration every six months to settle his account himself. This system is slowly expanding, and by 1998 six out of the 20 shepherd brigades in Yerbent peasant association had become independent (Lunch, C., 1999).

Shepherds in Yerbent peasant association are paid a type of salary in the form of an advanced payment since at the end of the year the amount paid is deducted from the shepherds' 80 % share. Each shepherd working under a lease contract receives 3,000 manats per month for each adult sheep and 1,000 manat per month for each lamb. This advance payment allows the shepherds to purchase necessary equipment to survive in the desert.

The law on livestock leaseholding insufficiently supports the issue of rational pastoral use. The contract stipulates a responsibility of the leaseholders to maintain the pasture's optimal condition. This, however, has a formal nature as the pastures still belong to the State. The water supply to the pastures the and rehabilitation of the pasture vegetation, including stimulus and punitive sanctions, have not yet been formed. The introduction and enforcement of these measures could help to preserve the carrying capacity of the desert pastures.

Since the collapse of the former Soviet system of *sovkhozes,* shepherds have been experiencing difficulties in marketing their wool. At the same time of the Soviet Union when the cutting of wool was organized by the State, the shepherds received assistance from the *sovkhozes* for shearing the animals twice a year in the spring and autumn. Based on the statements made in interviews, they were paid an acceptable amount of money, so that wool production became the main source of income for shepherds. Now the shepherds themselves have to take care of everything. To shear sheep, the leaseholders of state farm owned animals or the owner have to hire an assistant, who is paid 2,000 manat per sheep. With about two kilograms of wool from one sheep at a price of 700–500 manat per kilogram of wool shepherds make a losses. In addition, the wool can only be sold to the state, which has a monopoly on the wool price. However, sheep need to be sheared, and large amounts of unclaimed wool are wasted and spoiled in the open air every year as the storehouses have to be empty for next year's wool.

At present, legislation allows shepherds to hold as many animals within the private sector as they can manage. In addition to private animals, shepherds can hold leased animals. The introduction of the leasing system in animal husbandry is supposed to help strengthen shepherds' households by increasing their incomes and at the same time to support the unprofitable public livestock sector (Lunch, C., 1998). The opinion of the shepherds is that leasing animals offers pros and cons: "*… it gives you more troubles, but it also gives you a chance to increase your private herd. But the best is to have always a portion of your own animals in the leased herd. It provides some security in years of drought."*

When shepherds were organized in state farm units, they were supported by the government for many years with necessary facilities – fodder, veterinary services, and the construction and maintenance of wells. At the same time they were deprived of the possibility to increase their private herds, which is traditionally the only means of owing property and enabling prosperity for the shepherds. Now they have got a chance to manage their animals as real owners, and they are also encouraged to increase the number of privately owned livestock.

The lack of state support for animal husbandry is reflected in the insufficient treatment of the animals' health, provision of fodder, maintenance of water sources and insufficient marketing. In 1997, 5 % of the total livestock and 1.2 % of the private livestock was affected by a lung disease due to difficulties the livestock owners had purchasing the necessary medicines. Skin diseases have become common among the animals in recent years, causing a decrease in productivity and an increase in animal mortality. Because of financial constraints it is often impossible to carry out a timely and thorough treatment of the animals (Khodjakov, O.,1999).

Table 11: Distribution of Small Ruminants in Public and Private Sector of Turkmenistan in 1998

Velayats	Sheep & goats, total (heads)	Karakul (heads)	Karakul (%)	Saradjinsky (heads)	Saradjinsky (%)
Akhal	1,244,577	550,172	44.2	694,405	55.8
Balkan	750,792	345,491	46.0	405,301	54.0
Dashoguz	650,896	510,668	78.5	140,228	21.5
Lebap	1,106,304	901,930	81.5	204,374	18.5
Mary	2,204,293	1,719,132	78.0	485,161	22.0
Total	5,956,862	4,027,393	67.6	1,929,469	32.4

Source: TACIS Report, 1999, p. 14

Table 12: Dynamic of Livestock in Public Sector in Yerbent Peasant Association

Years	Sheep and goats	Camels
1983	51,275	1,496
1989	54,526	2,372
1991	51,587	2,325
1996	57,190	2,197
1998	45,127	2,126
1999	46,057	1,994

Source: Statistics from Yerbent Peasant Association, unpublished

Available information on the total livestock population in Turkmenistan and the number of livestock of Yerbent peasant association is often contradictory. Official statistics can deal only with the situation in the public sector of livestock breeding. Even if there is no longer a prohibition on increasing private herds, and this process is encouraged, shepherds hesitate to share information about the real number of their private animals. So, it is difficult to conclude to what extent the number of private animals has increased since the beginning of the 1990s. Even if an increase of private herds is taking place, one cannot speak of a drastic increase. Obviously, the problems affecting the public sector of livestock breeding, such as lack of watering points and supplementary fodder or unfavourable marketing for animal production hinder the development of the private sector as well. During Soviet period the number of private livestock and cattle was strictly limited and the people, who had more animals than were permitted tried to conceal them by any means. Thus, the real number of private animals was never included in the total livestock population. So, it is difficult to rely on the accuracy of the state census of animals. From the mid 1990s onwards, the number of animals in the public sector of Yerbent peasant association has been decreasing. One of the shepherds from the village of Bakhardok told the author:

"The number of state-owned livestock has diminished. During the Soviet Union there were 65 thousand heads of karakul sheep, but now there are 35 or 25 thousand of them left."

Experts at the State Commission on Reforms in Agriculture defined the main reasons for the decrease in the number of livestock in the state sector of peasant association. First of all, there is a sharply reduced area for cultivation of alfalfa, the main fodder crop. Since 1988 the area of alfalfa has been reduced by 42.3 % (94.1 thousand hectares). The same has happened to other fodder crops. Secondly, there is the growing tendency to slaughter the livestock for their own needs, for cash sales at the markets, in order to purchase spare parts or pay for labor. The third reason for the decreasing number of state-owned animals is the stagnation of reforms in the unprofitable livestock-breeding sector.

Photo 3: Livestock Watering Point in Dortadjy
Photo taken by the author, 1999

Over history livestock breeders through out the world have developed traditional methods of grazing, which were suitable for the different environmental conditions. In areas of arid lands including, the territory of modern Turkmenistan, a nomadic way of life made up the traditional economy. Based on these historical traditions shepherds today still migrate with the herds in a meridianal north-south direction. In the spring, when the ewes begin lambing and the desert vegetation reaches its highest productivity, the shepherds move southwards. The juicy plants compensate for the lack of water for the animals. In the winter, the herds move back to the north where the pastures have had a chance to recuperate from the previous grazing, and the animals do not need so much water as in spring and summer (see fig. 14).

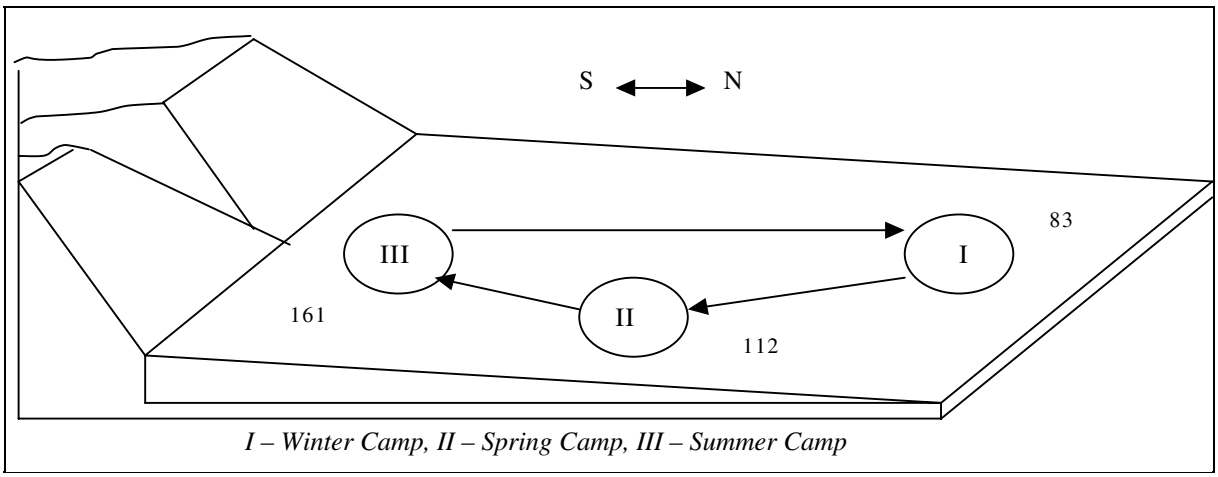


Figure 14: Scheme of Typical Migration of Shepherds in the Central Karakum Desert

The typical migration of herds in the Central Karakum deserts has meridian type – from winter camps on the northern pastures to summer camps on southern pastures. Such type of migration caused by early high pasture biomass in spring, cooler temperature on southern pastures in summer and saved pasture vegetation on northern pastures in winter. The slight declination of altitudes among the pastures is observed, but generally, migration in the Central Karakum desert adheres to horizontal type of migration.

Composed by the author, 2000

While the shepherds accompany their sheep and goats to distant pastures in the north and south, the camels and cows stay close to the settlements. Every morning the camels and cows leave the settlements to graze, sometimes wandering up to 5 km and every evening return to the settlements for the night. Because of the scarce vegetation, the method of "sector grazing" is being practiced in the Central Karakum. The pasture plots assigned for each herd have a circular shape with a well in the center and are divided into sectors. After they have finished grazing on one sector, the herd moves to the next sector but continues grazing on half of the previous sector. In other words, herds are gradually circling around the well. This method of grazing assures an even use of pastures and does not require enclosures.

As in the earlier times, the livestock grazing system is based on the availability of water. A the start of the Turkmen Soviet Socialist Republic the wells were in very poor condition. Sparse as they had been before the Revolution of 1917, the network of wells in the desert was almost completely destroyed during the following years of hostilities. Besides, before the revolution there had been virtually no systematic hydrogeological explorations in the deserts of Central Asia. During the first years after the revolution wells had to be built without hydrogeological maps. So that, during the Soviet period, the Turkmen Republic carried out considerable hydro-geological explorations of its territories. These have yielded extensive information on the origin, formation, depth and resources of underground water (Nikolayev, V., 1977).

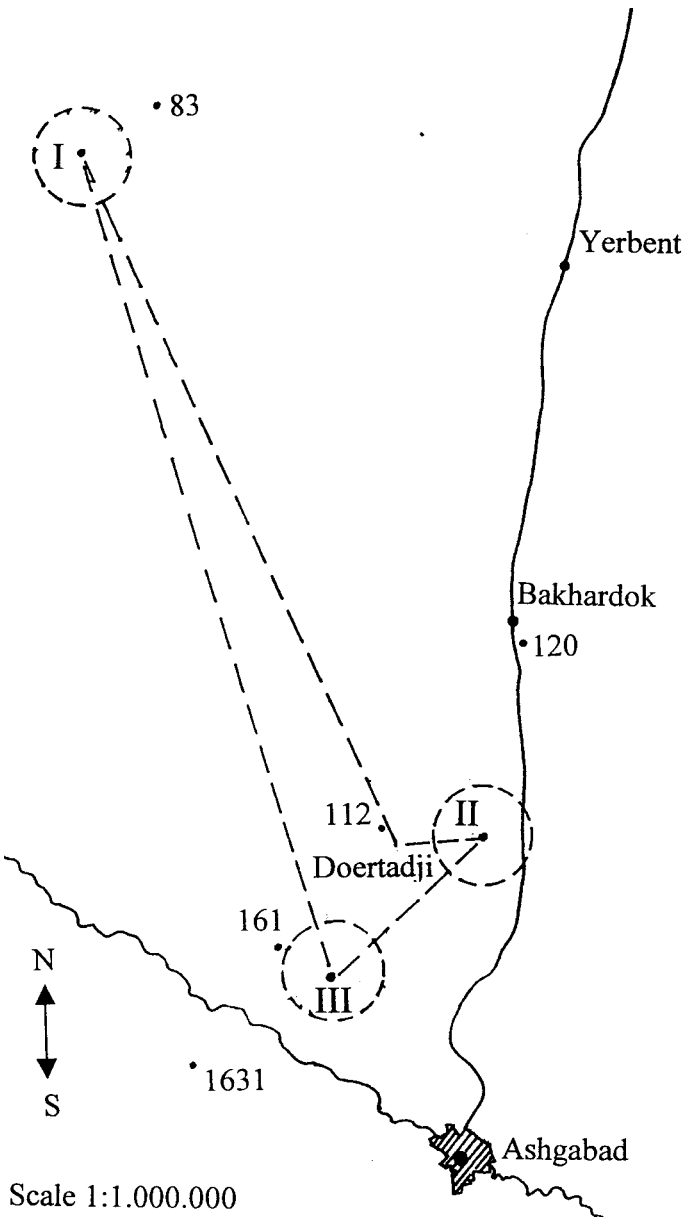


Figure 15: Migration Pattern on the Example of the Shepherds in Doertadji Village
Composed by the author, 1999

I – Spring camping lasts from March till April. Lambing period happens on spring pastures when vegetation is the most productive. During the lambing outside help is needed and, therefore, shepherds try to graze animals closer to their home village to ease the access of additional help. Spring pastures is provided by *sardoba*- underground water reservoir.

II – Summer camp. With falling of heat and drying up of annual grasses shepherds move their animals to summer camp, which is located southward closer to foothill of Kopetdag mountains where vegetation is still available. Here herds stay from June till September. Animals are grazed supplementary on wheat and grape residues. Stubble grazing is less-labor intensive than collecting and feeding the crops to animals. During this period livestock drinks from irrigation canals, which increases the danger of disease.

III – Since October till February herds stay on winter camp which are 120–150 km northwards from summer camp. To cover this route takes approximately one week. The well is a water source during winter. If there no drinking well water is available, shepherds order one track with capacity of 3.5 ton, which costs 500,000 manats (US$ 25, 1999). The ordered water will be diluted with salty water from well and it will be sufficient for one week.

The migration scheme is elaborated on the base of interview of shepherds from Doertadji village during their stay in the summer camp. The locations of camps are shown with altitudes above see level. The declination of altitudes from summer to winter camps is almost in two times.

By the beginning of 1969, according to an inventory of the water resources, the pastures of Turkmenistan were using 5,203 wells, 54 boreholes, 336 springs, and surface structures on takyr to collect precipitation. Moreover, by that time the Karakum desert pastures were being provided with water by seven pipelines of about 250 km in length. As a consequences, about 19 million hectares of pastures were able to be supplied with water. However, the availability of water for new pastures dropped drastically. This was mainly caused by a high mineralisation of the ground water on the remaining unwatered part of the territory (Babayev, A., 1996).

Presently, a lot of wells have been abandoned. The number of newly constructed wells is insufficient. It would be possible to have sufficient water if families were to collectively repair the wells that supply their livestock. On the pastures, shaft wells which are dug out, contain fresh water brought by trucks. The fresh water from shaft wells is used to dilute the highly concentrated water from deep wells.

Now that nomadism is no longer practised, scientists have became aware of the negative consequences of a sedentary life style of livestock breeders on pastures. The term “overgrazing” was introduced, which means the number of animals grazing exceed pastures carrying capacity. According to an inventory by the natural fodder fund about 30,000 hectares of pastures fall out of agricultural use per year in Turkmenistan.

Scientists of the Desert Research Institute have investigated the impact of grazing in the reserve station Garykul in the Central Karakum. The impact of grazing on the vegetation has been monitored over a period of 17 years (1960–1976) and can be applied to 10 million hectares of the adjacent desert territory including pastures of Yerbent p/a. The pastures around the well in Garygul are used by sheep and camels which have significant negative impact on the vegetation. The camels prefer to eat such desert plants as *Salsola Gemmascens* and *Aellenia Subaphylla*. As a result, the number of seeds decreases, and the renewal process of plants is inhibited. Thus, the process of desertification are accelerating.

Photo 4: Herd of Sheep Near the Bakhardok Village
Grazing often happens along the water pipeline (on the background), where better vegetation is available
Photo taken by the author, 1998

Under the conditions of intensive grazing on the sands, the desertification process takes place within 8 to 10 years. During the first half of this period, the production of total biomass and fodder is reduced by 20 %. The second half of the period is marked by a 50 % reduction of biomass with a gradual transformation of the pastures into useless lands (Nechayeva, N., 1970). The consequences of the overgrazing also affects the soil. Compaction of the soil by the livestock decreases the infiltration and increases the run-off of water, which reduces the moisture content of the soil and intensifies water erosion. The albedo is increased , wind erosion is also intensified.

A teacher from Bakhardok told us that 10–15 years ago the people in the village started keeping private cows, which had a very destructive effect on the vegetation.

> The cows were kept ever closer to the cities, in oases. Camels and sheep were traditionally kept in the desert. But now cows in the desert eat the selin (Aristida karelini) early in spring before the plants start spreading their seeds. Now we have less selin than before. When I moved to this village in 1977, everything was covered by selin. The Turkmens have a saying: "Among the farm animals the cow is the last one, and after the cow nothing is left" (Mallardan in sonky sygyr, syrdan son sigyr)

The lack of grazing also negatively affects the productivity of pastures. Presently, the economic potential of the pasture areas of the country is used insufficiently. For example, 17.3 heads of livestock were grazed on 100 hectares of pastures in 1998, while the optimal rate is 20 heads per 100 hectares (Atayev, A., Nepesov, B., 1999). In this case, the pasture is overgrown by moss, and the fodder crops are replaced by inedible species. According to the Agricultural Ministry of Turkmenistan, there are 10 million hectares of unused pastures in the Karakum desert. The difficulty using the pastures evenly lies in the fact that only 18 % of the total pasture territory can be used the year round, the rest is used according to the type of vegetation and according to the seasons (Atayev, A., 1999). However, a newly created possibility for livestock-breeders to increase their herds may eventually lead to an overload and a progressive degradation of the pastures.

Another aspect of grazing is a sedentary livestock husbandry. The sedentary way of life of desert inhabitants also contributes to the overloading of pastures around the shepherd settlements. Due to permanent living places, shepherds do not move far from them. Although, still changing the pastures over the year, shepherds try to keep their herds closer to the settlements.

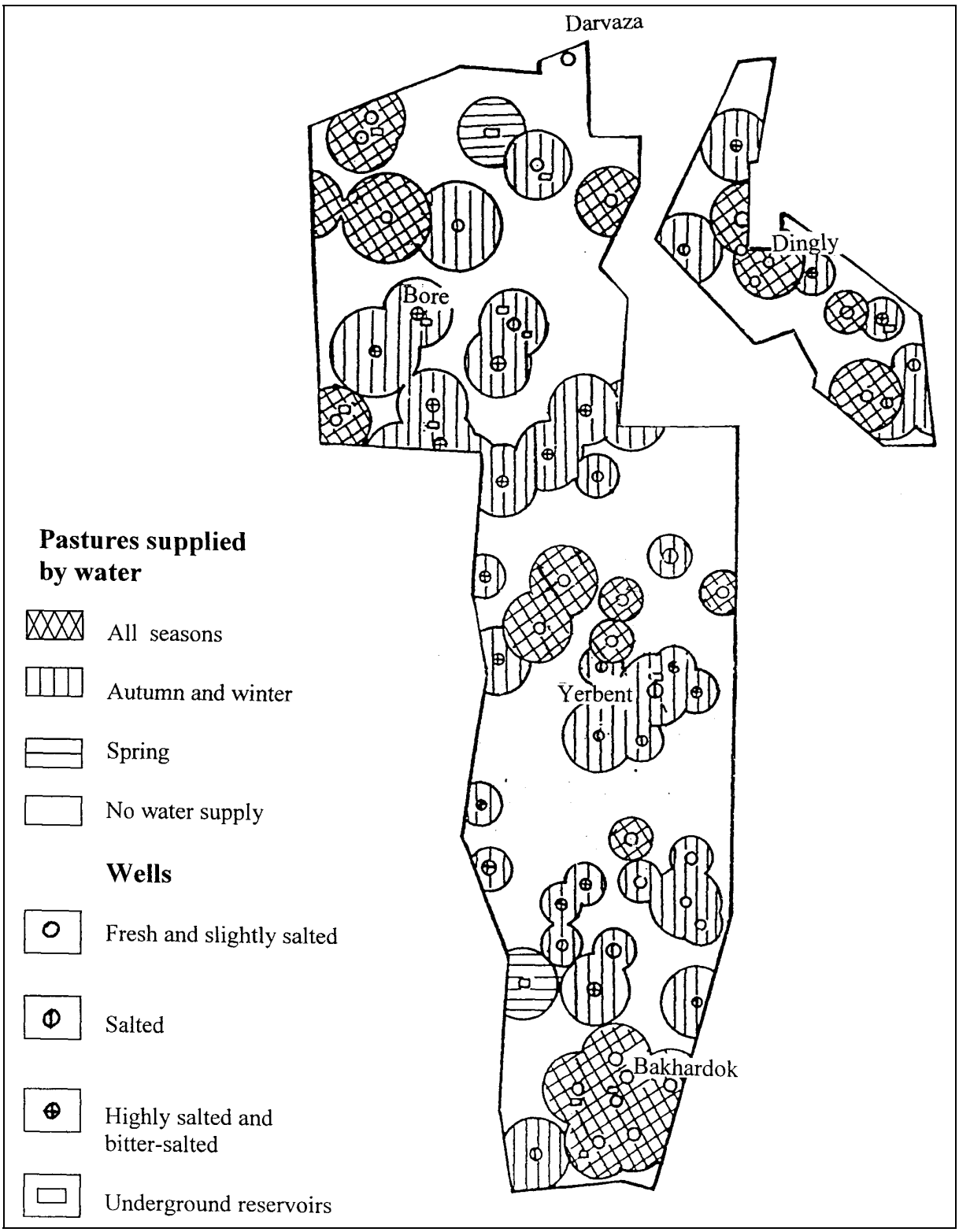


Figure 16: Schematic Map of Water Supply of Pastures in Yerbent Peasant Association
Source: V. Nikolaev, 1982

It is an interesting fact that the older shepherds frequently criticise the methods used by the modern shepherds. An older shepherd, whose sons are also shepherds, shared his opinion with us:

These days, shepherds are changing. They do not looking after their animals well. They do not stay over night with their herds. Even if they are 50 km away from their houses, they go home over night. In the summer, the sheep need to be grazed at night.

Another observation made in the course of the research is the fact that some families have started to practice a semi-migratory way of life. Having their permanent house in a village, the family members move with shepherds to remoter areas in search of better pastures. The unreliable support by the local administration for the provision of fodder and few possibilities of finding alternative ways of making an income, forced some shepherds to completely rely on livestock breeding and thus adjust their lifestyle to the grazing system. In addition the lack of control of school attendance makes it possible for the shepherds to move over longer distances with their families.

Livestock husbandry is a practical kind of land management on arid lands and at the same time supplies the inhabitants with a living. However, the pastoral economy is often compared with a "bust and boom" type of economy: a "boom" when rainfall is plentiful and herds grow, and "bust" when drought occurs and animals die (de Haan, C., Steinfeld, H., 1996). In the view of shepherds the number of livestock is not a decisive factor to the vegetation cover, but rather the amount and variability of rainfalls. The view is in compliance with conclusions drawn by scientists: abiotic factors such as rainfall rather than livestock density determine the long-term primary production and the vegetation cover (Mearns, 1996). We do not possess any precise information on how rich the desert vegetation and the productivity of pastures were at beginning of the 20th century. But we can conclude from reports by local people that even just 30–40 years ago the desert had a much denser vegetation cover. A large number of informants also mentioned that in previous years the rainfall were much heavier.

