UNIVERSITY OF BONN

INTERNATIONAL MASTER PROGRAMME

AGRICULTURAL RESEARCH AND NATURAL RESOURCE MANAGEMENT IN TROPICS AND SUB-TROPICS (ARTS)

"RELATIONSHIPS BETWEEN AGRICULTURE, THE ENVIRONMENT AND HUMAN HEALTH IN KHOREZM PROVINCE, UZBEKISTAN - A SPATIAL ANALYSIS"

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Abstract

Spatial analysis, visual observation, combined with principle component analysis to find the effects of environmental pollution, agriculture and socio-economic conditions to human health in Khorezm, Uzbekistan. Health status and socio-economic data were collected by household interviewing in the three sample rayons, Urgench, Khiva, Kushkupir and one city named Urgench. Digestive system diseases and respiratory diseases have high frequency during the survey.

Key words: environmental pollution, agriculture, socio-economic conditions, health

Acknowledgement

To my families, friends and Katholischer Akademischer Auslaender-Dienst who give me the good opportunities to study,

To teachers and colleagues at the University of Bonn and the State University of Urgench who help me to do this research.

1. INTRODUCTION

1.1. Background

The change of the Aral Sea alerts the world about water managements, human health and this is the big problem for countries in the area. It causes many negative effects to the life of local people, salinity increasing in groundwater and soil; many of large dust storms, which scour the seabed and transport millions tonnes of dust per year to be dumped on the surrounding land and its inhabitants; low yield of catching fishes; impact on the local climate, longer, colder winters and decreased precipitation. There is doubt that the bad conditions of environment affect on the health of local people via the sensitive tracts, respiratory systems and digestive systems.

The incidences of many diseases are increasing. Water borne infectious diseases including typhoid, hepatitis-A and diarrhoeal diseases have caused massive outbreaks. Tuberculosis and respiratory diseases are severe problems. Malnutrition and anaemia are at very high rate. Liver and kidney diseases are becoming more common, as are some types of cancer, particularly of the liver and oesophagus (Phillip Whish-Wilson, 2002)

With the purpose applying the knowledge learning from Agricultural Science and Resource Management in Tropics and Sub-tropics programme (ARTS) in the real research, I want to research the relationship between agriculture, the environment and human health in Khorezm province, Uzbekistan.

1.2. Motivation of research

Environmental problems: the heavy use of agrochemicals, diversion of huge amounts of irrigation water from the two rivers that feed the region, and the chronic lack of water treatment plants are among the factors that have caused health and environmental problems on an enormous scale. The Soviet approach to environmental management brought decades of poor water management and lack of water or sewage treatment facilities; inordinately heavy use of pesticides, herbicides, defoliants, and fertilizers in the fields; and construction of industrial enterprises without regard to human or environmental impact. Those policies present enormous environmental challenges throughout Uzbekistan.

Health care system: despite marked growth throughout the Soviet Era, the public health care system in Uzbekistan is not equipped to deal with the special problems of a population long exposed to high levels of pollutants or with other health problems.

Health economics: socio-economic conditions take the significant role in health care concern of the poverty, especially in rural areas where the health care systems lack of drugs, medical equipment and very few doctors, nurses. People be usually suffered the pollution of environment and ignore the diseases, when they come to the clinics the disease is dangerous and pressing.

The Aral Sea disaster is the most visible indicator of environmental decay, it is suitable to research the relation between environmental pollution with health care of local people.

1.3. Objectives

The objective of this project is to analyse the relationship between agricultural production, environmental factors and human health. Respective indicators will be collected and visualized using the geographical information system (GIS). Based on spatial data layers and statistics the relationship between environmental and socio-economic factors with health will be analysed in a spatially explicit way. Because of the lack of adequate data another objectives will be to exploit the options to combine primary data and secondary data.

1.4. Concept for the research project

Direct interview using questionnaire is selected method to collect social economic primary data. Dr. Doris Wiesman, the manager of the survey, compiled the detailed questionnaire (Appendix A) with nine sections divided into two rounds.

- Household Roster
- Description of the dwellings and dwelling expenditures
- Education and child care
- Health
- Agro-patoral activities
- Food expenditure and consumption
- Expenditure and durable goods

- Employment and income
- Real estate assets

The sub-questionnaire added in the health section of the survey focused on environmental pollutions and the effects on health of residents. (Appendix B).

- Number of members get sick during the survey
- Kind of diseases, clarify the chronic diseases
- The opinions of interviewees about environment around their living areas.

Combining to the secondary data which were collected during the last ten years from 1992 to 2001 related to

- Agriculture: agricultural production, amount of fertilizers used per crop,
- Environment: soil salinity, water salinity, air polluted indexes
- Population: male and female population, birth rate, life expectation, employed statistics
- Health care: number of physicians, nurses, hospitals, polyclinics

1.5. Regional focus of research

In the past, approximately half of the flow of the two main rivers, Amu Darya and Syr Darya, reached the Aral Sea. The drying of the Aral Sea became visible in 1960s. There was an average decline in water level during the 1960s of 0.21m/year, in the 1970s of 0.6m/year, and in the 1980s of 0.8m/year. It has now lost 80 percent of its volume and exposed 3.6 mil hectares of seabed. Its surface level has shrunk by half, the level fallen by 19m and in some sites the edge sea is over 100km from its former shore (Phillip Whish-Wilson, 2002, The Aral Sea environmental health crisis)

Figure 1.1: The image of the Aral Sea in 1985 (Nasa)

Figure 1.2: The Aral Sea in July 2003 (European Space Agency's Envisat)

[BBC News Online, 30 July, 2003]

Uzbekistan locates in central Asia, between the two major rivers Amu Darya and Syr Darya. It borders Kazakhstan to the north, Kyrgyzstan and Tajikistan to the east, Afghanistan to the south and Turkmenistan to the west. Ever since the Soviets started to foster large scale irrigated agriculture the country's water resources became scarce. Water usage in the second half of the 20th century was dominated by the production of a single crop, cotton, which is the Uzbekistan's agricultural sector. Unsustainable management of the irrigation systems resulted in huge ecological problems, for instance high levels of soil salinity because of the extremely high levels of evaporation and low precipitation. Because of the high soil salinity leaching of soils is a prerequisite to continue agricultural production. This contributes to the increasing demand for water and to the Aral Sea disaster, continuously declining sea level.

Figure 1.3: Map of Khorezm position in Uzbekistan

The Province of Khorezm is located in the north-western part of Uzbekistan along the lower part of the Amudarya River, in the Aral Sea basin. The climate is continental which is affected strongly by the Aral Sea, with cold winters and dry and hot summers. The province has a total area of 6,057 square km. There are 11 rayons: Bagat, Gurlen, Koshkupyr, Urgench, Khazarasp, Khanka, Khiva, Shavat, Yangiaryk, Yangibazar, and Pitkyak. Urgench is the administrative centre of Khorezm.

Population in Khorezm showed the upward trend in the last 10 years, 1.23 percent increasing. Urban population is about one-forth of the region population. There is a small change between urban and rural population during 10 year, from 1992 to 2001, because of mechanics migration. In 1992, urban population was 27 percent against 73 percent rural population, the ratio maintained one-third from 1993 to 1997, and from year 1998 up to 2001 the urban population is 24 percent comparing with 76 percent rural population.

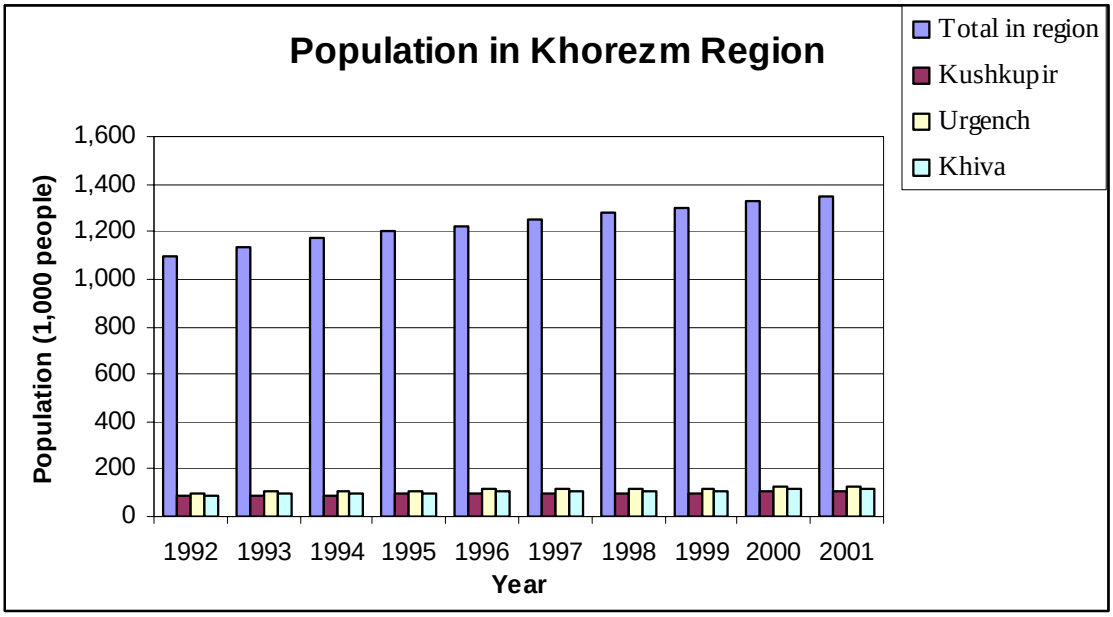


Figure 1.4: Population developing trend in Khorezm region

As in almost countries in the world, females enjoy an advantage over males in term of the expectancy. In developing countries, the average gap in the life expectancy between the sexes is approximately seven years, life expectancy of Uzbek women is 72 and life expectancy for Uzbek men is 65. [Uzbekistan Herman et al]

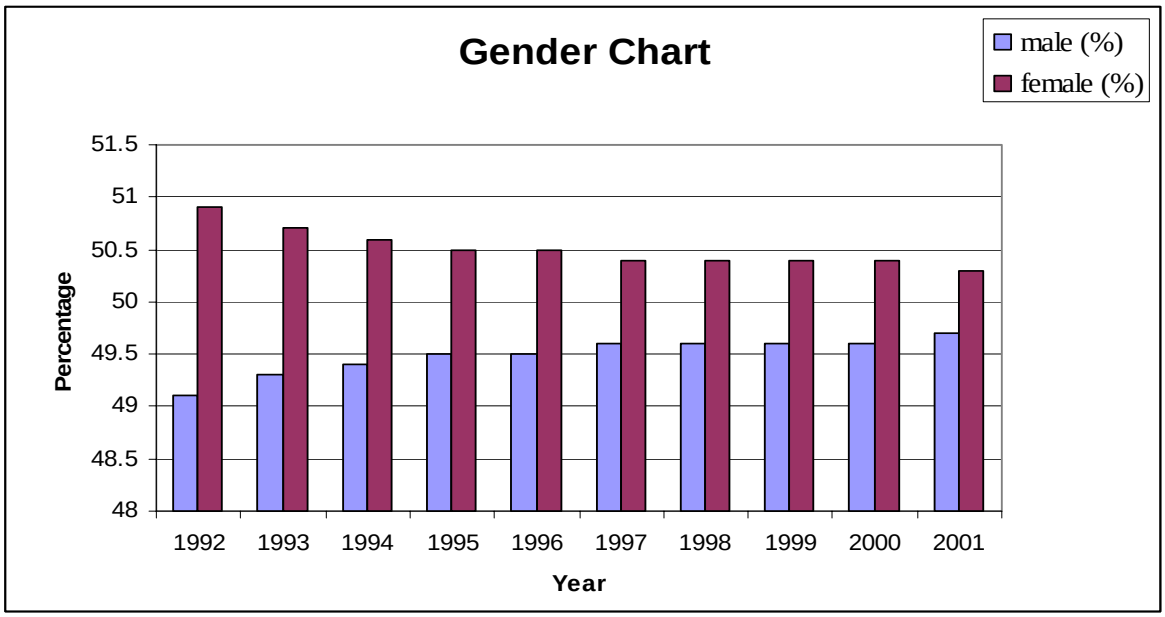


Figure 1.5: Gender chart of Khorezm region

However, the gap between male and female declines slowly during 10 years, from 50.9 percent of female and 49.1 percent of male in 1992, the proportion changed to 50.3 percent of female and 49.7 percent of male in 2001 (Figure 1.5). Since the development of economy bring about the enhancing living conditions and better health care, the life expectancy increase somewhat faster for males than for female with resulting declines in the proportion female at older ages.

The survey was conducted in one city and three rayons. The survey area is located in the middle of Khorezm region, total area is 1,487 square km. The survey was meant to be a kind of test to see whether it is worthwhile doing a survey on a larger scale in Khorezm. So only limited time and money was invested, and the sample size was limited to 177 households.

First Urgench city and Urgench rayon were selected because it is the most densely populated, most urbanised part of Khorezm, and probably also is the wealthiest in the region. Furthermore, Urgench city is the regional capital, and 23 percent of all households in Khorezm are located in Urgench city and Urgench rayon. Urgench is also close by the river, so that we may assume high water availability, in contrast to the rayons that are further away from the river. Another reason that Urgench city has a centralized water supply system, so we can study on different types of drinking water sources affecting on health.

Those are various reasons to select Urgench city and Urgench rayon for the survey although these areas are not located on the transects (Figure 1.6) where the natural resource being studied. But Khiva and Kushkupir rayons share largely the transects and are not too far from Urgench. Khiva is more distant from the river, but near to the desert, in recent years people complained about the shortage of water. Another advantage that some years ago there was a household survey in Khiva that included the examination of water samples from wells which can provide some pre-information on water source in the area. The last but not least selected rayon is Kushkupir. It is rather remote and the infrastructure is not good as comparing to Urgench city, for example, low share of households has centralized water supply, some parts of the rayon can be considered as quite poor.

So we had rayons with different characteristics that are close to Urgench city, form a coherent geographical area and comprise 52 percent of all households in Khorezm (and 51 percent of

the population). Thus, the survey results may be considered representative for half of the population in Khorezm - the population living in the selected area.

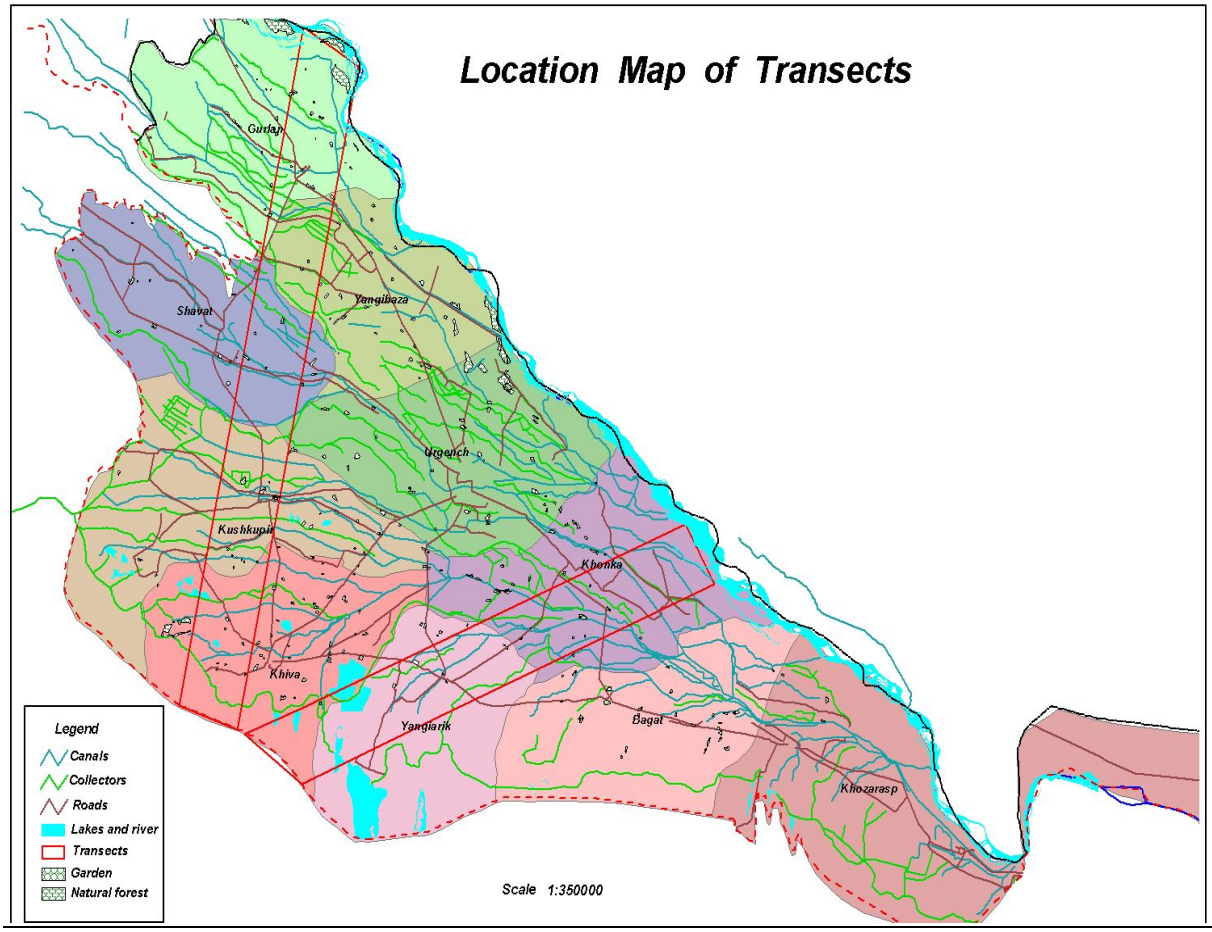


Figure 1.6: Survey area, Urgench, Khiva, and Kushkupir

2. STANDARDS OF LIVING IN KHOREZM

The population in Khorezm is mainly rural based. People and households in poverty do not have alternative income opportunities through own farms or other activities, are often headed by women with children, and live in families with many children. [ADB, Uzbekistan (2000-2002), Country assistance plan] Similarly in other Asian countries, sons in the rural areas of Uzbekistan after getting married build their own houses around the house of parents and rural domestic units centre around a courtyard, where the garden plot, poultry and animal may be kept.

In rural areas, especially in the remote places, infrastructure has been not developed perfectly, water supplies do not reach to all households, mostly people use water from wells pumped by hand. The government policy of transport development enable market-based transport management and operation, to provide employment opportunities and generate addition income in poor areas thus contribute to poverty reduction. [ADB, Uzbekistan (2000-2002), Country assistance plan] However, price deregulation and inflation also mean that people have to pay higher prices for staple goods, consumer products and services.

While the incidence of poverty is more widespread in rural areas, there are also significant urban poverty issues. Since Uzbekistan is independent, investment has slowed and basic urban social infrastructure service such as water supply, sanitation, drainage, solid waste management, district heating and hot water supply have deteriorated. The operation and maintenance of aging assets have become increasingly difficult. Performance efficiency has dropped and the cost of service delivery has risen. As a result the urban population is receiving service of a lower standard that is affecting their living and health conditions.

2.1. Agriculture

Agriculture of Uzbekistan contributes greatly to the national economy and also affects directly to the health of the population in the region. It accounts for about 30 percent of the gross domestic product, 44 percent of employment and 60 percent of export revenues. The agriculture sector comprises 60 percent of crops and 40 percent of livestock, with cotton and wheat being the two major products. Uzbekistan was the largest producer of cotton, fruit, and vegetable in the former Soviet Union and now is the world's fourth largest cotton producer

and cotton alone accounts for about 50 percent of export earnings.[ADB, Uzbekistan (2000-2002) Country assistance plan]

Another feature of Uzbek agriculture is its reliance on irrigation, which determines the size of the cropping area, and provides up to 96 percent of gross agricultural production. To the beginning of the last century the total irrigated area in present territory of Uzbekistan reached 1.2 mln ha, and by the end of the century has increased up to 4.2 mln ha or 3.6 times and makes 81 percent of the cultivated area. [FAO, April 2002] In Uzbekistan, all cropping area is irrigated, as the continental climate and the concentration of rainfall in the winter months make irrigation as an absolute necessity for crop production. The country has massive irrigation system when the State finance all investment costs and is responsible for operation and maintenance of all irrigation and drainage systems.

Since the independence of Uzbekistan, a number of laws and decrees have been issued in order to establish a legal framework for the establishment of mixed economy enterprises, businesses, farms and private domestic plots. The farms include 'shirkat' cooperative farms and 'dekhan' family farms. The land is on long-term lease from the state. The 'dekhan' farms account for more than 60 percent of gross agricultural output production, agricultural enterprises is 36 percent , and private farms is 4 percent. [FAO, 2003]

Cotton productions in Kushkupir and Urgench are not much different in the last four year from 1998 to 2001, and a bit higher than cotton production in Khiva.

