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DEVELOPMENT OF RIVER POLLUTION CONTROL IN UKRAINE THROUGH UNITED KINGDOM POLICY IMPORTATION

BY

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ABSTRACT

Since gaining independence in 1991 Ukraine has pursued a transition to a market economy along West European and North American lines. The transition has been coupled with dramatic economic decline. Environmental quality problems remained as serious as when economy was much stronger under Soviet Union.

In this study these problems are seen as linked to the socio-economic situation, rather then to the scientific, technical and regulatory background. Indeed Ukrainian technical know-how is good, but general ecological state of rivers is under stress. State authorities and scientists alike seek improvements to the system of environmental protection, including the prevention of river pollution.

As one option it may be possible to mitigate river pollution through importation of UK water policies (largely compliant with EU) identified as relevant to address the priority areas of river pollution control in Ukraine.

In Ukraine river pollution comes predominantly from industrial sources. It is highly location specific and non-uniform. Heavy pollution accidents are frequent. It appears that no effective mechanisms exist to prevent this occurring at a large scale. State and institutional control of pollution are ineffective due to failures in the operation of state environmental law enforcement authorities. A major shortfall indeed is shortage of state funding even at the level of meeting basic needs by environmental officers, a direct result of the government's distribution of scarce state budget expenditures.

In the society there is a great concern over environmental quality, but poor public support due to bad economic conditions and hence, poverty of almost 90 % of

Ukrainians. Unfortunately, the situation is unlikely to improve in the near future because the main reason of economic crisis, widespread corruption, is extremely difficult to address.

Because of great differences between UK and Ukraine, each policy requires an assessment for importation to Ukraine. This accounts for both present features of environmental pollution and socio-economic conditions in the country. The assessment produces policy recommendations, which, if implemented, may have a positive effect - in terms of less river pollution.

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List of Acronyms:

UK – United Kingdom

EU – European Union

TACIS – Technical Assistance to the Commonwealth of Independent States

CIS – Commonwealth of Independent States

IMF – International Monetary Fund

MAC – Maximum admissible concentration

GDP – Gross domestic product

EBRD – European Bank of Reconstruction and Development

GNP – Gross national product

SME – Small and medium enterprises

EA – Economic agents

VAT – Value added tax

OECD – Organisation for Economic Co-operation and Development

USSR – Union of Soviet Socialist Republics

BATNEEC – Best Available Technologies Not Entailing Excessive Costs

RAW – Radioactive waste

MEP – Ministry of Environmental Protection

NPP – Nuclear power plant

SEM – System of ecological monitoring

NGO – Non-governmental organisation

EIA – Environmental impact assessment

ITC – Intergovernmental technical committee

ISO – International standards organisation

UN – United Nations

DETR – Department of the Environment, Transport and the Regions

OFWAT – Office of Water Services

IPC – Integrated Pollution Control

SEPA – Scottish Environmental Protection Agency

EQS – Environmental quality standards

RQO – River quality objectives

RE – River ecosystem

DO – Dissolved oxygen

BOD – Biochemical oxygen demand

IWP – Index of water pollution

IPPC – Integrated pollution prevention and control

BAT – Best available techniques

ELVs – Emission limit values

UWWTD – Urban Waste Water Treatment Directive

GQO – General quality assessment

STW – Sewage treatment works

BATT – Best available treatment technologies

SPSS – Software package for social scientists

NMACs – Number of MACs

ANMACs – The analysis based on original NMACs

EWQI – Ecological water quality index

AEWQC – The analysis based on ecological water quality classification

MC – Maximum concentration

AC – Average concentration

HPA – Heavy pollution accidents

NHPA – Number of heavy pollution accidents

SSAC – Synthetic surface active compounds

REC – River ecology classification

USA – United States of America

USRIEP – Ukrainian Scientific and Research Institute of Ecological Problems

WWTF – Waste water treatment facilities

USCPW – Ukrainian Scientific Centre for Protection of Water

CHAPTER 1

Introduction: a country in transition

1.1 Outline of the research

Since independence in 1991, Ukraine's transition to a Western-style, market economy has been marked by a severe economic crisis and dramatic decline in productivity. Despite declining industrial activity, the ecological condition of Ukrainian rivers remained "stressed" (Kuzin, 1995); the general opinion of Ukraine's environmental experts is that the economic crisis is to blame for persistent river pollution. However, no research in this area had been undertaken (Barannik, 1996). Therefore, this project concerns itself with environmental issues alongside, and in relation to, the peculiar socio-economic conditions formed in Ukraine under economic transition during the 1990s. In particular, the research will focus on river pollution and the findings will be used to highlight possible ways of improving river pollution control in that country.

The proposition for the research is that: "***The limited financial capacity of the state and economic agents, stemming from the recession during the period of economic transition, is the main constraint to improvement of river pollution control. This is coupled with institutional deficiencies and a lack of experience in formulating, implementing and monitoring policies in a de-centralised economy. Significant scientific and regulatory potential of Ukraine is ineffective to control river pollution***".

Besides investigating the extent and causes of river pollution, the research also aims to consider mitigation of river pollution through screening United Kingdom (UK)-style water policies for importation: specifically those presently operated by the Environmental Agency for England and Wales. Ukraine has chosen to pursue a West

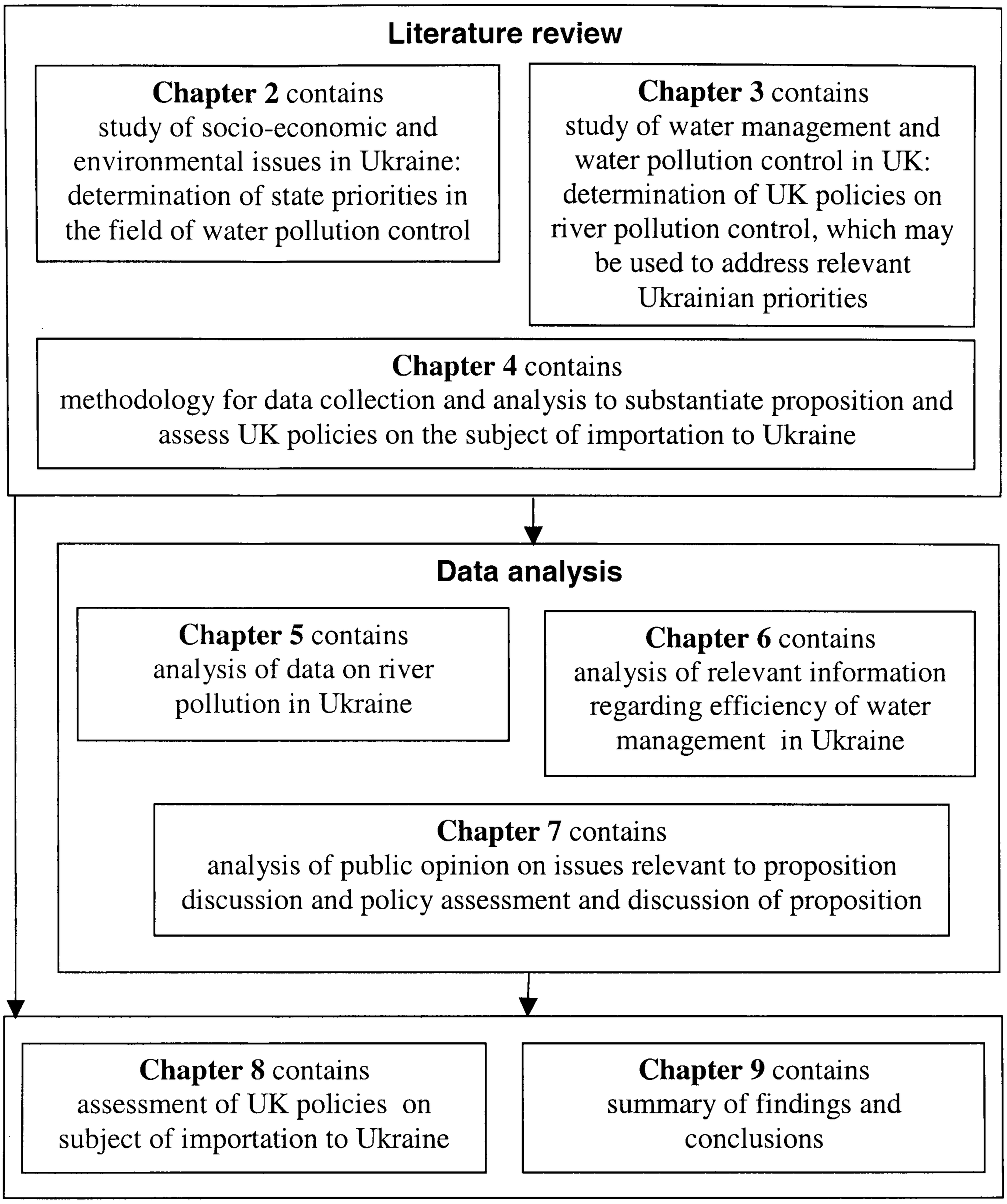
European-oriented economic and political system, and is likely to seek integration into the European Union (EU) in the future. Therefore the United Kingdom, where this research has been conducted, will serve as a model of a Western market economy influenced by EU policy.

The research objective will be achieved via quantitative and qualitative analysis of information collected from libraries, a 200-respondent survey of general public opinion and 12 in-depth interviews (including water experts). In addition, UK water management (largely compliant with EU guidelines) will be investigated and screened for policies relevant to Ukraine.

In the analysis of information collected in Ukraine, selected UK policies will be assessed under seven criteria established through literature review, to decide whether they will be effective and adaptable to Ukrainian conditions. This will produce recommendations regarding UK policies suitable for application in the Ukraine.

Note: *Throughout this thesis the convention adopted for the names of Ukraine's regions and rivers are in Ukrainian language translated into the Latin alphabet from the Cyrillic with the exception of a few well-known places such as Crimea, where English names are used. Relevant names in other countries of the Commonwealth of Independent States, as well as names of people and cities are presented in Russian language translated into the Latin alphabet.*

1.2 Structure of the thesis



CHAPTER 2

Proposition of the research and literature review

2.1 About the proposition of this research

The proposition of this research programme is that river pollution problems primarily arise from socio-economic aspects of life in the Ukraine. It will be argued that these socio-economic aspects arise from the political, cultural and historical background of the country as well as being shaped by present conditions during transition to both a market economy and a democratic society. It is considered that pollution issues are directly related to environmental education, media involvement - and hence public awareness - as well as the nature, scale and magnitude of economic activities.

Many national and international sources, such as TACIS (Technical Assistance to the Commonwealth of Independent States) (1996) describe the Ukrainian transition economy as experiencing "crisis" conditions. Poverty is widespread and latent unemployment rates are said to be about 20 % of people of working age (18-60 years) (Akimova, 1996). Many public services, including river pollution abatement and remediation, suffer from the chronic shortage of state funds (most of public services in Ukraine remain state-funded). Besides many other issues, the economic crisis is implicated in river pollution in the country (Gritzenko, 1995). Therefore, the research aims to understand how river pollution problems arise from economic performance and how economic performance is influenced by the way people think, act and behave in respect to production and pollution. These findings will be crucial in assessing the possibility of importing UK water policies into the Ukraine.

This thesis is concerned with the issue of river pollution, but first a geographical, economic and social overview of the newly independent country of Ukraine (including the river pollution prevention system) is presented.

2.2 Geography, climate and water resources

The newly independent Central European country of Ukraine is mainly a vast plain with no natural boundaries except the Carpathian Mountains in the southwest and the Black Sea to the south. The Dnipro River with its many tributaries economically unifies central Ukraine, connecting the Baltic coast countries with the Black Sea and the Mediterranean Sea. The mouth of the Danube River provides an outlet for Ukrainian trade with the Balkans, Austria, and Germany.

Ukraine has a complex geology with a rich variety of scenery and impressive contrasts in topography. Central and southern Ukraine is primarily steppe (prairie) used for agriculture. In the east is the industrial heartland containing large reserves of mineral deposits known as the Greater Donbass or Donetzk Basin.

Ukraine's land area is 233,088 square miles (603,700 sq. km): slightly larger than France. Ukraine has borders with Moldova and Romania in the south-west, Poland, Slovakia and Hungary in the west, Belarus in the north and Russia in the east and north-east (Appendix 2.1). The country has 25 administrative territorial units called “Oblast” (Appendix 2.2).

The climate of Ukraine is continental and characterised by significant, seasonally-induced temperature variations. The mean temperature is 19°C in summer and -6°C in winter.

Southern, central and eastern parts of the country are represented by vast plains stretching north from the Black Sea. Here hot and relatively dry summers together with relatively severe winters created good condition for the formation of the highly fertile "chernozems" (black soils). This explains why Ukraine is often proposed as a "granary" for Europe. In fact, almost 80 per cent of land in Steppe (plain semiarid areas with grass vegetation) and Lisostep (more humid areas with grasslands and woodland patches located to the north and north-west of the Steppe) zones is used for agriculture. This part of Ukrainian territory lies in semiarid climatic zones where average annual precipitation varies from about 400 mm in the southern region to 600 mm in the northern part (Ukraine.com, 1995). There are abundant freshwater resources and a relatively dense river network throughout the country, especially in the west.

In Ukraine there are more than 22,000 rivers with a total length over 170,000 km. They belong to catchment areas of the Black, Azov and Baltic seas. The largest river is the Dnipro with a catchment covering almost a half of the country's surface area. The other main rivers are the Danube, Dnistr, Pivdenny Bug, Seversky Donets. Over three thousand lakes cover 0.3% of Ukraine's territory. The coastal length of the Black and Azov seas is about 1,050 km.

The average water resources available from Ukrainian rivers total 50 km^3 per year (approximately 96.7 m^3 per person per year) and ground water abstraction occurs at a rate of 514 m^3 per sec. (MEP, 1998).

2.3 Economic conditions in Ukraine since independence

2.3.1 Economy in transition

Since 1991, the governments of all CIS countries have pursued economic reform. This has been in close co-operation with Western financial organisations; primarily the International Monetary Fund (IMF) and the World Bank. It is often stated in diplomatic declarations that the objective of the reforms is to build wealthy and democratic, free market societies similar to the industrialised countries of the West (Reuters Ltd, 2000). Indeed, inspired by mass media propaganda in the early 1990s, many Ukrainians believed that a free market would cure most economic ills, improve standards of living and would also provide the basis for rational and effective use of natural resources (Jaworsky, 1995).

To date, there have been several changes regarding freedom of speech and economic liberalisation (especially the removal of price controls), but fewer changes within the Soviet-style system of state administration. This is still primarily based on a hierarchy, "Centre→Region→District", via Regional and District Councils of People's Deputies and Executive Committees (MEP, 1998). However, contrary to major expectations, so far the economic transition has been coupled with a deepening socio-economic crisis due to the rapid and dramatic change:

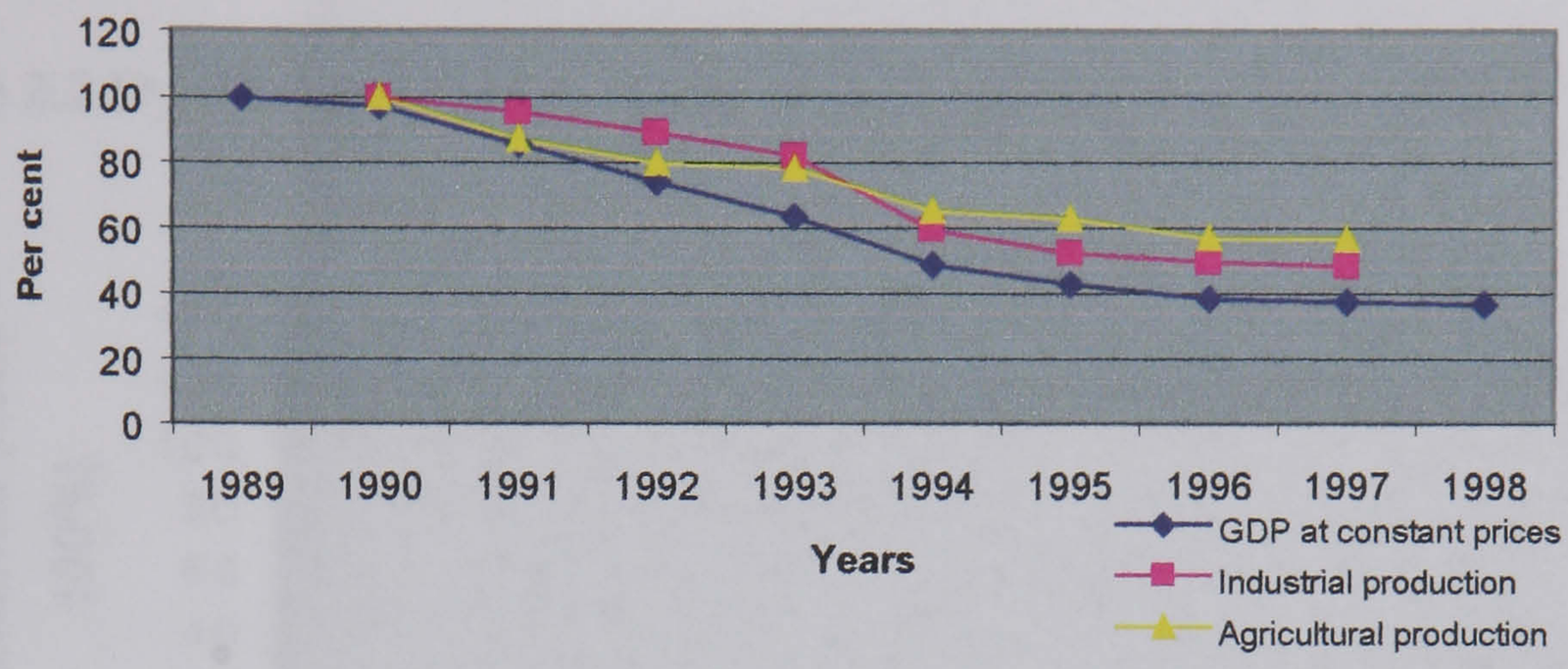
- From Communist rule to liberal democracy;
- From a Soviet Union republic to an independent state;
- From a command-and-control economy towards a free market.

In 1991 the prospect of transition was first marked by euphoria. However, Jaworsky (1995) describes widespread apathy and cynicism, the result of a dramatic economic decline. Associated problems include environmental degradation, social tensions continue to rise and there is a potential for societal conflict, which for some time, it has been feared, could push the country back towards authoritarian rule. To date, the obvious failure of socio-economic reforms suggests that Ukrainian society is struggling with the economic transition.

Short of state funding, all public services became an area adversely affected by the economic crisis. One of the services - environmental protection - lost aspects of its pre-independence efficiency. As a result, for example, general levels of river pollution between 1993 and 1996 show only a slight improvement with average concentrations of some parameters remaining well above 1 MAC (maximum admissible concentration) in 1996. This stands in contrast to the dramatic decline of industrial and agricultural activities, and the country's Gross Domestic Product (GDP) within the same time span. At the present time, while the economic crisis worsens, environmental quality remains poor.

On the other hand, economic decline in the country has been erratic having significantly slowed after 1996. This can be traced to changes in agricultural and industrial production as well as in GDP at constant prices (Figure 2.1). It is possible, however, that GDP will eventually start to grow (Ebergard, 1998).

Figure 2.1 Dynamics of change of GDP, agricultural and industrial production (1989-1998)



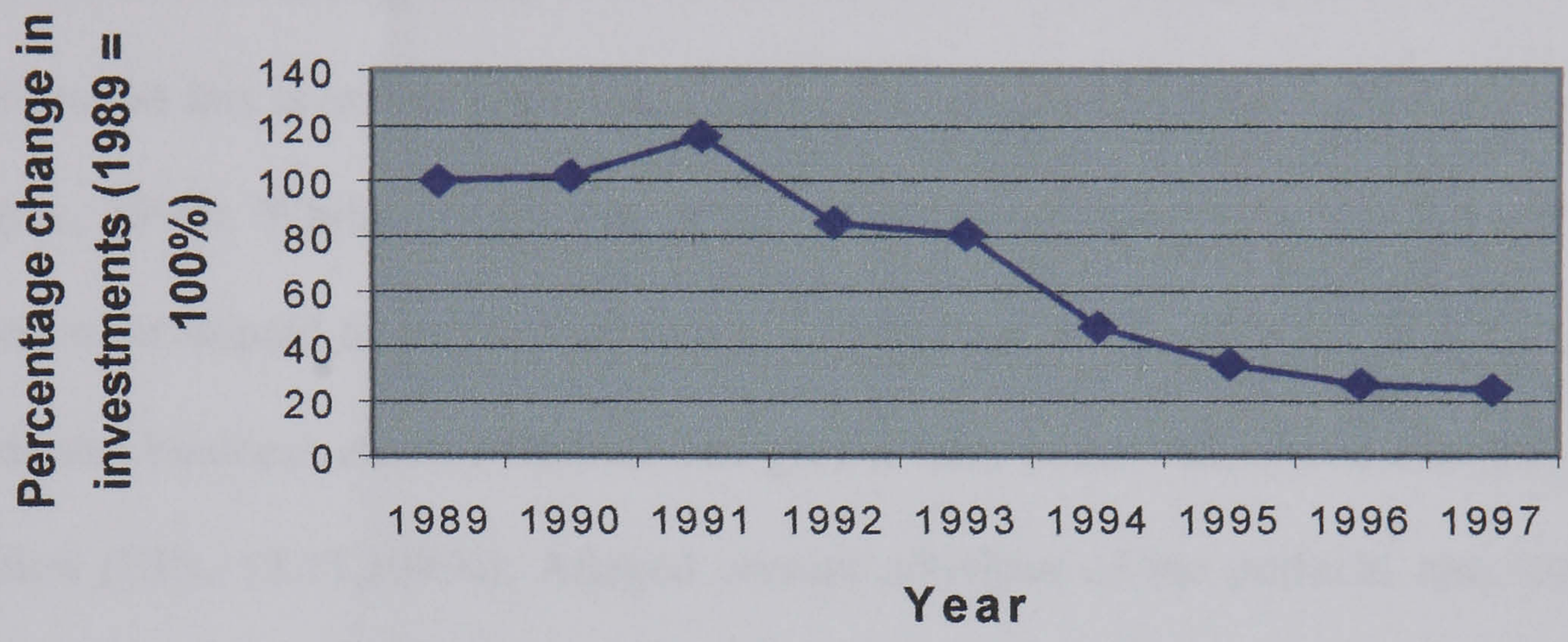
Sources:
EBRD (1995). Transition Report 1995 "Investment and Enterprise Development";
EBRD (1998). Transition Report 1998 "Investment and Enterprise Development";
Europa Publications Limited (1997). Eastern Europe and the Commonwealth of Independent States;
Ebergard P (1998). The Results of Socio-economic Changes in Poland and Ukraine.

According to the official exchange rate in 1990, GDP in Ukraine was about 2000 $US per capita (Ebergard, 1998). Towards 1998 this amount more than halved to 736 $US per capita. The same pattern (of constant decline) is also observed in terms of industrial and agricultural production. The fall of the value of these indices was greater during 1990-1995 than 1996-2000. Since 1995 the fall has slowed down and other signs of stabilisation of the national economy have begun to appear. However, the tendency towards further decline remains and it is not clear whether the changes in the national economy in the near future will be positive or continue to deteriorate (Semenov *et al*, 1998). Decline of industrial and agricultural activities caused investments into the national economy to diminish year on year over the same period.

Sources of the information provide differing values for annual investments, probably because of the unstable financial situation (Ebergard, 1998). Even though they cannot be considered as precise, they arguably reflect Ukrainian realities. According to official

statistics, investments in 1990 were 30.3 billion $US but only 6.9 billion $US in 1996. The dynamics of the decline from 1989-1997 are shown in Figure 2.2.

Figure 2.2 Dynamics of change in size of all investments during 1989-1997



Sources:
EBRD (1995). Transition Report 1995 "Investment and Enterprise Development";
EBRD (1998). Transition Report 1998 "Investment and Enterprise Development".

The overall decline between 1992 and 1997 was more than 80 % of the 1991 value. Decreasing and low investments reveal an absence of development prospects (Lipsey *et al*, 1995).

Having to face political changes coupled with economic crisis of transition to a market economy, Ukraine had to meet large expenditures associated with the transition. Therefore, the country had to borrow funds, mainly from financial institutions such as the International Monetary Fund (IMF) and the World Bank. Positive interest rates and economic policies applied by these financial institutions, corruption at the level of the national government and economic crisis are to blame for the growth of external debt stock (Kurbanov, 2000). Ukraine, which has just $1.3 billion in foreign currency reserves, faced foreign debts of $3.2 billion in 2000 and had only minimal direct foreign investment (EIN, 13.11.1999a).

During 1992-1997 the external debt stock increased rapidly. The amount of debt was only 0.5 billion $US in 1992. In 1997 it was already 11.8 billion $US. The growth of debt is not solely related to international financial institutions, which may charge positive interests starting from 3-4 % on the debt. The main reason cited is the corruption and this is endemic in virtually all governments of CIS countries (Interview: Kurbanov, 1999). While unemployment has swollen to chronic levels and wages and pensions went unpaid to the sum of two billion dollars in May 1999, a closely-linked political and business elite in Ukraine has grown rich, amid widespread allegations of corruption (EIN, 13.11.1999a). Alleged corrupt activities of the political elite include embezzling billions of $US received in loans from foreign financial institutions. In the same time international financial institutions require debt and interest payments. These press the Ukrainian Government to apply, among other things, unpopular legislation charging high taxes. These high taxes have a depressive effect on Ukraine's economy, and, alongside excessive level of unproductive consumption (i.e. consumption of funds, goods and services without any form of payment or barter for them), are arguably the main reasons for stagnation and decline of economic activities in the country (Lisitzki, 1999). Producers complain that production taxes are high and numerous (Appendix 2.3, and the markets for their goods are limited because consumers are short of cash (Semenov *et al*, 1998) (NBU, 1999).

When Ukraine was part of the Soviet Union, all production sectors of the economy, as well as all public services, were funded from the state budget. First the incomes from production activities were taken into the state budget and then the money was distributed to producers of goods and services. As a legacy of those times, some

production activities (large state owned plants and mines) and most public services (including wastewater treatment) are still subsidised by the state.

Very high taxation pushes economic agents outside the legal economy, where other, illegal taxation systems exist. The latter is effectively enforced by so called "shadow" structures, which are often informally linked to local state authorities and police (Lisitzki, 1999). Overall "shadow" economy makes up about a half of Gross National Product (GNP), which was equal to $US 1,400 per capita in 1995 (TACIS, 1997).

In the late 1990s in industrialised countries of the West, SMEs accounted for 46-78 % of total employment and produced 51.5-65 % of GDP. In Ukraine, only 5.7 % of people are employed in SMEs. The share of SMEs in GDP is 9.3 % (MLSP, 1998). A survey of 200 heads of SMEs in four Ukrainian cities (Dnipropetrovsk, Lvov, Kharkov and Vinnitza) reveals the problems related to operation of SMEs (Table 2.1).

Table 2.1
Analysis of problems hindering development of EA in Ukraine

Problems	Per cent of replies
Undeveloped real estate market	2
Lack of business information	4
Pressure of criminal elements	5
Inadequate knowledge of business management	9
Pressure of local authorities	9
Difficulty in obtaining credits	16
Great number of activities requiring licences	18
Non-payment of services by customers	32
Low demand by consumers	47
Great number of legislation acts	47
Frequent changes of legislation	60
Frequent changes of tax reporting procedures	70
Great number of different taxes	82
High taxes	95

Source: MLSP (1998). The Results of Expert Polling of Heads of Economic Agents in Dnepropetrovsk, Lvov, Kharkov and Vinnitza.

As confirmation to the statement made by Lisitzki (1999), Table 2.1 shows that most respondents pointed at issues related to taxation as major factors restricting the development of their businesses (95, 82 and 70 percent out of all respondents (100 %). There are 20 common taxes and more then 10 local taxes. Usually enterprises or economic agents (EA) are charged several such taxes and the total amount of taxes to be paid out of business profit may reach as high as 80 % (SSU, 1998a). This often causes EAs to face a dilemma: either to do business with scarce, if any revenue and risk going bankrupt, or, as mentioned before, to go into the shadow economy, where there are illegal operations beyond the control of state authorities.

2.3.2 Ukraine and the international financial scene

Economic reforms in the country are being conducted by the government in co-operation with international financial institutions, e. g. the International Monetary Fund (IMF) and the World Bank. As a precondition to obtaining loans from these institutions, the government of a borrowing country has to introduce certain policies. The purpose of these policies is relevant to the interests of the lenders. The interests are usually promotion of foreign investment and assurance of servicing the debt and the interest, which may be as high as 8 %, if the debt is not paid in time (Interview: Kurbanov, 2000). There are also other foreign lending institutions such as the London Business Club. Yet Ukraine, or any other country, is unlikely to obtain loans from other creditors if the IMF refuses to offer loans (EIN, 12.01.2001).

Thus, in 1999, the Ukrainian government applied to the IMF for continuation of lending and submitted a report on progress in meeting previous requirements put forward by the IMF. The following quotations from that report (IMF, 1999) are relevant to this thesis:

- *The real GDP will continue to decline and the consumer price index will increase by no more than 19 %.*

Further economic decline, price index increase and, therefore further loss of welfare are expected.

- *Large debt service obligations are due*

This is said about domestic and external debts. External debt to be paid in 2000 was about 3.2 billion $US (EIN, 23.01.2000). Total domestic debt grew up to 7.8 billion $US, which is smaller than the total external debt of 10.6 billion $US by July 2000 (EIN, 12.09.2000). The size of total domestic and external debts is more then 100 % bigger then the size of Ukraine's budget for 2001.

- *The stock of budgetary arrears on wages, pensions and benefits of 2.15 billion Hrivnias (54 Hryvnias per capita of persons aged above 15) will be reduced in 1998."*

The figure reported is not correct. If 2.15 billion Hryvnias (about $US 1 billion) of wage and pension arrears were the case, it would mean that people's wages would not be delayed or unpaid for more than one month on average. However the information may be misreported. In reality the arrears could be much greater.

- *Chernobyl tax has been eliminated and the payroll tax has been reduced by 5 %*

Elimination of Chernobyl tax (levied in order to alleviate the environmental stress caused by the 1986 Chernobyl accident) and payroll tax would ease the burden of taxation for employees and improve their welfare. But in the case of wages below 40 $US per month the improvement may not be significant.

- *VAT exemptions for critical imports have been eliminated*

VAT will now be charged even on critical imports, e.g. medicines and raw materials, to bring more revenues into the state budget. Consumers of these imported goods will be worse-off. This would be a painful experience for over 80 % of the population with incomes of around or less than 40 $US a month (Sokolyk, 1998) (Clarke, 1997), e.g. pensioners.

- *A parliamentary decision to reduce oil excises was also vetoed*

No reduction in oil excises means the prices for oil and oil products will be unlikely to decrease. Large numbers of consumers of such goods will continue to pay high prices due to excises.

- *A more aggressive plan will be implemented to pursue enterprises with large tax arrears and will accelerate the sale of seized assets from such tax debtors*

This refers to measures to punish EAs that do not pay 80 % tax on their income. The IMF requires higher revenues to Ukraine's state budget, first of all to pay back the loans and interest on the loans. It does not seem to care about the fate of EAs pressed by the tax burden – so it does not require significant lowering of

taxes. Does this mean that the IMF lacks economics experts who understand that such taxation policy in practice can destroy an economy? It cannot be so because the IMF is a powerful and respectable organisation. Therefore it looks as if, using corruption in the government, IMF in Ukraine consciously pursues an objective of keeping the country weak, poor and politically obedient.

- *Imposition of new fees to increase revenues of the Pension Fund. Indexation of pensions to be strictly limited*

  This is designed to pay pension arrears without changing the amount of pension paid. The fees will cause an extra burden on EAs.

- *A number of important structural fiscal measures that had been envisaged have not been implemented, mainly due to insufficient support in Parliament. In particular, coal and imported gas continue to be zero-rated for VAT, earmarked taxes for the Road Fund and the Innovation Fund as well as the Social Insurance tax have not been reduced.*

  This refers to the failure to increase the price for coal and gas through imposition of VAT, and reduce incomes to Road, Innovation and Social Insurance funds. After imposition of VAT, higher prices for coal and gas would reduce the welfare of consumers. Reduced payments to the earmarked taxes would increase welfare of EAs and employees.

- *A special two-year moratorium on the payment of taxes by the agriculture sector, including an explicit VAT exemption is not possible to remove at this time. No new*

tax exemptions or privileges (including special economic zones) will be granted during 1999.

This informs the IMF about the government's failure to scrap VAT exemptions in agriculture and also assures the IMF that no more exemptions will be made. This also reflects the IMF's desire for higher revenues into the state budget in order to pay debts at the expense of welfare in the agricultural sector. The situation of Ukrainian agriculture is already grim. Wages have been unpaid for up to 3 years and many farms are barely solvent.

- *The taxation of the unrealised capital gains on statutory capital of banks with foreign capital has been eliminated. Certificates of deposit issued by commercial banks will not be considered as gross earnings under the enterprise profit tax. The parliamentary decision, on the avoidance of double taxation, has been enacted. The state duty on transactions in the secondary market for securities will be repealed.*

This is to correct some distortions in the country's taxation system. The IMF is very conscious of the low amount of revenue collected:

- *Fiscal operations continue to be constrained by the use of various non-cash means for settling tax obligations. We have attempted to limit the use of such instruments but it has not been possible to completely eliminate this practice.* ***We are keenly aware of the need to collect more revenues in cash****, both to improve the transparency of the budget and* ***reduce the difficulties that we have encountered in meeting certain expenditure obligations****. To this end, we propose that quarterly targets on the collection of unearmarked cash revenues by the central government*

be included as a performance criterion under the program, which will target a significant increase in 1999.

The IMF therefore wants the tax obligations to be settled in cash. More cash revenues into the state budget would enable Ukraine to pay its debts and the interest. Great difficulty in elimination of non-cash means of paying taxes reflects the limited cash revenues of EAs.

- *On the expenditure side, the approved budget* ***reduces non-interest expenditures*** *on a commitment basis by about 6 percent of GDP relative to 1998 and further reductions will be necessary due to expected revenue and financing shortfalls.* ***The expenditure reductions are to be achieved by cutting NON-PRIORITY EXPENDITURES****. A further sizeable* ***reduction in budgetary employees*** *will be achieved during 1999, after a reduction of nearly 300,000 in 1998.*

This concerns the diversion of funds from non-priority sectors of the state budget into more important sectors. Priority sectors in the state budget are related to such issues as social welfare, wages to state workers and pensions, and payment of external debt. Insignificant spending for environmental protection is evident from the state budget. For example, only 40 million $US was allocated in 1996 (MEP, 1998), means this sector is given low priority and the (already poor) funding of the environmental sector is unlikely to increase.

- *In light of the depreciation of the Hryvnia since the start of the Extended Facilities Funds (EFF) program due to financial crisis in 1998,* ***substantial increases in the***

tariff rates for heating, water supply, sewage, rent, and public transportation *relative to their levels in 1998 will be necessary to achieve full cost recovery.*

It is necessary to achieve full cost recovery on energy consumption and public transport. Energy intensities in CIS countries are up to five times the average of OECD countries. Old and/or poorly maintained systems for production, transformation, transportation and consumption of energy resulted in substantial energy losses and excessive environmental pollution. (EBRD, 1998). Full cost recovery is intended to give incentives for more rational energy consumption, and lower emissions of pollutants and greenhouse gases in the air. Collected funds may be directed at improvement of infrastructure and more efficient use of energy.

On the other hand, coupled with possible imposition of VAT on coal and imported gas, this policy will increase consumer expenditure. Taking into account the low wages (about 40 $US a month) of most people, several month wage arrears, and high prices on vital goods such as food, the effect might be just the opposite. People will continue using resources such as water and gas and public transport, because this is vital for their survival, but many will refuse to pay for these. Already many people do not pay household bills regularly and in full. For instance, unpaid water bills have recently reached such huge proportions that the authorities have had to undertake a broad public campaign calling on people to pay (Appendix 2.4).

The last measure designed to achieve full cost recovery on household bills and public transport may fail, and this failure may be coupled with two major negative outcomes:

- Lower revenues to the state budget, and therefore an extra difficulty for the government to settle its debt obligations;
- A further decline in welfare of the population of Ukraine and performance of the national economy.

It seems therefore that the IMF fails to understand that certain laws and policies, which put significant financial pressure on consumers may prove inefficient for two reasons: poverty and corruption. In 1996 well over 90% of the population had aggregate incomes below $4 per day at the current exchange rate (Clarke, 1997). It is not surprising then, that many families physically cannot afford to pay extra bills for gas or transportation. On the other hand, the money obtained from the IMF, World Bank and other lenders, instead of being used for investments in the economy and people's welfare, are often diverted into private accounts of Western banks by a few individuals who hold the authority in the country (EIN, 25.02.1999). As an example, former Ukrainian Prime-Minister Pavlo Lazarenko, was detained by Swiss authorities when crossing the Swiss border with a Panamanian passport. He was later released on 3 million $US bail but now still faces charges by the Swiss authorities for money laundering in excess of 100 million $US (EIN, 5.12.1999). The idea that the IMF is assisting economic development via loans to the Ukraine, presents difficulties. In practice, most funds released to the Ukrainian authorities, one way or another, goes back into banks of the countries which lent it (EIN, 23.01.2000).

According to the MEP (1998) the differentiation of population according to the level of income continues to grow and many poor get poorer because of continuous economic decline. But poverty cannot increase forever. This brings about an issue of potential political instability in the foreseeable future, should the economic crisis continue to

worsen. However, the poor economic situation in the country is not the fault of the IMF, but due to rampant corruption in the government structures and elsewhere. If government is corrupt at the top, what can be expected from subordinate structures? Yet, in IMF reports about Ukraine there is not a word about corruption (IMF, 2001).

In general it appears that the main reasons for poor performance of EAs are high taxes and lack of state funds to stimulate the economy, which are a result of corruption of state authorities tolerated by lending institutions. Other factors include complicated and changeable legislation and overburden bureaucracy (MLSP, 1998).

For instance it takes almost 30 % of the work time of the heads of enterprises to solve regulatory problems. To a certain extent, bureaucracy also arises from low wages and poverty and can be used as a means to raise bribes (Gnybidenko, 1998; Posdnyakova, 1998).

Poverty and high taxes cause EAs to hide their real incomes to pay only a fraction of their tax obligations (Table 2.2).

Table 2.2 Proportion of tax unpaid by EA via hiding their real incomes

Revenues hidden from taxing, %	Percent of respondents
About 5 %	14
About 20 %	17
About 40 %	44
About 60 %	16
About 80 %	10

Source: MLSP (1998). The Results of Expert Polling of Heads of Economic Agents in Dnepropetrovsk, Lvov, Kharkov and Vinnitza.

As a response to high taxes, EAs try to hide their real incomes so as to remain in business. Most respondents (44 %) stated that they hide their income and do not pay

about 40 % of tax. In Ukraine the sum of all taxes reaches 80 %, whereas an average level of taxes in the world is only 30-35 %. Taking into account responses of other respondents, it appears that an average of up to 40 % of tax does not reach the state budget and is either spent for private needs or in the shadow economy (MLSP, 1998). The shadow economy is characterised by a high level of unproductive consumption, the extent of which has, however, not been studied (Semenov, 1998). Another difficulty in doing business in Ukraine is imperfect market competition (Table 2.3). There are no specific estimates on the scale of unfair competition, but it is broadly perceived as a "common case" (Semenov, 1998).

Table 2.3 Methods of unfair market competition

Major methods	Percent of respondents
Corruption, usage of state control authorities for execution	45
Anti-advertisement (true and false compromising information sent to partners and consumers), information diversion, undermining of reputation	39
Technological and production espionage (copying business ideas, technologies, goods, violation of trade mark regulations)	29
Price dumping	20
Law violation, sale of smuggled goods without import tax	17
Purposefully unpaid invoices and delayed payments	10
Physical pressure, racketeering	10
Making monopoly agreements	8

Source: MLSP (1998). The Results of Expert Polling of Heads of Economic Agents in Dnepropetrovsk, Lvov, Kharkov and Vinnitza.

According to 45 % of respondents, state authorities such as police, tax, fire safety and sanitary-epidemic inspectors, etc. are the most common tool of unfair competition.

This scenario appears to reveal the failure, so far, of free market reforms. The result of the failure is a deepening economic crisis in the country. A free market does not work effectively because of excessive state intervention in the economy, especially with respect to taxation. It has been demonstrated that bureaucracy, corruption and unfair

competition are other essential factors to blame for weakness of EAs in the Ukraine. So far, contrary to initial expectations of ordinary Ukrainians, instead of moving towards a strong market economy Ukraine, together with neighbouring Russia and Belarus, may slide into socio-economic chaos with unpredictable political implications for the country and the world.

2.3.3 The demographic position

For the majority of Ukraine's population, economic transition became a symbol of job losses, high prices and low wages, but no deficit of consumer goods on the positive side.

Before 1990 there was virtually no unemployment in the Ukraine. The state planned economy of the former USSR provided everybody capable of work with jobs. It was, furthermore, illegal to refuse an individual seeking employment. If the individual could not be employed by an enterprise, that enterprise was responsible for lodging the job application elsewhere (Gnybidenko, 1998). Since then deepening economic crisis induced growing unemployment.

The available official data suggest that, since 1991, general employment levels and labour force (minimum age 17 years, maximum age 55 years for women and 60 years for men) size have been decreasing whereas general unemployment has risen. Between 1991 and 1996 the labour force decreased by 5 %, state employment declined by about 40 % yet official general unemployment increased by just 2 %. In 1998 unemployment was more than 4 % higher then in 1996, suggesting an increasing trend (EBRD, 1995; 1998) (OECD, 1999). However, there are suggestions that further unemployment

remains hidden. Different estimates put hidden unemployment as high as 50 % (Gnybidenko, 1998).

