INSTITUTE OF SOCIAL STUDIES

Working Paper Series No. 239

HUMAN ECOLOGY IN KYRGYZSTAN
THE SOVIET LEGACY AND THE DYNAMICS OF TRANSITION

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February 1997

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Abstract

This paper focuses on some aspects of human development in Kyrgyzstan, one of the Newly Independent States (NIS) of the Former Soviet Union (FSU). The Soviet model of industrialisation and the inter-republican division of labour between the 'centre' and the 'periphery', with 'ruthless exploitation' of the country's abundant mineral resources, such as gold, uranium, antimony and mercury, determined much of the current structure of the Kyrgyz economy. The impacts of this model on human development, analysed from a human ecological perspective, were until recently a 'terra incognito'. However, during the late 1980s, and in particular after independence in 1991 research in this field has begun to develop.

The paper first investigates the conditions of 'high mountain environment', to which native inhabitants adapted their human physiology. However, these conditions -at the high altitudes where most of the Kyrgyz mines are located- turned out to be quite hostile for the many new-comers (soldiers, miners and other workers), in particular when the environmental pollution caused by the mine exploitation is taken into account. Age-gender data are presented for three regions (*oblasts*) and three villages, located at different altitudes. It is shown that the 'hidden' environmental disaster of 1964, caused by a heavily polluted mud-slide -originating in the Ak-tuz mine (of polymetal ores)- that swept through the Kichi-Kemin valley, is clearly visible with its demographic *echo*.

Second, the transition period is discussed in light of the negative development of some important indicators of human development, such as birth and death rates, infant mortality and life expectancy. During the transition access to food diminished, public health systems collapsed and rural-urban migration increased unemployment and poverty. While the severe contraction of the economy, in particular in the industrial and mining sectors, caused an initial reduction in environmental pollution, such as in the emission of air pollutants, the current socio-economic crisis dramatically worsened human livelihood conditions in Kyrgyzstan.

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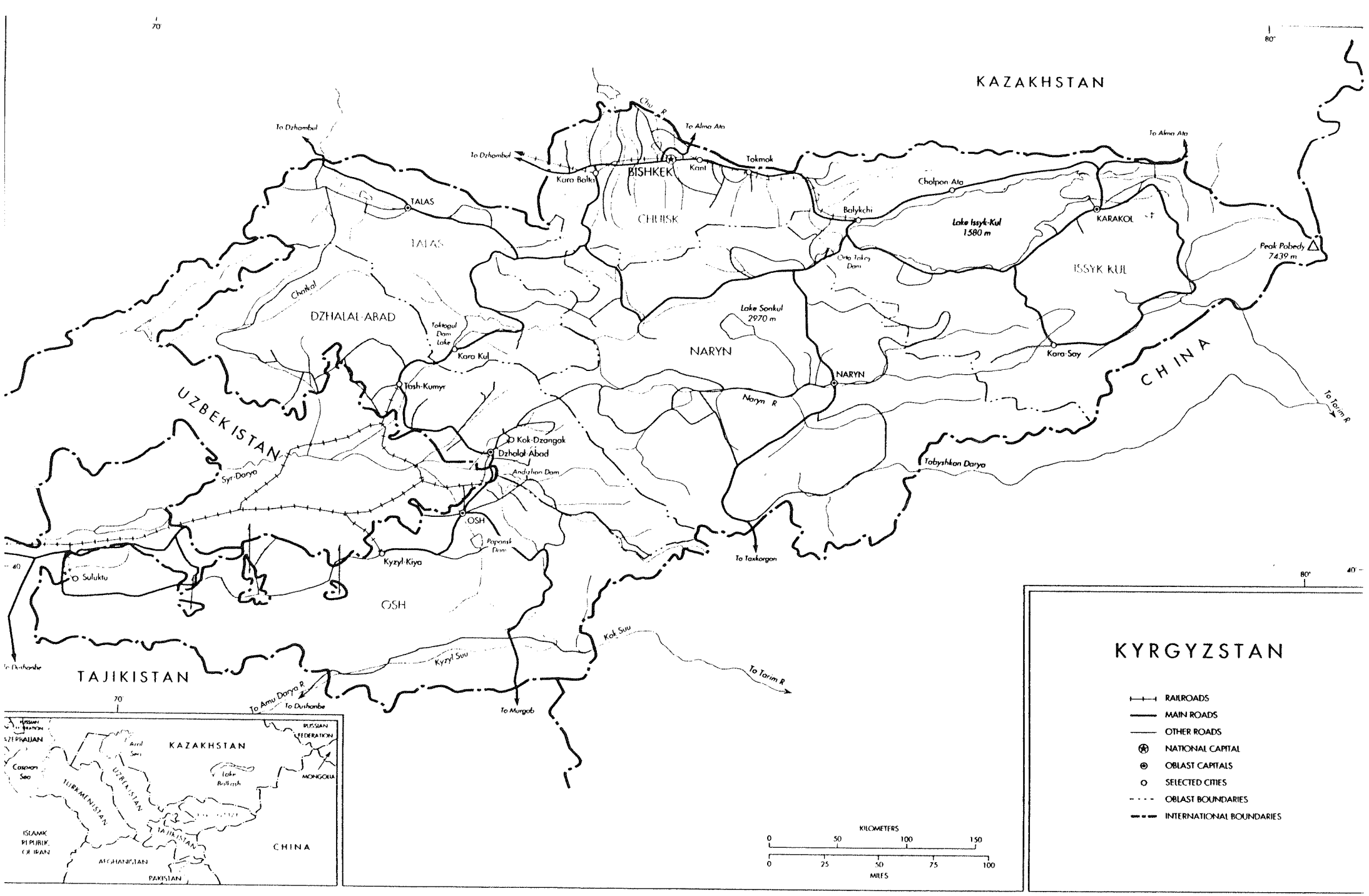
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HUMAN ECOLOGY IN KYRGYZSTAN
THE SOVIET LEGACY AND THE DYNAMICS OF TRANSITION

Kalia Moldogazieva*
Max Spoor

I. INTRODUCTION

In this paper some aspects of human development in Kyrgyzstan, one of the Newly Independent States (NIS) of the Former Soviet Union (FSU), will be analyzed. This is done by using tools of analysis originating in human ecology, as an association of corresponding branches of medical-biological, geographical, historical and other social sciences, focused on the interrelations of people with their natural (and man-made) environment, while taking into account social and economic (such as industrial and agricultural) development, livelihood conditions, cultural traditions and the state of health of the population as conditioned by the impact of the environment (Prokhorov, 1991). A central paradigm in human ecology is the assumption that phenomena of human development are shaped by a complex, interrelated network of factors (Maton, 1993). It is equally acknowledged that health and ecological aspects of human livelihood require interdisciplinary analysis, whereas in practice, they are often simplified and fragmented, with technical and anthropological or sociological considerations contradicting each other. We will analyse some of the impacts the Soviet development model had on Kyrgyzstan, using familiar indicators of human development, such as the age-gender pyramid, life expectancy and infant mortality.