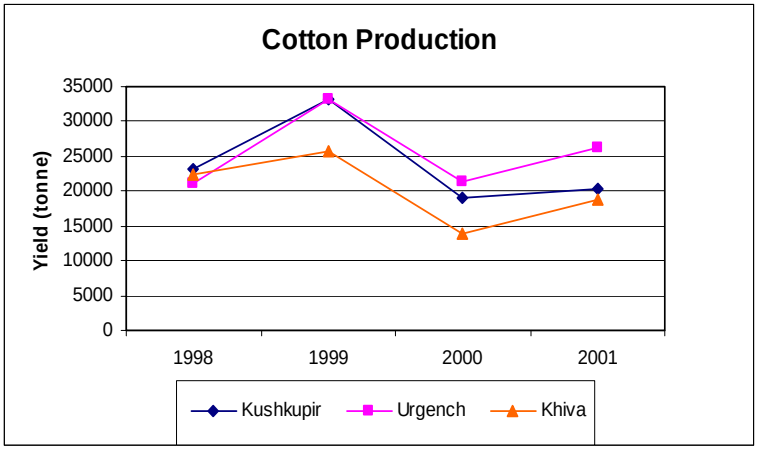


Figure 2.1: Cotton yield in four years, 1998 to 2001

The cotton cultivating area chart explains for the lower yield of Khiva rayon in comparing to cotton yield of Urgench and Kushkupir.

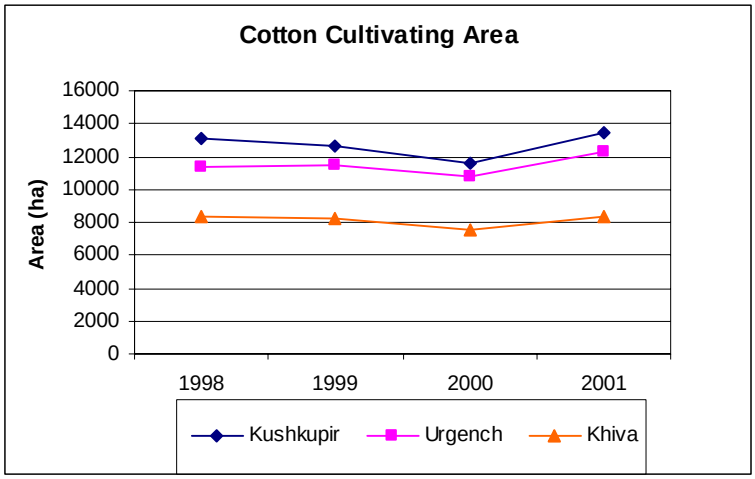


Figure 2.2: Cotton cultivating area from year 1998 to 2001

Most of farmers in Khorezm refer to plant cotton than other crops, thus cultivating areas of other crops were transferred to cotton. Another reason that the shortage of irrigation water also caused crop losses. Indications by in year 2000 the output of rice is likely to be halved due to reductions in the areas sown and in yields, while output of cotton is likely to contract by about 25 percent [FAO, Food crops & Shortages 11/00-Uzbekistan]. And the drought across central Asia in 2001 also reduces the output of rice. Cultivation area for rice in Khorezm was declined around 23.5 percent from 1998 to 2001. In Kushkupir rice cultivating area was completely changed in 2001.

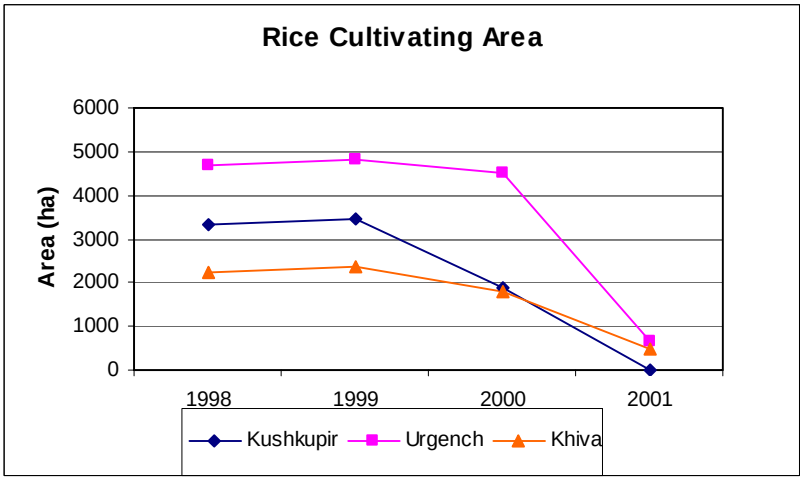


Figure 2.3: Downward trend of rice cultivating area in the survey rayons

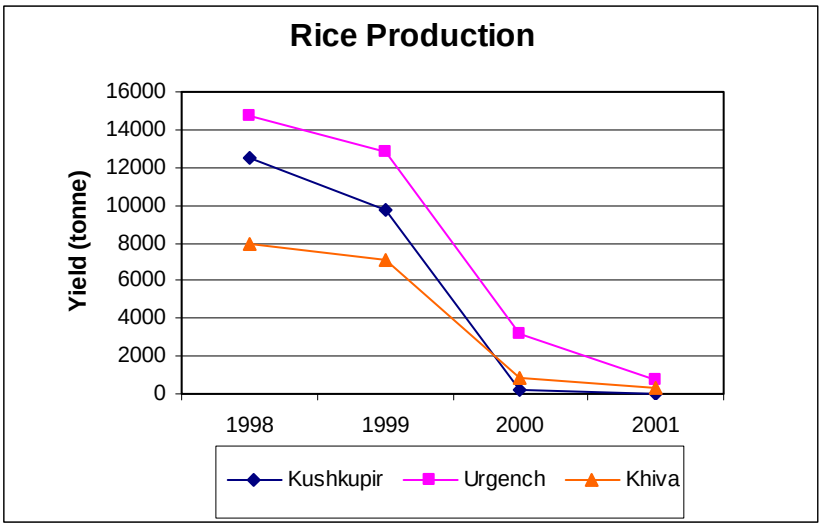


Figure 2.4: Rice output in Urgench, Khiva and Kushkupir

In year 2000, the government took a major export promotion measured by allowing farmers to export their output of fruits and vegetables freely and without any surrender requirements. The positive impact of this measure is already reflected in the increasing in agriculture output in year 2001 as this is made up largely of these crops. [Economic update Uzbekistan, ADB, 2001]

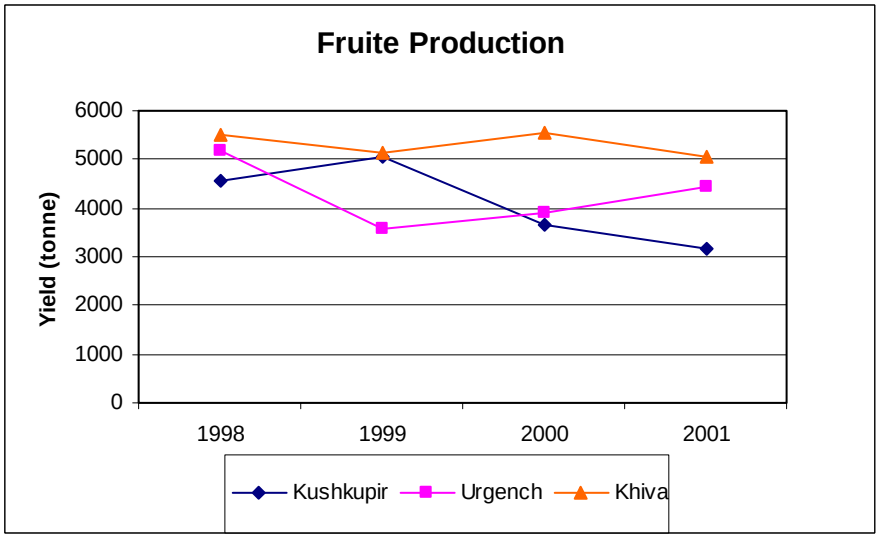


Figure 2.5: Production of fruits in the survey rayons

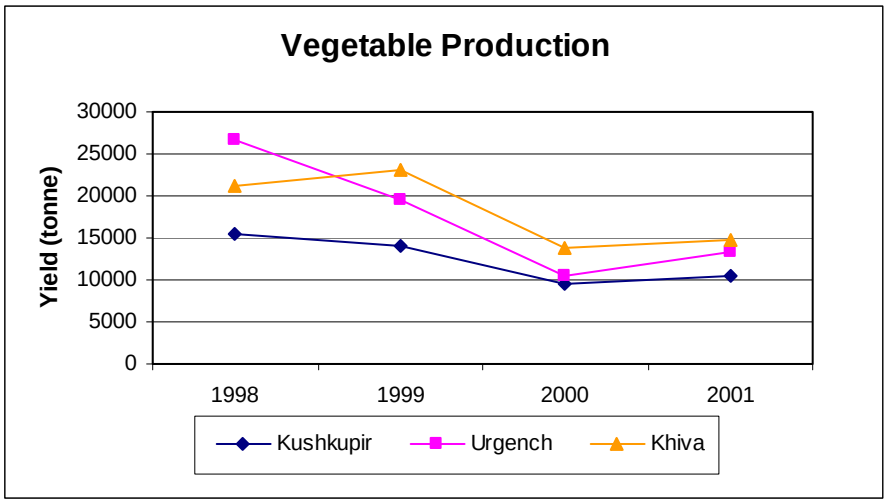


Figure 2.6: Vegetables production in the three rayons

2.2. Environment

Climate

Climate in Khorezm is extreme continental, arid and noted for abundance of solar radiation, small cloudiness, and poor atmospheric precipitation. Temperature in winter can fall to -20°C. In summer the territory in under influence of local tropical air, temperatures can reach to +50°C.

In a flat part of the country total solar radiation in from 130-160 ccal/cm^2 annually on the average, actual duration of solar light is 3000 – 3100 hours. In mountains duration of solar light is substantially determined by closeness of horizon, slope exposition and cloudiness. At attitude about 2000m it value ranges from 2300 – 2500 hours/year.

The precipitation average is minimal. The greatest amount of precipitation drops out in winter and spring months (60-70 percent). Autumn precipitation is much less and absolutely insignificant precipitation is observed in summer months. The droughty period in desert lasts 6 – 7 months (since May till November).

Deficiency of moisture for April – September reaches about 1300 – 1600 mm. In the largest oasis area having an ancient irrigated agriculture practice the special micro-climate of atmospheric near soil layer is formed. [FAO, 2002]

Atmospheric air:

The pollution of atmospheric air is defined by influx of polluting substances from natural sources, and also by physical-geographical and climatic conditions of the territory. Natural sources of dustiness of air are the Kara-Kum and Kizil-Kum deserts, and also dried up bottom of the Aral Sea from which by dust-storms the large weights of the salted dust are transferred from the West to the East.

People in Khorezm suffer the wind dust blow very often, because of the prevailing northerly winds, cars moving on the streets, there are 24 percent of 210 people who have chronical diseases in the field survey confirmed. Wind-blown dusts possibly contaminated by pesticides in the Aral Sea basin. It is difficult to estimate the health effect of total suspended particles (TSP) in Khorezm, because there is no equipment for measuring.

As a result of economic activity of industrial and transport sources, chemical substances (products of combustion of fuel, reprocessing of raw, processing of materials) yearly are spewed out into the air. The overwhelming majority (96 percent) of all waste is as oxide of carbon (50 percent), sulphur, nitrogen, and also hydrocarbon and firm substances, and only 4 percent is emissions of specific high-toxic substances numbering more of 150 names.

There is only one station in Khorezm located at the Urgench airport measures the amount of nitrogen dioxide and sulphured dioxide every day. Figure 2.7 and figure 2.8 display the average nitrogen dioxide and sulphur dioxide of February in three year from 2001 to 2003. The highest value of nitrogen dioxide is 0.08 $\mu g/m^3$ on February 26, 2001 which is very small as comparing the threshold “Short-term health effects for nitrogen dioxide do not occur until to an NO_2 level of 0.65 parts per million (averaged over 24 hours)”. [U.S. Environmental Protection Agency]

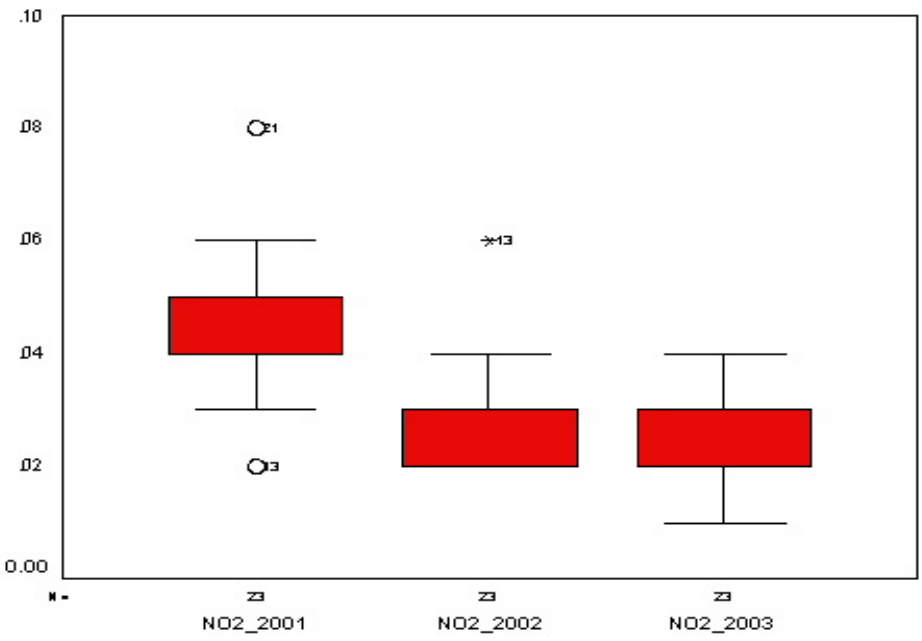


Figure 2.7: NO_2 daily average in February in Urgench

Being different with nitrogen dioxide content, the content of sulphur dioxide measured in February year 2003 reduces more than a half comparing to two previous years. The SO_2 measurements are still very far with the threshold "SO_2 level of 0.14 parts per million (averaged over 24 hours)", which is unhealthy for the Sensitive Groups, people with asthma should consider limiting outdoor exertion. [U.S. Environmental Protection Agency]

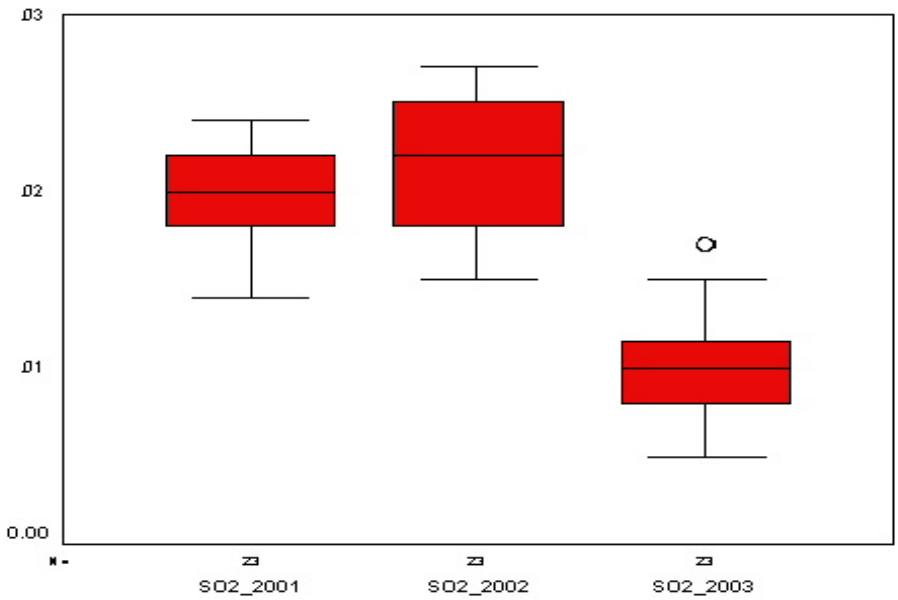


Figure 2.8: SO_2 daily average in February in Urgench

Measurements of nitrogen dioxide and sulphur dioxide in Urgench are suitable with the downward trend of air pollution emissions in the whole country.

Table 2.1: Estimated amount of major pollutants emitted into the air in 1990 and 1999

Major pollutants	1990 (t/year)	1999 (t/year)	Decrease (percent)
Total Suspended Particle (TSP)	252,100	122,800	51.3
SO_2	541,600	385,100	28.9
NO	117,100	72,200	38.3
CO	129,600	128,000	2.2
Hydro Carbon	215,200	132,800	38.3
Total	1,276,900	856,200	32.9

[Country profile of environment-Uzbekistan, JICA, 1999]

The characteristic of contamination of water

There is little data on the health effects of chronic consumption of heavily mineralized water, it seems likely that it may contribute to the increasing incidences of kidney and liver diseases in the region. The drinking water may be characterised as being of insufficient volume and contaminated with disease-causing microbes, high salt levels and toxic chemicals. [Phillip Whish-Wilson, 2002]

During the winter time, it is difficult to identify either snow or salts on the fields at the level around 2000m high from the airplane. Before starting the new crops, farmers have to get the pure water in the fields leach the salts. These activities have to be done at least two times before cultivation. The salinity water is returned to the drainage network then to the rivers.

Figure 2.9: Leaching salts on the field in Khorezm

Lakes, rivers are related to moderate-polluted and polluted zones. The content of pesticides, petrochemicals and heavy metals is constantly 3 -5 times higher than the established norms. Mineralization increases in comparison with background in 4 -5 times. The drainage network in the zone of farmlands is highly contaminated, and the mineralization of water exceeds the established specifications in 3 -5 times. [State of Environment Resource of Uzbekistan, 2000]

Table 2.2: Contribution of the pollution loads by sources

Pollution Sources	Percentage
Irrigated framing	78
Industrial waste water	18
Domestic waste water	4

[Country profile of environment-Uzbekistan, JICA, 1999]

Pollution of the soils

The majority of agriculture (95 percent) is carried out on irrigated lands. Occupying in agriculture of republic 15 percent, they give more than 98 percent of total agricultural production. One of the main reasons for the ecological condition detailed above is the

monoculture of cotton that caused loss of humus, exhaustion of the soil and its physical and chemical qualities, and general degradation of land. Content of the humus in the soil, which is basis of its fertility, has decreased by 30 - 40 percent. Soils with the very low humus content (0.4 - 1 percent) occupy about 40 percent of the total irrigated lands, and low productivity soils cover 0.5 million hectares.

Using of pesticides and chemical fertilizers has reduced significant volume since year 1985 to 1993. From around 100,000 thousand tonnes in year 1985 to less than 50,000 thousand tonnes in year 1993. Similarly chemical fertilizers was reduced almost a half of using from 1,500 thousand tonnes in year 1985 to around 500 thousand tonnes in 1993.

The soil pollution from herbicides such as dalapon, cotoran, trefman exceeding normal acceptable standard is extremely rare occurred, and such preparations as metafos, phosalone, tiodan, occur in soil in the form of traces due to their instability in dry climate. Local soil pollution from toxic chemicals in the areas near the former agriculture spray plane airfield storage and pesticides deposits causes the special alarm. [State of Environment of Uzbekistan, 2000]

2.3. Infrastructure

Drinking water supply

One of the highest priorities in creating healthy living conditions is the provision of safe drinking water, reducing water-borne diseases, particularly diarrheal diseases. This problem is especially pressing in the Khorezm and Bukhoro oblasts, where there are no local sources of clean, fresh water. According to World Bank studies about water supply, sanitation, and health, the benefits to improved human health greatly exceed the costs of developing a water supply.

In two years from 1998 to 2000, there is positive change in drinking water supply in Uzbekistan. The UNDP's report 1998, piped water supplies are available to 89.8 percent of urban population and to 64.5 percent of the rural population. The UNICEF's statistics in year 2000 is 94 percent of urban population and 79 percent of rural population using improved drinking water sources.

According to the official data there is 47.2 percent of population in Khorezm access water centre supply, and Urgench has 79.8 percent of population access tapped water. In fact, there are households have the tapped water system but the water is not available. In the Socio-economic Household Survey in Khorezm-year 2003, among 96 households can access the water supply, there are 15 households have availability of tapped water less than 12 hours per day, and 8 households do not have water at all.