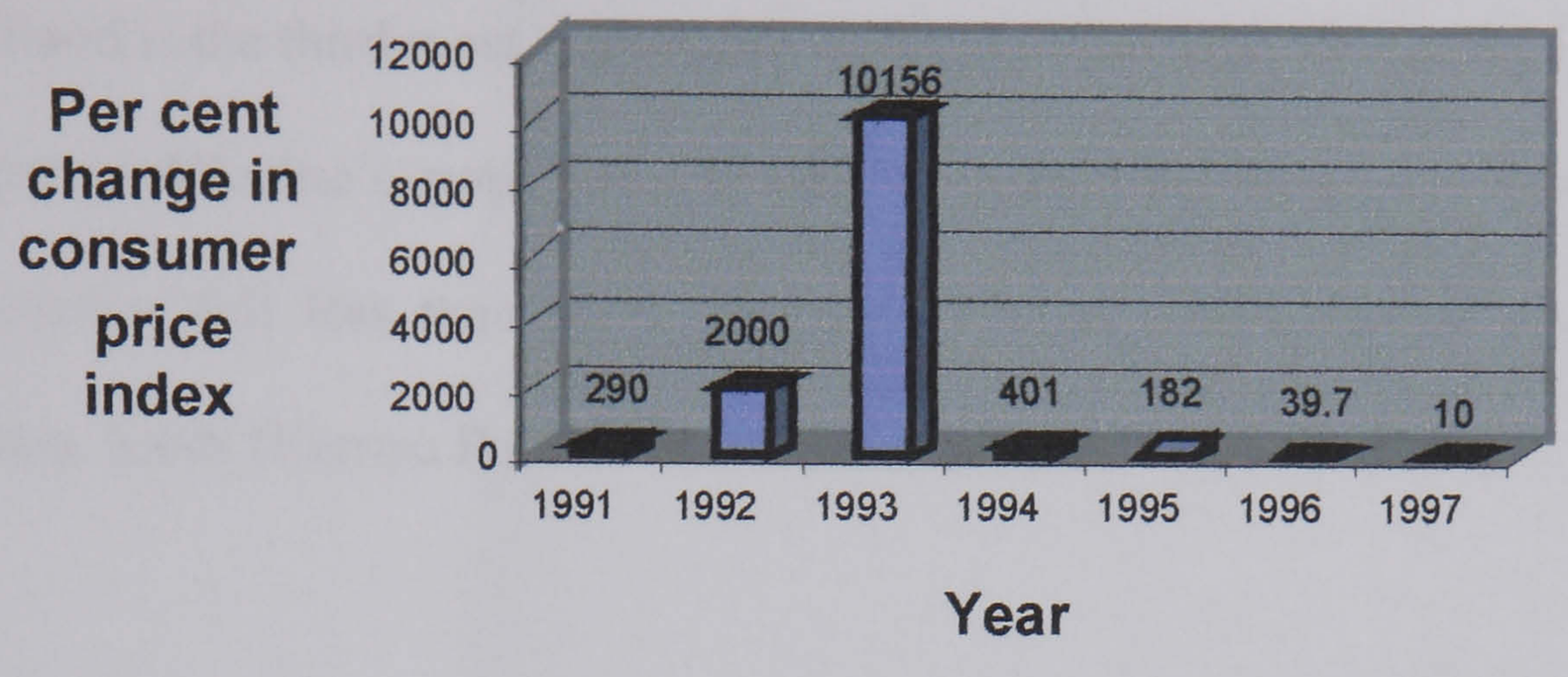
Economic hardships in the country found a reflection in the dynamics of population change. In 1980s, and before 1993, the population of Ukraine was growing and reached its peak of 52 million people. Since then there has been a rapid decline and in 1997 the number of inhabitants was about 50 million people, or the same as in 1980 (Europa Publications Limited, 1997) (EBRD, 1995). A large net loss of population is due to out-migration, lower birth rates and increased death rates. In 1996, for instance, 129 538 persons entered Ukraine and 246 724 left, a net loss of 117 186. Emigration of scientists, widely known as a "brain drain", reached considerable proportions, seriously endangering the intellectual potential of the country (IOM, 1998).

Combining the effects of low birth rate with steady out-migration, the population was decreasing by about 500 000 people (or 1 % of the total population) every year between 1996 and 1999. For comparison, during the 1980s, the population was increasing at an average rate of 0.4 % a year (Europa Publications Limited, 1997).

2.3.4 Personal incomes and cost of living

Declining employment is coupled with falling household incomes. Inflation and price increases (Figure 2.3) have been depleting the purchasing value of people's earnings. Also, since 1995 the government has applied strict fiscal policies to curb inflation. This resulted in massive delays and arrears of wages and pensions (Pozdnyakova, 1998). As was mentioned before, the backlog of the country's debt, both domestic and external, is growing.

Figure 2.3 Growth of consumer prices during 1991-1997



Sources:
OECD (1999). Agricultural Policies in Emerging and Transition Economies;
EBRD (1995). Transition Report 1995 "Investment and Enterprise Development";
EBRD (1998). Transition Report 1998 "Investment and Enterprise Development".

Considering non-food goods and services the purchasing value of meagre wages is diminished by the significant share occupied by food spending (about 60 % of personal income) and the factor of wage arrears (OECD, 1999). For instance if a household of two persons earns 80 $US a month, about 50 $US will be spent on food. So the household has 30 $US to spend on other goods and services, such as household bills, house maintenance, clothing, transportation, leisure, etc.

When people are short of funds the consumption of more expensive livestock products and processed foods (meat, milk, eggs and sugar) decreases more significantly than that of unprocessed food (fruits and vegetables). In 1997 the consumption of livestock products and processed food in Ukraine was 60-100 % lower than in 1990. The consumption of unprocessed food in 1997 was only 0-10 % lower than in 1990. The consumption of the most basic key products such as vegetable oil and potatoes (called "second bread" in Ukraine) has shown no change during 1990-1997 (Europa Publications Limited, 1997).

Without air a person can survive no longer then 3 minutes. Without water a person can live no longer then 3 days. Without food a person can unlikely survive for more then 30 days. Food is the third most important thing in our life. That is why, despite the incomes of most of Ukraine's population having decreased by about 4-7 fold, overall food consumption fell less than 50 % for certain foods, and even increased for cheaper substitute foods (Europa Publications Limited, 1997).

It is not expected that people would be spending much for other goods and services (including pollution prevention), if they can hardly afford to buy food. This will be demonstrated in Chapter 7. That is why any increases in tariffs on household bills or public transportation would not bring about the desired effect of boosting state budget revenues. On the contrary, more people would stop paying for these goods and services, simply because they will not be able to afford them. But they will not stop using them, because, for instance, one needs to be warm in winter and use transport to get to work. If more tax were imposed on industrial and agricultural goods, people would stop buying them. But this does not mean that they would stop consuming such vital survival goods. As a result crime rates in the country are high (Kulik, 2000). Further economic decline may push more people in society into further corruption, bribing, or illegal money extortion, thus making a vicious circle.

Once people are deprived of the possibility of buying even cheap, vital foods, the country may experience a radical change of the current democratic and pro-Western political regime. As historical experience suggests, this may be some totalitarian regime (Pavlyuk, 1999). During the last 350 years Ukraine has had in total only 14 years of independence. The establishment of such a regime is a matter of whether Russia (which has very similar pattern of socio-economic development) and Ukraine will be capable of

coping with deepening economic crises and thus, staying on the road to democracy. Because it is not clear whether the economic crises in Ukraine and Russia will get better, it creates a great uncertainty with respect to the political future of the country, even within the next five to ten years.

2.3.5 Other CIS states

Other CIS countries experienced similar patterns of socio-economic, environmental and political changes in the 1990s. Russia, for example, had a net loss of 800 000 people in 1999. Demographers have predicted that Russia's population may decline from the present 145 million to between 80 and 100 million by 2050 (Miletitch, 2000). For these countries, while the harsh economic situation is considered to be a major factor in population decline, poor quality of the natural environment is also an important factor regarding its adverse implications for human health (Kozak, 1997).

Only three former Soviet states: Latvia, Lithuania and Estonia have managed to improve their economies since 1991. Here, as in Ukraine and Kazakhstan, the last decade passed relatively peacefully. However, the transition of countries such as Kyrgyzstan, Uzbekistan, Tajikistan, Azerbaijan, Armenia, Georgia, Russia and Moldova has been associated with recurrent military conflicts, which have cost hundreds of thousands of lives, for example Russia's two wars in Chechnya (Reuters, 1999). Given such economic stress and political turmoil, it is not surprising that environmental quality receives little, if any, attention. The problem of environmental quality however, persists. All these countries have environmental "hot spots", where localised pollution presents a serious threat to human health and welfare. These are very often located in densely populated urban areas.

Two-thirds of Ukrainian families live in urban areas and Ukraine ranks 12th among European countries with respect to urban population density. At 86.0 people per square kilometre, this is greater then the United Kingdom, Spain, Austria, and Greece (United Nations Office in Ukraine, 1996).

It will be demonstrated that more then 90 % of respondents are concerned about poor environmental quality (Chapter 7). Indeed, in 1992, the Supreme Soviet of Ukraine declared the entire territory of the country a "zone of ecological disaster" emphasising, in this way, the urgent need to improve the "ecological health" of the nation.

2.4 An overview of environmental pollution

In the mid-20th century, Ukraine had extensive industrial development particularly metal processing, machine construction and military industries. In common with other CIS states, air and water pollution are a localised problem characteristic of urban and industrial areas. The primary sources of pollution are transport, household waste, mining, metallurgy and machine construction enterprises and the food industry.

Levels of many pollutants remain unacceptably high, largely due to deteriorating treatment of sewage effluents and increased emissions of air pollutants in urban areas. Environmental pollution is highest in the three major industrial centres - Donetzk, with 26.7 % of the nation's industrial output, Dnipropetrovsk with 14.8%, and Lugansk with 10.9% (MEP, 1997).

In 1994 alone, estimated 8.3 million tons of air pollutants were emitted in the Ukraine. On the other hand, general levels of environmental pollution have been declining since 1990. Apparently, the reason for this was a decrease in the number of operating factories due to the economic crisis (Semichaevsky, 1996). A steady growth in the number of registered motor vehicles during the 1990s has led to deterioration of the air quality in cities, with oxygen levels in downtown areas, on average, 42% lower than in suburban areas.

In 1994, waste sediments (which were deposited in lakes, rivers, streams and the sea) amounted to 15.9 billion cubic metres - 22% less than in 1990. Sewage accounted for 4.87 billion cubic metres of the total. Since then, the volume of sewage effluent has increased while industrial pollutants have declined and there has been no corresponding increase in the wastewater treatment capacity. Nation-wide, sewage accounted for 30.7 percent of total effluent in 1994, but locally it could be very high: 73% in Kharkov Region (called Kharkov Oblast*) (where outdated treatment facilities operate very inefficiently), 71% in Lugansk Oblast, 57% in Chernovtsi Oblast, 56% in Kherson Oblast, and 52% in Odessa Oblast (Semichaevsky, 1996). All these effluents are discharged into natural waters - rivers, lakes, and ponds - polluting them with metals and pathogens and creating risks to health.

By law water users not connected to sewage companies are required to treat own sewage effluents. They either need to maintain existing treatment facilities in working order or install new ones including those involving best available treatment technologies not entailing excessive costs (BATNEEC). Economic difficulties of many water users, unfortunately, remain a problem in their pollution prevention efforts (MEP, 1998).

The handling of industrial and household solid wastes has not yet been adequately addressed. Between 1991 and 1995, the economy of Ukraine was consuming, on average, 1.3-1.5 billion tonnes of natural materials or 25-29 tonnes per capita. Today 17 billion tonnes of various wastes are dumped over the surface of an area equal to 53 000 ha (or approximately 0.09% of the area of the country). The bulk of it consists of waste from the metallurgical and coal industries, most of which are located in the south-eastern part of the country.

Waste dumping often occurs without measures to prevent pollutants entering groundwater or watercourses. Mine spoil is deposited in large heaps near the ore or coal extracting and processing enterprises. Domestic waste may be dumped into small or average-size valleys or shallow pits, typically up to 600 m in diameter (Appendix 2.5). Then, when the facility is filled, the site is covered with a layer of topsoil perhaps only 0.5 to 0.8 m thick. Soluble chemical and biological components of the waste are readily dissolved and leached. Pollutants may leak into aquifers causing "hot spots" of heavy groundwater contamination, for example in the highly permeable sandy alluvium of many river valleys (MEP, 1994).

Towards the end of the 1990s, pollution from the agricultural sector in general, was not considered a serious problem because most farms could no longer afford to buy agrochemicals. However, with about 70 % of the country's territory under agriculture, wind and water erosion of soil remain problems that lead to sedimentary loading of water bodies (MEP, 1998).

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* Oblast is a regional administrative unit analogous to, but much larger than an English county. There are 25 Oblasts in Ukraine, these are subdivided into smaller districts.

It is because four-fifths of Ukraine's national product is from urban areas that the most acute problems of air and water quality are manifest here (Kozak, 1997). By contrast, there are many rural areas in central, southern, western and north-eastern Ukraine that enjoy water and air of good quality (Kuzin, 1995). For comparison, Russia has even vaster areas unaffected by human activities, while densely populated areas are often exposed to heavy soil, water and atmospheric contamination (SCRFEP, 2000).

2.5 Sources of adverse environmental externalities

2.5.1 Industry

Since 1991, industrial production has fallen by two thirds, significantly reducing the level of many air and water pollutants and the production of solid waste. But overall, levels of many pollutants remain unacceptably high.

In Ukraine, the main pollution sources of air and water bodies through precipitation, are thermo-electric power stations and metallurgy that are emitting respectively 32% and 38% of total pollution from stationary sources. Many metallurgical, mining and other enterprises located in the Donetsk-Dnipro region are the major cause of the ecological crisis there (Appendix 2.6). Moreover, most of them are located in the cities and other densely populated areas. Air emissions of these enterprises coupled with car exhaust gases cause poor air conditions in urban areas. The most striking quantities of pollutants are being emitted by enterprises in Mariupol city (Pozhivanov, 1995).

Almost 70% of electrical power generated in Ukraine is obtained by burning fossil fuel at thermal power stations with a total capacity of 37.6 GW. Of all energy producing enterprises, thermal power plants are the most significant sources of environmental pollution. This is attributed to outdated technology and the total absence of facilities for scrubbing sulphur and nitrogen oxides. Emissions caused by energy generating enterprises consist of solid particles (30% of the total pollution), sulphur anhydride (63%), nitrogen oxide (53%) (Semichaevsky, 1996).

The chemical industry also adds to air pollution by emitting, among other gases, sulphur anhydride, oxides of nitrogen, hydrocarbons and various volatile organic compounds. In addition, oil refineries may pollute underground waters with hydrocarbons. Although machine tool works emit little pollution in total, specific contaminants discharged may be extremely hazardous to life. For instance, the Dniprovsky Welding Tool Factory in Zaporizhzhya is responsible for only 3.5% of the total air pollution in that city, yet 80% of these emissions are carcinogenic and hence ranked as highly dangerous (Semichaevsky, 1996).

2.5.2 Agriculture

During the 1990s inadequate amelioration measures, improper storage and misuses of chemical fertilisers and pesticides often caused negative environmental impacts. In 1992, 71,000 tons of pesticides were applied in the country. This means that every hectare was treated with 2.2 kg; the average World application does not exceed 0.5 kg ha^{-1} (Kuzmenko, 1996). The picture has changed drastically since 1992 as farms ability to purchase and apply agrochemicals has been undermined by economic crisis. Now most farms apply very little or no artificial fertilisers or pesticides and environmental

experts do not consider the present loading of rivers by agrochemicals to be a problem (Danilishin, 1998).

Soil erosion remains a problem. According to data obtained by the State Committee on Land Resources of Ukraine (SCLRU, 1996) 34% of agricultural land is either vulnerable or being actively eroded by water and wind. It contributes to deterioration of drinking water quality by abundance of suspended solids during rain and spring floods.

2.5.3 Industrial and household waste

During 1991-1995 the economy of Ukraine was consuming, on average, 1.3-1.5 billion tons of natural materials or 25-29 tons per capita (Ministry of Statistics, 1995).

Most of them were returned to the environment as the waste from industries and consumers. Rough estimations showed that, if this trend persists, the quantity of waste would reach 25-30 billion m^3 by 2000. So far there have not been published any reports showing that this has already happened.

In 1992 industrial wastes mainly consisted of waste products from fuel production enterprises and energy plants (13.88 million tons of ashes and slug), coal mining and coal treatment enterprises (99.68 million tons). A large amount of waste also comes from other mining industries, ore-dressing facilities, chemical and military industries. Most waste is accumulated in the regions of Dnipropetrovsk and Donetzk (Appendix 2.6). The bulk of it consists of waste from metallurgy and the coal industry. Today 17 billion tons of various wastes are dumped over the surface of an area equal to 53 thousand ha (or approximately 0.09% of the area of the country). In the future recycling

this waste could be an important source of raw materials for the economy and may yet serve as a basis for future sustainable development.

The share of re-used materials in total consumption was steadily rising and in 1992 reached 20% (this is the highest figure across all CIS countries). However, the current level of recycling has gone down due to the severe economic depression.

A pressing problem in Ukraine is the storage of radioactive waste (RAW) and the use of radioactive materials. First of all this concerns the enormous amounts of RAW resulting from the Chernobyl accident. Second, attention should be drawn to the more than one thousand sources of radiation that are being applied for industrial, agricultural, medical and scientific purposes. In the third place more than 70 million m^3 of RAW are dumped or stored by the uranium industry, the mining and processing industries. The latter are a substantial source of the radioactive pollution to the environment, including roads, towns, villages and houses, since in certain cases material from the dumps is used for building purposes (Umanetz, 1995).

Since independence in 1991, Ukraine has faced a problem of treating spent nuclear fuel because, among the former Soviet republics, only Russia has the facilities for recycling. At present the spent fuel is stored in temporary reservoirs located at the nuclear power plants. For instance the Khmelnitzky Nuclear Power Plant had almost completely filled its own reservoir by 1995. Additionally, radioactive materials used by the military have to be disposed.

In 1992-93 foreign companies made more attempts than before to import into Ukraine so called "raw materials" that were in reality mere waste. Usually this is waste that is

difficult or expensive to treat and often consists of toxic chemicals. In this case, smart dealers (relying on dishonest Ukrainian partners) are taking advantage of the deficiencies of the Border and Customs codes of Ukraine, and of the absence of regulations regarding the prohibition of importing such materials. There is an urgent need for arranging an ecological service that will operate at the country's borders, and regulations should be worked out and adopted at an international level in order to stop Ukraine becoming a dumping place for the rest of Europe (MEP, 1997).

Upon the initiative of the Ministry of Environmental Protection (MEP) the Supreme Soviet of Ukraine adopted a resolution on the 17th of November 1993 charging the Cabinet of Ministers to approve a list of chemicals and materials that are regarded as hazardous waste and prohibited imports to Ukrainian territory. A form of a statistical report concerning "Toxic waste" was drafted and approved in 1993 (Semichaevsky, 1996).

2.5.4 Urbanisation

Ukraine's cities have grown around its huge, planned industrial centres, particularly in the machine tool, heavy engineering, fuel, metallurgical, aerospace, chemical, and food industries. During the 1970s and 1980s, many people migrated to Ukraine attracted by favourable climatic conditions, better working opportunities and state policies in different parts of former Soviet Union. From 1976 to 1995, the number of towns and cities increased from 304 to 445 and the number of urbanised settlements rose from 892 to 911. The most intensive urban development occurred in Crimea, Vinnitza and Kyiv Oblasts.

2.6 The impact of environmental quality on human health

Soviet rule was supposed to guarantee the right to unlimited free medical care, financed by the state. In practice, however, the constraints of funding and management and the absence of an incentive system limited the quality, efficiency, effectiveness and openness of the system. These problems pre-dated the period of transition and since then health standards have worsened further. The decline in recent years is apparently attributable to rapidly declining living standards, environmental hazards, poorer health care facilities, and a growing range of social problems (Palamarchuk, 1998). The decline in health is followed by negative population growth of –2 persons per 1000 (MEP, 1994). Population decline accelerated towards the end of 1990s.

2.6.1 Water quality

Ukraine has enough fresh water resources to meet the basic needs of industry, agriculture and households. However, due to poor control and drastic deterioration in sanitary and hygienic standards causing water pollution (Appendix 2.7), there has been a steady increase in the rate of infections of water-borne, and parasitic diseases - 18.5% between 1990 and 1994; diphtheria has increased by 27 fold, and measles by 44.1%. Since 1991, epidemics of cholera in the southern regions have become an annual occurrence. Before 1994, the number of cases ranged from 60 to 100; by 1994-1995 it had increased to more than 2 000, and the total number of cholera cases in 1994 contributed to more than half of cholera mortality in the whole of Europe (Gusakov V *et al*, 1995). This has caused alarm within the medical profession and public alike.

Insufficient drinking water supply in some areas of Ukraine is supposed to be one of the major reasons for acute epidemics of contagious diseases. In 1994 water was blamed for outbreaks of cholera, dysentery, typhoid and viral hepatitis A. Taking into account weather patterns in 1994, water was clearly identified as the cholera transmission agent. Cholera vibrios were identified in inland water bodies, in particular in the Crimea Autonomous Republic, Dnipropetrovsk, Poltava, Kharkov and Donetzk regions. In Dnipropetrovsk region (Kryvoi Rog and Zholti Vody) about 2 000 people were infected with the hepatitis A virus. Investigations concluded that this high morbidity was associated with a water transmission pathway (Semichaevsky, 1996). One in eight water samples analysed did not meet the bacteriological requirements of the State Standard. This water poses real dangers in terms of contagious diseases. Besides the low quality of the drinking water supply, there is one more hazardous factor; the bacterial contamination of inland water bodies that support direct human use (recreation, swimming, fishing, irrigation, etc.). This problem affects mainly the Crimea Autonomous Republic, Kherson, Nikolaev, Odessa, Zaporozhie and Donetzk regions.

Today, the quality of water supply to the Ukrainian population continues to suffer from a lack of funds to maintain and replace existing waste water treatment and water supply systems (Appendix 2.8). Also, the country is deprived of an integrated system of water supply management; water supply installations are operated under different ministries and managerial agencies, and existing water-treatment technologies can often barely ensure the required quality of water from the contaminated sources of the centralised water supply systems (Semichaevsky, 1996).

2.6.2 Air pollution

One third of the population of the country is subjected to excessive air pollution. This largely affects those living in urban areas, which traditionally experience high levels of air pollution.

During the 1990s morbidity in the Ukraine increased by 17.5%. An analysis has shown the growing number of diseases caused by negative environmental changes. These non-infectious pathogens, malignant tumours and diseases of the blood circulatory system, blood itself, hematogeneous organs and the endocrine system. Most cases are recorded in industrial regions (UNOU, 1996).

Respiratory diseases have traditionally accounted for a large share of all diseases (46.1% in 1994), and are also the principal cause of death (6% of all deaths and 5% of deaths of the population of productive age in 1994). Disorders of the nervous system and sense organs are the second most widespread (9.6% in 1994) due to a high incidence of psychological and emotional stress. Poisoning and injuries (8.6%), take the third place, in part because of high alcohol consumption (Libanova, 1996). In addition, the incidence of tuberculosis is rising - from 28.8 per 10,000 people in 1991 to 36.7 in 1994. The true increase may have been larger but many cases are not recorded by official statistics both because of lack of medicine in clinics and general deterioration of the socio-economic condition. These have forced many people to resort to self-treatment, inevitably leading to poor prognosis and relapse of the disease in more severe forms (Danilishin, 1998).

Four-fifths of primary diagnoses of active tuberculosis were registered for persons of working age, and approximately half of the patients with active tuberculosis are transmitters of the bacilli. Declining nutritional standards, poor sanitation and water quality, urban air pollution and congestion all contribute to the problem.

Declining standards of diagnosis and treatment, particularly among the young, have caused an increase in the share of chronic and degenerative diseases - a potential long-term threat to the nation's human resources. Cases of malignancies are also on the rise, from 139.9 thousand in 1985 to 160.8 in 1994, especially serious are cancers of the skin, breast, uterus, thyroid, lymphatic nodes and bone marrow.

2.6.3 Impact of radioactive contamination

Another factor affecting human health in the northern and north-eastern parts of Ukraine is radiation contamination, which is the result of the Chernobyl Nuclear Plant accident. In urban areas located in the northern part of Ukraine this factor is important, alongside air and water pollution.

Children are particularly vulnerable to the impact of radiation and the increase of birth abnormalities and child morbidity is alarming. Compared to 1985, in 1992 a 10% increase was observed. In 1992, 51 cases of malignant tumours of the thyroid gland were recorded in children. The annual incidence of thyroid cancer in children in Ukraine from 1981 to 1985 was 0.4-0.5 per million. It increased significantly to 3.1 per million in 1994, the incidence being higher in Kiev, Chernigov, Zhitomir, Cherkasy and Rovno Oblasts, in Belarus and in the Kaluga and Bryansk Oblasts of Russia. This has been one of the major health consequences of the Chernobyl accident, a positive correlation

having been established between the thyroid exposure dose and incidence of the disease (WHO, 1995).

Within the field of environmentally related impacts there are both major and minor factors that influence human health. For instance, major factors may be high radiation levels in some areas of Northern Ukraine, high air sulphur concentration in the south-eastern part and excessive amounts of nitrates in water in the south, in combination with minor ones, e.g. the presence of agrochemicals in food.

Besides health effects there are also a number of ecological problems related to water resources ranging from small-scale to regional ones.

2.7 Case study: regional ecological problems

In 1992 Ukraine's government stressed the urgent need to improve the 'ecological health' of the country. However, under the circumstances of the economic depression and the inability to provide appropriate financial support for nature protection and reclamation measures on a nation-scale, the only opportunity is to identify and focus on priorities.

Considering the pressing problems affecting water resources and the need to implement urgent measures to improve the environment, the attention of legislators and the executive authorities has been drawn to such regions as the Azov-Black Sea area, Polissya and the Dnipro River. In these regions the ecological situation is worse than in other parts of the country (MEP, 1997). These will be discussed in turn.

2.7.1 The Azov-Black Sea area

The Black and Azov seas are receiving pollutants from almost all Ukraine's territory. Within the catchment area of the Black Sea 12.5 billion m^3 of wastewater is discharged every year, including 2 billion m^3 of polluted water.

Every year within the catchment area of the Azov Sea, 4 billion m^3 of wastewater is discharged, including 1.9 billion m^3 of polluted water. Also, 28,000 tons of organic pollutants, more than 1000 tons of petroleum products and many other compounds are discharged to the sea. The main sources of pollution here are industrial plants located in Mariupol (Pozhivanov, 1995).

Intensive irrigation, especially for rice production in southern Ukraine, coupled with substantial pollution has led to hydrological changes influencing coastal territories. The discharges of pesticides in the recent past and of highly mineralized drainage waters have promoted sedimentation and the degradation of coastal inlets and bays. In case of the Azov Sea, damming and irrigation developments on the rivers Don and Kuban, which are its main sources of fresh water influx, increased the salinity of the sea. As a consequence (being simultaneously an indicator of environmental changes) a three fold drop in fish catches in the Azov-Black Sea area was recorded in the first half of the 1990s (Pozhivanov, 1995).

The ecological condition of the Azov and Black Seas can only improve if environmental conditions also improve in the catchments of rivers flowing into these seas.

The national programme regarding the ecological rehabilitation of the Dnipro river is partially focused on this objective and measures are now undertaken in the Donetzk-Dnipro region (central and south-eastern Ukraine). In May 1993 the MEP, the International Centre for Development and Research (Canada) and the Extraordinary Committee on Ecological Problems of the Dnipro River signed a protocol outlining intentions to improve the ecological state of the Dnipro. The Canadian Government provided financial assistance for this purpose.

International co-operation has a fundamental importance in such rehabilitation. Besides Ukraine, the Black Sea is shared by Romania, Bulgaria, Turkey, Georgia and Russia, with Russia also bordering the Azov Sea. Furthermore, international measures to improve the water quality of the Danube River are also required.

In Odessa on the 7th of April 1993, representatives of these countries signed a Declaration on the Protection of the Black Sea. This was considered as an intermediate stage in making progress towards an Action Plan concerning the Black Sea (MEP, 1997).

2.7.2 The Ukrainian Polissya

This area covers the northern parts of Lutzk, Rovno, Zhytomyr, Kiev, Chernigov, Sumy, and Lvov regions. The main economic activities are related to agriculture, where mainly drained land is used. Non-agricultural lands are largely occupied by temperate and coniferous forest. The adverse effects of human activities on the natural environment of Polissya region emerge mainly as degradation of soil involving the depletion of the humus layer (every year 5.27 million tons of humus is being lost). Also, as a result of

the Chernobyl accident, almost 5.9 million ha of land in Polissya have been contaminated, including 3.0 million ha of agricultural land.

Ecological matters in this region have proved controversial since the large-scale drainage of wetlands from 1966. Since then, the area covered by agricultural lands has increased by 1.6 million ha. However, lands threatened by deflation, acidification and erosion now comprise 24.4%, 47.1%, and 17.7% respectively of the total agricultural land.

The level of groundwater has dropped by an average 0.8-1 m, which has led to irreversible hydrological changes. The effect of these changes on the water regime of the Dnipro river, whose basin is a great part of the region, has not been explored. Reportedly, wildlife has suffered and specific flora has decreased in area and numbers (Semichaevsky, 1996).

A complex solution to the ecological problems of the Ukrainian Polissya can be found by implementing measures aimed at addressing the negative influences of drainage and radioactive pollution. Starting from an initiative of the MEP the Cabinet of Ministers of Ukraine (1993a) adopted a Resolution "On Urgent Measures Concerning the Improvement of Ecological Conditions in the Polissya".

In the MEP's opinion, work should be speeded up for establishing ecological grounds for the monitoring of ameliorating activities, the economic assessment of nature protection measures, and implementation of ecologically safe, resource-saving techniques and technologies with reference to amelioration or land reclamation (MEP, 1998).

2.7.3 The Dnipro River

It is difficult to overestimate the significance of this river that supplies water to almost two-thirds of the population of Ukraine. The catchment area (294,000 km^2) comprises almost a half of the country's territory. Most of the resources of surface and underground water originate here.

The ecological condition of the Dnipro River is far from satisfactory due to intensive consumption of water, discharge of pollutants coming in from industries, agriculture and sewerage. The run-off of fertilisers and pesticides from fields in the recent past, the negative influence of irrigation (in the South) and wetland drainage (in the Polissya area) further contribute towards poor ecological conditions. It is not yet realised, and society remains unaware of the consequences of transforming a huge river into a cascade of large and fairly shallow reservoirs. In reality the Dnipro River now consists of six such reservoirs. It is difficult to find another comparable situation in Ukraine where the natural, fluvial ecosystem has been so badly disrupted. Although this was undertaken for economic reasons (the benefits now seem unclear), it is obvious that the environment has suffered seriously (Semichaevsky, 1996).

As a consequence of Soviet industrialisation in the 1930s and after World War II, the river was dammed throughout its stretch from Kiev and Chernobyl in the north of Ukraine to the Black Sea in the south. Six large water reservoirs are mainly used by the electricity generating industry. The proximity of Donetzk region (rich in coal deposits) and the Kursk region of Russia (rich in iron ore) caused a boom in industrial development in the Dnipro basin.

Since the 1930s, there have been continuing landscape and hydroecological changes due to industrial development. New zones of industrial development were being created until the early 1990s that cause pollution from heavy metals and other toxic elements, compounds and radionuclides. Emissions and discharge of pollutants to the air and water are from factories and plants, and are also a result of intensive land use for agriculture (up to 63.5% of the territory). More than 50 ponds in the region are used for the accumulation of industrial wastewater (3.7 million m^3), and almost 100 wastewater filtering fields are operating here with a capacity of 270 thousand m^3 per day (Semichaevsky, 1996).

The outcome is a frequent eutrophication of water-bodies, the decline of fish catches (compared with 1989 in 1992 the total fish catch was 40% lower), polluted bottom sediments (toxic chemicals, heavy metals, etc.) and low water quality unsatisfactory for industrial, agricultural or domestic use without enhanced treatment. The situation has been aggravated by immense contamination of some parts of the Dnipro River catchment area and river sediments by long-living radionuclides (caesium-137, strontium-90, etc.) following the Chernobyl accident (Markham, 1996).

Today, due to the state budget deficit, in Ukraine the construction of water treatment plants is financed mainly in the Dnipro basin. Unfortunately, such financial resources are often misused and, instead of being spent on acquiring necessary equipment and installation works, benefits accrue to certain individuals, who are responsible for managerial and operational activities (Kuchma, 1995).

The Dnipro River could be rehabilitated if a nation-wide programme were adopted. Close co-operation should take place with Belarus and Russia. A crucial part of such a programme would be the ecological improvement of small rivers.

In 1992 the President of Ukraine signed a decree outlining measures to improve the ecological conditions in the Dnipro basin. Under this Decree an Extraordinary Committee has been organised to cope with the problem. In addition, the country has a complex and comprehensive system of state environmental management responsible for development and implementation of various measure to protect the environment including river pollution control.

2.8 Regulation of natural resource management and environmental protection

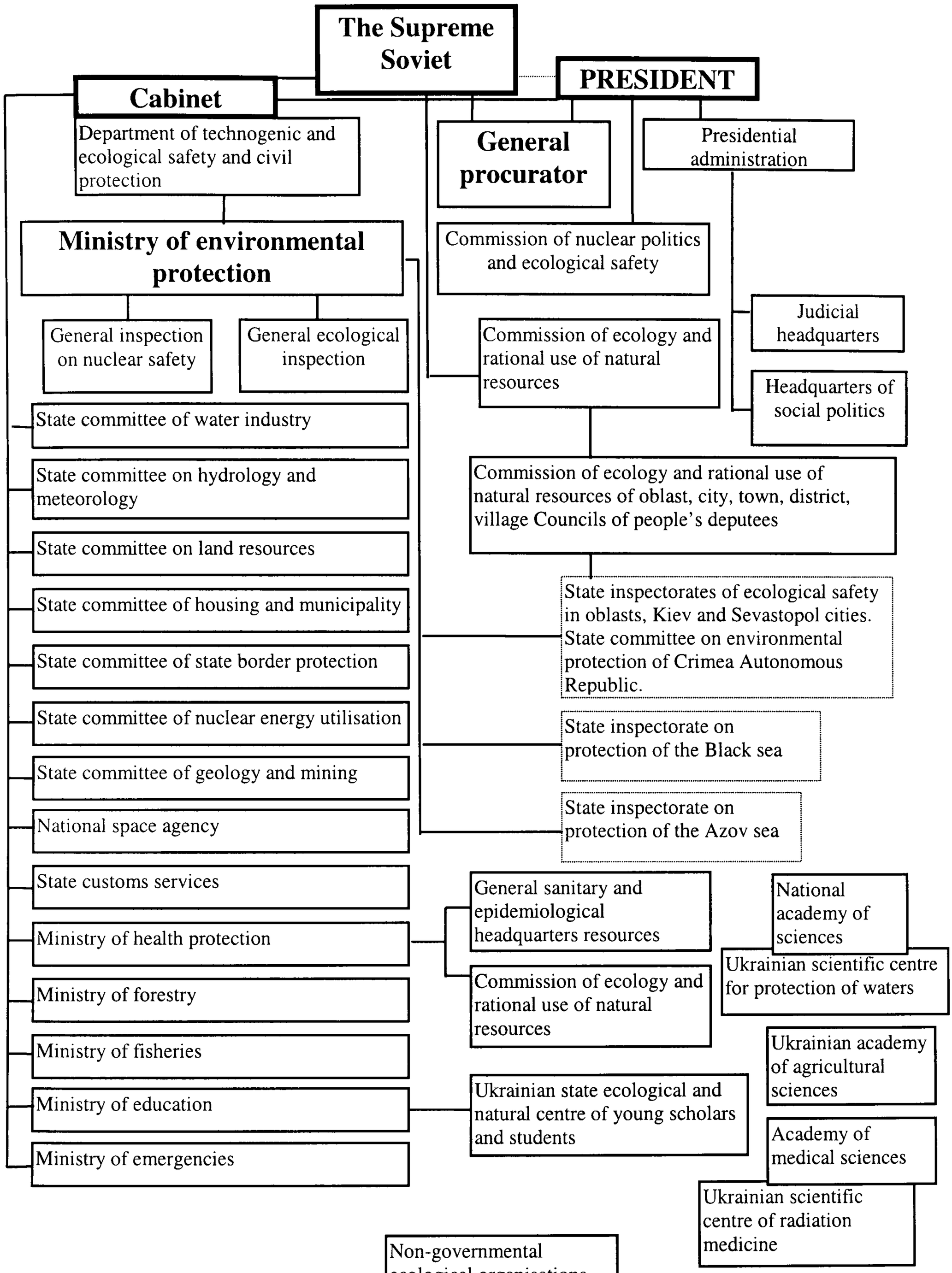
2.8.1 The system of state institutions

The Ministry for Environmental Protection of Ukraine (MEP) is the most senior governmental body charged with the complex administration of environmental protection and co-ordination of nature protection activities in the country. The MEP consists of a headquarters in Kiev and state departments in the Republic of Crimea, 24 administrative regions, the cities of Kiev and Sevastopol, a Superior state inspectorate and state inspectorates engaged in the protection of the Black and Azov seas (Figure 2.4). The number of personnel in 1993 totalled 2 600 (including 178 at the headquarters).

Article 20 of the Law of Ukraine "On the protection of the natural environment" authorises the MEP to carry out state control of the use and protection of land, mineral resources, surface and ground waters, atmospheric air, forests and other types of vegetation, animal wildlife, the marine environment, natural resources of territorial waters, and continental and maritime zones of the country. Ecological safety is also within the MEP's competence.

Figure 2.4

The system of regulatory bodies for environmental protection in Ukraine



Source: МЕР (1998). National Report on the State of the Environment in Ukraine in 1996.

The lack of direct financial support and insufficient authorisation are hampering the efforts of the MEP fully to implement the requirements of the environment protection legislation. In 1993 the MEP had at its command, approximately 0.02 % of national GNP. In Western Europe similar departments usually command 1 to 2.2 % of the GNP (MEP, 1994).

Another obstacle is the fact that natural resource management is actually carried out by a variety of institutions: Ministry for Forestry, State Committee on Geology and Natural Resources Use, State Committee on Water Management, State Committee on Land Use, etc. Some responsibilities are also carried by the Ministry of Health (monitoring, checking how ecological safety regulations are observed to abate the negative consequences of environmental pollution on human health, etc.), the Road Traffic Inspectorate of the Ministry of Internal Affairs (recording levels of transport vehicle waste-gas), and the State Committee on Hydrometeorology (monitoring).

At present there is no strict clarification of the responsibilities shared between the MEP and the Ministry for Forestry, the Ministry for the Protection of Population from the Consequences of Chernobyl NPP Accident, the State Committee on Water Management, the State Committee on Geology and Natural Resource Use, the State Committee on Fisheries and other central executive institutions of Ukraine. But by means of adopting by-laws, it is gradually becoming more clear about specific responsibilities of particular institutions regarding the management of natural resources (Semichaevsky, 1995).

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Before the Law of Ukraine "On the protection of the natural environment" (SSU, 1996) came into effect in April 1996, environmental protection activities were based on a resource principle. Now new departments have evolved such as Departments of Nuclear and Radiation Safety; Ecological Safety in Industry, Energy Generation, Building and Transport; Management of Complex Problems of Agriculture and Biological Resources. Control functions, as foreseen by Article 20 of the Law, have been handed over in general to the State Ecological Inspectorate and for this purpose it has gained more freedom of action within the system of the ministry. Its increased role has been stated by the Cabinet of Ministers of Ukraine (1993b).

Thus, the MEP now has a great possibility of concentrating on the development and implementation of state policies relating to environmental protection and sustainable management of natural resources.

2.8.2 State ecological monitoring

There is currently no system of ecological monitoring in the Ukraine that can meet the requirements of the Law "On the Protection of the Natural Environment". Monitoring is being conducted by several institutions through specially authorised state departments (MEP, 1997).

The strategic goal is to establish a uniform state system for monitoring the natural environment - SEM "Ukraina" (Cabinet of Ministers of Ukraine, 1993c). Preparations have started on the basis of a long-term scientific and technical programme of complex monitoring of the natural environment. In early 1992, the Academy of Sciences of

Ukraine elaborated the programme alongside a programme of urgent measures regarding the system of ecological monitoring (SEM "Ukraina") (authors - MEP and the Academy of Sciences). The programmes were authorised by the President, Mr. Leonid Kravchuk. Since the end of 1992, research and design began, legal grounds for SEM "Ukraina" are also being worked out, though slowly due to financial shortages.

In support of this action the Cabinet of Ministers of Ukraine, in September 1993, adopted a Decree "On the approval of the status of the state monitoring of the natural environment in the Ukraine".

2.8.3 Environmental education

An essential precondition for progressing to a mere sustainable future is promoting an ecological perspective in the general outlook of both individuals and society as a whole. This should be achieved by a system of step by step environmental education and by working out ecological thought (UNOU, 1996).

Unfortunately, while being conscious of the needs for public ecological education, state policy has not yet focused sufficiently on this problem. Ecological education, information sources and raising public awareness are not attracting enough attention.

However, some positive trends are observed regarding the introduction of elements of ecological knowledge to the educational programmes of state and private schools. Following a special initiative of the Education Ministry, ecological and nature protection departments have been established and appropriate subjects are included in educational curricula.

It is mainly universities, medical, educational, agricultural, industrial and technological institutes and colleges that are engaged in the action. More practice has been gained in educating personnel working in various branches of the economy by organising special training courses. In 1993, the MEP proposed to include a state list of ecological professions. In future, an environmental specialist can be legally included on the staff of any enterprise or institution.

There is therefore a growing interest in Ukraine in ecological education. Methods for promoting an ecological perspective in various age categories and professional groups are being sought. However, such initiatives are spontaneous and often supported only by initiatives and enthusiasms of particular individuals or groups (UNOU, 1996).

Today there is an urgent need to work out a conceptual frameworks and national programme for a permanent and incremental educational process backed by appropriate methods and a legal mechanism for procuring supporting funds. Unfortunately, the State national programme "Osvita" (Education) adopted in 1993 does not regard these problems as a priority. The present task is therefore to adopt both regulations and methodologies that underpin the willingness of the state to address problems and also recognise the right to an environmental education of the population. A mechanism to implement this 'right' is required.

2.8.4 Ecological social movements in the Ukraine

In Ukraine there are already a few nature protection non-governmental organisations (NGOs). The most numerous or active NGOs are the Ukrainian Society for Nature

Protection, the Ukrainian Ecological Association "Zeleny Svit" (Green World), the National Ecological Centre of Ukraine, the Ukrainian Ecological Academy, the Green Party of Ukraine and some other, regional societies.

The economic crisis causes a lack of financial support that naturally forces a re-estimation of values and causes a withdrawal from environmental movements of many potentially active people. Today no organisations can totally fulfil all the functions usually carried out by a typical NGO, such as raising public awareness, forming a constructive opposition to governmental institutions, generating and testing new ideas, mechanisms, solutions, etc. (MEP, 1997). Somewhat closer to this are the Ukrainian Ecological Association "Zeleny Svit" (uniting various groups), and the National Ecological Centre of Ukraine, the members of which are mainly scientists, politicians and state employees ("Oykumena. Ukrainian Ecological Review").

In Ukraine there is no special mechanism worked out for the interaction of NGOs and governmental structures regarding the solution of ecological problems, which restricts many public activities. The establishment of such a mechanism is also hindered by the lack of coherence between the civil rights of the people (here progress has been substantial) and their economic freedom (Semichaevsky, 1996). This and other issues are being addressed through economic and environmental reforms.

2.9 Environmental and economic reforms: an overview

2.9.1 Development of an economic mechanism for funding environmental protection and monitoring

In recent years, the MEP of Ukraine has been actively engaged in the development of environmental and economic reforms. One of the reform components includes the implementation of economic mechanisms to fund the monitoring and protection of natural resources.

Since 1994, a special entry, "Environmental Protection" has been included in the State budget of Ukraine. According to data from the Ministry of Statistics of Ukraine (1995), in 1994 total spending for environmental protection was valued at about US$ 470 million (US$ 116.9 million of capital investments and US$ 353.1 million of current expenses), scarcely more than US$ 9 per capita.

Fines and fees for using natural resources and environmental pollution have been authorised (SSU, 1995, 1996). These payments form the basis of extra-budget funds for local and regional Councils of the People's Deputies, as well as the national extra-budget fund for environment protection. These funds are also replenished through payments from penalties and lawsuits for violations of environmental legislation, and payments for over-limit consumption of natural resources (except payments for over-limit use of fresh water resources, this payment came into local budgets in 1995). Payments for the specialised use of mineral resources and fresh water resources were introduced, regulatory documents for payments for specialised use of forest resources, and fauna and flora resources are under development.

It is noteworthy that one of the major shortcomings is in the absence of an adequate mechanism for adjustment of environmental payments (e.g. penalties for environmental violations) in tune with changing economic circumstances. This substantially reduces their efficiency.