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This analysis will be complemented by the results of field research that was done in several mountainous areas of the country in 1989 and 1992, where industrial and mining development (characteristic for the Soviet period) have been prominent. It will be shown that there are close relationships between industrial pollution of water and air (in combination with the particular mountain environment) and the negative development of the quality of life for those who were sent to work in these harsh conditions or lived in nearby villages. Following this analysis, the current transitional period is discussed, in particular the severe economic contraction, that dramatically influenced human development in Kyrgyzstan. Although with the economic crisis some of the worst types of environmental pollution have reduced, the socio-economic impact of the crisis countered regressively this largely unintended side-effect.

Human ecology in the FSU is still a relatively new science, whose development was influenced by a rigid separation of biological, chemical, medical and social sciences relevant to problems of human development. Any current study of human ecology in Kyrgyzstan (or any of the other NIS) will therefore necessarily suffer from insufficient attention to this field during the Soviet period, the lack of reliable data and the fact that issues such as pollution caused by mines and industrial development -let alone some of the worst ecological disasters that took place in the area- have always been treated with a high degree of secrecy. Furthermore, science in Kyrgyzstan was for long completely dominated by Soviet science, with Kyrgyz people as well the other 'nationalities' (better understood as 'ethnic groups') being simply defined as 'Soviet people', in spite of their own traditions, culture, way of life and physiological peculiarities. Human development in contemporary Kyrgyzstan is largely a 'terra incognita' for researchers, the paper hopes to fill part of this existing knowledge gap.

a) The Geography of Kyrgyzstan

Kyrgyzstan is located in the north-eastern part of Central Asia, in the heart of the Eurasian continent. Its territory of 198,500 km^2 is equal to the combined area of Portugal, Switzerland, Belgium and the Netherlands. It stretches 900 km from east to west, and 425 km from north to south. Although most of the country has a climate that reflects its proximity to the Himalayas, the northern part of Kyrgyzstan is at the same latitude as Rome, with the most southern tail being at the level of the island of Sicily (Otorbaev et.al, 1994).

The borders of Kyrgyzstan largely follow natural boundaries: mountain ranges and rivers, with China, Tajikistan, Kazakhstan and Uzbekistan as its direct neighbours.

A bird's-eye view of Kyrgyzstan would reveal an amazing picture: the ridges of mountains, touching the clouds, with 90 percent of the territory of Kyrgyzstan at more than 1,500 meter above sea level. More than 41 percent are bleak, high mountain ranges with altitudes over 3,000 meters. Long chains stretch out from east to west in 88 mighty ridges of the great Tien Shan mountains (the Kyrgyz name is *Tenir-Too*, or 'heavenly mountains'). Most peaks lie well above the eternal snow line. Among them are the world-renowned peaks such as Pobeda (7,439 m), Lenin (7,134 m), and the legendary Han-Tengry pyramid (6,995m) of pink and white marble and granite. Apart from the densely populated Fergana and Chui valleys, it is mountains that dominate the geography of Kyrgyzstan. Small pockets of land with match'box-like houses, sometimes in the bends of rivers, together with the vast mountain and hill-side meadows complete this picture (Table 1).

TABLE 1 Geographical Indicators of Kyrgyzstan

Total area (x 1,000 km^2)	1993	198.5
Density of the population (man/km^2)	1993	22
Arable land (% from total land area)	1990-1993	7
Pastures (% of total area)	1993	46
Irrigated land (% from total arable land)	1990-1993	65

SOURCE: UNDP (1995); World Bank (1994);

b) Formation of the Kyrgyz Nation

The history of Kyrgyzstan can be roughly sub-divided in a pre-Soviet period (before the October Revolution in 1917), the Soviet period (until 1991) and the current transitional period. Although there are some references made to the name *Kyrgyzia* even as far back as 201 BC, it has been found that an early feudal Kyrgyz state emerged during the fourth and fifth century AC. The Kyrgyz people lived in the Minusin basin along the Yenisey river in

Siberia. Many ethnic groups had already been brought into the Kyrgyz nation. In 840 AC a Kyrgyz led army of an estimated 100,000 soldiers descended on the old Ujgurian capital Ordy-Balyk, located in the western part of modern Mongolia, which they took and destroyed. The great state of the Ujgurs disappeared, and in its place a large Kyrgyz Khanate was created. One of the branches of the Great Silk Road (leading into China) went through the territory of modern Kyrgyzstan and was called the 'Kyrgyz road'. The Kyrgyz Khanate included many non-Kyrgyz nations which had been subdued and integrated over the past centuries.

The Khanate did not survive very long, and by 10th century the Kyrgyz had returned to their origin habitat, the Yenisey basin. In the 13th century it disintegrated into several feudal-tribal areas, which became an easy target for the army of Djengis Khan in the early 13th century. In 1293 the Yenisey Kyrgyz state even seems to have completely vanished, although between the 14th to the 16th century Kyrgyz tribes were still involved in a struggle for survival, with the Mongols, and with well-known Central Asian warlords and leaders such as Tamerlan (or *Timur*) and Ulugbek or their descendants. They gradually moved towards the region of the central Tien Shan mountains, with the Chui valley in the north and the Fergana valley in the south, i.e. the territory of the modern Kyrgyzstan. Indeed, this area is now considered as the 'native land' of contemporary Kyrgyzstan. By the 16th century the Kyrgyz nation was finally formed in its contemporary shape. The ancient population of this region, known as *sacks*, *usunes* and *huns*, were assimilated by new-comers. For the Kyrgyz people, throughout the centuries of their existence, the nomadic style of life was one of its main characteristics, based on a balanced interaction with nature. They moved around with large herds of primarily sheep and lived in temporary dwellings, the *jurta*, a roundish shaped tent from felt and wood.[1]