We can conclude that livestock husbandry is native life style well suited to desert conditions. Having developed over the course of many centuries, livestock husbandry in arid lands follows natural biological phases of pasture vegetation, and is a necessary factor for the regeneration of vegetation. The opinion that the desert environment is extremely fragile and vulnerable, and grazing always leads to the degradation of the vegetation and soil was recently debated by many long-term researches (de Haan, C., Steinfeld, H., 1996). One of the major conclusions drawn was that in dry land areas with a highly variable rainfall, it makes little sense to define a long-term carrying capacity, since forage supply varies greatly from year to years. Strategies to adapt

to these variations are needed, rather than a limiting the number of animals to a hypothetical carrying capacity (Bayer, W., Water-Bayer, A., 1988).

The area of the most severe degradation, observed around wells and settlements, makes up only a small part of the total pasture area in the country. Under the conditions of periodical droughts, livestock husbandry depends on the availability of forage and water. While the ability of the vegetation to recover after a drought is an indicator of the biological sustainability of pastures, the ability of herds to maintain their number after droughts is an indicator of an appropriate policy in livestock husbandry.

The issue of pasture management is insufficiently covered in scientific publications. This is understandable, because it is far easier to promote good land husbandry practices on cultivated lands than to improve the management of pastures. Technically, it is often easy to restore the degraded pastures' productivity but the management aspects are complex (Reij, Eger & Steiner, 1998). Recent publications have argued that the conventional notion of the "carrying capacity" of the land is inadequate and inappropriate and does not take into account the opportunistic management strategies of livestock owners in pastoral areas with a widely fluctuating availability of fodder over time and space (Scoones, 1994).

The strategy of harmonisation in livestock husbandry in the arid land of Turkmenistan should focus more on other conditions within the structure of the system such as the inadequate infrastructure, lack of facilities, inappropriate price policies, and lack of incentives as well as institutional weaknesses. Unfortunately, there are few opportunities for international development agencies to work in these directions, because of the exclusive State monopoly which still controls and rules the agricultural sector.

4.2.2 Firewood Collection

Desert pastures are characterised by various positive features such as diverse and cheap fodder, relatively high nourishment content, long-term grazing period in most parts of the country and year-round grazing period in the southern regions. The disadvantage of desert pastures is their low productivity (1,5–3,0 ca/ha of dry mass). The floristic composition of the Central Karakum counts 200 species, the spread of which is presented in chapter 4.1.2 (Nechayeva, N., 1970).

The desert inhabitants have always used local plants for their domestic needs, but they obeyed the basic rule of not cutting vegetation in close neighbourhood from the settlements and

not collecting the young and healthy trees. Nowadays, most of the desert inhabitants do not go far enough to collect firewood. Families who own vehicles can drive deep into the desert in search for fuelwood. Taking into consideration that the population in the research area is constantly increasing, the anthropogenic pressure on vegetation is constantly growing as well. The author was told by the villagers that a family of 5–6 persons needs two trucks (a capacity of 3.5 tons) of wood for domestic needs per annum.

Photo 5: Collected and Stored Saxaul
Dry branches of saxaul are used for cooking, warming the houses and other domestic needs
Photo taken by the author, 1999

The problem of cutting the vegetation is a striking example of the impact of social conditions on the ecological situation in the region. According to a Decree of the President of Turkmenistan, the entire population of the country must be supplied with free gas. The territory of the Yerbent p/a area as well as most of the settlements in the Karakum desert have no pipeline gas provision. The population purchase gas-cylinders from the capital. The price of one gas-cylinder which is enough for 1 month for one average-size family is 5000 manat (US$ 0.50, 1998). A gas-cylinder does not cost a lot of money, but it is a problem to organise its delivery. Local people have to go to the capital to arrange the purchase or pay a high price to salesmen.

Though villagers have gas-cylinders, it is not sufficient to cover the need of the population for fuel. People use liquid gas-cylinders for boiling water for tea or to cook small meals. Wood is traditionally used for baking bread in a *tamdyr* (spherical clay oven). Each family has its own *tamdyr* and bakes bread two or three times per week depending on size of the family consuming several cubic meters of desert plants per year.

A – You have a gas-cylinder, is it not sufficient?

B – Recently, since with the road was built we have started to buy gas-cylinders. And with this gas you can boil water for tea, but you cannot heat a house.

A – Who does usually collect wood in your family?

B – Small branches can be collected by women and children, because they can not go too far. But to collect sufficient wood for heating we hire a track. It costs us 100 thousand manat.

A – How far do you move in the desert?

B – About 60 km. But there is another village and people from this village also collect wood. We meet each other.

Part from the interview with a resident of the Bakhardok village, 1999

Desert wood is used not only for cooking but also for warming the houses in the cold season. Due to the continental climate with large the fluctuation of temperatures during year and day, the cold season lasts from October till the end of March, making up half a year (see chapter 4.1.2). In the summer time small branches are used mainly for baking of bread, while the bigger sticks are saved for heating the houses in cold period.

According to the Principal of the school, to heat the classes of the local school in the central village of Bakhardok 40 trucks (of 3.5 t) of wood are needed every year. While the boarding school was still existing (till 1997) much more wood was consumed.

During the Second World War a Sulphur factory operated near the desert the village of Darvaza which is located 150 km northwards of Bakhardok village. The factory used desert plants, mostly saksaul, as fuel and according to the story of a villager the lack of saksaul is still perceptible in the northern part of Yerbent p/a, though a lot of time passed since then.

Traditionally, the rich owners of pastures protected their areas by controlling the cutting of vegetation. During the Soviet Union the State assumed the role of the pasture owners. The desert plants needed for making fuel were collected by state-owned timber enterprises and distributed to families, schools, and administrative organizations. People who wanted to collect desert plants had to have a permission from the forestry commission and could collect plants only on specially assigned areas, which were controlled by forest guards. There were protected areas around the desert settlements with a radius normally not less than 5 km depending on the size of the village. Any collection of desert plants was prohibited within these areas. The same rule applied to the near-by wells. In the Yerbent p/a the pastures with severe and moderate degree of degradation need a protective zone covering no less than 10–15 km around the settlements and the watering points.

In former time as well as today, there is a special rule for cutting plants, according to which only old trees which stopped to vegetate can only be collected. After cutting down the shrubs, small branches and shoots should be evenly scattered over the area where the shrubs were cut off in order to prevent wind erosion on this plot and to assure the regeneration of the plants. The areas adjacent to the settlements can be easily controlled and protected from violation. The rest of the huge pastures' territory however, is beyond control. Hiding from the shepherds and villagers people also cut trees illegally during the night.

In the Soviet Union the enforcement of the laws on wood collection was more strict. At present, with the transformation of many state enterprises and the system of ownership as well as a lack of power to enforce environmental legislation, the environmental violations are not being paid proper attention to.

The collection of desert plants also occurs along the highway and other big roads. Being the only ground communication for passengers and cargo between the capital Ashgabat and the north city of Dashoguz the highway serves as a place of rest for passengers on long-distance trip. With the absence of any truck stops along the highway, passing drivers use the cheapest and easiest way to obtain fuel: plants along the road. The shepherds, during the long-distance grazing migrations, use plants for cooking, boiling water, and for fire. There are also cases of urban residents cutting desert plants during camping.

The issue of pasture productivity under different regime of use as well as the conservation measures of pasture vegetation are the well-studied subjects, and were elucidated in a large number of scientific publications (Nechayeva, N., 1958; Antonova, K., 1976, Atayev, A., 1999). The Desert Research Institute of Turkmenistan has studied this problem over several decades. A lot of researches have been carried out on the territory of the Desert Institute's Reserve Station Garygul in the Central Karakum where the impact of grazing and the collection of plants on the processes of desertification has been profoundly investigated. A tremendous number of scientific recommendations for rational resource management were elaborated for the agriculture and the livestock-breeding in Turkmenistan (Mukhammedov, G., 1980; Nechayeva, N., 1981; Dobrin, L., Nuryev, B.,1987).

The inhabitants of Bakhardok village expressed the opinion (1999) that the collection of vegetation has a more destructive impact on pastures than grazing. To avoid biased opinions, the author interviewed families and individuals who are not directly occupied with livestock-breeding. It must be taken into account that those who are not directly connected with animal

husbandry nevertheless have their animals in herds watched by other shepherds. And due to the animals which now guarantee the survival in the desert and which were traditionally the main wealth and concern of the desert inhabitants, biased opinion and misjudgment still remain and can be the reason of the forgone conclusions. The opinion of the local people is supported by scientists of Turkmenistan who consider tree- and shrub-felling being more detrimental than overgrazing. It explained by the fact that the animals can not eat all vegetation that sprouts, while felling can totally eradicate shrubs and trees.

The supply of the inhabited regions of the Karakum desert with gas could help to reduce drastically the cutting of the vegetation. At present, there is no reliable supply of gas-cylinders for the villages of the Central Karakum. In the mid-term future permanent supply of gas can be expected with the construction of the North-South Transkarakum Railway which will be accompanied by a gas pipeline (the construction started in Ashgabad and Dashoghuz in 1999/ 2000 with a completion time of seven years). The process of transfer from wood as a source of energy to gas will take place gradually. With the experience in the south-eastern Karakum, where the gas pipeline first emerged, one can expect a rather rapid acceptance of the innovation. The convenience of gas is indisputable. The collection of firewood, including transport, physical labor, financial expenses, is a big concern of the local people. Undoubtedly, local people will welcome the emergence of the gas supply in their villages. It might be though a problem to provide the small remote settlements with gas pipeline. Furthermore, the traditional and cultural perception that food prepared on firewood tastes better than food prepared on gas might also hinder the adoption of gas facility. Additionally, during Turkmen religious and family holidays plants will still be used for fuel. Several decades will be needed after the installation of gas in the region to restore the degraded pastures and saxaul forests, but this process of restoration will be sustainable. Therefore, exhausted pastures with poor seed fund need external interference for renewal.

4.2.3 Impact of Human Activity on Pastures

The ecological investigation of desert vegetation in the adjacent area of two villages was done in order to reveal degree of degradation of pastures depending upon the size of the settlements and their population. In the research area of Yerbent peasant association population of the bigger villages caused a more negative effect on environment. A denser population means larger number of wood consumers and a larger amount of animals, which graze in the neighbourhood of village. This leads to an overload on the pastures.

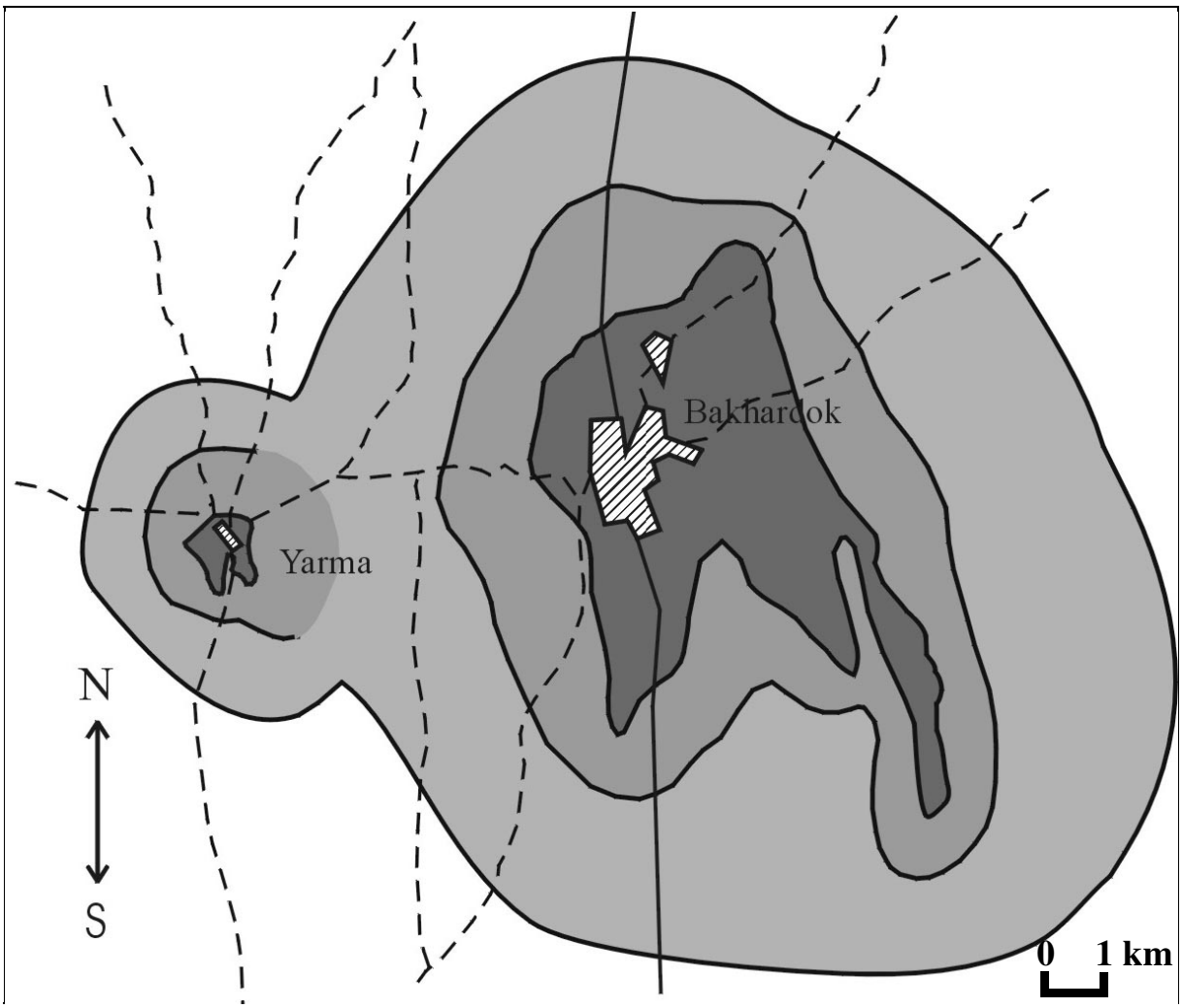


Figure 17: A Schematic Map of Pasture Circles of Degradation Around Villages of Bakhardok and Yarma and the Routes of the Transects
Composed by the author on the basis of a topographic map (1 : 123,000), 2000.

Above-stated interdependency is clearly seen on the example of the two villages – Bakhardok and Yarma. The village of Bakhardok with 2,032 inhabitants (06.01.98) is located on the highway and has water and electrical facilities. The second village, Yarma, lies 8 km wes of the highway. Access to Yarma is complicated by poor road conditions. Village has only 44 inhabitants (06.01.98) and no water and electrical facilities. Gas supply is absent in both villages.

To get a picture of the vegetation, a study of the plants in the area was carried out. A consecutive alteration of the plant as a result of various external and internal factors was found. This change takes place over a long-term and is often irreversible. The change usually takes place as a succeeding of plants types. The duration of complete succession of plants depends on intensity of the affecting factors.

To reveal stages of degradation of the vegetation 8 ecological transects were set up in the area adjacent to the villages with differing distances from the villages peripheries. 500 m walk from

road gave a comprehensive picture of the types of vegetation and its condition in each sector of investigated area. Covering a distance of 500 m in length and 4 m wide every species of plant, its age and size were recorded. Topographic map with a scale 1 : 100,000 was used for this investigation to outline the different areas and draw a scheme of stages of degradation of the vegetation.

Table 13: The Indicators for the Stages of Degradation of Pasture Vegetation around the Villages Bakhardok and Yarma

Circle of degradation	Distance from the village, km		Indicators of the stage of the degradation of vegetation
	Bakhardok	Yarma	Sands
I	12–15	3–4	Parent association: *Haloxylon persicum + Carex phisodes + Calligonum rubens*
II	5–7	1–1.5	Undamaged state of vegetation, close to the parent association. *Carex phisodes* is spread by spots between inter-shrubs lowerings.
III	2–3 2–5	0.3–1 0.8–1.5	Absolute disappearance of dominant species of *Haloxylon persicum* and *Carex phisodes* and semi-shrubs. Emerge *of Ammodendron conolii* among the shrubs. *Calligonum rubens* is partly saved.
IV	0–2 0–4	0–0.3 0–0.8	Sand dunes with total change of vegetation's composition. Absence of *Carex phisodes* and semi-shrubs. *Aristida karelini* with small portion of *Ammodendron conolii* can be met.

Composed by the author, 1999

Fixed successions of vegetation run continuously and without clearly fixed spacious borders between the different stages of degradation in space. That is why the number of stages determining the degradation of vegetation can be arbitrary. The author decided to distinguish four general stages of degradation. First stage (I) is considered as normal condition of vegetation under weak grazing. For the sandy desert of the Central Karakum the parent association *Haloxylon persicum* + *Carex phisodes* + *Calligonum rubens* is taken as a normal exemplary composition of plants. The following stages of degradation are defined in comparison with parent association. To reach an area with intact vegetation we had to move a distance 12–15 km into the desert away from the village of Bakhardok on and 4–5 km away from Yarma. The second stage (II) characterizes the degradation of vegetation under continual grazing. A disappearing of species *Haloxylon persicum* and *Carex phisodes* together with the inhibited growth of their young are the indicators of degradation. The emergence of *Ammodendron conolii* also indicates the beginning of degradation, because this plant can grow on the areas, which are free from

other big shrubs and undershrubs. Stage II appears like a belt around the villages in the area located between 5 kilometres around Bakhardok and between 1 and to 5 kilometres around Yarma. The third stage of succession (III) is degradation of vegetation under intensive grazing. The area and degree of degradation also depend on topographical elements. This degraded vegetation stretches along the barkhan ridge and extends over a distance of between 3 and 5 km around Bakhardok and 0.8–1 km around Yarma. The forth stage (IV) is complete alteration of the plant communities. This stage covers area within the villages and a strip between 2 and 4 kilometres around Bakhardok and 0.3 and 0.8 kilometres around Yarma.

The description of successions was made for sandy areas. The plots of the takyr depression along the transects were not attached to the description because they occupy an insignificantly small area and their ecotype depends on the adjacent element of topography and does not necessarily indicate a true succession.

4.2.4 Shifting Sands Hazard

In the late 1970s, according to scientific investigations, the area of bare sand around Bakhardok covered more than 50 km^2 (Arnageldiev A., Kurbanov O.R., 1977).

When approaching the huge dunes located around the village of Bakhardok it is possible to observe shifting sands on most parts of the road. Within the village the roads are even more affected by the encroachment of sand. This often creates problems for passing vehicles. In many parts of Bakhardok and other neighbouring villages sand dunes have come so close to the houses that it is no longer possiblefor people to live their. Another problem are the dust storms as even a low-velocity wind can raise a solid wall of sand in an area where dunes are deprived of vegetation.

Three areas can be distinguished within the territory of Yerbent peasant association and are based on the magnitude of wind deflation.

- *The slightly affected area* covers the territory of Farm 3, the southern part of Farm 4 and the northern part of Farm 2, making up 50 % of farms' pastures.
- *The moderately affected area* covers the whole territory of Farm 1, the southern part of Farm 2, the northern part of Farm 4 and 5, making up 38 % of pasture land.
- *The highly affected area* is mainly located on the territory of Farm 1 and 2, as well as around the settlements and the water points and along the highway, making up 12 % of all pastures (Arnageldiev, A., Kurbanov, O.R.,1980).

Photo 6: Part of the Road Ashgabat-Dashoguz
Photo taken by the author, 1998

The exploration of gas, the operation of the Sulphur Factory, and the concentration of people in settlements promoted the development of spots of deflation. Huge areas of pastures near the settlements and water points are subject to wind erosion. Among the natural factors the high summer temperatures, a low annual mean of precipitation (93–104 mm) and, in particular, the prevailing wind direction cause moving sand to emerge.

The annual wind records of the Bakhardok meteorological station show prevalence of western winds over the period of April to July and eastern winds between October and March (see Fig. 9). The eastern winds blow perpendicular eolian forms of relief; the winds are not regular and their average velocity is low. In the northern part of Yerbent wind deflation is caused by eastern and north-eastern winds which are more active in the cold season. During the warm months when north-western and western winds are dominant scooping out, movement and deposit of sand, reach the critical level. The central and southern parts of the peasant association are affected by northern and western wind, though the southern part of the peasant association is less affected to active winds (516 m/sec) than the northern (761 m/sec). Thus, the movement of sand dunes on the territory of the peasant association occurs in various way. In the northern part of Yerbent peasant association movement is south-westward, in the central part it is southward and in the southern part it is south-eastward. The final annual movement of sands occurs southwards along the top of barkhan ridges caused by northern winds and winds close to this direction.

Already in the late 1970s scientists stated a need for pastures' improvements. In the article by Arnageldiev, A., Kurbanov, O.R. in 1980 the authors write, "it was planned to improve 170

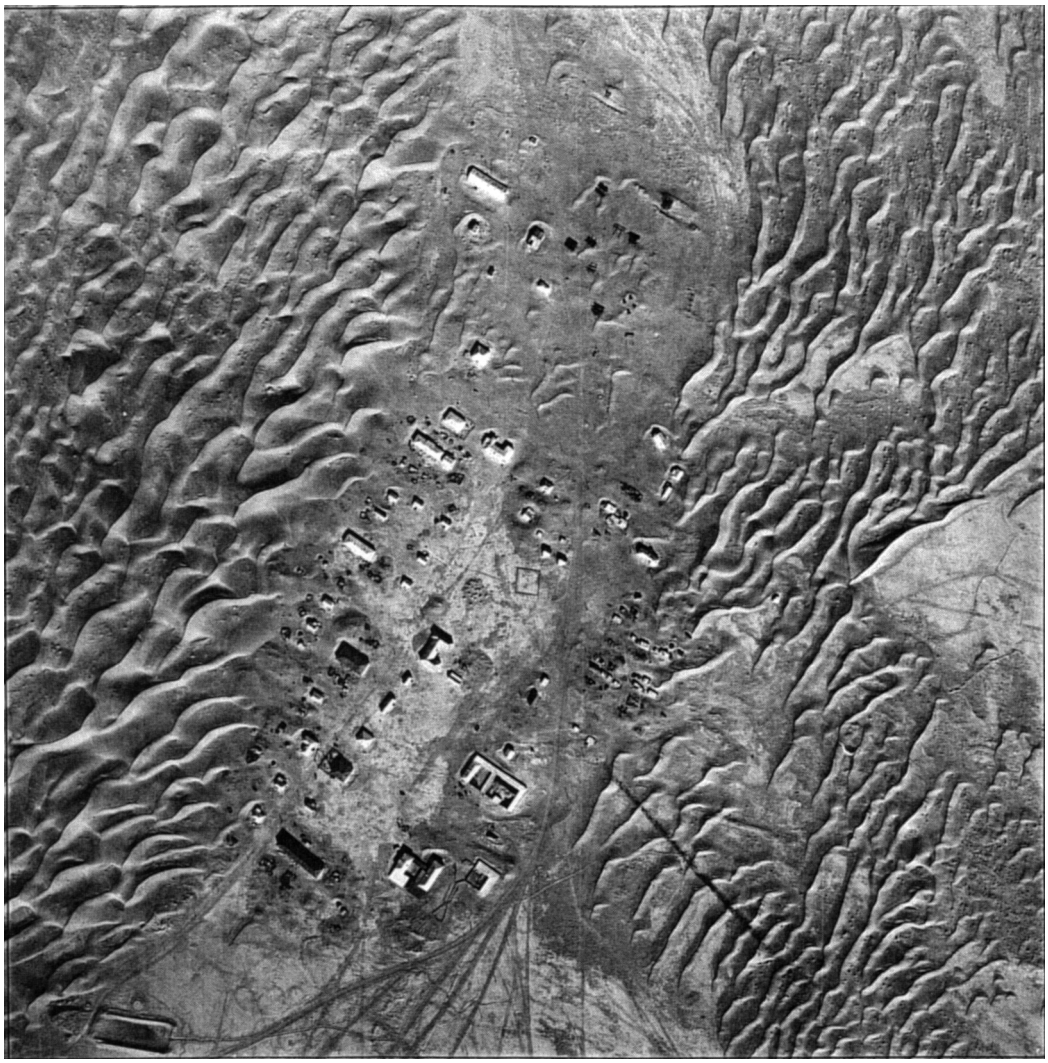


Photo 7: Aerial Photo of the Central Part of Bakhardok Village, 1986. Scale 1 : 80,000

thousand hectares of pastures in Yerbent sovkhoz. However, the pasture improvement activity has not yet been started". In fact, the authors continue, 209 thousand hectares in Yerbent area need the melioration measures. At that time, the scientists at the Desert Research Institute of Turkmenistan undertook experiments on the fixation and reforestation of pastures on the territory of Yerbent sovkhoz. These experimental actions showed that it is possible to stabilise sand dunes on the moderately deflated areas and on some slightly deflated areas through mechanically scattering the seeds of psammophyts. The expenses of pasture reforestation are justified because the artificial pastures are more productive than natural ones and are able to maintain their capacity for the next 15–30 years (Nechayeva, N., Prikhodko, S., 1966)

The nomads solved the problem of sand encroachment simply by relocating their tents, the *yurta*. Nomad dwellings were very well adapted to migratory and desert conditions. The location for their *yurta* was chosen carefully and were set facing wind. Sheds for the livestock were set in front of the *yurta* to divide the wind flow into two parts. This simple method prevented

the accumulation of sand near the house. If it was impossible to control the sand, the dwelling was relocated to a safer place.