The draft new law "On Environmental Protection" (1996) anticipates the introduction of compulsory and voluntary environmental insurance, which would allow the creation of a fund for environmental insurance used in the rehabilitation of consequences of accidents, disasters and other kinds of environmental pollution.

The MEP assumes that one of the major directions of environmental and economic reforms incorporates incentives to institutions that take efficient measures for environmental protection and produce environmentally friendly products.

The Ministry has furthermore started to develop a mechanism for implementation of environmental audits.

2.9.2 Improvement of the state management system for environmental safety

In late 1994, the Ministry for Environmental Protection was merged with the State Committee on Nuclear and Radiation Safety. Besides the departments of the State Committee, that joined the new nuclear regulation administration, some other new departments were formed within the Ministry. First of all they include the divisions for the control of natural resource use, both land and water resources. The Environmental Security Unit incorporates the departments of waste and secondary raw materials, the

Department of Industrial Environmental Safety and the Department of Ecological Expertise. The Economic Unit ensures implementation of the environmental reforms: introduction of payments for natural resource use, hazardous emissions, discharges and waste disposal. This unit consists of Departments of Economic and Regional Policy as well as the Department of Finance, Budget and Investment.

The Nuclear Regulatory Administration is one of the most important units. The unit has autonomous status; its structure corresponds to the Law of Ukraine "On Nuclear Energy Applications and Radiation Protection" and to the Nuclear Non-Proliferation Treaty. The unit incorporates the following departments: Normative Regulation and Emergency Planning; Nuclear Units Licensing; Nuclear Fuel Cycle Licensing; Radio-ecology; Radiation Technologies; and Radioactive Waste.

2.9.3 Introduction of environmental impact assessment (EIA)

Environmental Impact Assessment in Ukraine was introduced in 1993. In 1994 newly created state EIA departments of the Ministry of Environmental Safety of Ukraine checked more than 4.5 thousand items of pre-design and design documentation, development schemes, programmes, concepts, technical and economic backgrounds, technical and economic solutions, draft projects, working projects, documentation on introduction of new equipment, technologies, materials and substances.

As a result of these reviews, almost 32% of applications were either returned for further adjustment, or rejected completely as unacceptably harmful to environment.

The most important objects of ecological expertise of national significance included:

- "The Programme of Ukrainian Chemical Industry Development"
- "The Integrated Programme of Titanium Industry Development"
- "The National Programme of Ukrainian Mining-Metallurgy Complex Development"
- "The National Programme for Production and Consumption of Helium in Ukraine"
- "The National Programme for Development of Internal Combustion Engine Production in Ukraine".

The bodies of the Ministry of Environmental Protection of Ukraine have considered more than 6,800 applications for preliminary siting of different installations. About 8% of these were rejected as unjustified. As a result, possibilities to save 2600 ha of arable land and 146 ha of best quality forests were found (Semichaevsky, 1996).

During the 1990s, compared to any other sector, the legal sector of environmental protection and natural resource management experienced the greatest development.

2.10 Improvement of legislation on environmental protection and water management

2.10.1 The main laws in effect before 1994

The Law of Ukraine "On the Protection of the Natural Environment" adopted in 1991 is the main document for regulating social relationships in the area of environmental protection, guaranteeing the right of people for life in an ecologically safe environment. This law can be effective only if it is strengthened by a set of relevant laws and special by-laws. The first steps in this direction have been made by adopting such laws as "On

the Natural Reserve Fund of Ukraine", "On the Protection of Atmospheric Air" and "On the Animal World".

A draft law has been prepared and passed over to the Supreme Soviet "On Amendments and Additions to the Code of Ukraine Concerning Administrative Violations". According to this law, the MEP would have the power to record officially administrative violations of nature protection and natural resource management and undertake the necessary inquiries (Semichaevsky, 1996).

2.10.2 New laws

Laws and regulations adopted after 1994 contribute substantially to the improvement of the country's environmental legislation.

The Forest Code of Ukraine, approved by the Supreme Soviet of Ukraine (21.01.1994) provides the legislative base for new approaches to the use, afforestation and protection of Ukrainian forest resources, and provides for more environment friendly uses of forested areas.

The Mineral Resources Code, approved by the Supreme Soviet of Ukraine (27.07. 1994) regulates mining-related issues. Its main aims are: to ensure rational use of natural resources, to satisfy mineral resource demand, other social needs, to ensure natural resource protection, to ensure public safety, property and environment within mining-related activities, to ensure protection of legal rights of institutions, agencies, organisations and citizens.

The new edition of the Water Code of Ukraine (approved on June 6, 1995) regulates water use. It is aimed at ensuring scientifically-based, rational water consumption for domestic and industrial purposes, replenishment of water resources, water protection from contamination, prevention and elimination of adverse water impacts, improvement of water bodies' quality and protection of the legal rights of institutions, agencies, organisations and citizens in water use.

The Law of Ukraine "On Environmental Impact Assessment"; (February 9, 1995) is of great importance. The aims of this law are: to regulate social relations within environmental research, analysis and assessment of pre-design documentation and projects that might adversely affect environment and public health, that might pose some danger to the environmental safety of individual citizens or the whole society.

2.10.3 Draft legislation

In order to ensure further improvement to the legislation related to environmental protection, natural resource use and environmental safety, a draft law of Ukraine "On Additions and Amendments to the Ukrainian Law on Environmental Protection" has been developed. The draft law can be considered as an attempt to expand the range of civil rights, and environmental rights in particular; for voluntary and compulsory environmental insurance; for law suits to limit, to suspend or terminate activities associated with location or operation of environmentally hazardous installations/activities; for law suits on protection of violated environmental rights. This would assist in the protection of citizens' environmental rights and ensure better

environmental safety at different stages of adverse environmental activities (Semichaevsky, 1996).

Taking into account these new functions, the status of the Ministry for Environmental Protection and Nuclear Safety of Ukraine is identified as the national state authority responsible for environmental management and supervision of environmental protection, natural resource use and environmental (including nuclear) safety in Ukraine (MEP, 1997).

The draft law anticipates, in particular, new approaches to ensuring environmental safety, and sets out a system of governmental, legal, organisational, scientific, technical, economic and other social measures that is aimed at maintenance (protection) of high quality environment, safe for human health, natural systems and complexes. The draft law includes exact definitions related to environmentally hazardous activities, introduces new norms for environmental safety (levels of environmentally hazardous activities) and sets out criteria and grounds for the application of disciplinary, administrative and criminal responsibilities for environmental law violations.

The draft law on waste is quite important for further development of environmental legislation. The provisions of the draft are based upon the main principles and provisions of the Basel Convention on control of transboundary transfer and disposal of hazardous waste.

A long-term project to compile a draft Law on Environmental Emergency Zones was started in 1994. The draft law is of major importance to the people of Ukraine, since a substantial proportion of the population lives in complicated environmental conditions

(both because of natural disasters and adverse industrial impacts on the environment). For instance, this law will regulate activities in the Chernobyl zone, some areas of Donetzk and Kryvoi Rog regions and other areas where environmental emergencies will arise. Therefore, the draft law is oriented towards prevention and mitigation of the consequences of environmental emergencies, setting up special legal regimes for such zones (organisational and economic measures, definition of the state, legal and individual liabilities, and compensation for the damage due to natural disasters or technogenic impacts on the environment, life and health of the citizens, social warranties to victims and sanctions for violating the law).

It is necessary to note that the draft law is socially-oriented since its provisions are to ensure social protection of citizens, who suffer from environmental accidents, and to introduce a system of compensation for people living in an environmental emergency zone (major environmental disaster zone / limited environmental disaster zone).

2.10.4 Regulations

The work on systematisation of regulations is underway. These regulations are the building blocks of the environmental legislation of Ukraine. Among these, it is worth pointing out the Decree of the President of Ukraine on Setting Up the Ministry of Environmental Protection and Nuclear Safety of Ukraine (December 29, 1994) (EcoPravo, 1998).

Besides this, Decree No. 117 was entitled "On Measures to Control Import of Waste (Secondary Raw Materials) and Its Transit Through Ukrainian Territory" (February 22, 1994). The Decree specifies the list of substances and materials that compose the

hazardous waste category and establishes the procedure for issuing import permits for waste (secondary raw materials) and for their transfer through Ukrainian territory. The Decree states that these permits are to be issued by the bodies of the Ministry of Environmental Safety of Ukraine with approval by the Sanitary Inspector General of Ukraine.

Several decrees of the Cabinet of Ministers are of major importance. They are as follows: "On the Payment Procedure for Specialised Use of Freshwater Resources" (No. 75, February 8, 1994) with subsequent amendments and additions (No. 247 April 26, 1994 and No. 615, September 5, 1994); "On the Temporary Payment Procedure for Specialised Use of Mineral Resources in Mining "(No. 85, February 8, 1994); "The List of the Most Environmentally Dangerous Activities and Objects" (No. 554, July 27, 1995)

2.10.5 Environmental standards

The Technical Committee for Standardisation (TK-82) operates in the framework of the Ministry of Environmental Safety of Ukraine, ("Environmental protection and rational natural resource use in Ukraine") and incorporates six sub-committees.

The Technical Committee develops standards according to established directions and definitions: classifications, norms and methods for contamination measurement, rules for protection and rational use of natural resources, methods for determination of parameters of natural features, etc.

In accordance with the initiative of the Committee, which was supported by the Cabinet of Ministers of Ukraine, on December 20-22 1994 an intergovernmental workshop on standardisation was convened (attended by participants from Republic of Moldova, the Russian Federation and TK-82). At workshop sessions it was decided to set up intergovernmental technical committees (ITC) comprising specialists from CIS countries with secretariats based in Ukraine. These committees will operate in a way similar to the technical committees of the International Standards Organisation (ISO). The ITC body includes the following committees: "Quality of Inland, Ground and Waste Waters", "Environmental Management" and "Radioactivity Control".

The State Standard of Ukraine (DSTU 2730-40) "The System of Standards in the Field of Environmental Protection and Rational Resource Use. Quality of Natural Water for Irrigation Purposes. Agronomic Criteria" was developed and approved in 1994.

In order to improve the efficiency of the environmental monitoring, the Metrological Service was set up. This body incorporates the whole system of analytical laboratories of the Ministry of Environmental Safety.

2.11 Plan of further actions by the MEP

2.11.1 What should be done

According to a MEP report (1997), critical conditions affecting the environment can be characterised as:

- Structural abnormalities of the economy caused by the predominance of extractive industries and industries exceeding standards for raw material consumption, using outdated technologies, the functioning of which cannot be recognised as ecologically safe;
- Extensive development of agriculture that is nonetheless incapable of providing the population with sufficient quality food products;
- An almost total absence of effective administrative and economic mechanisms that could protect the natural environment;
- The limited ecological culture and education within society and the absence of ecological thought among the leadership.

As described earlier in this Chapter, the resulting problems have been in existence for the last decade and have contributed to health problems, decline in birth rates and average life expectancies. Consequently they are endangering the biological and genetic heritage of humans in Ukraine. The well-known Chernobyl radiation disaster of 1986, together with its long lasting medical, biological, economic and social consequences, has aggravated the environmental problem (Markham, 1996).

This is why radical and rapid changes are needed in state policies regarding natural resource management (MEP, 1997), namely:

- From a point of view of general humanitarian values, the existing economic system and legal rules for natural resource management should be revised;
- The state administrative system for natural resource management and environmental protection should reach a considerable improvement;
- Industrial technologies should be adapted to scientifically based ecological requirements;

- An effective system should be established for economic and ecological regulations;
- Industries must operate under ecological licenses;
- There is a need for a gradual build-up of common culture of natural resource management and resource-saving, taking into account the demographic structure of various regions.

The combined plans for action should be in conformity with the economic concept for the development of the country, they should be backed by legal institutions and regulations, mechanisms for economic and administrative supervision and implementation.

The MEP has drawn up and published in September 1993 a draft Concept of environmental protection in Ukraine. Proposals have been made to implement plans of action in Ukraine through a three stage process:

Stage 1: between 1993 and 1997 it was intended to bring about a new system for managing nature protection activities, establish the main legal regulations, and produce a reliable comprehensive assessment of the country's ecological condition. However, only the adoption of legal regulation has been progressing well. Development of the new natural resource management system is still to be accomplished; assessment of the ecological condition in the country is hampered by financial problems.

Stage 2: up to the year of 2000 there should be an improvement of public health. The main goal of this stage is to gain an equilibrium between the harmful impact of economy on the environment and its ability for self-restoration. Improvement of public health before 2000, however, has not been achieved.

Stage 3: it is envisaged there will be an ecologically balanced system for managing the development of society that should stimulate the restoration of the environment, a system that would provide conditions for competent management of natural resources and steady production.

According to the plan of action prepared by the MEP (1998), there exist five basic priority directions in the field of environmental protection and natural resource management.

2.11.2 Priorities in the area of environmental protection and natural resources management

When taking planning measures to protect the natural environment, it should be noted that priorities of state policies regarding environment protection are to a great extent dictated by the actual condition of the country and by problems that have been emerging for decades. Taking these into account, according to MEP (1998), the most appropriate thing to do would be to focus efforts in the following directions:

Introduction of an economic mechanism for natural resource management

An ecologically favourable economy envisages the implementation of a balanced policy for the exploitation and renewal of natural resources. In this area the main tasks are:

- Setting standards on the use of natural resources;
- Working out mechanisms for the assessment of the value of natural resources and cost for their use;

- Introduction of taxation and loaning on favourable terms for resource-saving and ecologically friendly technologies;
- Introduction of effective mechanisms of enforcement of fines for the excessive use of natural resources and their pollution.

Establishing a financial and economic framework for environmental protection activities

The deep economic depression in the country is the main reason why, in the foreseeable future, nature protection will hardly receive any additional investment. In such a situation there should be a change of the principles of fund allocation and spending, and the following measures should be undertaken:

- Establishment of an Ecological Bank;
- Within the state budget a special expenditure should be set-aside for "environment protection". The MEP as a relevant state body could apply for access to these funds and administer them in the course of the implementation of ecological programmes;
- State support should be provided for ecological business;
- A market of ecological services should be formed;
- Guidelines should be set up for ecological certification and licensing;
- Mechanisms should be worked out for compensating ecological damage to nature as a result of transboundary pollution, the functioning of oil and gas pipelines, electricity lines entering Western European countries, and transportation over Ukrainian territory of goods by roads, rail and ships.

Developing the legislative and legal framework for nature protection activities

Ecological law (as a special legal institution) should be established in Ukraine and new legal regulations should be worked out to control natural resource use. Mechanisms for

the functioning of law-courts in the case of ecological violations could be more effective if:

- Appropriate additions and amendments were made to the Administrative and Criminal codes;
- Severe economic sanctions were imposed;
- A governmental body with sufficient powers and resources were authorised to enforce ecological control (some kind of "ecological police");

Also the following areas require new legal regulations:

- Setting national environmental quality standards in line with EU ones in view of Ukraine's possible integration into the EU;
- Effective environmental audit under existing EIA procedures.

The conservation and protection of biodiversity

Conservation of biodiversity and the protection of wildlife is one of the national priorities not only for Ukraine but for most of the countries of the World. Thus it is necessary:

- To ratify the UN Convention on Biodiversity and join other international agreements regarding the conservation of biodiversity and protection of wildlife;
- To establish a new (in a qualitative sense) system of protected areas based on recognised international standards. Special attention should be drawn to the conservation of ecosystems and natural landscapes;
- To focus on stretches of virgin land for creating a system of nature reserves.

The interaction of governmental organisations and NGOs in the field of nature protection

All over the World "green movements" have demonstrated a growing or even decisive role in the protection of nature. The ecological crisis from which Ukraine is suffering now demands a much wider performance of public activities. NGOs should form a constructive opposition to the government in the area of nature protection. On the other side, the government is in need of support, especially with regard to ecological education and raising public awareness.

The implementation of these priorities will undoubtedly enable the country to approach a new era of economic activity based on the principle of sustainable development."

In tune with this objective the Ukrainian government is conducting environmental and economic reforms.

2.11.3 Priorities regarding better control of river pollution

Sections 2.11.1 and 2.11.2 provided an overview of what has been done and what is being done in line with state priorities in the field of natural resource use and protection. This section provides a summary of all policy shortfalls described above, which are applicable to the field of river pollution control:

Introduction of economic mechanisms:

- Developing mechanisms for the assessment of the value of water resources and the cost of their use. This would account of the actual cost of pollution;
- Introduction of taxation and loaning on favourable terms for water saving, water recycling and pollution abatement;

- Imposing and effectively enforcing fines and other penalties for excessive river pollution.

In the area of establishing a financial and economic framework for river pollution control:

- Special state budget expenditure for "environment protection", which the MEP could utilise in the course of the implementation of ecological programmes within the fields of natural resource use and protection only;
- State support for activities that prevent river pollution;
- Formation of a market for environmental services;
- Mechanisms for compensating damage from transboundary pollution, the functioning of oil and gas pipelines, and transportation over Ukrainian territory of goods by road, rail and water.

In the area of developing the legislative and legal framework for nature protection activities:

- Setting river water quality standards in line with the EU;
- Imposing severe economic sanctions for river pollution;
- Pollution control by one established governmental body;
- Implementation of effective environmental audit under existing EIA procedures.

In the area of interaction of public, governmental organisations and NGOs:

- Promotion of public support to national “green” NGOs and environmental authorities.

An outline of the areas of river pollution control that need further policy development has been presented. Now it is possible to move to the stage where the system of river pollution control in United Kingdom (UK) can be reviewed in order to be able to identify measures that may be applicable to the Ukraine.

It is intended to screen for relevant UK policies in the field of river pollution control, which can potentially help Ukraine to address the policy shortfalls summarised above. Eventually, screened UK policy options will be assessed on the subject of importation to the Ukraine using a methodology established later on in this thesis. After testing proposition the final objective of the research is to make suggestions about which UK policies might be suitable for importation to the Ukraine as well as potentially beneficial in terms of improved river pollution control.

CHAPTER 3

Screening Water Policy in England and Wales

3.1 Objective

This Chapter provides an overview of water management systems and policies in England and Wales. Specific policies are deemed relevant only where they may potentially be applied to water resource management as defined by the Ukrainian MEP (1998), that is *they meet the national goal of achieving sustainable development.* Chapter 2 has shown that certain policy priorities have not yet been adequately addressed and this is where relevant UK experience may prove to be beneficial.

The screening process ensures that only United Kingdom (UK) water policies that address issues appropriate to Ukrainian priorities will be described. Data will be used to assess the possibility of importation of specific policies to the Ukraine, so as to fill gaps in the national water management system as outlined by the MEP (Section 2.12.1).

Section 3.2 considers the goals and priorities outlined by the UK Government in the field of river pollution prevention within the national framework of national water resource management. In the present situation, UK water policies relating to pollution are ultimately driven by EU Directives and other international agreements.

3.2 Sustainability and water use

Water policy in the UK aims to protect both public health and the environment through maintaining and improving the quality of water (NRA, 1994). This chapter will largely

draw examples from England and Wales. Scotland has its own systems for both the utility side and regulatory arrangements of the water environment.

The UK Government seeks to balance the goals of environmental protection and enhancement with economic and social progress. The aim is to achieve a pattern of development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This philosophy, known as sustainable development (Biswas *et al*, 1993), guides water policy in England and Wales.

Similarly, the Ukrainian Government aims at shaping water policies to provide future sustainable development. Plans are therefore formulated, in accordance with the concepts of sustainable development, to create all-inclusive policies. This includes the wise management of natural resources, conservation of natural ecosystems, including the conservation of biodiversity, energy efficiency, implementation of ecologically favourable technologies, recycling, introduction of economically-based methods of natural resource management, and raising public awareness of ecological problems (Serageldin, 1995).

In a similar fashion to Ukraine, the UK funds available for environmental improvements are limited and are weighed against other Government priorities as well as against different environmental objectives. The Government also seeks to ensure that there is a proper assessment of the costs and benefits of any action affecting the environment (NRA, 1994).

3.3 Responsibility for water pollution prevention in England and Wales

The Environment Agency (EA) implements Government policy on the environment in line with the powers granted to it through legislation. The EA has a responsibility to protect and enhance the environment as a whole, monitoring and enforcing aspects of air quality and waste as well as water. The Agency was set up in 1996, bringing together the functions of the National Rivers Authority (1989-1996), Her Majesty's Inspectorate of Pollution (1987-1996) and the waste regulation functions of local authorities (DETR, 2000).

The Department of the Environment, Transport and the Regions (DETR) oversees water policy, working closely with the Welsh Office. The Environment Agency ensures that these policies are carried through. The Agency has a responsibility to protect and enhance the environment as a whole, monitoring and enforcing aspects of air quality and waste as well as water. The Welsh Office implements Government environmental policy in Wales and aims to protect and improve the Welsh environment (DETR, 2000).

DETR leads the Government's drive to integrate environmental concerns into decision-making. Its aims for environmental protection are to:

- Promote sustainable development;
- Ensure that businesses exercise environmental responsibility in their work;
- Protect the environment by encouraging better management techniques;
- Protect human life, health and safety from risks of pollution and contamination;
- Protect natural resources that have a potential economic value - both renewable and non-renewable;

- Conserve things in the natural world that people value highly for their own sake and which are under threat (DETR, 2000).

The Government works with other states at regional (e.g. European Union and North Sea Conference) and global (e.g. United Nations) levels, to protect human health and improve the quality of the environment. The DETR is furthermore concerned with the quality of all water - drinking as well as natural surface and groundwater.

The Drinking Water Inspectorate (a part of the DETR and the Welsh Office) monitors whether water companies carry out their quality checks properly. The Inspectorate can take enforcement action against companies if they fail to comply with standards (EA, 2000).

There are ten water and sewerage companies and, together with the 19 'water only' companies in England and Wales (often known as the 'Water Industry') are collectively responsible for the supply of drinking water and the collection, treatment and disposal of sewage. They must observe standards set by domestic law and European Community Directives. The Office of Water Services (OFWAT) is the regulator responsible for making sure that they provide an efficient, reliable service, for which the customers pay a fair price. The independent Director General of Water Services is the head of OFWAT (DETR, 2000).

In 1999 the European Union (EU) consisted of 15 member states responsible for implementing legislation at the national level that is drafted by the European Commission and approved by the European Parliament.

In view of the existing trend towards EU expansion eastwards, there is a need for gradual harmonisation of environmental standards. While the Ukraine is not yet considered a potential candidate for integration into the EU, it is thought of as a 'buffer' zone between Russia and the EU and is friendly to both (Reuters, 2000). With or without integration, common standard setting would facilitate undertaking joint actions by Ukraine and EU countries on transboundary environmental problems and international environment-related projects. By analogy, Switzerland (a non-EU state) tends to regulate its own environment along EU lines.

3.4 Water quality principles

3.4.1 Prevention is better than cure in formulating policies

In line with the principles of sustainable development, the challenge is to find ways of enhancing total wealth while using common natural resources prudently so that resources such as water can be conserved. Reversing or rectifying damage to the environment can be difficult and costly. For this reason pollution should be prevented from taking place (prevention), rather than cleared up after it has happened (remediation). Wherever possible, the need to respect the environment should be reflected in other policies relating to economic development.

Pollution is a world-wide problem, consequently it cannot be solved by one state on its own. Governments need to agree with each other regarding how international action might be taken. However, the different environmental conditions that exist in different places also need to be taken into account in reaching decisions.

Polluters should pay towards meeting the costs of the effects of their activities on the environment. Where sewage is concerned, all members of the public are polluters: they pay through sewerage charges which are included in water bills (Ofwat, 1998). In Ukraine public funds are raised through water charges, which include both water supply and sewage treatment charges. However, the charges are collected by the state and the efficiency of enforcing these charges is low (MEP, 1998).

Policies are to be based on the best available scientific knowledge. However, scientific knowledge about water and pollution is sometimes incomplete. Policy must also reflect necessary precautions required to protect the environment, including international agreements and meeting local environmental requirements.

Achieving a sustainable pattern of development does not necessarily mean having a lower rate of economic development, or even that every aspect of the present environment should be preserved at all costs. What is required is that decisions throughout society are taken with proper regard to their environmental impact (Biswas, 1993).

These principles are reflected in the current environmental legislation of the UK. Among the policies developed to address water resource issues, setting water quality objectives emerges as the most important and also closely echoes EU Directives.

3.4.2 Key legislation affecting water policy

Safeguarding water supplies for the future is a vital task. It is a legal duty not to cause or allow water pollution, as well as an environmental and social responsibility (Cook, 1998; DETR, 2000). Some key UK Acts of Parliament follow:

- The Environmental Protection Act established statutory provisions for a range of environmental protection purposes including integrated pollution control for dangerous processes (HMSO, 1990);

- The Water Resources Act 1991 consolidated previous water legislation in respect of both the quality and quantity of water resources;

- The Water Industry Act 1991 consolidated legislation relating to the supply of water and the provision of sewerage services (Statutory Instruments, 1994);

- The Environment Act 1995 established the Environment Agency, and introduced measures to enhance protection of the environment, including further powers for the prevention and remediation of water pollution.

However, member states enact their legislation in order to comply with European Union Directives. Some key examples follow:

- The Bathing Water Directive (76/160/EC) sets standards aimed at protecting the health of bathers and maintaining the aesthetic quality of bathing waters;

- The Urban Waste Water Treatment Directive (91/271/EC) sets requirements for the provision of collecting systems and the treatment of sewage according to the size of the discharge and the nature of the receiving water;

- The Dangerous Substances Directive (86/280/EC), together with the Water Resources Act 1991, requires control over inputs of dangerous substances into water;

- The Groundwater Directive (80/68/EC) is related to the Dangerous Substances Directive and applies to groundwater protection;

- The Freshwater Fish (78/659/EC) and Shellfish Water Directives (79/923/EC) are aimed at protecting the health of freshwater fish and shellfish populations, by designating waters in need of protection and setting quality standards for those waters. There is also a Directive implemented by the Ministry of Agriculture, Fisheries and Food and the Department of Health, which aim to protect the health of consumers of shellfish by enforcing bacterial quality standards;

- The Nitrate Directive (91/676/EC) requires member states to reduce the nitrate pollution in waters that arises from agricultural inputs;

- The Surface Water Abstraction Directive (75/440/EC) set quality objectives for the surface water sources from which drinking water is taken (DETR, 2000).

Presently nothing comparable with EU directives is in effect in the Ukraine and the situation is similar in the neighbouring CIS states of Russia, Moldova and Belarus.

It is important to point out that, for the purpose of this research, the UK water resource management system has been chosen for two reasons: availability of information and efficiency – there has been considerable consolidation of a wide range of policies since 1989. The next part of this Chapter will briefly review the efficiency of managerial approaches in the UK.

3.4.3 The current situation

In the UK, water management has long been undertaken on a river catchment basis (Ayton, 1994), which makes it appropriate to draw comparisons with Ukraine where the basis for water management are the basins of large rivers. The catchment focus enables uses of water to be scrutinised in detail for a defined area. This includes not only abstractions (these affect river flow, dilution and hence the extent to which the waters are able to degrade and accommodate polluting matter and self-purify) and also the main sources of discharges and other potentially polluting inputs. Apart from in-stream activities (such as fishing, boating and canoeing), the use of water can broadly be characterised as cyclical. Water is abstracted and supplied for domestic, industrial and agricultural purposes and returned to watercourses (in many cases by means of the sewerage system) as treated wastewater or, less directly, through precipitation and run-off and leaching from land. The quality of water at any given point reflects all of these factors. However, others are also important and there may be differences in their relative impact on lakes, rivers and estuaries due, for example, to differences in their capacity to self-purify (Mason, 1996).

In the UK, it is a criminal offence to cause water pollution, which is defined as the entry of poisonous, noxious or polluting matter (HMSO, 1990) to most inland and coastal waters including groundwater. The law has established the principle that such entry should be the exception and, where necessary, it must be controlled. The primary means of doing so is the system of discharge consents under the relevant legislation and, for discharges from prescribed processes (HMSO, 1990), integrated pollution control (IPC) authorisations ('authorisations'). These are administered in England and Wales by the Environment Agency, in Scotland by the Scottish Environmental Protection Agency (SEPA) and in Northern Ireland by the Environment and Heritage Service of the Department of the Environment for Northern Ireland (Cook, 1998). A similar system of discharge consents exists in Ukraine. However their enforcement is inefficient (Gritzenko, 1995).

The relevant UK regulatory bodies may include such conditions in consents as they see fit. For example, conditions relating to: the places and periods at which a discharge may be made, its volume and rate, its nature, origin, composition and temperature and the steps to be taken to minimise its effects on controlled waters. In addition, monitoring requirements may be imposed as well as requirements for the keeping of records. Most importantly, however, consents and authorisations limit discharges of certain substances. These limits may be either numeric - specifying the maximum permissible discharge volume and concentration of pollutants - or descriptive in relation to the conditions to be met. Numeric limits apply to discharges containing substances, which are potentially of the greatest environmental impact (DETR, 1998).

Consents are set consistent with the achievement of environmental quality standards (EQSs), which establish concentrations of specified substances for the relevant waters.

These objectives may be either informal or statutory. For rivers, in England and Wales, the former National Rivers Authority (now the Environment Agency) has been engaged in setting informal 'river quality objectives' (RQOs) on the basis of a system known as the 'River Ecosystem (RE) Classification'. The classification is intended to provide an assessment of the general health of a river by reference to its chemical quality and thereby to provide an indication of its potential for different uses. The Secretary of State has powers under the Water Resources Act 1991 to make these objectives statutory, giving the Government and the Environment Agency a legal duty to ensure that they are achieved (DETR, 1998).

The key chemical parameters on which the RE system is based are dissolved oxygen (DO), biochemical oxygen demand (BOD), ammonia, pH, copper and zinc. The first two of these parameters largely reflect the extent to which waters are affected by sewage discharges and rural land use run-off containing organic, degradable matter both of which affect the concentration of oxygen in the water. The others (with the exception of pH) measure toxic substances, which affect the ability of the river to support aquatic life. The main three components are given in the Table 3.1.

Table 3.1
Water quality classification

Water quality	Grade	Dissolved Oxygen (% saturation)	Biological Oxygen Demand (BOD), (mg l^{-1})	Ammonia (mg l^{-1})
Good	A	80	2.5	0.25
	B	70	4.0	0.6
Fair	C	60	6.0	1.3
	D	50	8.0	2.5
Poor	E	20	15.0	9.0
Bad	F	-	-	-

Source: DETR (2000). Environmental Protection.

A similar scheme exists in Ukraine and is called "Differential Water Quality Classification". It has five water quality classes: "very clean", "clean", "slightly polluted", "polluted", "highly polluted". However, the set of parameters in the scheme is quite different from standards in England and Wales: coliform (bacteria) index, smell, DO, BOD_5, pH, colour, suspended solids, general mineralisation, chlorides and sulphates. Another classification scheme is called "Index of Water Pollution" (IWP). It includes DO, BOD, ammonia, oil products, phenols and describes water quality by categories: "clean", "moderately polluted", "polluted", "significantly polluted", "extremely polluted". The system is normally applied for general water quality assessment (Gritzenko, 1995). Compared to the RE system, the IWP contains two more elements: oil products and phenols. The difference is due to an abundance of gas and coke production, petroleum, power generation and chemical industries in Ukraine, while in UK industrial pollution is insignificant partly due to de-industrialization (Interview: Dean, 2000).

Unlike the UK, for Ukraine no water quality objectives are set for different rivers or stretches of rivers. The final goal of water pollution control is that all polluters meet quality standards or pay for "special" water use, i.e. for the right to pollute. In practice, however, polluters often neither observe the quality standards nor pay for "special" water use (Barannik, *et al*, 1996). Apparently this drawback arises from inefficient enforcement of legislation and, likely incompatibility of relevant legal provisions with current economic and social situation in the country.

Regarding economic aspects of pollution control in the UK, relevant regulatory bodies seek to consider the costs and benefits of improvements by reference to local conditions and the uses made of surface waters (Baird, *et al*, 1996). The Environment Agency and

SEPA now have statutory duties under the Environment Act 1995 to take into account (unless it would be unreasonable or unlawful to do so) the likely costs and benefits in the exercise of any of their powers.

Statutory environmental quality standards (EQSs) have been set to give effect to European Union legislation. For example, the Dangerous Substances Directive establishes EQSs for listed substances and other Directives have set standards for particular uses of water (e.g. abstraction for potable supply). Thus for some stretches of river there are both informal river quality objectives (RQOs) and statutory EQSs (NRA, 1995).

In contrast to EQSs, some domestic and EU legislation has established technology- or technique-based requirements relating to particular processes responsible for discharges (whether they discharge to sewer or direct). In the UK this is via integrated pollution control (IPC) authorisations but the approach has been extended by the recent Integrated Pollution Prevention and Control (IPPC) Directive. Under IPPC, processes prescribed under the Environmental Protection Act 1990 emitting specified substances (including biodegradable matter and nutrients) must be operated reflecting application of best available techniques (BAT) determined at the level of industrial sectors. Emission limit values (ELVs) for these pollutants are to be based on BAT and take account of certain site-specific factors (Howsam, *et al*, 1996).

Other legislation has also established specific emission limits for discharges. The Urban Waste Water Treatment Directive (UWWTD) requires one of a number of specified uniform emission standards or percentage reduction targets (comparing the concentrations in effluent from the sewage treatment works with influent to the works)

to be achieved by sewage treatment works (for BOD). In practice this amounts to a requirement for a specified level of treatment of effluent. Of the 9,000 works across the UK, about 2,000 (the largest ones which treat 90% of UK sewage) will be required by 2005 to install secondary treatment to achieve 70%-90% reductions in BOD concentrations.

A small number of coastal or estuarine discharges may be permitted to have a minimum of primary treatment, which the Directive specifies as a 20% reduction of BOD and 50% reduction of suspended solids. For the remainder 'appropriate treatment' is required to meet the relevant quality objectives and the relevant provisions of the UWWTD and other Directives. Consent conditions are to be set on a case by case basis but generally are broadly equivalent to primary treatment (to reduce BOD by, say, 20% and suspended solids by, say, 50%), with the conditions often expressed in descriptive rather than numeric terms. Should the Agency consider it appropriate, these smaller discharges might receive treatment at least as stringent as that which is applied to the largest discharges. The Directive also regulates the larger discharges from certain industries within the food and drink sectors, which are also subjected to specific conditions set on a case by case basis.

3.5 Monitoring water quality: some ways in which water quality is measured

The water quality in about 40 000 km of rivers and canals in England and Wales is routinely monitored.

3.5.1 General quality assessment (GQA)

GQA is the scheme used by the Environment Agency for classifying water quality. It will eventually consist of assessments based on a number of measures. The measure most widely used so far is chemical grading. Biological grading is also included in the Agency's 1996 River Quality Survey and assessments of aesthetics and nutrients are being considered for inclusion in the future (EA, 1997).

3.5.2 Chemical grading

The system assesses water quality on the basis of biochemical oxygen demand and concentrations of dissolved oxygen and ammonia (see 3.4.3).

3.5.3 Biological grading

This measures water quality by comparing the number and diversity of macro-invertebrate species at 7,000 sites against the range of those species that might be expected if the sites were in a pristine, unpolluted condition.

3.5.4 Dangerous substances

In addition to the above, there is an extensive Environment Agency programme of monitoring for dangerous substances. The most dangerous substances are placed into List I. Broader range, less dangerous substances are included in List II (more details in 3.7.11). List I substances are subject of stricter control because of their more ecologically harmful properties. The scheme is compliant with EU regulations (Harrison, 1992).

3.6 Efficiency of water resource management regarding water quality

3.6.1 Rivers and canals

In recent years, there has been a significant net improvement in the chemical quality of much river length in England and Wales. Over 25% of river length (of the 40 000 km monitored) has improved by a class or more between 1990 and 1996. The proportions of river length in England and Wales falling within each class in 1990 and in 1996 are shown in the Table 3.2. In Northern Ireland the 1995 survey showed that the chemical quality of 88% of rivers monitored was in the range from very good to fair. In Scotland, where the classification scheme is slightly different, the quality of most rivers is already good. The proportion of the 50 000 km of rivers classified in the highest ('unpolluted') chemical class has been high for many years. Since 1980 this proportion has increased from 95% to 97% (EA, 1998).

Assessment of biological quality (on the basis of invertebrate life on river beds) is also undertaken in the context of a general quality assessment. In England and Wales, about 35% of river length fell in the highest category (very good) and over 30% in the second category (good). Less than 2% fell in the bottom grade (bad). Again there has been a significant improvement between 1990 and 1995, with the net result that over 25% of river length has moved up one class or more. In Northern Ireland the 1995 survey showed that 99% of rivers were of very good to fair biological quality (EA, 1998).

Table 3.2
River water quality

Class	A	B	C	D	E	F
Length 1990 (%)	18	30	23	14	13	2
Length 1996 (%)	27	32	21	10	9	1
Length 1996 (km)	11 054	12 835	8 663	4 222	3 607	423

Source: EA (1997a). Assessing Water Quality - General Quality Assessment.

Whilst water quality in the UK is good and improving and there is a need for continued effort to maintain current quality and scope for further improvements. A target of upgrading 1000 km of river length in England and Wales by one RE class by the year 2000 should be achieved largely through planned improvements including implementation of the Urban Waste Water Treatment Directive (DETR, 2000).

According to IWP, in 1995 in Ukraine only 2,475 km (15 %) of major rivers were considered as "clean". Most rivers (11,367 km or 68.6 %) were considered as "moderately polluted". 1,993 km (12 %) of rivers were classified as "polluted". River stretches with a total length of 667 km (4 %) and 62 km (0.4 %) fell into categories "significantly polluted" and "extremely polluted" respectively (Appendix 3.1).

One of the essential reasons for improvement in the quality of river water is the process of de-industrialisation in UK. Nowadays UK industries tend to move their production branches overseas, primarily in developing countries that enjoy civil peace. As an economic attraction in those countries the cost of labour is cheap and natural resource use, including environmental pollution, is much cheaper than in the West (Obadina, 2000). Thus, the fewer production and processing industries located within the UK pollute less. Ukraine is also experiencing a process of de-industrialisation, but it is very different because it is the outcome of severe economic crisis (Semenov *et al*, 1998).

3.6.2 Groundwater

Groundwater is a valuable resource, which needs to be protected from pollution. In England and Wales, 75 % of groundwater abstracted is used for drinking water. In Ukraine only 10-15 % of water needs are met from groundwater sources (MEP, 1994).

Groundwater is not easily accessible and is difficult to clean up: because it flows so slowly, any pollution takes a long time to disperse naturally. In protecting it, therefore, the emphasis lies heavily on the prevention of pollution: discharges are controlled and other measures aim to protect springs, wells and boreholes, which are open to contamination. In many cases protection zones have been established to try to reduce diffuse pollution by restricting potentially polluting activities. In Ukraine groundwater pollution normally occurs in the areas of large industrial plants and landfill sites.

3.6.3 Bathing waters

The EU Bathing Water Directive's compulsory standards must be complied by all bathing waters to which the Directive applies. It also sets higher standards for EU states to observe as guidelines. In addition, the water industry is running a £2 billion bathing water improvement programme to raise the standard of waters currently at risk of failing to achieve consistent compliance with the Bathing Water Directive.

In 1996, 472 UK bathing waters were covered by the Directive, which requires that these waters are sampled regularly. The results are made available on public registers at local offices of the Environment Agency and elsewhere.

The results of monitoring show that the improvement programme is having a major impact. The majority of schemes are now complete, and 90% of the UK's waters passed the Directive's mandatory coliform (bacteria) standards during the 1996 season, up from 66% in 1988.

Ukraine can not afford to run any water quality improvement programme involving comparable expenditure.

3.7 More about guarding the resource

3.7.1 Protection through consents

It is an offence to cause or knowingly permit polluting matter to enter into rivers, estuaries, coastal waters or groundwater in the UK without permission. Permission is generally obtained as a discharge consent granted by the Environment Agency. The Agency sets conditions, which may control volumes and concentrations of particular substances or impose broader controls on the nature of the effluent. Each consent is based on the objective set by the Agency for the quality of the stretch of water to which the discharge is made, as well as any relevant standards from EU Directives. Protection is ensured through enforcement (DETR, 2000).

If pollution occurs, including when the conditions of a consent are broken, a criminal offence has been committed. In these cases the polluter can be prosecuted, usually by the Environment Agency, and may be fined and made to clean up the pollution.

The Environment Agency can serve notices requiring consent holders to take action to remedy a breach of consent. There are also new powers, which will enable the Agency to require other polluters to carry out works to clean up pollution and to meet the costs of doing so (DETR, 2000).

In the Ukraine there exists a similar system which is called 'Permission for Special Water Use'. Regulations for 'special water use' are well elaborated by national legislation such as The Water Code of Ukraine. Administrative and criminal prosecution is applied in case of pollution, which results from breaking the conditions specified in the "permission on special water use"

3.7.2 Protection through pollution prevention

In UK prevention of pollution can be achieved in a variety of ways.

1. Through education, publicity and guidance - advice can be given through codes of practice, guidance notes, pollution prevention awareness campaigns and site visits to farms and other operations;

2. Through regulations, which establish controls necessary to prevent pollution. For example, regulations introduced in 1991 in the UK set minimum standards for the construction of stores for agricultural waste (silage, slurry, and agricultural fuel oil) because such substances can be highly polluting to water;

3. Through notices requiring action, which the EA can serve on consent holders requiring action to be taken to prevent breach of a consent. There are also new powers, which will allow the Agency to require potential polluters to carry out works to prevent pollution.

In the Ukraine, implementation of water resource protection measures is mainly the responsibility of water users and subject to enforcement by environmental authorities. However, environmental culture and education needs significant development throughout society.

3.7.3 Environmental impact assessment

In the UK environmental impact assessment (EIA) now represents a major part of the water project planning process. EIA is essentially a systematic process which aims to examine the consequences of development actions in advance (Cook, 1998). Ukraine introduced a system of EIA in 1993-1994 (MEP, 1997). However, it still lacks mechanisms for implementation of one of its most important components: environmental auditing.

3.7.4 Protection through abstraction licensing

In addition to preventing pollution occurring, the Environment Agency is responsible for ensuring that water resources are managed effectively, so that there is enough to meet all public needs. Almost anyone who wants to take water from a surface or underground source must obtain a licence to do so from the Agency. Conditions placed on abstraction from surface waters enable flow to be maintained at levels which the

Agency considers necessary to ensure that quality objectives are achieved (Gray, 1994). Similarly in the Ukraine, no new water abstracting industry can commence operation without an abstraction licence (SSU, 1995).

3.7.5 Economic instruments

From the point of view of neo-classical economic theory, environmental pollution is a negative 'externality' - a cost imposed upon society by an individual or firm, but which is not paid for by that individual or firm. For example, the discharge of effluents into a river which subsequently affect the production costs of downstream industries and/or the enjoyment that members of the public derive from the river, yet for which no costs are incurred by the polluter. The presence of externalities means that firms and consumers, motivated by their own private costs and benefits, ignore the negative impacts of their pollution on others, leading to excessive levels of pollution (Hanley *et al*, 1997).

By putting a price on these externalities, economic instruments provide an alternative to traditional regulation (or 'command-and-control' measures) by which to alleviate environmental damage, with the potential to achieve a given level of pollution abatement at lower overall cost. In UK the 'price' is imposed as an emission charge.