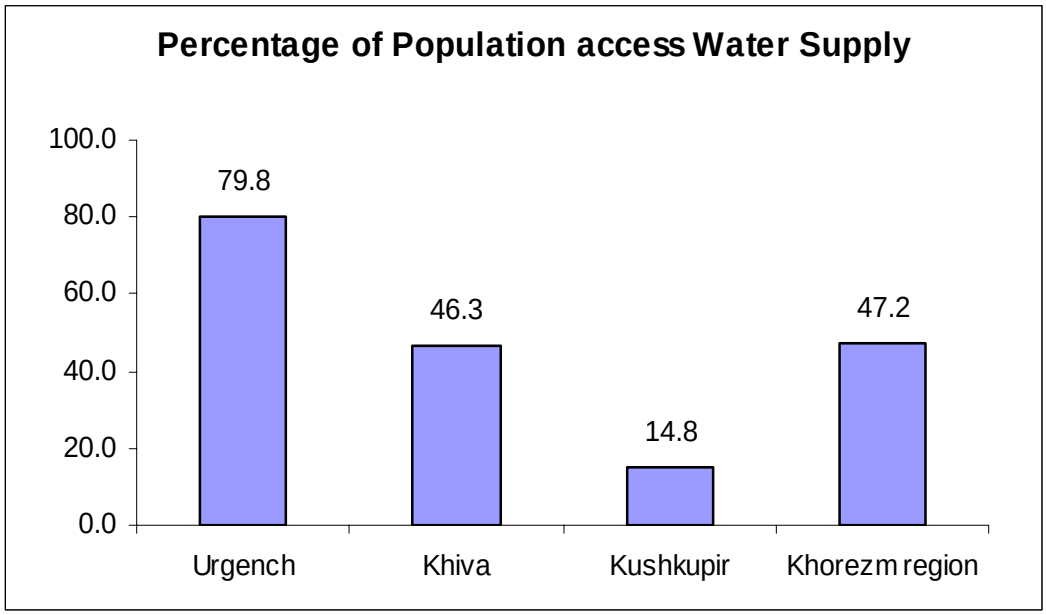


Figure 2.10: Percentage of population connect to water supply in Khorezm

Sanitation and sewerage treatment

The significant part of waste is ecologically dangerous, because it contains substances, which have dangerous properties (high reactionary ability, harmfulness etc.) and they are really dangerous to health of people or harmful to environment. The products of dusting, evaporation, burning are spread by air to large distances. These products pollute air, soil and vegetative cover, bring in secondary pollution to water basin, and as well they are harmful to population and animal world. Stores of liquid waste are located in the lowered forms of a relief, frequently near settlements or on the territory of enterprises that are situated in industrial cities, and also near water objects. These stores are constantly working sources of pollution and they are being filtered by underground and ground waters. [SoE, 2000]

Waste water from agriculture in Khorezm goes directly to drainage canals then flows to rivers, apart stored in lakes. The high salinity in waste water is visible through the salt condensed white on the fields.

Energy for living

Oil and gas are sufficient resources to produce heat in winter, more than 70 percent of electricity production from natural gas source. Heat and warm water is normally provided in the urban by the municipal services through special piped infrastructures.

While the majority of existing piped systems (which were built 20-30 years ago) need rebuilding to keep warm for urban people in winter, many of households in rural areas are forced to use wood for heating in winter. Due to shortages in heating material, there is no heat in public areas like university and post office.

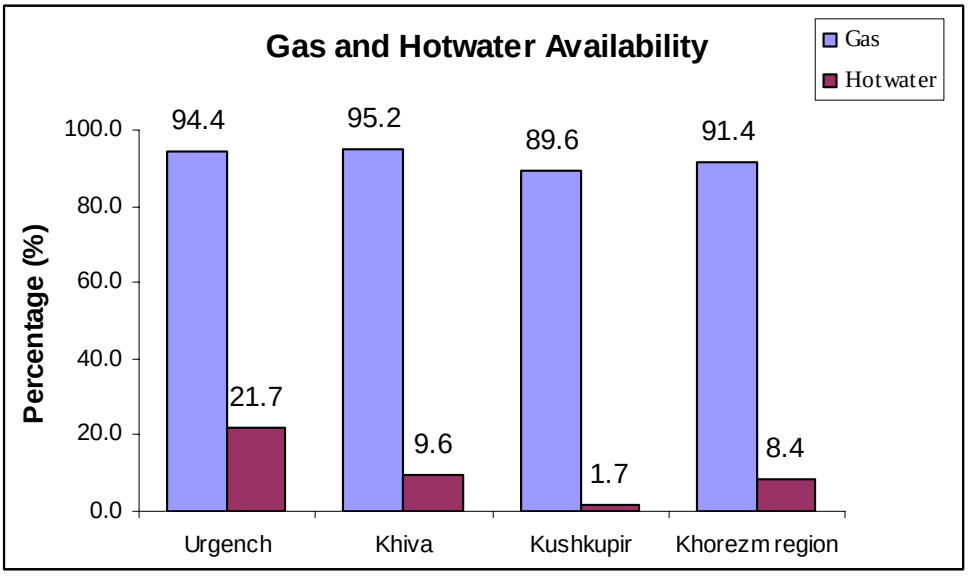


Figure 2.11: Percentage of households has gas and hot water supply in Khorezm

2.4. Health conditions

Main diseases cause deaths in the majority of countries that report to WHO is due to diseases of the circulatory system, including heart disease and strokes. In Uzbekistan, diseases of the

circulatory system are leading to the cause of death both in people up to 65 years and the group of older age. The mortality of under-65 year-old people is attributed by diseases of the circulatory system, respiratory diseases, digestive system diseases, infectious and parasitic diseases.

Diseases of the circulatory system

Diseases of the circulatory system are the most important causes of death, responsible for between 26percent to 63 percent of all male deaths in the countries of the former Soviet Union.

Women suffer even more than men from this group of diseases which cause between 31 percent and 70 percent of all female deaths. Cause-specific mortality peaks are found in Turkmenistan, Russian Federation and Uzbekistan. [WHO, February 1997, Life Expectancy at Birth Plummets in the Countries of the Former Soviet Union]

Neoplasms (cancers)

Various cancers or neoplasms constitute the second most important group of causes of death. They are responsible for between 8 percent to 32 percent of all male deaths. In Uzbekistan which report less than 10 percent of male deaths due to neoplasms.

Neoplasms cause between 8 percent to 30 percent of all female deaths in the countries which have provided their national public health data to WHO. Uzbekistan is one of the countries has the lowest rates which is less than 10 percent of deaths. [WHO, February 1997, Life Expectancy at Birth Plummets in the Countries of the Former Soviet Union]

Respiratory diseases (principally pneumonia)

This is the third most important group of causes of death accountable for between 4 percent to 15 percent of deaths in male population. While in the female population respiratory diseases cause between 2 percent to 15 percent of deaths. One problem specific to Uzbekistan is the high incidence of bronchial asthma in around the environmental disaster area around the Aral Sea. [WHO, February 1997, Life Expectancy at Birth Plummets in the Countries of the Former Soviet Union]

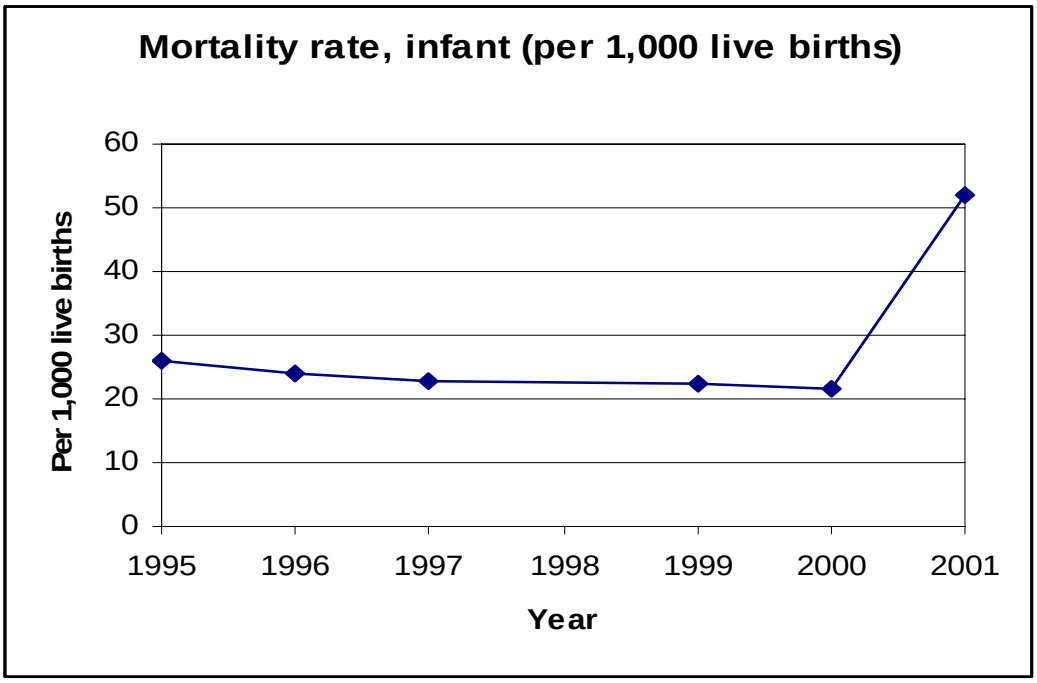
Injuries and poisoning

National and religious characteristics mean that mortality due to injury and poisoning in Uzbekistan has not been so strongly affected by alcohol consumption as in most newly independent states. Mortality due to road traffic accidents is also comparatively low, causes 1percent of deaths in Uzbekistan.

2.5. Mortality and children's health

The survey in July, 2001 in the south-eastern oblast of Khorezm conducted by UNICEF, revealed that three out of every four children are sick. Their illnesses are largely due either to the decline in the quality of drinking water, which is a result of the worsening ecological situation, or to a general decline in living and nutritional standards due to the current drought. Most families have vegetable gardens which supplied them with a range of fresh fruit and vegetable. But the lack of rain has meant they have been able to grow little or nothing there over the past two years. Those who can afford it buy their green vegetables from the market.

The drought in Khorezm has magnified and compounded existing health issues. Rates of hepatitis, diarrheal diseases, acute respiratory infections, gallstone diseases, and anaemia have all shot up. In Khorezm, it is estimated that 98 percent of women of fertile age are anaemic, as are 50 percent of children under fourteen. Last year's health survey of nearly half a million children in the oblast concluded that only 23 percent could be considered in full health. And child mortality rates have also risen. A UNICEF study puts them at double the figures provided by the government. A robust health infrastructure is needed to handle such an alarming situation. [UNICEF, 2001]



(from 1995 to 2000 is WB's source, data in 2001 is UNICEF's source)*

Figure 2.12 :Mortality rate, infant in Uzbekistan

3. THEORY ON THE RELATIONSHIP BETWEEN THE ENVIRONMENT, AGRICULTURE, AND HEALTH

People realize the importance of the environment only when the environment alerts by the bad effects which are caused by their operations. There are many studies to improve the deteriorated environment, protect it, and research the environmental risks to health.

3.1. Case study 1 - Environmental risks to children's health – Statistical Researches of the Population Reference Bureau, USA

Indoor air pollution

Half of world's households use biomass fuels, including wood, animal dung, or crop residues, that produce particulates, carbon monoxide, and other indoor pollutants. The World Health Organisation (WHO) has determined that as many as 1 billion people, most women and children, are regularly exposed to levels of indoor air pollution that are up to 100 times those considered acceptable.[1] Young children, who spend more time indoors, are more exposed to the noxious by products of cooking and heating. In India, where 80 percent of households use biomass fuel, estimates show that nearly 500,000 women and children under age 5 die every year from indoor pollution, largely from acute respiratory infections (ARIs).[2]

Exposure to indoor pollutants can cause or aggravate ARIs, including upper respiratory infections such as colds and sore throats, and lower respiratory infections such as pneumonia. Acute lower respiratory infections are one of the primary causes of child mortality in developing countries, and led to 2.2 million deaths in children under age 5 in 2001.[3]

[1] WHO, June 2002, Danger in the Air ; N. Bruce et al., 2000, Indoor Air Pollution in Developing Countries: A Major Environmental and Public Health Challenge
[2] K. Smith, 2000, National Burden of Disease in India from Indoor Air Pollution, Proceeding of the National Academy of Sciences of the United States of America 97, No. 24
[3] Hiremagalur N. B. Gopalan and Shannon Ryan, 2001, Urban Air Pollution Management Focusing on Children's Health (paper presented at the Workshop on Air Pollution in the Megacities of Asia, South Korea)

Outdoor air pollution

Data suggest that over 60 percent of the diseases associated with respiratory infections are linked to exposure to air pollution.[1] Outdoor pollutants such as sulphur dioxide, ozone, nitrogen oxide, carbon monoxide, and volatile organic compounds come mainly from motor vehicle exhaust, power plant emissions, open burning of solid waste and constructions, and related activities. In Mexico City, pollution levels are well above WHO's limits of 90 micrograms per cubic meter ($\mu g/m^3$) for particulates and 50 $\mu g/m^3$ for sulphur dioxide and nitrogen dioxide.[2]

Unsafe drinking water and poor sanitation

Human faeces may contain a range of disease-causing organisms, including virus, bacteria, and eggs or larvae of parasites. The micro organisms contained in human faeces may enter the body through contaminated food, water, eating and cooking utensils and by contact with contaminated objects. Diarrhoea, cholera and typhoid are spread in this way and are major causes of sickness and death. Children are especially vulnerable to these infections.

Sullage is waste water from kitchens, bathrooms, and laundries which can contain disease-causing organisms, particularly from soiled clothing. But its main health hazard occurs when it collects in poorly drained places and causes pools of organically polluted water.

Contaminated water and inadequate sanitation cause a range of diseases, many of which are life-threatening. The most deadly are diarrheal diseases, 80 to 90 percent of which result from environmental factors. In 2001, diarrheal infections caused nearly 2 million deaths in children under age 5, primarily due to dehydration; many more children suffer from non-fatal diarrhoea that leaves them underweight, physically stunted, vulnerable to disease, and drained of energy.[3] Poor sanitation conditions and inadequate personal, household, and community hygiene are responsible for most diarrheal infections.[4]

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[1] Kirk R. Smith et al., 1995, How much Global Ill Health is attributable to Environemntal Factors?, Epidemiology 10, No. 5

[2] United Nations Population Division, World Urbanization Prospects : The 1999 Revision, www.un.org/esa/population/publications/wup2001/wup2001dh.pdf

[3] UNICEF, Global Water Supply and Sanitation Assessment : 2000 Data, www.childinfo.org:eddb/water.htm

[4] WHO, Health and Environment in Sustainable Development

Infectious disease vectors

Vector-borne diseases, such as malaria, represent an international public health problem, particularly in tropical areas of Africa, Asia, and Latin America. Approximately 1 million children under age 5 in sub-Saharan Africa die of malaria each year. Malaria causes about 25 percent of all deaths among children living in remote rural areas with poor access to health services.[1] Malaria also contributes to low birth weight, one of the leading risk factors for infant mortality because pregnant women are more susceptible to both malaria and anaemia.[2]

The prevalence of malaria is strongly related to environmental factors such as irrigation and other agricultural practices, land clearing, and changing demographic patterns. Higher temperatures, as well as deforestation, increase the risk of malaria and related epidemics.[3]

Exposure to hazardous chemicals

Inorganic waste, such as fuel ash, can be hazardous to health. Items such as empty pesticide containers should be crushed and buried to ensure that they are not accidentally recycled.

As countries pursue economic development, the increased risk of exposure to chemical hazards may worsen other risks to children's health, such as unsafe water and poor hygiene. Industrialization and modernized agriculture have many benefits, but they have often been accompanied by problems, such as exposure to pesticides, that disproportionately affect children. Other potential toxins include lead discharged from battery-recycling operations, mercury in fish, and nitrates, arsenic and fluoride in drinking water.

In many countries, children are exposed to toxic chemicals in working place. According to the International Labour Organisation (ILO), more than 352 million children from age 5 to 17 engage in "economic activity", an internationally accepted standard that includes unpaid and illegal work and work in the informal sector. Of those children, about 50 percent work in hazardous occupations or situations, defined as those "likely to have adverse effects on the

[1] H. Gelband and S. Stansfiled, 2001, The Evidence base for Interventions to reduce Under-Five Mortality in Low-and-Middle-Income Countries.
[2] UNICEF, Malaria Statistics, www.childinfo.org/eddb/Malaria/index.htm
[3] Gurinder S. Shahi et al., 1997, International Perspectives on Environment, Development, and Health: Toward a Sustainable World

health, safety, or moral development of children".[1] In one district of Manila, for example, a government report suggests that there are nearly 14,000 child scavengers.[2]

3.2. Case study 2 - Health effects from ambient and indoor air pollution in China

Air pollution is thought to be one of the leading risk factors for respiratory diseases, such as chronic obstructive pulmonary disease (COPD), lung cancer, pulmonary heart disease and bronchitis that are the leading causes of deaths in China. The fact that men and women have similar rates of these diseases despite women have much lower smoking rates, provides evidence that this high disease burden is related to pollution.[3]

Although only a limited number of epidemiologic studies have been conducted, air pollution has clearly contributed to both excess mortality and morbidity in China. At this stage, however, it is extremely difficult to test apart which sources of air pollution have the greatest impact on human health, indoor or outdoor. In urban areas, there is a great deal of exchange between indoor and outdoor air, both of which are polluted from different sources – indoor primarily from the burning of coal for cooking and heating. Summaries of selected recent estimates of health impacts are presented to provide a more complete understanding of the complex relationship between air pollution and human health.

Based on dose-response functions from studies conducted within China and in other countries, the World Bank has estimated the number of deaths and diseases associated with air pollution among urban populations. Using the Chinese standard as a benchmark, they estimated the number of deaths that could be prevented if air pollution were reduced to those levels. According to their calculations, approximately 178,000 deaths, or 7 percent of all deaths in urban areas, could be prevented each year. Another measure of air pollution's impact on health is the number of hospital admissions from respiratory diseases. This study found 346,000 hospitalizations associated with the excess levels of air pollution in urban areas. [4]

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[1] International Labour Office, 2002, International Programme on the Elimination of Child Labour and the Statistical Information and Monitoring Programme on Child Labour
[2] Environmental News Service, Children bear the heaviest burden of environmental disease, www.who.int/peh/ceh/articles/burden.htm
[3] Op. cit. 12, p. 17-18
[4] World Resources Institute, 1998-1999, Regional profile: China's Health and Environment

In China the effect of outdoor air pollution are compounded by those of indoor air pollution. Households using coal for domestic cooking and heating are especially at risk because coal emits very high level of indoor particulate matter less than 2.5 microns in size – the size believed to be most hazardous to health.

Indoor air pollution affects both urban and rural populations. Nor is it simply a problem indoor, numerous studies have shown that intense indoor coal burning can affect ambient air quality as well. For instance, rural neighbourhoods are generally unaffected by urban sources of air pollutants but can be extremely polluted from the burning of coal indoors. Table 3.1 shows the extremely high levels of particulates in both rural and urban indoor environments. Indoor air pollution causes as many health problems as smoking, with the effects concentrated among women and children.[1]

Table 3.1: Indoor particulate air pollution from coal burning in China (Sample Studies)

Place	Urban / Rural	Particulates (micrograms/m^3)
Shanghai	Urban	500 – 1,000
Beijing	Urban	17 – 1,100
Shenyang	Urban	125 - 270
Taiyuan	Urban	300 – 1,000
Harbin	Urban	390 - 610
Guangzhou	Urban	460
Chengde	Urban	270 – 700
Yunnan	Rural	270 – 5,100
Beijing	Rural	400 – 1,300
Jilin	Rual	1,000 – 1,200
Hebei	Rural	1,900 – 2,500
Inner Mongolia	Rural	400 – 1,600

[Source: World Health Organization (WHO), Health and Environment in Sustainable Development: Five Years after the Earth Summit (WHO, Geneva, 1997), p.86]

[1] Op. cit. 12, p. 19

3.3. Case study 3 - Water scarcity, water pollution, and health in China

China has some of the most extreme water shortage in the world. Of the major 640 cities in China, more than 300 cities face water shortage, with 100 cities face severe scarcities. As discharges of both domestic and industrial effluences have increased, clean water has become increasingly scarce. The impact of water pollution on human health has been valued at approximately 41.73 billion yuan per year (US$3.9 billion), which is almost certainly an underestimate.[1]

Industrial and municipal waste water threatens China's water quality.

Each year, large amounts of pollutants are dumped into China's water bodies from municipal, industrial, and agricultural sources. China is the world's largest consumer of synthetic nitrogen fertilizers. As a result of these activities, pollution is widespread in China's rivers, lakes, and reservoirs. Except for some inland rivers and large reservoirs, water pollution trends in China have worsened in recent years, with the pollution adjacent to industrially developed cities and towns being particularly severe.[2]

Some of the major threats to water quality stem from inadequate treatment of both municipal and industrial waste water. In 1995, China discharged a total of 37.29 billion cubic tonnes of waste water, not including waste water from township-and-village enterprises, into lakes, rivers, and reservoirs. Approximately 60 percent was released from industrial sources, the rest from municipal.[3]

Water bodies near urban areas are generally the most severely polluted, and the situation is deteriorating. Many urban sections of rivers are polluted by toxic and even carcinogenic compounds, such as arsenic. Although most Chinese attempt to protect themselves from bad water by boiling it, but boiling water does not affect many of the toxins.