At the time of the Soviet Union sand removal was the duty of state farms. Nowadays, there is no governmental aid available. The control of sands encroachment has become solely the concern of villagers and it is up to them to get rid of the dunes near their houses or not.

Local perception of sand encroachment, which in some places has reached a critical level, is contradictory. In the northern and north-eastern part of Bakhardok village people are more affected by sands and they show more concern for the problem. But this concern seems to be caused more by uncomfortable living conditions than the real danger of abandoning their houses. Indeed, in the course of conversations with villagers, whose houses are very close to dunes and in the course of participatory observation of the local terrain the author listened to several different opinions of local people:

> *"Yes, sands are disturbing my family. But we cannot afford to borrow a tractor to remove the sand. Well, the wind will change direction and the sand will be blown away"*
>
> *"If you ask desert inhabitants if they want to have a garden near their houses they will tell you no, because a garden attracts more snakes and mosquitoes".*

The different opinions of local inhabitants gives a picture of the mentality of desert people – the sand, even if it advances, does not present a danger for them. Turkmen desert inhabitants are called *gumly,* which means "men from the sands". Sands are the normal environmental habitat for people living in the desert. Since ancient times when people started to exploit the vast territory of the desert, their lifestyle and economy has been adapted to the specifics of the desert.

5 Sand Encroachment and its Control

5.1 Choice of Plots and Techniques

The village of Bakhardok was chosen for testing people's participation in the control of sand encroachment by a Turkmen-German Technical Co-operation Project in 1998. The large moving sand dunes surround the village like a thick ring. They affect to different degrees the livelihood of the inhabitants. Houses located in the north, north-east and on the west periphery of the village are threatened more severely than those in the central and southern parts. But all inhabitants of the village suffer to the same degree from dust storms which are intensified by the proximity of the huge unstable sand masses. Some sections of the highway which run through the village are also subject to sand invasion.

Two approaches to combating sand movement in the village of Bakhardok in the Central Karakum have been tested as a part of the Technical Co-operation Project: the first activity is setting up mechanical protection with further planting of desert species (*Haloxilon persicum*). This activity is intended to control sand expansion. The objective of the second kind of activity is the improvement of the living conditions of the villagers and the fostering of planting skills among local inhabitants. It was supposed that by diversifying the species of fruits and vegetables in private gardens, people would become motivated to take better care of their land.

Photo 8: Sand Dune Approaches a House in the Village of Bakhardok
For many households sand dunes have become a part of the normal surroundings.
Photo taken by the author,1998

Participating families were supplied with seeds and seedlings and advised by experts from the NIDFF. In the beginning, interest was mostly shown by families which had already practised gardening. In some cases the two types of activities (sand control and gardening) were applied to the same households.

The population of the village of Bakhardok can be divided into 3 groups with respect to their attitude towards the cultivation of private plots.

The *first group* consists of households which do not cultivate any plants, vegetables, fruits or fodder species, or just cultivate small plots on the adjoining land. These are the families who have recently moved to Bakhardok from other villages and have not started any major cultivation; this group also includes the shepherds' families who gain the major part of their income from animals and have neither the interest nor the time to cultivate their land. The adult males usually look after the garden, as the women and small children can only manage small plots. Otherwise, the women are busy all day with routine household chores.

The *second group* is composed of families who grow some fruit and vegetables. The men in such families are not busy with shepherding, because they are pensioners or employees. Because of a lack of money, equipment and experience they cannot extend their gardens but they are interested in the diversification of the plant species. This group of people has the interest and the possibility to cultivate their land. They have understood that by investing labour and some money they can have their own fruit and vegetables that will support them with additional income and will enrich the meals, which as a rule mostly consists of animal products. Representatives of this group showed an interest in undertaking voluntary actions to enrich their gardens and learn some more techniques for growing under desert conditions. This group is composed of the biggest number of villagers and represents a transitional stage in local attitudes towards gardening.

The *third* – and smallest – group is composed of households with large and old gardens. They started to cultivate the land right after the arrival of the piped water supply. Trying to understand the difference between such opposite perceptions of the local people, the author asked the owner of a big garden to clarify the difference in cultivation habits.

A – What was the main reason you started the garden? To have a harvest or to stop the sands?

B – To grow fruits and vegetables first you need to stop the sand. Without it, sand will cover all your plants. We have very strong and hot winds here. The sand moves and all your work is in vain. Now we have shade and fodder for the young camels.

A – But why do the others not plant anything? Are they just lazy?

B – No, you cannot say it is because of the laziness. You plant the tree and sand covers it soon, and it happens again and again and people give up. You have to clean the soil and water it every day. It takes all your time.

The problem of the emergence of big masses of moving sand first appeared together with the rapid increase in the population of desert settlements; that is why it did not disturb the people a few decades ago. It explains the absence of traditional knowledge about the stabilisation of moving sand. During interviews with the oldest inhabitants of the village of Bakhardok no local methods for controlling sand encroachment were mentioned.

The meetings between the members of the Turkmen-German Technical Co-operation Project and the villagers preceded the activities intended to stabilise the sand. During the meeting the team of experts explained the overall mission of the project and discussed future common activity strategies.

Stabilisation of the sand dunes along the highway was the first experiment in testing people's participation. For this purpose, a part of the highway in the centre of the village, that is frequently subjected to drifting sands was chosen. To carry out the activity project representatives worked with the local school, including both the teachers and the pupils. Mechanical stabilisation involved the establishment of a chessboard protection – a method that has been successfully tested by the Desert Institute in many parts of the Karakum desert. This method was used mostly for the protection of industrial sites, railways and roads but not around the settlements.

With regard to participation of local people, the experiment did not show encouraging results. The school community was not overly interested in combating sand encroachment along the road because none of the participants directly benefited from these actions. A big factor in this failure is a lack concern for common resources, if the land belongs to the state, it is the government's responsibility to take the necessary measures. This perception, which was fostered during the many decades of the Soviet regime, is typical for all state-controlled countries and nowadays is a difficult problem to overcome.

To motivate the people to participate more it was decided by the project team to shift the major concern of the project from public lands to private households and infrastructure objects. The choice of six experimental sites for controlling sand invasion depended on the seriousness of the threat and the willingness of the heads of the households to take part in sand controlling activities.

Generally the sites can be divided into two categories due to the varying wind dynamics:

1. Sites affected by drifting and sweeping sand; which were located in the western and south-western parts of the village.

2. Sites affected by the invasion of barkhan formations which had northern locations.

The techniques used to stabilise the sand varied depending on the type of site. One of the methods tested on the sites threatened by the invasion of sand dunes, was the establishment of a chessboard protection system. This technique has two main objects – to temporarily halt the movement of sand grains by setting up a network of screens constructed of local materials, and thus, to create conditions for the development of vegetation inside the cells of the network. The height of this screen is approximately 50 cm. The trunks of dried reeds plaited together in belts served as the material for this technique.

Photo 9: Establishment of a Chessboard Protection System from Dried Reeds
Photo taken by the author, 1998

For the same purpose of halting sand movement, the project's team tested less expensive methods which used local gypsy stones from natural depressions located 5–10 km to the north, east and south-westward of Bakhardok. For this purpose trucks and people were hired. But using stones proved to not be very effective because the stones were quickly covered over by the sand.

In the case of high (10 m to 15 m) moving barkhan formations the objective was not to stop the sand from moving but to reduce the size of the barkan. The principle of this technique allowed for the movement of sand in the wind without further accumulation. A linear mechanical protection was set up in rows on ¾ of the barkhan slope leaving the summit of the barkhan open. This allowed the wind to sweep the top-sand away. This "cutting" technique has proved itself effective on some test sites where smaller dune masses where able to stabilised as a consequence.

Photo 10: One of the Experimental Plots with a Stone Chessboard Protection in Bakhardok
Photo taken by the author, 1999

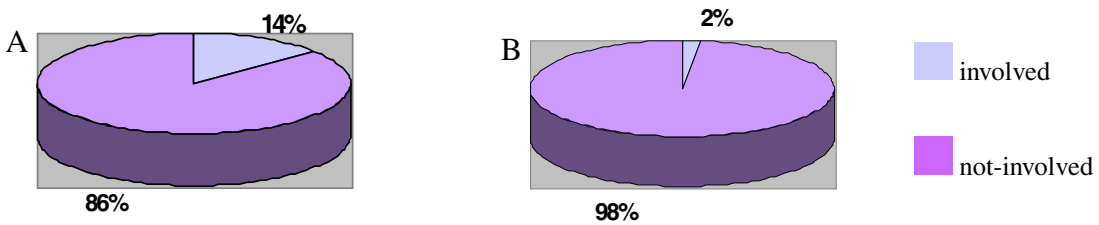
In the course of the participatory sand control activities, the establishment of nurseries was also tested at several sites. Small shoots, 5–6 cm tall in plastic containers, were planted in rows with approximately 50 cm between containers. The absence of precipitation during and after the time of planting, frequent dry winds, the insufficient training of the local people as to how to treat small plants and their lack of knowledge about planting contributed to the failure to grow healthy, strong plants. Although the trees showed little ability to adapt and the survival rate of the nursery plants was very low this method should be tried again when climatic factors are more favourable and the population is more experienced in this particular technique of cultivating a nursery.

In addition, species of native desert plants (*Haloxylon persicum, Haloxilon aphyllum, Calligonum rubens*) were planted on bare sand formations in order to create favourable conditions for the accumulation of plant seeds and a continued reforestation. Harsh climatic conditions in the years of the planting activities (1999–2000) affected some parts of the plantation. People became pessimistic. Different plots showed different abilities of the plants to survive. The plots which were located near the houses with better protection from the wind and easier access to water points showed generally better results than plots located far from the dwellings. Remoteness from water points made the watering process very complicated. Water had to be brought to these plots in buckets due to the lack of water hoses. The bigger seedlings adapted easier to severe climatic conditions while the sand covered most of smaller seedlings and burnt them out.

On the other hand, much better results were observed in the promotion of private gardens and the diversification of garden plants. Projects members helped with the seeds and seedlings and consulted the families which had no experience in land cultivation. Regular visits by project's members to Bakhardok and monitoring by the local experts ensured good maintenance of the plants and a stable running of this part of the project. The figures prove good results for the experiment: at the beginning of the "garden" activities in 1999 there were only 6 households willing to co-operate while in 2000 there this number reached around 50 households.

Reports by observers showed that the number of households involved in garden enrichment were much larger than the number of households willing to carry out activities to stabilisation of the sand and plant desert species (see Fig. 18). This shows that the local people have a stronger concern for their own economic conditions (food security) than for the environment (moving sand, soil degradation). It should also be noted that relatively fast results from the private gardens (the first harvest of vegetables could be collected the same year) are more motivating and convincing for the local people than long-term results on the fixation of sand, which bring no direct income.

Figure 18: Shares of the Village Community Involvement in the Project's Activities
A. Garden plant diversification. B. Sand fixation and the planting of desert vegetation
Composed by the author, 2001



5.2 The Maintenance and Protection of Plots

The planting season and the setting-up of windbreak protections with dried reeds takes place from October till February during the rainy season when the sand substratum is moist. The amount of rainfall, its distribution, its depth of infiltration, the availability of soil moisture and the ranges of temperature are the determining factors for the success of the plants' adaptation and survival. Due to the instability of the weather in the winter time, the start of planting activities depends on the particular year. Late planting can be dangerous, resulting in low adaptation and survival rates of the seedlings and less stability of the mechanical protection. Ideally, when planting is carried out timely and rainfall is normal, seedlings will adapt well but however, supplementary watering will still be needed. Watering is conducted manually or with hoses. The

gardens in close proximity to the dwellings are easier to water but some experimental plots are far away from water sources and this creates problems of water provision.

Any planting activities are only effective if they are protected from roving animals and from being picked by man. It was necessary to install protective wire fences around each experimental plot. The wire fences can stop animals, but they are no protection against humans. One old man, an owner of one of the experimental plots, complained:

> "*The neighbours let their animals enter my plot. They ate some of the green seedlings. A few days ago I saw my neighbour collecting some plants. What can I do?"*

During the next visit to his plots one month later, the same man was satisfied with the adaptation of the seedlings and said: "*If this continues, in 4 to 5 years I can bring my goats to graze here"*.

Photo 11: Young Sampling of Saxaul Covered by Drifting Sands
Hot sands bury the plants and burn them up.
Photo taken by the author, 2000

Maintaining the plantations of desert shrubs was the most important and at the same time the most difficult task of the activity. Plantations need to be watered and protected from the wind and roving animals. All these requirements were difficult for many villagers to fulfil. During our observations one could feel that the people were losing their optimism to maintain their plantations. The main reason for the people's pessimism toward the survival of the plantations was the dry weather conditions in the spring and following summer. The amount of rainfall was extremely small and dry wind constantly covered the saplings with sand. People were complain-

ing about the weather conditions, saying that it was very difficult to watch and maintain the plants. Under the system of “common-land grazing” it is also difficult to stop livestock from entering the plantation plots near the village. Erecting fences around all the areas to be protected would be very costly.

In general one can say that it was possible to emphasise the importance of the planting activities because they assured the people’s livelihood within a medium to long term perspective. However, the planting measures were not easily adopted by the desert population because this kind of activity did not belong to their traditional environmental behaviours and attitudes. For better understanding of people’s attitudes it is important to consider a traditional factor, which still dominates the live of the desert inhabitants. A longer time and clear motivations will be needed to change a traditional behaviour of former nomads to make them stronger connected to their land.

6 Possibilities and Constrains of Popular Mass Participation.

6.1 Applicability of Participatory Tools

After two years of fieldwork in the area of Yerbent peasant association in the Central Karakum, it is possible to analyze what has been successful and what can be improved in the field of desertification control with participation of the local population. This research can be considered as the first step in the analysis of participatory desertification control in Turkmenistan. As mentioned in the Chapter 2 “Methodology”, some of the tools of the participatory approach showed good applicability, some of them failed. These failures should be taken as a basis to learn from mistakes and make steps forward for applying more appropriate strategy for community-based actions.

The main activities on which the analysis is based can be summarized thus:

- A variety of tools of participatory information collection were tested before the planting activities, that formed part of the project. Firstly, selected families were randomly interviewed. Later on, when activities of the project were set up households were deliberately chosen on the basis of their willingness to participate in planting and fixation activities.
- Meetings with the village community were organized in order to create popular awareness of ecological problems among the people. Different ways of setting up the dialogue were tested: common meetings with village inhabitants; separate meetings with teachers, shepherds and women; art competition for school children.
- Different techniques of sand fixation were tested together with local people. Methodological and logistical help were offered by the project team to find the technique that is most effective under severe climatic conditions and most acceptable for local people.

Due to the fact that livestock breeding is the dominant economic activity and the main source of income for the local people in the research area, no strict division of people into different target groups was made during the research. In fact, all male respondents in the research area are linked directly or indirectly with livestock breeding and, thus, all of them can provide with helpful information on livestock breeding. The women often contributed to the issue of grazing and pasture environment, but they are more competent in questions of animal production, its marketing and household problems. As the thesis does not pursue a gender problem analysis, proportion of interviewed women is smaller that of men. This is explained by the Turkmen cultural traditions. As a rule, outsiders, especially when the men are among them, should not enter the house

when the adult male members of the family are absent. When family members including both men and women are gathered for the interview, women hesitate to speak openly and contribute little to the interview. Therefore, often men and women were interviewed separately.

During the above mentioned activities different participatory tools proved to be successful. Experimenting with participatory tools, learning from mistakes, searching for more appropriate tools for specific local conditions were at the same time a challenge and a test of communication skills of the author and colleagues involved.

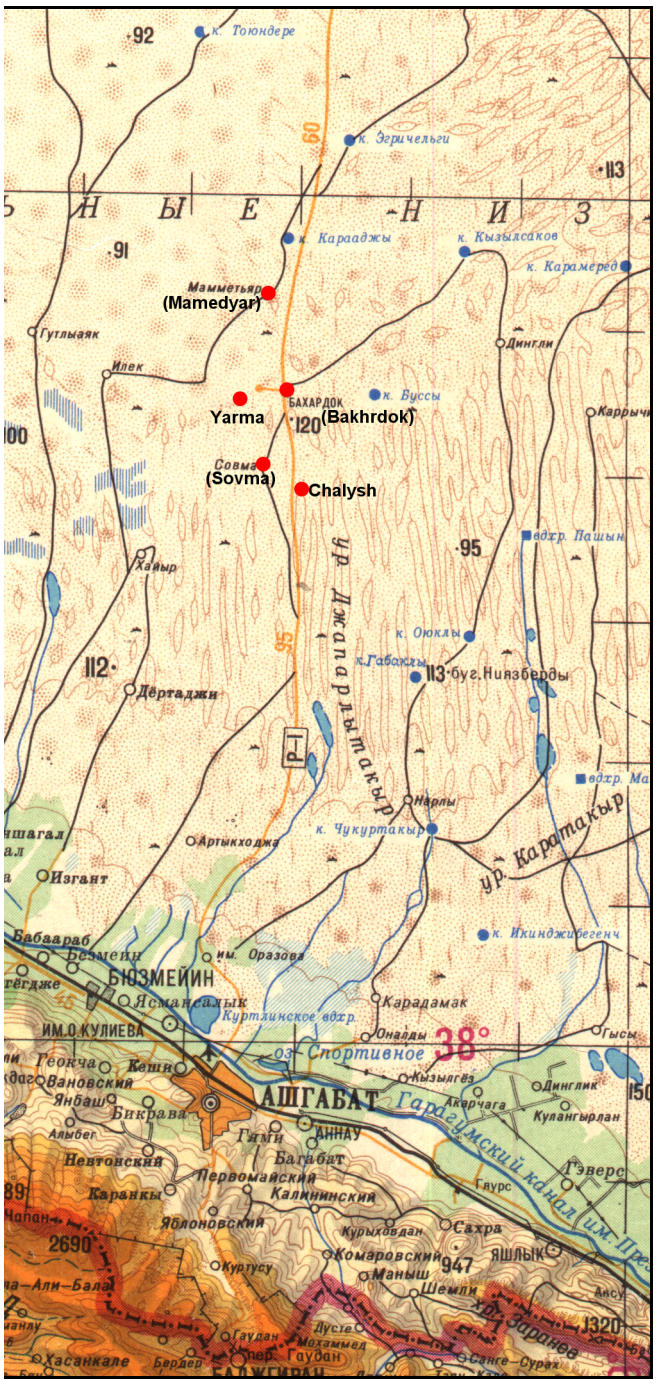


Figure 19: The Map of Central Karakum with Location of Research Villages (1:1,000,000)
Source: Map of Turkmenistan, 1994

Here are the results using the participatory tools during the information collection.

Interviews

Interviews were conducted with 61 individuals from the different villages (Table 14). The research proved the feasibility of participatory tools in the conditions of desert rural communities in Turkmenistan. Local people felt comfortable to participate in semi-structured interviews including interviews with the key persons, other individuals and groups. Experience showed that this tool of participatory approach is the most suitable and informative. During the research the greater part of data was acquired by means of interviews with the local population: family's structure, occupation of family members, present and perspectives of family. Semi-structured interviews

Table 14: Numbers and Places of Conducted Interviews
Composed by the author, 2001

Place	Number
Central Karakum desert	
Bakhardok village	39
Yarma village	2
Sovma village	3
Mamed-yar village	4
Chalysh village	5
Summer camp of the shepherds near Doert-Adji village	8
Total	61
among them:	
men	43
women	18
Research organizations in Turkmenistan	14
Research and development organisations in Germany	11

were the first step in establishing communication and dialogue in order to take the local perceptions into account. Interviews started with some previously formulated key questions, which left open space for further discussion. Two or three persons with one or two of them taking notes usually conducted the interviews. Tape-recorder was also used for recording the conversation. Most of the interviews were conducted in Turkmen, while some in Russian. Usually, good skill of Russian language is a characteristic of better education, position in administration, and living or working experience in the cities.

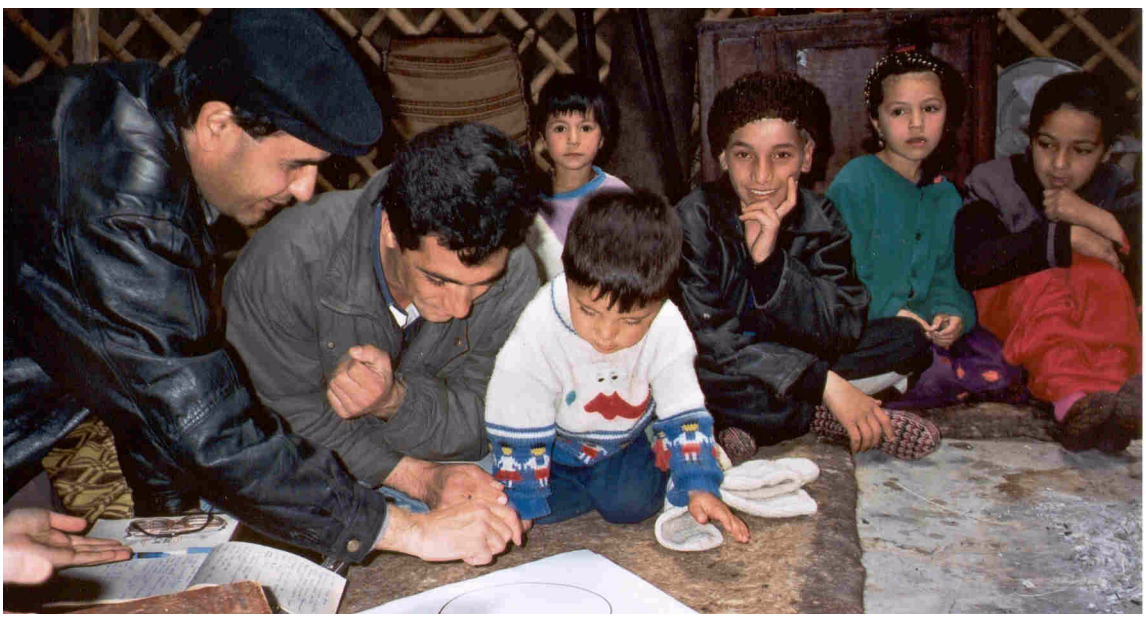


Photo 12: Interview of one Family in Bakhardok Village
Photo taken by the author, 1998

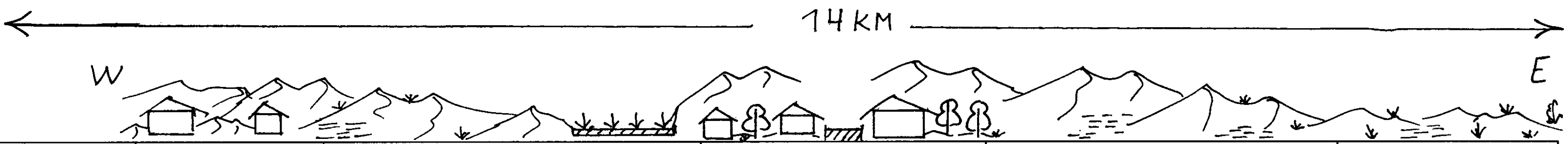
Interviewed people especially elders and shepherds have ease to express themselves orally. Often interviews have a form of personal stories, when interviewer hear a lot of information he or she did not ask about. The task is to sieve relevant information correctly. With the help of interviews with key informants and small groups the information on terrain, pasture condition, grazing management, and traditional knowledge were obtained in the course of the research.