Emissions charges on discharges based on the quantity and nature of pollutants. Such charges are likely to be most effective in relation to point source discharges where emissions can be more readily measured and where the damage caused by emissions varies in line with the amount of pollution. The main issues reflected in charging schemes are:

a. The pollutants to be included within any scheme (which is related both to the substances that have greatest effect on the aquatic environment and its uses, and the need for a reasonably simple and comprehensible system);
b. The relative polluting impact of different pollutants (an essentially scientific question) so that the system can reflect these different impacts via different rates of charge;
c. Weightings to reflect:
    - the quality of the receiving waters (to reflect the different values placed by society on marginal changes in quality given different existing or desired qualities in those waters);
    - the specific location at which the discharge is made. This could reflect a number of aspects such as the flow in the watercourse, the length of watercourse downstream impacted by the discharge (intended to be a proxy for any uses made of the affected waters which are not implicit within the wider quality weighting), as well as the type of water body concerned;
    - the season in which the discharge is made, given that its impact could depend on changes in the quantity and composition of the waters during the course of the year (DETR, 2000);

In Ukraine households and some industrial water users pay a fixed so called "water" fee, which covers both water supply and wastewater treatment. This is usually based on the area of the house living space, number of people residing there and volume of wastewater produced. In case of individual households neither water supply nor sewage effluents are metered (MEP, 1998). Introduction of metering and charging based on volume and contents of effluents would be beneficial regarding more rational use of water as well as funds of individuals and enterprises.

3.7.6 Existing charging schemes for discharges

Currently, a charge is made to cover the costs of issuing and monitoring consents and authorisation conditions. For monitoring directly related to a discharge an annual charge is payable on a cost-recovery basis so that total income covers the costs of issuing consents and monitoring compliance. Each discharge consent is converted into an equivalent number of pollution units for which a standard charge (set annually) is then made. The factors reflected in the charging scheme are: volume (m^3 day^{-1}); content; and the nature of the receiving waters (Winpenny, 1994). For each factor there are various bands. Each is ascribed a value reflecting the associated monitoring costs (not environmental damage). The overriding cost recovery requirement which caps the level of charges greatly reduces any resulting incentives. Nonetheless, the charge structure potentially provides a basic model for the development of a charging scheme (Appendix 3.2).

3.7.7 Substances

There is a considerable number of substances, which could, in principle, be considered for inclusion in a charging scheme. However, the substances chosen must be relevant to the achievement of specified objectives. Thus different substances may be significant in some cases but not others. The scope for, and cost of, reductions to be made in emission levels are also relevant factors.

3.7.8 Biochemical oxygen demand

Biochemical oxygen demand (BOD) is widely used as a measure of the polluting potential of a discharge. It is a measure of the oxygen used (demand) by bacteria in breaking down the organic biodegradable load (fats, proteins, etc.) in sewage and other discharges. As a result BOD values are fundamental to the health of a watercourse. BOD is therefore the basic component of charging schemes developed in EU countries. A high proportion of BOD inputs arise from domestic sewage (for which no reductions at source are likely to be practicable), with most of the remainder from the food and drink sectors. In cases where there is little scope for a reduction in input at source (e.g. domestic sewage) the incentive effect of the charge would fall largely on the sewage treatment works. In the UK such discharges are subject to the provisions of the Urban Waste Water Treatment Directive.

3.7.9 Suspended solids

Suspended solids include matter such as faeces and discarded sanitary products found in sewage. These are a major component of sewage treatment works discharges. Apart from having a polluting impact in their own right they can have important consequences for the discharge of other substances such as metals which may bind to solids. The consents for sewage treatment works (STWs) will frequently include a condition limiting suspended solid emissions.

3.7.10 Nutrients

About 50% of phosphate inputs are from point sources. The majority of these are probably from STWs and represent inputs from the domestic sector (either dietary or from detergents - split about equally). Some other point sources such as food and drink manufacturers will also contribute. Up to about 20% of nitrate inputs derive from point sources. For sewage treatment works the main inputs are dietary. Some other point sources such as food and drink industries and fertiliser manufacturers will also contribute. As with BOD and suspended solids, to the extent that inputs to sewers cannot be influenced, it would be desirable that the incentive effects of a charge should fall on STWs.

The most cost effective means of achieving further improvements depends on the relative abatement costs of further treatment and reductions in inputs.

3.7.11 Dangerous substances

Different control procedures must be applied to chemicals on Lists I and II under the Dangerous Substance Directive. List I metals such as cadmium and mercury may be found in sewage discharges (not just as a result of industrial inputs) as well as in direct industrial discharges. Compared to List II substances, they are subject to stricter control because of their higher toxicity, persistence, and bioaccumulation properties. STWs are required to rely on best available treatment technologies (BATT), especially when dealing with dangerous substances (Backes *et al.*, 1999). A number of List II substances are particularly important; for example, ammonia (included in the RE system) and metals such as zinc and copper (also included in the RE system). Others such as lead,

nickel and chromium will be typical constituents of sewage as well as arising from direct industrial discharges and from urban run off. The UK also monitors inputs to the marine environment (both directly and via rivers) of some dangerous substances as part of commitments for reductions in such inputs under the North Sea Conference Declarations (Harrison, 1992).

As regards sources, there are some available data on the relative contributions to STWs between different sectors, which indicates that there is a number of significant inputs. The relative contribution of these different sources is likely to vary considerably between catchments, depending on the extent and mix of industrial processes and the extent to which they discharge direct to watercourse or to sewers. The extent to which the domestic sector contributes to inputs of some metals will also depend on water hardness in the area (and therefore the ability of the water to dissolve copper and lead plumbing and piping) and the nature of the piping in use, as well as the extent to which urban run off is collected (and hence traffic effects). To the extent that there is little scope for reductions in inputs at source the main effect of the incentive would be on STWs (Cook, 1998).

3.7.12 Impact of individual pollutants

A simple load-based charge would concentrate on a relatively straightforward tariff reflecting the quantity of contaminants discharged. However, this would be likely to result in some perverse effects given the very different hazards represented by different pollutants. Moreover, in principle, charge rates should match as closely as possible the marginal damage caused by a discharge (which will be likely to vary for different levels

of emissions). Some means of reflecting those different hazards therefore still needs to be found.

The UK approach is to convert each discharge into a number of standard pollution units according to the composition of the discharge, for example in relation to oxygen depleting substances. An annual monetary value (rate) per standard unit of pollution can then be applied to give the amount payable annually per discharge (this being the product of the annual monetary rate per unit and the relevant number of pollution units). An approach of this kind has been adopted in a number of other countries. For example, in Germany the charging scheme reflects a relationship between BOD, ammonia and heavy metals, which values damage in the ratio 1:3:80. However, this remains a simplified approach which does not take into account now different aspects of water quality (and hence uses) may be affected differently by different substances.

As noted above, concentration is also an important influence on the polluting impact of a discharge. All other things being equal, for biodegradable substances, the more dilute a discharge, the lower the polluting impact and hence the lower the charge that should be imposed. This could be addressed in various ways, e.g. through a volume credit in the charge with the relative weight to be attributed to volumes discharged assessed on the basis of 'pollution' units. Any such approach would need to take into account the potentially complex interactions with abstraction controls and any economic instruments for abstraction (DETR, 2000).

3.7.13 Public awareness and action – a call for growth

There are many ways in which the public can help to protect the water environment. For instance, by not allowing polluting liquids such as oil or litter to enter watercourses. Oil - which is a major cause of pollution incidents - should be taken to recycling centres and litter should be taken home or placed in a litter bin.

Any environmental incidents seen, such as pollution, damage or danger to watercourses or flooding, can be reported directly to the Environment Agency by telephoning a 24 hour free emergency hotline. This is to avoid environmental damage through prompt action (DETR, 2000).

In the Ukraine there is no free telephone emergency hotline on water quality matters only. Normally, public complaints are submitted to public inspectors or local Councils of People's Deputies. The matter is then reported to, and handled by, a competent authority. Unfortunately, there is a lack of environmental education for public through literature and media in Ukraine. Neither are there recycling facilities for such waste as metals, glass, oil, paper, etc. All wastes are dumped at landfill sites, which are often poorly arranged in terms of preventing the leakage of polluting effluents into surface and underground waters (MEP, 1997).

In the World "green movements" have demonstrated a growing influence on the nature protection decision-making process. The 'ecological crisis' from which Ukraine is suffering today demands a much wider performance of public activities. On the other hand, environmental movements do not gain wide public support, partly due to the low living standards of most people. According to Rapawy (1996) average income of almost

70 per cent of households in Ukraine ranges from $US 15 to $150 per month (from 31 to 308 Hryvnias in Ukrainian currency units). The official poverty line in 1996 was an income less than $US 26 a month per adult (Clarke, 1997).

Also, as already discussed, there is a lack of proper education and media coverage of environmental issues. It is argued that another reason has a psychological cause. During more then 70 years under the communist Regime of the former USSR, people became accustomed to central state authorities making decisions without recourse to public opinion, or even prohibiting public participation if not in line with state priorities. A decade the after the collapse of the Regime, there has been little change in the perception of most Ukrainians. Together these factors cause a low level of concern regarding environmental protection and education.

Ideally, as public concern about the environment grows, "green" NGOs should develop constructive opposition to the government in the area of nature protection. At the same time, the government is in need of organisational and financial support, particularly with regard to ecological education and raising public awareness. For example, the creation of mass media programmes on the subject of ecological information, education and ethics might be explored by both government and non-governmental decision-makers and opinion-formers. Unfortunately, to date, there has been no significant success in raising public awareness of the environment. In Ukraine, as elsewhere, the success of water resource and environmental protection depends to a large extent on public concern.

3.8 Major UK policies, which may be suitable for implementation in Ukraine

Through the process of screening carried out in the preceding section it is possible to select a number of policy tools, which have potential for preventing river pollution by industrial and municipal effluents in Ukraine, in line with the priorities outlined in Chapter One section 2.11.3. These are:

3.8.1 Pollution control and prevention

1. Setting quality objectives for water bodies and rivers supported by legislation;
2. More detailed planning of river pollution prevention activities in smaller river catchments rather than on a river basin basis only;
3. Establishment of procedures for consideration of likely costs and benefits of waste water treatment by regulatory bodies taking into account local conditions and the uses made of surface waters;
4. Licensing of abstraction to enable flow to be maintained at levels which the Agency considers necessary to ensure that quality objectives are achieved;
5. For certain substances, especially highly poisonous ones, best available treatment techniques (BATT) should be applied as determined at the level of industrial sectors. Emission limit values (ELVs) for these pollutants should be based on BATT and take account of certain site-specific factors;
6. Setting targets for gradual reduction in certain effluents (emission standards or percentages) from sewage treatment works at the end of specified, realistic time periods;
7. Enforcement mechanisms to ensure effectively that conditions of discharge consents are observed, achieved through conducting more frequent checks of enterprises;

3.8.2 Economic regulation

The cornerstone of effective control of river pollution in the UK is charging consumers and investing significant amounts in water treatment. As a rule, investments to improve drinking water quality and wastewater treatment are obtained through the levy of charges on all water users by private sewage and water companies. The charges may be high, but they cannot exceed the "cap" established by the Office of Water Services, which protects UK water consumers against these natural monopolies. The following policy tools applied by UK sewage and water companies can be considered for importation to Ukraine:

1. Introduction of a charge that would cover the costs of issuing and monitoring consents and authorisation conditions;
2. Establishing a charging scheme that converts each discharge into a number of pollution units for which a standard charge is to be set annually. The factors reflected in the charging scheme should be: volume (cubic metres per day); multi-substance content; and the nature of the receiving waters including their self-purification capacity (see Appendix 3.2);

3.8.3 Public awareness and participation

1. Mass media information and educational propaganda making the public aware of environmental issues is intended to reduce illegal dumping of polluting substances such as oil or litter into landfill sites and water bodies;
2. Establishment of a 24 hour free environmental emergency hotline as well as an authority under the MEP umbrella, where people can submit their complaints,

comments and ideas on environmental matters, which are to be communicated to executing and decision-making authorities.

However, there may be numerous limitations in the Ukraine at present, which may render these policy tools ineffective. Such limitations can arise from the present socio-economic environment, which is very different from that of the UK, due to the economic crisis. Therefore, before making suggestions on policies for importation into Ukraine it is necessary to conduct an assessment of each of the policies, which would take into account major features of the current situation in the country. The assessment will rely on information obtained through data analysis. The methodology for data collection and analysis, as well as policy assessment is set out in Chapter Four.

CHAPTER 4

Research methodology

4.1 Introduction

Information was collected through library literature searches, the purchase of certain information sources, public opinion polls and interviews with people in environmental and other relevant occupations.

Consequently, a comprehensive analysis is presented which incorporates not only water quality issues, but also a socio-economic analysis. Analyses will be both quantitative and qualitative. Quantitative analysis assesses the magnitude and extent of river pollution, and also aspects of the Ukrainian economic crisis. Qualitative analysis is used to address the shortfalls of quantitative analysis where arguments require development in a more analytical, sociological context.

The research progressed according to the established time scale set out in Appendix 4.1, subject to adjustments as required by the somewhat changeable working circumstances.

4.2 Information sources

Information regarding water pollution control practices is primarily to be sought from legislative frameworks, available data bases, libraries, personal interviews and public opinion surveys (Denscombe, 1998).

In order to explore the stated *proposition* (i.e. "the river pollution problems arise from socio-economic aspects of life in Ukraine rather than the lack of experience, or scientific developments and expertise"), it is essential to collect and analyse cross-disciplinary information.

Information relevant to river pollution in Ukraine and UK is obtained from libraries and the environmental authorities in each country. The information includes:

- Annual records of river pollution and other river uses;
- Annual accounts of the working practices of environmental inspectorates;
- Management efficiency (in terms of pollution reduction and its costs);
- Type and scale of activities;
- Legislation compliance and socio-economic and political factors (e.g. institutional operation, rates of pay, investments, etc.);
- Number and water pollution potential of enterprises in Ukraine;
- Availability, quality and effectiveness of treatment facilities;
- Plans of activities of environmental authorities for the future.

Most environmental information collected has been collated at the regional and national level in order to ensure both region-specific and country-wide perspectives.

There are three reasons:

1. It may be difficult to deal with abundant, but dispersed, information. This research is conducted on the country-wide scale and therefore requires a more general approach. For this reason, non-extensive data sets (e.g. on pollutant concentration in river water) are likely to be available for analysis;

2. There are time and resource constraints with collecting, retrieving and analysing large volumes of dispersed data;
3. Avoiding repetition (Statement 1 above) requires information to be published by a relevant Ukrainian environmental authority, typically the MEP (Ministry of Environmental Protection).

Conclusions will be drawn following both quantitative and qualitative analyses of the information collected, as recommended by Allan, *et al.* (1991).

4.3 Contacts

It was important to achieve co-operation with environmental administrators and scientists in Ukraine. This would ensure acquisition of valuable information regarding practical experience and the opinions of experts. Most contacts were to be established by direct visits with prior appointments made by phone. Interviews were held with five members of staff from the Ukrainian Scientific Centre for Protection of Water under the Ministry of Environmental Protection who had experience with issues of water pollution monitoring and control. Seven members of the general public were interviewed regardless of gender and social group, all of whom were above 17 years of age.

Interviews took the form of a conversation focused on the key questions of concern to this research (see Appendix 4.2), with the interview results recorded in a notebook. This was preferred to using a tape-recorder because it might have caused confusion for some people, leading them to give incomplete or incorrect answers and comments (Nichols, 1991).

While discussion-based interviews allow for a detailed analysis of the reasons behind people's attitudes, broader public opinion polls simply present a general picture of those attitudes for the whole of society. Therefore, in addition to interviews, around 200 members of the general public from the Kharkov region were asked to fill out two questionnaires. One contained questions on selected water and environmental issues and the other on some environment related socio-economic issues. For instance, questions were designed to study public awareness about water pollution, quality of water services and public opinion about measures to improve environmental protection, willingness to pay, etc. (see Appendices 4.3 and 4.4). Questionnaires were prepared in line with methodological guidelines of traditional social and behavioural research (Sudman, *et al.*, 1982).

4.4 Literature search

Much useful information was collected from Ukrainian libraries as well as research, scientific, educational and meteorological institutions e.g. the Ukrainian Scientific Centre for Protection of Waters. This information was largely about environmental pollution and its ecological and socio-economic consequences (the emphasis being on industrial river pollution); other water uses; water quality standards; environmental legislation; seasonal changes in inland water bodies, etc. Investigations in big libraries, such as Kiev State Library, Korolenko State Library on all the above mentioned issues was also helpful.

In the UK, educational and institutional sources of information were searched, including: the British Library, other scientific and educational libraries, water supply

and waste water treatment utilities, the Environment Agency, the Chartered Institute of Water and Environmental Management. The information collected in UK is largely concerned with issues of river pollution control in UK and other (mainly EU) countries. Many literature sources in UK have been obtained through interlibrary loans.

Unfortunately, the interlibrary loan system does not exist in the Ukraine, nor there is computerisation of library facilities, which makes efficient literature searching somewhat difficult although guidance was sought from the relevant professionals.

4.5 Data analysis

Both quantitative and qualitative data analyses were employed. Quantitative analysis is derived from statistical data on river pollution and other digital information, supplemented with non-numerical information from observations, interviews and literature (Nichols, 1991; Denscombe, 19928). The use of both kinds of information allows a more holistic approach.

This approach permits a number of ways to analyse data, and these were employed in the research (Frankfort-Nachmias, *et al.*, 1992; Marsh, 1998):

- Graphical presentations of numerical data supported with written observations;
- Mathematical calculations (using Microsoft Excel spreadsheets) and their presentation supported with observations, discussions and conclusions;
- Construction of tables, figures and diagrams etc. to present data summaries;
- Visual presentations including photos, maps and figures for description or to support certain arguments;

- Conversion of text information into digital data and its computer aided analysis;
- Software Package for Social Scientists (SPSS) v.10 used to process large volumes of statistical information generated through surveys, interviews and literature searches. Minitab v. 12 used to plot correlation charts and carry out interpolation of outcomes of analyses;
- Presentation of qualitative data with reference to credible sources of information.

These combine to form a general social science methodology applied to address the political and socio-economic aspects relating to the importation of water policies into the Ukraine.

4.6 Policy assessment

Every policy proposed for importation is tested to assess its viability and efficiency under the existing social, economic and political conditions in the Ukraine. This is the 'feasibility principle' that requires low cost policy implementation to suit state and local budgets. Also, there has to be obvious potential for public benefits associated with policy importation, e.g. better amenity value of a river stretch.

The cost-benefit analysis alone is often used to suggest best practice concerning different developments. Currently, however, principles of sustainable development require a wide range of issues to be considered, associated with a particular development. Therefore, in this work, a number of other criteria were included in the analysis. These are less tangible political and social criteria.

The selection of policy options therefore considered all the following criteria, some of which are virtually impossible to quantify (Winpenny, 1994):

- Efficacy;
- Economic efficiency;
- Fiscal effects;
- Political and public acceptability;
- Sustainability;
- Administrative feasibility;
- Importation risk.

Development of environmental policy is a multidisciplinary and, to a great extent, subjective process (EPA, 1982). Major UK policies on river pollution prevention will be considered for importation to Ukraine in this work. The objective is to develop existing Ukrainian system of river pollution prevention. Ukraine has got rapidly changing socio-economic and political environment very different from UK, so UK policies must be subjected to multidisciplinary assessment on the selected criteria.

4.6.1 Efficacy

Policy options were assessed for their potential in achieving a specific objective, such as a decrease in pollution, reduction in consumption, etc. The assessment was empirical based, considering the following factors:

- Successful practical implementation in England and Wales;
- Suitability to effectively address priority areas in the field of river pollution control as outlined by MEP (Section 2.11.3);

For this criterion, assessment had to be based on subjective judgements supported with available specific data.

4.6.2 Economic efficiency

The efficiency criterion requires that the economic benefits of policies exceed their costs. Moreover, the policies should achieve a social optimum when the supply of an environmental good meets public demand for it, and the gains from pollution prevention are maximised. This requires knowledge of trends of public demand and willingness to pay for clean river water as amenity and drinking water as a vital good.

The demand for better ecological quality of rivers in the Ukraine was studied through public survey. The benefits of pollution abatement were intended to be studied through established environmental valuation techniques, for instance willingness to pay (used in this research), contingent valuation, travel-cost and hedonic pricing methods (Merrett, 1997). Possible costs of policy importation are easier to determine. The costs would vary depending on efforts of environmental authorities, state and private water users to achieve specific objectives of pollution control.

Affordability to obtain river water quality as a public good would be discussed taking into account people's willingness to pay obtained through survey.

4.6.3 Fiscal effects

Ukraine, in common with many other countries with serious environmental problems, also has limited public finances. The fiscal impact of policies is therefore important,

both for general macroeconomic management and for the proper funding of wastewater treatment and sanitation provision. The main issue is the net effect of a policy on the finances of central and local government. The effects on the finances of the water utility, irrigation agency, etc. also need to be taken into account.

Fiscal effects can be either positive or negative, e.g. the gain to the budget from a tax, price increase or charge, or the costs to the budget from a subsidy or tax relief. In the context of current budget deficit in the Ukraine, it was considered that the impact of any imported policies ought to benefit the finances of the state and water utilities (Boland, 1991).

Therefore the fiscal effects of policies were assessed in terms of the gain or loss to the finances of regulation authorities and state water utilities. Obtaining "environmental good" has to be affordable for the society. UK policies entailing excessive costs to state and local budgets as well as consumers cannot be suggested for importation.

4.6.4 Political and public acceptability

Policies that are acceptable to the parties affected have better prospects of being implemented than those which are likely to encounter serious resistance in the political process, or amongst consumers or other interested parties. There will normally be some proportionality between the effort that goes into introducing a policy measure (sacrificing political goodwill, spending political credit, steering legislation through parliament, overcoming public resistance and lobbying, etc.) and the pay-off from that policy. A policy that achieves little, but has a great political cost or arouses much public antagonism, is clearly undesirable.

Some of the factors that would determine acceptability are: the severity of the problem; the distribution of costs/benefits; the lead given by political and community figures; publicity; the educational level and public-spiritedness of the population; and the extent of the behavioural changes implied. These factors were largely determined through quantitative and qualitative analyses of data from public surveys and interviews (Marsh, 1998).

Decisions concerning the suitability of UK policy resulted from discussion of relevant research findings.

4.6.5 Sustainability

Certain policies have a once-and-for-all impact, while others have a continuing or even a growing effect. Short-term measures introduced in response to an emergency, such as a drought, may have a strong immediate impact, but one which tails off sharply when the worst of the emergency is over. Policies that make a long-term impression on water use, such as technological adaptation and changes in user habits, are more sustainable. Best of all are measures whose impact increases over time, e.g. because their elements reinforce each other, or because they provide incentives for continuing and cumulative effects.

If policy appears to have a short-run effect only less then one year, it may not be worth recommendation for importation.

4.6.6 Administrative feasibility

This has several facets. Operating a policy must be within the administrative capability of the department or agency involved. Its effects should be monitorable with the resources of the responsible agency, and the regulatory agency should have adequate powers of enforcement. Policies should be intelligible to those affected.

The question is: "Does there exist an administrative and legislative basis for policy implementation and efficient enforcement? " If no, is there a possibility of introducing changes into an administrative structure, which would allow for a policy to be implemented?

4.6.7 Importation Risk

Ukraine is a special country. Its history in the past 500 years was characterised with so many wars, famines, bloodshed, destruction, suffering, tribulations and instability, which very few, if any, nations in the world can match (Reid, 1997).

"Importation risk", as defined in this study, reflects the degree of uncertainty considering changes in the political and socio-economic situation of the Ukraine and adaptability of policy to current Ukrainian conditions. Possible radical changes in politics and economics would have a direct impact on the willingness and ability of society to adopt Western-style policy tools to prevent river pollution. The main purpose of this section is to screen for policies whose efficiency would be least affected by socio-economic and political changes.

History suggests that political change may fall somewhere within the range: "Complete liberalisation - complete centralised state control". Both extremes are unlikely to take place. However, the policy can be safely proposed for importation if it appears to be viable at both extremes of this political barometer. For instance, if policy can only be operable on the grounds of private property rights, but there is a possibility of political changes, which would abolish private property rights, the policy would be rejected.

For simplicity, the assessment will be made on the basis of stating "yes" if policy appears to be viable within the next 5-7 years, and "no", if it does not. The argument will largely be based on the findings of literature review in Chapter Two and analysis completed in Chapters Seven and Eight.

4.7 Policies selected for importation

When policy assessment and comparison of policy options was complete, a list of policies for importation to the Ukraine was constructed. Each of the policies was accompanied with a brief description of its benefits as well as possible limitations and importation difficulties.

In the end, policies will be considered on the basis of their introduction into river basin management plans.

CHAPTER 5

Assessment of river water quality

5.1 General methodology

This chapter will investigate the extent and pattern of river pollution in Ukraine through an analysis of official statistics. The analysis will be undertaken on the basis of major pollution parameters in eight Ukrainian river basins: Zakhidny Bug, Danube, Pivdenny Bug, Dnistr, Dnipro, Severský Donetz, Priazovie and Crimea (Appendix 5.1). The information was obtained from reports of the Ministry of Environmental Protection (MEP) on the state of environment and environment related activities across the country.

A comparison of pre-independence (1985-1992) (Gritzenko, 1994) and post-independence levels (1993-1996) of river pollution is presented. Greater emphasis will be placed on the dynamics of pollution change during 1993-1996. Pollution data for 1985-1992 is available for only five river basins and five parameters, while the data for 1993-1996 cover all eight river basins and 13 parameters.

The final outcome of data analysis in this Chapter will be priority lists of individual river basins and individual pollutants. The magnitude of pollution problems will be reflected through percentile units of measurement in these lists. The lists will further be used as a scheme for efficient allocation of state funds.

5.1.1 Analysis based on maximum admissible concentrations

The analysis will study the dynamics and magnitude of pollution change. The magnitudes of actual concentration of pollutants during 1993-1996 will be presented as *number of MACs (Maximum admissible concentrations)* in chart form. Values in measurement units equivalent to 1 MAC for pollutants are summarized in Appendix 5.2. All data on concentration of pollutants are presented as number of MACs (NMACs) for drinking and recreational use of surface water bodies. The data are taken from MEP reports (1994, 1997 and 1998) covering years 1993-1996 only (Appendix 5.3) because no new relevant data for post-1996 years were found through a search of public libraries and other sources in 1999 and 2000. Calculations will also be made on the basis of concentration of pollutants being presented in the *number of MACs* according to stages and procedures established by the researcher in Sections 5.1-5.3. The main outcomes of data analysis will be presented as percentile values reflecting the magnitude of pollution change or share of a pollutant or river basin in terms of overall pollution.

In MEP reports (1994, 1997 and 1998) and Gritzenko's book (1994) the concentrations of pollutants are presented in *NMACs* (Appendices 5.3 and 5.5). It should be noted that a MEP report produced in 1997 contains pollution data not for single years but average pollution data for two years: 1994 and 1995.

In parallel to this analysis, another type of analysis is conducted. This will express the pollutants in units of concentration (e.g. mg l^{-1}) subsequently converted into ecological water quality classes. Initially, water quality classes for individual pollutants were developed on the basis of study and scientific research into water-related ecological issues and first adopted at the meeting of water industry representatives of the EEC

(EU) countries (EEC Commission, 1982). This approach is not only convenient for the data set provided, but, according to Richard (2000) "remains valid in EU countries".

5.1.2 Analysis based on water quality classes

There are six water quality classes applied to each individual pollutant: class I – "very clean"; class II – "clean"; class III – "insignificantly polluted"; class IV – "moderately polluted"; class V – "polluted"; class VI – "very polluted". Each water quality class for a given substance is determined across a range of concentrations expressed in physical units of measurement such as mg l^{-1}or μg l^{-1}.

Major river pollutants (from MEP reports) are assigned a water quality class according to concentration (Appendices 5.4 and 5.6). For analysis, pollution data will be converted in the following way:

- Any concentration which falls between ecological water quality classes I and <III, will be assigned a value of 0. This is because water quality in this range is considered to be "very clean" to "clean";
- Any concentration between classes III and <IV or "insignificantly polluted" will be assigned a value of 1;
- Any concentration between classes IV and <V or "moderately polluted" will be assigned a value of 2;
- Any concentration between classes V and <VI or "polluted" will be assigned a value of 3;
- Any concentration equal or higher than the margin value for class VI or "very polluted" will be assigned a value of 4.

The initial data in the tables, where the analysis is carried out, will already be presented as mathematical values 0, 1, 2, 3 or 4 after conversion from concentration values presented in Appendices 5.4 and 5.6 according to concentration ranges specified in Appendix 5.7.

5.1.3 Parallel analyses

Through these two parallel analyses, the river pollution problem in Ukraine will consider:

1. The extent to which river water quality meets drinking as well as various economic and domestic needs of population (the analysis based on original NMACs or ANMACs). Later, this analysis will be referred to as ANMACs;
2. The seriousness of the river pollution, from the point of view of ecological water quality (the analysis based on ecological water quality classification or AEWQC). Later, this analysis will be referred to as AEWQC;

The results of the two analyses will be compared. It should be noted that in Ukraine water quality is monitored on the basis of water quality standards reported as MAC values, while ecological water quality classification is mainly used for scientific purposes (Gritzenko, 1994).

Finally this Chapter will undertake a qualitative analysis of information relevant to water management and pollution control in Ukraine.

5.2 Comparison of river pollution, 1985-1992 and 1993-1996

This section compares the pollution loads on Ukrainian main water bodies in 1985-1992 and 1993-1996. The first period mainly covers pre-independence (Soviet) times, which lasted until 1991. It is largely characterised by social stability, high levels of economic activity, low unemployment rates (less then 3 % of people between 25 and 55 years old) and a far higher standard of living for the population at large. By contrast, the post-Soviet (independence) period 1993-1996 is characterised by a deep economic crisis, inflation, high unemployment rate and a more then eight-fold drop in living standards; yet social stability is still maintained (Gnybidenko, 1998).

Subject to data availability from public information sources, the concentrations of the following pollutants will be considered: oil products, ammonium, nitrite, copper compounds and phenols. The analysis compares the following river basins: Zakhidny Bug, Dnistr, Pivdenny Bug, Dnipro and Seversky Donetz (Appendix 5.1). The choice of these components has been determined by the availability of data. While detailed pollution data are available for 1993-1996 from MEP reports, information on approximate average concentration of only five pollutants in five river basins was found for pre-independence late 1980s, 1991 and independence 1992 from other literature source.

First the objective is to establish whether there is a change in water pollution in the period 1993-1996 as compared to the period 1985-1992, and then estimate its magnitude. Table 5.1a contains *ANMACs* for 1985-1992. Data used in this analysis is displayed in Appendix 5.5.

Table 5.1a

ANMACs of pollution data for five river basins for 1985-1992

River basins	Oil products	Ammonium Compounds	Nitrites	Copper compounds	Phenols	*Average*
Zakhidny Bug basin	1.5	0	0	7.7	3.2	*2.5*
Dnistr basin	3	2.3	4	3.2	2	*2.9*
Pivdenny Bug basin	11.5	4	7	10.5	7	*8*
Dnipro basin	0	0	1.5	2	0	*0.7*
Seversky Donetz basin	3	1.1	4	0	0	*1.7*
Average	*3.8*	*1.5*	*3.3*	*4.7*	*2.4*	*3.1*

In these five basins (over 80 % of Ukraine's territory) the average levels of pollution exceeded 1 MAC. For individual pollutants the levels varied from 1.5 MACs to 4.7 MACs. The average pollution load for all river basins is 3.2 MACs.

Table 5.1b presents *AEWQC* for 1985-1992. Data for this analysis were taken from Appendix 5.6.

Table 5.1b

AEWQC of pollution data for five river basins for 1985-1992

River basins	Oil products	Ammonium Compounds	Nitrites	Copper compounds	Phenols	*Average*
Zakhidny Bug	0	0	0	4	0	*0.8*
Dnistr	1	2	4	4	0	*2.2*
Pivdenny Bug	2	4	4	4	0	*2.8*
Dnipro	0	0	4	4	0	*1.6*
Seversky Donetz	1	2	4	0	0	*1.4*
Average	*0.7*	*1.3*	*3.3*	*2.7*	*0.0*	*1.6*

The analysis suggests that most pollution levels were serious and therefore posed a threat to human health and natural ecosystems alike. Also, the presence of both zero values and high values often exceeding minimum "passmarks" for ecological class VI (marked 4 in Table 5.1b) show that serious water pollution was a location-specific problem in the country. Some areas might be highly polluted with serious human health

and ecological implications whereas others could be without any pollution. The average value for the five river basins during 1985-1992 was equal to 1.6, or within ecological class III described as "insignificantly polluted".

Tables 5.2a and 5.2b present ANMACs and AEWQC of concentrations of comparable pollutants during 1993-1996. It should be noted that the data on average pollution by five parameters for 1993, 1994-1995 and 1996 in the tables are the results of three separate calculations for 1993, 1994-1995 and 1996 carried out in the same manner as in Tables 5.1a and 5.1b.

Table 5.2a

ANMACs: determination of average pollution levels during 1993-1996

Years	Oil products	Ammonium Compounds	Nitrites	Copper Compounds	Phenols	*Average*
1993	4.4	5	2.8	18.2	1.5	*6.4*
1994-1995	3.3	2.9	2.7	3.4	2.2	*2.9*
1996	5.8	4.7	3.9	6.1	1.2	*4.3*
Average	*4.5*	*4.2*	*3.1*	*9.2*	*1.6*	*4.5*

Table 5.2b

AEWQC: determination of average pollution levels during 1993-1996

Years	Oil products	Ammonium Compounds	Nitrites	Copper Compounds	Phenols	*Average*
1993	1	4	4	4	0	*2.6*
1994-1995	1	4	4	4	0	*2.6*
1996	1	4	4	4	0	*2.6*
Average	*1.0*	*4.0*	*4.0*	*4.0*	*0.0*	*2.6*

As to whether pollution control measures were more efficient in the Soviet period, there is no literature published after 1991 that would provide a comparison. However, the remaining part of the analysis may provide an indication.

The average values of pollution loads during 1985-1992 (bottom row of Tables 5.1a and 5.1b) will be compared with the average pollution loads during 1993-1996 (bottom row of Table 5.2a and 5.2b). The comparison is presented in Tables 5.3a and 5.3b respectively. The average values for 1993-1996 (B) are deducted from the average values for 1985-1992 (A) to derive the difference D, which is the change in level for a given pollutant, either positive (+), i.e. reduction of pollution or negative (-), i.e. an increase in pollution. The percentile value of the change is determined to show the rate of change for both individual pollutants and the total of average pollution levels.

Table 5.3a

ANMACs: comparison of average pollution during 1985-1992 and 1993-1996

Periods, values	Oil products	Ammonium compounds	Nitrites	Copper compounds	Phenols	*Average*
A (1985-1992)	3.8	1.5	3.3	4.7	2.4	3.1
B (1993-1996)	4.5	4.2	3.1	9.2	1.6	4.5
Difference, D = A-B	-0.7	-2.7	0.2	-4.5	0.8	-1.4
D as per cent of (A)	*- 18.4 %*	*- 180 %*	*+ 6 %*	*- 95.7 %*	*+ 33.3 %*	*- 45 %*

* - means more pollution by an individual parameter during 1993-1996 and + means less pollution by an individual parameter during 1993-1996.

The analysis of levels of the comparable pollutants for five major comparable river basins suggests an average 45 % increase in pollution during 1993-1996 as compared with the Soviet period 1985-1992. As to individual pollutants, a wide variation of change is observed from a 33.3 % reduction of pollution by phenols to a 180 % increase of pollution by ammonium.

Table 5.3b

AEWQC: comparison of average pollution during 1985-1992 and 1993-1996

Periods, values	Oil products	Ammonium compounds	Nitrites	Copper compounds	Phenols	*Average*
A (1985-1992)	0.7	1.3	3.3	2.7	0	*1.6*
B (1993-1996)	1	4	4	4	0	*2.6*
Difference, D = A-B	- 0.3	- 2.7	- 0.7	- 1.3	0	*- 1*
D in per cent of (A)	*- 42*	*- 208*	*- 21*	*- 48*	*0*	*- 63*

AEWQC also suggests that, during 1993-1996, pollution was higher than in 1985-1992 for all the above pollutants except phenols, which are present in insignificant concentrations, at least as far as ecological water quality is concerned. As to the individual parameters during 1993-1996, there has been observed: a 42 % increase in "ecologically significant" pollution by oil products; a large (208 %) increase in pollution by ammonium; a 21 % increase of pollution by nitrite; a 48 % increase of pollution by copper compounds; and no change in pollution from phenols. Data are available for a more detailed analysis of water pollution change for period 1993-1996. Such an analysis would determine the trend and rate of pollution change in middle and late 1990s.

The results of comparison of average pollution levels during 1985-1992 and 1993-1996 in Table 5.3b confirm the analysis presented in Table 5.3a so that, during 1993-1996, pollution loads in the main Ukrainian river basins were generally higher than during 1985-1992. The analysis through water quality classes reveals that pollution was 63 % higher during 1993-1996 than 1985-1992. This is 18 % more then the 45 % increase obtained through the analysis based on number of MAC. It should be mentioned that *AEWQC* only shows an approximate percentile change in ecologically significant pollution since independence, as compared to Soviet times.

Both analyses suggest that river pollution in the period of independence of Ukraine is likely to have more severe ecological and human health implications than before 1991.

The increase of pollution is set in contrast to a dramatic decline in economic activities and living standards of the population. As an illustration, the production of key consumer goods such as bread, meat, sausages, butter, sugar, sunflower oil, tissues and shoes *decreased* an average of 3.7 times, and electric goods, bicycles and other metal products on average of 14.7 times. The income of an average household, in monetary terms, dropped 6-8 fold (MEP, 1998). These socio-economic features are discussed in Chapter Seven.

Therefore it is essential to establish the relation between human activities and environmental pollution during the period of independence so as to inform the appropriate policy options for development of water resource management. As a first step it is essential to undertake a detailed analysis of available quantitative data on water pollution in the period 1993 to 1996. This covers individual river basins and individual pollutants for the purpose of prioritising them according to the extent of the pollution problem. Further analysis is expected to give more insight on the pattern of river pollution, and suggest probable future trends.

5.3 River pollution 1993-1996

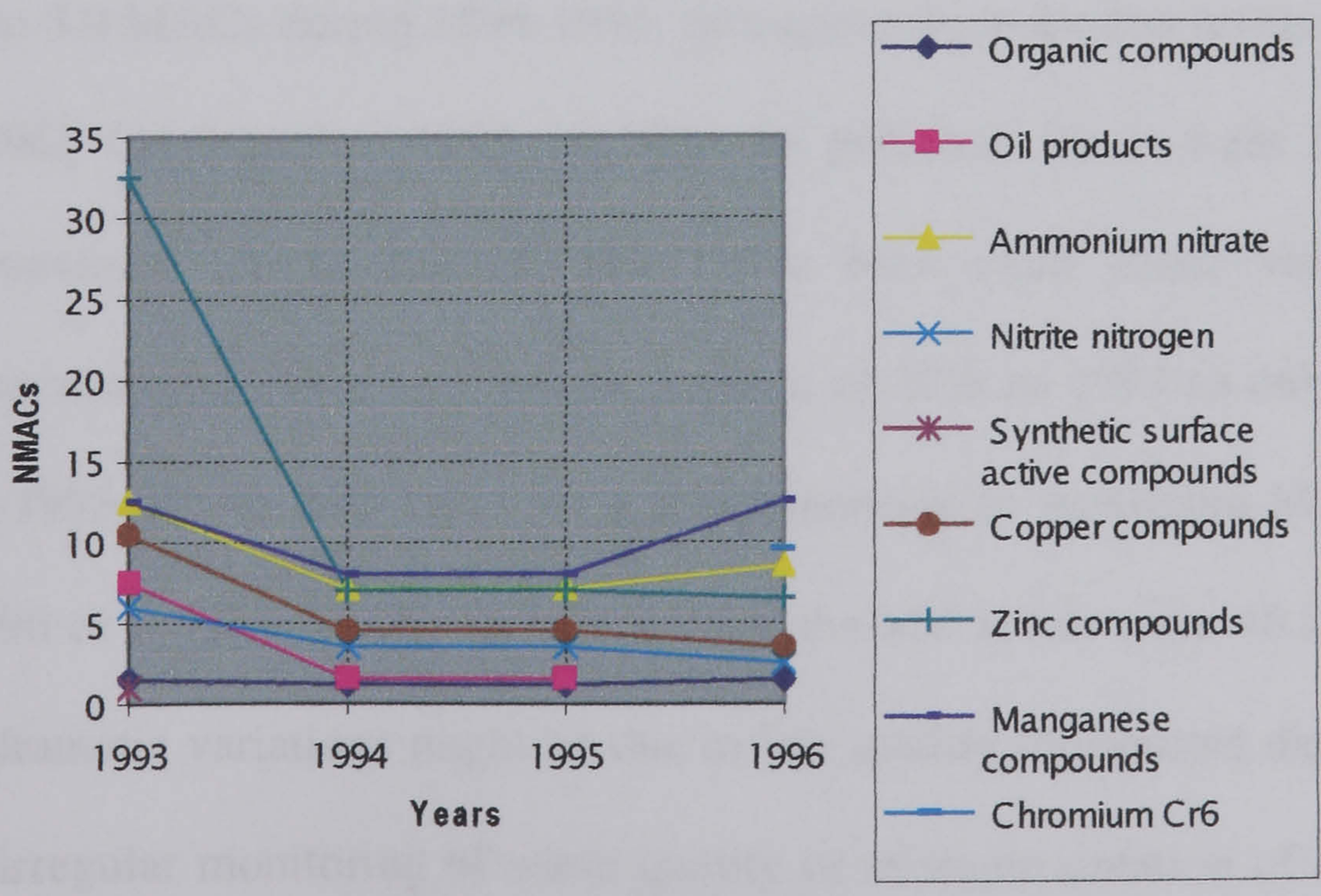
5.3.1 Analysis for individual river basins

The situation in individual river basins

The basic methodology for the estimation of pollution change during the period 1993 to 1996 is the same as in the previous section. Greater data availability permits a more detailed analysis.

All data on maximum (MC) and average (AC) concentrations of pollutants for main river basins will be used in the assessment. Concentrations of pollutants expressed in NMACs and values relevant to water quality classes will be subjected to Excel spreadsheet analysis. The analysis is intended to reveal an approximate percentile change of pollution, trace pollution trends and other features. Figure 5.1 below shows the dynamics of change of AC of key pollutants in the *Zakhidny Bug basin.*

Figure 5.1 Average concentration of key pollutants



The Figure 5.1 shows that during 1993-1996 in Zakhidny Bug basin a slight decline in average levels of river pollutants was observed.

Tables 5.4a and 5.4b contain *ANMACs* and *AEWQC* of data on average and maximum concentration of pollutants in the Zakhidny Bug Basin during the period 1993-1996. The data have been taken from Appendices 5.3 and 5.4.

Table 5.4a

ANMACs: pollution in Zakhidny Bug basin in 1993, 1994-1995 and 1996

Pollutants	Average NMAC			Maximum NMAC		
	1993	1994-5	1996	1993	1994-5	1996
Organic compounds*	1.5	1.2	1.5	2	1.4	1.5
Oil products	7.5	1.5	0	70	2	0
Ammonium	12.5	7.1	8.5	45	11.2	20
Nitrite	6	3.5	2.5	24	4.5	11
Synthetic surface active compounds (SSAC)	1	0	0	1	0	0
Copper compounds	10.5	4.5	3.5	38	6	5
Zinc compounds	32.5	7	6.5	92	7	81
Manganese compounds	12.5	8	12.5	32	8	39
Phenols	0	0	0	0	0	0
Pesticides DDE and DDT	0	0	0	0	0	0
Pesticides α- and γ- GKIG	0	0	0	0	0	0
Average	*7.6*	*3.0*	*3.2*	*27.6*	*3.6*	*14.3*

* Note: In this place as well as elsewhere in the thesis the term "organic compounds" refers to: "easily oxidized organic compounds measured according to BOD 5".