Biological contamination remains as a problem as well. Indeed, fecal coliform, mostly from sewage, has become the most challenging drinking water pollutant in the country. In 1994,

[1] Op. cit. 12, p. 23, 87-88
[2] Vaclav Smil, 1996, China Shoulders the Cost of Environmental Change, Environment, Vol. 39, No. 6, p. 33
[3] Op. cit. 46

there are 54 out of 134 rivers tested did not meet Grade 4 and 5 surface water standards, indicating that the water was deemed unsuitable for even industrial or agricultural use. About 90 percent of the sections of rivers around urban areas were found to be seriously polluted. Because heavy industry is concentrated in northern China, the major river systems in the North are more heavily polluted than those in the South.[1]

Infectious diseases associated with poor water quality

Despite an overall decline in mortality from infectious diseases in China, the population still suffers from a number of diseases associated with inadequate drinking water quality and sanitation. For the past two decades, diarrheal diseases and viral hepatitis, both diseases associated with fecal pollution, have been the two leading infectious diseases in China. In year 1995, the incidence of hepatitis was 63 per 100,000. A sudden upswing in the incidence of typhoid fever in 1991 and a large outbreak in some provinces in 1992 were also partly attributed to the poor drinking water quality in rural areas. In 1991, typhoid fever incidence reached as high as 10.6 per 100,000. Although the incidence of waterborne diseases is still high compared with many other countries, effective medical care has kept mortality low, averaging less than 0.1 per 100,000.[2]

It is more difficult to establish the impact of industrial and chemical water pollution on human health than pollution by human waste. However, recent epidemiological studies suggest that exposure to organic and inorganic chemicals in drinking water may significantly contribute to chronic diseases. Liver and stomach cancers are the leading causes of cancer mortality in rural China. Many studies in China and aboard have been shown a strong association between drinking water pollution and cancer incidence and mortality. An example is a study conducted in Lujiang County, Anhui Province, where mortality rate for stomach and liver cancers were associated with the high levels of inorganic substances in surface water.[3]

In southern China, where some of the population has long depended on ponds for drinking water, the rates of digestive system cancers are very high. An investigation of 560,000 people in 23 villages and towns showed that between 1987 and 1989, cancer mortality was 172 per

[1] Op. cit. 10
[2] China Ministry of Public Health, 1991-1995, Selected Edition on Health Statistics of China, p. 69-70
[3] Guili Chen, 1996, The Warning of Huai River, Contemporary Magazine, Vol. 2

100,000, which is much higher than average mortality rates in rural China. Gastric, oesophageal, and liver cancers accounted for 85 percent of all cancers.[1]

Impact of waste water irrigation on health

Irrigation with waste water has been a common practice in many parts of China throughout its 2,000 year-old-agricultural history. In the past several decades, however, the age-old practice of using night-soil has been supplemented by the use of industrial waste water as well, leading to problems with both biological and chemical contaminants. Irrigation with industrial wastes is especially common in the northern regions, where water is scarce. Pollutants, including some organic pollutants, heavy metals, and carcinogens, enter the food chain in the irrigation process and can affect human health.

Numerous studies since 1970s have shown significant increases in cancer rates and deaths, as well as birth defects in areas that reply on waste water for irrigation. For example, research in Shenyang and Fushun showed that the incidence of intestinal infections and enlargement of the liver was respectively 49 percent and 36 percent higher in the irrigation areas than in the control area. There were twice as many cancer patients in the sewage-irrigated area. In Fushun, in Liaoning Province, more than 13,000 hectares of farmland are irrigated with water polluted with oil. The adjusted rate of malignant tumour mortality was almost twice than of the control area and the incidence of congenital malformation was double the rate in the control area.[2]

Access to safe drinking water is key to protecting public health

The health of China's people depends, to a great extent, on the quantity and quality of drinking water supply. Drinking water quality is largely determined by sources of incoming water, modes of water supply and the level of water treatment. The majority of Chinese urban and some suburban residents now have access to tap water, while the largest portion of the rural population still relies on hand or motor-pumped wells, or they fetch water directly from rivers, lakes, ponds or wells with little or not treatment at all. Large rivers are the most

[1] Liang et al., 1987, Epidemiologic Investigation of Relationships Between Drinking Water Types and Liver Cancers, Cancers Vol. 6, No. 3, p. 177
[2] Yuan, 1993, Etiologic Study of High Stomach Cancer Incidence Among Residents in Waste Water Irrigated Areas, Environmental Protection Science, Vol. 19, No. 1, p. 70-73

common source of urban drinking water, as well as the major source for rural residents in many parts of country.

In only 6 of 27 largest cities in China have drinking water quality meet state standards through one recent study. Groundwater did not meet state standards in 23 of these cities.[1] The problem is more pronounced in rural China. In some rural areas, the fecal coliform in the drinking water supply exceeds the maximum level by as much as 86 percent. In towns and small cities, the rate is about 28 percent. Currently, around 700 million people in China drink water that fails to meet state standards for fecal coliform.[2]

3.4. Conclusion from case studies for the theory

The three case studies are typical samples of many researches showing the cause-and-effect relation between environment, agriculture, and human health. Waste from the living activities of human that were discharged freely to the air, the water and the ground affect directly to the human. They are responsible for many respiratory diseases, digestive system diseases and other chronic diseases.

Coal or other organic material like animal dung, straw and coconut husk are the popular material used for cooking or heating in developing countries, where gas or electric supply hardly reach. They release high carbon monoxide, total suspended particles (TSP) to the air as burning. Another contributing condition caused the high rate of respiratory diseases is the air-tight kitchen, no chimney discharge smoke in the rural households that keep the polluted air stay indoor longer. Women and young children who spend more time indoors are more exposed to the noxious by products of cooking and heating.

If the respiratory rate caused by indoor polluted air is high in the rural areas, the outdoor polluted air is the main reason caused high respiratory diseases in the urban areas. High sulphur dioxide, nitrogen oxide, carbon monoxide, and TSP discharged to the air by dense vehicles, industrial manufactories and constructions.

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[1] Vaclav Smill, 1996, Environmental Problems in China: Estimates of Economic Costs, , East-West Center Special Report No.5, p. 2, 24

[2] Cai Shiwen, China Environmental Pollution and Health Problem (paper presented at the Second Conference of the China Council of International Cooperation and Development, Beijing, 1993

Polluted water sources in rivers, lakes and reservoirs caused high rate of digestive diseases for human is also the centre research of those case studies in the previous chapters. Pesticide, chemical fertilizer and organic fertilizer used in agricultural activities flow through the drainage to rivers, lakes and reservoirs lead to problems with both biological and chemical contaminants. Pollutants enter the food chain in the irrigation process and can affect human health which caused high rate of malignant tumour mortality and congenital malformation in the areas replied on waste water for irrigation.

Waste water from industrial activities and municipals are the considered sources contributed to pollute the water environment in developing countries. Since in the developing countries the economy grows rapidly, there are a lot of small and medium scale enterprises running. However, the environmental protections do not have enough attention. Waste water discharged freely to culverts, canals and rivers. There are no recycling water factories or these factories are too few to treat the huge amount of waste water. It becomes the most challenging drinking and domestic using water pollutant in these countries. The polluted water is responsible for many digestive system diseases. Diarrhoea is very popular diseases caused the high rate of death for children under age 5. Polluted water is also responsible for cancer because of high toxic contain.

Poor sanitation around the living areas also shows the cause-and-effect relation between environment and human. Human faeces and waste water from kitchen, bathroom and laundries do not have the sanitary treatment which can cause a range of diseases. These contaminated water and faeces containing a range of disease-causing organisms may enter the body through contaminated food, water, eating and cooking utensils. They are also the good environment for disease vectors reproduce and develop as discharged freely to the ground. Malaria, hepatitis and diarrhoea represent public health problems in developing countries which cause the high mortality rate in children.

The three case studies show the close relationship between environment, agriculture, and human health that people will receive the bad effects to health as they treat the environment in the negative ways. That is also the reason of the survey in Khorezm to research the effects of environment, agriculture and poor living conditions to human health.

4. RELATIONSHIP BETWEEN HEALTH, SOCIO-ECONOMIC VARIABLES AND AGRICULTURE IN KHOREZM

4.1. Field research in Khorezm

The Aral Sea disasters obviously affect to the environment, agriculture, socio-economics of adjacent areas. How the combination between polluted environment, agriculture and socio-economics affect to health of local people is one target of the Socio-economic Household Survey in Khorezm year 2003.

The “two-stage sampling” was applied to choose households for the survey. There are two stages in the random selection process, first selecting smaller geographical areas within the survey region, called mahallas, and stratify separately for urban and rural areas, second choose households within selected mahallas.

The mahallas are the administrative units below the rayon level where the books for all households within their borders are kept. So it was very convenient to go to the administration of the selected mahallas and ask for the number of households living in the mahallas and for the household books with the addresses. Another advantage as choosing mahalla is that mahalla was usually called "cluster" in the literature on survey strategies. Therefore mahalla was considered as the suitable unit.

In the first stage, the random selection of mahallas separately for the urban and rural parts of the rayons (all of Urgench rayon, however, is rural by definition whereas all of Urgench city is considered as urban. Khiva and Kushkupir have both rural and urban mahallas) was conducted to make sure that rural and urban households are both adequately represented in the sample.

Then the mahallas (clusters) themselves were selected after rural-urban stratification. All selected mahallas were named by number and putted in separate “shelves”, for example urban Khiva, rural Khiva, then randomly drawing a pre-defined number of them. There is no fixed rule for the number of clusters to be selected. For sure, the number of clusters should not be too small - this would limit the representative - but also not so big that travelling costs increase very much.

In the second stage, after knowing the total number of households living in the selected mahallas, the households were randomly chosen as the same system selecting clusters was describes above. The number of chosen households depended on the number of households living in the mahalla in relation to the number of households in the total survey area. For example, if 751 households were living in a mahalla and 6 households should be selected randomly. The households are usually numbered in these books (from 1 to 751 as in the example). So the addresses of the households with the numbers would be written down.

The survey was conducted through interviewing 189 households (HHs) in the first round and 182 households in the second round. (3 households refused response, and 4 members of other households were absent during the second round conducted.) However, the spatial locations of the houses in the survey were not recorded correctly during the survey. The household locations were checked and recorded again through the cooperating research, "Salinity of drinking water sources and related cardiovascular health risks", conducted by doctoral student Ms. Susanne Herbst at Centre for Development Research (ZEF) – Bonn. There are 177 households response and recorded the locations in the cooperating survey.

Table 4.1: The Socio-economic household survey in Khorezm, year 2003

Area	HHs response in 1st round	HHs response in 2nd round	HHs response in cooperating survey
Urgench city	50	50	44
Urgench rayon	43	38	40
Khiva rayon	52	51	51
Kushkupir rayon	44	43	42
Total	189	182	177

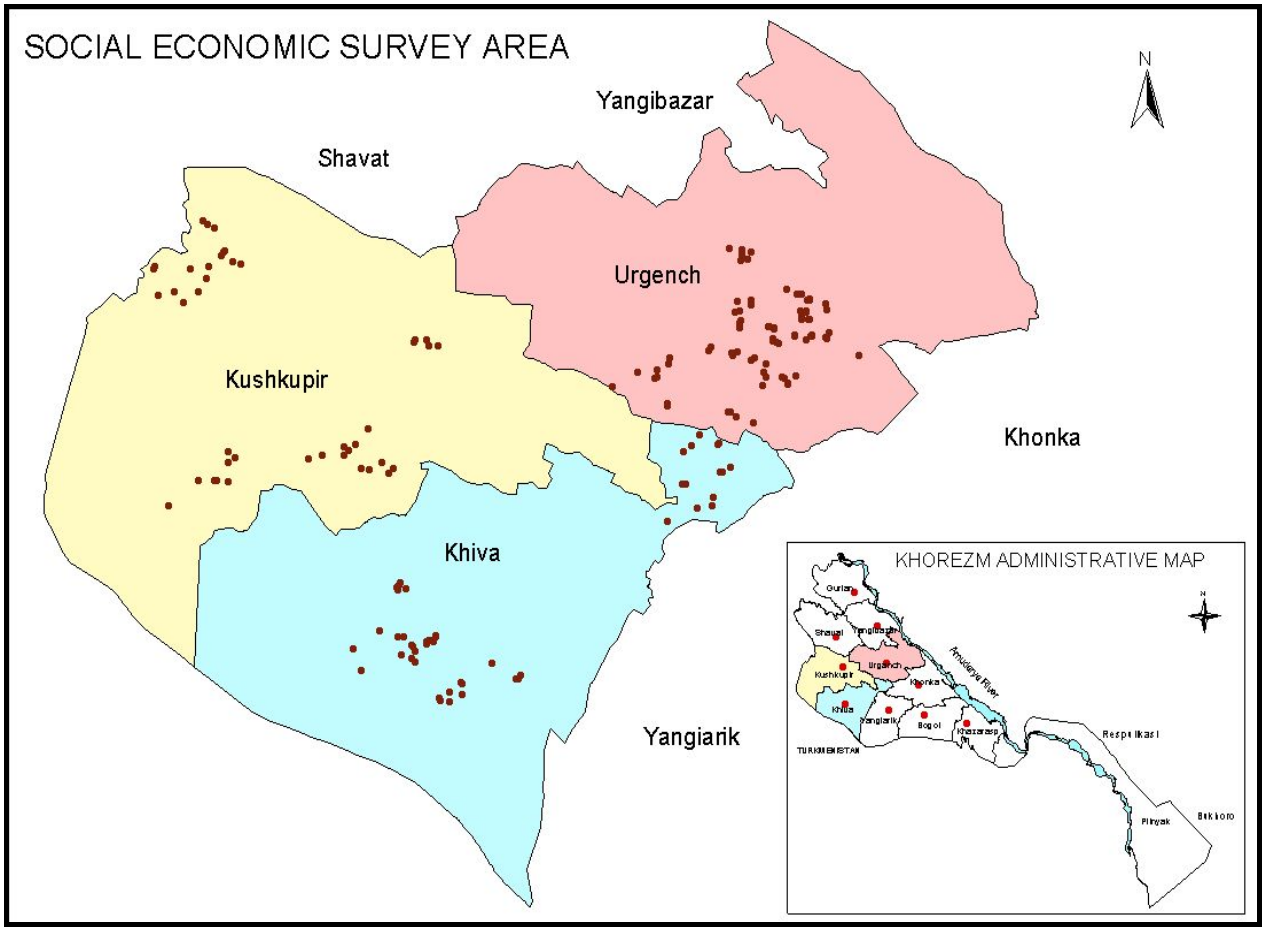

Figure 4.1: Map of Locations of households in the survey.

Household identification is set up by the combination of group numbers, rayon code (from 1 to 4 indicating respectively Urgench city, Urgench rayon, Khiva rayon and Kushkupir rayon), mahalla code, and household code.

HH_ID = Ryon Code + Mahalla Code + Household Code

as example 10511 = 1 05 11

Sub-survey of the Socio-Economic and Health Survey year 2003 is focused on diseases to study the relationship between environmental pollution, agriculture, socio-economic conditions with human health in Khorezm. There are 206 ill people (17.59 percent of 1,123 people belong to 177 households were interviewed in the survey. Diseases are grouped together in five groups, respiratory tract diseases, digestive system diseases, high-mineral affected diseases, flu / catch a cold and the other diseases showed in tables 4.2.

Table 4.2: Diseases in Socio-economics and Health Survey Year 2003 – Khorezm.

Respiratory tract diseases	Digestive system diseases	High mineral affected diseases	Flu / Catch a Cold	Other diseases
Asthma	Blind gut	High blood pressure / Hypertention	Catch a Chill / Cold	Allergy
Bronchial asthma	Cholecystitis	Gallstone	Flu	Anaemia
Bronchitis	Chronic gastritis	Kidney disease	Radiculitis	Antritis
Heavy breathing	Colitis			Bilateral nephritis
	Diarrhea			Blood circular system disease
	Hepatitis			Brain
	Liver disease			Cerebral Palsy
	Stomach Ulcer			Chromical spleen disease
	Stomachage			Congenital disease
				Cystitis
				Ears disease
				Endocrin system
				Eyes disease
				Fits, Cramp
				Goiter
				Guickened raptatia
				Heart circulatory system
				Heart disease
				Heart stitch (nerve)
				Hemorrhage
				Hernia
				Injury (broken bone) / Insult
				karamiq
				Legs' pain
				Loins pain
				Meningitis
				Meoma/ Myoma??
				Migraine
				Mis-shapen feet
				Nephritis
				Nerve
				Nose-bleeding
				Pemphigus
				Poliomyelitis
				Polypus / Polypi
				Postraumatic consequences
				Prostatitis
				Psoriasis
				Rachitis
				Rheumatism

				Rickets
				Skin disease
				Small of the back
				Stenocardiac
				Swelling in the nose (hard breethe when sleeping/gasp)
				Swelling tumour (unknown reason)
				Tachycardia
				Tonsilitis / Quinsy
				Tumour appeared on the heel /Salt amssed)
				Uterus disease
				Valgus
				Varicose veins
				Weak immunity

Respiratory tract diseases

Although there are few cases of respiratory diseases recorded in the survey, but they are distributed mostly in Urgench city and centre of Khiva rayon, where there is high density of smoke and dust caused by transportation than in Kushkupir rayon. This evidence strengthens the hypothesis that polluted environment in Khorezm which has high particulate threaten to health of local people.

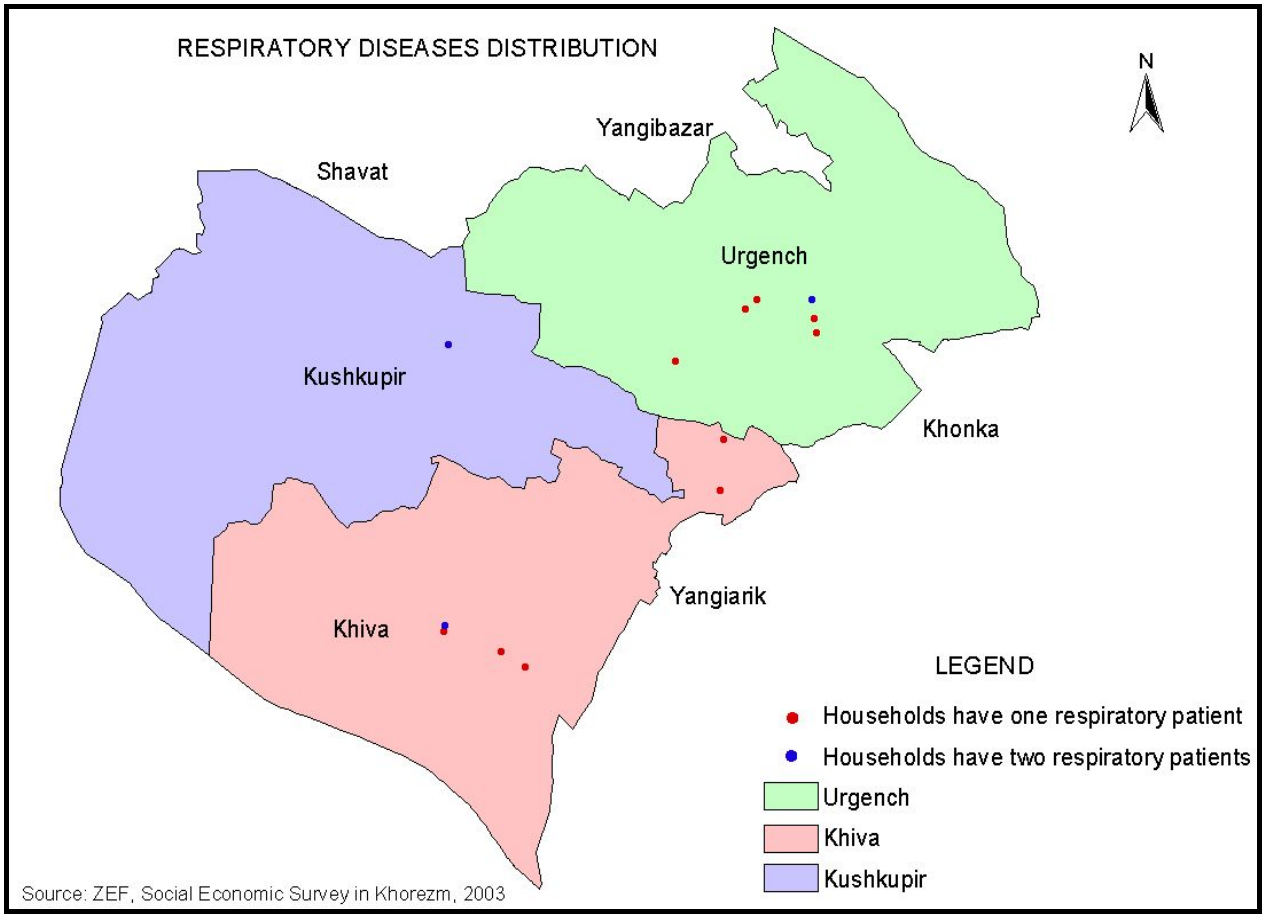

Figure 4.2: Map of Respiratory diseases distribution

There are 16 cases of asthma in the last Socio-environment and Health Survey scattered in three rayons, three households have two members having chronic respiratory diseases. Most cases of respiratory diseases reported were asthma.