It must be admitted that due to insufficient training and lack of experience in sociological research members of the project team (natural scientists) sometimes unconsciously dominated in the course of the interviews as it was a new methodology for all for them. Through analyzing mistakes, the team understood that local specific and sometimes delicate conditions dictate a very diplomatic and tactful approach. If someone wants to establish a trustful dialogue it is for instance better not to ask a shepherd directly how many sheep he has or how big his salary is; such questions make the atmosphere of conversation formal and remind the local people of state control.

An important point is the choice of place for conducting the interview. The author noted that inhabitants of desert feel more comfortable and self-confident being interviewed outside of houses in the yard sitting on the ground where they usually rest.

Transect Walk

Two types of transect walk were conducted in the research area. First, it is a socio-ecological profile of the terrain with length of 14 km which stretches across the Ashgabad-Dashoguz highway (see Fig.20). The transects were conducted with the representatives of the Bakhardok village. The central part of the transect which reflects the situation in and around the Bakhardok village was carried out by walking and observation. For further description of the terrain a car was used to cover longer distances, though it was no longer a transect walk but rather a transect drive. The whole transect's stretch was presented by a habitat of the pastoral society which lives and work within the relatively homogeneous landscape. While walking or driving, the explanations of the villagers were recorded. For the research area the different natural and social units were distinguished such as settlements, the highway, the water pipe-line, irrigated lands, takyrs, solonchak and bare sand dunes. Therefore, the best way to cover all important social unites and ecological micro-zones was a transect profile along and across the highway which runs through the Bakhardok village. Setting up the transect allowed to collect the general information on desert vegetation, the dynamic its alteration, and the role of vegetation in the life of the local population.



Type of landuse	**Yarma village** 4 families, approx. 30 inhabitants;	**Desert pastures** Complex of dunes and takyr depressions. 900 ha of irrigated lands near the village.	**highway** **Bakhardok village** More than 300 families, approx. 2000 inhabitants.	**Desert pastures.** Complex of dunes and takyr depressions	**Desert pastures** Complex of dunes and takyr depressions
Type of labour	W:house-keeping, milking, producing of dairy products	W: seasonal help on pastures, fields work on irrigated lands. M: grazing, fields work on irrigated lands Ch: seasonal help on pastures	W: house-keeping, gardens M,W: work in state organisations - local administration, school, shop, hospital	M: grazing W,ch: seasonal help on pastures	M: grazing W,ch: seasonal help on pastures
Vegetation	No household planting due to absent of water for irrigation. Native desert vegetation is highly degraded	Degraded vegetation presented by Carex phisodes, Calligonum rubens, Salsola richteri. Alfalfa, wheat, vegetables on irrigated lands	In households: apricots, apple trees, mulberry, grapes, vegetables Native desert vegetation is highly degraded	Degraded vegetation presented by Carex phisodes, Calligonum rubens, Salsola richteri. Alfalfa, wheat, vegetables on irrigated lands	Less degraded vegetation presented by Haloxylon persicum,Carex phisodes, Calligonum rubens, Salsola richteri.
Problems	No water, gas and electricity supply. Lack of supplementary fodder.	Degradation of pastures due to overgrazing and wood collecting. Shifting sand near the village. Soil salinisation on irrigated lands.	No gas supply. Lack of drinking water. Lack of supplementary fodder. Shifting sand around the village. Frequent sand storms.	Degradation of pastures due to overgrazing and wood collecting. Shifting sand near the village. Soil salinisation on irrigated lands	Degradation of pastures due to overgrazing and partly undergrazing. Lack of water source for animals.
Possibilities for improveme nt	Creation of small gardens using precipitation collection from takyr surface	Pastures improvement by phytoreclamation, introduction of protected areas with prohibition of human activities. Improvement of desert roads	Processing of livestock products. Sand fixation. Creation of household gardens. Establishment of small-scale carpet and other traditional needlework production.	Pastures improvement by phytoreclamation, introduction of protected areas with prohibition of human activities. Improvement of desert roads	Pastures improvement by phytoreclamation. Fixing of wells.

Figure 20: Explanatory Transect set up Across the Highway

Composed by the author, 1998

The second type of transect was conducted by the author with help of the colleagues from the National Institute of Deserts, Flora and Fauna in order to reveal the degree of pasture degradation around the villages Bakhardok and Yarma (see chapter 4.2.3 and Pic. 17). Ecological investigation was conducted by setting up 8 transects together with geo-botanical description of vegetation.

Observation

On-site observation with villagers was also a productive technique, especially when the author talked to the people about their cultivated plots. Some of them were very proud showing the gardens, sharing their experiences and problems. During two years of research, on-site observation became a common method. After planting seedlings of *Haloxylon persicum* and installation of mechanical protection to control sand encroachment, observation of every experimental site became necessary.

In general, participatory tools based on interviews and on-site observation proved to be more suitable and appropriate for inhabitants of the desert as they have a long tradition of verbal culture.

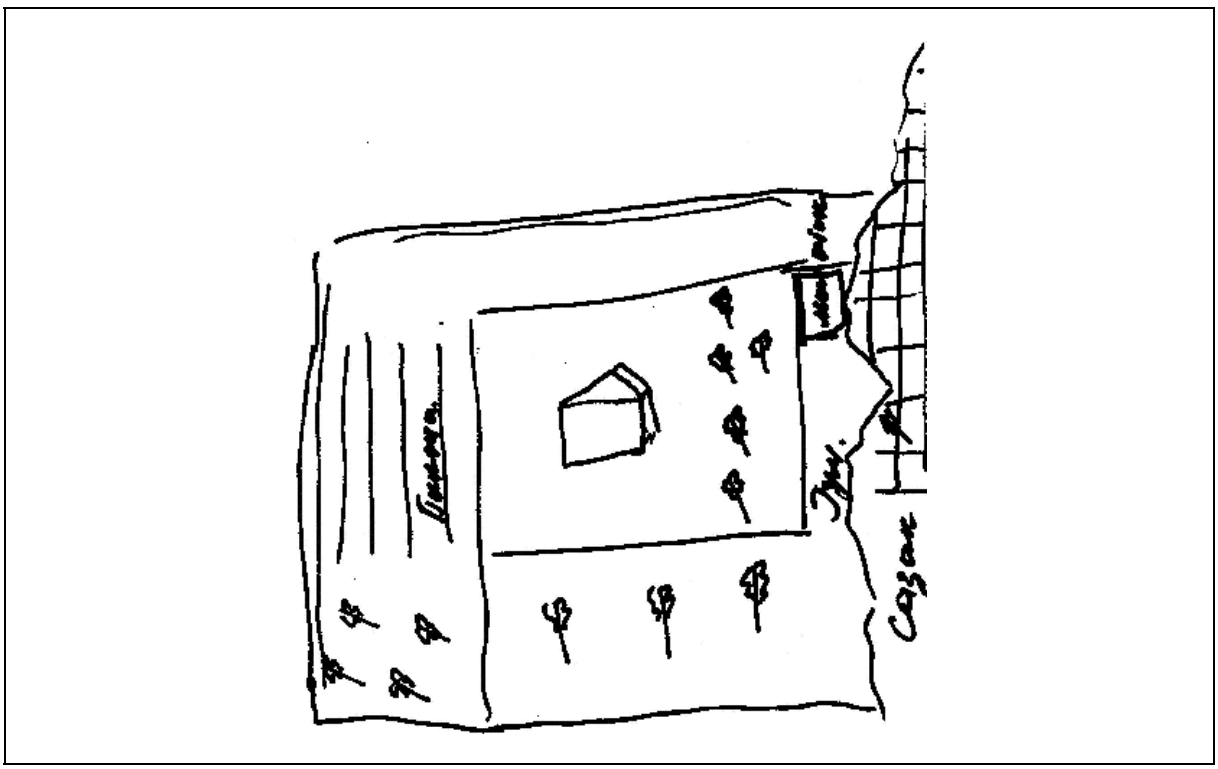


Figure 21: The Picture of Household in Bakhadok Village Drawn by the Owner During the Interview, 1999

Problem Ranking

In the course of the research problems of daily life were discussed during the interviews with the villagers. Revealing the problems was sometimes difficult and a bit tense task for the local people. The direct expression of the problems is complicated by the inherited perceptions of people not to admit and discuss the social and economic problems with representatives of state administration. Here, the task of the outsiders is to establish a trustful dialogue with the local people and to avoid as much as possible the element of state administrative actions. People have to feel free to share their problems with external experts, and the latter, in their turn, have to be competent and tactful to support trustful communication and not to make people speak of the problems which they might think external experts would like to hear.

During the interviews with and stories telling by the local people (including women and men of different age) the following problems were mentioned most often:

- Insufficient salary and untimely payment
- Abolition of the state subsidy for the children
- Low pension rate
- Low state prices for wool and meat
- Drinking water needs to be bought
- Low employment opportunity for the youth (especially for young women)
- Lack of teachers in the local school, closing of the boarding school
- The purchase of fodder and vaccination for livestock should be arranged individually by livestock breeders
- Theft of livestock

The above-presented problems are the main problems, which were most mentioned by the local people. This list does not include environmental problems, though the frequent droughts and sand storms were mentioned by the village inhabitants as a disturbing factor for livelihood, and lack of precipitation and reduction of pastures biomass were stressed more often by the shepherds.

Another point to be noticed in relation to the application of problems ranking-technique is that the local people prefer to speak of the problems rather that put it in any kinds of visualized form like diagrams or problem trees.

Aerial Photo Interpretation

Local people showed good ability to work with aerial photos. They easily and quickly recognized village's units: school, administrative buildings, hospital, households. Unfortunately, the photo presented, was old (see Fig. 22 and Photo 7) but villagers showed keen interest to see how their village had grown over time. During the discussion they showed the buildings that no longer exist and the newly constructed places.

Photo 13: Interpretation of Aerial Photo by the Villagers at Village Community Meeting
Photo taken by the author, 1999

Questionnaire

One hundred questionnaires were distributed in the Bakhardok village and 84 returned back with answers. The use of questionnaire allowed covering a bigger number of villagers in a shorter period of time. Many factors should be considered while composing the questionnaire list like literacy rate, age, socio-cultural background. The questions should be chosen deliberately and carefully so as to avoid confusing and sophisticated formulations. With the help of questionnaire, such information as preferable plants species in the gardens, proportion of people with big gardens or people who do not have garden at all was shown. The answers contributed to the discussion of environmental behavior of villagers.

The data collected revealed an educational level of respondents in the village of Bakhardok indicating the prevalence of secondary school education and occupational college education.

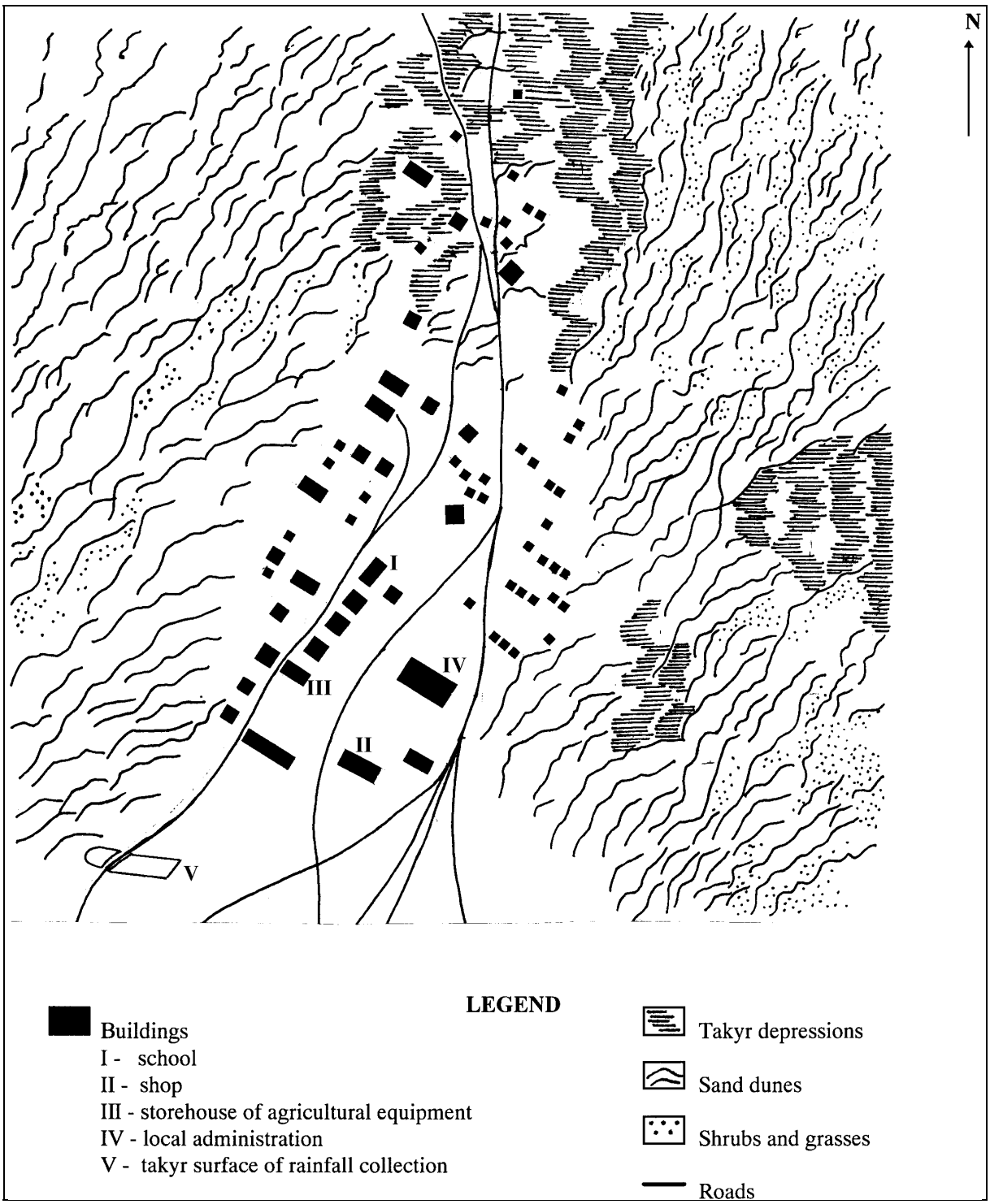


Figure 22: Map of Landuse and Desertification of Bakhradok Village
Source: aerial photo of 1986, illustration made by the author, 2001

The percentage of men who continued education after school is higher than those for women. Questionnaires also gave general information about people's migratory patterns (see chapter 3.1). It was found that people have been migrating mostly to Bakhardok village from other smaller neighboring villages within the administrative border of the peasant association.

In the experience of the author, the method of using questionnaires has both advantageous and disadvantageous sides. It is helpful to get a general picture of the situation and to build up a statistical database, in particular, when one deals with big areas and has limited time. A disadvantage concerns the limited character of questions. People tend to give simple and approximate answers and hesitate to answer open questions. For instance, what else could be done to improve environmental and social situation in their village beside the actions proposed by the cooperation project? Most of the people mentioned that ongoing activities should be continued, some did not answer, and just a few mentioned the problem of unemployment (see Annexes). One has to keep in mind that figures obtained by the method of questionnaire are statistical data and do not necessary reveal problems and their nature. Therefore, a questionnaire is only one of the participatory tools, which should serve as an addition source of information but not as the only basis of participatory information collection.

The above mentioned tools of participatory approach proved to be acceptable to the local population. An important amount of information on different issues was collected. The question arises why the activities of desertification control on the grass root level in the research area had certain limitations and were not always realized as planned (see chapter 4).

6.2 Challenges on the Different Administrational Levels

According to Leurs (1996) there are six different levels on which participatory processes can face challenges: individuals, community, organizational, project and program, donor and policy level. The author would combine them in four major levels, which obviously affected participatory research in Turkmenistan. They are individual, community, organizational and political levels.

Political Level

Any participatory process and activities on the grass root or individual level depends directly on the higher levels of the state administrational pyramid (Fig. 23). Each of them defines the possible sphere of activities on the lower levels.

To which extend is a country centralised or decentralised? How independent, flexible and empowered all administrational institutions in the country? This factor sets the first frames of future project, it makes the project possible or impossible to be implemented in one particular country. The barrier of political condition of the country is the most difficult factor to overcome or sometimes presents an insurmountable hindrance for developing projects. In Turkmenistan

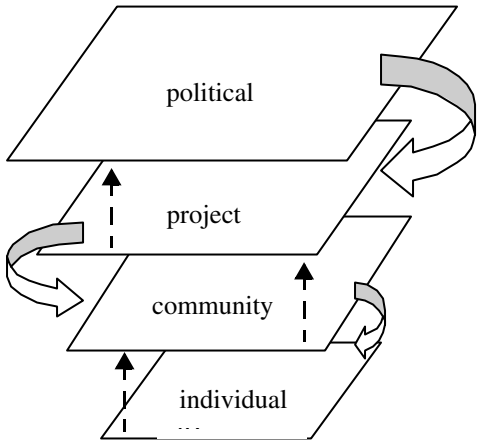


Figure 23: Hierarchy of Different Administrational and Social Levels of Society
Composed by the author, 1999

where a centralised regime is combined with governmental obligations to fulfil international conventions, project activities are put into rigid frames of applicability.

The policy system in Turkmenistan determines the main trends of the economy, presence and pace of reforms, and possesses the mass media. In the Turkmen policy system, the problem between decision-makers and the grass root level is even more critical. After the collapse of Soviet Union Turkmenistan continues to adhere to a Soviet-like policy system but with a new national ideology. The transformations that are taking place in all spheres of people's life, in all branches of national economy have not moved far. Turkmenistan is still a country where people's initiatives and ideas about private business and non-governmental funds do not find support from the government side and can hardly be realised. Such conditions favour the passiveness of people and their poor decision-making capacity. The perception of people that any decision has to be approved by the "top" hinders the voluntary participation in developing projects.

Another consequence of the Soviet policy of common property is an indifferent attitude of people towards natural resources, which under the Constitution belongs to the people. Post Soviet policy in Turkmenistan introduced the right of private land ownership, but the legislation on land privacy is not completely established. The laws, which suppose to defend the interests of owners, have not much real power and many landowners still feel insecure to invest much money in their land. An example of that is the interviews undertaken in Chalysh village, which is 9km southwards of Bakhardok village. Most of inhabitants of this village have leased plots of lands from the newly developing territories on a long-term basis. One man said:

"You get a plot of land and establish a contract for 2 years which needs to be extended afterwards. And after you put so much work and money into the land, which has not been treated before, you have your first harvest. In two years they might give you a completely new plot of land and you have to start everything anew".

Gained the status of Neutrality in 1996, Turkmenistan remains the country with a controlled mass media and restricted access to Internet. Nevertheless, thanks to number of international conventions, which Turkmenistan has joined as an independent state, some positive steps towards the creation of people's ecological awareness became possible.

The transformations in the agricultural sector do not represent dynamic changes. Land privatisation has not progressed so far, at least not in terms of the establishment of a substantial and viable private (family-run) farm sector. A growing process of centralisation in Turkmenistan makes the institutions in the rural areas unable to take over the task of land use planning, in particular, if it comes to grass-root level.

Institutional Level

Below, the author describes the complex relations between donor agencies and receiving organisation, as well as the problems of project management which may occur during the co-operation.

The "Participatory Management of Natural Resources in Three Pilot Areas of Turkmenistan" project is the first experience with applying participatory methods for community-based research in Turkmenistan. The special training courses for the staff of the National Institute of Deserts, Flora and Fauna were conducted by German experts. Among them are "Introduction to project planning and elaboration of a proposal for pilot project in Yerbent" (1997), "Introduction to GIS" (1998), "Introduction to participatory approaches and appraisal methods" (1998). To carry out the fieldwork, the permanent team was composed of scientists from the NIDFF. The team included experts from natural and technical sciences and no experts on sociology. This manner of choosing members of the team led to a narrower analysis of the socio-economical situation in the research area. Since the end of 1999, when the project broadened its activities into two more new areas, there has been no permanent team any longer and the same scientists have been hired by the project's leaders. But neither sociologists nor economists were involved in the three project's areas.

Community Level

During the project activities, the team worked with different kinds of communities. At the early beginning of the project, a meeting for the inhabitants of Bakhardok and neighbouring villages was conducted to explain the idea and general objectives of the project and to establish a dialogue between village community and project members. When the first activities were chosen main target groups or main communities were identified, such as school community, community of shepherds, women and gardeners.

Photo 14: Discussion of Project's Activities at the Meeting of Bakhardol Village Inhibitants
Photo taken by the author, 1999

The co-operation on the community level was usually more formal and superficial. It was observed that most of the people in the group did not feel free to express their opinions and views, even if they were the members of one community and had the same interest and problems. The situation was even worse when the representatives of village authorities attended the meetings. One obvious reason of this behaviour is that the people are still affected by Soviet-type meetings, which had to be obligatory participated and did not attract people to discussion and were rather monologue of the leadership but not a dialogue. Considering this factor, project's team decided not to organise big meetings and to avoid as much as possible participation from local administration.

Another big challenge facing the participatory processes at the community level in the Central Karakum is the indifference of community's members to common property, which translates into a lack of interest to improve the common natural resources. One example is the poor results of fixing sands along the Ashgabad-Dashoguz highway. The road, which is running

through the Bakhardok village, is threatened by sand expansion, creating problems for passing vehicles. It was decided to carry out mechanical protection of some parts of the road, which are the most subjected to sand blowing with a help of pupils of the local school. The project in its turn provided the school community with logistical help and consultants. The fixation measures had slower pace than it had been expected and due to the continuous delay of the work mechanical fixation was finished later. This negatively affected the quality of the work. The project had poor communication with the school community, had neglected the factor of motivation and as a results the wrong strategy had been chosen to solve this problem.

During the work with communities it was clear that people sometimes hesitated to work in the group. Very often work on the community level was transformed to work with individuals and their families.

Individual Level

Work with individuals or families proved to be the easiest strategy during the course of the project. Many families separately considered the project's team as friends, which was, of course, helpful for better understanding. On the other hand, this hindered the work with families in groups. Visits of each family's plot to monitor the running of experimental work also took much time for the project's team.

The main advantage of working with individuals or their families is their interest in common property. Members of one family also feel comfortable to speak with outsiders. During the course of the project the team had collected enough evidence of prevailing individual interest over the collective ones. It happened, for example, when owners of experimental plots of sand fixation did not want to join their lands into a common protected area. People hesitated to join in any kinds of communities or unions as they were afraid to lose their property. The communication between owners of sand fixation plots was very poor – people had little interest of what was happening on the neighbouring plots. Often news was transmitted by the project's team. A local expert chosen from the villagers by them and the team members was responsible for monitoring the plots and serving as a connecting-link between separate household and household and the project team.