ANMACs for the Zakhidny Bug basin reveals a 61% reduction in average pollution from 7.6 in 1993 to 3.0 MACs during 1994-1995. Subsequently, pollution levels rose by 7 % to 3.2 in 1996). Compared to 1993, in 1996 the pollution levels were 58 % lower. Regarding maximum concentrations, there have been even wider variations. For instance there was an 87 % drop from an average of 27.6 in 1993 to only 3.6 MACs during 1994-1995. There then followed a sharp increase in maximum MACs to 14.3 MACs in 1996 or by 397 %. Compared to 1993, the MC levels were 48.2 % lower in 1996. Such dramatic variations might be due to low quality of reported data as a result of poor and irregular monitoring of water quality or misrepresentation of data in MEP reports.

Table 5.4b

AEWQC: pollution in Zakhidny Bug basin in 1993, 1994-1995 and 1996

Pollutants	AC values			MC values		
	1993	1994-5	1996	1993	1994-5	1996
Organic compounds	0	0	0	1	0	0
Oil products	3	1	0	4	1	0
Ammonium	4	4	4	4	0	4
Nitrite	4	4	4	4	4	4
SSAC	0	0	0	0	0	0
Copper compounds	4	4	4	4	4	4
Zinc compounds	4	3	3	4	3	4
Manganese compounds	2	2	2	4	2	4
Phenols	0	0	0	0	0	0
Pesticides DDE and DDT	0	0	0	0	0	0
Pesticides α- and γ- GKIG	0	0	0	0	0	0
Average	*1.9*	*1.6*	*1.5*	*2.3*	*1.3*	*1.8*

AEWQC shows, that during 1993-1996, the ecological water quality index based on AC has shown a slight decrease. This means there was an *improvement* of ecological water quality because the index fell from 1.9 in 1993 to 1.5 during 1994-1996, or by 21%. In the case of the analysis based on MC, the index dropped by 43 % from 2.3 in 1993 to 1.3 during 1994-1995. It rose again from 1.3 in 1994-1995 to 1.8 in 1996 or by 38%. The overall *decrease* in the index of MC was 22 % from 2.3 in 1993 to 1.8 in 1996.

Both analyses show a decline in pollution between 1993 and 1996, but the magnitude of declines is different. According to *ANMACs* the overall reduction of pollution was 48 % for AC and 32 % for MC, while *AEWQC* shows a decrease of 21 % for AC and 22 % for MC.

In the same manner, analysis has been conducted for the *Danube, Dnistr, Pivdenny Bug, Dnipro, Priazovie, Seversky Donetz and Crimea basins*. Brief discussions of the findings of the analyses for each basin are provided below. The results are summarised in Tables 5.5a and 5.5b.

Danube

ANMACs: Annual AC of pollutants in the Danube basin show a gradual decline in content of most pollutants between 1993 and 1996. During 1993-1996 there has been a two-fold decline observed in the magnitude of the AC of pollutants. The average pollution loads dropped by 46 % during 1994-1995 as compared with 1993. Further, a drop in average pollution from 1.9 to 1.5 MAC, or by 21 %, took place in 1996. Compared to 1993, average pollution had dropped by 57 % by 1996. The dynamics of change in magnitude of MC are similar to those in the Zakhidny Bug river basin. From 1993 to 1994-1995 pollution levels dropped from 22.5 to 9 MAC or by 60 %. From 1994-1995 to 1996 a 21 % increase in MC was observed. For the whole period 1993-1996 maximum pollution decreased by 52 % from 22.5 to 10.9.

AEWQC: During 1993-1995 the ecological water quality index for AC remained at approximately the same levels. The index based on MC varied: a reduction by 22 % from 1.8 in 1993 to 1.4 during 1994-1995 was followed by 7 % increase to 1.5 in 1996. Compared to 1993, in 1996 MC index was 17 % lower.

AEWQC shows a slight downward trend in pollution levels during 1993-1996, mainly due to the decline in MC index. By contrast, *ANMACs* shows that river pollution in the basins declined by more then 50 % during the same period of time.

Dnistr

ANMACs: After a slight drop in pollution levels during 1994-1995, as compared to 1993, there is a tendency towards greater pollution from the key pollutants by 1996. Average pollution declined by 78 % from 9 MACs to 2 MACs during 1994-1995. In 1996 it rose to 6 MACs or by 200 % if compared to 1994-1995. In comparison to 1993

average pollution had declined by 34 % in 1996. Maximum pollution dropped by 79 % from 27.3 MACs in 1993 to 5.7 MACs in 1994-1995. Between 1994-1995 and 1996, maximum pollution rose by 116 % from 5.7 to 12.3 MACs. During 1993 - 1996 the pollution declined by 55 % in comparison to 1993.

AEWQC: Water quality AC index varied with approximately the same value of 1.8-1.9 in 1993 and 1996 with a 20 % drop to 1.5 during 1994-1995. MC index was 2.2 in 1993 and decreased by 23 % to 1.7 during 1994-1995. The index increased from 1.7 to 2 (by 18 %) towards 1996. In 1996 it was 9 % lower than in 1993.

During 1993-1996, according to ANMACs, AC and MC declined by 34 % and 55 % respectively, while according to AEWQC AC varied, but did not tend to decrease (or increase) and MC decreased by only 9 %. This is similar to findings from the analyses for the Danube basin.

Pivdenny Bug

ANMACs: Similar to the situation in the Dnistr basin, the annual average pollution levels in Pivdenny Bug basin tend to decrease during 1994-1995 and increase towards 1996. The increase is particularly pronounced in the case of manganese compounds. Thus, during 1994-1995, average pollution fell by 33 % from 3.6 to 2.4 MACs in 1993. It increased again by 67% from 2.4 MACs in 1994-1995 to 4.0 MACs in 1996. In comparison to 1993, by 1996 pollution had increased by 10%. Maximum pollution decreased by 33 % from 17.4 MACs in 1993 to 11.7 MACs in 1994-1995. During 1994-1995 - 1996 the magnitude of extreme pollution levels remained virtually the same. In comparison to 1993, maximum pollution had declined by 33% in 1996.

AEWQC: During 1993-1996 AC and MC of pollutants varied slightly, but generally remained at approximately the same levels.

The trend for AEWQC is different to that obtained through ANMACs: 10 % increase in AC and 33 % decrease in MC.

Dnipro

ANMACs: In the Dnipro basin annual AC of pollutants tends to decrease. In 1996 AC of 7 pollutants is still too high – 1 MAC or more. Compared to the analyses completed for other river basins there have been observed quite steady levels of pollution in the Dnipro basin. This is important because the basin occupies almost half of the entire territory of Ukraine. Thus, average pollution levels fell by 26 % from 2.7 MACs in 1993 to 2.0 MACs during 1994-1995. Subsequently, levels rose by 15 % to 2.3 MACs in 1996 as compared to 1994-1995. In comparison to 1993, there was a 15% reduction in average pollution in 1996. The maximum pollution decreased by 17 % from 8.0 to 6.6 MACs during 1993 - 1994-1995. In 1996 it decreased further by 20 % to 5.3 MACs. If compared to 1993, in 1996 maximum pollution was 34 % lower.

AEWQC: During 1993-1996 there was only a slight variation in water quality index within the range 1.2-1.4 in case of AC and 1.5-1.7 in case of MC. The pattern of variation in both cases appears to be similar.

ANMACs shows that during 1993-1996 there was a decrease in AC and MC by 15 % and 34 % respectively. On the other hand, according to AEWQC, pollution levels vary but tend to remain at approximately the same levels.

Priazovie

ANMACs: During 1993-1996 in the small rivers of Priazovie Basin (Near the Azov Sea), AC of pollutants varied with levels well above 1 MAC in nine cases. The average pollution in Priazovie basin dropped by 23 % from 7.5 MACs in 1993 to 5.8 MACs in 1994-1995. It continued to decrease, dropping by 9 % from 5.8 to 5.3 from 1994-1995 to 1996. Compared to 1993, in 1996 pollution levels were 29 % lower. The magnitude of MC decreased by 44 % from 34.5 in 1993 to 19.3 in 1994-1995. Then it increased by 17 % to 22.6 in 1996 as compared to 1994-1995. In 1996, maximum levels of pollution were 34 % lower than in 1993. The reason for 1995-1996 pollution increase is not clear.

AEWQC: Ecological water quality did not change significantly from 1993 to 1996. For average concentrations there was a very slight drop in the index by 5 % from 2.4 in 1993 to 2.3 during 1994-1996. Similar patterns of change occurred in maximum concentrations, when the index declined from 2.5 in 1993 to 2.3 during 1994-1995 and 2.2 in 1996 (or by 12 % overall).

ANMACs revealed that AC declined by 29 % and MC declined by 34 % during 1993-1996. *AEWQC* finds the same trend but the magnitude of decline in less pronounced: 5 % in the case of AC and 12 % in the case of MC.

Seversky Donetz

ANMACs: Towards 1996, the AC of most key pollutants in Seversky Donetz river basin either tended to increase or remain at approximately the same (unacceptably) high levels as in 1993. There was an increase in average pollution between 1993 and 1996; for the period 1993 to 1994-1995, pollution increased by 29 % from 3.1 to 4.0 MACs. By 1996 it had increased further by 48 % from 4.0 to 5.9 MACs. If compared to 1993, pollution

levels were higher by 90 % in 1996. By contrast maximum pollution levels decreased. A small decrease (of 1 %) from 18.5 MACs in 1993 to 18.3 MACs took place during 1994-1995. Then there was a 26 % decrease from 18.3 MACs to 13.6 MACs in 1996. In 1993 maximum pollution was 26 % lower than in 1996.

AEWQC: In the case of AC, the water quality index did not change during 1993 to 1996, while MC decreased. There was a decrease of 12 % from 2.5 in 1993 to 2.2 during 1994-1995. During 1995-1996 the decrease was 4 % from 2.2 to 2.1. In 1996 the index was 16 % lower than in 1993.

The *ANMACs* between 1993 and 1996 show that pollution in the basin was increasing. A large 90 % increase was recorded in the case of AC. In contrast MC decreased by 26 %. According to *AEWQC* AC remained at approximately the same levels, while MC declined by 16 %.

Crimea

ANMACs: The AC for the six key pollutants shows a steady increase in the rivers of the Crimea region. In comparison to other regions of Ukraine, river pollution in Crimea is not that high, probably due to the influence of tourist resorts. Crimea has traditionally been a resort region with a low number of manufacturing and processing industries capable of causing serious pollution. Therefore, in 1993, there were no unacceptable concentrations of pollutants in Crimean rivers, nor were there registered any heavy pollution accidents. In 1994-1995 and 1996 this situation changed. In 1994-1995 pollutants appear in the rivers with concentrations exceeding 1 MAC. However, the average value for all pollutants is still below that limit and is equal 0.5 MAC. In 1996 there followed a further increase of 200 % from 0.5 to 1.5 MACs as compared to 1994-

1995, a similar situation was found for the average of maximum concentrations. This was 0.8 MAC in 1994-1995 and increased by 438 % to 4.3 MACs in 1996. If the current trend persists, Crimea may lose some of its resort value in the near future.

AEWQC: During 1993-1996 the river water quality in Crimea was deteriorating. The high ecological quality of this resort area in 1993 with AC and MC water quality indices equal to zero were adversely changed during 1994-1995, when the index increased to 0.9. A further increase followed bringing the indices up by 22 % to 1.1 in 1996. Because Crimea is not an industrial region, pollution increase could be attributed to deteriorating standards of services related to water supply, sewage treatment and waste disposal.

Significant increases in river pollution during 1993-1996 were revealed by both *ANMACs* and *AEWQC*. The difference is the estimated magnitude of pollution increase. Thus, during 1994-1996, pollution levels increased by 438 % according to the *ANMACs* estimation but by just 22 % according to *AEWQC*.

In general *AEWQC* shows a smaller magnitude of change in river pollution than *ANMACs*. This is explained by the fact that concentrations of common pollutants such as nitrites, ammonium and copper compounds are very high. Almost all of them fell into VI water quality class and were therefore assigned the greatest value '4' in the analysis. Whether they declined or increased between 1993 and 1996, they still remain within water quality class VI.

General analysis for the whole country on the basis of eight river basins

In order to determine the general trend of overall pollution change in Ukraine between 1993 and 1996, it is necessary to collate and analyse pollution data for all river basins.

These data are the result of the analyses completed for individual river basins and include both average and maximum concentrations of pollutants.

Tables 5.5a and 5.5b present collated outcomes from previous mathematical analyses of pollution in the eight river basins summarised above.

Table 5.5a

ANMACs: collation of outcomes of analysis for AC and MC of pollutants during 1993-1996

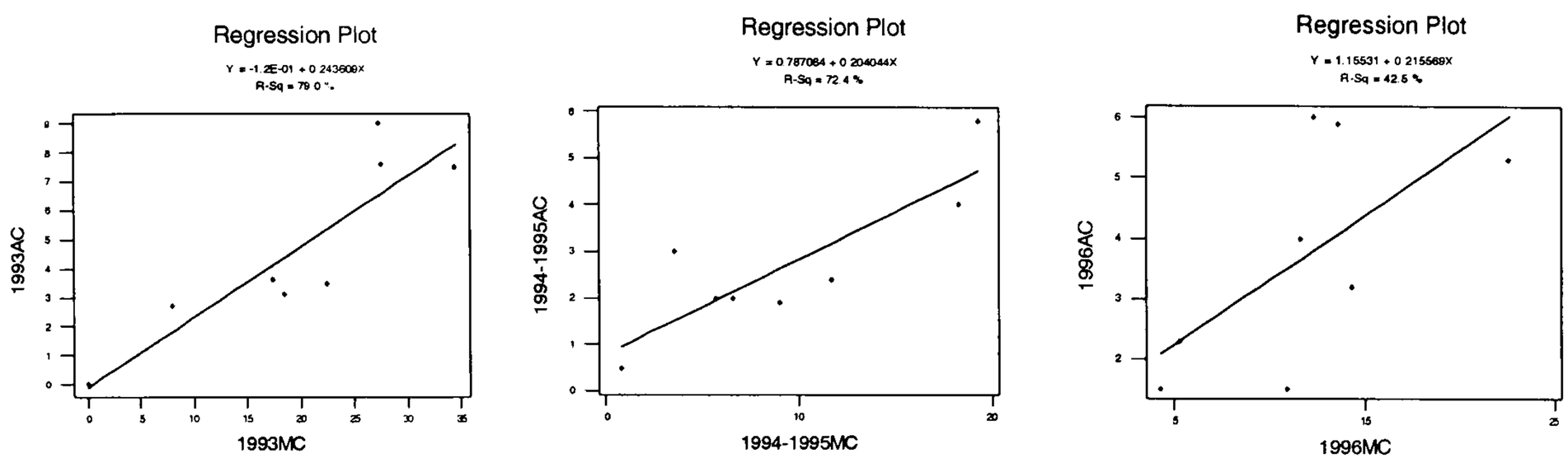
River basins	Based on AC			Based on MC		
	1993	1994-1995	1996	1993	1994-1995	1996
Zakhidny Bug	7.6	3.0	3.2	27.6	3.6	14.3
Danube	3.5	1.9	1.5	22.5	9.0	10.9
Dnistr	9.0	2.0	6.0	27.3	5.7	12.3
Pivdenny Bug	3.6	2.4	4.0	17.4	11.7	11.6
Dnipro	2.7	2.0	2.3	8.0	6.6	5.3
Priazovie	7.5	5.8	5.3	34.5	19.3	22.6
Severský Donetz	3.1	4.0	5.9	18.5	18.3	13.6
Crimea	0	0.5	1.5	0	0.8	4.3
Average value	*4.6*	*2.7*	*3.7*	*19.5*	*9.4*	*11.9*

During 1993-1996 there has been an observed change in the average magnitude of key pollutants in the basins of Zakhidny Bug, Danube, Dnistr, Pivdenny Bug, Dnipro, Priazovie, Severský Donetz and Crimea. From 1993 until 1994-1995 there was a decline in pollution levels of 41 % (from 4.6 to 2.7 MACs). In comparison to 1994-1995, an increase of 37 % (from 2.7 to 3.7 MACs) had occurred by 1996. Thus, in 1996 the average pollution levels appear to be 20% less than in 1993 (3.7 as opposed to 4.6 MACs in 1993).

Within the same period, there is a significant variation in the average value of total maximum MACs for key pollutants in the eight river basins. From 1993 to 1994-1995, there was a decrease of 52 % (from 19.5 to 9.4 MACs) in maximum pollution loads. This was followed by an increase of 27% (from 9.4 to 11.9 MACs) from 1994-1995 to

1996. Compared to 1993, the maximum pollution levels had fallen by 39 % (from 16.5 to 12.7 MACs) by1996. The three plots below (Figure 5.2) reveal correlation between the AC and MC of key pollutants (for example, Table 5.4a) between 1993 and 1996.

Figure 5.2
Correlation between AC and MC of key pollutants in 8 river basins according to *ANMACs* (in 1993, 1994-1995 and 1996).



ANMACs: According to the rules of statistics, two sets of data are described as highly correlated if their R-Sq value is more then 80 % for eight pairs. Correlation between data sets also exists when the R-Sq value falls into the range 60-80 %. When comparing sets of pollution data based on AC and MC for all river basins (eight basins, eight observations of AC and eight observations of MC) the correlation is 79 % for 1993, 72.4 % for 1994-1995 and 42.5 % for 1996. It appears that there thus a is general correlation between reported AC and MC of pollutants during 1993-1995, but no significant correlation (< 60%) for the data in 1996. In general, interpolation of correlation results shows that reported AC and MC are related, i.e. a change in MC would result in a change of AC and vice versa. Poor correlation of results for 1996 suggests that such changes are likely to be disproportionate.

Table 5.5b

AEWQC: collation of outcomes of analysis for AC and MC of pollutants during 1993-1996

River basins	Concentration					
	Average			Maximum		
	1993	1994-5	1996	1993	1994-5	1996
Zakhidny Bug	1.9	1.6	1.5	2.3	1.3	1.8
Danube	1	0.9	1.1	1.8	1.4	1.5
Dnistr	1.8	1.5	1.9	2.2	1.7	2
Pivdenny Bug	1.5	1.4	1.5	1.9	1.8	1.8
Dnipro	1.2	1.4	1.3	1.5	1.7	1.6
Priazovie	2	1.9	1.9	2.5	2.3	2.2
Seversky Donetz	1.7	1.7	1.7	2.5	2.2	2.1
Crimea	0	0.9	1.1	0	0.9	1.1
Average	*1.4*	*1.4*	*1.5*	*1.8*	*1.7*	*1.8*

In general, the ecological quality of river water based on AC of pollutants remains at approximately the same levels throughout 1993 to 1996. A slight increase of 7 % from 1.4 during 1993-1995 to 1.5 in 1996 is due to higher pollution loads in the Seversky Donetz and Crimea basins.

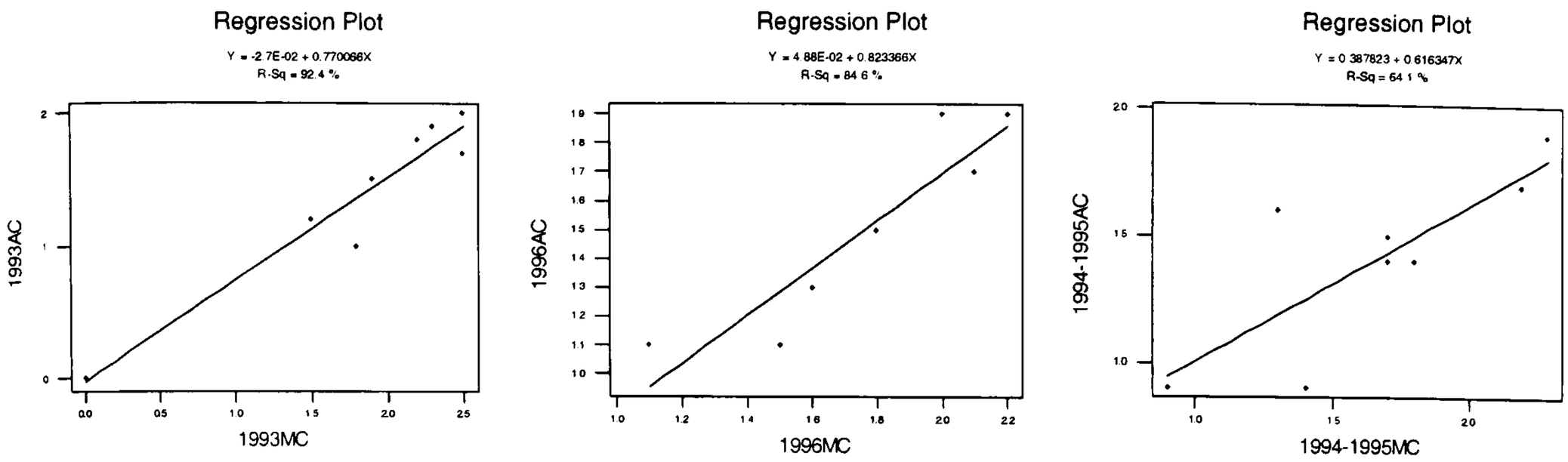
The values 1.4-1.5 belong to the water quality classes III - <IV, so Ukrainian rivers could be characterised as "insignificantly" polluted. However it would not be correct to state this because certain parameters were found to have an index value of 4, belonging to water quality class VI, which means "very polluted".

As to pollution levels based on MC during 1993-1996 it varied within the range 1.8-1.7 without a clear tendency to change. This matches the pattern of change of pollution based on AC.

The three plots below (Figure 5.3) show correlation between AC and MC of key pollutants (for example, Table 5.4a) for 1993, 1994-1995 and 1996.

Figure 5.3

Correlation between AC and MC of key pollutants in 8 river basins according to *AEWQC* (in 1993, 1994-1995 and 1996).



AEWQC: Through comparison of the sets of pollution data based on AC and MC the R-Sq for 1993 is 92,4 %, for 1994-1995 - 64,1 %, for 1996 - 84.6 %. It appears that there is correlation between reported AC and MC of pollutants, if these are transferred into water quality classes. It is somewhat different from analogous correlation results obtained for *ANMACs*, where no correlation was observed for 1996. A likely reason for the difference is that, under *AEWQC*, variations of concentrations of pollutants tend to be less clear, than under *ANMACs*. As in the case of *ANMACs*, interpolation of results under *AEWQC* suggests that a change in MC of pollutants will result in a change of their AC, but the change will be disproportionate.

In general, *AEWQC* shows that, for the whole country, there is no overall change in river pollution (in terms of ecological water quality index) between 1993 and 1996. The severity of pollution in different basins may differ depending on the nature and extent of the human activities that caused it. In 1996 pollution by certain parameters such as copper and nitrites were indicative of ecological water quality class VI ("very polluted"), which is unacceptably high. Because pollution levels do not tend to change, high concentrations of these parameters may persist in the future unless measures of abatement are applied. On the other hand the time frame 1993-1996 is short. Pollution

change trends might look different if pollution data for 1997-2000 were available in the public domain.

It is now possible to create a ranked list of river basins, beginning with the most heavily polluted and ending with the least heavily polluted. This is a priority list, which will rank river basins according to the extent of average pollution levels expressed in units of MAC. Both average and maximum concentrations will be taken into account with priority given to persistent average concentration of pollutants. The ranking according to *ANMACs* and *AEWQC* is presented in Table 5.6 relate to 1996 only.

Table 5.6

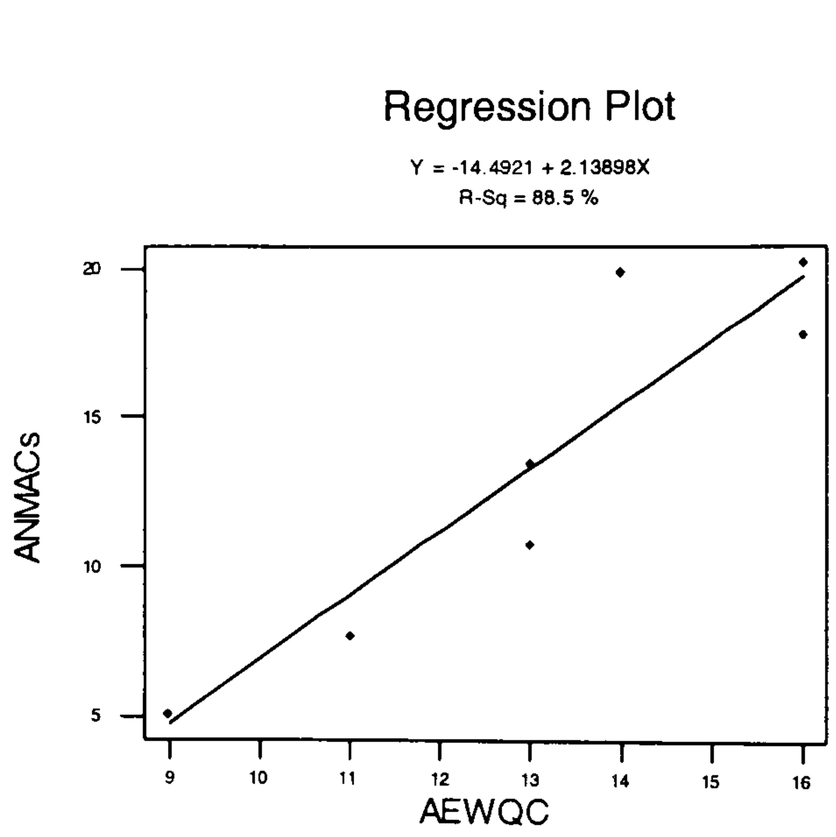
The list of river basins ranked according to their average value out of total MAC. Left part of Table - according to *ANMACs*, right part of Table - according to *AEWQC*.

Num-ber	River basins	Average pollution load	*Sha-re, %*	Num-ber	River basins	AC index (A)	*Sha-re, %*
1	Dnistr	6.0	*20.2*	1	Priazovie	1.9	*16*
2	Seversky Donetz	5.9	*19.9*	1	Dnistr	1.9	*16*
3	Priazovie	5.3	*17.8*	2	Seversky Donetz	1.7	*14*
4	Pivdenny Bug	4.0	*13.5*	3	Zakhidny Bug	1.5	*13*
5	Zakhidny Bug	3.2	*10.8*	3	Pivdenny Bug	1.5	*13*
6	Dnipro	2.3	*7.7*	4	Dnipro	1.3	*11*
7	Danube	1.5	*5.1*	5	Danube	1.1	*9*
8	Crimea	1.5	*5.1*	5	Crimea	1.1	*9*
	Total	29.7	*100*		Total	$\sum = 12.0$	*100*

Figure 5.4 below shows correlation between the shares of river basins in Table 5.6.

Figure 5.4

Correlation between river basin shares (in %) according to *ANMACs* and *AEWQC*



R-sq in the regression plot is equal to 88.5 %. This means that shares of pollution of river basins obtained through *ANMACs* and *AEWQC* are highly correlated and reflect similar patterns of pollution distribution across river basins. Interpolation of shares of pollution, derived from R-sq equal to 88.5 %, suggests that deterioration of water quality from the point of view of sanitary, hygienic and economic requirements will result in similar deterioration of water quality with respect to its ability to support aquatic ecosystems, and vise versa.

In both analyses the "share" based on average pollution levels will be combined with "share" calculated on the basis of the number of heavy pollution accidents in river basins. The final objective of combining these "shares" is to develop a scheme for efficient allocation of scarce state funds for river pollution prevention in river basins, which would take account of both pollution magnitude and basin size.

There will also be "shares" calculated for individual pollutants. In a similar fashion the list of priorities for individual pollutants will be drawn. The purpose is to be able to address the most harmful pollutants first.

Besides being used for funds' allocation the "shares" for individual river basins considered along with the "shares" for individual pollutants may allow screening for existing industries throughout the country, which will become priorities for monitoring by state environmental inspectorates and state investments into water pollution prevention measures.

In this research all "shares" are calculated only for the year 1996, because they are intended to take into account the most recent pollution trends. While pollution tends to

decline during 1993-1996, this trend is not clear because concentrations of pollutants in rivers are very unstable, and the period 1993-1996 is too short.

The next step is to obtain similar "shares" for river basins using another measurement – number of heavy pollution accidents.

5.3.2 Analysis of change in number of heavy pollution accidents (HPA)

Data on the number of HPA (NHPA) in the eight river basins for 1993-1996 and analysis are presented in Table 5.7. The data have been taken from MEP reports (1994,1997 and 1998).

Table 5.7
Analysis of change in NHPA in main river basins in 1993, 1994-1995, 1996

River basins	NHPA		
	1993	1994-1995	1996
Zakhidny Bug	79	60	71
Danube	48	30	47
Dnistr	36	32	31
Pivdenny Bug	24	32	32
Dnipro	10	294	522
Priazovie	118	78	63
Seversky Donetz	185	185	180
Crimea	0	0	0
Average for 8 basins	62.5	88.875	118.25

Zakhidny Bug. Recorded NHPA declined by 24 % between 1993 and 1994-1995. From 1994-1995 to 1996 the number increased by 18 %. In 1996 NHPA was 10 % lower than in 1993. Thus, there is a slight overall tendency towards decline in the NHPA and, at the same time, according to previous analysis there was a 17 % improvement in ecological water quality during 1993-1996.

Danube. The NHPA decreased by 38 % from 1993 to 1994-1995, but then increased by 57 % in 1996. In 1996 the NHPA was about the same as in 1993. No clear tendency towards decline or increase in NHPA can be traced, although over the same period ecological water quality index worsened by 30 %. A lot of pollutants in Danube come from Western and Central European countries located upstream.

Dnistr. The NHPA declined by 11 % during 1993 to 1994-1995. In 1996 there were 31 HPA, or almost the same as in 1994-1995. There is a slight tendency towards decline in the NHPA and it is not clear whether this tendency will be maintained. As to pollution levels, they vary, but they also do not display any clear trend between 1993 and 1996.

Pivdenny Bug. There was a 33 % increase in the NHPA from 1993 to 1994-1995. From 1994-1995 towards 1996 the NHPA did not change. It is not clear whether the NHPA would tend to decline or increase. Despite that, during 1993-1996, there was a 21 % decrease in pollution considering ecological water quality index (EWQI) based on AC.

Dnipro. Between 1993 and 1995 there was a dramatic increase (2900 %) in the NHPA. Between 1994-1995 and 1996 the number increased by a further 78 %. In 1996 the NHPA was more then 5100 % higher than in 1993. Hence there is a clear tendency towards further increases in the NHPA. This happens in the basin, which occupies 45 % of Ukraine's territory. As to pollution in terms of EWQI based on AC, it varied slightly but remained at approximately the same levels during 1993-1996.

Priazovie. There is a clear tendency towards decline in the NHPA. The overall decline during 1993-1996 was 47 %. Despite this significant decline in the NHPA, overall pollution levels during 1993-1996 declined by only 4 %.

Severskv Donetz. During 1993-1996 the NHPA in the basin did not change significantly. Virtually no change was recorded from 1993 to 1995. Towards 1996 NHPA declined by 3 %. Slight further decline may be maintained, but this is not clear. This coincides with an unclear trend in pollution change during 1993-1996. The pollution varied slightly but generally remained at about the same levels.

Crimea. No HPA were recorded in this basin. Despite that, the ecological conditions in Crimean rivers were rapidly deteriorating during 1993-1996. The pollution here may not be coming through uncontrolled industrial and municipal discharges but from other sources, such as leaking water mains or landfill sites (MEP, 1998 and Semchuk, 1997).

Thus NHPA in the Priazovie basin, which has been a pollution 'hot spot' since the 1950s (Pozhivanov, 1995), shows a clear tendency towards decline. A slight tendency towards decline in the NHPA can be traced for Zakhidny Bug, Dnistr and Seversky Donetz. No clear trend in NHPA can be traced for Danube and Pivdenny Bug basins. NHPA in Dnipro basin dramatically increases during 1993-1996 by 5100 %. No NHPA were recorded in Crimea basin.

The dynamics of change in NHPA has different patterns in different basins but, in general, the overall NHPA in the country increases dramatically during 1993-1996. Possibly before Ukraine's independence issues related to serious HPA were censured and, therefore, underreported. Compared to 1993 the number of heavy pollution accidents increased by 42 % during 1994-1995. This is followed by further 33 % increase in 1996 if compared to 1994-1995. There is a 90 % increase in the number of heavy pollution accidents in 1996 compared to 1993. The increase is primarily linked to

the Dnipro river basin, which is the largest in Ukraine and occupies almost half of its territory.

The trends of change in NHPA and pollution levels do not match each other very well for such basins as Danube, Pivdenny Bug, Dnipro, Priazovie and Crimea. The reason for this is likely to be a great number of 'non-heavy' pollution accidents and unrecorded HPA: non-heavy pollution accidents are those related to small but frequent discharges of under-treated and untreated pollution effluents. The actual number of unrecorded "heavy" and "non-heavy" pollution accidents are unknown and this is a real limitation in the environmental information available for public access.

Through the analysis of available information river basins can now be ranked according to the number of heavy pollution accidents on their territory in 1996 (Table 5.8).

Table 5.8
Ranking river basins according to number of heavy pollution accidents

Number	River basins	NHPA	*Share, %*
1	Dnipro	522	*55.2*
2	Seversky Donetz	180	*19*
3	Zakhidny Bug	71	*7.5*
4	Priazovie	63	*6.7*
5	Danube	47	*5*
6	Pivdenny Bug	32	*3.4*
7	Dnistr	31	*3.3*
8	Crimea	0	*0*
	Total	946	*100*

It is now possible to combine the outcomes of mathematical assessments of pollution in terms of EWQI based on AC and NHPA. This will facilitate the ranking of river basins according to the extent of river pollution problems.

5.3.3 Final priority ranking for individual river basins

Collation of the results of analyses and final priority ranking for river basins

The purpose of collation of the results of two assessments is to produce a list, which will rank river basins according to their share in overall pollution in Ukraine in 1996. Due to the limitations of environmental information already discussed, the ranking may not be precise, but it should generally reflect the real situation of river pollution in the country. Simple ranking procedures utilise the outcomes of *ANMACs* and *AEWQC* based on AC and NHPA in Tables 5.9a and 5.9b respectively.

Table 5.9a

ANMACs: determination of an average share out of two analyses

Ranking number	River basins	Shares from two analyses, %		*Average share for two analyses, S (%)*
		NMAC based on AC	NHPA	
		A	B	*S = (A+B)/2*
1	Dnipro	7.7	55.2	*31.5*
2	Seversky Donetz	19.9	19	*19.5*
3	Priazovie	17.8	6.7	*12.3*
4	Dnistr	20.2	3.3	*11.8*
5	Zakhidny Bug	10.8	7.5	*9.2*
6	Pivdenny Bug	13.5	3.4	*8.5*
7	Danube	5.1	5	*5.1*
8	Crimea	5.1	0	*2.6*
	Total	100	100	*100*

It appears, that the greatest contribution (31.45 %) towards overall river pollution comes from the Dnipro basin. While average concentration of pollutants in rivers of the Dnipro basin is significantly lower than in other basins, e.g. Priazovie (NMAC based share equal to 17.8 %), its area, and NHPA are much greater than the ones of any other basin.

Table 5.9b

AEWQC: determination of an average share out of two analyses

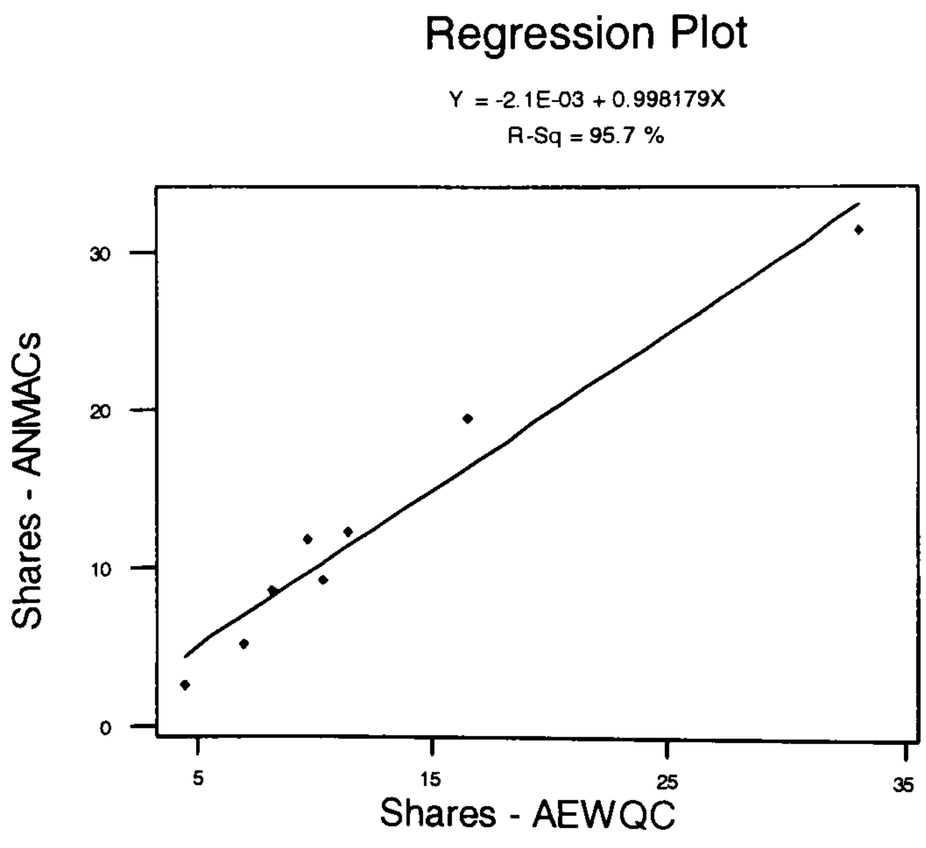
Ranking number	River basins	Shares from two analyses		*Average share for two analyses, S (%)*
		EWQI* based on AC of parameters	NHPA	
		A	B	*S = (A+B)/2*
1	Dnipro	11	55.2	*33.1*
2	Seversky Donetz	14	19	*16.5*
3	Priazovie	16	6.7	*11.4*
4	Zakhidny Bug	13	7.5	*10.3*
5	Dnistr	16	3.3	*9.7*
6	Pivdenny Bug	13	3.4	*8.2*
7	Danube	9	5	*7.0*
8	Crimea	9	0	*4.5*
	Total	100	100	*100*

* Ecological Water Quality Index

The final ranking in Table 5.9b is similar to the ranking of Table 5.9a. In Table 5.9a, the Dnistr basin is ranked fourth and the Zakhidny Bug basin is ranked fifth. In Table 5.9b, the Zakhidny Bug basin is fourth while Dnistr basin is fifth. Also, the magnitudes of shares between these two analyses are somewhat different. The correlation presented in Figure 5.5 below confirms highly similar results (R-Sq = 95.7 %) obtained through *ANMACs* and *AEWQC*. Interpolation shows that any change regarding river basin shares according to *ANMACs* criteria will be matched by an almost proportional change according to the *AEWQC* criteria.

Figure 5.5

Correlation between two shares for 8 river basin according to *ANMACs and AEWQC*



Later in the thesis, these shares (obtained through *ANMACs*) will be used to determine the optimum regional allocation of state budget funds designed to implement measures of river pollution control within basin management plans. This is a legitimate step, because MACs are used in Ukraine as a formal estimation of water quality. The shares obtained through *AEWQC* will not be used for that purpose, because this type of assessment of river water quality is not a legal exercise in Ukraine (Gritzenko, 1994). It is now essential to analyse pollution data with a view to determining the most harmful parameters within river basins. These would be addressed first through pollution control measures.

5.3.4 Analysis of pollution by individual parameters

The purpose of ANMACs and AEWQC for major individual parameters is to rank the parameters according to the magnitude of their concentration in NMAC and according to ecological quality class. Most "abundant" pollutants will be identified as primary targets for pollution control. The analysis will cover the period 1993-1996 with emphasis on 1996.

The general methodology of the analyses will be the same as in previous sections. Source data for the analysis are taken from Appendices 5.3 and 5.4.

Tables 5.10a and 5.10b present *ANMACs* and *AEWQC* for organic compounds and oil products.

Table 5.10a

ANMACs: pollution by organic compounds and oil products

River Basins	Organic compounds						Oil products					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	1993	1994-5	1996	1993	1994-5	1996	1993	1994-5	1996	1993	1994-5	1996
Zakh. Bug	1.5	1.2	1.5	2	1.4	1.5	7.5	1.5	0	70	2	0
Danube	0	0	1	0	0	1	5.5	5.75	1.35	58	9.5	1.7
Dnistr	1	1	0	1	1	0	4.5	4	3.5	56	7	6
Pivd. Bug	1.5	1.5	0	2	2	0	0	0	0	0	0	0
Dnipro	0	0	0	0	0	0	7	0	7	7	0	7
Priazovie	1.5	1.5	1.5	2	2	2	18	21.5	4	70	96	7
Sev.Don.	2	1.5	1	3	2	1	3	11	18.5	21	97	59
Crimea	0	0	1	0	0	1	0	0	0	0	0	0
Average	*0.9*	*0.8*	*0.8*	*1.3*	*1.1*	*0.8*	*5.7*	*5.5*	*4.3*	*35.3*	*26.4*	*10.1*

During 1993-1996, the average concentration of organic compounds remains stable and their maximum concentration tends to decrease. Compared to 1993, in 1996 the maximum concentration of organic compounds in water declined by 38%. The concentration of oil products tends to decline. In case of average concentrations, the overall decline was 25%. The reduction in maximum concentration was 61%.

Table 5.10b

AEWQC : pollution by organic compounds and oil products

River Basins	Organic compounds						Oil products					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	1993	1994-5	1996	1993	1994-5	1996	1993	1994-5	1996	1993	1994-5	1996
Zakh. Bug	0	0	0	1	0	0	3	1	0	4	1	0
Danube	0	0	0	0	0	0	2	2	1	4	3	1
Dnistr	0	0	0	0	0	0	2	2	2	4	3	2
Pivd. Bug	0	0	0	1	1	0	0	0	0	0	0	0
Dnipro	0	0	0	0	0	0	3	0	3	3	0	3
Priazovie	0	0	0	1	1	1	3	4	2	4	4	3
Sev.Don.	1	0	0	2	1	0	2	3	3	4	4	4
Crimea	0	0	0	0	0	0	0	0	0	0	0	0
Average	*0.1*	*0*	*0*	*0.6*	*0.4*	*0.1*	*1.9*	*1.5*	*1.4*	*2.9*	*1.9*	*1.6*

During 1993-1996 AC of organic compounds was low and therefore did not represent a threat to water ecology, while the MC tended to decrease. Comparing 1993 and 1996 the MC of organic compounds in water declined by 83%. Should this trend persist, already in 1997 ecological river water quality across the country in terms of concentration of organic compounds would be "good". The concentration of oil products declined during 1993-1996. Considering AC, the overall decline was 26%. The reduction in the ecologically significant MC was 45%.