From the middle of 19th century onwards the Kyrgyz tribes were gradually included in the Russian Empire, some voluntarily, the rest of them by force, after suppressing an uprising that originated in the adjacent Kokand Khanate in the Fergana valley. In this process of this inclusion some of the Kyrgyz tribes began to move away from their nomadic life style, while the southern tribes (who had settled in the Fergana valley) had gone into settled farming long before.[2] Towards the end of the First World War, in 1916 the Kyrgyz rose against the Tsarist (Russian) rule, a movement which was cruelly suppressed, with many

Kyrgyz people consequently taking refuge in the Ujgur region of western China. Nevertheless, in passing over the highest mountain-passes, many of these refugees died of cold and acute mountain diseases. Thus, the attempts of creating an independent Kyrgyz nation failed.

c) Kyrgyzstan and the Soviet Era

After the October revolution of 1917 the Kyrgyz people were absorbed in the Turkestan Autonomous Republic. In 1924 Kara-Kyrgyz autonomous *oblast* (region) was formed, which subsequently transformed in an Autonomous Republic in 1926. Only ten years later, in 1936, the Kyrgyz Soviet Socialistic Republic (*KSSR*) emerged, as one of 15 Soviet Republics. For the Kyrgyz nation its inclusion in the Soviet Union had positive as well as negative consequences. With the passage to a more settled way of life (and mode of production) some contradictory processes occurred. The dominance of ideological factors in the Soviet Union led to the revival and even reinforcement of tribal and clan-relations. On the other hand, tendencies appeared that gave rise to an atomization of communities and family structures. The marginalization of nomadic life-styles and the introduction of settled agriculture and animal husbandry alienated the Kyrgyz from nature, rapidly loosing the previously existing harmonic relationship between man and environment (Shukurov and Shukurova, 1994).

The inter-republican division of labour within the USSR gave rise to regionalisation (and the physical moving) of heavy industry and mining activities, in part as a consequence of the Second World War (Spoor, 1995). The abundant mineral resources of the Kyrgyz Republic gave a boost to this forced industrial development of the country, which is 'blessed' with an enormous hydro-electrical potential, significant deposits of gold, uranium, antimony, coal, oil, natural gas, mercury, bismuth, lead and zinc. The extraction of these resources (although often not leaving the value added in the former Republic) played an important role in the sustained economic growth that was relatively high in the 1960s and 1970s, while slowing down somewhat during the 1980s. The negative aspects are clearly to be found in the impact of the natural resource extraction on the environment itself and on the human ecology of those who worked (and still work) in these mines and industrial complexes, or living close by and indirectly effected by air, soil or water pollution. During the Soviet period this was completely unknown in Kyrgyzstan, and even less in the West. It was only

a few years ago that the West learned about the 'hidden disasters' in Kyrgyzstan, such as the leakage of radio-active wastage and polluted mud-slides in some of the mining areas (the case of Ak-tyz, which will be discussed below).

Since the country became independent in 1991, Kyrgyzstan has opened up to the world. The transition to a market economy is taking place at a relatively higher speed than the other Central Asian states, while democratic developments also have progressed. Nevertheless, the economy -which was completely dependent on its vertical integration of its economic sectors in the FSU- suffered enormously from the disintegration of the Soviet Union. Negative growth rates have caused the GDP to reduce in 1995 to around 46 percent of 1990 (Spoor, 1996). The withdrawal of the state from several social sectors, within a generalized economic crisis, has contributed to the emergence of severe social problems, poverty and deterioration of public health in Kyrgyzstan. Although data is still scarce, some preliminary remarks will be presented further on, related to the impact on human ecology of the transition.

The modernization of the Kyrgyz society was in part boosted by its integration into the USSR, with as one of its consequences a developed education system, level of social protection and public health institutions. However, this forced development also suppressed the free expression of the Kyrgyz culture. The Kyrgyz language was not a state language and it was mostly even forbidden to speak it, while the original Latin script was replaced by the Cyrillic one. Social, economical and political life of Kyrgyzstan was under strict control of Moscow, and the slightest deviations from the directives of the Central Committee of Communist Party were brutally suppressed. Many representatives of the Kyrgyz intelligentia, accused of nationalism, Trotskism or other 'isms', were shot or put in prison in the late 1930s. Finally, part of the Soviet legacy was that Kyrgyzstan remained in complete isolation from the West or any other parts of the world, an isolation which has been particularly devastating in the development of social sciences. On the other hand (as a positive note), the distant location of Kyrgyzstan from Moscow, the presence in Kyrgyzstan of many of 'repatriated' ethnic groups (Germans, Chechens and Turks) and the repressed (or banned) representatives of the Russian intelligencia gave an opportunity to develop a somewhat hidden, but relatively free intellectual environment and the spreading of ideas of tolerance, in particular between ethnic groups and minorities.

II. HUMAN ECOLOGY IN KYRGYZSTAN

Scientific research in Human Ecology field during Soviet period was mostly done under the name of *autecology*, which looked at the influence of environmental (natural, man-made) factors on the life of separately taken individuals. In Kyrgyzstan during the last 40-50 years this field of Soviet science focused on clinical medicine and human physiology devoted to the study of the influence of high-mountains. For example, *mountain physiology* studied the influence of high-mountain environment on tissues and cell structures in the human organism. In spite of the inherent quality of these rather segmented and limited studies, the modern conception of human ecology that integrates social sciences with biology, chemistry and medicine into a multi-disciplinary framework was sometimes a far cry for Soviet scientists. Interestingly enough physiological research was focused on the military, the health of workers in mining industries, and in general to new-comers in the rather hostile high mountain environment. These mountainous industrial and mining enterprises were actually preferred by new-comers, as they received material privileges to compensate for the harmful conditions of work. In fact, within the industrial labour force in 1987, native Kyrgyz only represented 25 percent of the total number of workers (Lewis, 1992). This phenomenon was partly induced by internal policy of the former Republic's communist government. However, native Kyrgyz who lived close to these factories or mines, did not have any material compensation, although they suffered equally from the negative impact of these enterprises, as will be shown below.