Asthma

Asthma is an inflammatory disorder of the airways, characterized by periodic attacks of wheezing, shortness of breath, chest tightness, and coughing. The alternative names are

Bronchial asthma; Exercise induced asthma - bronchial; Reactive airways disease (RAD). In sensitive individuals, asthma symptoms can be triggered by inhaled allergens (allergy triggers), such as pet fur, dust mites, cockroach allergens, moulds, or pollens. Asthma symptoms can also be triggered by respiratory infections, exercise, cold air, tobacco smoke and other pollutants, stress, food, or drug allergies. Aspirin and other non-steroidal anti-inflammatory medications (NSAIDS) provoke asthma in some patients. [VeriMed Healthcare Network, 2002]

Digestive system diseases

Diarrhoea, colitis, gastritis and hepatitis-A have high frequency in group of digestive system diseases in the survey. There are 126 cases of digestive system diseases reported in three rayons. Diseases distribute regularly in all groups of households conducted the interview and also not much different in percentage of people in households interviewed among three rayons where the irrigation and drainage systems are very dense. Kushkupir has 12.18 percent, Khiva has 9.88 percent, and Urgench is 11.22 percent.

Obviously through the figure 4.1, Kushkupir has the denser drainage canal system than Urgench and Khiva rayon. It also is the remote rayon where the infrastructure is less developed. These conditions are logical with higher percentage of digestive system diseases in Kushkupir than the other two rayons and consolidate the hypothesis that polluted water and poor living condition affect on health of people in Khorezm via digestive system.

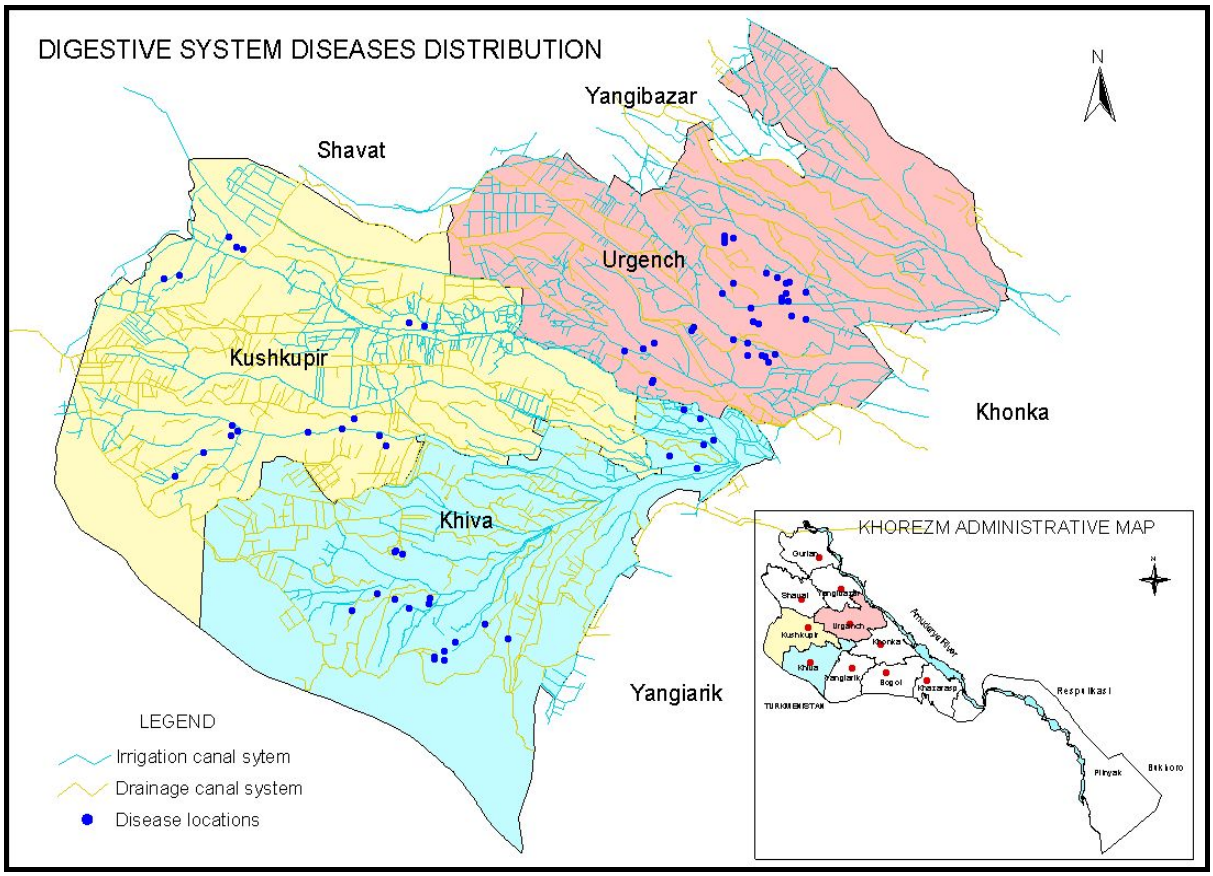

Figure 4.3: Map of Digestive system diseases distribution

Colitis

Colitis (also called ulcerative colitis) is an acute or chronic inflammation of the membrane lining the colon - large intestine or bowel. The inflammation makes the colon empty frequently, causing diarrhoea. Ulcers form in places where the inflammation has killed colon lining cells. The ulcers bleed and produce pus and mucus. Patients may have abdominal pain, diarrhoea, rectal bleeding, painful spasms (tenesmus), lack of appetite, fever, and fatigue.

Infectious colitis: A variety of “bugs” may cause colitis. They have developed a variety of ways to overcome our natural defences and ultimately cause colitis. Included bacteria which commonly found in food or contaminated water; viruses; protozoa. [The American Academy of Emergency Medicine, 2003]

Gastritis

Gastritis, an inflammation or irritation of the lining of the stomach, is not a single disease. Rather, it is a condition that has many causes. Gastritis is associated with a variety of

medications, medical and surgical conditions, physical stresses, social habits, chemicals, and infections through the contaminated environment. Bacterial infections: *H pylori* infection is the most common. Many other bacteria—even those that usually cause pneumonia or bladder infections—can cause gastritis. Gastritis is a common medical problem. [The American Academy of Emergency Medicine, 2003]

Diarrhoea

Diarrhoea was estimated to be the number one killer of children under five at the beginning of the decade and now continues to be a major cause of death among the world's children. Diarrhoea is caused by ingesting certain bacteria, viruses or parasites which may be spread through water, food, utensils, hands and flies.

Most diarrhoea-related deaths in children are due to dehydration - the loss of large quantities of water and electrolytes (sodium, potassium and bicarbonate) from the body in the liquid stool. Many of these deaths can be prevented with the use of oral rehydration therapy (ORT) - the oral administration of sodium, a carbohydrate and water. In addition to ORT, efforts to control diarrhoea over the past decade have been based on multiple interventions which include the promotion of breastfeeding adequate complementary feeding, measles immunization, safe water supply and safe faeces disposal. The improvement in socio-economic status and female education may also contribute to the control of diarrhoea. [WHO, UNICEF.]

Hepatitis-A

Hepatitis-A does not cause chronic (ongoing, long-term) disease. Although the liver does become inflamed and swollen, it heals completely in most people without any long-term damage. The risk of infection is greatest in areas with poor sanitation or poor personal hygiene standards.

- The virus can transmit through drinking or swallowing the contaminated food or water.
- The virus can also be spread by eating raw or undercooked shellfish collected from water that has been contaminated by sewage. [The American Academy of Emergency Medicine, 2003]

High mineral affected diseases.

There are 24 cases of high-mineral affected diseases in the survey, mainly are high blood pressure, gallstone, and diseases of kidney. Urgench and Khiva have almost same percentage of disease, 2.4 percent, and 2.6 percent respectively. Kushkupir has the lowest percentage, 1.075 percent.

Observing the map of high-mineral-affected diseases distribution, there is not clear spatial relationship between environment and disease distribution. However, the hypothesis that high salinity in water of the region can threaten health of local people will be researched by spatial analysis in the next chapter.

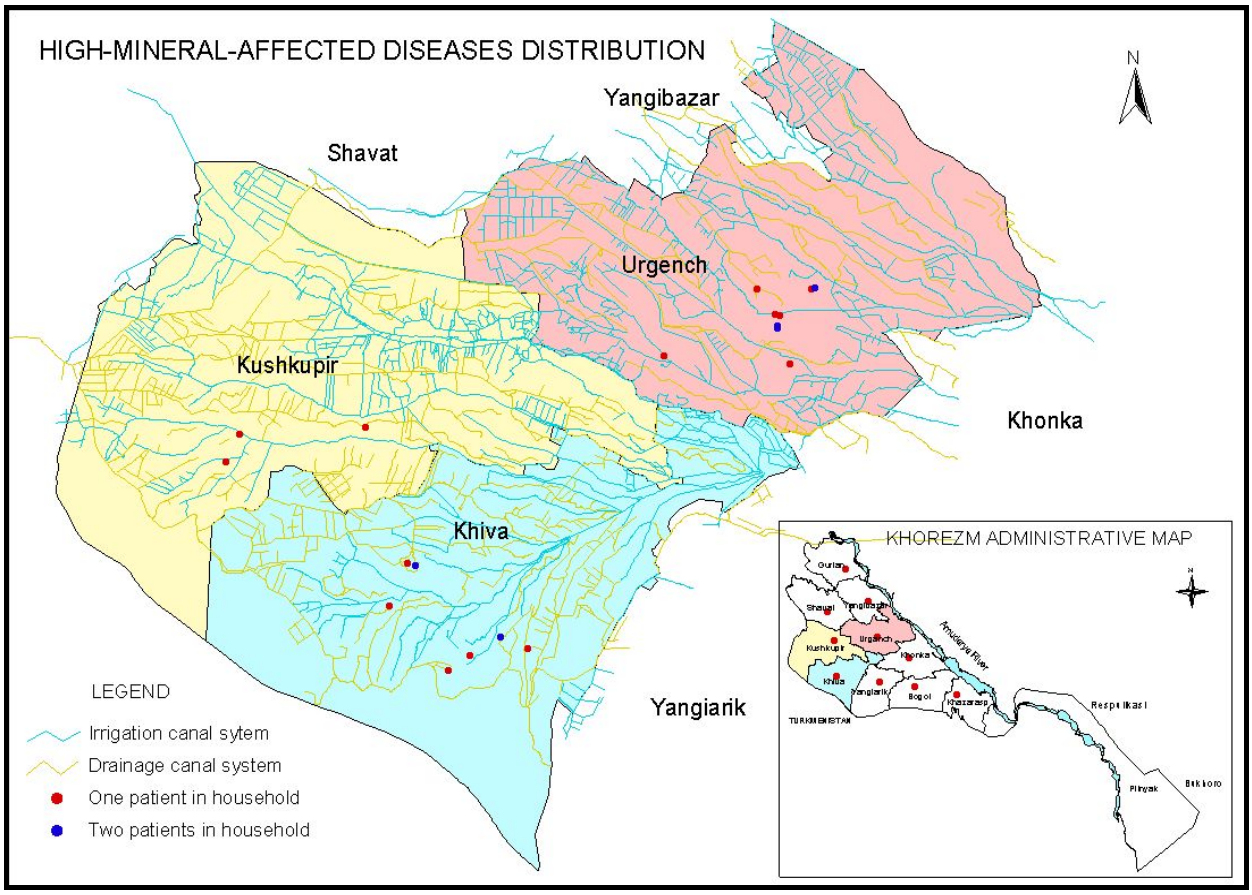

Figure 4.4: Map of High mineral affected diseases distribution

High Blood Pressure

Uncontrolled high blood pressure is indirectly responsible for many deaths and disability resulting from heart attack, heart disease, stroke, vision loss, and kidney failure.

Although the specific cause is unknown, sodium (salt) sensitivity in one of certain factors is recognized as contributing to high blood pressure. Some people have high sensitivity to sodium (salt) and their blood pressure goes up if they use salt. Reducing sodium intake tends to lower their blood pressure. [The America Academy of Emergency Medicine]

Gallstone

Gallstones are lumps of rock-like material that form inside the gallbladder. Scientists are just beginning to learn what causes gallstones to form. Gallstones may be as small as tiny specks or as large as the gallbladder itself. The vast majority, however, are smaller than 2.54 cm (1 inch) and may be one of two major types:

- Cholesterol gallstones, account for approximately 80 percent of gallstone cases.
- Pigment stones, composed mainly of calcium salts of bile pigments and other compounds, account for about 20 percent.

Gallstone type is important since cholesterol stones are more likely to respond to nonsurgical treatment [University of Connecticut Health Center]

Chronic kidney failure

Chronic kidney failure is a gradual loss of kidney function over time. It is a common and serious medical problem. It can be caused by kidney diseases, but it usually results from a disease elsewhere in the body that injures the kidneys or prevents them from working. This is dangerous because water, waste and toxic substances build up that normally are removed from the body by the kidneys. [The American Academy of Emergency Medicine, 2003]

<u>Flu / Catch a cold</u>

Flu and catch a cold are the most popular diseases in Khorezm especially in winter time. There are 315 people got sick in 1,123 population in the survey (28.05 percent), in some families all members were infected. Flu and catch a cold are also the infection of the airway tract, however, due to the high frequency of these diseases in the area they are researched separately.

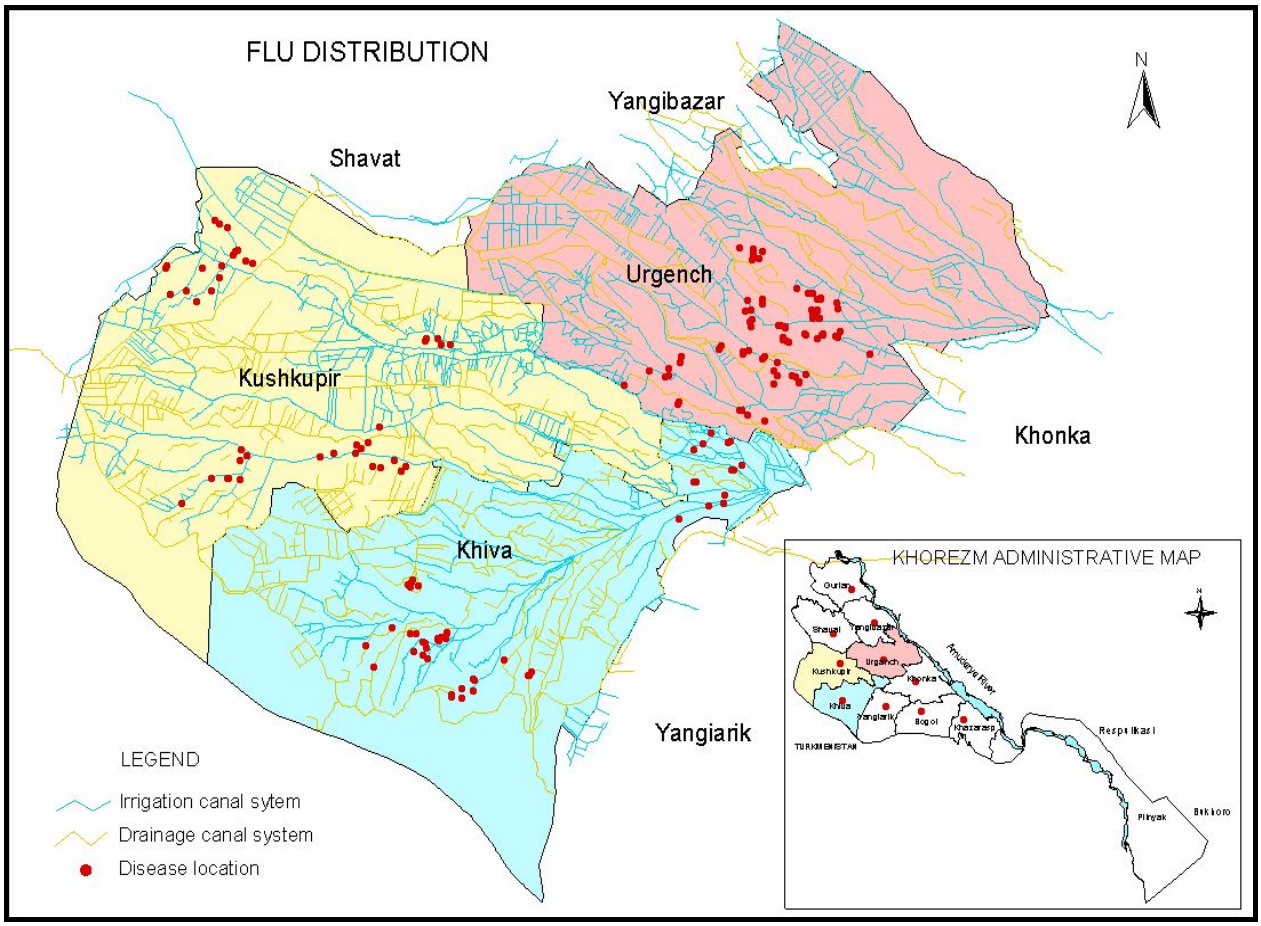

Figure 4.5: Map of Flu distribution

Many people commonly and incorrectly confuse influenza (the flu) with the common cold. Flu differs from the cold in that someone with the flu gets sick suddenly, looks much sicker, and feels much weaker than if the ailment were a common cold. Influenza is a highly contagious disease.

The common cold is a mild infection frequently caused by viruses other than the influenza virus. Flu is an acute infection of the airway tract in the nose and throat that can sometimes spread down into the lungs. It is the most frequent cause of acute respiratory illness and can affect people of all ages. It occurs every year mainly in late fall and early winter and in a widespread fashion affecting many people of different ages at the same time. The peak season for the flu is from November through March. [The American Academy of Emergency Medicine, 2003]

4.2. Living conditions

Poor living conditions affect directly to health, people could not get enough sanitary domestic water, lack of heat in winter time or the sewage and toilet system has poor sanitary condition.

Water supply

There are 7 different sources of water using in Khorezm, (1) tapped water, (2) hand pumped water, (3) water from the swallow wells, (4) arik (water from irrigate canal), (5) rain water or melted snow, (6) water carried from trucks and (7) bottled water. Although tapped water is the highest percentage, 37 percent for domestic use and 38.6 percent for drinking, but people in rural areas could not reach the water centre supply, and tapped water is not available in some households in rural areas. They look for water from different sources to support for daily use. Tapped water and bottled water are considered sanitary water sources, however, they are not the main supply due to the rareness. Figure 4.1 displays the water sources for daily uses of 177 households in the survey.

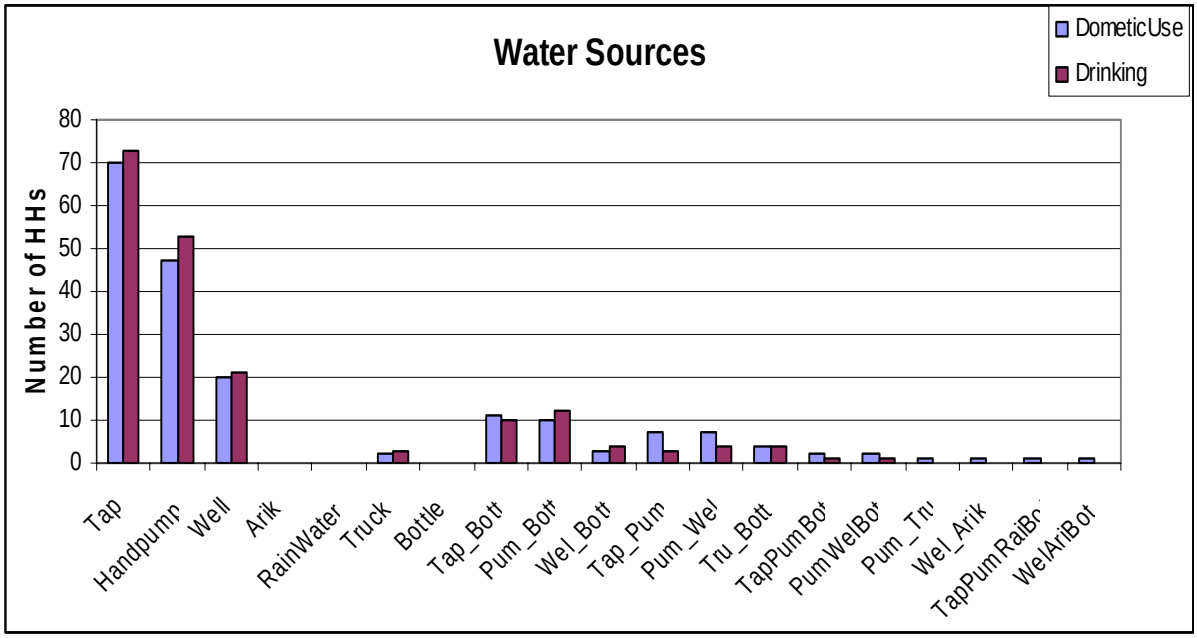

Figure 4.6 : Water sources

It is nearly a half of households in the survey that can not access tapped water (49.7 percent), however, tapped water is not available whole day long in all 53.4 percent of households which had tapped water supply. Only 38.6 percent of households have tapped water availably more than 10 hours per day. Figure 4.2 illustrates the availability of tapped water in the survey.