Using the same method, an analysis of pollution by *ammonium compounds, nitrites, synthetic surface active compounds; copper, zinc and manganese compounds, phenols, pesticides DDE, DDT, Alpha- and Gamma- GKIG* was conducted. The analysis produced the following findings:

Ammonium compounds and nitrites

ANMACs: Throughout 1993-1996 the concentration of ammonium compounds varied, but had a tendency to decrease towards 1996. Average concentration of this parameter had decreased by 16 % in 1996 compared to 1993 and its maximum concentration varied with a tendency to decrease by 33 %. The average concentration of nitrites tended to increase during 1993-1996 whereas their maximum concentration tended to decline. Thus, in 1996 the average concentration was 120 % higher than in 1993. The maximum concentration decreased by 41 % from 1993 to 1996.

AEWQC: Throughout 1993-1996 the concentration of ammonium shows little change, the AC of this pollutant had increased by 7% in 1996 as compared to 1993 whereas its MC had decreased by 12 %. High concentrations of nitrites tended to increase during 1993-1996. Thus in 1996 both the AC and MC in all cases reached 4 - the highest

possible score in this assessment of potential ecological impact. Compared to 1993 it is at least 37% higher.

Both analyses show similar patterns of change. As in the case of analyses for river basins, magnitudes of change vary and *AEWQC* tends to reveal a lower magnitude of change than *ANMACs*.

Synthetic surface active compounds (SSAC) and copper compounds

ANMACs: Synthetic surface active compounds are found in quantities less then 1 MAC in the case of both average and maximum pollution loads. There is heavy pollution by copper compounds in all river basins. During 1993-1996 pollution loads of copper compounds varied with a tendency to decrease towards the end of the period. The decrease was 56% in the case of average concentrations and 45% in terms of maximum concentration.

AEWQC: Synthetic surface active compounds are found in quantities considered not to produce any significant ecological impact, however, there is serious pollution by copper compounds in all river basins. Concentrations of copper compounds are assigned a value of 4 in most cases. Throughout 1993-1996 in terms of both average and maximum concentrations pollution remains steadily at the highest levels considering potential ecological impact. In 1993 no pollution by copper compounds was recorded in the Crimea basin. Mainly for this reason general pollution for copper compounds in the country was 12% less in 1993 than in all other years.

Both analyses confirm that river pollution by SSAC is insignificant. In contrast, pollution by copper compounds is heavy and serious. According to ANMACs it

declined by 56 % during 1993-1996. However, according to AEWQC the levels of copper compounds in 1996 remained high. Thus, many rivers can be characterised as "very polluted" by copper compounds (water quality class VI).

Zinc and manganese compounds

ANMACs: The change in average and maximum concentrations of compounds of zinc is similar to that of copper compounds. For the whole period 1993-1996 the average concentration fell by 41% with the lowest concentration of 5.1 MACs in 1994-1995. The maximum concentration decreased by 23 % from 46.9 MACs in 1993 to 36.2 in 1996. The lowest maximum concentration of 19.8 was recorded during 1994-1995. The average concentration of manganese compounds increased by 81 % between 1993 and 1996. The maximum concentration varied and reached its minimum of 27.9 in 1994-1995 with a further increase to 43.0 by 1996. In contrast to the average concentration, maximum concentration tends to decrease. In 1996 the maximum concentration of 43.0 was 11% lower than the 48.5 recorded in 1993.

AEWQC: The average concentration of compounds of zinc tends to decrease. For the whole period 1993-1996 the concentration fell by 25%. It should be noted, however, that during 1994-1996 the concentration remained at about the same level of 2.4-2.6. The maximum concentration of 3.5 was the same in 1993 and 1996 despite an 11 % decrease to 3.1 in 1994-1995. Considering potential ecological impact, the average concentration of manganese compounds tended to increase between 1993 and 1996 at a rate of 46%. The maximum concentrations remained stable at 3.4 between 1993 and 1996 despite a 15 % decrease during 1994-1995.

The trends in pollution change traced through ANMACs are similar to the trends obtained through AEWQC.

Phenols and pesticides

ANMACs: During 1993-1996 both average and maximum concentration of phenols were rapidly decreasing unlike most other substances. The main reason for this could be the decline of national chemical and coal processing industries. In the case of average concentration the decrease was 71 % from 1993 to 1996. The maximum concentration decreased ten fold from 15.0 in 1993 to 1.5 in 1996 or by 90%. 1993 was the only year when concentration of 4 MACs for DDE and DDT as well as the concentration of 2 MACs for Alpha- and Gamma-GKIG were recorded and this relates only to the Danube basin. In no other cases was the presence of these or any other pesticides reported in concentrations exceeding 1 MAC. In the country as a whole pollution by agrochemicals is insignificant because farms cannot normally afford to buy and apply them on the scale that would affect chemical composition of river water.

AEWQC: During 1993-1996 both average and maximum concentration of phenols gradually declined to an ecological value of 0 in 1996. In 1993 the average concentration value was 0.1 and the maximum 0.4. Four types of pesticides were grouped together for the analysis because it appeared that the value for their concentrations would be not more than 0, i.e. the concentrations were unlikely to result in an adverse ecological effect. The reason for that is due to the economic crises in the country, making the application of pesticides to fields very limited because they are too expensive for farms to buy them.

No appreciable pollution by these pollutants was found through two analyses.

Verification of analysis in 5.3.1 and 5.3.4

To confirm the validity of ANMACs and AEWQC for individual river basins, the data of the analysis for individual parameters are collated and analysed (Table 5.11). The data are taken from calculations presented in Section 5.3.4.

Table 5.11

Calculation of overall pollution change in the country during 1993-1996

River basins	According to *ANMACs*						According to *AEWQC*					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	93	94-5	96	93	94-5	96	93	94-5	96	93	94-5	96
Organic comp.	0.9	0.8	0.8	1.3	1.1	0.8	0.1	0	0	0.6	0.4	0.1
Oil products	5.7	5.5	4.3	35.3	26.4	10.1	1.9	1.5	1.4	2.9	1.9	1.6
Ammonium	3.7	2.3	3.1	14.6	4.2	9.8	2.6	2.8	2.8	3.3	2.4	2.9
Nitrites	2.5	3.4	5.5	19.0	11.9	11.2	2.5	3.5	4	2.5	3.5	4
SSAC	0.1	0	0	0.1	0	0	0	0	0	0	0	0
Copper comp.	14.2	3.9	6.3	32.6	7.6	18.0	3.5	4	4	3.5	4	4
Zinc compounds	13.1	5.1	7.7	46.9	19.8	36.2	3.4	2.4	2.6	3.5	3.1	3.5
Manganese comp.	6.8	6.9	12.3	48.5	27.9	43.0	1.3	1.4	1.9	3.4	2.9	3.4
Phenols	3.1	1.9	0.9	15.0	4.4	1.5	0.1	0	0	0.4	0.1	0
Pest.* DDE, DDT	0.5	0	0	0.5	0	0	0	0	0	0	0	0
Pest. α-, γ- GKIG	0.3	0	0	0.3	0	0	0	0	0	0	0	0
Average	*4.6*	*2.7*	*3.7*	*19.5*	*9.4*	*11.9*	*1.4*	*1.4*	*1.5*	*1.8*	*1.7*	*1.8*

* "Pest." means "Pesticides"

The final results of analysis (average values for 11 parameters) are the same as in Tables 5.5a relating to *ANMACs* and 5.5b relating to *AEWQC* (average values for 8 river basins). This confirms the correctness of the calculations made for river basins and individual pollutants for 1993-1996. Correlation between average results for 1993-1996 according to *ANMACs* and *AEWQC* are presented below in Figure 5.6.

Figure 5.6

Correlation between average values of AC and MC for 11 pollutants (during 1993-1996) according to *ANMACs* and *AEWQC*

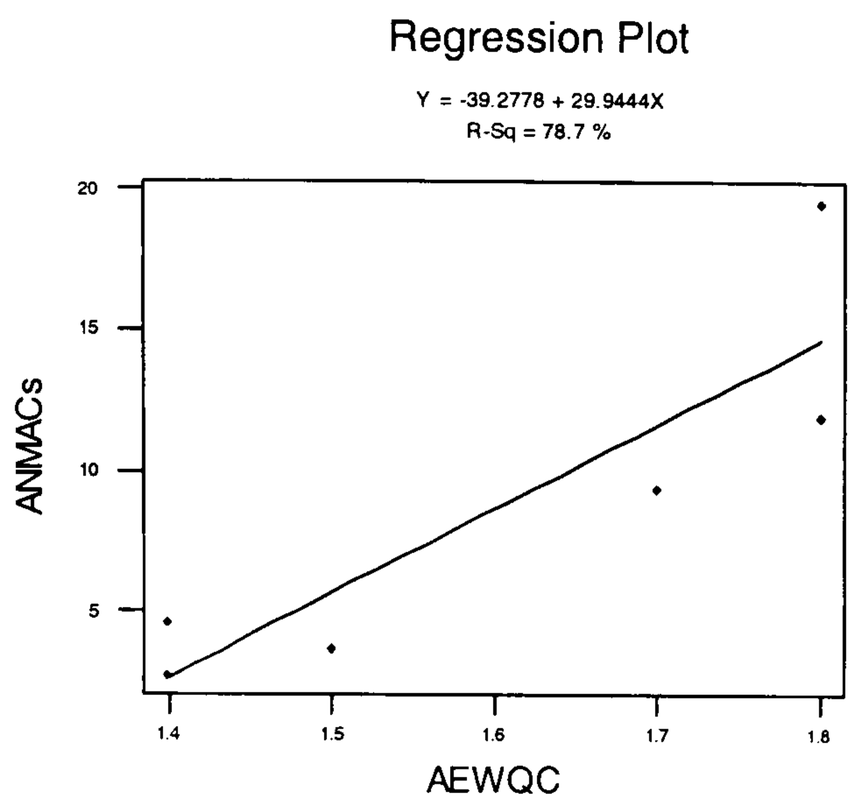


Figure 5.6 shows a good correlation between the average results of *ANMACs* and *AEWQC* because R-Sq is equal to 78.8 %. Thus the outcomes of analyses appear to be inter-dependent and any change in the *ANMACs* criterion will result in a similar change in the *AEWQC* criterion. As in the case of individual river basins, both analyses suggest similar patterns of pollution change and trends.

Priority ranking of individual parameters within river basins

As source data suggest (MEP, 1998) pollution mainly originates from uncontrolled discharges of under-treated and untreated effluents into water bodies. These often result in heavy pollution accidents. Within river basins industries releasing effluents which contain most abundant pollutants should be targeted first. Funds for measures to prevent pollution should be allocated according to the share assigned to each pollutant. These will be different in each river basin. Ranking is presented below and it covers the year 1996 only. This is the final year for which information is available, and policy development for the post-1996 period will primarily utilise information on average levels of river pollution in 1996. Tables 5.12a and 5.12b show shares (S) in per cent assigned to pollutant according to their AC in 1996 through *ANMACs* and *AEWQC* respectively.

Table 5.12a

ANMACs: calculation of share "S" (in %) based on AC for 11 pollutants in 1996

Pollutants	River basins															
	Dni-pro		Seversky Donetz		Priazovie		Zakhidny Bug		Dnistr		Danube		Pivdenny Bug		Crimea	
	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*
Org. c.	0	*0*	1	*1.6*	1.5	*2.6*	1.5	*4.3*	0	*0*	1	*5.9*	0	*0*	1	*6.1*
Oil prod.	7	*28*	18.5	*28.6*	4	*6.8*	0	*0*	3.5	*5.3*	1.4	*8*	0	*0*	0	*0*
Ammon. c.	0	*0*	1.5	*2.3*	3	*5.1*	8.5	*24.3*	4.5	*7*	0	*0*	4.4	*9.9*	3	*18.2*
Nitrites	2	*8*	13	*20.1*	9.5	*16.2*	2.5	*7.1*	9	*13.7*	2	*11.9*	2.7	*6.1*	3	*18.2*
Copper c.	3.5	*14*	5	*7.8*	6.5	*11.2*	3.5	*10*	11	*16.8*	3.5	*20.8*	7.5	*16.9*	9.5	*57.5*
Zinc c.	5	*20*	8.5	*13.2*	12	*20.5*	6.5	*18.6*	18.5	*28.2*	4.5	*26.7*	6.4	*14.4*	0	*0*
Mang. c.	6	*24*	12.5	*19.4*	20.5	*35*	12.5	*35.7*	19	*29*	4.5	*26.7*	23.5	*52.7*	0	*0*
Phenols	1.5	*6*	4.5	*7*	1.5	*2.6*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*
Total	25	*100*	64.5	*100*	58.5	*100*	35	*100*	65.5	*100*	16.9	*100*	44.5	*100*	16.5	*100*

Notes: No pollution by either SSAC or pesticides was reported in 1996; abbreviation "c." means "compounds".

Table 5.12b

AEWQC: calculation of share "S" (in %) based on AC for 11 pollutants in 1996

Pollutants	River basins															
	Dnipro		Seversky Donetz		Priazovie		Zakhidny Bug		Dnistr		Danube		Pivdenny Bug		Crimea	
	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*	AC	*S*
Oil prod.	3	21.4	3	15.8	2	9.5	0	0	2	9.5	1	8.3	0	0	0	0
Amm. c.	0	0	3	15.8	4	19	4	23.5	4	19	0	0	3	17.6	4	33.3
Nitrites	4	28.6	4	21.1	4	19	4	23.5	4	19	4	33.3	4	23.5	4	33.3
Copper c.	4	28.6	4	21.1	4	19	4	23.5	4	19	4	33.3	4	23.5	4	33.3
Zinc c.	2	14.3	3	15.8	4	19	3	17.6	4	19	2	16.7	3	17.6	0	0
Mang. c.	1	7.1	2	10.5	3	14.3	2	11.8	3	14.3	1	8.3	3	17.6	0	0
Total	14	100	19	100	21	100	17	100	21	100	12	100	17	100	12	100

Now it is possible to summarise rankings of river basins and pollutants for 1996.

According to *ANMACs*

1. Dnipro (PS* = 31.5 %)

1. Oil products (28 %)
2. Manganese compounds (24 %)
3. Zinc compounds (20 %)
4. Copper compounds (14 %)
5. Nitrites (8 %)
6. Phenols (6 %)

2. Seversky Donetz (PS = 19.5 %)

1. Oil products (28.6 %)
2. Nitrites (20.1 %)
3. Manganese compounds (19.4 %)

According to *AEWQC*

1. Dnipro (PS = 33.1 %)

1. Nitrites and copper comp. (28.6 %')
2. Oil products (21.4 %)
3. Zinc compounds (14.3 %)
4. Manganese compounds (7.1 %)

2. Seversky Donetz (PS = 16.5 %)

1. Nitrites and copper compounds (21.1 %')
2. Oil products, ammonium and zinc Compounds (15.8 %')
3. Manganese compounds (10.5 %)

4. Zinc compounds (13.2 %)
5. Copper compounds (7.8 %)
6. Phenols (7 %)
7. Ammonium compounds (2.3 %)
8. Organic compounds (1.6 %)

3. Priazovie (PS = 12.3 %)

1. Manganese compounds (35 %)
2. Zinc compounds (20.5 %)
3. Nitrites (16.2 %)
4. Copper compounds (11.2 %)
5. Oil products (6.8 %)
6. Ammonium compounds (5.1 %)
7. Organic comp. and phenols (2.6 %')

4. Dnistr (PS = 11.8 %)

1. Manganese compounds (29 %)
2. Zinc compounds (28.2 %)
3. Copper compounds (16.8 %)
4. Nitrites (13.7 %)
5. Ammonium compounds (7 %)
6. Oil products (5.3 %)

5. Zakhidny Bug (PS = 9.2 %)

1. Manganese compounds (35.7 %)
2. Ammonium compounds (24.3 %)
3. Zinc compounds (18.6 %)
4. Copper compounds (10 %)
5. Nitrites (7.1 %)
6. Organic compounds (4.3 %)

6. Pivdenny Bug (PS = 8.5 %)

1. Manganese compounds (52.7 %)
2. Copper compounds (16.9 %)
3. Zinc compounds (14.4 %)
4. Ammonium compounds (9.9 %)
5. Nitrites (6.1 %)

7. Danube (PS = 5.1 %)

1. Zinc and mang. comp. (26.7 %')
2. Copper compounds (20.8 %)
3. Nitrites (11.9 %)
4. Oil products (8 %)
5. Organic compounds (5.9 %)

8. Crimea (PS = 2.6 %)

1. Copper compounds (57.5 %)
2. Ammon. comp. and nitrites (18.2 %')
3. Organic compounds (6.1 %)

3. Priazovie (PS = 11.4 %)

1. Nitrites, ammonium, copper and zinc Compounds (19 %')
2. Manganese compounds (14.3 %)
3. Oil products (9.5 %)

4. Zakhidny Bug basin (PS = 10.3 %)

1. Nitrites, ammonium and copper Compounds (23.5 %')
2. Zinc compounds (17.6 %)
3. Manganese compounds (11.8 %)

5. Dnistr basin (PS = 9.7 %)

1. Nitrites, ammonium, zinc and copper Compounds (19 %')
2. Manganese compounds (14.3 %)
3. Oil products (9.5 %)

6. Pivdenny Bug basin (PS = 8.2 %)

1. Nitrites and copper compounds (23.5 %')
2. Ammonium, zinc and manganese Compounds (17.6 %')

7. Danube basin (PS = 7 %)

1. Nitrites and copper compounds (33.3 %')
2. Zinc compounds (16.7 %)
3. Oil products and manganese comp. (8.3 %')

8. Crimea basin (PS = 4.5 %)

1. Nitrites, copper and ammonium Compounds (33.3 %')

* "PS" means "Share in the overall river pollution in the country";
' means share for each of pollutants mentioned.

Rankings of river basins and individual pollutants will be used mainly in the final chapter.

A general ranking of individual pollutants on a countrywide scale is calculated through the relevant pollution share for each river basin. The shares of individual pollutants will be proportionately reduced according to the pollution share of each river basin. For example, the river basin of first priority, Dnipro, with the greatest pollution share (31.5 %), can be assigned a coefficient of 1. In this case the coefficient of the Seversky Donetz (19.5 %) will be equal:

$$\text{Co} = 1 \times \frac{19.5}{31.5} = 0.619$$

In the same manner the coefficients for all other river basins have been determined using shares in Tables 5.12a (for outcomes of *ANMACs*) and 5.12b (for outcomes of *AEWQC*) adjusted correspondingly to coefficient values. The adjusted values and calculation of approximate average share of every individual pollutant are presented in Tables 5.13a and 5.13b for *ANMACs* and *AEWQC* correspondingly.

Table 5.13a

ANMACs: determination of average share of individual pollutants on a country-wide basis

Pollutants	Dni-pro	Seversky Donetz	Pria-zovie	Dni-str	Zakhid-ny Bug	Pivden-ny Bug	Dan-ube	Cri-Mea	Ave-rage	*Sha-re, %*
	31.5 %	19.5 %	12.3 %	9.7 %	9.2 %	8.2 %	5.1 %	2.6 %		
Mang. c.	24	12.0	13.7	13.4	8.5	7.2	8.5	0.0	10.9	*27.4*
Zinc c.*	20	8.2	8.0	7.0	8.2	7.2	2.3	0.0	7.6	*19.1*
Oil prod.	28	17.8	2.7	0.0	1.5	2.2	0.0	0.0	6.5	*16.3*
Copper c.	14	4.8	4.3	3.7	4.9	5.6	2.7	4.8	5.6	*14.1*
Nitrites	8	12.5	6.3	2.7	4.0	3.2	1.0	1.5	4.9	*12.3*
Ammon. c.	0	1.4	2.0	9.1	2.0	0.0	1.6	1.5	2.2	*5.5*
Phenols	6	4.3	1.0	0.0	0.0	0.0	0.0	0.0	1.4	*3.5*
Organic c.	0	1.0	1.0	1.6	0.0	1.6	0.0	0.5	0.7	*1.8*
Total									39.8	*100*

* "c" means "compounds"

Table 5.13b

AEWQC: determination of average share of individual pollutants on a country-wide basis

Pollutants	Dni-pro	Seversky Donetz	Pria-zovie	Dni-str	Zakhid-ny Bug	Pivden-ny Bug	Dan-ube	Cri-Mea	Ave-rage	*Sha-re, %*
	33.1%	16.5 %	11.4 %	10.3 %	9.7 %	8.2 %	7 %	4.5 %		
Oil prod.	21.4	7.9	3.3	0	2.8	2.1	0	0	4.7	*12.3*
Ammon. c.	0	7.9	6.5	7.3	5.6	0	3.7	4.5	4.4	*11.7*
Nitrites	28.6	10.5	6.5	7.3	5.6	8.2	5	4.5	9.5	*25.1*
Copper c.	28.6	10.5	6.5	7.3	5.6	8.2	5	4.5	9.5	*25.1*
Zinc comp.	14.3	7.9	6.5	5.5	5.6	4.1	3.7	0	6	*15.7*
Mangan.c.	7.1	5.2	4.9	3.7	4.2	2.1	3.7	0	3.9	*10.2*
Total									38	*100*

Calculations made in Tables 5.13a and 5.13b provide us with the following ranking, which reflects the pattern of pollution by individual parameters in the country:

According to *ANMACs*

1. Manganese compounds (27.4 %).
2. Zinc compounds (19.1 %).
3. Oil products (16.3 %).
4. Copper compounds (14.1 %).
5. Nitrites (Share = 12.3 %).
6. Ammonium compounds (5.5 %).
7. Phenols (3.5 %).
8. Organic compounds (1.8 %)
9. SSAS and all pesticides (0 %)

According to *AEWQC*

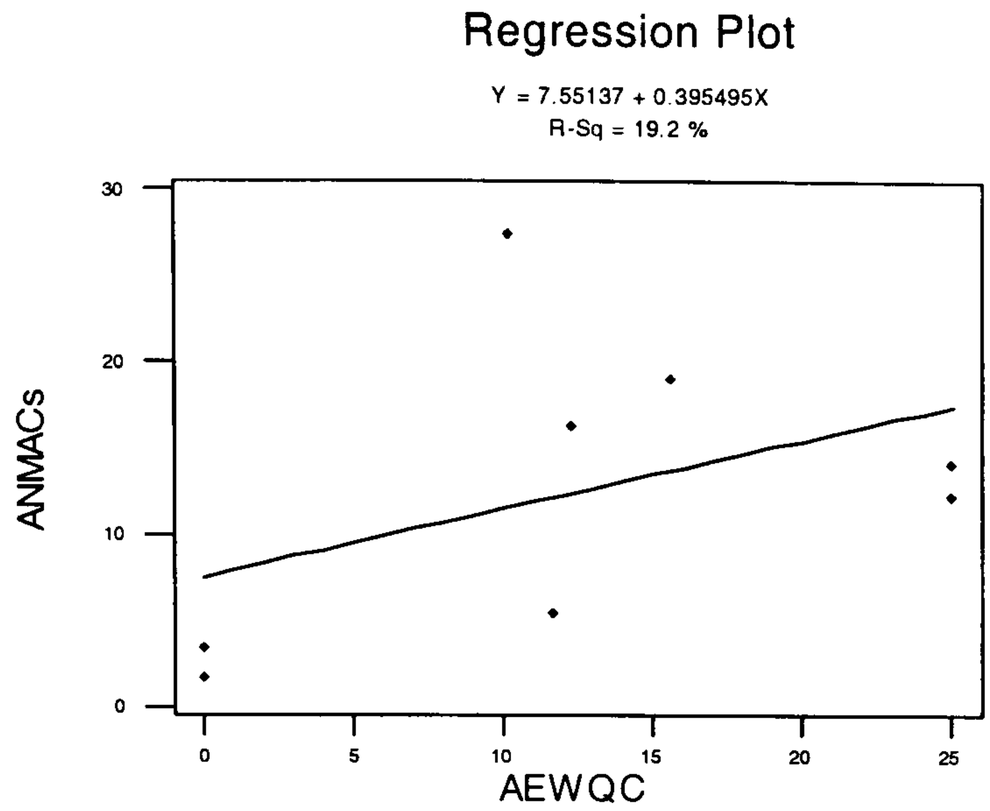
1. Nitrites and copper compounds (Share = 25.1 % each);
2. Zinc compounds (15.7 %);
3. Oil products (12.3 %);
4. Ammonium compounds (11.7 %);
5. Manganese compounds (10.2 %);
6. Organic compounds, SSAS, phenols and all pesticides (0 %).

For brief information about major properties of these pollutants and the way they enter water bodies see Appendix 5.8.

Figure 5.7 shows a poor correlation between shares of individual pollutants on a country-wide scale obtained through two analyses.

Figure 5.7

Correlation between shares for 11 pollutants according to *ANMACs* and *AEWQC*



According to the result (R-sq equal to 19.2 %) there is no significant correlation between shares for individual pollutants obtained through *ANMACs* and *AEWQC*. The most likely reason for this is that these analyses consider pollution from different points of view. *ANMACs* assesses quality of river water from the point of view of its suitability for drinking, economic and domestic purposes, while *AEWQC* was designed to assess river water quality from the point of view of its suitability for river ecology. This created a rather random pattern of ranking and shares for individual pollutants. For instance, manganese compounds have 27.4 % share according to *ANMACs*, but according to *AEWQC* their share is only 10.2 %. Interpolation of these shares suggests that an increase in the significance of a pollutant according to the criterion of *ANMACs* may not result in a similar increase according to the criteria of *AEWQC*, and vice versa.

5.4 General observations

The analysis of data on river pollution reveals the following:

- Pollution originates from industrial and municipal sources rather than agriculture;

- The general pollution trend is downward across the rivers of Ukraine during the period 1993 to 1996. This is more pronounced in the case of *ANMACs* than *AEWQC*; however the trends vary considerably for individual pollutants and river basins;
- Correlation of sets of data across river basins and individual pollutants shows that both analyses give very similar pictures of distribution of magnitude of pollution for the eight river basins in 1996. Thus, both analyses produce similar findings regarding pollution in river basins. There is also correlation between AC and MC of pollutant in *ANMACs* and in *AEWQC*. By contrast, there is no correlation between rankings of individual pollutants according to *ANMACs* and *AEWQC*. This can be explained by the criteria used in the analyses: *ANMACs* targeted river water quality on the subject of suitability for drinking, economic and domestic needs, while *AEWQC* – on the subject of suitability for existence of natural water ecosystems;
- Interpolation derived from correlation of outcomes of *ANMACs* and *AEWQC* suggests that, in respect to individual river basins, the change in water quality from the point of view of meeting people's drinking, domestic and economic needs will be matched by similar change in the ecological water quality. In respect to individual pollutants, increase in MC will cause an increase in AC and vice versa. However, an increase or decrease in significance of an individual pollutant according to *ANMACs* is unlikely to result in similar change for this particular pollutant according to *AEWQC* and vice versa;
- Average concentrations of several pollutants in the country for 1996 often exceed 1 MAC and may reach several MACs. This is unacceptably high by Ukrainian water quality standards;
- A change common to most river basins is that pollution tends to drop during 1994-1995, but increases again for 1996, while usually remaining above MAC limits for pollutants during the whole period 1993 to 1996. This relates to such pollutants as

nitrites, oil products, ammonium, copper, zinc and manganese compounds. As USCPW experts Alexander Z. and Georgy S. (1998) supposed prolonged drought in 1996 might be the reason for somewhat higher concentrations of pollutants in rivers, when river flows were generally lower than usual. The future trend of river pollution change is not clear;

- NHPA in the country tends to increase primarily due to increases in the Dnipro Basin, which occupies almost half of Ukraine's territory. As to other basins, the number of HPA tends to decrease or remain at about the same levels;
- Pollution by synthetic surface active substances, phenols, organic compounds and all pesticides does not represent a significant threat to industry, human health or river ecology;
- Pollution levels in Ukraine's pre-independence and post-independence periods for monitored pollutants still remain unacceptably high by national standards of water quality expressed as maximum admissible concentration (MAC). This confirms recent reports of national environmental experts, who characterise general ecological conditions of Ukraine's water bodies as "stressed" (Kuzin, 1995);
- Pollution levels in Ukraine's pre-independence time appear to be lower than post-independence;
- During the period 1985-1996 the overall peak pollution levels appear to be in 1993;
- The dynamics of maximum and average pollution levels change 1993-1996 is similar for all basins: the higher pollution levels are in 1993, then there is a drop in pollution during 1994-1995, which is followed by further increase in 1996. There are few exceptions;
- Both average and maximum pollution in the country tended to decrease between 1993 and 1996. However, the decrease is not significant and pollution levels remain above national standards;

- Regarding the analysis based on ecological water quality classification, river water quality does not improve nor significantly worsen during 1993-1996. Ecologically adverse pollution by nitrites and copper compounds is significant. In case of maximum concentrations reaching 10-100 MACs, even in the short run (from a few hours to a few days), severe negative ecological and human health implications may take place;
- Some basins, such as Priazovie, are obviously becoming "cleaner" towards 1996. Other basins, particularly Crimea, where there are many resort areas, were becoming more polluted between 1994 and 1996;
- The annual number of heavy pollution accidents increased dramatically during the period 1993-1996. This is especially true for the Dnipro basin, which occupies almost a half of the territory of the country. Apparently it is related to unauthorized discharges of wastewater into rivers by industrial plants and institutions.

The last statement may explain the occurrence of temporarily high concentrations of pollutants in water which often range as wide as 10-100 MACs. Table 5.14 illustrates how significant the pollution is through comparison of EU and Ukrainian MACs for relevant pollutants.

Table 5.14

Comparison of Ukrainian and EU water quality standards for major pollutants

Parameter	Unit of Measurement	EU MAC	Ukraine MAC	Ukraine MAC / EU MAC
Nitrates	mg NO_3 l^{-1}	50	10	0.2
Nitrites	mg NO_2 l^{-1}	0.1	0.2	2
Ammonium	mg NH_4 l^{-1}	0.5	2.0	4
Dissolved or emulsified oil products	µg l^{-1}	10	50	5
Phenols	µg C_6H_5OH l^{-1}	0.5	1	2
Polycyclic aromatic hydrocarbons	µg l^{-1}	200	500	2.5
Dry residuals (after drying at 180° C)	mg l^{-1}	1500	1000	0.7
Iron	µg Fe l^{-1}	200	500	2.5
Chromium	µg Cr l^{-1}	50	100	2
Manganese	µg Mn l^{-1}	50	-	-
Copper and zinc (at outlets of utilities)	µg Cu/l, Zn l^{-1}	100	1000	10

Sources: Gray N.F. (1994). Drinking Water Quality: Problems and Solutions;
MEP of Ukraine (1996). Water Quality Standards.

Given that pollution is mainly caused by discharges from point industrial and municipal sources, other causes are breakdowns in pipeline systems and poorly arranged landfill sites that also contribute to river pollution. It appears that a deepening socio-economic crisis in the country, and resulting de-industrialisation, are linked to heavy pollution accidents. These are responsible for peaks of pollutant concentrations reaching tens of MACs, also relevant to persistently high average levels of pollution. The extent to which heavy pollution accidents contribute to overall river pollution in Ukraine has not been studies and is unknown; but undoubtedly HPAs are a common and important feature of river pollution in the country.

Due to continuous economic decline some potentially polluting enterprises would close down operations and hence end pollution. On the other hand, operating enterprises may be decreasing investments, if any, into treatment of their effluents due to the difficult economic situation and thus create more pollution than they did before. This would "compensate" for the loss of pollution due to closure of some enterprises. As analysis revealed, such a "balance" would be different depending on region. Indeed an MEP

report (1998) confirms that environmental pollution and associated adverse human health and ecological impacts have regional features. In some regions, pollution increases, while in others it tends to decrease. Also, pollutants are represented with different types of parameters depending on the nature of human activities. Due to the predominantly industrial character of pollution it is possible to single out the following "oblasts" (administrative territorial units): Zaporozhie, Kirovograd, Dnepropetrovsk, Lugansk, Donetzk (Appendix 2.2). These are areas where a lot of mining and heavy metallurgy enterprises are located and all cities in the country which are the center of industrial production and are provided with large municipal wastewater treatment facilities (MEP, 1998).

Out of the above observations it appears that despite economic decline, the levels of pollution remain almost as high in 1993-1996 as in 1985-1992. Apparently, in 1993-1996 wastewater generated by operating enterprises received increasingly insufficient, if any, treatment (MEP, 1994, 1997 and 1998). This is viewed to be a major reason why general levels of pollution remain persistently high despite a significant downturn in the national economy. In 1996, at the scale of administrative regions (for nine oblasts) river pollution tended to increase while remaining stable or declining in sixteen others (Nazarov *et al*, 2000).

The large number of recorded heavy pollution accidents, when accumulated wastewater is discharged without, or with very little, treatment, the wide variation in pollutant concentrations, and average and maximum concentrations far exceeding one MAC (Table 5.7 and Appendix 5.3) confirm that enterprises are involved into wide-scale contravention of Article 44 (3) of the Water Code of Ukraine (1995), which prohibits discharges of effluents containing concentrations of pollutants in excess of 1 MAC.

Somewhere in the system of pollution control in the country there are problems which are responsible for the failure to meet the requirements of environmental legislation. The next chapter will therefore provide an analysis of information on the activities of environmental authorities in the country in an attempt to highlight these failures.

CHAPTER 6

Efficiency of state control of river pollution in the country

6.1 Control of river pollution

There are two types of river pollution control in Ukraine: state control and institutional control. State control is carried out by the relevant agencies authorised by the government. The system of regulatory bodies in the field of environmental protection and nuclear safety of Ukraine is shown in Figure 2.4 (Chapter 2).

Institutional control, on the other hand, is carried out by all water users. Most of the information obtained from water pollution control activities is generated by industrial plants, municipal water supply enterprises and waste water treatment facilities. For each measurement taken by the state environmental authorities there are some 200 measurements by the institutions - the water users. The most important task of state pollution control agencies is to ensure that the information provided by institutions is correct. Therefore it is of key importance to ensure high precision in the measurement of pollution levels and to enforce the responsibility of institutions in undertaking the measurements according to the requirements and guidelines established by state environmental authorities (Barannik, 1996).

In general the term "state control of water pollution", as understood in Ukraine, refers to a set of activities by authorised state authorities on water quality monitoring; enforcement of water quality standards through, for example, setting discharge consents to reduce environmental contaminant loading, subsidies (loans) to install waste water

treatment facilities, penalties, etc.; and any other measures to abate or prevent the pollution.

Therefore, correct measurements of water quality are the key component of water pollution control. The consensus of Ukrainian environmental experts suggest that the following scientific methodologies are central to ensuring high quality measurements of water properties and chemical composition (Zatula, 1996):

- Development of analytically justified and economically sound precision standards of measurements and their introduction (through the standard setting system) into the practice of water quality analysis;
- Analytical attestation of measurement methods (MM) and their assessment to meet applied norms and standards;
- Development of effective methods and technical bases to control the accuracy of results;
- Creation of a system of operative and statistical control of measurement quality;
- Standardisation of sampling.

To assess the chemical composition of natural and waste waters, a range of physical methods are applied. These are: spectrophotometry, gas chromatography, electrometry, differential polarography and potentiometry methods. Some of them allow precise measurements of concentrations of certain substances. For instance, the "oscillographic polarograph" allows measurement of the contents of chemical parameters equal to 1 maximum admissible concentration (MAC) and below (Romanov, 1977). Through these methods the following main parameters can be measured: turbidity, pH, organic matter, oil products, ammonia, nitrates, nitrites, methaphos, hexachlorcyclohexane, chlorophos, cadmium, zinc, copper, nickel, cobalt, chromium (VI) and (III), vanadium (IV).

Methods are presently being developed for ecological and analytical control based on the application of automated computerised techniques. One such new method is atomic absorption spectrophotometry. This is very sensitive for precise determination of copper, nickel, chromium, arsenic, beryllium and chromium (III) and (VI) concentrations in highly mineralised natural and waste waters (Lozansky, 1995).

In the 1980s a process called "passportisation" was introduced for many large industrial chemical enterprises in the country. Through passportisation a number of analytical methods to determine the concentration of different organic and inorganic pollutants were developed and validated. The government produced many standard documents on how to generate precise data for the measurement of water properties and chemical composition. These included: two state standards; more then 10 documents on analytical standardisation; the setting of absolute standards; and a package of 30 validated measurement methods. The package of documents is considered by Ukrainian water experts as sufficient for theoretically high quality provision of analytical control of the composition of wastewater (Gritzenko, 1994).

6.2 Institutional aspects of water pollution control

The cost of environmental protection in Ukraine is considered uneconomical by all branches of industry. Individual enterprises are not interested in making use of natural resources in sustainable way including their conservation. One of the main reasons is that methods and criteria of economic efficiency applied to industrial production *do not take into account any restrictions related to the use of natural resources* (Gritzenko,

1994). Enterprises which do not have additional expenditure for rehabilitation of land, waste utilisation, introduction of water saving technologies, etc. achieve higher profits but this is because no account is taken of the social and environmental externalities of production. Thus, social and environmental benefits such as improved health and welfare and improvements through reducing pollution levels are foregone in return for economic revenues.

Recently, joint efforts by national scientists in economics, geography and ecology have created a methodological basis for the study of economic aspects of the environmental protection activities of industrial enterprises. The quantitative theoretical and practical determination of ecological and economic efficiency has been explored in works by Balatzky (1995), Gofman, Shishenko and others (see Gritzenko, 1994).

However, in practical resource management terms, there are insufficient methodical provisions for harmonising environmental protection activities alongside the system of economic management by industrial enterprises. It should be noted that, at present, almost all operational industrial enterprises remain in state ownership. Clearly, expenditure on environmental protection activities needs to be harmonised with existing state plans for industrial enterprises and economic regions (Gritzenko, 1995). This is feasible where there is social and economic stability in a country, but since 1990 Ukraine has experienced a deepening economic crisis. The crisis brought about poor commercial revenues and, therefore, chronic shortages of funds for most industrial enterprises causing many of them to interrupt operations or even completely shut down. It is arguable this is the main reason of reluctance to spending on pollution abatement, which often makes water users to be looking for ways to pass around and break the

requirements of the Water Code and other environmental legislation (some information on this subject is provided in Chapter 2).

The crisis also creates a further and important difficulty - shortage of funding for monitoring and enforcement has resulted in weak pollution control. Consequently, the requirements of laws, legal acts and supportive documents (which provide the basis for the practical implementation of law) are not met. The responsibility for ecological protection is not strictly enforced and is sometimes purely symbolic in character (Krysachenko, 1994) (interview: Vladimir K., 1999).

For instance, according to state statistics in 1995, the oblast state authorities for environmental protection recorded about 110 000 contraventions of environmental law, including breaching of standards, pollution accidents and adverse ecosystem impact. In 107 000 cases administrative penalties were applied. In total, fines equivalent to US $ 65 000 have been levied against polluters, although only US $ 49 000 was actually received. There were also charges for the rehabilitation environmental damage caused by the activities of enterprises and individuals (MEP, 1997). The charges amounted US $ 6 million although less then US $ 0.25 million were actually paid.

In 1995 inspectors directly subordinate to the Ministry of Environmental Protection (MEP) investigated 63 000 enterprises and institutions. About 39 000 administrators including heads of state enterprises were found to be responsible for breaking environmental standards and fined a total of US $ 29 000, while fines totalling US $ 122 000 were levied against foreign companies and individuals. The level of foreign investment in Ukraine is, however, very low. Among all enterprises charges for the rehabilitation of damage caused by human activities amounted to almost US $ 6 million,

however less then US $ 0.15 million was recovered. In all, 585 polluting enterprises were closed as a result of breaches of the law, meaning that 240 000 m^3 of contaminated effluents were not discharged into rivers and 9000 tonnes of pollutants did not enter the atmosphere. For severe offences there were 450 investigations by the police authorities. 127 responsible administrators and individuals were brought to criminal prosecution (MEP, 1997).

Since 1991 the introduction of measures to protect the natural environment has declined from year to year. These include water treatment facilities, water protection zones (through afforestation) and embankments for flood protection or impoundment. In 1996 it was planned to establish 888 protection areas such as buffer zones and nature reserves. About US $ 212.3 million were allocated for this purpose but only US $ 137.1 million were actually spent, just 64.6 % of its total available (MEP, 1998). The analysis of all investments 1995-1996 showed that, in the field of protection and rational use of water resources, allocated funds were used in the least satisfactory manner compared to any other sector of state expenditure. Thus 72.2 % of the funds allocated to enterprises and institutions in 1995, and 58.7 % in 1996, were utilised. Possibly the funds were used for purposes other then investment into pollution control. Taking into account issues of corruption in the country (Chapter 2), the funds may have also been abused. All this is occurring when the condition of water resources in the country is in continual decline (MEP, 1998).

There is insufficient construction of new, and poor maintenance of existing, sewage treatment facilities in Ukrainian settlements. While the production of goods and commodities in the country steadily shrinks, the amount of polluting effluents also decrease (for instance, in 1996 the decrease was 543 million m^3 of effluent discharge).

However, in some oblasts the amount of such sewage effluents is tending to increase. These are Vinnitza, Lutzk, Donetzk, Zaporozhie, Nikolaev, Poltava, Kharkov, Kherson, Khmelnitzky Oblasts (Appendix 2.2). The main reason is unsatisfactory operation of available treatment facilities, their resulting overloading, and even complete break down. Operations of public wastewater treatment facilities are still funded from central and local budgets where water users pay water charges for the services of the facilities. Insufficient state support results in poor maintenance of the facilities (Correspondent of "Green World" newspaper, 1997; MEP, 1998; Georgy S., 2000).

The state inspectorate for ecological safety penalises enterprises which overload their own treatment facilities and discharge untreated effluents into water bodies. In 1996 7.9 thousand administrators and individuals were prosecuted for breaking water legislation. The sum of fines imposed was US $ 68,300. The operation of 100 enterprises was stopped, which resulted in 21.3 million m^3 less waste water discharge. Bills were prepared for rehabilitation of damage done to natural resources amounting to US $ 5.7 million. Out of these only US $ 591,000 were actually paid (MEP, 1998). Incomplete payment is due to both delays with decisions of civil courts and lack of financial resources for polluting enterprises.

Besides the producers of goods and services being reluctant and/or unable to meet payments for environmental protection purposes, the system of state control has its own shortcomings. The country lacks a unified system of control. Ministries and institutions control their own production activities. There is no distinct separation of controlling functions among such national authorities as the Ministry of Environmental Protection (MEP), the Ministry of Forestry, the Ministry of Chernobyl, the State Agency of the Water Industry, the State Committee on Geology, the State Nuclear Inspectorate, the

State Committee on Hydrology and Meteorology, the State Committee on Land Resources and the State Agency for Fisheries (MEP, 1994). This leads to overlapping responsibilities, goal conflicts and a tendency to hive off responsibility to another agency. For example, according to the Water Code two agencies are authorised to monitor mine water quality: the Ministry of Environmental Protection and the Ministry of Geology and Mining. However, in some mining areas there is no monitoring at all because each expects the other to do it and bear the cost of doing so. Alternatively, both agencies may monitor without agreeing upon joint monitoring activities. Even though the information collected by the two bodies may be useful for comparison, there would be an issue of excessive monitoring costs.

The separation of administrative functions goes beyond the authority of the MEP. In practice the MEP has not been able to agree with the ministries and institutions concerned with adoption of legislation and guidelines how to tackle this problem. All ministries and institutions appear to pursue their own authoritative and economic interests.

There is another issue affecting the efficiency of state control. Local environmental authorities are subordinate to two state executive bodies: the MEP and local state administrations. For example, when the municipal water treatment utilities discharge large amounts of untreated polluted effluents, it is impossible to prosecute the polluters because the environmental authorities are often subordinate to the state administration, which either turn a blind eye or actually give pollution "a green light".