Research on the human ecology of native Kyrgyz people, who live at high altitudes since many generations, initially expressed amazement about the remarkable adaptability highlanders to their environment and their fitness in general. The point of view even existed that all changes in their organism were positive and useful. For a better understanding of the physiological peculiarities of the human organism of highlanders, it is necessary to look at the geographic-climatical characteristics of mountain regions, such as the low degree of oxygen pressure, sharp daily fluctuations in air temperature, frequent and strong winds, intensive sun radiation, air dryness and uneven distribution of chemical elements in soils. Furthermore, in the mountains natural calamities often occur such as snow avalanches or mud torrents.[3] The development of the flora depends on the precise location of the area, its

altitude and even its positioning towards the sun. In Kyrgyzstan several types of climate can be found: dry continental to polar in the high Tien Shan ranges, sub-tropical in the south-western Fergana valley, and temperate in the northern foot-hill zones. Vast mountain pastures occupy half of the republic's territory, and a significant area is blanketed by forests. The ancient nut forests of the Chatkal, Fergana and Turkestan ranges are the largest in the world. In the Chui, Talas and Fergana valleys, the fertile soil, long growing season and abundance of sunlight are combined with man-made irrigation systems to create favourable conditions for intensive agriculture (grains, vegetables and cotton).

a) High Mountain Environment and Human Physiology

These rather extreme (and often harsh) conditions influence the physiological, psychological and behavioral peculiarities of the highlanders in Kyrgyzstan. Typical for mountain inhabitants is the dryness and choppiness of their skin, face and hands, the enlarged size of the thorax and the skeleton as a whole (Mirrakhimov and Goldberg, 1978). The enlarging of bones of the skeleton is connected with the increased production of erythrocytes in the bone-marrow. These peculiarities are caused by an overall deficiency of oxygen. Highlanders normally have a quickened breathing and increased lung ventilation. The throughput of blood that is pumped by the heart per minute is also generally higher at an altitude above 3,000 meters. On the whole the organism of highlanders is quite well adapted to life in the mountains, but there are also peculiarities of growth and development of human beings living at these high altitudes (Baker, 1981). The high-mountain population of the Tien Shan (like in the Andes, or in the Himalayas) is characterized by a slowing down of the process of growth and development of the organism (Alekseeva, 1986). In investigations of cardio-vascular systems of elderly highlanders in Kyrgyzstan we could show, that this was caused by a decreased cardiac output and increased resistance of blood vessels. The tempo of aging of cardio-vascular systems of highlanders is slowed down by approximately 10 years, in comparison with inhabitants of the valleys. One could summarize this by saying that the 'fire of life' of highlanders (because of the deficiency of oxygen) might burn not so strong and bright as in the valley, but it burns much longer (Moldogazieva, 1984).

Nevertheless, life in such harsh and extreme conditions places high demands on the human organism, which is manifested by diseases that are wide-spread in the mountainous

regions of Kyrgyzstan. These are so-called ecologically conditioned anomalies, such as various innate heart diseases -amongst others the open arterial duct- which occur much more frequently than in the plains, or high pulmonale arterial pressure, characteristic for highlanders throughout their lives (Baker, 1981). In mountainous regions more often endemic goitre occurs because of deficiency of iodine in the food, since mountainous soils are poor of iodine. In 1994, with 39 of a group of 440 investigated children (below 14) in a UNICEF-led research (Minzdrav, 1994), the size of the thyroid gland was bigger than normal. Dysadaptations and diseases can furthermore include: neuroses, psychoses, brain oedema, injuries of the heart muscle, lung oedema, or kidney insufficiency (Mirrakhimov and Goldberg, 1978).

In the more than 70 years of Soviet science, physiological research of new-comers in mountain areas who face long-term adaptation problems, has progressed a lot. Miners and soldiers, situated in high mountains one year and more, have been investigated in detail. These so-called 'volunteers' (as even soldiers used to be labeled in scientific articles and dissertations in the FSU) were followed at different altitudes, ranging from approximately 800 to 3,800 meter above sea level, with a period of adaptation in the mountains of up to two years. It was surprising to note in research on cardio-vascular changes amongst the groups of new-comers that there was a more expressed process of aging of the cardio-vascular system in comparison with persons of the same age in the foot-hills, possibly because of the excessive strain on the cardiac muscle (Moldogazieva, 1988). With workers exposed to vertical migration, the process of aging was fomented. Even in their outward appearance these men, on average 30-35 years old, looked much older. In Kyrgyzstan, particularly during the 1960s and 1990s, large groups of people were exposed to vertical migration, such as the traditional shepherds, but increasingly also the new-comers: soldiers, drivers, miners and not to forget mining and industrial specialists, such as geologists. While studying physiological changes in the human organism at different altitudes, the concept of 'effective' altitude that was used as a measure of extremity of mountainous conditions, not only taking the altitude of a location but also other factors such as air humidity, speed of the wind, barometric pressure, temperature and level of solar radiation into account. Belkin and his colleagues proposed the Bio-climatic Index of Severeness of Meteo-regime (BISM), that includes all these different factors (Belkin et.al, 1989). In some cases, the BISM at the

altitude of 2,800 meter turned out to be lower than at an altitude of 3,600 meter, as the area was less comfortable.

b) Industrial Pollution and Quality of Life

Further to the research mentioned above, during the latter part of *perestroika* and the beginning of the transitional period (1989-1993), work was done that looked more specifically to labour conditions in mountainous areas, in particular in industrial and mining sites, where man-made factors such as noise, vibration, dust, radiation, vertical migration and the working in long shifts were added to the already harsh natural conditions. The conditions of work were investigated, and a time-study of the working day was undertaken, using different psycho-physiological tests. In particular, a full investigation of shift workers in the Makmal gold mine (in the south of Kyrgyzstan), who worked in 15-day shifts (followed by a similar period of rest), was conducted in 1989. The results of this research showed that the 15-days shifts with a vertical migration from the settlement, located at an altitude of 1,200 meter to the quarry at 2,800 meter, caused physiological changes of the cardio-vascular, respiratory and nervous systems, and affected the work capacity of the inspected persons. Interestingly -but also cynically- enough, the stabilisation of most physiological indices came only towards the end of the shift. In order to avoid some of the problems it was proposed to work with monthly shifts (followed by an equally long period of rest), in order to overcome some of the adaptational problems.