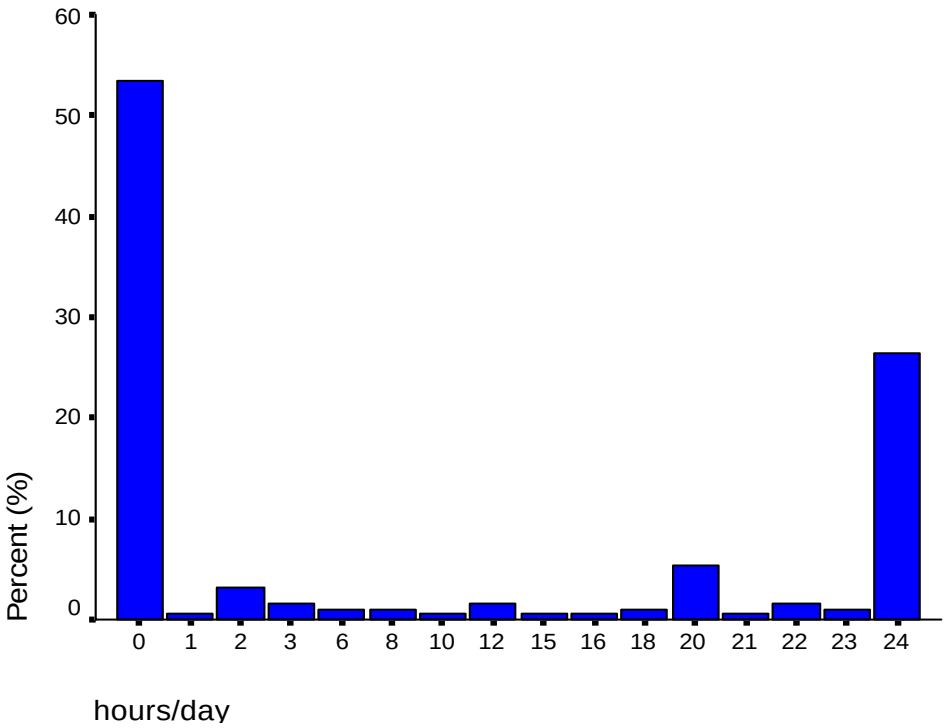

Figure 4.7: The availability of tapped water

Hot water supply meets the small demand of households in the survey (11.64 percent). Mostly people use gas to boil or warm water for using in the houses (60.32 percent).

Spatial identification of households using different water sources is considered as an important aspect in analysing the effect of water use on health. The data of which water sources are used for drinking, cooking and other domestic uses in the households, the origin or locations of these water sources will be useful to search for the linkage between diseases and water pollution. Figure 4.3 displays the household positions which are classified due to the different sources of water for domestic using daily. Households are divided in 8 categories based on the sources of using water: (1) Tapped water, (2) Tapped water, hand-pumped water, bottled water, and rained water, (3) Hand-pumped water, (4) Hand-pumped water, bottled water, water from well, water from truck, (5) Only water from well, (6) Water from well, arik and bottled water, (7) Water from truck only and (8) Water from truck and bottled water.

Most of households in Kuskupir, especially in remote area, use water from hand-pumped water, water from well, truck or bottled water and therefore there is low percentage of households access tapped water. In Urgench there are more households having water supply,

and the tapped water is available so it has the highest percentage of household using tapped water.

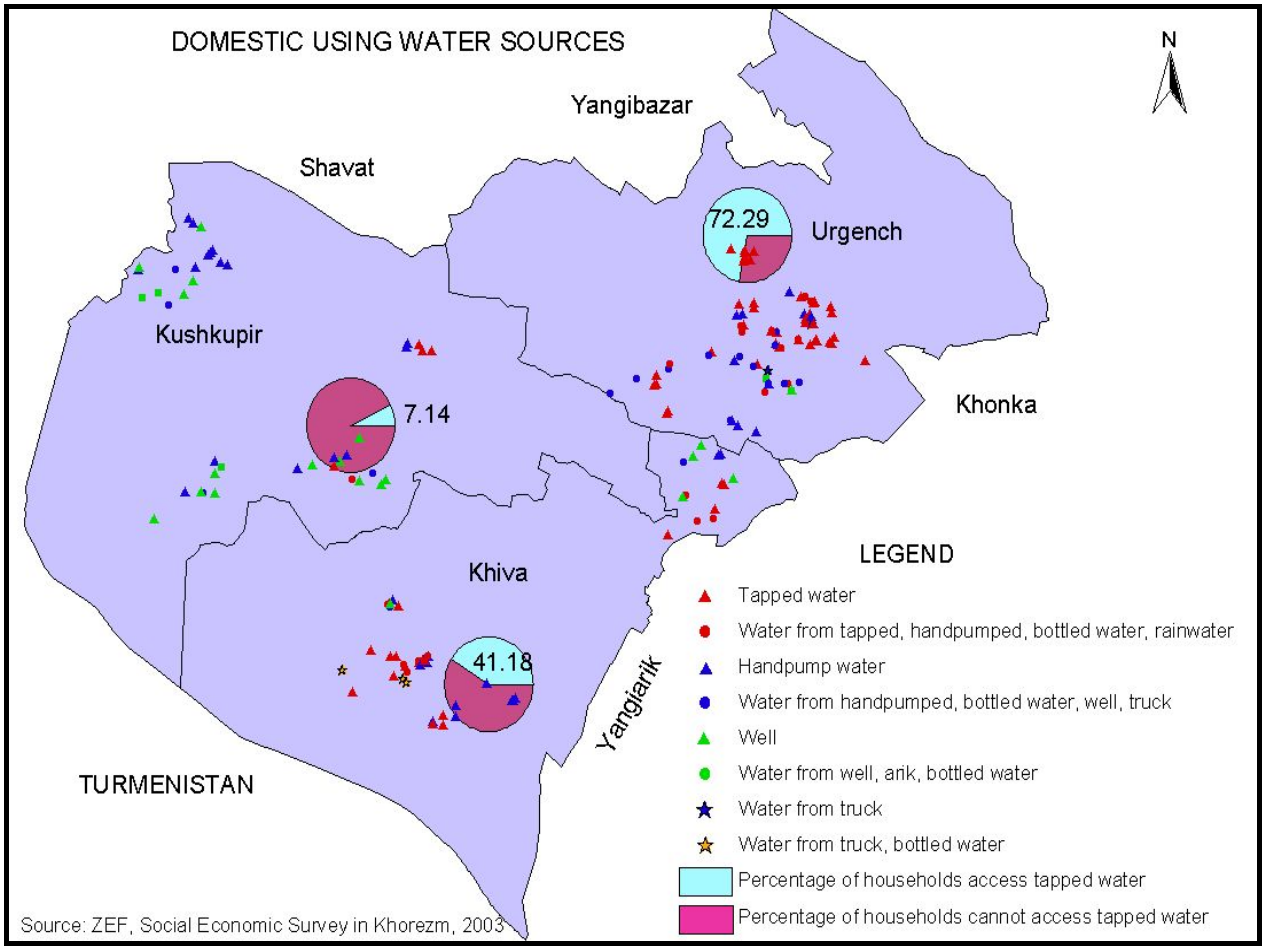

Figure 4.8: Map of Domestic using water sources

Gas supply

The sufficiency of natural gas in Uzbekistan makes it become the main energy source, 96.8 percent of dwellings in the survey used piped gas for heating, and cooking. Due to the pipeline system did not upgrade after long time using, there are 10.1 percent of dwellings can not have gas supply and use wood instead. Percentage of dwellings has gas availability 12 hours per day and upwards is 84.1 percent.

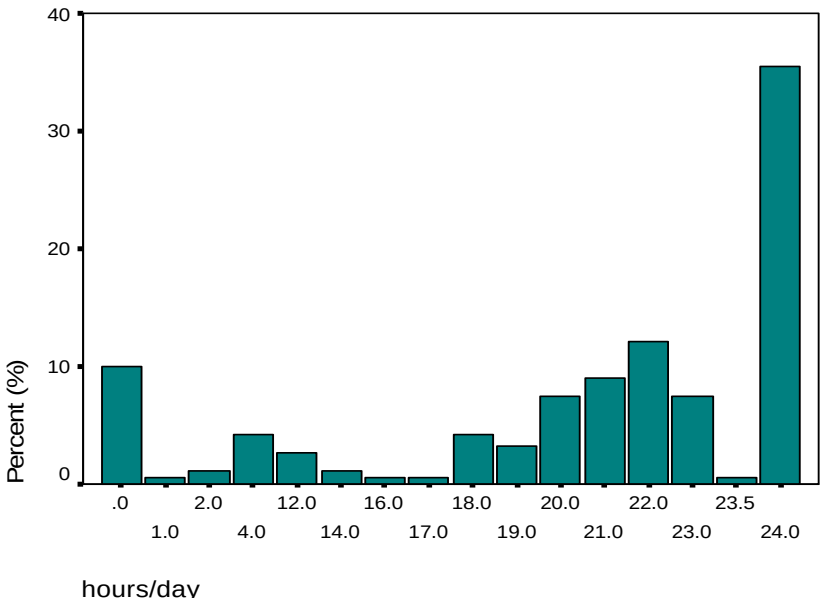

Figure 4.9: The availability of piped gas

Since the gas supply is not stable and not available for the whole day, it is not warm enough in dwellings considered have gas availability. Heated dwelling and warm dwelling are two sub-groups classified in order to identify the relation between poor living conditions with health. The figure 4.5 displays the relation between heated dwellings and warm dwellings in the survey. There are fewer dwellings were not heated but the number of dwellings were not warm is higher, 3.2 percent of dwellings no heated at all, however, the percentage of dwellings not be warm is 16.9 percent. The correlation r = 0.65 indicated the positive linear association between heated dwellings and warm dwellings, the more days heated the warmer that dwellings have

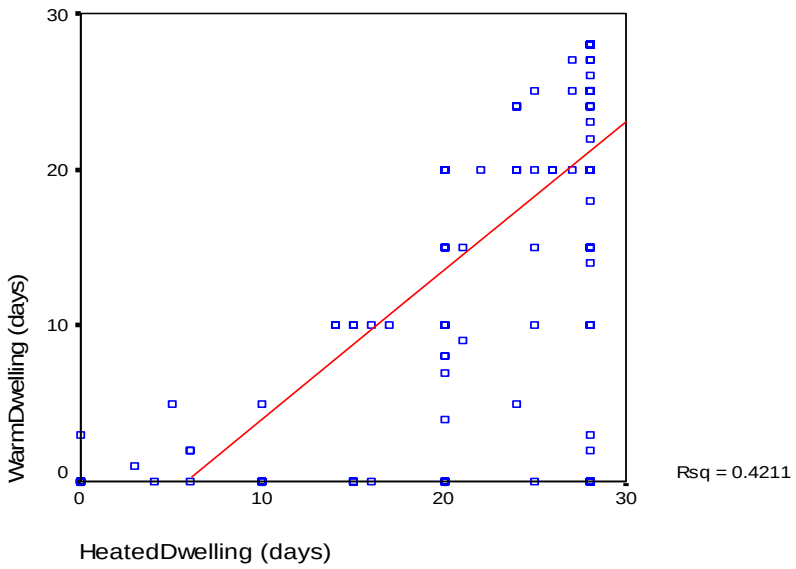

Figure 4.10: The relation between heated dwellings and warm dwellings

Electricity, public transportation, and telephone service

Electric power is supported to every dwelling in both urban and rural areas. All dwellings have electricity for living although the support is not available for the whole day. In some households (0.5 percent of the total survey households) have electricity available only four hours per day. However, the un-stable situation of the electricity supply affects badly on the bus system, which is the sole public transportation in Khorezm and run by electric power. Sometimes there is no power, the bus has to stop suddenly on the street.

Averagely local people take 12 minutes to walk to the bus stop stations. In particular case, it takes 2 hours walking to the bus stop station. Due to long time waiting and the un-stable electricity of bus, taxi is the popular transportation in Khorezm, cheap and flexible.

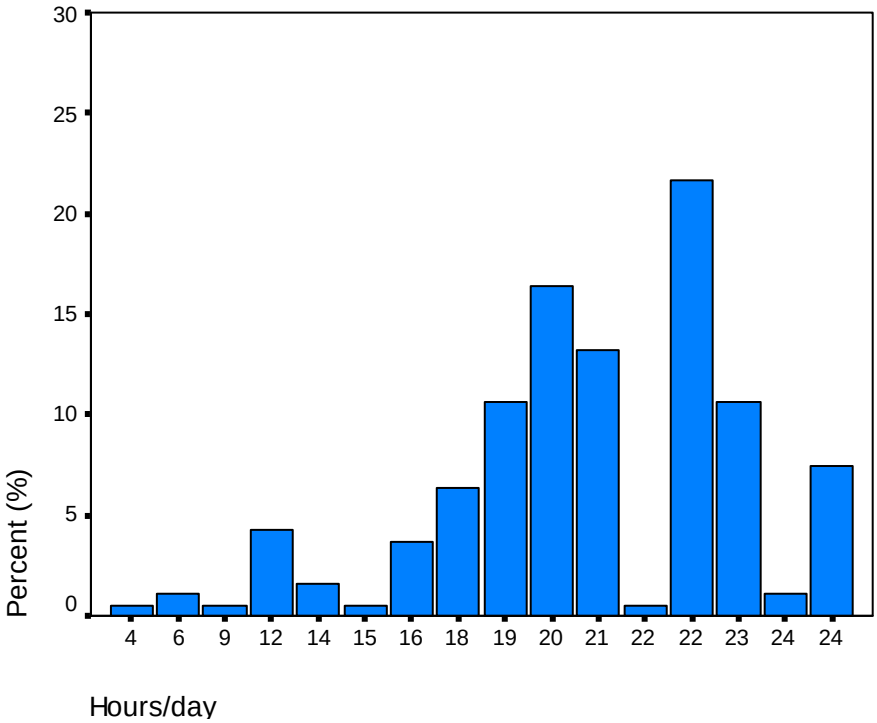

Figure 4.11: Electricity availability per day.

There are 46.6 percent of households in the survey have telephones at home. Internet service is not popular in Khorezm, there is only station located at the post office centre. The access fee is still very high (USD 3.00 per hour) comparing to the daily income of local people.

Toilet and bathroom

"Poor ecology", "garbage on the streets", "garbage around the buildings", "latrine in the garden" are repeated responses of interviewees about the environment around their houses in the field survey to estimate relationship between health and environment factors in Khorezm year 2003.

Among 177 households interviewed in the survey, there are 3 households (1.69 percent) use the public toilets (toilet on the street), 2 households (1.13 percent) have both flush toilets and latrines, 21 households (11.86 percent) have flush toilets and the majority of households (85.31 percent) have latrines.

There are only 58 (32.77 percent) dwellings interviewed in the survey have bathrooms for their owns use. The rest ones either use the wooden floor in the kitchen to take shower or go to the public bathroom.

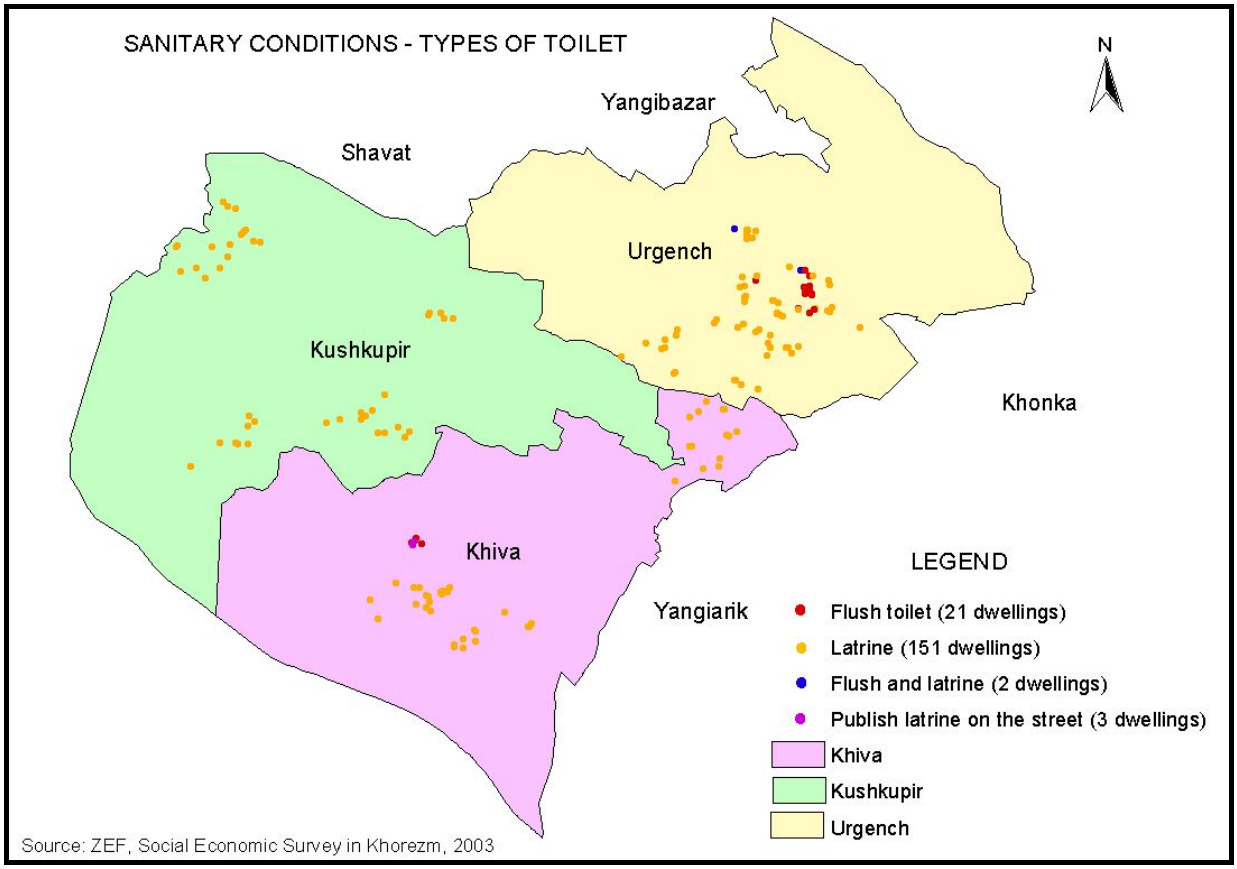

Figure 4.12 Type of toilet location map in the survey area

4.3. Agriculture

Chemical fertilizer

Fertilizer application in Urgench, Kushkupir and Khiva has a downward tendency during five years from 1997 to 2000, as illustrated in the figure 4.8.

Cultivated plants normally take up nitrogen in the form of nitrate. The advantage of nitrate is its immediate availability, the disadvantage is its high vertical mobility. The amount of N-fertilizers applied in three rayons Kushkupir (N_KU), Urgench (N_UR), Khiva (N_KH), from year 1997 to year 2001 were quite differential. Kushkupir consumed most which the average was around 16,700 tonnes per year and Khiva consumed least around 12,000 tonnes per year. It was about 31 percent of the total amount of nitrogen fertilizers consumed in Khorezm.

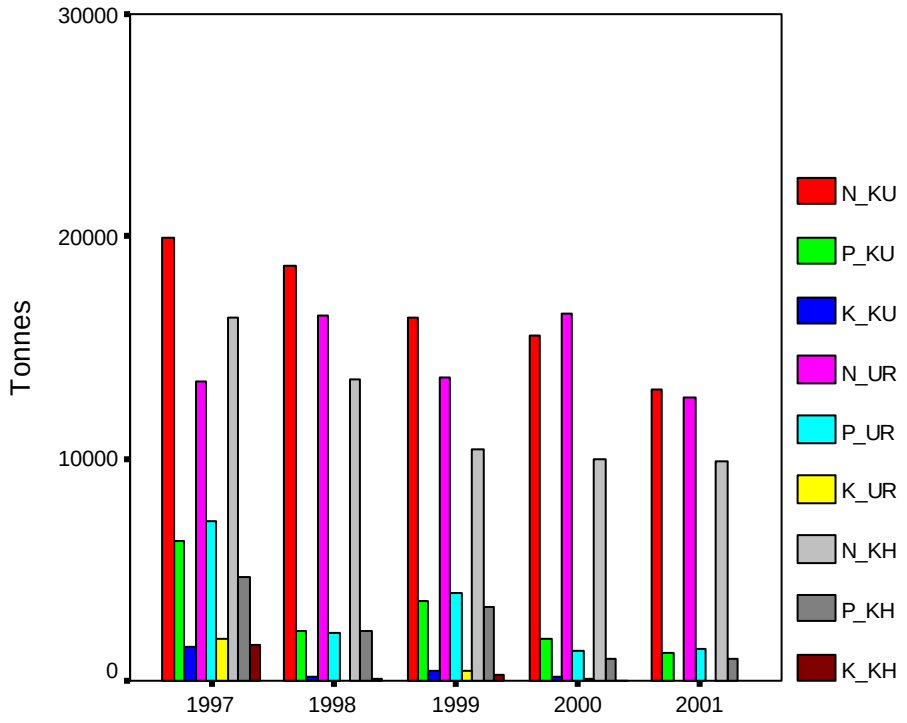

Figure 4.13: Fertilizers applied in three survey rayons

Phosphorus (P) is the second most important plant nutrient. Moreover, the efficiency of phosphoric fertilizers in soils is 20-30 percent provided the phosphoric fertilizer used is granular, has high P content and water solubility is above 80 percent. The P availability to plant may still be lower if these conditions are not met. The use of phosphoric fertilizer has

been low and there is not much differential in three rayons, Urgench applied phosphorus fertilizer more than Kushkupir and Khiva, specially in two years 2000 and 2001 Khiva used only around 950 tonnes per year.