The low efficiency of ecological control is also a result of an insufficient number of MEP inspectors - only 850 individuals for 100,000 plants, enterprises and institutions in

the country. With this staff it is only possible to conduct checks among 20-25 % of natural resource users per annum (MEP, 1994). Here the efficiency could be significantly improved through increased state spending to meet the needs and create incentives for staff of environmental protection agencies. The present and deepening economic crisis continues to impact state and local budgets, bringing about lower spending on environmental protection (Pavlyuk, 1997). For instance, composed in 1996 the state budget for 1997 allocated about US $ 40 million out of total budget of US $ 15,073.3 million (Appendix 6.1) or about 0.27 % for environmental protection (MEP, 1998). Most of the above information is incorporated into Table 6.1.

The state control measures for other kinds of adverse environmental impact such as nuclear and industrial waste dumping and air emissions encounter the same problems as the state control of water pollution. Thus, while the economic crises continues, environmental quality in the country remains poor.

Table 6.1
Summary of information related to pollution control for 1995 and 1996.

Indices	Year	
	1995	1996
Number of MEP inspectors	-	850
Number of enterprises - potential polluters	-	100,000
Number of recorded breaches of environmental legislation	110,000	-
Number of individuals brought to responsibility for pollution	39,000	7,900
Number of individuals brought to criminal responsibility	127	-
Number of enterprises closed due to heavy pollution	585	100
Fines imposed on national enterprises, US $	65,000	68,300
Fines paid by national enterprises, US $	49,000	-
Fines imposed on foreign enterprises, US $	122,000	-
Fines paid by foreign enterprises, US $	122,000	-
Charge for nature rehabilitation imposed, US $	6 mil.	5.7 mil.
Charge for nature rehabilitation paid, US $	0.25 mil.	0.6 mil.
State funds released into pollution prevention measures, US $	-	212.3 mil.
State funds actually invested into measures against pollution, US $	-	137.1 mil.
Total state budget expenditure for environmental protection, US $	-	40 mil.

6.3 Conclusions

From the above it can be concluded that poor environmental conditions are basically an outcome of the inefficiency of state control measures. Furthermore, adverse impacts on human health and natural ecosystems take place as a result of such conditions. In summary the main causes are:

- The absence of a unified system of state control in the field of environmental protection and the uncoordinated activities of the authorities responsible for this control;
- Double subordination of local environmental protection authorities to the MEP and regional state administrations;
- Inefficiency in charging and collecting fines and rehabilitation bills for breaking environmental law;
- Poor compliance with environmental legislation;
- Overlap of institutional responsibilities and a resulting tendency to assume that responsibility is taken by other agencies;
- Insufficient number of state inspectors and insufficient financial and material support for the environmental protection sector.

Out of all these the last statement is probably the most important one because it is related to the economic crisis. This crisis has brought about a state budget deficit, which has caused cuts to many social services including environmental ones: environmental quality is also a good, which has a cost.

On the other hand, the crisis has also caused many enterprises to experience severe financial constraints, so that they cannot afford the full cost of measures on pollution

prevention. Frequent heavy pollution accidents suggest how enterprises often deal with effluents: they accumulate them and then release them into water bodies in great quantity when, perhaps, there is no immediate danger of environmental inspection.

Due to data limitation, analysis in this Chapter covered the period of Ukraine's independence only up to 1996. However, even though comprehensive data for 1997-2000 have not been found, it is possible to assume that river pollution continues in a manner similar to that during 1993-1996. The reason is that, unfortunately, the condition of the national economy deteriorated and little was provided to address environmental problems. For instance, in December 2000 the Ukrainian government adopted a tight state budget for 2001. Its size is only 7.6 billion $US (AFP, 2000), which is half of what it was in 1996 (15 billion $US in total). If in 1996 only 40 million $US were spent on environmental protection, the amount that would be spent for the same purpose in 2001 is likely to be even less.

An obvious, but not easy solution to the water pollution problem of Ukraine is to improve the national economy so that programmes of monitoring and enforcement can be afforded by the state, and their provisions – by water users. There is neither a problem of technical know-how nor (largely) of suitable equipment; both exist alongside adequate legislative instruments and standard setting. In addition, cultural assimilation of the concept of *sustainable development* will be important so that in a strengthening economy, full environmental protection measures may be enshrined in the consciousness of planners and industrialists alike (Danilishin, 1998b). Water bodies would thereby not be stressed beyond their "carrying capacity". Such a vehicle may come to incorporate notions of "Catchment Management Planning" and groundwater protection measures, presently well developed in Western Europe and the USA.

The present environmental conditions are not sustainable and are likely to have significant implications for the continued existence of ecosystems and for human health in the short and, possibly, long terms (Danilishin, 1998a; Lystopad, 1997; Boreiko, 1995). Ukrainian society has to solve both its economic and ecological problems if it is to develop economically to meet present needs without compromising the needs of future generations (Danilishin, 1998b).

Through analysis of pollution data in Chapter Five river pollution in the country has been examined, while this Chapter has highlighted the institutional shortcomings of state water pollution control. In policy making it is important to take account of people's opinions, wishes and attitudes towards the issues being addressed via policy development. Next Chapter will provide analysis of public polls, which is intended to provide additional information necessary to substantiate proposition and assess UK policies.

CHAPTER 7

Public opinion surveys and discussion of the proposition

The purpose of public opinion surveys is to collect supplementary information useful for discussing the proposition of this research and the assessment of water policies for importation. This information covers issues related to social and natural environments such as:

- Public awareness of environmental quality;
- Public attitudes to environmental protection and water quality;
- Public willingness to pay for environmental goods (emphasis on industrial water pollution);
- Public opinion about the quality of water supply and waste water treatment services;
- Public opinion about the reasons for failures in the system of river pollution control;
- People's ideas on how to improve pollution control;
- People's opinions and views on a range of socio-economic and political issues.

There were two surveys. During each, about 100 respondents were questioned in various locations. Samples did not discriminate among people on the basis of gender, occupation, nationality or income. However an attempt was made to question approximately the same number of people for age categories 18-35, 36-55 and above 55 years old. Only individuals less than 18 years old were excluded from the surveys because most of them are not financially independent.

In the first survey people were asked to answer eight questions presented on a sheet of paper (Appendix 4.3). This survey related to water resource management issues in the country. In the second survey respondents were asked to complete a questionnaire

containing seven questions (Appendix 4.4) of environmental, socio-economic and political character. The second survey was to determine the opinions of people about the reasons for current economic problems and how the situation could be changed in the ways they wished it to be.

The answers were converted into quantitative data and analysed with the aid of SPSS v.10 software.

7.1 Findings of the first poll

7.1.1 SPSS analysis of frequencies

Question 1: What do you think about the quality of drinking water (a) where you live; (b) where you work or study?

For this question five options were provided: "very good", "good", "satisfactory", "bad", "very bad", assigned the respective values 1, 2, 3, 4, 5. The same methodological procedures of applying a value to an option were applied to other SPSS tests. The values were analysed using SPSS and the following outcomes were obtained (Table 7.1 serves as an example):

Table 7.1

Outcomes of SPSS analysis of frequencies regarding the question on people's opinion about the quality of drinking water where they live

	Frequency	Percent	Valid Percent
Good	6	6.0	6.0
Satisfactory	18	18.0	18.0
Bad	66	66.0	66.0
Very bad	10	10.0	10.0
Total	100	100.0	100.0

In this Chapter the same procedure for analysis of frequencies was applied to all questions and answers: first input into SPSS database (Appendix 7.1 as an example), then analysis to obtain results in the form of Table 7.1.

a) According to this analysis the majority of respondents (66 %) consider that the quality of drinking water in the place where they live is bad. The second largest group of respondents described the water quality as satisfactory (18 %). The water quality was characterised as very bad by only 10 % of respondents. The smallest number of respondents (6 %) referred to the quality of water as "good", whereas none chose the option "very good". In general most people perceive the quality of drinking water where they live as "bad".

b) 61 % of respondents considered the quality of drinking water at their place of work or study as "bad". The second largest category was "Satisfactory", which accounted for 22 % of the answers. The third most common answer was "very bad" (15 %). Only 2 % of respondents answered that the quality of water at their working place was "good". In general people think that drinking water quality is "bad".

This coincidence with the previous answer can be partly explained by the fact that most living and working premises are supplied with drinking water through large-scale water supply systems. Such water supply networks can cover an entire town or a large part of the city, so that most premises in the city will obtain water of about the same quality from the same supply system. Also, all plants for purification of drinking water apply similar purification procedures. Presently this public sector is short of funds, therefore the quality of water, usually abstracted from surface inland water bodies, even after

purification is "bad". The surface inland water bodies experience both seasonal changes (spring floods) and pollution (mainly industrial and municipal). These all impact on the quality of tap water in Ukrainian households, institutions and enterprises.

Question 2. What is your opinion about quantity of water supplied?

The following three response options were provided: "Sufficient for all needs", "Sufficient for vital needs", "Insufficient for vital needs".

The largest number of respondents (71 %) replied that the quantity of water supply is sufficient to meet their vital needs. Other people (22 %) said that the quantity of water supply is enough to meet all their needs. The smallest number of respondents (7 %) indicated that the quantity of water supply is insufficient to meet their vital needs. The most common public perception is that water supply is sufficient to meet the vital needs of the population.

Question 3. What do you think of the regularity of water supply?

Four answers were provided in the questionnaire: "Always regular", "Reasonably regular", "Irregular", "Very irregular".

The water supply is "reasonably regular" according to the opinion of 70 % of respondents. The second biggest group of respondents (17 %) replied that water supply is "always regular". The opinion of other people (11 %) was that water supply is "irregular". Only 2 % of respondents said that water supply was "very irregular". It appears that in general the water supply is "reasonably regular".

Question 4. What do you think about the ecological and amenity quality of water in surface inland water bodies in the Ukraine?

This question had the following answer options: "Good", "Satisfactory", "Bad", "Very bad".

The biggest group of respondents (50 %) replied that the ecological quality of surface inland water bodies is "bad". The second biggest group (31 %) described the conditions as "very bad". The opinion of the third biggest group was that the surface inland water bodies have "satisfactory" ecological conditions. Only 1 % of respondents thought that the ecological quality is "good". According to most responses the ecological conditions of surface inland water bodies can be described as "bad".

Question 5. Please, rank the above mentioned issues according to their importance for you from the most important (1) to the least important (4). Tick only one box for each column.

The question is designed to find out what people think is more or less important considering four issues related to water supply and water quality: "Good drinking water quality", "Sufficient quantity of water supply", "Regularity of water supply", "Good ecological condition of surface inland water bodies".

The respondents have obviously given priority to the issue of drinking water quality. In total 94 % of them indicated that it was the most important issue. Another 6 % pointed to the issue as the second most important.

Sufficient quantity of water supply is not given an overwhelming priority. Respondents replied in the following order: 46 % - " second important", 45 % - "third important", 6% - "least important", 3 % - "most important". In general the majority of answers indicate this issue to be somewhere in between the third and second most important issue, but closer to the latter.

The answers considering the importance of regularity of water supply indicate the following order: 50 % of respondents replied "third most important", 39 % - "second most important", 9 % - "least important", 2 % - "most important". According to general public opinion this issue can be described as "third most important".

Good ecological quality of surface inland water bodies in the country clearly carries the least public concern compared to issues of good drinking water quality, sufficient quantity of water supply and regularity of water supply. Thus 86 % of respondents indicated that good ecological quality is the "least important" issue, 8 % - "second most important", 5 % - "third most important" and 1% - "most important".

It is possible than to generalise, Ukrainians give the highest priority to the issue of good drinking water quality, the next most important issue is sufficient quantity of water supply, which is closely followed by the regularity of water supply. And obviously the least important issue is the ecological condition of surface inland water bodies.

Question 6. How much would you be willing to pay in total from your monthly income to have desired improvements in the issues mentioned in questions1, 2, 3 and 4?

This question was intended to determine public willingness to pay for "Good drinking water quality", "Sufficient quantity of water supply", "Regularity of water supply" and "Good ecological condition of surface inland water bodies" assuming the funds were channelled into improving water services.

The biggest number of respondents (48 %) chose to pay for good drinking water quality within the range of 1-3 Hryvnias per month. In this category this will be around 96 Hryvnias in total. A smaller number of respondents (39 %) was prepared to pay 4-7 Hryvnias. However, the total amount that "would be" paid appears to be the largest: 214.5 Hryvnias. The third biggest category of respondents (6 %) did not want to pay anything. There are 5 % of respondents who indicated the range of 8-12 Hryvnias, that is about 50 Hryvnias in total. And the smallest number of people (2 %) was willing to pay 13-18 Hryvnias or 31 Hryvnias in total. Thus an overall amount is 391.5 Hryvnias per 100 people or 3.915 Hryvnias ($US 1.15) per capita, per month.

Most people (70 %) chose the category 1-3 Hryvnias per month for sufficient quantity of water supply. This will give a total of 140 Hryvnias. The second biggest group of respondents (15 %) indicated that they are not willing to pay anything. Fewer respondents (9 %) would agree to pay 4-7 Hryvnias or 49.5 Hryvnias in total. Only 6 % of people would pay 8-12 Hryvnias, a total of 60 Hryvnias. So the overall amount is 249.5 Hryvnias for 100 people or 2.495 Hryvnias ($US 0.73) per capita per month.

The majority of respondents (73 %) would agree to pay 1-3 Hryvnias a month to have regular drinking water supply, or 146 Hryvnias in total. The respondents who were not willing to pay anything comprise 11 %. There are 9 % of people who agree to pay 4-7 Hryvnias, 49.5 Hryvnias in total. The remaining 7 % of respondents indicated willingness to pay 8-12 Hryvnias, which would amount to 70 Hryvnias in total. The overall amount is 265.5 Hryvnias for 100 respondents, which is 2.655 ($US 0.78) per capita per month. This is slightly more than the willingness to pay for sufficient quantity of water supply.

As in the previous three calculations the largest group of respondents (63 %) were willing to pay the minimum amount of 1-3 Hryvnias, 126 Hryvnias in total to obtain good ecological quality in surface inland water bodies. Another 20 % of respondents indicated 4-7 Hryvnias or 110 Hryvnias in total. The third biggest group (16 %) was not willing to pay anything and 1 % of all questioned valued the good ecological condition of surface inland water bodies as high as 13-18 Hryvnias or 15.5 Hryvnias in total. The overall amount is 251.5 Hryvnias for 100 respondents or 2.515 Hryvnias ($US 0.74) per capita per month. Surprisingly, given their responses to previous questions, this is slightly more than they were willing to pay for sufficient quantity of water supply. This may be because 71 % of people consider quantity of water supply sufficient to meet their vital needs.

If $US 0.74 per capita is multiplied by about 32 million (about two/thirds of Ukraine's population of nearly 50 million, who are wage and pension earners) and by 12 (number of months a year), the approximate amount would be about $US 280 million a year. Comparing to annual state budget spending on environmental protection, this amount

could be a more significant contribution towards pollution control. It could also be raised without public antagonism provided people are aware that the money is being spent for improving environmental quality.

Taking into account present socio-economic conditions and the level of water services in Ukraine, the public give the highest priority to the quality of drinking water. This is clearly reflected in public opinion that the quality of drinking water is "bad", therefore attributing greater importance to it (see previous question) and the willingness to pay is the highest (3.915 Hryvnias per capita). People believe that the drinking water supply is "sufficient for vital needs" and "reasonably regular" so the willingness to pay is lower in comparison with the issue of drinking water quality (2.495 and 2.655 Hryvnias respectively). The ecological quality of surface inland water bodies in Ukraine is publicly perceived as the "least important" issue compared to the three other issues of drinking water quality, quantity and regularity of water supply. Despite that, people are willing to pay as much for it as for the sufficient quantity and regularity of water supply (2.515 Hryvnias per capita). This may be explained by the fact that while quantity and regularity of water supply are viewed as satisfactory, the ecological quality of surface inland water bodies is perceived as "bad" and people want to contribute more towards its improvement.

In general the willingness to pay is rather low. The reason for that is the low income of most people. A salary usually falls in the range of 80-150 Hryvnias per month, i.e. an equivalent of $US 20-40). Pensions are equivalent of $US 13-17 and unemployment pay is less than $US 10 per month. Also, salaries and all other payments are sometimes delayed by up to six months. In some occasions they are paid out partially (for instance, 70 % of total amount due) or not paid at all (Interviews: Dima M., Zoya M., Olga N.,

Alla G., Vladimir T.). In May 1999 the total amount of unpaid wages and pensions reached two billion dollars (EIN, 13.11.1999b).

Question 7. Do you think that the water resource management system in the Ukraine should be improved?

The public opinion is that something has to be improved in the water resource management system. Almost 100 % of respondents said "yes". This is related to the common opinion that the ecological quality of inland surface water bodies is "bad".

Question 8. If you have answered "Yes" for the question 7, what do you think the improvements ought to be (please, tick as appropriate):

The suggested measures on improving water resource management can be arranged in the following order of priority:

1. Most positive responses were given for improving environmental legislation and its practical efficiency (79 %);
2. In tune with the first priority, development of water legislation and enhancing its practical efficiency better management of water resources is considered important by 55 % of respondents;
3. Almost half of respondents (46 %) believe that changes in the structure of state management and executive authorities will bring about positive changes;
4. There are 37 % of respondents, who are positive about implementation of some mechanisms of market economy as a tool to improve the system;
5. Further improvement of existing mechanisms of economic regulation is considered an effective response by 20 % of respondents;

6. Implementation of measures for protection of life and property from floods were approved only by 11 % of respondents. Due to climate conditions in the Kharkov region, where the poll has been conducted, the occurrence of disastrous floods is a very rare event (Kovalenko, 1994);
7. The privatisation of water supply and wastewater treatment enterprises is considered capable of producing positive results by only 10 % of respondents;
8. Only 4 % of respondents think that privatisation of surface inland water bodies will make the system of water resource management more efficient. People are afraid that privatised water bodies may be abused in such a way that it may lead to heavier pollution and more restricted access for leisure (Interviews: Victor G., Alexei K.).

Two other suggestions were made:

1. Large-scale introduction of new wastewater treatment technologies;
2. Encourage (and not to discourage) metering of water supply in living accommodation.

7.1.2 Outcomes of SPSS crosstabs analysis (Chi-square test)

The crosstabs analysis of data from the first survey centred on the relations between what people think about ecological quality of inland surface water bodies and the other issues examined in the survey. The analysis has primarily been focused on the ecological quality of water bodies as the major issue of this thesis. According to the rules of statistics, relationships between variables are found there where the value of Asymp. Sig. (2-sided) is less then 0.05.

The same procedure for crosstabs analysis of frequencies was applied to all questions and answers: first input into SPSS database, then analysis to obtain results in the form of Table 7.2.

Table 7.2
Results of SPSS crosstabs analysis

Issues		Value	df	Asymp. Sig. (2-sided)
Importance of regularity of water supply * Drinking water quality where people work or study	Pearson Chi-Square	18.425(a)	9	.031
Opinion about quantity of water supply * Opinion about regularity of water supply	Pearson Chi-Square	51.412(a)	6	.000
Opinion about ecological quality of water bodies * Should the water resource management system be improved	Pearson Chi-Square	100.000(a)	3	.000
Opinion about ecological quality of water bodies * Opinion about quantity of water supply	Pearson Chi-Square	21.831(a)	6	.001
Should the water resource management system be improved * Drinking water quality where people live	Pearson Chi-Square	15.825(a)	3	.001
Drinking water quality where people work or study * Drinking water quality where people live	Pearson Chi-Square	117.806(a)	9	.000

The following relationship has been traced for the variable "Opinion about ecological quality of water bodies" and "Should the water resource management be improved": in general respondents believed the ecological quality of surface inland water bodies to be "bad", suggesting that water resource management should be improved.

The relationship between the opinion about the ecological quality of water bodies and quantity of water supply is viewed as a coincidence of people's views. The commonly held views are that while the amount of water supply is sufficient to meet the vital needs of people, ecological quality is perceived as "bad".

The variable "Drinking water quality where people work and study" is relevant to the variables "Importance of regularity of water supply" and "Drinking water quality where people live". The former relation is the following: people consider the quality of water, where they work or study, as "bad" and the regularity of water supply as "third most important", probably because the supply is "reasonably regular". The relation exists because the opinions of people on these two issues coincide. In the same way it is possible to explain the relation to the latter variable. The "quality of drinking water where people live" is also considered as "bad".

The variable "Should the water resource management system be improved" is only relevant to "Drinking water quality where people live". The relation is the following: the common opinion is that drinking water quality is "bad" which is in tune with the public opinion that the water resource management system should be improved.

There is a relation between the variables "Opinion about quantity of water supply" and "Opinion about regularity of water supply". This is due to the common public opinion: the quantity of water supply is "sufficient for vital needs" and the water supply is "reasonably regular".

7.1.3 Summary of findings of the first survey

In summary, the following main findings were obtained from the first survey:

- In general drinking water quality is perceived as "bad". The reason for that is both contamination of natural water sources by polluting effluents and insufficient

purification of water abstracted for drinking purposes (Interview: Georgy S., Victor G., Alexander Z., Maxim B.) (Semchuk, 1997).

- It is widely accepted in public that there is no shortage of water and quantity of water supply is sufficient to meet the vital needs of people, and drinking water supply is reasonably regular.

- Ecological quality of surface water bodies is bad. Previous findings produced in this research reveal that the chief reason for that is contamination of water bodies by mainly industrial and municipal effluents and improper arrangement of landfill sites. National MACs are often exceeded 2 or more fold.

- Public opinion places the highest importance on drinking water quality, the second on sufficient quantity of water supply, the third on regularity of water supply, the least on good ecological quality of inland surface water bodies.

- Assessment of the willingness to pay is not precise because of continuous inflation of the Hryvnia. Thus at the time of the survey in 1998 $US 1 was equal to 3.4 Hryvnias, 4.5 Hryvnias till late autumn of 1999 and 5.1 Hryvnias in autumn 1999 (EBRD, 1999) (EBRD; 2000) and most of 2000 (on average). Thus comparing to 1998 national currency lost over 40 % of its value by the end of 1999.

- In addition to existing water payments, willingness to pay for good drinking water quality is $US 1.15 per person, per month. For sufficient quantity of water supply and regular water supply – $US 0.73 and 0.78 correspondingly. For good ecological quality of inland surface water bodies – $US 0.74. Now, taking into account the

factor of inflation these values are likely to be lower. Although on some occasions wage and pension increases were made, they were far outpaced by the inflation. So presently people might be willing to pay for good drinking water quality only $US 0.72, for sufficient quantity of water supply – $US 0.46, for regular water supply – $US 0.49, for good ecological quality of inland surface water bodies – $US 0.47 (about 2 % of average monthly salary of around $US 30) because between summer 1998 and autumn 1999 national currency Hryvnia lost about 40 % of its value. Since then the exchange rate of national currency to foreign currencies has been largely the same, e.g. $US 1 has been equal to 5.4-5.5 Hryvnias (NBU, 2001).

- Almost everybody agreed that there have to be changes and improvements in the system of water resource management in the country. The reason for that is the need for better environmental protection. This is confirmed by the opinion that the ecological quality of water bodies is "bad". Another confirmation is seen in replies to Question 8 about measures to improve the system;

- The public is concerned with "bad" quality of water bodies, and almost everyone wants this quality to be improved. This is reflected in people's responses and in the pattern of their willingness to pay for some water related "goods". However, the willingness to pay for better environmental quality as well as for other "goods" is low. This is because of the low living standards of most people, who cannot afford to pay a lot for the "environmental good", when they have to spend so much of their incomes on vital needs such as food and clothing. As an example, people are willing to pay somewhat more for good drinking water quality (which is currently "bad"). According to the survey this is more important for their welfare than the good ecological quality of surface inland water bodies.

Analysis of environmental information and data obtained through the questionnaire survey showed how the economic crises in Ukraine impacted on the ability of society to pay for the environmental "good". A brief study of macroeconomic and microeconomic issues is required to assess the present state of the economy and predict possible socio-economic and political developments. This will assist in the proposition substantiation, and the findings of the study can be utilised in policy assessment.

7.2 Findings of the second questionnaire survey

7.2.1 SPSS analysis of frequencies and crosstabs

Question 1: Do you think, present economic crisis in the country is the main reason for river pollution problems?

There were five options: "definitely yes", "probably yes", "difficult to say", "probably not", "definitely not."

Most people (61.5 % saying "definitely yes" or "probably yes") feel that the problems of river pollution arise due to the economic crisis, while only 19.2 % (saying "probably not" or "definitely not") do not see economic crises as a reason for pollution. The same number of people (19.2 %) found it difficult to give a definite answer. In general, the public opinion is that the main reason for pollution is economic crisis.

There is, though, a great degree of uncertainty (42.3 % of respondents said "probably yes"), which may mean, that to them the relation between economic crises and river pollution is not clear.

Question 2: Below are some possible reasons for shortcomings in the system of river pollution prevention. Please rank them according to their significance.

Five possible reasons were given and people were asked to rank them as "most significant", "second most significant", "third most significant", "fourth most significant" or "least significant".

The first option was "inefficient legislation".

Almost half of respondents (49 %) considered the issue of inefficient legislation as the least significant shortcoming in the system of river pollution prevention.

The second option was "lack of economic incentives to prevent water pollution"

Here the single biggest group of respondents (27.5 %) considered lack of economic incentives as the third most significant shortcoming of river pollution prevention. However, other respondents chose this issue as a second (23.5 %) or fourth (25.5 %) most significant.

The third option was "lack of state funding of environmental protection".

The majority of respondents (51%) clearly determined the factor of insufficient state funding as the most significant shortcoming. Second most common reply was "second most significant" (32.7 %). Few people chose other options.

The fourth option was "negligent public attitudes or poor public awareness".

This option was rated "fourth most significant" by 36.5 % of respondents and 23.1 % saw it as "least significant". Less then 40 % of people chose other categories.

The last option was "lack of environmental professionals and expertise".

When ranking the last option people marked different categories without a clear favour to a particular one. However, the most frequently marked category was "third most significant" (27.5 %), followed closely by "fourth most significant" (23.5 %) and "least significant" (21.6 %).

Considering ranking of issues in Question 2, according to public opinion insufficient state funding is the "most significant" shortcoming of the river pollution prevention system. Lack of economic incentives is the "second most significant" factor. Thus, economic issues are viewed by people as a crucial factor concerning the efficiency of river pollution prevention measures. Lack of environmental professionals and expertise is considered as the "third most significant" factor. Negligent public attitudes or poor public awareness were seen as the "fourth most significant" shortcoming, whilst inefficient legislation was clearly considered as the "least significant" shortcoming of the system.

In should be noted that both "lack of economic incentives" and "lack of environmental professionals and expertise" are credited with most replies in the category "third most significant". In the ranking, however, the former comes second because, compared to the latter, it is credited with more replies in the categories "most significant" and "second most significant".

Question 3: In general the ecological condition of surface inland water bodies in Ukraine can be characterised as "stressed". Altogether there are five categories. These are: "catastrophic", "critical", "stressed", "satisfactory" and "good". Please state your willingness to pay, extra to what you are paying for water services now on monthly basis, for having "satisfactory" and "good" ecological conditions.

The following pay options (in Ukrainian Hryvnias) were indicated: "0 Hryvnias", "1-3 Hryvnias", "4-6 Hryvnias", "7-10 Hryvnias", "11-15 Hryvnias", "Other amount".

First people were asked to show their willingness to pay for a "satisfactory" ecological condition of water bodies.

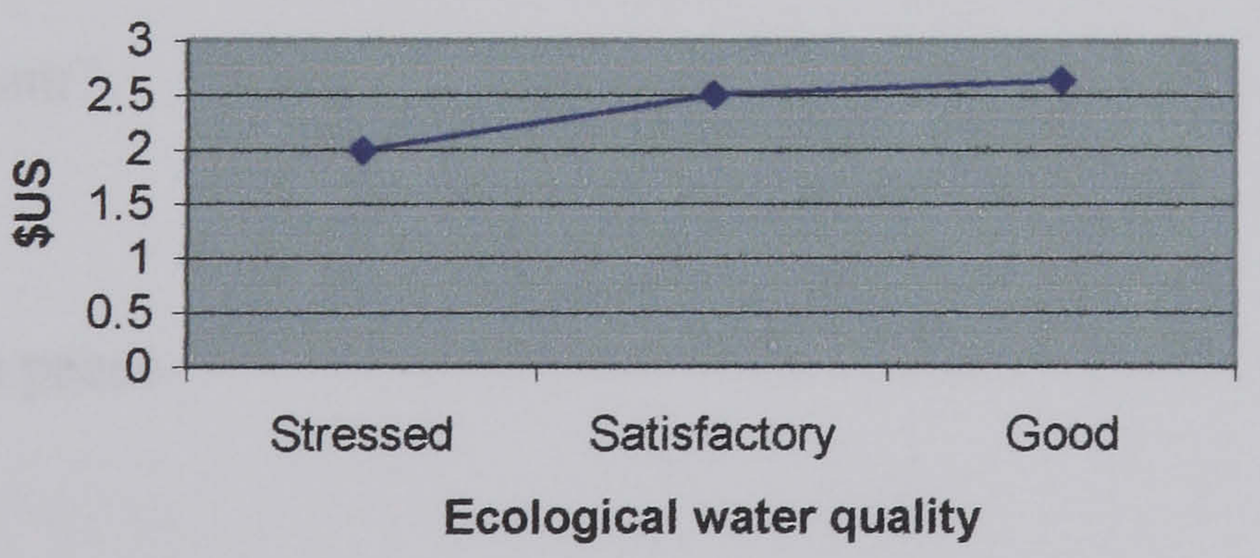
A majority of respondents (69.2 %) indicated the willingness to pay 1-3 Hryvnias. 4-6 Hryvnias (or about $US 1) was suggested by 15.4 % of respondents. Equal numbers of respondents (15.4 % altogether) were not willing to pay anything or would pay 7-10 Hryvnias. In general the willingness to pay is 2.81 Hryvnias or $US 0.51 a month per capita.

In order to find out more about the elasticity of demand for improvements in the ecological quality of inland water bodies, people were asked about their willingness to

pay for "good" ecological quality. Here the term "good" means quality close to natural conditions of water bodies.

Again the largest category of answers was "1-3 Hryvnias" (57.7 % of respondents). Second category was "4-6 Hryvnias" (23.1 %) and third category – "7-10 Hryvnias". Few people (5.8 %) are not willing to pay anything. General willingness to pay for "good" ecological quality is 3.45 Hryvnias or $US 0.63. Comparing to the willingness to pay $US 0.51 for "satisfactory" ecological quality the difference appears insignificant – only $US 0.12. Meeting the demand for good ecological quality of water bodies is hampered by poverty in Ukrainian society, so the willingness to pay for the environmental good is "inelastic" (Figure 7.1). In other words people are prepared to pay just a little more for a significant 20 % change from an inferior category of water quality to a superior one.

Figure 7.1 Inelastic willingness to pay



This survey reveals that willingness to pay for good ecological water quality is only $US 0.63 per capita a month in addition to an existing water & sanitation charge of about $US 1.5 - 2 per person (Figure 7.1). Altogether this would add an extra $US 1.26 to existing cold water & sanitation charge of $US 5-8 a month on average per household consisting of 2 adults. In total this is more then 3 times less than the $US 34 a month on

average paid by households in England and Wales (BBC News, 21.11.1999). The incomes in Ukraine though, are 50 times smaller than in UK.

If $US 0.63 per capita is multiplied by about 32 millions (about two/thirds of Ukraine's population of nearly 50 millions, who are wage and pension earners) and by 12 (number of months a year), the approximate amount would be about $US 240 million a year. This mid-1999 amount is $US 40 million less then the mid-1998 of $US 280 million because during 1998-1999 people incomes have been adversely affected by ongoing inflation.

Question 4: Please, rank the social aspects of well-being below according to their priority to you.

Ranking of each of the five options (peace, economic stability, environmental quality, low crime levels, other aspects) involved assigning one of the categories: "most important", "second most important", "third most important", "fourth most important" or "least important".

First option was peace

Attitudes varied greatly. The biggest group of respondents (33.3 %) indicated peace as "third most important". The second most popular ranking was "least important" (27.5 %). So far Ukraine lives in peace, so people do not indicate this issue as a priority.

Second option was economic stability

People greatly value what they do not have in the Ukraine. Indeed, the economic crisis is deepening, therefore this issues is of primary concern to 74.5 % of respondents.

Environmental quality was the third option

Environmental quality was ranked as "second most important" by 43.1 % of respondents. This is another "good" the Ukrainian public is missing. As the previous analysis has shown, people are not willing to pay much for this "good", because they can not afford to do so.

Low crime level was the last "good" indicated in this question.

Low crime is clearly considered as the "least important" issue by 56.9 % of respondents. It means that such crimes as theft, robbery, drug dealing and murders do not affect the lives of most people as seriously as the other three issues.

Thus the social aspects of well-being can be ranked according to public priorities:

1. Economic stability;
2. Environmental quality;
3. Peace;
4. Low crime levels.

The analysis reveals the features of the economic crises: the economy is falling apart, environmental quality is bad and affects human health. However, the country enjoys peace and acceptably low crime levels.

7.2.2 Summary of findings of second questionnaire survey

The following main findings were obtained through analysis of information from the second opinion survey:

- Most respondents (61.5 %) believe that river pollution is the result of economic crisis, while almost half of respondents (49 %) considered the issue of inefficient legislation as the least significant shortcoming of the system of river pollution prevention;

- Insufficient state funding appears to be viewed as the chief reason for the failure of activities aimed at river pollution prevention (51%), while the lack of environmental professionals and expertise, as well as negligent public attitudes, are considered as minor factors. Thus general public opinion confirms the proposition of the research;

- General willingness to pay for "good" ecological quality is inflexible. While the present water charge is about $US 2 per person per month the willingness to pay for "satisfactory" and "good" ecological quality is only an extra $US 0.51 and $US 0.63 respectively. Poverty induced by economic crisis is the reason for this inflexibility;

- People's primary concern today is economic stability according to 74.5 % of respondents. Environmental quality is also of major concern for many respondents

and appears to be "second most important" after economic stability. Despite that the willingness to pay for this "good" is low, because people cannot afford to do so;

This chapter completes the analysis of data required to prove proposition. In the following section of the Chapter the proposition of this research will be discussed using findings of literature review and data analyses.

7.3 Discussion of the proposition

The proposition of the research is that river pollution problems in the Ukraine primarily arise due to serious economic recession.

Chapter Six described river pollution control in Ukraine, which has an extensive system of monitoring and auditing by state authorities as well as expertise to measure and control river pollution. It was indicated that the funds allocated for environmental protection by the government were insufficient effectively to address environmental pollution problems. It was found from interviews with water specialists, that the shortage of funds is primarily related to economic crisis.

In Chapter Two a study of the present state of the socio-economic conditions in Ukraine was presented. The study confirms that the crisis is the major factor to blame for the shortage of funds to invest in environmental protection (which includes river pollution control).

According to the public polls, most people are concerned with water quality in rivers and lakes, because it is "bad". They wish to improve both drinking water quality and ecological quality of surface inland water bodies. Their willingness to pay for these two goods (extra to existing water charges) is, however, low. Data gathered for this research suggest that the total annual amount, which can be raised without public antagonism, would be about $US 280 million for good ecological quality of water bodies according to the first survey conducted in 1998. Together with annual state budget expenditure for water pollution prevention, the total amount could be higher – about $US 300 million. However due to inflation during 1998-2000 second survey revealed a continuous reduction in willingness to pay. Taking into account the factor of consumer price and national currency inflation total estimated nation-wide willingness to pay was about $US 245 million in 1999 compared to $US 280 million in 1998. To a large extent this inflation was due to the Russian financial crisis of August 1998.

Thus, while environmental quality remains poor, the economy and human welfare were going from bad to worse during 1990s. When the country was richer (before 1990) there were more industrial and agricultural activities, and hence more water pollution from these activities, but also more funds were available to control river pollution and implement measures against it. In 1996, the industrial and agricultural activities were about 50 % lower, but river pollution was only 20 % less than it was in 1990. This is mainly because investments to replace or maintain ageing wastewater treatment facilities have been reduced and state financing of law enforcement, monitoring and scientific areas of river pollution control is very scarce. The reason for that is the small size of the state budget due to poor tax revenues from economic agents, most of whom are struggling for survival in the harsh realities of Ukraine's economy. Also, the widespread poverty of Ukraine's population alone does not allow "sufficiently" high

monthly tariffs for environmental protection. Due to large expenditures for social protection and the service of external debts, the area of state budget called "environmental protection" is chronically under-funded considering the extent of river pollution problems in the country. ***This suggests that the socio-economic situation in the country is largely to blame for "stressed" ecological conditions of rivers and other inland surface water bodies***. *Thus the proposition is supported.*

It is not clear now whether the country's economy will improve or worsen in the near future. If the economy continues to worsen, it is not expected that more funds from the state budget will be available for implementation of measures to improve river pollution control. It is possible to increase spending on river pollution control by about $US 240 million, and this only if special "environmental" tariffs are introduced on a monthly basis and the money is not diverted for any other purposes. It may also be possible to improve river pollution control through UK policy importation. Those policies will work, which address the desired objective, are reasonably "cheap" to implement and, preferably, unlikely to have political ramifications in Ukraine.

Major socio-economic and political features of the crisis have to be taken into account when suggesting UK policies for importation. In this research UK water pollution control policies with potential for importation have been highlighted. Policy assessment procedures have already been elaborated. In Chapter Eight policies will be assessed using findings of literature review and data analyses.

CHAPTER 8

UK policy assessment and importation

8.1 Introduction

Twelve major UK policies relevant to river pollution control have been selected for the assessment of importation potential based upon the literature reviews of Chapters Two and Three. Their summary is provided in Section 3.8. Then in Chapter Four there were established seven procedures to assess the policies on their potential of importation to the Ukraine (Section 4.7). Thus each policy will be discussed in terms of efficacy, economic efficiency, fiscal effects, political and public acceptability, sustainability, administrative feasibility and importation risk. Chapter Four also contained a methodology of data analyses used in this research. The analyses were intended to provide the information necessary for testing the proposition of this research and policy assessment.

Now, that the data analyses and proposition substantiation have been completed, it is possible to carry out the assessment of the suitability of UK policies for importation to the Ukraine. To a large extent policy making is a subjective process (Winpenny, 1994), and it is often impossible to apply rigid quantitative criteria to determine whether a policy would work or not (FAO, 1995). Therefore in this research the assessment of the policies on seven criteria will be subjective yet they involve relevant quantitative and qualitative findings of environmental and socio-economic data analyses.

8.2 Policy assessment

8.2.1 Setting river quality objectives (RQOs) for water bodies and rivers

Legally supported RQOs will be set on the basis of a system known as the 'River Ecosystem (RE) Classification'.

Efficacy

As shown through the analysis of the system of river pollution control in Chapter Six, Ukraine has comprehensive legislation. Although this does not contain provisions for the setting of RQOs, the adoption of relevant legislation would be a useful guide to local environmental authorities in pursuing gradual improvements to the ecological quality of rivers in their territory, within river basin management plans. Implementation of informal RQOs alongside statutory Environmental Quality Standards (EQSs) may be more beneficial in achieving gradual improvement of ecological river quality, than the application of EQSs alone, especially in river basins with excessive river pollution such as Seversky Donetz. The Ukrainian authorities can adopt the content and methods of application of the UK RE Classification (REC) system when setting RQOs.

Economic efficiency

Similar to other activities on environmental protection implementation of the policy would have to be funded by the state. Costs of this policy may be very high after the policy is applied on a broad scale. The costs would primarily be associated with measures undertaken to achieve improvements in ecological water quality of rivers. The measures would range from changes of staff in local environmental authorities to

significant investments into wastewater treatment, some of which can be made by industrial enterprises and other institutions.

While RQOs and REC scheme may be imputed from the UK (Appendix 9.1), the costs to state budget to ensure RQOs are met may not be afforded in full. As an illustration for 2001 the state budget was intended to be only about 7 billion $US. With environmental expenditure of 0.3 % (about 20 million $US) there will be many limitations considering implementation of measures to prevent pollution. However, even with few funds available, the efforts may bring about some improvements of river water quality, especially in heavily polluted basins. Should government manage to find more funds, or should state budgets improve through economic revival, the implementation of this policy would become more successful.

Fiscal effects

Implementation of this policy will result in increased public spending as more state investment would be required to implement measures aimed at achieving RQOs. The fiscal impact on state budgets would be negative. It is important that authorities should set RQOs with due consideration of the negative fiscal effects of their implementation and prospective benefits.

Political and public acceptability

This policy may only become unacceptable if it results in large public spending. However implementation of the policy can be flexible and involve less spending while efficacy of the policy would be lower.

Sustainability

The policy of setting RQOs can be pursued for as long as river pollution takes place. The policy is capable of encouraging further improvements considering pollution prevention measures.

Administrative feasibility

Ukraine has a developed structure of state administration represented by Supreme Soviet, regional, district and village Councils of People's Deputies as well as other central (committees and ministries) and local authorities. For instance specialists at the MEP can develop RQOs. Then these would be communicated to local inspectorates of MEP, which would be responsible for implementation of measures required to achieve RQOs. Achieving RQOs has to be consistent with available means and resources.

Importation risk.

This policy is politically neutral because it can be "adjusted" according to governmental wishes.

This policy appears to be suitable for importation to Ukraine, with reservations.

8.2.2 Planning for river pollution prevention activities on a small catchment basis

Planning for river pollution prevention activities on a smaller catchment basis (within large river basins), rather than on river basin basis only, enables greater targeting of local pollution sources. Furthermore such a focus could be more meaningful to the local population and also local enterprises.

Efficacy

The advantage of planning river pollution prevention activities on a smaller catchment basis is that more account may be taken of specific pollution sources, and the nature and extent of pollution (NRA, 1995). The greater local focus afforded would be an advantage to introduce detailed, priority-oriented measures to prevent water pollution in highly polluted river catchments within the scope and objectives of river basin management plans. Particularly this measure would be useful in densely populated areas where many people are exposed to significant water pollution.

Economic efficiency

Efforts to provide more detailed planning of water pollution prevention measures in certain areas, and implementation of these measures, would involve significant expenditures to attract executing staff and techniques. This is a hard task in present day Ukraine because, on one hand in late 1990s, 300,000 state employees were under threat and a number has been made redundant (March 2001). On the other hand there is insufficient state funding of environmental protection in the country. Taking into account these major limitations, it may not be possible to cover the whole territory of the country, but it could possible to address certain densely populated areas of river basins where river pollution is most dramatic. Depending on the scale of implementation of this policy, state expenditure would vary. Applied on the small scale, this policy would be affordable to the state and national industries.

Fiscal effects

Public spending for prevention of high pollution in densely populated river catchments would be beneficial to residents' health and, therefore, to the local economy and local

and state budgets. However, it is virtually impossible to quantify better conditions of human health, ecological and amenity qualities of natural water bodies in terms of economic revenue.

Political and public acceptability

As long as the costs of implementation of this policy fall within acceptable limits, there would not be any political or public resistance. As opinion polls have shown, people are concerned with poor ecological quality of water bodies but their willingness to pay for its improvement is low.

Sustainability

In future, the policy has good prospects of being implemented on a river catchment basis throughout the country to achieve better pollution control. Instead of basin management, catchment management planning may become the vehicle for sustainable development through achieving water quality objectives.

Administrative feasibility

Legislation allowing for planning of pollution prevention activities on the basis of river catchments first needs to be adopted. Executive environmental authorities represented by the Council's of People's Deputies and MEP inspectorates are competent to carry out this task, but would need more expert and financial support from the state.