6.3 Problems and Realities of Participatory Approach

Problems and realities of participatory approach have been studied together with the process of its development (see chapter 2). Pretty (1993) offers his own typology of participation (as

quoted in Waters-Bayer and Bayer, 1995) which ranges from passive participation, participation in information giving, participation by consultation, participation by material incentives, functional participation, interactive participation to self-mobilisation. The spectrum of definitions of the term "participation" is very broad. The problem of frequent divergence between the concept of participation and its practical realisation occurs in most of the developing projects worldwide (Müller-Glodde, 1991; Bliss, 1999; Cleaver, 1999).

The Turkmen-German Technical Co-operation Project "Participatory Resource Management in the Central Karakum Desert" was a first experience of developmental aid in the rural desert areas of Turkmenistan. Application of participatory methods was a new experience for both Turkmen and German colleagues. Since the three years of its function, project has passed the different stages of participation beginning from the passive participation (meetings), through the information giving (interviews), to the functional participation (gardening, sand fixation). The further steps of interactive participation and self-mobilisation are to be achieved next.

After a well-organised theoretical part (meetings and seminars with the villagers), the implementation of the practical activities turned to be not an easy task. The reluctance of local population to the land cultivation and sand fixation activities could be explained by many factors. The author will try to explain it by making a comparison between Turkmenistan and other countries with a similar natural and social background.

There is no way in which to duplicate directly of participatory approaches from other countries with similar natural conditions for Turkmenistan, even if they were successful there. PRA will vary greatly from country to country, and the inclusion of different stakeholders within PRA and poverty assessment should be attuned to the country's overall political, social, economic, and institutional environment (Robb, C.M., 1998). If we take an example from the Sahel region in Africa with some conditions more or less similar to those in Turkmenistan – arid climate, strong dependence on livestock, unstable economy – the strategy of desertification combat can not be automatically copied for Turkmenistan. Analysis of local natural, social, and historical-cultural preconditions of a country is important in choosing appropriate strategies and tools of participatory approaches. Among the principal differences between Turkmenistan and other developing arid countries, which demand a specific strategy, generally, the following can be mentioned.

Firstly, desert areas of Turkmenistan have never experienced big-scale catastrophic droughts, which could jeopardise animal breeding and livelihood in desert in general. This fact says that people still "trust" their environment, they understand but they are not anxious of what can happen if vegetation and soil resources become exhausted. The main consequence of severe droughts - the food security - has never been under a big threat in Turkmenistan. A problem for developing projects in this case is to find common interests among local people in undertaking activities that improve natural conditions. People who are satisfied and "happy" with their environment can hardly participate voluntary in such activities. Let us take example of experience of Mauritanian "Stabilization and Fixation of Dunes" project (UNSO, Technical Publication Series, N5, 1991), whose main objectives were similar to some of those in the Turkmen-German Technical Co-operation Project, namely, "testing of dune fixation techniques and development of a methodology for ensuring the dissemination of this knowledge and its assimilation by the population ..." Aridity, population growth, sedentarization of rural dwellers, slow economic development are the same frame conditions for both countries. The project in Mauritania proved to be effective and "ascertained the degree of interest and level of adaptation of the new methods by the population". The same targets have still not been reached in Turkmenistan. One should think of the difference in acuteness of the problem in the eyes of local population and their indifferent attitude toward natural resources as common property and their remaining opinion of state "care".

With the reference to Maslow's Hierarchy of Needs (Fig. 24), the Turkmen livestock breeders' priorities are an adequate income for the daily needs and security of livestock lease and land tenure. It is imperative that these physiological and security needs are addressed first before the local communities will begin to think of their environmental problems which are proposed to them in the participatory activities. The social needs belong to the third level of Maslow's hierarchy. This practically requires a giant or even an impossible leap from the local communities whose more basic needs are yet to be met. Desertification control including planting and fixation of moving sands is not a direct income-generating activity. For those single families whose gardens are threatened by sand encroachment, desertification control measures is more important. But such families are the minor part of the village community. Therefore, desertification control for the major part of the village community is neither income-generating nor security-assuring activity. Hence, participatory approach in desertification control is superseded by these fundamental needs

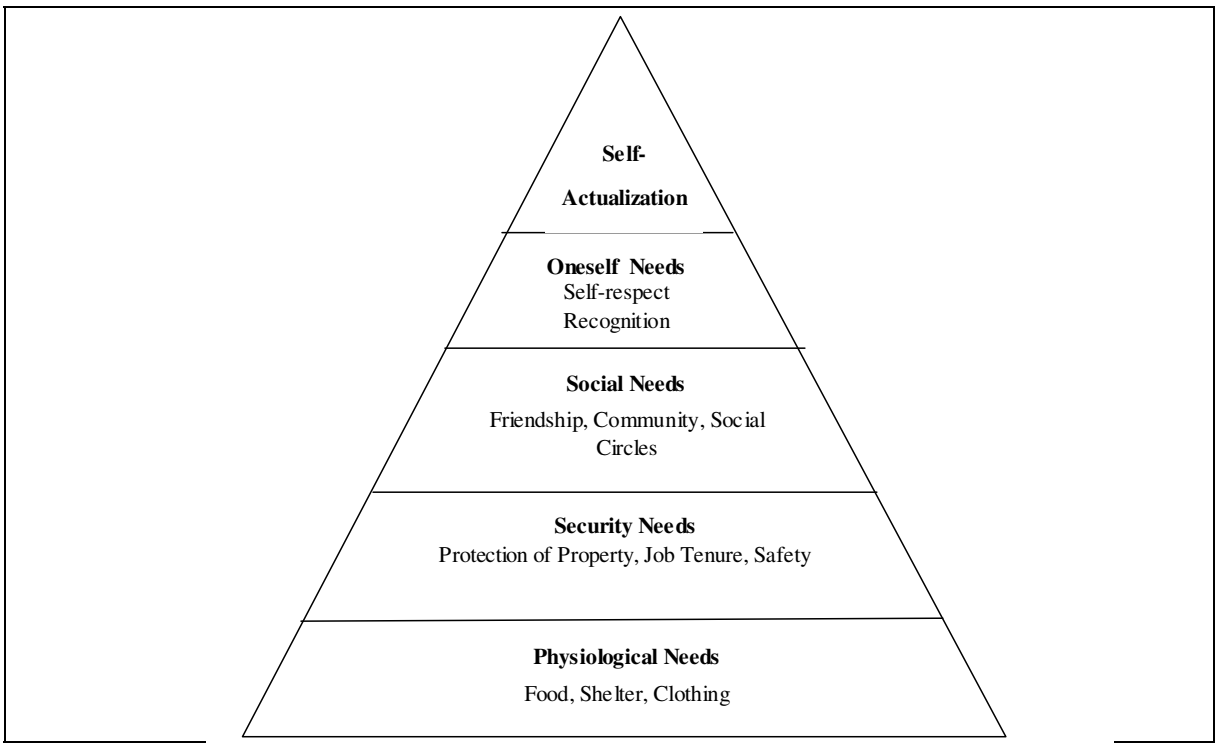


Figure 24: Abracham Maslow's Hierarchy of Needs, 1970
The pyramid illustrates individual endeavours to satisfy the baser needs first before it progresses to the higher level needs

In contrast, in developed countries where farmers have a substantial income and firm legislation supporting the agricultural industry, the participatory approach implemented through cross-compliance has better success. However, personal gains still surface even in these more favourable conditions compared to those in the developing countries.

Since the beginning of the Sahelian crisis in the 1970s, affected African countries have been under steadfast attention of various international organizations and agencies. The strategy to combat desertification has been integrated with the national policies of those countries. Three generations of different approaches were developed over the decades (Hammer, T., 2000). Allocation of huge monetary budget for Sahelian countries allowed developing projects to tackle the problem on a bigger scale and with more logistical help. Having engendered failures and successes, the strategy of desertification combat in Sahelian region is far from being 100 % effective. Community-based developing projects in Turkmenistan, which started only a few years ago should, therefore, make wise use of this rich international experience.

It is important to mention, that sand fixation activities chosen in the project as one of the principal measures to combat desertification and which was intended to prove the effectiveness of the meetings organized earlier with villagers, were *not, in fact, fully accepted by them*. Here we have to take into account that planting never was a traditional occupation for desert nomads. The

project got a response from a few interested individuals whose households are threatened by sand invasion. It is difficult to contribute to awareness-building at the level of the whole village community when only a few are affected by the problem. "To achieve sustainable development emphasis must be placed on practices which meet other needs – notably the demand for food and income. There is no point in trying to 'sell' sustainable farming practices on the ground of conservation along, when the farmers themselves see their problems differently" (Pahlman, C., 1992). Nevertheless, with accelerating processes of land degradation and losses of vegetation around permanent desert settlements, sand fixation activities are urgently needed! Spots or belts of fixed sand will be the sources of future pastures afforestation. One should change the approaches of research and have more solid motivation for people to get their voluntary and constant participation. Better arrangement of location, size and number of fixing plots is necessary to make those measures effective.

The second unique distinction of Turkmenistan is a transition period, which is responsible for the immediate-benefit priorities of country's economic development. Until the year 1991, when Turkmenistan was a part of the Soviet Union the country was considered to be developed. Indeed, during the Soviet period the Desert Research Institute was the host institute that organised training courses to help developing countries to combat desertification. After the collapse of Soviet regime, in a short time Turkmenistan joined the list from developing countries and now in its turn, receives assistance from donor countries. The most attractive sectors of the Turkmen national economy are the petroleum and the construction sectors. There is a lack of domestic and foreign investments in the agricultural sector of Turkmenistan and the process of optimisation of legislation on land ownership remains slow. Reforms in agriculture, which are not reinforced through appropriate legislation, cause more confusion and trouble rather than really help rural inhabitants. Absence of former facilities such as supply of gas balloons, wool collection, vaccination of livestock has deteriorated rural socio-economic live conditions. Under the complicated and unstable conditions of transition period, the gab between prosperous and poor rural inhabitants is growing. Some are taking advantage of the transition while others become even more economically and socially marginalized.

The third distinction is highly developed administrative hierarchy and strongly centralised government in Turkmenistan. All administrative institutions in the country are strongly dependent on higher organisational levels. There was and is no rural community, which could act more or less independent from the government. During the Soviet time there were certain advantages to centralised management, such as centrally organised control over the animals and their

markets. Nowadays, when governmental support for rural areas has weakened, remaining centralised management represents serious hindrances for the application of the participatory approach. There is almost no way in which to undertake village activities without obtaining approval from the village administration. At the present stage of country's transition, strict laws with subsequent strict control of their implementation are needed to set up behaviour patterns for people, both urban and rural. Without governmental support, or even with limited support, the impact of the PRA is lessened. Because the ultimate objective is to influence policy rather than just produce technically sound documents, the value of conducting a PRA with little government support should be questioned (Robb, C.M.,1998).

Desertification is, undoubtedly, one of ecological and economic problems of Turkmenistan. Despite of joining the United Nations Convention to Combat Desertification in 1996, there is a lack of interest and support of the State to the problem of desertification in the arid areas of the country. Taking into account that desert territories occupy more than 80 % of the country, one can rank desertification as national environmental problem number one. At the same time, the World Bank (1996) estimates that the whole desert population in Turkmenistan counts 0.7 mln, which is less than 15 % of country's population. Thus, compared the other ecological problems of the country the desertification problem does not affect the biggest part of the population. Of course, there are many villages and settlements on the conjunction of desert and irrigation lands and within the irrigation area, which are subjected to land degradation processes. The number of such settlements and their population is not available. The ecological and economical problem of Turkmenistan, which affects the whole population of the country, is a problem of water deficiency and water quality. Rural population is a big direct consumer of water. The livelihood of both farmers and livestock breeders depends on its availability and quality and, therefore, they will suffer to a much bigger extent than urban population. Lack of drinking water and bad quality of available water was one of the most frequently mentioned problems of the inhabitants of Bakhardok village.

According to Smith (1998) who defined "weakest forms of participation" as utilisation, contribution, enlistment, co-operation, and consultation and "stronger forms of participation" as involving control over decisions, priorities, plans and implementation, the project in the Central Karakum succeeded in weak forms of participation. Good results obtained from application of participatory tools revealed the ability of local people to appraise their environmental and economic situation. The subsequent step of the PRA, involving a stronger form of participation such as empowerment of local people to analyse and make decisions, is more complicated and

requires the efforts of the project's leadership and good professional skills of external experts. It is important that participatory process proceeds from the appraisal phase to the phase of empowerment of local people to choose their priorities. Without the second phase all the participatory activities remain a subterfuge for donors and recipients.

Risk Areas. The Possible Problems, which can be met during Participatory Research in Turkmenistan.

- Lack of reliable statistical data. Access to the databank of the State Statistical Committee is complicated. To be allowed to use statistical information one needs an official letter from related authorities (Ministry, Institute, etc.). In some organizations managers are reluctant to support their information with data. Very often data on similar subjects can range substantially.
- Lack of updated environmental figures. Due to the lack of research, which requires field trips, use of remote-sensing methods, availability of modern equipment, disconnection with research institutes in former Soviet Union, it is impossible to draw any comparisons and to outline a dynamic trend of environmental processes.
- Highly developed subordination system in the state organizations makes interview hard to arrange. Often interviews bear superficial character.
- Restricted access to Internet. To use the Internet, which is scarce in the capital, one needs to pay one to two dollars per hour (for comparison: monthly salary in the public sector US$ 40–50, 10.2001).

7 Comparative Analysis on Desertification Control Activities – Example of Mongolia and Israel.

Two countries, the Republic of Mongolia and the State of Israel, are brought for comparative analyses in this chapter. The choice of the comparison cases is deliberate. First of all, geographical and climatic conditions in both countries make them desertification prone areas. Second, both of them are to a large extent involved in desertification control activities and research to support them. Mongolia and Israel are the members of the UN CCD. Experience of Mongolia was also chose to show the differences in agricultural development of Turkmenistan and Mongolia after being relieved from the central monopoly of Soviet Union. The Mongolian case study puts more emphasis on desert livestock breeding. The experience of Israel shows the possibility of alternatives to the livestock breeding sector of dryland and irrigated cropland agriculture.

Mongolia is a land of mountains and vast elevated inter-mountain plains, 90 % of these plains are not lower than 1,000–2,000 m above sea level with lowest point 552 m above sea level. Mongolia is characterised by vertical zones stretching from desert zone on the south of the country, desert steppes and steppes in central part and high mountains on the north. Low precipitation – from 100 mm on the south to 400 mm on the north, wide variation of daily and yearly air temperatures, together with strong spring winds, are the main climatic features of Mongolia. In the northern part, mean air temperature falls below –30 °C in January and in July it is higher than 20 °C in most areas of the country. The northern part of Mongolia has a well-developed river system. Various orographical and climatic conditions cause a great differentiation of soils, which are represented here by mountain tundra and taiga soils, chestnut soils, and burozem desert soils in Gobi desert. Vegetation cover is also diverse – belts of mountain tundra and mountain taiga vegetation, mountain forests, steppe, semi-desert and desert vegetation.

83.5 % of the territory or 127 million hectares are suitable for pastures. High-yielded pastures are situated in the north, north-west, and north-east of Mongolia. The central part of the country is occupied by middle-yielded pastures and only the south-west part is occupied by low-yielded pastures. Abandonment of sparsely-inhabited territories is a similar feature for both countries. In Mongolia the vertical model of herds migration is usual, whereas in Turkmenistan it is mainly a horizontal model.

During the last decades Mongolia has enjoyed closer attention of foreign scientists and international development agencies, which promote development in all sectors of Mongolia (Müller,

2000). That has been manifested in a great number of publications (The International Congress on the State and Dynamics of Geosciences and Human geography of Mongolia held in Berlin 2000 is one of the evidence of this statement). This factor distinguishes Mongolia from its north-western neighbour, Turkmenistan. Having been strongly influenced by the Soviet regime, Mongolia at the same time has benefited from its powerful neighbour in terms of education, sciences, medicine and industry. Presently, the country has to pay for the same services, most of which are now difficult to arrange because of shifting priorities and the transitional economy of Russia. There is an obvious tendency in Mongolia to re-establish connection with China, the country with a more similar historical and cultural background. One can easily find analogies in the situation of Turkmenistan, when, presently, after gaining independence the country has to pay to get the same services from Russia. This has forced Turkmenistan to ask its southern partners, Turkey and Iran, for economic co-operation.

One can follow the similarities in development of Turkmenistan and Mongolia during the Soviet time. After 1991, the two countries have chosen different methods of transition, which have been reflected in rural development policy. The process of economic liberalisation and market-oriented development in Mongolia in the second half of 90ies has attracted many international and national donors such as IMF, World Bank, ADB, UNDP, TACIS as well as Japan. Germany and USA, but there is still lack of interest and support for rural areas (Janzen, 2000).

One of the most important issues for the dominantly rural countries that Mongolia and Turkmenistan belong to, is the issue of livestock management. The first discrepancy in this connection is the different types of livestock husbandry. Mongolia adheres more to mobile livestock husbandry, which is often called nomadic. The efforts of the socialist regime to control nomad tribes in Turkmenistan were much more successful because of possibility of direct impact (see chapter 3.3). In Mongolia, despite big efforts to enforce the *Soviet-Centralasian Transhumance* model of pastoral society, 34 % of livestock-breeders continued to pursue a nomadic way of life. Nowadays, there is a clear tendency among Mongolian livestock-breeders to concentrate near the big settlements and along main roads. Vicinity of market where they can sell their animal production pushes shepherds to move closer to favourable locations, which inevitably leads to increasing pressure on environment (Janzen, 2000).

After the collapse of the kolkhoz and sovkhoz system in the Soviet Union and of collective farming in Mongolia, the process of decollectivisation of livestock took place in both countries, though in a different manner. In Mongolia privatisation of livestock happened together with

privatisation of large part of state-owned production sites, raising the number of private farms in service sector (90 %) and in agriculture (79 %), which fostered the establishment of a free market economy (Janzen, 2000). In Turkmenistan most of state-owned animals were given to individuals on a lease-based contract (see chapter 4.2.1). Like in Turkmenistan, distribution of livestock in Mongolia has caused increasing social differentiation and deepened the gap between rich and poor layers of rural society. The prime reason behind this problem is generally the same for both countries – collapse of state-planned economy with all its interconnections and monopolies. Nowadays, in rural areas of Mongolia and Turkmenistan can be found the individuals with a few animals who compose the poor strata of society, and individuals who have built up huge herds. It is interesting to note, that size of the herds in both countries are different: in Mongolia big herd is considered to be up to several thousand heads, while in Turkmenistan it is seldom more than a thousand heads. High prices on cashmere dictated a drastically increasing amount of goats in herds in Mongolia (Klein, 2000), while in Turkmenistan the disappearing market on astrakhan felts in the last decade caused Turkmen shepherds to breed more sheep for meat in the private sector.

Another principal difference in the transformation of rural areas of Mongolia and Turkmenistan is different status of economic liberalisation. In Turkmenistan, the leasing process of animals seems to be the only step to economic democratisation, which was not further supported by any kind of subsequent decentralisation processes, such as privatisation of pastures and rural infrastructures, promotion of free market of animal production, etc. At the same time, the process of privatisation of livestock in Mongolia is supported by the real introduction of a free market, that allows farmers trying an alternative to livestock business, increasing number of family business. Therefore, there is more appropriate ground in rural Mongolia for self-organising and self-developing initiatives.

As a conclusion one can underline a few similar features of rural development in Mongolia and Turkmenistan. Both have been dependent for decades on the socialist regime of the Soviet Union. Nowadays, after collapse of the centralised monopoly, the countries undergo social and economic transformation, reforms in livestock-breeding sector of agriculture. Poor rural facilities, high population density result in increasing pressure on land and progressive desertification processes. The main difference in further development of two countries is the process of decentralisation, which took a broader scale in Mongolia, and therefore, has more favourable character for stabilisation and advancing animal husbandry in the country. The importance of a pastoral economy is strongly integrated in the new Constitution of Mongolia. Among other

objectives of the governmental program for supporting animal husbandry in Mongolia, the following, in the view of the author, are the most important for consideration for Turkmenistan:

- Offering financial help to those herdsmen who want to be involved in voluntary co-operative society and farming.
- Creating a network for the purchase of animal raw products from herdsmen. Offering loans to those in the countryside who want to run small and middle sized enterprises and helping them with a special taxation policy.
- Establishment of protected zones in Mongolia (20.4 million ha in 2000) with controlled grazing, collection of firewood and any other kind of economic activities is a step towards sustainable use of natural resources.

The experience of Mongolia in desertification control activities can be examined and appropriate and applicable examples should be taken into account for the same activities in Turkmenistan.

Israel is another country worth examining for its desertification control policy. The reasons for that are, first of all, similar climatic conditions of semi-arid and arid territories of both countries. Secondly, for the tremendous experience amassed by Israeli experts in field of natural resource management in arid and semi-arid areas.

The State of Israel was founded in 1948, and since that time the government of the country has been paying great attention to the issue of environmental protection, understanding the importance of conservation of scarce and vulnerable natural resources under the geographical and climatic conditions of the country. Israel is a Eastern-Mediterranean country, and stretches from south to north (470 km long and 135 km wide across its widest point). Within the small area of 22,145 km^2 , Mediterranean scrubs, the Asian steppes and African desert all exist. The climatic features of all three bio-geographical zones of Israel is a short, cool rainy winter, and a long, hot dry summer. Within these areas rainfall decreases from 700 mm to 30 mm.

The traditional occupation of inhabitants of semiarid and arid drylands in Israel was nomad livestock breeding (sheep, goats, camels). Until 1948 mainly nomadic Bedouin tribes inhabited the semiarid and arid lands. But already in mid 19^{th} century Bedouins started farming on the areas, which traditionally belonged to pasturelands. As of 1948 number of Bedouins in the Negev desert dropped from 70,000 to 12,000 persons. The pressure of livestock on the vegetation of these areas considerably decreased due to the reduced number of Bedouins and other socio-economic changes, including land privatisation, farming and complete abandonment of no-

mad lifestyle. Most of the pasturelands relieved from grazing pressure have been transformed into irrigated croplands. The process of transformation of pasturelands to irrigated cropelands in Turkmenistan has not reached such a large scale as it did in Israel, but the tendency is obviously growing. The process of developing new agricultural lands in Turkmenistan is restricted by lack of water for irrigation, whilst the land is available.

Another effort to prevent and combat land degradation in Israel is afforestation campaigne, which started with foundation of the country. In 1999 afforestation was carried out on the area of 911 km^2 , mostly with indigenous species of plants (Israel Masterplan 22, 1993). Presently, 15 % of the dry sub-humid and semiarid regions of Israel are afforested. Together with the direct soil conservation effect of activity, afforestated lands are not used for pasturing anymore. An afforestation practice called "savannisation" was successfully experimented within semiarid drylands of Israel. This practice is based on harvesting of surface run-off in the area with precipitation range of 150–200 mm. Afforestation has been used in Israel for preventing gully erosion and bank erosion through planting along creeks, for stabilisation of sand dunes, for reducing impacts of wind and dust, and specially in recent years, for recreation and leisure activities.

Israel has developed its dryland agriculture under a sharp water deficiency. The system of ground and underground water pipe-lines, interim reservoirs and tunnels supply semiarid areas with water from the central and northern part of Israel. Highly developed agricultural technologies minimise risk of desertification and make irrigated croplands very productive. Technologies of drip and sprinkler irrigation, green houses, brackish water use, and aquaculture are widely used in agriculture of Israel. Whereas drylands similar to those of Israel are expected to double their agricultural input by the end of 25 years since their initial development, Israeli agricultural production increased 12-fold during such a period. During the last 18 years water input to the Israeli irrigated agriculture remained static or even decreased, while productivity went up by 2.9 times.