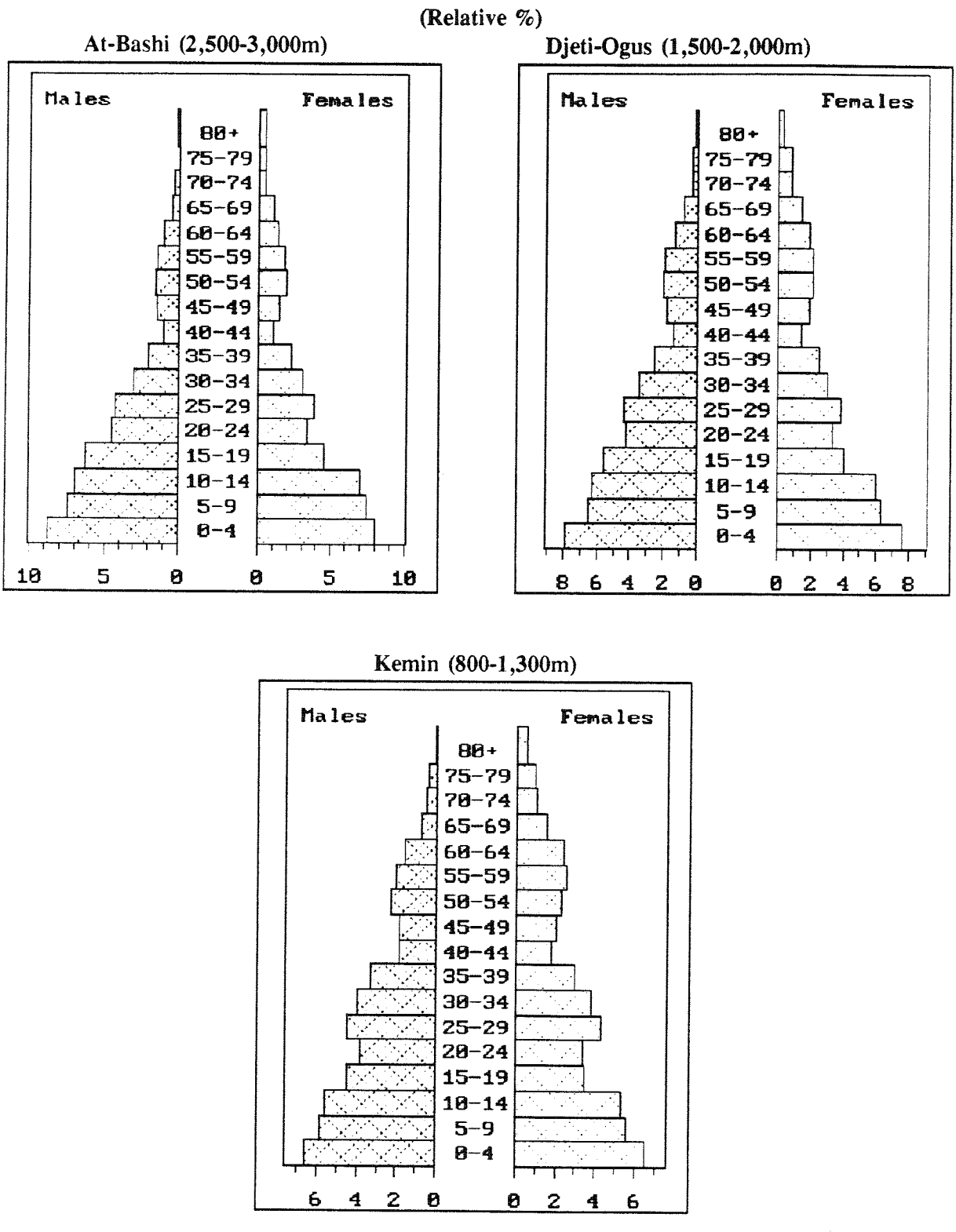
In 1992 an investigation was conducted at the Talas gold-mining complex. Workers of the mine who were operating in shifts were investigated, such as miners, bulldozer drivers, excavator operators, drivers of the large lorries. The conditions of living in the settlement where shift workers resided were seemingly reasonably good. Every day the workers were transferred from the settlement (at 2,800 meter) to the mining and construction sites, located at different altitudes between 3,300 and 3,800 meter. The research results testified that the productivity of the workers was influenced by the climatic discomfort (temperatures, winds, levels of sun-radiation and barometric pressure). However, on most of the work-sites also an excess of noise could be noted (up 106 dB with an 'acceptable' threshold of 80 Db), while the level of dust equally exceeded the permissible level, in some cases 2-4 times.[4]

The conclusion of this research was that the combined effect of natural (climatological, geographical) and man-made factors caused a particular type of the 'anthropo-ecological stress' (Kaznacheev, 1988) with the inspected and interviewed persons, who displayed symptoms of chronic deficiency of oxygen, dysadaptation of the nervous system and tiredness (Moldogazieva, 1995). The number of work days lost by (particularly new-coming) miners and industrial workers in mountainous regions was higher than the average for these sectors, in particular because of a longer average period of illness per case.[5] Also, one might reasonably expect that there are diseases caused by the above cocktail of factors. As part of the outcomes of the research project it was proposed to the mine management to create a special 'recovery' room for the workers, equipped with training apparatus and oxygen machines, where they could be treated, take herbal medicine and tea, or receive massage, while similarly -like above- a radical change in the labour-regime of the workers was seen as necessary in order to improve health conditions.

c) Human Development in Contemporary Kyrgyzstan

In order to understand more of the human ecology in Kyrgyzstan, and -in a following section- to discuss some aspects of the impact of the transition period, we will look briefly at demographic data derived from research undertaken in the early 1990s, in particular at age-gender population pyramids. These pyramids provide 'snapshots' of generations, with annual rings of age increases. Some interesting peculiarities of these age pyramids for Kyrgyzstan can be noted, when analyzing them in different regions and separate settlements of the country, with some having mining enterprises located at various altitudes (Moldogazieva, 1994). Age-gender pyramids of three regions (*oblasts*), namely At-Bashi, Dgeti-Ogus and Kemin were constructed, located at different altitudes above sea level (Figure 1). For the Kemin region, in the low-to medium high mountains, the pyramid has a bell-shaped form characteristic for a stationary population. The age-gender pyramid of the Dgeti-Ogus region, in the medium-high mountains, has a wider basis which indicates a higher birth-rate and the prevalence of youngsters in the population. Finally, the age-gender pyramid of the At-Bashi region, located in a high mountain area, has the shape of a isosceles triangle with an even broader base. Such pyramid is typical for high mountain countries, such as Peru or Nepal.

FIGURE 1 Age-Gender Pyramids of the Oblasts At-Bashi, Djeti-Ogus and Kemin



One of the differences of the population pyramids found in Kyrgyzstan compared with other developing countries, is a distinct gap in one age segment, 40 and 44 years, which can be observed in all the three regions, and therefore is irrespective of the altitude. This is obviously caused by World War II, when the birth rate went down and infant mortality went up (while simultaneously -but not any more visible- the death rate of particularly men went up sharply). Thus, the smaller 'ring' reflects the demographic echo of the war, characteristic for all countries in the Former Soviet Union as well as in Germany (Valentei, 1985).