Potassium (K) is required by all plant and animal life. Plants require potassium for photosynthesis, osmotic regulation and the activation of enzyme systems. Potassium chloride (KCl), also called muriate of potash, is the most commonly used potassium fertilizer. It is a relatively inexpensive nutrient and deficiencies can often be corrected with moderated rates of application. A major concern of cotton producers is the appropriate application of potassium fertilizer to ensure the crop is both high yielding and of high quality.

Since the official data using potassium fertilizers are not available for all three rayons and the whole time of comparison, especially in year 2001, thus it is difficult for statistics the application. The requirement of potassium in three survey rayons is lower than nitrogen (N) and phosphorus (P) as in year 2000 Khiva applied only 42 tonnes of potassium.

Irrigation and drainage, salinity

Chloride in surface and groundwater from both natural and anthropogenic sources, such as run-off containing road de-icing salts, the use of inorganic fertilizers, landfill leakage, animal feeds, industrial effluents, irrigation drainage and seawater intrusion in coastal areas. Potassium chloride is used in the production of fertilizers.

The amount of dry matter (DM) and chloride anion (CL) in irrigated and drained water were measured continuously from year 1991 to 2000 in Khorezm to investigate the salinity in ground water. Dry matter and chloride anion in irrigated water are quite stable and same amount of value in all three rayons, Kuskkupir, Urgench and Khiva, which the amount of chloride anion is not higher than 0.25 g/l and dry matter is not higher than 1.05 g/l. Measurements in Kushkupir is a little higher than in Urgench and Khiva due to Kushkupir locates at the end of the irrigation systems.

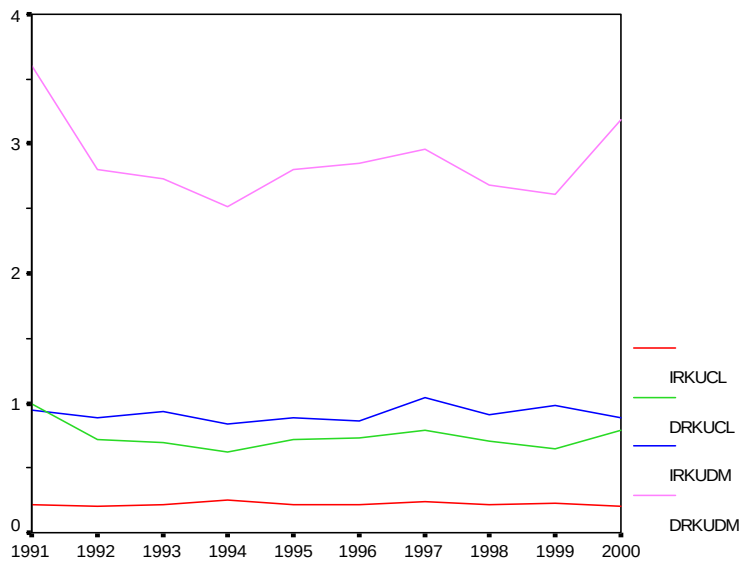

Figure 4.14: Dry matter and chloride anion measurement in Kushkupir

The salinity in water increased so high after irrigation. Dry matter and chloride anion levels in drained water is more than three times higher than in irrigated water, particularly in Khiva is four times higher. However, the amount of dry matter and chloride anion reduced sharply in year 2000 caused by the reducing of fertilizer application.

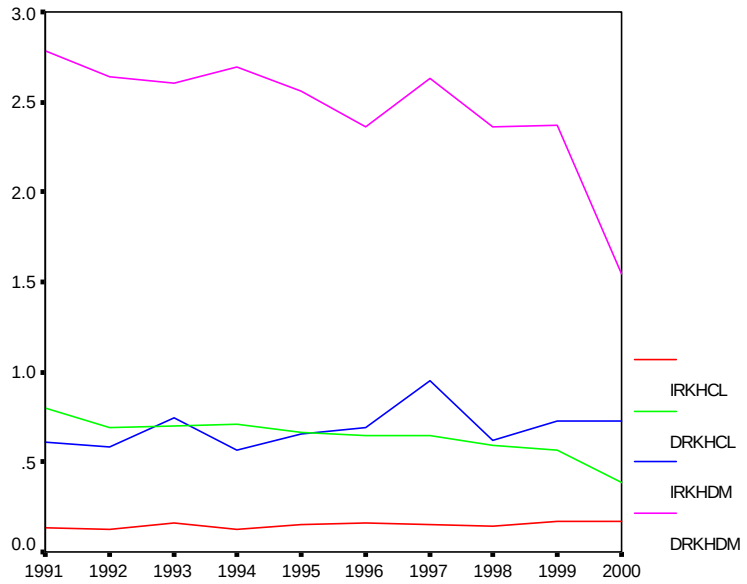

Figure 4.15: Dry matter and chloride anion in Khiva

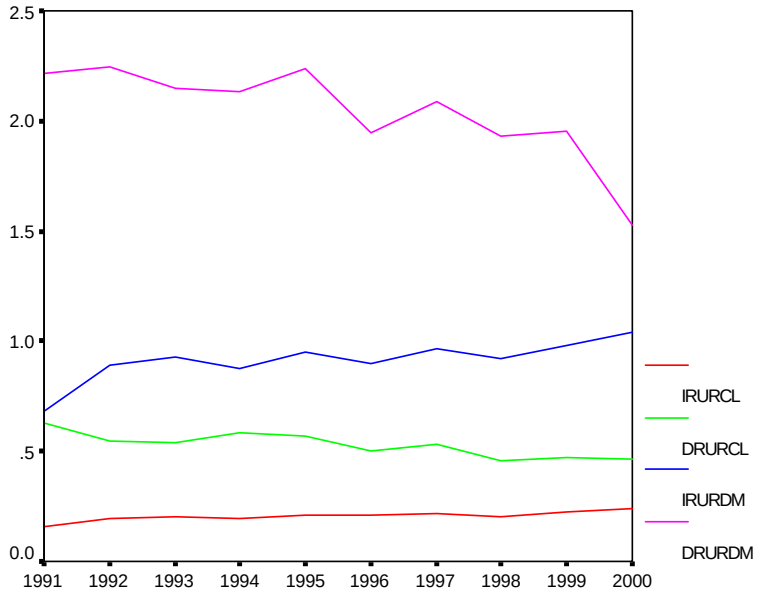

Figure 4.16: Dry matter and chloride anion measurement in Urgench

<u>The threshold of saline water on health</u>

The taste threshold of the chloride anion in water is dependent on the associated cation. Taste thresholds for sodium chloride and calcium chloride in water are in the range 200–300 mg/litre. A normal adult human body contains approximately 81.7 g chloride. On the basis of a total obligatory loss of chloride of approximately 530 mg/day, a dietary intake for adults of 9 mg of chloride per kg of body weight has been recommended (equivalent to slightly more than 1 g of table salt per person per day). For children up to 18 years of age, a daily dietary intake of 45 mg of chloride should be sufficient. A dose of 1 g of sodium chloride per kg of body weight was reported to have been lethal in a 9-week-old child.

Chloride toxicity has not been observed in humans except in the special case of impaired sodium chloride metabolism, e.g. in congestive heart failure. Healthy individuals can tolerate the intake of large quantities of chloride provided that there is a concomitant intake of fresh water. Little is known about the effect of prolonged intake of large amounts of chloride in the diet. As in experimental animals, hypertension associated with sodium chloride intake appears to be related to the sodium rather than the chloride anion.

Chloride concentrations in excess of about 250 mg/litre can give rise to detectable taste in water, but the threshold depends upon the associated cations. Consumers can, however,

become accustomed to concentrations in excess of 250 mg/litre. [***Guidelines for drinking-water quality,*** WHO, 1996. pp. 201-206].

The high salinity in water source in Khorezm attracts the attention of many scientists researching the effects on the environment and on health of local people. The theory is drinking water can be the transmittal of diseases from pollution of environment to human.

In the three survey rayons, there are different water sources for domestic use, however, water sources for drinking are only from tapped water, hand-pumped water, water from well, truck or bottle. Spatial classification the households through the drinking water sources is useful to identify the unsanitary drinking water sources, and bound the region which has the polluted water. Kinds of drinking water sources used for households were collected during the interview, there are 12 groups of households in the survey area: (1) Tapped water, (2) Tapped water and hand-pumped water, (3) Tapped water, hand-pumped water, and bottled water, (4) Tapped water, bottled water, (5) Hand-pumped water, (6) Hand-pumped water and water from well, (7) Hand-pumped water, bottled water and water from well, (8) Hand-pumped water and bottled water, (9) Water from well, (10) Bottled water and water from well, (11) Water is carried from truck and (12) Bottled water and water from truck.

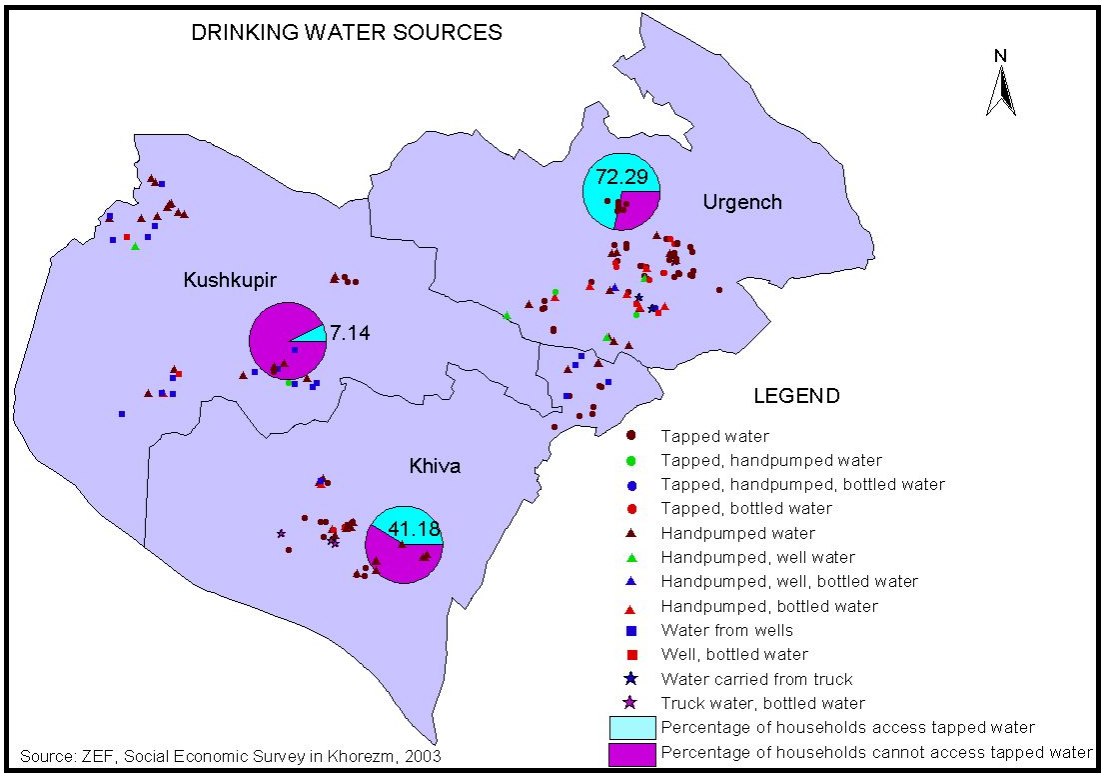

Figure 4.17: Drinking water sources in the survey area

5. METHODOLOGY AND EMPIRICAL ANALYSIS

5.1. Concept for analysis

Principle Component Analysis

Human health also is affected by poor living conditions. Primary data collection was focused on the factors can affect to the health of local people. There are 12 variables are considered:

- WATER : Domestic using water source
- TapWaterAvail : Tapped water availability
- DriWa_code : Drinking water sources
- HOTWATER : Hot water availability
- GASAVAIL : Availability of gas supply
- Heateddwelling : Heated dwellings in winter
- Warmdwelling : Warm dwellings in winter
- ElecAvail : Availability of electric supply
- ToiletTypes : Types of toilet
- BATHROOM : Having bathroom in the house
- Telephone : Having telephone line
- TimeBusStop : Time requiring to walk to the nearest bus stop station

For investigations involving a large number of observed variables, it is often useful to simplify the analysis by considering a smaller number of linear combinations of the original variables. Principle Component Analysis will be applied to reduce the complexity of multivariate data by transforming the data into principle components space then choose the first n principle components that explain the most of the variance in the original variables. Finding the correlation between new variables extracted via variance maximizing (varimax) rotation of the original variable space and the correlation between components.

GIS applications in environmental health research

The analysis of the links between environment and health will comprise the following essential steps:

- Generation of thematic layers for environmental risks and health outcomes.

- Visual observation of the spatial arrangement of these maps and their exploratory analysis.
- Spatial statistical analysis of these indicators.

The generation of thematic layers for environmental risks and health outcomes requires geo-referenced data which consist of points (household positions), lines (drainage canals), and marked areas (salinity contaminated areas in soil and ground water). Interpolation techniques and distance calculations will produce continuous data layers for the raster GIS. Health data collected for the basic administrative units is converted to grid layers of the same spatial resolution for comparison and analysis. The raster GIS approach enables to estimate the impacts of exogenous variables on health conditions in a spatially explicit way.

5.2. Principle component analysis

Which poor living conditions significantly affect to health of local people, twelve variables present for poor living conditions can affect to health of local people as

- WATER, TapWaterAvail, DriWat-Code, HotWater, ToiletTypes are category variables
- The variables GasAvali, HeatedDwelling, WarmDwelling, ElecAvail, TimeBusStop are quantitative
- BathRoom and TelePhone are binary (1= yes, 2 = no)

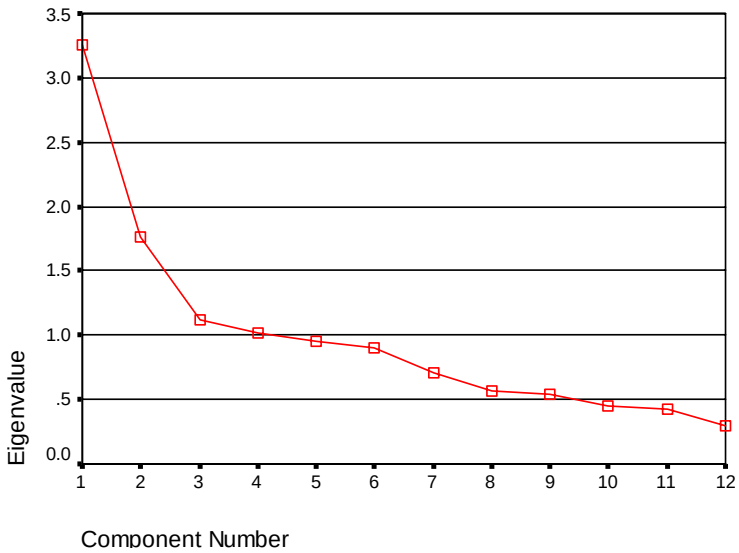

Figure 5.1: Screeplot for the living condition variables

The Kaiser criterion applied to retain the components, components with eigenvalues greater than 1 are saved to the working file. Apparently the first four components are chosen, together they explain 59.617 percent of the variance.

Table 5.1: Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.261	27.172	27.172	2.423	20.189	20.189
2	1.762	14.684	41.857	2.189	18.245	38.434
3	1.120	9.331	51.187	1.400	11.668	50.102
4	1.012	8.429	59.617	1.142	9.515	59.617
5	.958	7.979	67.596			
6	.898	7.481	75.077			
7	.710	5.914	80.991			
8	.570	4.747	85.739			
9	.543	4.523	90.262			
10	.448	3.730	93.991			
11	.426	3.547	97.539			
12	.295	2.461	100.000			

Extraction Method: Principal Component Analysis.

The *Total* column of the Initial Eigenvalues gives the eigenvalue, or amount of variance in the original variables accounted for by each component, which were illustrated on the SrceePlot above. The *% of Variance* column gives the ratio of the variance accounted for by each component to the total variance in all of the 12 variables. Then the percentage of variance accounted for by the first *n* components accumulate in the column *Cumulative %,* at the forth component there is 59.617 percent.

In the Rotation Sums of Squared Loadings, the variation is now spread more evenly over the components. The large changes in the individual totals suggest that the rotated component matrix will be easier to interpret than the unrotated matrix. The two last columns, *% of Variance and Cumulative %*, contain the similar meaning as other two in the Initial Eigenvalues table.

Table 5.2: Principal Component Loadings

	Component			
	1	2	3	4
WATER	.527	-.062	.115	.275
TapWaterAvail	-.670	.198	-.256	-.191
DriWa_Code	-.063	.059	.726	.258
HOTWATER	.399	-.294	.187	.316
GASAVALI	-.218	.721	.116	.027
HeatedDwelling	.081	.889	.029	-.029
WarmDwelling	-.204	.823	-.190	.009
ElecAvail	-.500	-.028	-.483	.121
ToiletTypes	.049	.040	-.035	.882
BATHROOM	.687	-.236	-.022	-.120
telephone	.798	.027	.015	-.043
TimeBusStop	.276	-.104	.688	-.231

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

The rotated factor model, given by the rows of the table, is

$$\text{WATER} = \mathbf{0.527}F_1 - 0.062F_2 + 0.115F_3 + 0.275F_4 + e_1$$

$$\text{TapWaterAvail} = \mathbf{-0.670}F_1 + 0.198F_2 - 0.256F_3 - 0.191F_4 + e_2$$

$$\text{DirWa\_Code} = -0.063F_1 + 0.059F_2 + \mathbf{0.726}F_3 + 0.258F_4 + e_3$$

$$\text{GASAVAIL} = -0.218F_1 + \mathbf{0.721}F_2 + 0.116F_3 + 0.027F_4 + e_4$$

$$\text{Heatedwelling} = 0.081F_1 + \mathbf{0.889}F_2 + 0.029F_3 - 0.029F_4 + e_5$$

$$\text{Warmdwelling} = -0.204F_1 + \mathbf{0.823}F_2 - 0.190F_3 + 0.091F_4 + e_6$$

$$\text{ToiletTypes} = 0.049F_1 + 0.040F_2 - 0.035F_3 + \mathbf{0.882}F_4 + e_7$$

$$\text{BATHROOM} = \mathbf{0.687}F_1 - 0.236F_2 - 0.022F_3 - 0.120F_4 + e_8$$

$$\text{Telephone} = \mathbf{0.798}F_1 + 0.027F_2 + 0.015F_3 - 0.043F_4 + e_9$$

$$\text{TimeBusStop} = 0.276F_1 - 0.104F_2 + \mathbf{0.688}F_3 - 0.231F_4 + e_{10}$$

The rotated component matrix can help to determine what the components represent. A large coefficient (in absolute value) corresponds to a high loading, while a coefficient near to zero has a low loading.

- The first component is most highly correlated with WATER, *TapWaterAvail*, *BATHROOM*, and *telephone*.
- The second component is most highly correlated with *GASAVAIL*, *HeatedDwelling*, and *WarmDwelling*.
- The third component is most highly correlated with *DriWa_Code*, and *TimeBusStop*.
- At the forth component *ToiletTypes* showed the highest correlation.

The *telephone* variable has the better representative, it is highest correlation with component 1, and however, it is not the poor living condition that could threaten to health of human.

The negative effect of bathroom is waste water discharging to canal system or to the ground, that can pollute the environment. However, there is low percentage of households have bathrooms in the house, only 32.17 percent, on the other hand the sanitary condition of the bathroom was not the researching point of the survey.

Therefore *telephone* and *BATHROOM* variables are not used for the further analysis. There are 8 variables of living conditions retained and used in the next visual observation analysis, (1) Domestic using water sources, (2) Tap water availability, (3) Drinking water sources, (4) Gas availability, (5) Heated Dwelling, (6) Warm Dwelling, (7) Time bus stop, and (8) Toilet types.

5.3. Spatial Analysis

In order to search the relationship of diseases and 8 retained variables of living condition, visual observation of the spatial arrangement of diseases with maps of living conditions or maps of environment pollutions is the analytic methodology.