The success and sustainability of dryland agriculture in Israel is supported by a comprehensive Water Law enacted by the State, according to which, the water is public property and subject to the State control. The major policy instruments are quotas and water-pricing for each sector of consumers (agriculture, domestic and industry), which may vary between year dependent on the country's water balance. Success of such agriculture demands constant investment in research and dissemination, and implementation of new practices and technologies.

It should be noted, that together with state support given for promotion of sustainable development of the country, no decision has been taken in Israel with respect to the National Action Plan to Combat Desertification. It is likely, that Israel will produce a holistic and integrative action plan for sustainable development, which will incorporate three UN Conventions (CCD, Convention on Bio-diversity, and the Framework Convention on Climate Change UNFCCC).

With the example of management of natural resources in arid areas of Israel, one can see a clear case where appropriately-developed legislative and environmental policy, strengthened research activities and application of advanced technologies can be efficient preventive and active measures against land degradation. Turkmenistan, a 10-year old state, is beginning to implement agricultural reforms. Stronger efforts are needed to overcome the old system of use of natural resources in the country. The examples of Mongolia, with relation to livestock breeding sector, and Israel, with relation to dryland agriculture, offer different ideas of development for Turkmenistan. Both of them are appropriate and partly applicable to the current conditions of Turkmenistan.

8 Conclusions and Recommendations.

The research conducted in the Central Karakum with support of National Institute of Deserts, Flora and Fauna in Turkmenistan and Geographical Institute of Cologne University in Germany reveals the following findings.

I Transformations, which are taking place in Turkmenistan after obtaining independence, are reflected in all spheres of the country. In agricultural sector the government still tends to develop the cotton market. Livestock breeding as a traditional branch of Turkmen economy was set aside and does not enjoy state investments to improve the poor rural farm facilities and remains unprofitable.

II Reforms in agriculture, both in land tenure and livestock tenure, have brought frustration for rural people. Some of them have overcome the difficulties and have adjusted to the new market conditions, while others have failed. But both winners and losers have lost the sense of stability and confidence in support of the State.

III Legislation on environmental protection, tenure and property regulations are not firmly reinforced in practice. In newly created conditions people feel insecure about their property and impunity regarding violation of common resources.

IV Economical instability in the country affected non-profit institutions including those in scientific sphere. It is reflected in the lack of financial support for the National Institute of Deserts, Flora and Fauna that is an executive body of implementation of the UN Convention to Combat Desertification in Turkmenistan. Closing many laboratories and cutting the Institute's personnel of led to the standstill of scientific research.

V According to the National Action Plan to Combat Desertification in Turkmenistan 70 % of pastures are at the stage of slight degradation, 16 % are subject to moderate degradation and 6 % have severe degradation, mainly, as a result of vegetation degradation, water and wind erosion, and soil salinization. Desertification processes develop locally near the settlements, wells, roads, and industrial objects.

VI Analysis of many-years meteorological database shows the change in main climatic parameters in Turkmenistan. According to different models, increase of annual mean of temperature will vary from 6.1 °C to 4.2 °C and decrease of annual mean of precipitation will vary from 56 % to 0.0 % by the middle or end of 21 century. Climate change phenomenon in Turkmenistan is a part of worldwide warming processes. It intensifies

droughts, aggravates degradation processes of soil and vegetation degradation, and hinders the restoration of vegetation cover.

VII Traditional occupation of desert nomads was the migratory livestock breeding. Presently, two generations have changed since the time when this activity was practicing back in the early 1920s. For the largest part of the settled desert population livestock breeding is still the main source of income. Majority of the population is reluctant to undertake planting activity because it was not a part of their usual behavior and therefore, the lack of such skills and experience is evident.

VIII The new law on livestock breeding that permit unlimited number of animals in private herds, may contribute to the overuse of pastures, which are used very unevenly. At the same time, lack of appropriate facilities and services for shepherds hinder drastic increasing of livestock. Presently, the process of transfer of livestock from state to private sector is taking place rapidly.

IX Participatory tools such as interviews, transect, visualization, meeting, and so forth proved to be applicable and helpful method in information gathering on local community level. At the same time, experience had demonstrates that, so far the empowering of local people to analyse problems and to set up the activities made slow progress.

X Local people were reluctant to form groups to act jointly, for instant, in planting activities. Planting and sand fixation measures were carried out by different households separately, which proved the prevalence of individual interests over collective ones.

According to Smith (1998) “in developing countries benefits may be derived from the weakest form of participation”. These recommendations range from general, which assure favorable for participatory approach frame conditions and those for project planning.

I The lesson for development projects in field of desertification control in Turkmenistan should be, first of all, to incorporate strategic approaches into national development planning. For achieving sustainable development, a convergence of “top-down” and “bottom-up” methods must be established. This should include government initiatives through legislation and financial subsidies, and the empowerment of the rural people to participate in decision-making processes and to provide them with ownership right concerning livestock or land. One alternative solutions of improving desert environment on the national level could be national task of reviving traditions of decedents. In reviving traditional

knowledge of harmonic co-existence with nature, one possible way could be the improvement of existing pastures usage, making it more nomad-like.

II The team of external experts should consists of a multidisciplinary group including representatives of natural sciences as well as social and other specific disciplines if needed. The mono- disciplinary choice of experts leads to the poor reflection of the situation, imposing the expert's visions and perceptions and later on to the narrow analysis of the problems. Training for external experts should not only be oriented towards the application of participatory tools but also towards the ability to reflect on the results of participatory surveys. Information obtained during participatory surveys is to be strongly integrated into project planning. Project's leaders should pay more attention to interviews with local people, try to join as far as possible separated individuals into small groups for common discussion, and to use information obtained during such discussions for planning future project's activities.

III Two main prerequisites are needed for real participation on the grass root level. First, decentralisation of decision-making mechanisms on different hierarchical levels, and, second, the choice of objectives/activities with a major impact at the grass roots level. Representatives of the grass root level must be involved in the project planning phase and not only later in the implementation phase.

IV Promoting the creation of village units or communities further strengthens the participation of the grass roots level. People who have the same concerns should be welcomed in organising into groups with fixed targets, rights and duties. Governmental or non-governmental organisations should assist this kind of self-organisation with financial, administrational, legislative and logistical support. Most likely, contract based arrangement would be the best solution of the problem of people's distrust to co-operate with each other.

V Improving village infrastructure would be the most logical and most obvious assistance offered to local communities. Solve the problem of gas supply, road communication, improving and increasing the numbers of wells would minimise main human causes of desertification. Reviving traditional method of precipitation use can be alternative decision of insufficient water supply of pastureland. Use of renewable energy sources such as solar and wind energy can substantially improve the living conditions of desert inhabitants and reduce out-migration. These are also the kinds of activities that are welcomed by

the local population. But these body of measures should not be just a concern of rural developing projects and NGOs, they have to be an integrated part of national development policy.

VI As described in chapter 4.2.3, degradation of desert pastures develops by circles of different stages of degradation. Depending on the degree of degradation the protection area around the source of desertification (settlements and wells) must be set up. Here co-operation between the local authority and the local population is needed. Within such protection circles any human activity, which may negatively affect desert environment, must be prohibited. Regulating the activities on soil and vegetation rehabilitation can be carried out together with local communities.

VII Optimisation of pasture management is an urgent demand for achieving sustainable resource use in the desert. More efficient rotation of pastures should be an emphasis for rural policy. The method of pastures' enclosure can be tested. Rational use of pastures by shepherds requires their private interests in implementing conservation measures. Ownership or long-term lease of pasturelands could be a strong motivation for shepherds.

VIII A contractual participation model, which proved to be effective in many countries can be tested in Turkmenistan. The contract would assign reciprocal rights and duties for both people interested and project. The project would imply monetary or other kind of incentives for individuals or group of individuals who are willing to participate and accept the terms of contract. The project would pay on the base of achieved results chosen by people themselves. The contractual basis should be arrange preferably with group of people rather than with single individuals in order to develop collective responsibility for measures to be undertaken. One can argue here that monetary motivation will not provide continuous follow–up of the project's activities. This might be true, but use of different kinds of incentives during the first years of the project can deliver good results (sand fixation, crop diversification, etc), which can then trigger the interests and belief of people that something can be changed through their effort. Once the incentives are not longer delivered, the probability of continuation of activities will be much higher when people already have appreciated and benefited from the results, than after reluctant participation and no encouraging results.

Problem of desertification in Turkmenistan is indisputable. Process of land degradation is accelerating year by year. Presently, desertification processes in the country have not yet

reached a stage of disaster but it certainly can be called alarming. The process of land degradation can be turned back. But if no additional measures are undertaken in order to control desertification and mitigate its consequences at the local and regional level, in the near future the life and economy of desert inhabitants will be seriously jeopardised. The activities undertaken by the scientists and co-operation projects until now represent small-scale experiments, which do not change the ecological situation as a whole. Emphasis should be placed on participatory activities, which meet the situation and agree with priorities and interests of local people. The role of State here is to support them with a safe legislative basis. Environmental management and economic development do not exclude each other. The challenge is to find ways in which decision-makers and grass root level, and if necessary developing agencies, can successfully co-operate.

9 Summary

Southern continental location and arid climate make the territory of Turkmenistan a desertification prone area. As it was adopted at United Nations Program on Environment and Development in 1992 in Rio-de-Janeiro: "Desertification is *land degradation* in arid, semi-arid and dry subhumid areas resulting from various factors, including *climatic variations* and *human activities*" (UNCCD, 1999). Land degradation includes the complex processes of soil deterioration, loss of vegetation, wind and water erosion. Approximately 70 % of the country's territory are at the stage of slight degradation, 16 % are at the stage of moderate degradation, and 6 % subject to severe degradation processes (Babayev, 1996).

Admitting the desertification problem in the country, Turkmenistan signed the United Nations Convention to Combat Desertification in 1996. In 1997 a first version of a National Action Program was prepared by the Turkmen scientists and submitted to the government of Turkmenistan. The National Institute of Deserts, Flora and Fauna of the Ministry of Environmental Protection of Turkmenistan (NIDFF) was appointed as an executive body for the implementation of the UN Convention. In 1997 the Turkmen-German Technical Co-operation Project "Participatory Management of Pasture Resources in the Central Karakum Desert" was initiated in the NIDFF, aiming to combat desertification jointly with the population in the affected area. The author was engaged in the on-going project as a short-term expert during the period of 1997–1999. The Doctoral thesis is based on the author's own research conducted in the period of 1998–2001 in the Central Karakum desert and the experience obtained working with the project.

As a methodological basis, the Participatory Rural Appraisal is applied for the first time to the conditions of Turkmenistan. Using the participatory tools such as group interviews, interviews with individuals, transect walks, observation, visualisation, and the use of questionnaires, the author investigated the factors causing desertification according to the perception of local inhabitants. Qualitative data based on scientific studies and statistics and quantitative data obtained from the interviews with local people give a comprehensive basis for the analysis of the present situation in the field of desertification control in Turkmenistan.

For the research into the participatory approach in desertification control, pasturelands of the Karakum Desert were chosen. The main volume of research was conducted in the village of Bakhardok (2,000 inhabitants) in Central Karakum. Another villages were used for supplementary research.

The territory of Central Karakum is a complex of sand ridges with takyr depressions with high fluctuation of air temperature during day and year (maximum +41 to +47 °C and minimum −26 to −30 °C) and great variability of precipitation (24−564 mm) (Babayev, A., 1996). The region has no surface water sources. The area has grey-brown, sandy, takyr-like, takyr, and solonchak soils with desert vegetation, among which the complex of Haloxylon persicum and Carex phisodes is the most typical mother association in the Central Karakum desert.

The thesis also discusses the effects of global climate change. According to the First National Report on Climate Change in Turkmenistan (1999), the average annual temperature rose from 0.2 °C in eastern part, 0.3 °C in western part, to 0.6 °C in northern and mountainous parts of the country. According to calculations of the scientists, the concentration of CO_2 in the atmosphere will double by the middle or the end of the 21 century. According to different models, the increase of mean annual temperature avaraged for the territory of the country will vary from 6.10 °C to 4.20 °C and the decrease of mean annual precipitation avaraged for the territory of the country will vary from 56 % to 0.0 % by the middle or end of the 21 century. Presently observed warming contributes to a great extent to the acceleration of desertification processes in the country.

The thesis explains the impact of the economy and the lifestyle of the the inhabitants of the Central Karakum desert on natural resources. Extensive livestock breeding descended from nomad livestock breeding is the main economic activity and the source of income of the inhabitants of the research area. A sedentary way of life, a lack of watering points for animals in the desert and insufficient supplementary fodder are the main causes of irrational management of pastures, which leads to their uneven use due to overgrazing and undergrazing processes in different parts of the pastures. Social instability due to recent agricultural reforms, low market prices on wool, and poor veterinary service have weakened the livestock sector and made life more insecure for the people who rely exclusively on livestock. The interviews with shepherds, their opinions on local social and environmental problems formed the main volume of information

Another form of human activity contributing to desertification processes is a collection of desert vegetation. The research area as well as the whole territory of the Central Karakum desert has no gas pipeline supply. The inhabitants of the research area have to collect desert plants for cooking, construction and heating in the cold period. Like with overgrazing phenomenon, the issue of pasture management is arising again while considering the problem of plant cutting. Traditionally, rich owners of pastures protected their areas by controlling the cutting of vegetation. During the Soviet Union the State assumed the role of pastures owners. Protected circles

around desert settlements were set up prohibiting plant cutting within their area. At present, with the transformation of many state enterprises, and of the system of ownership, with the lack of power to apply environmental legislation, and the lack of state control, no proper attention is paid to violations on the environment. In the opinion of the local population collection of vegetation has a more destructive impact on pastures than grazing.

The interviews with village inhabitants, both women and men of different ages, shepherds on the grazing camps and their opinions on local social and environmental problems formed the main volume of information. Technical recommendations on the application of the different participatory tools are included in the thesis.

Pursuing the objective of improving local living and environmental conditions, the Turkmen-German Technical Co-operational Project started in 1998 with work on sand fixation and on the promotion of private gardens. Despite the external and internal problems emerging during the implementation of these activities, the experience of three years shows their general positive results. External problems like the lack of precipitation, high air temperature, prolonged drought, strong and dry wind during the planting and vegetation period hindered the productiveness of sand fixation and planting activities. Internal factors, such as the lack of ecological education, poor planting skills, the reluctance of desert inhabitants to take part into joint activities, posed certain difficulties in motivating local people for the conservation of natural resources. Experience of practical participatory activities clearly shows the predominance of individual over collective interests; people proved to be more concerned with improving their living conditions than with environmental problems (shifting sands, pasture degradation, sand storms, etc.).

Different participatory tools were tested by the author in the research villages. The experience obtained indicates the productive application of participatory tools, such as interviews, observation, transect walk. It also shows the need to take into account the social and cultural settings of the country while applying participatory methods. A mere replication of participatory tools successfully applied in other developing countries, without their adjusting them to local conditions is impossible and will produce poor or negative results. Among the specific conditions of Turkmenistan, which should be considered by the external practitioners using participatory approach are the high level of education of the local desert inhabitants, developed scientific basis of the country, and the strong affiliation to administrational units of the country (peasant association, district administration and regional administration).

The question arises: if there are certain local, regional and national conditions, under which the participatory approach can be applicable in the country and if so, what are they? The research points out four levels, where a participatory approach can face the challenges: on individual, community, project and political levels. Though the author's research was conducted on the individual and community levels, it also discusses the interdependence of all social levels. Experience obtained from the research indicates the possibility and productivity of participatory methods used on individual and community levels, which means that the participatory tools are applicable in the conditions of Turkmenistan. At the same time, the author underlines that without the involvement of decision-makers any participatory activities will have very limited effectiveness.

The forms a participatory process can take were proposed by Waters-Bayer and Bayer (1995) and range from passive participation, participation in information giving, participation by consultation, participation by material incentives, functional participation, to interactive participation, and self-mobilisation. In short, from the weakest form of participation to its most intrusive form. So far, the participatory process during the implementation of the project has taken a form of four varieties: passive participation, information giving, and participation by consultation, and partly functional participation. A further extension to the stronger forms of participation has not yet taken place in the research area.

The lack of concern shown on the governmental and local community levels as regards a rational desert resource management and can also be explained by the fact, that the desert areas of Turkmenistan have never experienced large-scale catastrophic droughts, which could jeopardise animal breeding and livelihood in the desert. The main consequence of severe droughts – food security – has never been a real threat in Turkmenistan. The second reason is that considering many ecological problems of the country (water deficiency, degradation of irrigated lands, loss of biodiversity), the desertification problem in arid areas does not affect a bigger part of population of the country's population. Though it takes up more than 80 % of country's territory, the Karakum desert is inhabited only by 15 % of the total population of the country (World Bank, 1996). It is water deficiency and poor water quality which are crucial environmental problems, affecting every inhabitant of the country without exclusion. The livelihood of both farmers and livestock breeders depends on the availability and quality of water and they suffer from it to much bigger degree than urban population. Lack of drinking water and bad quality of available water were one of the most frequently mentioned problems of inhabitants of the research villages.

So far, desertification processes in the Karakum desert have not yet reached a stage of disaster but they certainly can be called alarming. The process of local land degradation can be stopped and land quality can be improved. But if no additional measures are undertaken in order to control desertification and mitigate its consequences, in the near future the life and the economy of desert inhabitants will be seriously jeopardised. The activities undertaken by the scientists and development projects until now are small-scale experiments, which do not change the ecological situation as a whole. Emphasis should be placed on participatory activities, which meet the concrete needs and agree with the priorities and interests of local people. The role of the State here is to support them with a safe legislative basis. Environmental management and economic development do not exclude each other. The challenge is to find ways in which the co-operation of decision-makers and the grass roots. and, if necessary development agencies, becomes a reality.

Zusammenfassung

Turkmenistan ist wie zahlreiche Länder im Trockengürtel der Alten Welt verschiedenartigen Prozessen der Desertifikation unterworfen. Diese wird in Anlehnung an die Definition der wie folgt umschrieben: „Desertifikation ist Landdegradation in ariden, semiariden und trocken-subhumiden Gebieten. Sie ist das Ergebnis unterschiedlicher Faktoren, inklusive Klimaschwankungen und menschlicher Aktivitäten". Landdegradation umfasst Prozesse wie Bodendegradation, Vegetationsvernichtung, verstärkte Erosion durch Wind und Wasser.

Forschungen in den Wüsten von Turkmenistan haben eine lange Geschichte. Erste Studien zu den Ökosystemen der Wüste und zu Vorgängen der Ausbreitung wüstenhafter Bedingungen im Gebiet des heutigen Turkmenistan wurden im 19. Jahrhundert im Zusammenhang mit dem Bau der Transkaspischen Eisenbahn durchgeführt. Grundlagenforschung in den Wüsten des Landes begann mit der Gründung der Forschungsstation Repetek in der südöstlichen Karakumwüste im Jahr 1912. Auf dieser wissenschaftlichen Basis baute das Wüstenforschungsinstituts der Akademie der Wissenschaften der Turkmenischen Sowjetrepublik seit 1962 auf; es knüpfte zugleich an die Ergebnisse russischer Studien an (z.B. Lopatin 1930; Petrov 1933; Korovin 1934). Während mehrerer Jahrzehnte widmete sich das Wüstenforschungsinstitut in Ashgabad, der Hauptstadt von Turkmenistan, und an seinen Außenstellen auch Studien zur Technologie der Desertifikationsbekämpfung durch präventive und korrektive Maßnahmen. Das Institut erfuhr erhebliche Förderung durch den Staat und unterhielt enge Beziehungen mit allen sowjetischen Forschungseinrichtungen. Wie oben gesagt, galt das besondere Interesse der Grundlagenforschung über die Wüstenökosysteme in Zentralasien; hinsichtlich der Desertifikation standen eher die Auswirkungen als die Ursachen dieses Prozesses im Vordergrund. Die Erkenntnisse zu präventiven Maßnahmen blieben in der Praxis weitgehend unberücksichtigt, obwohl Entwicklung und Tests erfolgreich waren. Im Zusammenhang mit dem Zusammenbruch der UdSSR und der Neuformierung der Staaten Zentralasiens gingen die Aktivitäten und internationalen Beziehungen des Wüstenforschungsinstituts drastisch zurück. Wissenschaftliche Erkenntnisse und Erfahrungen blieben verborgen in Zeitschriften – oder hinter den Mauern des Instituts; die praktische Umsetzung von Erkenntnissen blieb minimal. In der gegenwärtigen Situation des Landes, eines der Transformationsländer Zentralasiens, wird die Kontrolle und Bekämpfung der Desertifikation durch mehrere Faktoren erschwert: Wirtschaftlicher Niedergang, inadäquate Umweltgesetzgebung, unzureichende Beachtung von Umweltproblemen, fehlende Umsetzung der Strategie und der Pläne zur Desertifikationsbekämpfung (nach Babajev, 1999). Wegen der Verbreitung der Desertifikation in Turkmenistan unterzeichnete das Land

1996 die UNO-Konvention zur Bekämpfung Wüstenbildung. Schon 1997 wurde die erste Fassung des Nationalen Aktionsplans zur Wüstenbekämpfung, erarbeitet im Institut für Wüstenforschung, der Regierung von Turkmenistan und internationalen Organisationen zur Kenntnisnahme und zur Umsetzung vorgelegt. 1998 wurde das Wüstenforschungsinstitut als Nationales Institut für Wüsten, Flora und Fauna in das turkmenische Ministerium für Umweltschutz eingegliedert.

Unter veränderten sozioökonomischen Bedingungen sollten turkmenische Wissenschaftler *neue Methoden* der Desertifikationsbekämpfung anwenden. Ihre Forschungen müssen bis zum „grass roots level" reichen, Menschen integrieren, die in desertifikationsbetroffenen Gebieten leben und diese Gruppen in die Maßnahmen zur Wüstenbekämpfung einbeziehen. *PRA (Participatory Rural Appraisal)*, zu deutsch Partizipative Erhebungsmethoden ist hierzu ein bislang in Turkmenistan unbekannter Forschungsansatz dar, – die Dissertation stellt die Frage nach der Anwendung dieser Methode des partizipativen Vorgehens im Rahmen der Desertifikationsbekämpfung zum ersten Mal für Turkmenistan in den Mittelpunkt der Untersuchung.

Die geringen Erfolge bei der Umsetzung des Aktionsplans zur Wüstenbekämpfung, wie ihn die UNO-Konferenz in Nairobi 1977 verabschiedet hatte, ließen Forscher nach neuen Ansätzen suchen. Dabei erwies sich community participation/Beteiligung von Basisgruppen im Entwicklungsprozess als ein vielversprechender Ansatz. PRA entstand in den beginnenden 1980er Jahren, als Soziologen und Entwicklungsexperten diese Methode auf der lokalen Ebene im ländlichen Raum von Entwicklungsländern testeten. PRA wurde eingesetzt als eine Alternative zu den engen Disziplin- bzw. Sektor-orientierten Entwicklungsansätzen der 1970er/1980er Jahre, die eine Beteiligung der sog. Zielgruppen, der in Projekte involvierten Bevölkerungsteile, weder bei der Konzeption noch bei der Planung der Projekte kannte. Qualitative multidisziplinäre Ansätze standen am Anfang von PRA, wobei sich diese Methode darauf konzentrierte, Lebensumstände „vor Ort" von den Beteiligten zu erfahren, analysieren zu lassen und ihre Entwicklungsperspektiven kennenzulernen. Diese Methode legt zugleich großen Wert auf die Erfassung der traditionellen lokalen und regionalen Kenntnisse der Nutzung der natürlichen Ressourcen, die unter dem „Gewicht der Moderne" und der Technik-Orientierung in der Entwicklungszusammenarbeit der 1970er/1980er Jahre untergegangen war bzw. unterzugehen drohte. Zugleich ermöglicht der partizipative Ansatz, der auf Verhalten, Gewohnheiten und Ansichten der lokalen Bevölkerung eingeht, das Vertrauen der Beteiligten in ein Projekt zu erwerben, ihre persönliche Teilhabe sicherzustellen. Zugleich trägt dieser Ansatz dazu bei, die Bevölkerung, insbesondere benachteiligte Gruppen, zu „bemächtigen" im Sinne des „*empowerment*", Entscheidungsprozesse aktiv mitzugestalten und bei der Durchführung von Maßnahmen

als gleichberechtigte Partner zu fungieren. Konzeption, Planung und Durchführung eines Projektes, etwa im Rahmen der Desertifikationsbekämpfung, müssen heute auf der Bereitschaft der lokalen Bevölkerung beruhen und die Ideen der Gruppen integrieren, die das Projekt implementieren werden. Externe Berater, z.B. Wissenschaftler, haben die Rolle von Moderatoren/ Beratern; das bilaterale oder multilaterale „Projekt" gewährt finanzielle und logistische Hilfe. Die Anwendung von PRA setzt Respekt vor den kulturellen, historischen und sozioökonomischen Gegebenheiten „vor Ort" voraus, und bedeutet „Grenzziehungen" für Wissenschaftler und Experten der Entwicklungszusammenarbeit.