In order to reveal the influence of man-made factors (apart from the above mentioned ones) we have constructed age-gender pyramids of three settlements, Orlovka, Ak-Tyz and Ak-Tala, the first two located in the Kemin region (see Figure 2). The age-gender pyramid of the settlement of Orlovka, where there is a mining enterprise is bell-shaped. In comparison, the age-gender pyramids of Ak-Tuz (with its mine of polymetal ores) has the shape of an irregular bell with uneven edges, while Ak-Tala has the shape of a isosceles triangle, with a broad base. In Orlovka, Ak-Tuz and Ak-Tala the gap for the age of 40-44 years is common. However, in Ak-Tuz and Orlovka there are two distinct gaps for the age of 15-19 and 20-24 years. People of these age intervals were born in the period between 1965 and 1970, right after an ecological disaster in Ak-Tuz in 1964.

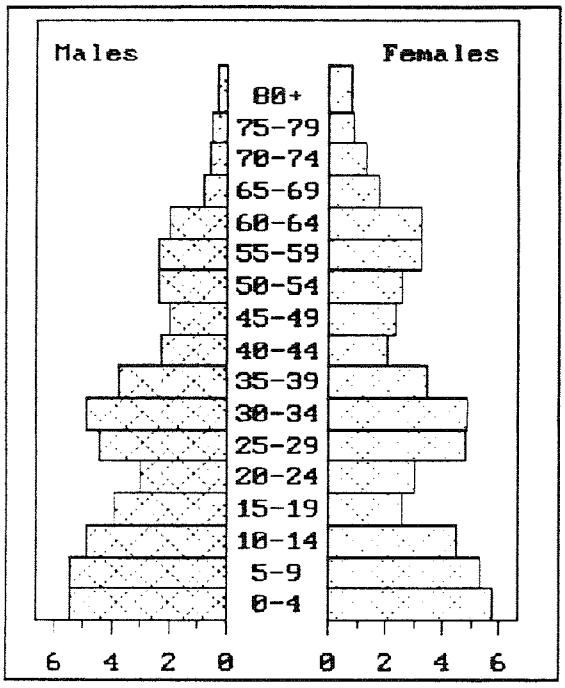
Although it has been a 'hidden disaster' fore many years, in Kyrgyzstan it is now well-known that in the Ak-Tuz mine, which has been functioning for more than 60 years, a dramatic accident took place when mud-slide with heavy metals and even radioactive elements heavily contaminated the soil, water, air, flora and fauna in the Kichi-Kemin valley. During the following years the death rate (and infant mortality) in the region increased sharply while birth rate similarly plummeted. Thus the age-gender pyramid recorded a demographic 'echo' of the environmental (men-made) disaster of 1964.

We have also analyzed general indices such as the birth rate, death rate, natural growth rate of the population and infant mortality for various places in Kyrgyzstan, such as in the settlements of Terek-Sai (where the rare metal of antimony is extracted), in Kadzi-Sai (with the former uranium mine), Chong-Alai, Ak-Tuz and Orlovka. The highest infant mortality was measured in Terek-Sai, Kadzi-Sai and Ak-Tuz, i.e. in settlements with industrial and mining development.

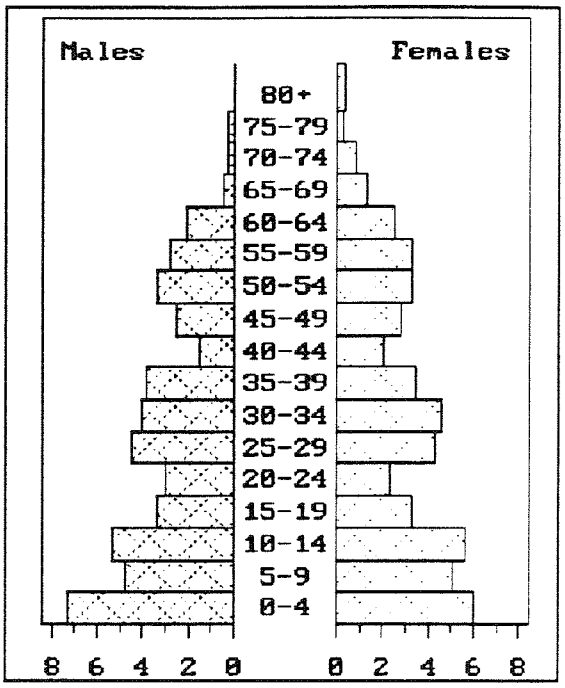
FIGURE 2 Age-Gender Pyramids of the Settlements Orlovka, Ak-tyz and Ak-tala

(Relative %)

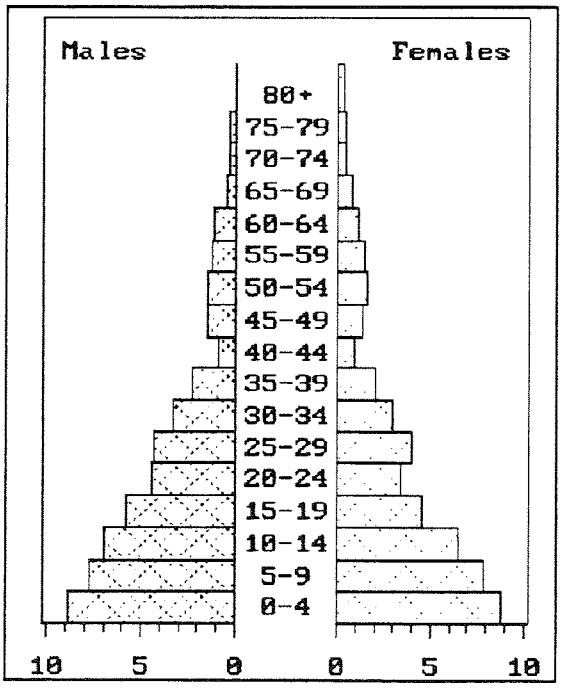
Orlovka (1,000m)



Ak-Tyz (2,500m)



Ak-Tala (2,500-3,000m)



Furthermore, in Ak-Tuz even a negative natural population growth was noted. The highest death rates were in Ak-Tuz, Terek-Sai, as well as in Dgeti-Ogus and At-Bashi regions, i.e. in places where mining enterprises are located, or in the vicinity of Lob-Nor region, where the main nuclear testing site of China is located.