<u>Visual observation analysis of digestive system diseases and living condition variables</u>

Living condition variables, which can lead to the digestive system diseases like drinking water source, domestic using water source and toilet types are displayed on the maps. In order to simplify the analysis, (1) drinking water from water supply (tapped water) and bottled water are considered the sanitary drinking water, the other source are grouped in the unsafe water source, (2) domestic using water source has the same classification with drinking water, water from tap and bottled water are considered the sanitary group, the other sources grouped in unsafe group, (3) flush toilet is considered the sanitary toilet, latrine or public toilet grouped in unsanitary toilets.

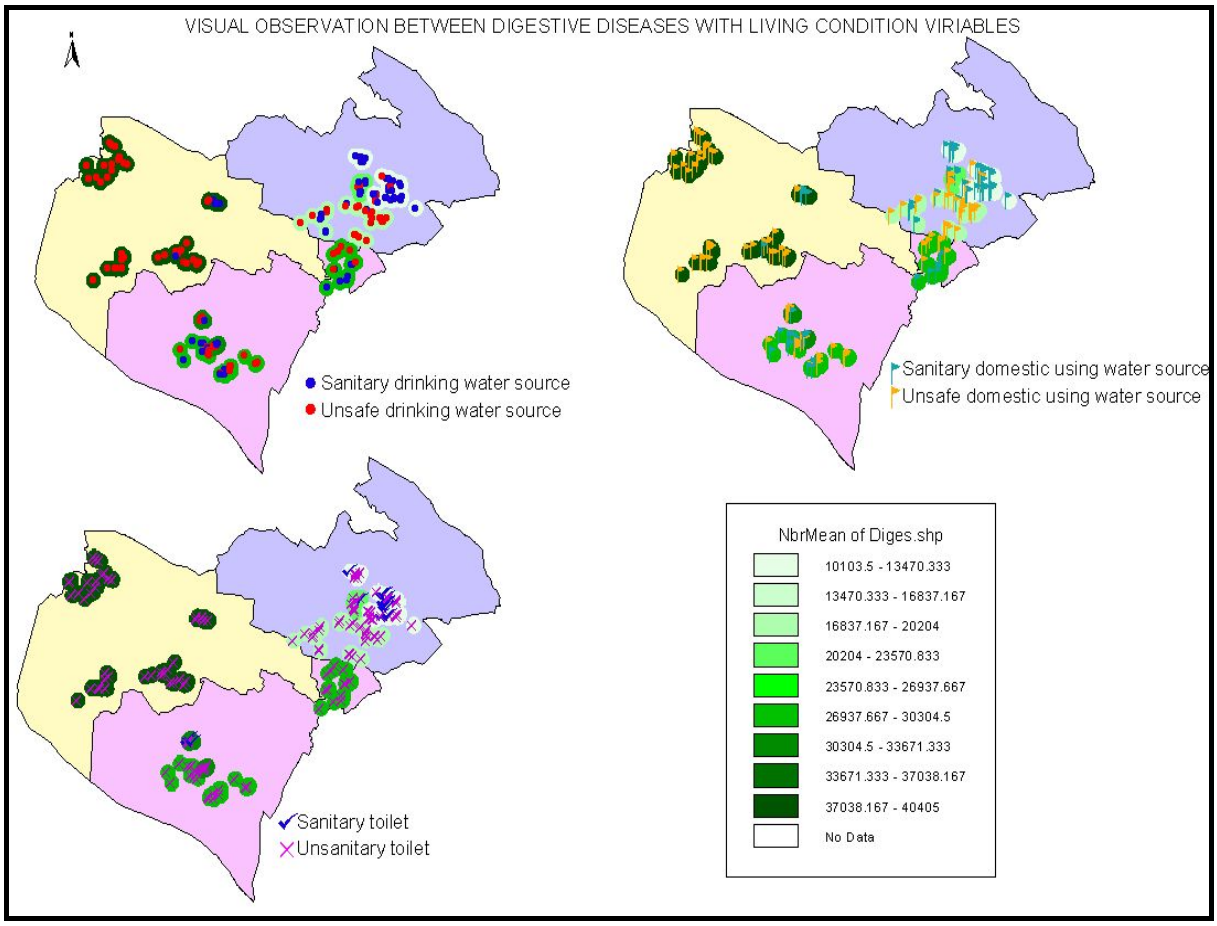

Figure 5.2: Visual observation of digestive diseases with poor living conditions

Neighbourhood Statistics used to compute mean based on the values of digestive disease points within a specified neighbourhood, the result showed on the figure 5.2. Obviously, high concentration of unsanitary drinking water source appears at the high value of digestive system disease area at Kushkupir and high frequency of sanitary drinking water source accompanies with the low value of digestive system disease area in Urgench. There is not much different between the number of households have sanitary water source to the number of households do not have sanitary water sources in Khiva, there are 22 households have sanitary water sources against 29 households do not have sanitary water sources. Therefore the mean of digestive system diseases indicates at the average.

The map of domestic using water shows the similar result as observation on the map of drinking water sources. High value of digestive system diseases concentrates on the area has high number of households using unsanitary water sources for domestic activities. The low value of neighbourhood statistics of digestive diseases appears in Urgench city and Urgench rayon where there is high number of households have sanitary domestic using water sources.

In Khiva those 22 households have the sanitary drinking water sources also have the sanitary water sources for domestic use, and 29 households use unsafe water sources.

High number of sanitary toilets concentrates in Urgench city and there is not sanitary toilet in Kushkupir correlates with the mean of neighbourhood value of digestive system diseases in Urgench and Kushkupir, which is low mean of neighbourhood value in Urgench, and high mean of neighbourhood value in Kushkupir.

In Khiva, although there are some households use sanitary toilets, but the average mean of neighbourhood value should be considered that toilet condition has the relation with digestive system diseases.

Visual observation analysis of respiratory diseases

The “Heat map” is considered as the sub-map of the “Warm map”. There are a few of households have around 4 or less hours of heating in the Heat map, therefore the percentage of households have gas supply are very high in all three rayons. However, there is a correlation between the neighbourhood statistics of respiratory disease-flu with the number of dwellings have enough warm. Observing in the “warm map”, mean neighbourhood statistics of respiratory disease-flu variable displays high value in Kushkupir and low value in Urgench, meanwhile there is high percentage (35.71 percent) of dwellings get less than 5 days warm in Kushkupir comparing with 11.9 percent only in Urgench.

Khiva has the average value of dwellings get less than 5 days warm per month, 23.53 percent, comparing to Urgench and Kushkupir. The neighbourhood mean of respiratory diseases – flu also displays the average value.

It is not much difference of time need to walk to the nearest bus stop (time-bus variable) in the survey area. There is not obvious relation between time-bus variable and respiratory-flu diseases which could indicate the expected hypothesis that the longer time need to walk to the bus stop the higher risk to get respiratory disease-flu.

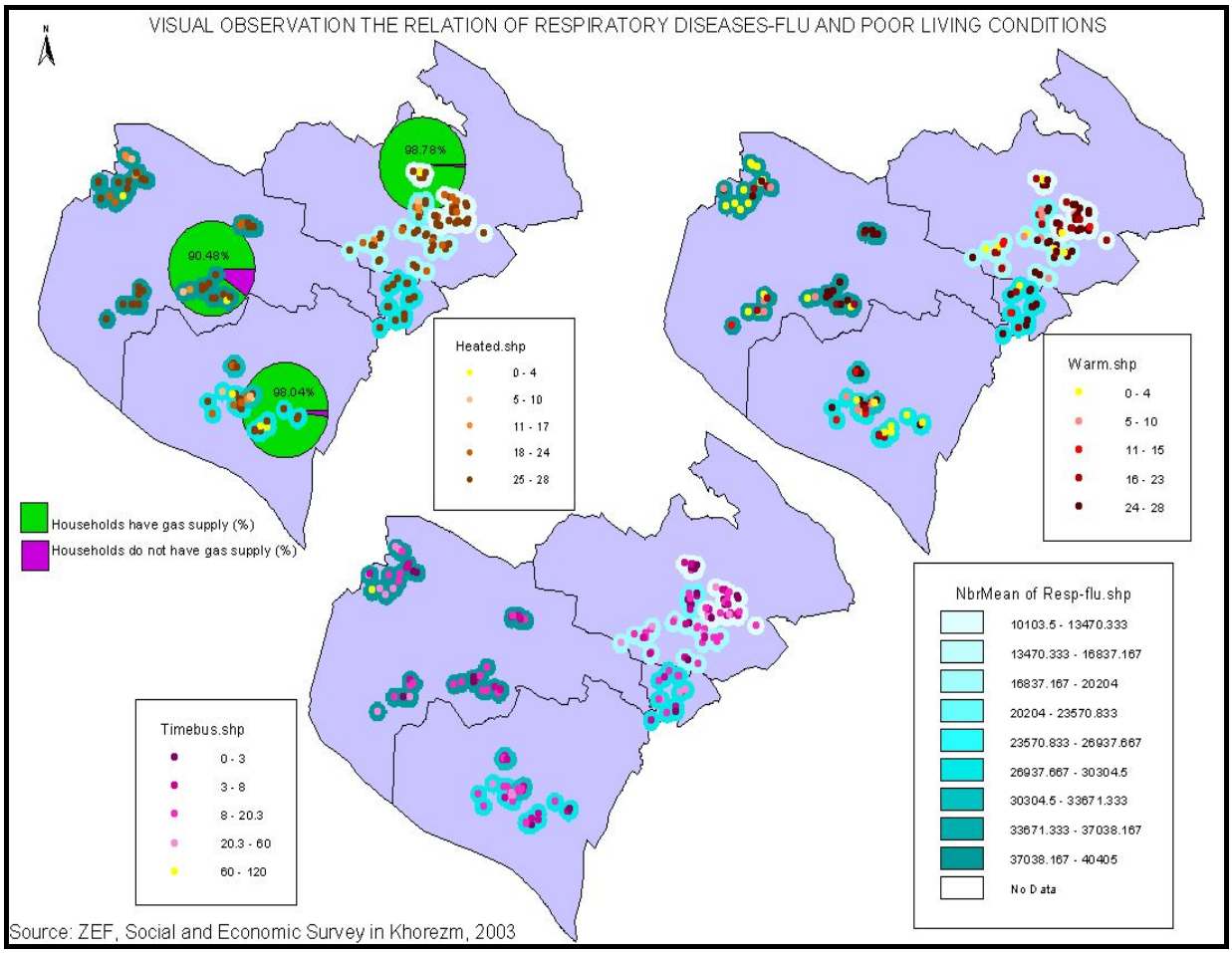

Figure 5.3: Visual observation of respiratory diseases-flu with poor living conditions

<u>Visual observation analysis of high-mineral-affected diseases</u>

Groundwater salinity samples were taken (1) in April, beginning of the cropping season, (2) in July, during the cultivation, and (3) in October, finish the crop. Salinity in groundwater of each month and in soil are presented from low to high levels which are indicated from light to dark color in monochromatics.

Obviously the salinity in soil and groundwater in Kushkupir is higher than in Khiva and Urgench, however, the patients of high mineral affected diseases are less than in Khiva and Urgench during the social economic survey (3 patients). This observation is somewhat logical to number of samples. There are 42 households (23.73 percent households of the survey) in Kushkupir with 280 people interviewed.

In Khiva, the salinity in soil and groundwater considered lower than other two rayons, but it has highest percentage of high mineral affected diseases, 2.62 percent.

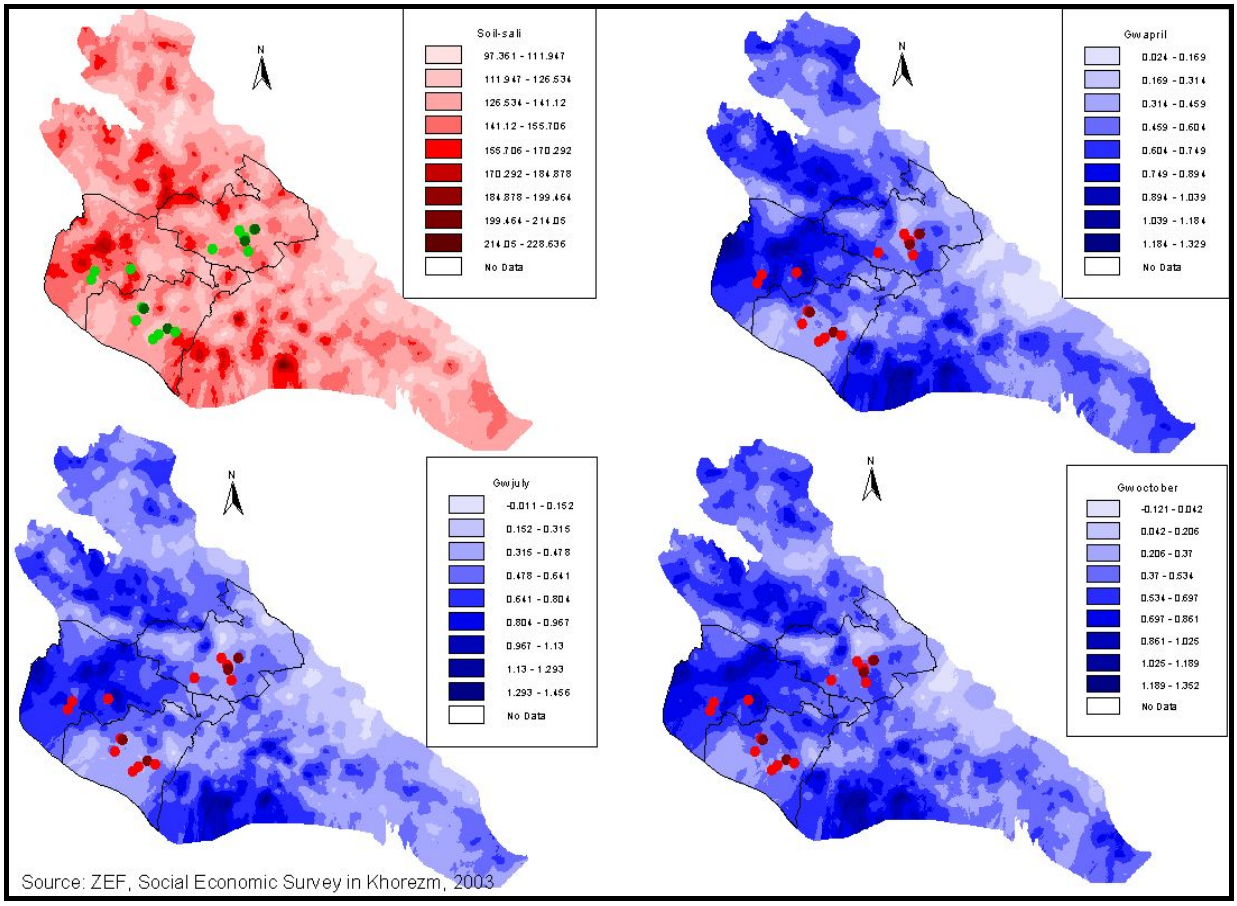

Figure 5.4: Visual observation map of the relation between high mineral-affected disease with soil and groundwater salinity

Table 5.4: Summary of High mineral-affected diseases

	Kushkupir	Khiva	Urgench
Number of households	42	51	84
People in the survey	280	343	499
High mineral-affected disease patients	3	9	12
Percentage of patients	1.07	2.62	2.4

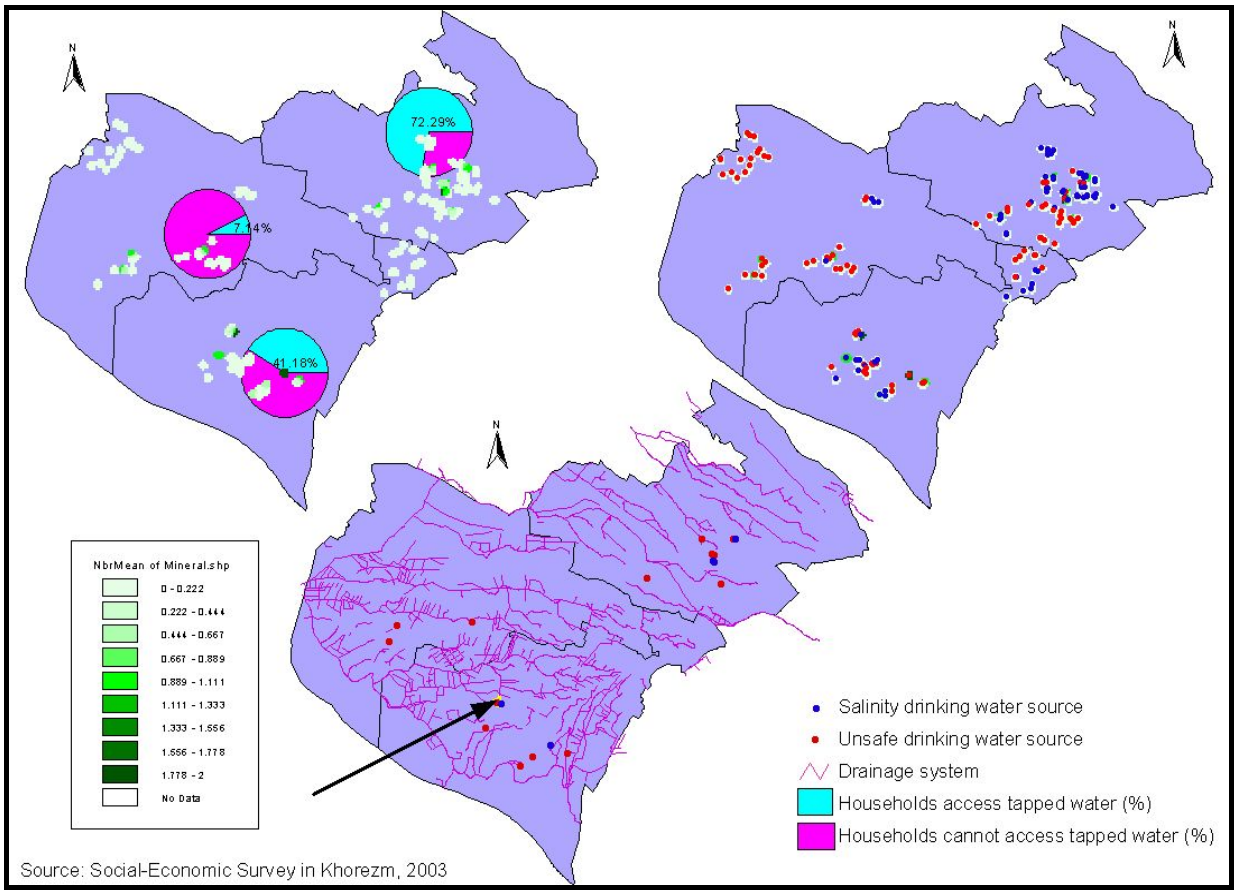

Figure 5.5: Visual observation of high mineral-affected diseases with poor living conditions

The mean of neighbourhood statistics for high-mineral-affected diseases indicates low value in Kushkupir and most clusters of households in Urgench. Visual observation map could not show the relationship between unsafe drinking water source and high mineral-affected diseases in the survey area as in hypothsis, since those households in Khiva and Urgench city using sanitary water sources have higher mean neighbourhood statistics of diseases.

Neighbouring Effect method is applied to find households have high mineral-affected diseases patient within the distance 100 meters from the drainage canal system. The result shows one household which has two patients in Khiva rayon.

As the observation analysis can not show any correlation of high mineral-affected diseases and the poor living conditions in the survey area. A few cases of diseases are also a limitation to do the further research.

6. SUMMARY AND CONCLUSION

Effect of living environment to health of people via many ways, respiratory system and digestive tract have highly direct effect from negative environmental factors. Negative environmental factors also affect to people indirectly via living conditions like no heat in the winter, poor ecology, and lack of green trees.

The hypothesis of this project is that the illnesses prevalent today in Khorezm where has heavy effect from “Aral Sea disaster” are related to the worsening of the ecological situation, for instance the decline in the quality of drinking water and an increase in pollutants in soil and air. On the purpose to find the relationship between environmental pollution and health in Khorezm oblast, 177 households in three rayons Kushkupir, Khiva and Urgench and Urgench city were selected to do the socio-economic survey at the beginning of year 2003. The survey focus on the socio-economic conditions, health situation of the local people, and environment around the living areas.

The shortage of air pollution data does not allow studying further the effect of polluted air on health of local people. High salinity in soil and groundwater are the present concerned problems in Khorezm. Geographic Information System (GIS) data of salinity in soil and groundwater were created from the dense net of samples around Khorezm. Social and economic data about living conditions were also used in analysis. Primary data about sickness were collected and classified in three main groups of disease, respiratory diseases-flu, digestive tract diseases, and high mineral-affected diseases.

Although the research focus mainly on the visual observation analysis due to lack of data but there is the visual correlation between digestive tract diseases with poor living conditions, unsafe domestic using water source, drinking water source and unsanitary toilet. The respiratory system diseases also have visual relation with lack of heat in the household in winter. High mineral-affected diseases did not show the relationship with any analysing variables. If there is an opportunity to study further, the results will be more conclusive.

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