Im *Mittelpunkt* der Dissertation steht, wie oben erwähnt, die Frage nach der Anwendung von partizipativen Methoden beim Schutz bzw. Management der natürlichen Ressourcen in den Halbwüsten- und Wüstengebieten von Turkmenistan. Untersucht werden die Effektivität des partizipativen Ansatzes und die Analyse der mit dieser Methode verbundenen Probleme unter den spezifischen Rahmenbedingungen von Zentralturkmenistan. Für die Forschungen wurde ein Ausschnitt aus den Weidewirtschaftsgebieten der zentralen Karakumwüste gewählt, die den größten Anteil (ca. 70 %) der landwirtschaftlichen Nutzfläche des Landes umfasst. Die Fallstudie konzentriert sich auf den Ort Bakhardok und sein Umland in der zentralen Karakum. Diese Siedlung mit ca. 2,000 Einwohnern, verteilt auf ca. 370 Familien, ist das Verwaltungszentrum der Yerbent Peasant Association (Yerbent Bauern-Vereinigung), zu der ein Gebiet von fast 9,000 km² gehört. Die Wahl von Bakhardok beruht auf folgenden Kriterien: Das Gebiet ist typisch für die Karakum – Sandwüste hinsichtlich Relief, Böden und Vegetation; es zeigt die spezifischen Formen von „ökologischem Stress" um Siedlungskerne in der zentralen Karakum; Kleinviehhaltung von Woll-Fleisch-Schafen und Kamelhaltung (Wolle, Milch) sind die Hauptwirtschaftszweige; Wasser für Bewässerungszwecke steht zur Verfügung, so dass Tests zum Fragenkreis von Baumschutzpflanzungen möglich sind; die Erreichbarkeit von Ashgabad, Landeshauptstadt und Sitz des Instituts für Wüsten, Flora und Fauna (ca. 80 km Teerstraße). Im Rahmen der Studie wurden mehrmals Interviews mit 61 Einwohner im Untersuchungsgebiet durchgeführt. Diese Gruppeninterviews sind aber nur EIN Teil des PRA-Ansatzes. Sie wurden ergänzt durch die gemeinsam von Bewohnern und Wissenschaftlern durchgeführten Aufnahmen von Landschaftsprofilen (transects), durch die Nutzung von visuellen Hilfsmitteln wie Luftbildern, durch den Einsatz von Fragebögen und teilnehmende Beobachtung. Mit diesen Methoden gelang es der Verfasserin, Ursachen für die Desertifikation in der Perzeption der lokalen Bewohner, Bauern und Hirten, zu erfassen. Qualitative und quantitative Unterlagen ermöglichen zugleich eine Analyse und Bewertung der aktuellen Maßnahmen zur Wüstenbekämpfung in Zentral-Turkmenistan.

Bei der Erarbeitung der Unterlagen für die Dissertation zwischen 1997 und 2001 wurde die Verfasserin im Rahmen eines Sandwich-Stipendiums des DAAD von den Professoren Agajan G. Babaev, Institut für Wüstenforschung, Ashgabad, und Bernd Wiese, Geographisches Institut der Universität zu Köln, betreut. Forschungskontakte zu den Prof. J. Grunert, Mainz (Desertifikation, Sahelländer Westafrikas), K.-H. Barth, Paderborn (Desertifikation in Spanien), F.-V. Müller, Berlin (mobile Tierhaltung in der Mongolei) trugen zur Vertiefung und Erweiterung der Fragestellungen bei. Die Verfasserin hatte die Möglichkeit, im Rahmen des 1997 begonnenen Turkmenisch-Deutschen Entwicklungsprojektes „Partizipatives Ressourcenmanagement“ als Kurzzeit-Expertin mitzuarbeiten.

Desertifikation in Turkmenistan muss vor dem Hintergrund der *geoökologischen Situation* des Landes gesehen werden. Die klimatischen Bedingungen in der zentralen Karakum sind mit Mittelwerten wie mittlerem Jahresniederschlag von 110 bis 150 mm mit Winterregenregime (Maxima im Dezember bis März) und Jahresmitteln der Temperatur von 15.8 °C (Bakhardok) nur unzureichend umschrieben: Die Niederschläge in der zentralen Karakum können mehr als 200 mm erreichen (1968/69), können aber auch auf unter 50 mm/Saison fallen. Sommertemperaturen erreichen im Maximum 42 bis 44 °C, die Bodentemperaturen 60 bis 70 °C. Die potentielle natürliche Vegetation der Karakum-Sandwüste ist eine schüttere Strauchformation (Walter/Breckle 1986, Kap. 5.3.4); Haloxylon persicum (Weißer Saksaul) und Carex physodes sind Leitpflanzen. Oberflächenwasser gibt es nicht. In Brunnen fördern die Bewohner Wasser aus einer Tiefe von 15 bis 25 m. Das Wasser der meisten Brunnen hat einen hohen Mineralisierungsgrad von 5 bis 9 gr/l, so dass es sich nicht als Trinkwasser eignet; auch das Wasser der Pipeline vom Karakumkanal ist mineralisiert und nicht für den menschlichen Gebrauch geeignet; deshalb kommt Trinkwasser aus ca. 80 km Entfernung aus der Landeshauptstadt Ashgabad mit Zisternen-Lastkraftwagen.

Überweidung wird von Wissenschaftlern als eine Hauptursache für Desertifikation in allen Trockengebieten der Erde genannt. Dies gilt auch für die zentrale Karakum: Über 70 % der Weidegebiet in Turkmenistan befinden sich im Stadium der leichten Degradation und ihre Produktivität hat abgenommen (National Action Plan to Combat Desertification/NAPCD 1996). Die Auswirkungen der jüngsten Reformen in der Viehwirtschaft von Turkmenistan auf die Wüstenökosysteme sind ein wichtiger Teil der vorliegenden Studie. Nach dem Zusammenbruch der UdSSR im Jahre 1991 und der Unabhängigkeit von Turkmenistan im Jahre 1991 begann der Staat mit Reformen im Agrarsektor: Transformation von Sowchosen wie in Yerbent, aber auch von Kolchosen in Bauern-Vereinigungen (Peasant Associations); Langzeit-Pachtverträge für

Vieh aus dem früheren Staatssektor an die Mitglieder der Bauernvereinigungen; Abschaffung der Begrenzung der Viehzahl bei Privaten; begrenztes privates Eigentum an Land für den Pflanzenbau (Hausgärten).

Auf der Basis der Informationen, die die Verfasserin von Hirten im Untersuchungsgebiet erhielt, werden die aktuellen Eigentumsformen der Viehhaltung und ihre Auswirkungen auf die Weidegründe dargestellt. Drastische Veränderungen in der Zahl der Weidetiere sind nicht eingetreten; vielmehr vollzog sich eine Verlagerung vom staatlichen auf den „Pachtsektor". Das ökonomische Potential der natürlichen Weiden ist zur Zeit unzureichend genutzt, – es könnte einen größeren Viehbesatz tragen –, aber die gegenwärtige Situation der staatlichen Dienstleister und der Infrastruktur in der Viehhaltung lassen keine substantielle Vergrößerung der Herden zu: Es fehlt an Wasserstellen/Tränken, an Futter zur Überbrückung von Risikozeiten, an Veterinärdiensten, – und zusätzlich sind die staatlich festgesetzten Preise für Wolle so niedrig, dass kein Produktionsanreiz besteht; die Bauern konzentrieren sich daher auf die Fleischproduktion, deren Erzeugung in der Hauptstadt Ashgabad abgesetzt wird. Dass trotz dieser Situation Desertifikation auftritt, beruht auf der Konzentration der Viehbestände um die Siedlungen bzw. um die Tränken, wie die Analyse der Beweidungsgewohnheiten ergab.

Weidewirtschaftssysteme in ariden und semiariden Gebieten sind von der Erreichbarkeit der Wasserressourcen abhängig. Für die zentrale Karakum ist eine horizontale Wanderweidewirtschaft vom Typ des Halbnomadismus und der Transhumanz charakteristisch mit dem Wechsel von Winterweiden im Norden, Frühjahrsweiden im Bereich der Siedlungen in der zentralen Karakum und Sommerweiden im Süden des Landes. Die Weidegründe liegen stets in der Nähe der Wasserstellen; die Tiere weiden in etwa kreisförmig um die Wasserstellen; dabei folgen die Hirten einer Rotation, aber eine Rotationsweide im strengen Sinne mit eingezäunten Weideblöcken gibt es nicht. Wegen der geringen Zahl der Wasserstellen und ihrer ungleichmäßigen Verteilung werden die Weidegründe ungleich genutzt, so dass Überweidung und geringe Nutzung nebeneinander auftreten. Wissenschaftler des Wüstenforschungsinstituts haben auf der Forschungsstation Garykul in der zentralen Karakum die Auswirkungen der Beweidung auf die Naturweide zwischen 1960 und 1976 untersucht. Unter den Bedingungen einer intensiven Beweidung tritt Desertifikation nach ca. 8 bis 10 Jahren ein. In den ersten vier bis fünf Jahren wurde die Produktion der Biomasse um ca. 20 % reduziert, in der zweiten Hälfte des Versuchszeitraums trat eine Verminderung bis zu 50 % ein, so dass die Weidegründe erheblich an Wert verloren (Nechayava, 1970).

Die Interviews mit den Hirten machten deutlich, dass nach ihrer Erfahrung *Dürren*, vor allem von mehrjähriger Dauer, eine noch stärkere Auswirkung auf die Degradierung der Weidegründe haben als die Beweidung. Sie führten als Grund an, dass die Weidetiere niemals die natürliche Weide komplett abweiden; nach Auffassung der Hirten ist auch die Zahl der Tiere kein entscheidender Faktor der Degradierung. Sie sehen einen wesentlichen Ursachenbereich in der geringen Menge und in der Variabilität der Niederschläge. Dieses Ergebnis der Interviews deckt sich mit wissenschaftlichen Erkenntnissen, nach denen abiotische Faktoren wie Niederschlag die Primärproduktion und die Vegetationsbedeckung stärker beeinflussen als die Bestockungsdichte mit Vieh (Mearns, 1996). Unter den Bedingungen von periodischen Dürren hängt die Weidewirtschafts aufs engste von der Verfügbarkeit von Futtermasse und Wasser ab. Die Fähigkeit der Vegetation, sich nach Dürren zu regenerieren, ist ein Indikator der biologischen Nachhaltigkeit der Weidegründe; die Fähigkeit, die Herdengröße während Dürrezeiten kaum zu verringern, sagt dagegen etwas aus über die Qualität des Weidemanagements. Technisch ist es oft leicht, die Produktivität degradierter Weide wieder herzustellen, aber die Aspekte des Weidemanagements sind komplex (Reij, Eger, Steiner, 1998). In Turkmenistan hat die internationale Technische Zusammenarbeit keine Chance, auf das Weidemanagement Einfluss zu nehmen, da das Staatsmonopol bis heute den Landwirtschaftssektor kontrolliert. Solange nur isolierte technische Projekte zur Verbesserung der Weidebedingungen möglich sind (z.B. Anlage von Tränken, Wegen, Unterstützung von Veterinärdiensten), kann keine nachhaltige Entwicklung in den degradierten bzw. desertifikationsgefährdeten Gebieten einsetzen, da eine entsprechende Gesetzgebung zum Weidemanagement fehlt und keine ausreichenden Investitionen in den Viehwirtschaftsbereich erfolgen.

Vegetationszerstörung durch den Menschen ist ein weiterer Faktor der Desertifikation. Weder im Untersuchungsgebiet noch an anderen Orten der zentralen Karakum gibt es eine Ferngasversorgung. Die Verfügbarkeit von Gaszylindern in der Karakum ist unsicher und kostspielig, während die Gasversorgung der Haushalte ansonsten kostenlos ist, wovon die Städte am meisten profitieren. So müssen die Bewohner in der Karakum Brennstoffe zum Kochen und Heizen (von Oktober bis März) sowie Baumaterial aus der spärlichen Vegetation der Wüste sammeln. Deshalb entstehen um alle Siedlungen stark degradierte Flächen, und oft wachsen die Bereiche mehrerer Sieldungen zu weitflächigen Desertifikationsgebieten zusammen.

Die Vegetationsvernichtung hängt auch mit dem heute unzureichenden Weidemanagement zusammen. Traditionell, in vor-sowjetischer Zeit, ließen wohlhabende Viehhalter ihre Weidegründe gegen Vegetationsvernichtung schützen. Während der Zeit der UdSSR übernahm der

Staat die Rolle des „schützenden Eigentümers“. Brennmaterial aus der Halbwüste wurde von staatlichen Holzversorgungsunternehmen gesammelt und an Familien, Schulen und Verwaltungseinrichtungen verteilt. Um Siedlungen wurden Schutzgebiete eingerichtet, in denen eine Holz- und Pflanzenentnahmen verboten war; allerdings kamen kleinere Verstöße vor. Seit 1991/92 werden derartige Umweltvergehen wegen der Transformation der Staatsbetriebe, Unklarheit über Besitzverhältnisse und fehlende Durchsetzungsorgane für Umweltvorschriften nicht mehr belangt. So hat nach Meinung der lokalen Bevölkerung die Vegetationsvernichtung für Brennholz- und Bauholzbeschaffung eine höhere Bedeutung für die Desertifikation als die Beweidung, eine Aussage, die durch Ergebnisse wissenschaftlicher Studien in der ehemaligen UdSSR bestätigt wird.

Die mit der lokalen Bevölkerung im Rahmen der Anwendung von PRA-Methoden durchgeführten *Transekte* zeigten deutlich den Einfluss der Desertifikation um die Siedlungsplätze. Dabei wurden Transekte für zwei benachbarte Siedlungen unterschiedlicher Größe gelegt, um den Einfluss der Siedlungsgröße auf die Degradationsreichweite nachzuweisen. Das unmittelbare Umfeld der Siedlungen hat den stärksten Druck menschlicher Aktivitäten zu ertragen, so dass die Vegetation weitgehend vernichtet ist und Wanderdünen auftreten. Mit der Entfernung von der Siedlung nimmt die schüttere Vegetationsbedeckung wieder zu. Es folgt eine Zone, in der sehr gering degradierte Weidegründe und Böden auftreten. In etwa 12 bis 15 km Entfernung von den Siedlungen finden sich geschlossene Bereiche intakter geoökologischer Einheiten.

Die völlig degradierten Gebiete um die Siedlungen sind eine direkte und die Bewohner unmittelbar tangierende Folge der Desertifikation. Daten von 1980 zeigen, dass auf ca. 50 % des Weidelandes der Yerbent Peasant Association leichte *Winddeflation* herrschten; 38 % waren von moderater Deflation betroffen, und 12 % waren von erheblichen Prozessen der Winddeflation betroffen (Arnageldyev, Kurbanov, 1980). Die Geländebeobachtungen im Jahr 2000 ergaben, dass sich die Gebiete hoher und mittlerer Deflation aufgrund des Bevölkerungswachtums und des gestiegenen Drucks auf die natürlichen Ressourcen vergrößert haben (Eine Luftbild- oder Satellitenbild-gestützte Analyse war im Rahmen der Dissertation nicht möglich, da administrative, technische und finanzielle Einschränkungen bestanden.) Intensive Winderosion um die Siedlungen beschleunigt die Bildung von Wanderdünen, die Gebäude und Straßen überrollen; die Wirkung von Sandstürmen wird unerträglich. In Bakhardok sind die Haushalte im nördlichen Ortsteil stark von Sandbewegungen und Dünen betroffen. Obwohl an manchen Häusern noch Hausgärten zu finden sind, bedrohen Sanddünen die meisten Grundstücke; Gärten und Gebäude sind stets in Gefahr zu versanden. Diese Situation hat das Turkmenisch-Deutsche

Entwicklungsprojekt veranlasst, Aktivitäten zur Kontrolle der Sandbewegungen einzuleiten als direkte Maßnahme zur Bekämpfung der Desertifikation; Diversifikation der Gartenpflanzen und eine Verbesserung der Kenntnisse in Pflanztechniken sollen dazu beitragen, mittelfristig die Lebensbedingungen der lokalen Bevölkerung zu verbessern. Auf Versammlungen bemühten sich die Mitarbeiter des Projektes, das Bewusstsein der lokalen Bevölkerung hinsichtlich des Managements der natürlichen Ressourcen zu stärken, um anschließend über Pflanzmaßnahmen mittel- bis langfristig eine Bekämpfung der Desertifikation zu erreichen. Die lokale Bevölkerung sollte in Turkmenistan entwickelte und bekannte Techniken der Sandstabilisierung anwenden, wobei die Mitarbeiter des Projektes logistische Hilfe und Beratung leisteten. Dieser Ansatz erwies sich bei der Durchführung des Projektes als schwierig, und einige Herausforderungen sind bis heute geblieben. Die Partizipation, insbesondere bei der Stabilisierung der Sanddünen an der Straße Ashgabad – Daschoguz, ließ sehr zu wünschen übrig. Die Bevölkerung war nicht interessiert an gemeinschaftlichen Maßnahmen zur Verbesserung der Situation, obwohl ALLE von der Verschlechterung der Lebensbedingungen betroffen sind. Diese Haltung ist das Ergebnis von Dekaden der Sowjetherrschaft, in denen Selbsthilfe unbekannt war, in denen Staatskontrolle und Staatsfürsorge alle Bereiche umfasste, – eine Haltung, die heute ein schwerwiegendes Entwicklungshemnis darstellt.

Bessere Ergebnisse zeigten sich bei der Förderung des *privaten Gartenbaus*. Die Projektmitglieder halfen mit Pflanzgut und Beratung den Familien, die über keine eigene ausreichende Erfahrung verfügten. Regelmäßige Besuche und Beratung trugen dazu bei, die Zahl der teilnehmenden Haushalte an dieser Komponente des Projektes von acht (1999) auf 50 (2001) zu steigern. Die Tatsache, dass wesentlich mehr Haushalte an diesen Pflanz- und Gartenbauaktivitäten teilnehmen als an Maßnahmen zur Stabilisierung der Dünen zeigt, dass die Bewohner mehr Interesse haben, ihre persönliche soziale und wirtschaftliche Situation über erhöhte Nahrungsmittelsicherheit zu verbessern als Umweltschutzmaßnahmen im allgemeinen Interesse durchzuführen, – ein weltweit anzutreffendes Verhalten. Zudem ist eine kurzfristige erste Gemüseernte „überzeugender“ für einen Arbeitseinsatz als erst mittelfristig wirksame Maßnahmen zur Stabilisierung der Sandverwehungen.

Die Aktivitäten des Projektes und die Arbeiten der Verfasserin ergaben, dass verschiedene *participatory tools* erfolgreich waren. Interviews erwiesen sich als des produktivste Instrument der Kommunikation und der Beschaffung von Informationen; die Gespräche wurden per Band aufgezeichnet. Interviews erwiesen sich auch deshalb als ein angemessenes Instrument für die Bewohner der zentralen Karakum, da sie eine lange Tradition in der oralen Kultur haben. Der

Ansatz, partizipativ Probleme zu nennen, diese zu verknüpfen und in eine Hierarchie zubringen (problem ranking), erwies sich als langwierig, da die Prioritätensetzung Schwierigkeiten bereitete. Dabei ergab es sich, dass wirtschaftliche Probleme wie unzureichendes Einkommen, Fortfall des staatlichen Kindergeldes, niedrige staatlich festgesetzte Preise für Wolle und Fleisch oder geringe Beschäftigungsmöglichkeiten einen höheren Rang besetzten als Umweltprobleme. Häufige Dürren und Sandstürme wurden von den Bewohnern als Negativfaktoren der Lebenssituation bezeichnet; Hirten nannten häufiger Niederschlagsmangel und Verlust an Biomasse auf den Weiden. Die lokale Bevölkerung in der zentralen Karakum konnte gut mit Luftbildern arbeiten: sie entdeckten schnell Einheiten der Siedlung wie die Schule, die Verwaltungsgebäude, die Krankenstation oder ihre Häuser. Auch ein Fragebogen kam zum Einsatz, um die Zahl der befragten Dorfbewohner zu steigern und die Datengrundlage zu verbreitern. Man sollte aber bei der Anwendung von PRA daran denken, dass der Fragebogen nur eine zusätzliche Informationsquelle ist.

Obwohl die Akzeptanz bei der Verwendung von PRA-Methoden hoch war, erwies sich der nächste Schritt, ein „*empowerment*“ der lokalen Bevölkerung mit dem Ziel, die Planung und Durchführung der Aktivitäten selbst in die Hand zu nehmen, als schwierig. Hierfür sind nach Leurs (1996) eine Reihe von Gründen auf unterschiedlichen Ebenen des partizipativen Vorgehens zu nennen. Im Fall der zentralen Karakum ermittelte die Autorin vier Ebenen: die des Individuums, die Ebene der Gemeinschaft, die Projektebene und die politische Ebene.

Es stellt sich zunächst die Frage, wie unabhängig, flexibel und ausführungsberechtigt die *Verwaltungsinstitutionen* des Landes als Durchführungsorgane der politischen Entscheidungsträger sind. Dies ist eine bedeutende Rahmenbedingung für zukünftige Projekte der Entwicklungszusammenarbeit. Auch nach der Auflösung der UdSSR blieben die Verwaltungsstrukturen des Landes hochgradig zentralisiert mit sehr wenig Entscheidungsspielraum auf unteren und mittleren Ebenen. Die Reformen, die in der Wirtschaft, der Gesetzgebung oder im Erziehungswesen stattfanden, haben noch keine Folgen für eine nachhaltige Nutzung der natürlichen Ressourcen gehabt. Turkmenistan ist ein Land, in dem Ideen und Initiativen der Bevölkerung hinsichtlich privaten Unternehmertums und der Aktivitäten von Nichtregierungsorganisationen von Regierungsseite nur eine geringe Förderung erfahren und kaum umgesetzt werden können. Derartige Bedingungen fördern die Passivität der Menschen und erklären ihre geringe Bereitschaft, selbstbestimmt zu leben.