TABLE 2 Pollution and Demographic Development

Place	Birth Rate	Death Rate	Infant Mort.	Poll. of Air (%)	Poll.of Food (%)	Pollution of Drinking Water (%)
Kyrgyzstan	24.6	8.3	29.1	-	-	-
Kara-Kol	17.1	9.9	42.4	18.7	28.6	34.6
Tokmok	19.9	10.0	20.9	14.4	22.9	7.4

Other man-made factors (apart from the contamination caused by mining and industrial sites) also influenced the human ecology in Kyrgyzstan. Comparing the demographic indices and pollution factors in the most polluted cities (except the capital Bishkek), namely Kara-Kol and Tokmok, gives a sense of the impact of pollution on demographic indicators, such as infant mortality (Table 2). The degree of contamination of the environment in Kara-Kol (located in the Issyk-Kul *oblast*) was significantly larger than in Tokmok (in the populated Chui valley in the North of Kyrgyzstan), especially if one focuses on the pollution of air, drinking water and food. Accordingly in Kara-Kol infant mortality is more than twice that of Tokmok. Unfortunately, the absence of sufficient data on ambient pollution, in combination with corresponding demographic indices, prohibits the possibility of doing a reliable regression analysis.[6]

III. DEMOGRAPHIC DEVELOPMENT IN THE TRANSITION PERIOD

In order to measure at least in a preliminary form the impact of transition on demographic development (and more in general on the human ecology in Kyrgyzstan), in this section we will present some data from the period between 1987 and 1995.

TABLE 3 Population Growth in Kyrgyzstan (1985-1995)

(per 1.000)	1985	1987	1990	1993	1994	1995
Birth Rate	32.0	32.7	29.3	26.1	24.6	25.9
Death Rate	8.1	7.3	7.0	7.7	8.3	8.1
Growth	23.9	25.4	22.3	18.4	16.3	17.8

SOURCE: StatKom Kyrgyzstan, 1996.

This period comprehends the final years of the pre-transition Soviet era and transition period after having proclaimed independence in 1991. How should one interpret the tendencies in Table 3? The reduction of the birth rate in Kyrgyzstan, from 32.0 in 1985 to the lowest point of 24.6 in 1984, is firstly connected to an increase in the cost of living; secondly, to the deterioration of the national health care system, in which an increased number of medical services has to be paid for; and thirdly, to improved family planning and the use of contraceptives, especially in the cities.[7] The death rate in Kyrgyzstan increased somewhat from 7.3 in 1987 to 8.3 in 1994 per 1,000 people (Table 3). The increase of the death rate in this period is connected to several other causes, such as the general contraction of the economy and its impact on the livelihood of the population, and more specifically, the shortages and high prices of medicines and the introduction of an increasingly non-balanced nutrition (Table 4). Although the death rate is still relatively low, the trend is a rising one, rather contrary to the world average which was decreasing during this period.

Another important demographic index, reflecting the ecological and social situation, is infant mortality. Infant mortality in Kyrgyzstan amounts to 28.1 per 1,000 new-born in 1995, but fluctuates over different regions of Kyrgyzstan: in Jalal-Abad it is 26.2, in Issyk-Kul 29.8 in Naryn 29.8, in Osh 30.2 in Talas 26.9, in Chui 18.3 and in Bishkek 37.1 per 1.000 new-born. The very high infant mortality in Bishkek is connected with the severe air pollution in this city, in spite of the more developed medical system in the capital. Emission of pollutants in Bishkek amounted to 20,900 tons in 1995, while for the republic as a whole this figure stood at 55,000 tons (Table 5). In some 'unfavourable' regions of Kyrgyzstan

infant mortality is even higher, between 48-60 per 1,000 new-born, as we have seen in the cases where mining and industrial enterprises seriously contaminated the environment. In these regions, this is combined with a low level of the medical aid and low income levels from which no expensive medical treatment can be afforded.

Maternal mortality in Kyrgyzstan fluctuates: in 1985 it was 42.8 women per 100,000 live births; in 1990 62.9; in 1992 49.9; in 1993 44.5; in 1994 44.7; in 1995 44.3. The highest maternal mortality was measured directly after 1991, during the break-down of Soviet Union, when the health care system more or less collapsed. The decrease in maternal mortality in the last years does not seem to indicate an improvement of the situation in the health care of women, as it is most likely connected with a decreasing of the birth rate.

TABLE 4 Consumption Patters During Transition

Consumption/Day	1991	1992	1993	1994
Proteins (g)	55.1	54.2	53.5	47.9
Carbohydrates (g)	334.0	318.8	339.3	304.6
Fats (g)	63.6	59.1	54.5	47.0

SOURCE: StatKom Kyrgyzstan, 1996

Finally, with GDP per capita sharply decreasing during the post-1991 period, nutrition became insufficient and relatively more carbohydratic, with a clearly descending trend with regards to proteins and fats. This has contributed to the deepening of health problems in Kyrgyzstan, in which wide-spread poverty and even malnutrition (previously unknown) have become commonplace. The generalized social crisis can also be noticed in one of the most important demographic indices, namely life expectancy, which is the (average) number of years a new-born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. In Kyrgyzstan in 1991 life expectancy stood at 68.8 years (64.6 for men and 72.7 for women), and has decreased to 66 years in 1995.

a) Economic Crisis and the Environment

The break-up of the Soviet Union, and the transition to a market economy have had a dramatic effect on human development in the country. The economic contraction was severe and for a number of years the economy was distorted by galloping inflation. In particular, the collapse of industry and the mining sectors -with its negative impact on income and employment- was dramatic. Yet this led to an improvement in terms of the levels of air contamination (see Table 5).

TABLE 5: Emission of Air Pollutants in Kyrgyzstan (1985-1995)

	1985	1990	1993	1994	1995
Thousand Tons	203.0	194.0	94.1	64.8	55.0

SOURCE: StatKom Kyrgyzstan, 1996.

Although the general volume of air pollutants has declined in the transition period, it should be noted that, for example, cancer has a long period of latency. Furthermore, the degree of pollution is varying strongly in the different regions of Kyrgyzstan, as mentioned above. What however did change, is the socio-economic environment during the transition period. Open unemployment emerged, with social stress becoming widespread. Apart from the already mentioned poverty that is emerging, it is criminality that has become a generalized phenomenon, unfortunately at all levels of society.

b) Migration and Human Development

Population development during the transition period was and is strongly influenced by migration -which makes the interpretation of aggregate population data difficult. Firstly, some minorities of non-Kyrgyz ethnic origin, such as Russians, feared for their future, while others responded swiftly to the possibilities of migration to for example Germany and Israel. While the population of Kyrgyzstan increased from 4,051,600 people in 1985 to 4,546,800 in 1996, official data estimated that the net outmigration from Kyrgyzstan was between 300-

400,000 people. Using the (most likely also unreliable) natural growth rates of the population, the Kyrgyz nation should have counted well over 5,000,000 people by the 1996, which suggests a even higher figure of migrants. Secondly, the deteriorating economic situation is particularly grave in the Kyrgyz countryside where in 1993 still 65.3 percent of the people lived. Rising rural unemployment with the breakdown of the *kolkhozy*, has contributed to a rapid (domestic) rural-urban migration.