Die Zusammenarbeit auf der Ebene der *Gemeinschaft*, z.B. einer Siedlungsgemeinschaft, wirft eigene Fragen auf. Es besteht das Risiko einer nur formalen und oberflächlichen Zusam-

menarbeit. Für gewöhnlich fühlen sich die Leute in einer Gruppe nicht frei, ihre Meinung zu sagen, und sie verlieren das Interesse an einer Zusammenarbeit, da sie glauben, ihre individuellen Probleme würden nicht zählen. Die Menschen sind indifferent, wenn es um die Erhaltung gemeinsamer Ressourcen geht, und daher kann die Arbeit mit einer Gruppe z.Z. nur erfolgreich sein, wenn die Aktivitäten die privaten Interessen der Gruppenmitglieder berühren. Ein Beispiel aus der Weidewirtschaft: die Dorfgemeinschaft nutzt gemeinsame Weidegründe, aber sie hat keine Kontrolle über sie, da diese sich immer noch in Staatseigentum befinden; daher hat die Dorfgemeinschaft auch kein Interesse an einer nachhaltigen Nutzung.

Während der Projektaktivitäten zeigte es sich, dass die Arbeit mit Einzelpersonen oder *Familien* der erfolgreichste Weg für die Verwirklichung eines Dialoges war. Hier spielt das Interesse am Eigentum eine wesentliche Rolle. Das Überwiegen individuellen Interesses vor kollektiven Belangen ist sehr evident. Die Weigerung der Menschen im Untersuchungs- und Projektgebiet, gemeinsam zu arbeiten, stellt ein echtes Problem für die Verwirklichung von Projektaktivitäten dar. Es kommt darauf an, ein Gruppenbewusstsein zu schaffen und zu stärken, um die gemeinsame Planung und Durchführung von Maßnahmen zu erreichen.

Die Kriterien für einen „partizipativen Prozess“ reichen nach Waters-Bayer/Bayer (1995) von „schwachen“ zu „starken“ Formen der Partizipation, z.B. von der Partizipation einer Gruppe bei der Lieferung von Informationen bis zu interaktiver Partizipation oder bis zu Eigeninitiative/Selbstmobilisierung. Die Anwendung von PRA-Methoden im Untersuchungsgebiet begann mit passiver Partizipation, z.B. der Teilnahme an Seminaren, mit der Lieferung von Informationen durch die Bewohner und mit „Partizipation durch Konsultation“, d.h. die Befragung von Zielgruppen und ihren Mitgliedern durch Externe. Methoden der funktionalen Partizipation wurden durch die Pflanzaktivitäten eingeführt. Der Übergang zu „starken Formen“ der Partizipation wie z.B. interaktive Teilnahme an Entscheidungsprozessen oder farmer-to-farmer-Erfahrungsaustausch steht noch aus.

Das geringe Interesse des Staates an einem nachhaltigen Management der natürlichen Ressourcen kann auch zurückzuführen sein auf die Tatsache, dass die Wüsten und Halbwüsten in Turkmenistan bisher noch keine katastrophalen Dürren von großem Ausmaß erlebt haben, die Weidewirtschaft und Überleben in den Trockengebieten im Kern bedrohten, wie es im westafrikanischen Sahel in den 1970er Jahren der Fall war. Hungerkatastrophen als Folge von Dürren hat es bisher in Turkmenistan nicht gegeben. Auch berührt die Desertifikation in Turkmenistan nur einen kleinen Teil der Bevölkerung: Wenn auch ca. 70 % der Landesfläche auf die

Karakum entfallen, so leben in diesem riesigen Gebiet nur ca. 15 % der Bevölkerung. So verwundert es nicht, dass die Frage der *Wasserversorgung und der Wasserqualität* für alle Bewohner des Landes an erster Stelle steht, dass dies das Umweltproblem erster Ordnung ist, allerdings auch verknüpft mit den Prozessen der Desertifikation. Grade die ländliche Bevölkerung und ihre Lebensgrundlage, das Vieh, hängen von dieser knappen Ressource entscheidend ab; Wassermangel und schlechte Wasserqualität waren auch erstrangig genannte Problem in den Dörfern des Untersuchungsgebietes.

Zu Beginn des 21. Jahrhunderts hat die Desertifikation in den Weidegebieten der Karakumwüste Turkmenistan noch nicht das Ausmaß einer Katastrophe erreicht, aber die Situation ist *alarmierend*. Noch lassen sich die Prozesse der Degradierung der natürlichen Ressourcen aufhalten und umkehren. Doch falls keine Maßnahmen zur Desertifikationskontrolle und zur Minimierung ihrer Folgen ergriffen werden, sind die Wirtschaft und das Leben der Wüstenbewohner in naher Zukunft mindestens auf der lokalen und regionalen Ebene ernstlich bedroht. Die Aktivitäten der nationalen Forschung sowie der bilateralen oder multilateralen Entwicklungszusammenarbeit stellen zur Zeit „Experimente“ in kleinem Maßstab dar, die die geoökologische Gesamtsituation nicht verändern – und auch keine durchgehende Sensibilisierung der Bevölkerung für den Problemkreis der Desertifikation erreichen. Die Studie konnte zeigen, dass sich aber auf der lokalen Ebene durch den Einsatz von partizipativen Methoden Aktivitäten zur Kontrolle der Desertifikation anregen und durchführen lassen, wenn sie die Prioritäten und Interessen der lokalen Bevölkerung zur Verbesserung ihrer Lebenssituation berücksichtigen. Der Staat muss hierzu geeignete Rahmenbedingungen schaffen, auch für eine praxisorientierte Forschung. Management der natürlichen Ressourcen im Sinne von „Nutzung und Schutz“ oder „nachhaltiger Nutzung“ schließt eine wirtschaftliche Entwicklung, d.h. für die Bevölkerung zunächst Einkommensteigerung und Wohlstand, nicht aus. In diesem Sinnen gilt es Wege zu finden, mit denen eine Zusammenarbeit der Entscheidungsträger auf nationaler und regionaler Ebene MIT der „Basis“, dem grass roots level, möglich wird, auch unter Hinzuziehung von Experten und Mitteln der Entwicklungszusammenarbeit.

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Annexes

1 Sample of the Used Questionnaire

Questionnaire.

During two last years the scientists from the Desert Research Institute together with the German scientists have been carrying out the research in Bakhardok village. Please, let us ask you some questions concerning the living and ecological conditions of your village. It would be very helpful for the research if you could answer the questions. It is not necessary to write down your name on the list of questions.

1.Information on family members

N	Members of family	Age	Education rate	Occupation
1				
2				
3				
4				
5				
6				
7				
8				

2. Type of livestock ownership (underline appropriate answer)

Private Leasehold Both

3. Household water supply.

Do you have a pipewater in your household?YesNo

4. Do you cultivate your private land plot?

Yes No

5. What do you plant on your land plot? (underline appropriate answer)

Tomato	Eggplant	Potato	Fig
Wheat	Alfalfa	Pomegranate	Apricot
Apple	Grape	Palm	Others_____

6. What kind of animals from listed below (livestock and poultry) do you have?

Sheep Goats Cows Camels Horses Poultry

7. How far (km) from the village you graze your livestock in different seasons?

Winter Spring Summer Autumn

8. Where do you usually sell the surplus of animal products? (underline appropriate answer)

In the village Along the road In Ashgabad Do not sell

9. How many years have you been living in Bakhardok village?_____

10. Where have you moved in Bakhardok village from?_____

11. Would you like to leave Bakhardok village?_____

12. Do you feel any changes in weather recently? What exactly has been changed?_____

_____

13. During last two years school art competition, fixation of moving sand along the road have been carried out. Seeds and sampling were distributed to some families. Do you think these activities are helpful for your village? What kind of improving activities would you like to be carried out in your village?

_____

Thank you for answering these questions.

2 The Results of Questionnaire Conducted in Bakhardok Village, 1999

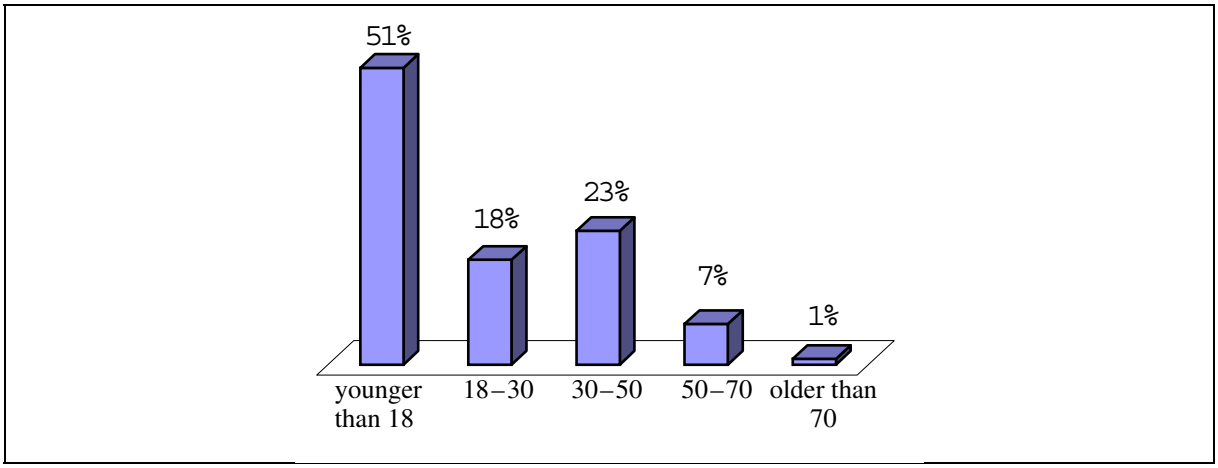
The total number of questioned families: 84.

Percentages are given in correlation with number of questioned families. (84 = 100 %)

1.1. Size of Families.

Number of family's members	Number of households
2	1
3	6
4	8
5	12
6	10
7	18
8	16
9	5
10	2
11,12,14	1

1.2. Age Structure of Population.



1.3. Education Rate

Education rate was calculated among the people who have completed their study.

Educational Rate	Women	Men
Higher	1	12
Secondary	66	85

2. Type of Livestock Ownership (in %)

private	98
leashold	1
both	1

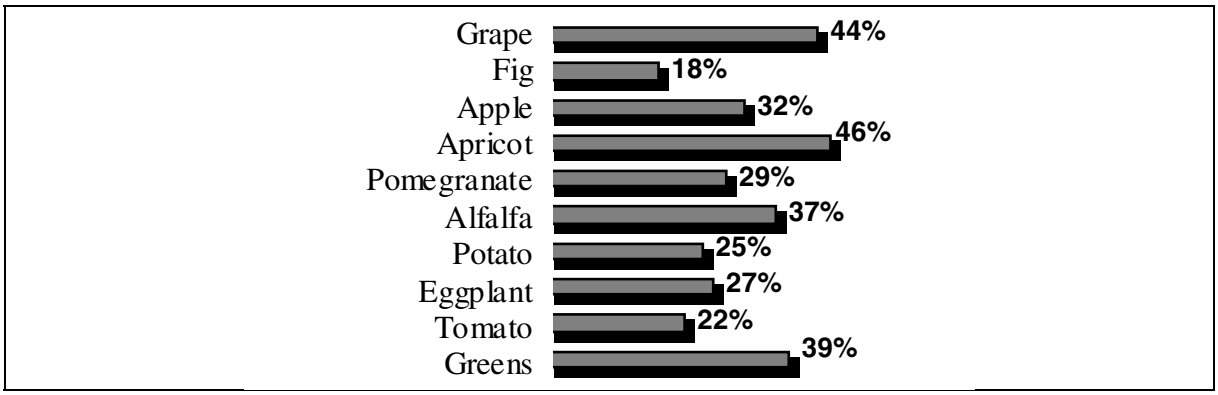
3. Supply of the Households by Water from Pipe

Have water supply	93 %
Have no water supply	7 %

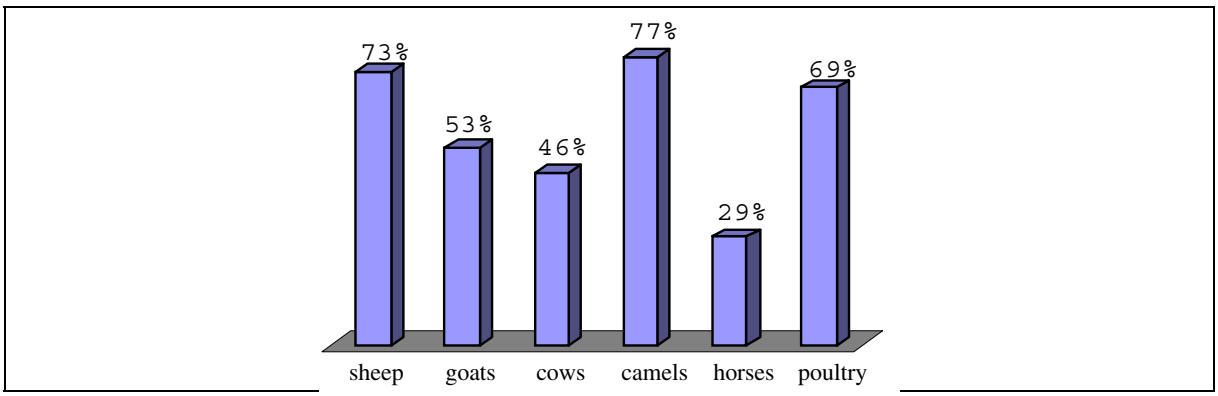
4. Cultivation of Private Land Plot (in %)

cultivate	75
do not cultivate	15

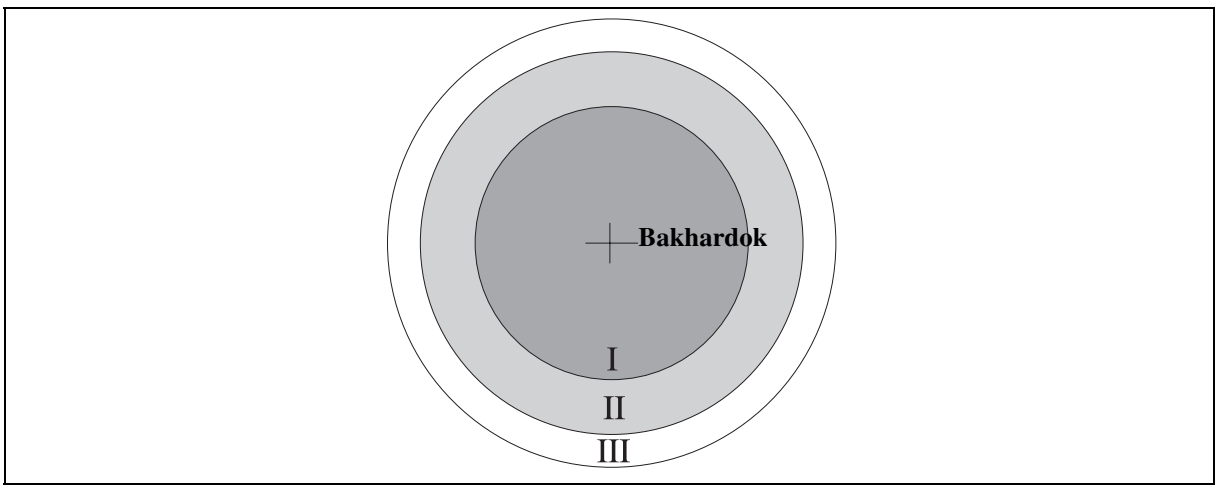
5. Diversity of Garden Species



6. Composition of Animals in Households

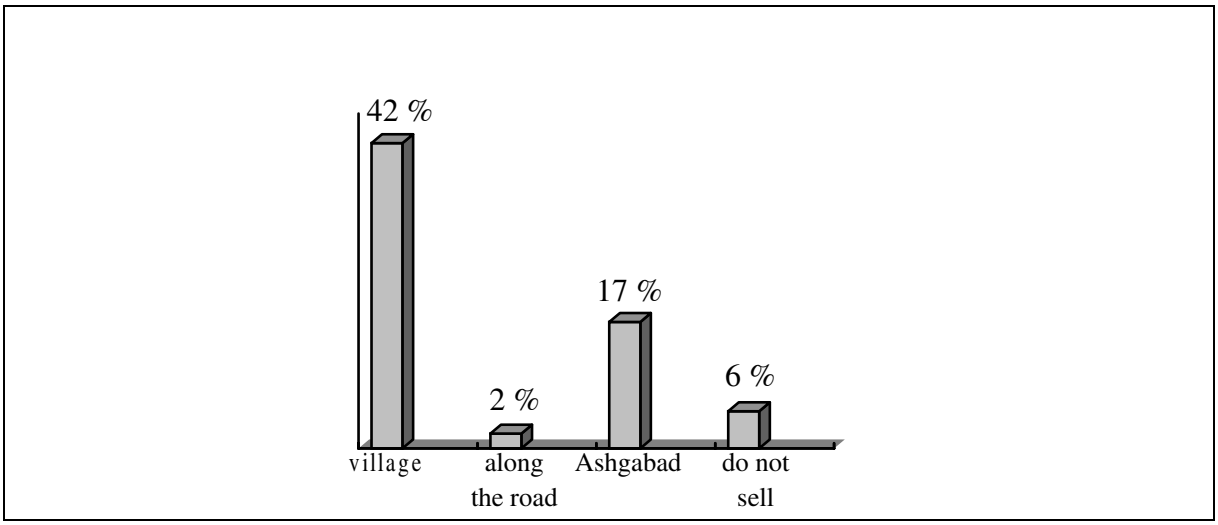


7. Grazing Distances

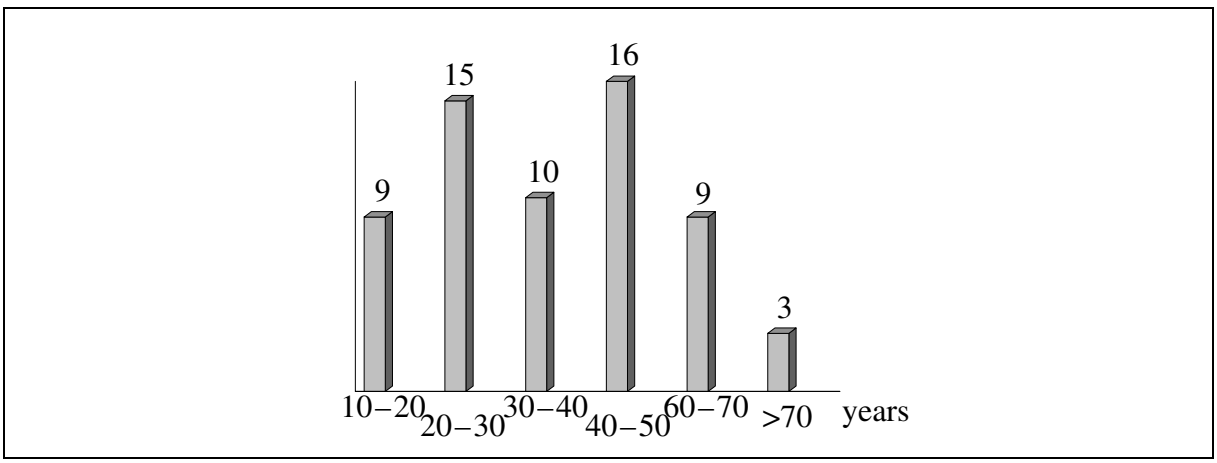


I = summer and spring (r = 13 km), II = autumn (r = 18 km), III = winter (r = 21 km)

8. Marketing of Animal Surplus Products



9. Duration of Residence (in %)



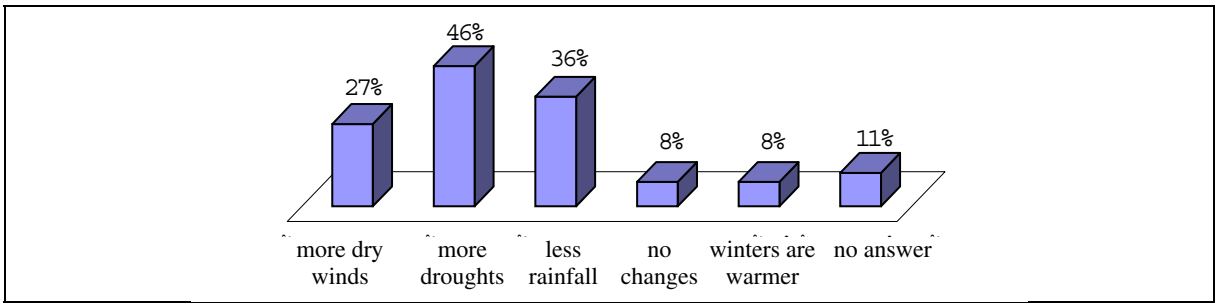
10. Migration to Bakhardok Village

Places of origin	Number of families
Darvaza	10
Goek-tepe	5
Ashgabad	4
Yerbent	4
Sovma	3
Mamed-Yar	3
Garyja	2
Dingli	1
Boere	1

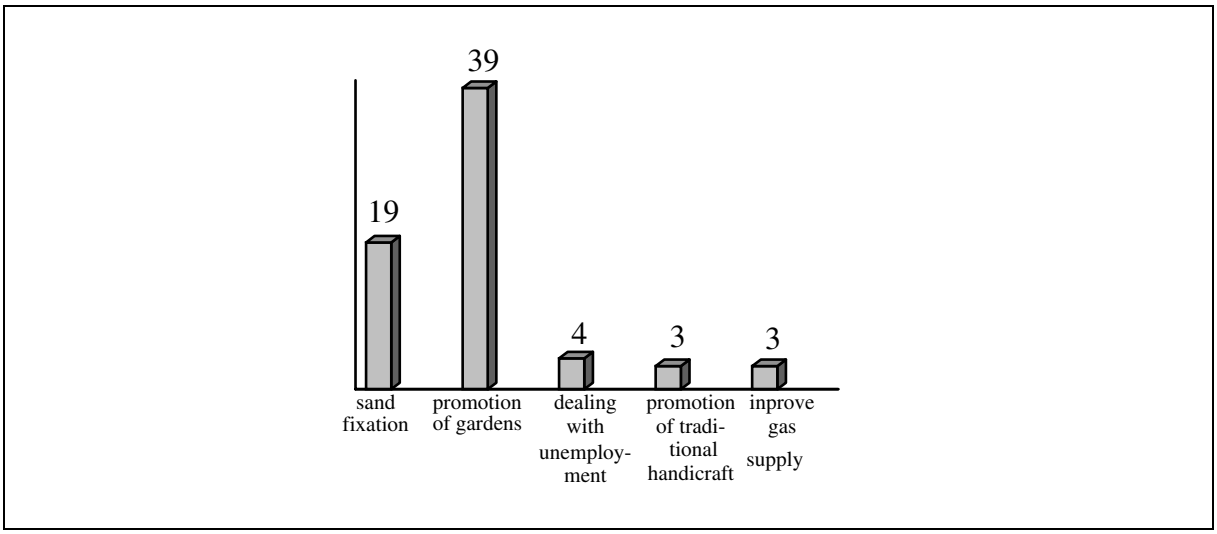
11. Willingness to Move from Bakhardok Village

Places of distination	Number of families
Ashgabad	4
Chalysh village	1

12. Climate Change Viewed by the Respondents



13. Types of Future Activities Proposed by the Respondents (in %)



Erklärung

Ich versichere, dass ich die von mir vorgelegte Dissertation selbständig angefertigt, die benutzten Quellen und Hilfsmittel vollständig angegeben und die Stellen der Arbeit – einschließlich Tabellen, Karten und Abbildungen –, die anderen Werken im Wortlaut oder dem Sinn nach entnommen sind, in jedem Einzelfall als Entlehnung kenntlich gemacht habe; dass diese Dissertation noch keiner anderen Fakultät oder Universität zur Prüfung vorgelegen hat; dass sie noch nicht veröffentlicht worden ist sowie, dass ich eine solche Veröffentlichung vor Abschluss dieser Promotionsordnung nicht vornehmen werde. Die Bestimmungen dieser Promotionsordnung sind mir bekannt. Die von mir vorgelegte Dissertation ist von Prof. Dr. B. Wiese betreut worden.

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Köln, 8. November 2001