IV. CONCLUSION

As human ecology in Kyrgyzstan is still in its early stages of development, much more research is needed in the multi-disciplinary field where environment and human development are being studied. This is a real challenge, taking into account the general break-down of the previously strong scientific system. Nevertheless, in spite of data (and other) limitations we have shown above that there is a complex set of natural and man-made factors which explain some of the current human development problems in Kyrgyzstan. Firstly, we have discussed the particular problems, from a human ecological perspective, that were caused by the Soviet model of industrialisation and inter-republican division of labour, in which a 'ruthless exploitation' of the abundantly present natural resources was systemic. On the one hand the environmental conditions of high mountains (dominating most of Kyrgzystan's geography) are determined by a combination of factors like altitude, temperature, air and wind speed, conditioning the physiology and metabolism of its traditional inhabitants. On the other hand industrial development and mine exploration in a number of mountainous areas during the Soviet era has caused the already harsh mountain environment to deteriorate, in which the new-comers (soldiers, miners, drivers, geologists etc.) were affected, while also indirect effects were observed within the physiology of native inhabitants.[8] By means of example, we presented age-gender pyramids of some *oblasts* and villages, showing the existence of an *echo* of an ecological disaster that occurred during the Soviet era, when a heavily polluted mud-slide in the Ak-tyz mining area swept through the Kichi-Kemin valley in 1964.

Secondly, during the -post 1991- transition period in Kyrgyzstan most demographic indicators worsened: birth rate, death rate and life expectancy. The deep economic crisis, resulting from the collapse of the Soviet Union and the transition to a market economy, caused rapidly worsening livelihood conditions, while the country also felt the negative

consequences of internal and (very major) external migration. The social well-being of rural and urban communities from the mid-1980s to 1994 steadily deteriorated and poverty became a widespread phenomenon. The collapse of public health systems, a decreased access to food markets and an increased carbohydratic content of food consumed, all negatively contribute to the deterioration of livelihood conditions.[9]

Thirdly, some environmental indicators seem to have improved during the transition, such as the total emission of air pollutants, as a consequence of the profound contraction in industrial and mining sectors. Nevertheless, in the main urban sectors, such as Bishkek, Kara-kol and Tokmok, pollution of air, food and drinking water is still problematic. Taking the increased demand into account, in combination with a strongly reduced presence of the state in the maintenance of public services and infrastructure, it is to be expected that their deterioration will still continue, in spite of first signs of economic recovery in 1996.

Finally, the worsening of human development conditions is also shown by the Human Development Index (HDI), which includes life expectancy, literacy and GDP per capita. In 1992 the HDI in Kyrgyzstan was equal to 0.689; in 1993 0.664, and in 1994 0.618 (UNDP, 1996). It shows a decreasing trend in the process of human development in Kyrgyzstan. If we compare the HDI of Kyrgyzstan with other countries of the world, Kyrgyzstan relates to a medium level of human development (HDI from 0.500 to 0.799), but the dynamics of HDI in the republic are alarming. In the structure of Kyrgyzstan's HDI the near full literacy rate is an important component, followed by the life expectancy and GDP index components. From these three elements of the HDI, the level of literacy remained at the same level during regarding period, but the life expectancy and GDP have decreased steadfastly during the transitional period.

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NOTES

1. The history of the Kyrgyz people has been reflected in the Kyrgyz epos 'Manas' that is larger than the well-known 'Iliad' and 'Odyssee'. The 1,000th anniversary of the epos 'Manas' was celebrated as an important event under the auspice of the UN in Kyrgyzstan in 1995 year.

2. The religion of the Kyrgyz was Islam already for many centuries, but in ancient times they adhered *tengirizm*, a belief of harmony with nature, and the worship of the sky. Mountains were sacred places for the Kyrgyz, in particular the ancient mountain burial grounds.

3. The barometric pressure in Kyrgyzstan varies from 520 to 702 mm Mercury (depending on the altitude), and the average summer temperature fluctuates from 16 to 25 C°, with a relative air humidity of from 24 to 50 percent (Mirrakhimov and Goldberg, 1978).

4. Having a small centre of mountain physiology significantly enriched the above research, in which the complex of meteorological factors, the vertical migration, the anthropo-ecological stress, the long-term adaptation and the combined influence of natural and man-made factors could be integrated in the final analysis.

5. During the years 1991 and 1992, the average number of lost days through illness for each 100 workers was around 628 days. The average disease period per case was 2.5 times longer than for an industrial worker in general.

6. A first attempt to do such correlation analysis was done with still inadequate data originating from 17 different (in particular mountainous) regions of Kyrgyzstan.
The regression equations that were calculated included the death rate and infant mortality with average air temperature and level of bacterial pollution as explanatory variables:
1) $f = 6.27 + 0.018x + 0.03z$, where f = death rate, x = average annual temperature of air, z = the bacterial pollution of water.
2) $g = 36.74 - 0.506x - 0.051z$, where g = infant mortality.
Only the correlation between the death rate and bacterial pollution of water ($r = +.36$) was close to being significant (at 5% level), with a clearer dependence between death rate and pollution (Aidaraliev and Moldogazieva, 1994).

7. In 1993 25.4 percent of women at fertile age used contraceptives (UNDP, 1995). We can also indirectly measure this, by looking at the development of abortions: in 1985 the number of abortions stood at 72.4 per 1,000 women at fertile age; in 1990 this figure was 52.4; 1991 46.9; 1992 41.8; 1993 35.8; and in 1994 29.1; i.e. the number of aborts sharply decreased in this period, in spite of the economic crisis (StatKom Kyrgyzstan, 1995).

8. A significant change in the immune status was observed with persons living near the Khaidarkan mercury complex in the South of Kyrgzystan (Omurzakova et.al, 1995).

9. In 1995, a relative improvement in some demographic indicators could be observed. This might indicate that the most acute consequences of the transition period have been absorbed, and there are signs of stabilisation (and positive economic growth in 1996). Nevertheless, the socio-economic crisis is still of a profound nature.