Importation risk.

This policy is adjustable to the needs of the state, and therefore would be viable under any political regime. It is furthermore well tested elsewhere, e.g. England and Wales, Scotland, France and USA.

This policy appears to be suitable for importation to Ukraine, with the reservations identified.

8.2.3 The establishment of procedures for consideration of the likely costs and benefits of wastewater treatment by regulatory bodies

The procedures have to take account of local conditions and the uses made of surface waters.

Efficacy

Because of very limited state funding, it is necessary carefully to weigh all costs and benefits related to wastewater treatment at every discharge. National scientific and research institutes (e.g. USRIEP) can establish basic procedures, which would utilise the tools of environmental economics. Copying UK system of assessment to Ukraine may be inappropriate because of very different socio-economic situation and quite different ways of controlling pollution between these two countries.

Economic efficiency

Most expenditures will be related to the development of procedures by scientific and research institutions such as USCPW. It is difficult to determine the amount of funds involved, but the total sum should be affordable (Georgy S., 2000). For instance, costs of wastewater treatment would mainly comprise of the costs of purchasing, installing and maintaining wastewater treatment facilities (WWTF). Benefits are more difficult to quantify but are self-evidently justified because they mainly arise from improved human health and better amenity quality of rivers and related ecosystems. However some

system of assessment of benefits related to greater security regarding human health and improved amenity quality of water bodies should be developed. Rivers in densely populated areas, from which drinking water is drawn, should be prioritised regarding assessment of pollution prevention benefits.

Fiscal effects

This is an institutional measure, which would require some public spending which, firstly, is necessary for implementation of measures on pollution prevention and, secondly, is likely to be affordable.

Political and public acceptability

Every society, and commonly every individual in it, needs most efficient investment of limited resources. The procedures would likely be established by a group of scientists through application of certain techniques (including economic ones), e.g. contingent valuation (how people value their livelihoods near a water body) and willingness to pay methods, on a limited scale within a case study area. This work should be affordable to the state and serve the interests of politician and general public.

Sustainability

In the future, such procedures will be required for the assessment of potential efficiency of investments into wastewater treatment. As approaches to pollution control would be changing with time, the assessment procedures can also be adjusted and modified.

Administrative feasibility

Properly developed assessment procedures can be an easy-to-use tool for environmental authorities of all levels. The procedures would facilitate decision-making on rational investments by local environmental authorities and need to be supported legally.

Importation risk

Any political system is interested in utilising available resources rationally and efficiently. The outcomes of this policy would be valuable advice to decision-making authorities, whatever their political orientation is. Therefore the policy is politically neutral.

The policy appears to be acceptable for importation.

8.2.4 Maintenance of flows through licensing of abstractions

Licensing of abstractions by the environmental authorities should enable flows to be maintained and enable sufficient effluent dilution to meet water quality objectives.

Efficacy

In most of the country located in the area of 500 mm of precipitation per annum and more, there are no chronic flow shortages, and water in water bodies is sufficient to meet the needs of people and industries. Only southern and south-eastern regions of Ukraine (e.g. Donbass) with annual precipitation of about 400 mm per annum tend to experience irregular droughts in summer. Coupled with heavy industrialisation of some parts of these regions, droughts can induce excessive water pollution due to low flow. This policy could be applied in summer for certain watercourses during prolonged periods of dry weather in southern and eastern parts of Ukraine.

Economic efficiency

During summer, the environmental authorities in the southern and eastern parts of Ukraine can apply licensing of water abstraction to maintain river flow at acceptable levels. Depending on the extent and duration of drought event, the costs of issuing and enforcement of license requirements may be affordable or less affordable to state budget. Approach of prioritisation could be applied if it would appear impossible to meet all relevant costs. There would also be a negative impact on the income of water users, whose economic activities might be restricted by lower abstractions. Due to serious economic crisis this factor needs also be taken into account when limiting abstractions.

Fiscal effects

While it may not be too expensive to issue licenses, enforcement costs may have significant negative effects to public finances, so environmental authorities may have to resort to prioritisation of licensing abstractions.

Political and public acceptability

Enforcement of restrictions to water abstraction for industrial and household needs may bring about some political and public antagonism. The level of antagonism may run high if restrictions are severe. In a country plagued by crisis, economic issues would dominate over environmental. Therefore, consideration of issues related to licensing abstractions must take account of the needs and wishes of water users.

Sustainability

After the introduction of licensing abstractions can be implemented as an annual measure in southern and eastern Ukraine during prolonged dry weather spells. The policy has a potential to develop to suit local conditions and changeable weather patterns.

Administrative feasibility

Upon governmental authorisation, local Councils of People's Deputies can apply and enforce this policy in certain areas during dry weather spells.

Importation risk.

Under a dictatorship local authorities would unlikely be given the freedom of decision-making on this issue. But licensing abstractions may be prescribed under river basin and river catchment management plans and approved by central authorities upon the request from local authorities.

This policy is recommended for importation, at least on a trial basis, but with the reservations expressed.

8.2.5 Implementation of BATT for treating highly poisonous effluents

Best available treatment technologies (BATT) should be applied as determined at the level of industrial sectors. Emission limit values (ELVs) for these pollutants are to be based on BATT and take account of certain site-specific factors.

Efficacy

Introduction of BATT is important because there are industries in Ukraine, especially heavy metallurgy, which produce dangerous substances (Chapter Two). The location of such industries in Ukraine are usually in densely populated areas where there is a need to protect life and health of the residents (Baranovsky, 1996).

Economic efficiency

Taking into account the level of environmental expertise and funding in Ukraine it is feasible for Ukrainian water experts to develop ELVs based on BATT applicable to Ukrainian industries (Barannik, 1996). Obtaining and implementing BATT, however, may be very expensive and amount to hundred millions and even billions $US, which is not affordable to the state budget. Alternatively, non-state water users may not be able to afford BATT due to low incomes and corruption. Therefore, due to fund shortages, BATT may be applied only to address the most urgent priorities in the country. The state has to ensure that such priorities are adequately addressed.

Fiscal effects

Wide-scale application of BATT may prove to be too expensive when considering negative effects on public finances. However implementation of BATT in the cases of the most dangerous pollution, considering the factors of physical amount and public exposure, may be necessary.

Political and public acceptability

High costs of implementation of BATT may be the reason for resistance and non-compliance of co-operative and private water users. Rational investments of state funds though are likely to be acceptable for economic agents, people and government.

Sustainability

Heavy metallurgy and coal processing industries of Ukraine continue to produce poisonous substances despite de-industrialisation in other sectors. Many processing plants discharge directly into adjacent water bodies. There is no sign though, that such industries in Ukraine, as it is the case in UK, would be gradually disappearing. It is possible that should economic crisis be abated, the sectors of heavy metallurgy, mining and machine construction would become more active. BATT would need to be continuously applied to such industries in the future and, possibly, such application might need increasing.

Administrative feasibility

In general the present legal and administrative system is adequate for the implementation of this policy, but some major improvements in the system such as reduction of bureaucracy and corruption (when large amounts of money are handled), would be essential. Reduction of corruption is particularly difficult issue which may prove virtually impossible to address in the short term.

Importation risk

Any government can be expected to use expensive BATT for highly dangerous effluents, which threaten people's health and life.

The policy appears to be suitable for importation, with the reservations expressed.

8.2.6 Targets for the gradual achievement of effluent reduction

Setting targets for the gradual achievement of reductions in certain effluents (emission standards or percentages) from sewage treatment works to be achieved over a realistic period of time.

Efficacy

In line with RQOs, water users may be encouraged to follow a gradual procedure of reducing their own polluting effluents. Legal economic mechanisms, such as production tax benefits, can be introduced which would give water users incentives to reduce pollution. Pursuing this policy it is possible to reduce polluting effluents to very low levels.

Economic efficiency

Indirect costs related to this initiative would involve a gradual improvement of WWTF system and other measures on river pollution control. Effective implementation of this policy on a country-wide basis would likely be hampered by fund shortages in the short-term (up to 5 year) and, possibly in the longer-term (5-15 years) because economic crisis has not been abated yet. However some measures within river catchments may prove beneficial, for instance upgrading of sewage treatment equipment of large municipal sewage companies.

Fiscal effects

Due to the deepening economic crisis, public funds in the Ukraine have steadily shrunk. This means that some planned pollution prevention measures may not be possible to implement due to lower than expected budget revenues should the crisis continue to worsen. Because the crisis is presently worsening, it is most likely that for some time public funds will be decreasing. This may mean, that what is planned today may not be possible to implement tomorrow because the resources, which are available today and which are expected to be available tomorrow, may not be available tomorrow. So in the present unstable economic and political situation it appears impossible to carry out a reliable planning of measures to prevent pollution over a specified period of time, but only to carry out current pollution control.

Therefore the policy is rejected in the short-run. In the longer term though, the policy may be effective should Ukraine's economy stabilise or improve.

8.2.7 Improvement of enforcement mechanisms

In order to improve enforcement mechanisms, more frequent checks at enterprises would be required.

Efficacy

Frequent checks of legislation compliance by water users are important to ensure that discharge consents are being met, especially if water users tend to avoid the requirements of environmental laws, as is the case in Ukraine.

Economic efficiency

Increases in the number of state environmental inspectors is necessary to enforce better legislation compliance by Ukraine's enterprises and institutions. However, attracting people to this job is becoming increasingly difficult due to poor funding for environmental protection in the country. There were only 850 inspectors for 100,000 plants, enterprises and institutions in 1996 (MEP, 1998). Since then, according to analysis in Chapters Seven and Eight, the economy of the country has been worsening and is expected to continue to worsen. The government continues cutting budget spending on lower priority areas such as environmental protection. Also, Ukraine's government is planning to continue decreasing the number of state employees by up to 300,000 (IMF, 1999). Logically, the number of the inspectors is expected to be even smaller, and will continue to decrease in the case of further cuts in budget spending on environmental protection.

So for the present the practical implementation of this policy is regrettably unrealistic. However this may change should the country come out of present recession.

8.2.8 Charges for issuing and monitoring consents and authorisation

The introduction of a charge for water users to cover the costs of issuing and monitoring consents and also authorisation conditions by environmental authorities under MEP would assist with administrative costs.

Efficacy

Such charges will facilitate work of environmental authorities on issuing and monitoring consents and authorisation conditions.

Economic efficiency

According to analysis in Chapters Seven and Eight, the introduction of such a charge may be an unpopular measure among water users, which they may try to avoid by various means, because they already have to bear a heavy burden of various taxes and payments. Besides the size of informal "shadow" economy, where little enforcement of the state laws is possible, is almost 50 % of national economy. Water users in the shadow economy can hardly be made to make legal payments. On the other hand, state environmental funds are limited. Nevertheless full responsibility of the state to cover the costs of issuing and monitoring consents would be preferred to avoid potential problems with charge non-compliance by water users. For instance, depending on circumstances water users can be allowed to apply for partial or full state funding of issuing and monitoring consents and authorisation conditions. In present situation of economic hardship, it is difficult to say whether the policy would find a broad application in Ukraine. However this may happen even without boosting present budget expenditure if sizes of such charges will be sufficiently low. It is possible that after issuing discharge consent a long time, years, may pass before an enterprise may need a new one, and so pay new change. This is very much the case for Ukrainian enterprises now, most of whom can not upgrade their capacity due to chronic fund shortages.

Fiscal effects

There will be no direct impact on public finances if enterprises will bear the full costs of issuing and monitoring discharge consents and authorisation conditions. However the finances will be adversely affected if the costs will have to be paid by the state from central and/or local budgets. However it is likely that such costs would be low and, therefore, affordable to state and private enterprise budgets.

Political and public acceptability

There will not be significant political and public resistance if the charge will not result in excessive spending of enterprise and public funds, and the objectives of the policy are clearly realised by people and politicians. Otherwise the policy will not work.

Sustainability

The policy is sustainable because the system of charges can be further developed and improved as the conditions of water use and environmental management approaches change.

Administrative feasibility

If supported legally, present system of state environmental authorities is capable to implement this policy.

Importation risk

It is possible that the policy may turn politically unpopular if a dictatorial regime will emerge in Ukraine. As history suggests, one of features of such regime is that the central authorities want to have a maximum possible control over all transactions. Therefore subordinate authorities may not be allowed being paid directly through the charge. However, even in this case, the policy may not be rejected but modified. For instance, the charge may be paid to the state budget.

This policy is accepted with the reservations stated.

8.2.9 Setting a structure of charging scheme

A charging scheme would convert each discharge into a number of pollution units for which a standard charge is to be set annually. The factors reflected in the charging scheme are: volume (cubic metres per day); several-substance content; and the nature of the receiving waters including their self-purification capacity.

Efficacy

The charging scheme would target at rational water use and fair cost recovery by sewage treatment enterprises. The basic principles establishing the structure of charging schemes can be copied from the UK, or a different scheme can be developed by Ukrainian scientists. The scheme would have to take account of features of environmental pollution in the country, its socio-economic aspects, and the natural properties of water bodies.

Economic efficiency

Implementation of the policy and compliance with it would require significant investments of state funds by wastewater treatment enterprises. As data analysis has shown the country is very short of funds for environmental activities therefore it is unlikely that the policy will find a broad-scale application within the next 5 years. However, on case-by-case basis this policy may be applied.

Fiscal effects

Wide-scale implementation of this policy may be unacceptably costly. The measures on a case-by-case basis are feasible should available public or enterprise finances be sufficient.

Political and public acceptability

The policy may be unacceptable to the public if charges appear to be very high. In this case some institutions and individuals will try to avoid, or protest against, paying them. The situation can be overcome through reducing charge rates and providing state subsidies.

Sustainability

The structure of charging schemes can be further modified and improved in the future.

Administrative feasibility

Expertise for charge development, authorisation and implementation already exists in Ukraine. Relevant institutions, e.g. wastewater treatment facilities, would have to carry out technical measures in line with scientific guidelines.

Importation risk

Should dictatorial rule emerge in Ukraine, wastewater treatment services may remain free of direct charge to a sewage company, as it was in the Soviet Union and to a certain extent continues to be (e.g. public transport, medical treatment and water services). It is likely that water users will pay a fee for water services to a central budget, which will allocate some of the money to water services. Such an approach (free of charge services plus state funding) would be chosen by an authoritarian government for two reasons: to prevent misuse of funds, which is a common case in Ukraine today under the present government (Bonner, 1997) and to distribute budget funds in line with state priorities. The latter is how the things are now in Ukraine. However any government would agree with this policy if it will not entail excessive spending, but will bring more benefits

regarding better prevention of pollution and more efficient use of economic resources of water users.

The policy can be recommended for importation.

8.2.10 Public awareness campaign against illegal dumping and pollution

Mass media and educational information aimed to make the public aware of environmental issues is intended to reduce illegal dumping of polluting liquids such as oil or litter at landfill sites and water bodies.

Efficacy

For more than 70 years before Ukraine' s independence, it was the case that the government was the sole participant in taking decisions on matters concerning the life of society. Therefore there was no "need" for public awareness when something would go wrong. Cases of environmental disasters were frequently hidden from the public so that they would continue to believe that "everything was all right" in the "best country in the world" (meaning the former USSR). Some environmental education was provided within the framework of general Communist Party ethics and it would have a political bias. Now it is essential to fill this gap and, at best, introduce a regular television and/or radio channel to inform and educate the public about environmental issues. At least, there should be legal provisions that remove any barriers to media communication of environmental issues to the public.

Economic efficiency

Creation of environmental channels on radio and television including programmes relevant to schools, may involve significant, but not unreasonable, expenditure, because the technological basis for implementation of this policy already exists. Already there is involvement from artistic, professional and educational staff in the mass media. The annual cost of such a policy may be affordable, and the benefits (in terms of cultivating positive attitudes towards the environment) may be significant though impossible to quantify.

Fiscal effects

The impact of the establishment of mass media environmental services costs on public finances would vary. The optimum choice of the services may be found, which would be both informative and cheap.

Political and public acceptability

Because public is concerned with poor environmental quality in the country, most people would likely support this policy. Under present political regime though the policy may not be acceptable regarding dissemination of accurate information on environmental accidents and their consequences to public. People who disseminate information, which is considered adversely to effect the present government, may be prosecuted or even murdered. For instance President Kuchma and some of his ministers have been accused of ordering the murder of an independent journalist Gongadze in autumn 2000 (EIN, 24.02.2001). This murder triggered a political crisis acting as a catalyst where the population is already poor, this developed into mass protests. However educational aspects of this policy would not interfere with the government or public interests.

Sustainability

Media services aimed to educate the public on environmental issues have the potential to develop from the present modest base where environmental information provided to the public through mass media is scarce and sporadic.

Administrative feasibility

It is possible to create special environmental channels, or produce and broadcast more environmental programmes via existing channels. This policy does not require special legal and administrative arrangements.

Importation risk

It is possible to assume that both democratic and authoritarian governments would, to some extent, encourage environmental ethics amongst their people. Therefore, mass media work related to environmental education would be acceptable under possible political changes. On the other hand, dissemination of environmental information may be heavily censored, and this part of the policy would likely fail to operate, should an authoritarian regime emerge. Even now, as the data search revealed (Chapter Three), there is scarce published or mass media derived information on the state of the environment in the Ukraine.

The policy is therefore suitable for importation.

8.2.11 Public participation campaigns

The establishment of a 24 hour, free, environmental emergency hotline under the aegis of the MEP is proposed. Here, people can directly inform about environmental

emergencies, submit their complaint, comments and ideas on environmental matters and these will be communicated to the responsible decision-making authorities.

Efficacy

This policy would facilitate the public's relation with environmental authorities and prompt these authorities to quicker action in cases of environmental emergency. A long bureaucratic procedure of reaching top decision-makers via local authorities will thus be avoided.

Economic efficiency

Considering approximate staff wages, rent, purchase and maintenance of equipment, the establishment of such an effective facility would likely be affordable to the state budget.

Fiscal effects

Creation and maintenance of such a service may not require significant spending of state budget funds.

Political and public acceptability

This policy is acceptable because both the public and the government would find it beneficial to deal quickly with emergencies.

Sustainability

In the long run development of close co-operation and communication between public and environmental authorities will be an important tool of pollution prevention.

Administrative feasibility

Creation of such public facilities would only be an extension to current MEP services.

Importation risk

Any government needs to be aware of any emergencies as soon as possible. Therefore the policy is likely to succeed either under liberal-democratic or authoritarian rule, and would be suitable for importation.

8.3 Summary of policy assessment

Out of eleven policy options assessed on the subject of efficacy, economic efficiency, fiscal effects, political and public acceptability, sustainability, administrative feasibility and importation risk, two options were rejected. The policy option assessed in section 8.2.6 "Targets for the gradual achievement of effluent reductions" was rejected on the criterion of fiscal effects and the option in 8.2.7 " Improvement of enforcement mechanisms" – on the criterion of economic efficiency. After being rejected on one of the criteria, policy options were excluded from further assessment.

Policy options in sections 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.2.5, 8.2.8, 8.2.9, 8.2.10 and 8.2.11 have been recommended for importation to Ukraine (Table 8.1).

Table 8.1
UK policies recommended for importation

Section of Chapter 8	Short policy name
8.2.1	Setting river quality objectives (RQOs) for water bodies and rivers.
8.2.2	Planning for river pollution prevention activities on a small catchment basis.
8.2.3	The establishment of procedures for consideration of the likely costs and benefits of wastewater treatment by regulatory bodies.
8.2.4	Maintenance of flows through licensing of abstractions.
8.2.5	Implementation of BATT for treating highly poisonous effluents
8.2.8	Charges for issuing and monitoring consents and authorisation
8.2.9	Setting a structure of charging scheme.
8.2.10	Public awareness campaign against illegal dumping and pollution.
8.2.11	Public participation campaigns

Out of these policy options assessed in sections 8.2.3, 8.2.8, 8.2.10 and 8.2.11 can be applied nation-wide while the options assessed in sections 8.2.1, 8.2.2, 8.2.4, 8.2.5 and 8.2.9 can be implemented on case-by-case basis due to financial and technical limitations, result of socio-economic crisis in the country. In Chapter 9 application of these policies and other findings of this research will be considered.

CHAPTER 9

General findings, recommendations and conclusions

This research were undertaken in seven distinctive stages (Figure 9.1).

Figure 9.1 All research stages



As an essential part of research, many Ukrainian sources of information concerning environmental pollution and its factors were obtained through search in the library of Ukrainian Scientific Centre for Protection of Water, photocopied and brought to the UK for use in literature review and data analyses.

In the UK, some information was found via a direct search in the library of Imperial College at Wye and the British Library; most sources were obtained via interlibrary loans. Additional information has been found on Internet sites of mass media agencies, water and environmental institutions.

The first information search took place in September 1997 in the library of USCPW and Korolenko State Library. Both libraries are located in Kharkov, which is Ukraine's second largest industrial, scientific and cultural centre after Kiev. Also Kharkov and its region were selected due to severity of pollution in this former Soviet industrial heartland. At this stage of research information related to environment (centred on river pollution) was selected.

Unfortunately there appeared to be scarcity of recent specialist literature. Professor G. A. Sukhorukov (1998), a laboratory head from USCPW, explained the lack of information on environmental and water resource issues: "The information, which is readily available, is that published before 1992. Due to the present economic crisis and budget deficit national science, supported by the state as in Soviet times, receives insufficient funding. Therefore the market for many scientific publications in the country is very limited, only a few sources get published".

In order to unveil the prevailing wishes and attitudes towards the issues of adults, a public poll was conducted into public attitudes towards water services and related issues such as water management and river pollution. One hundred people were asked to fill out a questionnaire each containing eight questions. Explanations, clarifications and reformulation were provided should a respondent become confused when answering a question. Respondents under 18 years old were excluded from the poll.

The survey included five experts of USCPW, who were interviewed to obtain their views on the situation in the field of water pollution prevention. Interviewees were asked to answer 13 core questions. Around those questions intensive discussions were involved. The answers to the questions as well as interesting points from discussions

were written down in a notebook, because the presence of a microphone can cause a loss of spontaneity in some individuals.

Environmental information obtained via the literature search in Ukraine has been screened mainly to extract data on river pollution. The data were a subject to spreadsheet analyses. These included plotting charts, quantitative calculations and some qualitative observations.

The operation of the system of pollution control in the country has also been studied. This relied upon qualitative presentation and analysis of information from Ukrainian literature sources (e.g. MEP annual reports and other publications). Discussions, especially on the key issues, were referenced from literature sources and interviews, and supported with figures and sample data in tables.

The findings of the qualitative analysis revealed that pollution problems in the country are serious. While there are human resources and technologies to tackle it, there are insufficient funds, and also some other lacks in the system of pollution control.

Further investigation was required to see how the socio-economic situation affects availability of such funds. Thus another information search was completed to obtain more information on socio-economic issues to update and extend findings in Chapter 2 essential for policy assessment and update environmental information found in previous search.

In parallel with the literature search, another public poll was conducted. One hundred and four people were asked to fill in questionnaire with seven questions on socio-

economic and political issues relevant to the theme of the thesis. The experience of conducting the first poll was taken into account, however there were few drawbacks. For instance, on four occasions respondents missed questions and in Question 5 more then 40 % of respondents rejected one option as irrelevant. More interviews were taken from seven other people of different age and occupations. Similarly to interviews with USCPW experts these were based around the same 13 core questions and involved further discussion.

Information collected via the polls has been analysed with Statistical Package for Social Scientists (SPSS) v.9. First, the answers for each answer option of poll questions were converted into mathematical values. Then in SPSS the options were presented as variables, with the values recorded for each variable. These were subjected to analyses of Frequencies and Crosstabs ('Chi-square' test).

Analysis of Frequencies produced a pattern of the distribution of opinions and wishes regarding different answer options. Crosstabs analysis revealed relationships between different answer options. These were supported with qualitative observations, brief discussions and interview references. It appears that the public is seriously concerned with the bad ecological conditions of water bodies, but in the face of a hard struggle for survival in a sagging economy, people are willing to pay only a fraction of "a full price" to obtain this good.

The findings of literature review on the subject of socio-economic situation, and analysis of data relevant to river pollution, allowed to substantiate research proposition.

Third information search in Ukraine allowed to update previously collected literature and poll information with new library and retail entries as well as interviews.

UK/EU water policies highlighted in literature review were assessed on the subject of importation to Ukraine. Policy assessment procedures had to determine whether the policies would work and be effective and efficient in Ukraine. The assessment produced a list of policies, which appear capable of improving river pollution control in Ukraine.

After policy assessment it became possible to summarise major findings of this research.

Central finding is that persistent river pollution in urban and industrial areas, due to present socio-economic conditions, mainly originates from uncontrolled discharges of untreated and under-treated effluents, often in large quantities. The effluents usually contain heavy metals or sewage type substances. Throughout the country the most abundant pollutants are manganese and zinc compounds. However there are no known human health effects from manganese. In several basins these and other pollutants, e.g. oil products and copper compounds, represent a serious threat to river ecosystems and human health due to high, average and very high, short-term, maximum concentrations.

Data analysis has revealed the mechanism of origin of the pollution. Effluents are produced during sewage treatment and processing or manufacture operations at plants. According to the law, they have to be treated to a given standard before entering water bodies. This is often not the case because the enterprises, which have their own treatment facilities, can not use them properly because they are obsolete and unfit for the required treatment. Again, according to law, it is the responsibility of water users to

ensure the proper operation of wastewater treatment facilities. But because of crisis and taxes sometimes reaching 80 % of income, the enterprises often simply cannot afford the operational costs.

Some enterprises, most institutions and urban dwellers use large public treatment facilities. They discharge effluents and pay a standard fee for water use. Due to the economic crisis, most of the enterprises, institutions and individuals are poor. About 90 % of Ukraine's population find it difficult to make the ends meet in respect of basic nutrition, clothing and accommodation. Consequently, people often avoid paying certain bills for water services, gas, electricity and rent (Chapter 2). Therefore under-funded public services have to "adjust": turn off electricity for a number of hours a day, reduce gas pressure in pipelines and carry out unsatisfactory sewage treatment (Chapter 6).

It is the duty of state environmental inspectors to ensure that effluents disposed of into water bodies meet discharge consent conditions. Where enterprises do not comply, the inspectorates have the right to impose penalties ranging from warnings and fines to criminal prosecution. Enterprises that cannot afford proper treatment therefore may try to avoid fines in three ways:

1. Invest in WWT to reach a required standard;
2. Accumulate effluents in special places and discharge them when there is no threat of inspection (e.g. during holidays or a night);
3. Often influence local inspectors including bribing in exchange for false reports which meet required standards.

It should be noticed that options two and three are often combined together and that option three nowadays is a very common means of settling various issues in Ukrainian

society - and many other CIS countries (all interviews). In fact, bribing and false reporting became so common during the 1990s that it is considered as a "norm of life" despite widespread criticism both nationally and internationally.

River pollution in the country is primarily a result of government socio-economic policies, corruption and the behaviour of water users (including "co-operation" between water users and environmental inspectorates). On the other hand, it should not be presumed that public opinion wishes this to be the case. Public polls revealed that people are concerned with the poor ecological quality of water bodies and bad drinking water quality. They are willing to pay for the quality to be improved. They appear unable to pay a lot, but according to research estimates of the total amount deduced from the willingness to pay exercise may be as high as $US 240 million a year, which is seven-times more than the total budget environmental spending in 1996. If relevant consumer fees were introduced, this would boost financial support for pollution control.

Comparing to anticipated spending of £ 5.3 billion during 2000-2005 by UK water and sewage companies to protect and improve environment (EA, 2001), $US 240 million a year is not a big sum for Ukraine, whose population is almost the same as that of UK. Yet it may contribute significantly towards the clean up of initial amounts of heavy water pollution because, according to the rule of environmental economics, the lower the level of pollution the higher is the marginal cost of reducing it still further (Pearce, 1990).

First, the bulk of funds could be used for upgrading, maintenance and installation of WWTF at point sources as a major priority. The allocation and utilisation of the funds must remain under governmental control.

Then some of the funds might be used to correct the shortcomings in the present system of water pollution control considered in Chapter Six, namely:

- The absence of a unified system of state control in the field of environmental protection and the uncoordinated activities of the authorities responsible for this control;
- Double subordination of local environmental protection authorities to the MEP and regional state administrations;
- Inefficiency in charging and collecting fines and rehabilitation bills for breaking environmental law;
- Some drawbacks and gaps in environmental legislation, especially the Law of Ukraine "On Environmental Protection", the Code of Ukraine "On Administrative Offences", and the Criminal and Water Codes;
- Overlap of institutional responsibilities and a resulting tendency to assume that responsibility is taken by other agencies;
- Insufficient number of state inspectors and insufficient financial and material support for the environmental protection sector.

Also the funds may help to address river pollution issues through importation of the following UK policies:

- Setting river quality objectives (RQOs) for water bodies and rivers;
- Planning for river pollution prevention activities on a small catchment basis;
- The establishment of procedures for consideration of the likely costs and benefits of wastewater treatment by regulatory bodies;
- Maintenance of flows through licensing of abstractions;
- Implementation of BATT for treating highly poisonous effluents;

- Introduction of charges for issuing and monitoring consents and authorisation;
- Setting a structure of treatment charging scheme based on volume and composition of wastewater;
- Public awareness campaign against illegal dumping and pollution;
- Public participation campaigns.

Because Ukraine, so far, has taken the course of economic reforms designed to build, eventually, a West European–style society, it is important that environmental protection would also be reformed through learning from West European experience. At this stage though Ukrainian economic reforms are considered to be "slow" by the West (EIN, 20.12.2000).

Thus, due to general economic depression and rampant corruption of state authorities resulting in an economic crisis, it is unlikely that UK policies will find a widespread application within a short time span. Also, there is great uncertainty about political changes in the country in the short-run. Only UK-style policies that are unlikely to have significant political ramifications for Ukraine are selected. Nevertheless the foundation for prospective broader application of West European approaches to deal with river pollution can be laid now through importation of the nine policy options.

At this stage, five options have been priority-oriented, due to shortage of funds (which must be used rationally). Namely, they should be implemented:

- In densely populated and industrial areas, where pollution is high;
- Where pollution is very dangerous to ecosystems and human life;
- Where development projects of potential great environmental impact would take place;

- In areas prone to summer droughts;
- Other areas, where point source sewage and industrial pollution can cause serious damage to economic activities and human health.

Policy options related to public environmental awareness, education and participation are dependent on the development of mass media and communications, so they can target every individual living in the country. Most households have a TV set and phone, virtually every household has a radio and every year increasing numbers of people are able to access computer facilities and the Internet. Consequently, these policies will be very useful to promote environmental ethics in the society and establish better co-operation between the general public and environmental authorities.

However, without change in the present attitude of Ukraine's government to environmental protection, it is unlikely that there will be any significant positive change in river pollution control. So there is an uncertainty whether the government will reconsider its position and start placing greater effort in dealing with environmental issues. The uncertainty is primarily related to the unstable economic and, hence, political situation of the country. Successful importation of UK policies is also conditional on government willingness and ability to persuade the general public to pay a set-aside environmental fee, which must not be used for any other purpose than environmental protection. This step is vital because, as mentioned above, it may boost state budget environmental spending six times and more that provided in 1996. Also, it is not clear, whether the IMF will allow the government (and the government may or may not comply) to take more care of the natural environment if this is not in tune with IMF interests.

Thus, these complications and uncertainties can create difficulties not considered in this research. Nevertheless, should the Ukrainian government be willing to provide practical support, the UK policies suggested for importation, coupled with the existing Ukrainian practice of dealing with river pollution issues have sound potential for improving the ecological quality of rivers. Should government concern remain and the national economy improve, the situation would be even better. Then even more environmental and economic experience can be "imported" from the West. And this learning and application of good national and foreign experiences will provide a basis for sustained improvement towards, or maintenance of, desirable environmental quality.

As the famous Ukrainian philosopher, Shevchenko (1814-1861) said: "*DO learn what is good from foreigners, DO NOT reject what is good of your own*". Since then it became a proverb.

REFERENCES

1. AFP (7.12.2000). Ukraine Adopts Balanced Budget for 2001. News release of information agency "Agence France Presse", http://www.afp.com/english/home/;

2. Akimova I. (1996). Marketing Approaches and Organization for Marketing in Ukraine. Central and East European Economic Research Centre, Warsaw University, Warsaw, Poland;

3. Allan G., Skinner C. (1991). Handbook for Research Students in the Social Sciences. The Falmer Press, London;

4. Ayton W. (1994). Catchment management planning in the National Rivers Authority. Water Science and Technology. 1994, 29: 3, 351-355;

5. Backes C., *et al* (1999). Integrated Pollution Prevention and Control: The EC Directive from Comparative Legal and Economic Perspective. Kluwer Law International, London;

6. Baird D., *et al* (1996). Aquaculture and Water Resource Management. Blackwell Science Ltd, Oxford, UK;

7. Balatzky O., Lukyanykhin V. (1995). Assessment of Economic Damage Caused by Contamination of Water Bodies in Ukraine under the Conditions of Economic Transition. Herald of Sumy State University N^{o} 3, 1995, Sumy, Ukraine;

8. Barannik V., *et al* (1996). The Problems of Environmental Protection. Collection of Scientific Works of USCPW, USCPW, Kharkov, Ukraine;

9. Baranovsky V. (1996). Environmental Pollution. Atlas RD, Kiev, Ukraine;

10. BBC News (21.11.1999). Call to Slash Water Bills.

http://news.bbc.co.uk/hi/english/uk/newsid%5F530000/ 530331.stm;

11. Biswas A., *et al* (1993). Water for Sustainable Development in the Twenty-first Century. Delhi, Oxford University Press;

12. Boland J. (1991). Legislative and Economic Approaches to Water Demand Management. United Nations, New York, 1991;

13. Bonner R. (1997). Ukraine Staggers on Path to the Free Market. New York Times, April 9, 1997;

14. Boreiko V. (1995). The "Greens" of Ukraine: Grim Perspectives. Eurasia 1 (26) 95: Ecological Monitoring, Moscow, Russia.

15. Cabinet of Ministers of Ukraine (1993a). On urgent measures concerning the improvement of ecological conditions in the Polissya. Resolution of the Cabinet of Ministers of Ukraine, 23 September 1993, Kiev, Ukraine;

16. Cabinet of Ministers of Ukraine (1993b). Statute of the State Ecological Inspection of the Ministry for Environmental Protection of Ukraine. Decree of the Cabinet of Ministers of Ukraine, 12 November 1993, Kiev, Ukraine;

17. Cabinet of Ministers of Ukraine (1993c). On the Approval of the Regulation on State Environmental Monitoring in Ukraine. Decree of the Cabinet of Ministers of Ukraine, 23 September 1993, Kiev, Ukraine;

18. Clarke S. (1997). Poverty in Ukraine. Department for International Development, the University of Warwick, Coventry, UK;

19. Cook H. (1998). Protection and Conservation of Water Resources: A British Perspective. John Wiley & Sons, Chichester;

20. Correspondent of "Green World" newspaper (1997). The State of Environment.

Green World, No 2, 1997, Kiev, Ukraine;

21. Danilishin B. (1998a). How Can You Be Healthy, If... Green World, No 1, 1998, Kiev, Ukraine;

22. Danilishin B. (1998b). Ukraine: Hard Road to Sustainable Development. Green World, No 1, 1998, Kiev, Ukraine;

23. Dean R. (2000). Individual interview: *River Pollution Control in UK*. Environmental Agency officer, UK;

24. Denscombe M. (1998). The Good Research Guide for Small-Scale Social Research Projects. Buckingham Open University Press, Philadelphia, USA;

25. DETR (1998). Environmental Protection. Publications of Department of the Environment, Transport and the Regions (DETR), UK, http://www.environment.detr.gov.uk;

26. DETR (2000). Environmental Protection. Publications of Department of the Environment, Transport and the Regions (DETR), UK, http://www.environment.detr.gov.uk;

27. EA (1997). Assessing Water Quality - General Quality Assessment. Fact sheet, Environment Agency (EA), Bristol, UK;

28. EA (1998). The state of the environment of England and Wales fresh waters. Environment Agency publications, London Stationery Office;

29. EA (2000). Enforcement and Prosecution Policy. Environment Agency for England and Wales, http://www.environment-agency.gov.uk;

30. EA (2001). Achieving the Quality. Environment Agency for England and Wales, http://www2.environment-agency.tv/quality/pdf/atqreport/atq_eng.pdf;

31. Ebergard P (1998). The Results of Socio-Economic Changes in Poland and Ukraine. Journal "Economics of Ukraine", Kyiv: Ukraine Press, №2, 1998;

32. EBRD (1995). Transition Report 1995 "Investment and Enterprise Development: Economic Transition in Eastern Europe and the Former Soviet Union". European Bank for Reconstruction and Development, London, UK;

33. EBRD (1998). Transition Report 1998 "Investment and Enterprise Development: Economic Transition in Eastern Europe and the Former Soviet Union". European Bank for Reconstruction and Development, London, UK;

34. EBRD (1999). Transition Report 1999 "Investment and Enterprise Development: Economic Transition in Eastern Europe and the Former Soviet Union". European Bank for Reconstruction and Development, London, UK;

35. EBRD (2000). Update of Transition Report 1999 "Investment and Enterprise Development: Economic Transition in Eastern Europe and the Former Soviet Union". European Bank for Reconstruction and Development, London, UK;

36. EcoPravo (1998). About Environmental Legislation of Ukraine. EcoPravo publications, Kharkov, Ukraine;

37. EEC Commission (1982). Unified Criteria of Water Quality. EEC Commission publications, Brussels, Belgium;

38. EIN (12.01.2001). Who Caused the Debt Panic? Traces Lead to the IMF. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

39. EIN (12.09.2000). Ukraine to Spend USD 1 Billion for Debt Servicing in 2001. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

40. EIN (13.11.1999a). Corruption in Ukraine. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

41. EIN (13.11.1999b). Ukrainian Leader Faces Communist In Presidential Poll. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

42. EIN (20.12.2000). EU Calls for Joint Effort to Help Ukraine. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

43. EIN (23.01.2000). Emerging Debt - Ukraine Gives Fright. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

44. EIN (24.02.2001). Ukraine President Says FBI Will Investigate Death of Journalist. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

45. EIN (25.02.1999). No One Fighting Corruption. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

46. EIN (5.12.1999). Ukrainian Leader Heads Off On Three-Nation Tour. European Internet Network, Russia Today, Http:/www.russiatoday.com/;

47. EPA (1982). The National Environmental Policy Act of 1969, as amended. 13 September 1982, Environmental Protection Agency (EPA), Office of Federal Activities, Washington DC;

48. Europa Publications Limited (1997). Eastern Europe and the Commonwealth of Independent States. Third edition, London;

49. FAO (1995). Reforming Water Policy a Guide to Methods, Processes and Practices. Food and Agriculture Organisation (FAO) of the United Nations, Rome;

50. Frankfort-Nachmias C., Nachmias D. (1992). Research Methods in the Social Sciences. Fourth Edition, St. Martin's Press Inc., Sevenoaks;

51. FVT (1997). Welcome to Ukraine. Frontier Vision Technologies, Inc., Chicago, USA;

52. Gnybidenko I. (1998). Social Problems of Ukraine during the Transition to Market

Economy. Journal "Occupation and Job Market", №8, 1998. Ukrainian National Academy of Sciences, Kiev, Ukraine;

53. Gray N.F. (1994). Drinking Water Quality: Problems and Solutions. John Wiley & Sons, Chichester;

54. Gritzenko A. V. (1994). Surface Waters of Ukraine and Scientific and Practical Basis to Improve the Efficiency of Their Protection. RIP "Original", Kharkov, Ukraine;

55. Gritzenko A. V. (1995). Regional Aspects of Improving Efficiency of Water Protection Measures in the Ukraine. USCPW, Kharkov, Ukraine;

56. Gusakov V. and Mulyar L. (1995). Health and Environmental Protection. Paper prepared for Ukraine Human Development Report 1996. Kyiv. Mimeo;

57. Hanley N., Shogren J. and White B. (1997). Environmental Economics in Theory and Practice. Basingstoke Macmillan Press, London;

58. Harrison R. (1992). Pollution: Causes, Effects, and Control. The Royal Society of Chemistry, Cambridge, Henry Ling Ltd., Dorchester;

59. HMSO (1990). Integrated Pollution Control and Air Pollution Control by Local Authorities. Environmental Protection Act. Her Majesty Stationery Office Ltd (HMSO). Publishing and Parliamentary Services, London;

60. Howsam P. (ed.), Carter R.C. (1996). Water policy: allocation and management in practice. E & F N Spon Ltd, London, UK;

61. IMF (1999). The Letter of Intent of the Government of Ukraine for Financial Support from the IMF. M. Camdessus (Managing Director). International Monetary Fund, Washington, USA;

62. IMF (2001). IMF publications (keyword search: Ukraine). International Monetary

Fund, http://www.imf.org/external/pubind.htm;

63. IOM (1998). Country report: Ukraine. Publication of International Organisation for Migration (IOM), Geneva, Switzerland;

64. Jaworsky J. (1995). Ukraine: Stability and Instability. McNair Paper 42, National Defence University, USA;

65. Kovalenko M. (1994). Regional Problems of Water Use and Protection. Regional Problems of Nature Resource Use and Ecology in Ukraine. Kharkov State University, Kharkov, Ukraine;

66. Kozak V. (1997). Kryvbass: It Seems Not Possible To Live Here But People Live. Newspaper Green World, No 11, 1997;

67. Krysachenko O. (1994). Capability of National Legislation to Protect the Environment in the Ukraine. Ukrainian World 5 - 12, Kiev, Ukraine;

68. Kuchma L. (1995). President Kuchma's Speech Regarding Evaluation of the Accomplishments of the Campaign Against Corruption and Organized Crime. Ukrinform Ukraina: Khronika Podii, 31 January 1995, Kiev, Ukraine;

69. Kulik A. (2000). The short description of crime situation in Ukraine. Publication of the National academy of internal affairs of Ukraine, Kiev;

70. Kurbanov Y. (2000). Individual interview: *About general activities of IMF*. Officer at IMF mission in Tajikistan, UK;

71. Kuzin A. (1995). The Concept of Water Protection. USCPW, Kharkov, Ukraine;

72. Kuzmenko E (1996). Report on the Environment "The state of the environment and activities in Ukraine". Ministry of Environmental Protection and Nuclear Safety of Ukraine, Kiev, Ukraine;

73. Libanova E (1995). The state of public health, incidence rates of diseases and

mortality. Paper prepared for Ukraine Human Development Report, 1996. Kiev, Mimeo;

74. Lipsey R., Chrystal K. (1995). An Introduction to Positive Economics. Oxford University Press, Oxford, United Kingdom;

75. Lisitzki V. (1999). Light and Dark Sides of National Economy. Herald of the National Bank of Ukraine N^{o} 4, National Bank of Ukraine, Kiev, Ukraine;

76. Lozansky V. R. (1995). Determination of Priority Compounds and Their Groups for Water Protection Purposes. USCPW, Kharkov, Ukraine;

77. Lystopad O. (1997). It Is Better Not To Drink From Our Water Supply Systems. Green World, No 13, 1997, Kiev, Ukraine;

78. Markham M A (1996). Chernobyl and its consequences. Netscape Gold, Russia;

79. Marsh C. (1998). Exploring data: an introduction to data analysis for social scientists. Oxford Polity, Oxford;

80. Mason C. F. (1996). Biology of Freshwater Pollution. Third Edition. Addison Wesley Longman Limited, Harlow, UK;

81. MEP (1994). National Report on the State of the Environment in the Ukraine in 1993. Ministry of Environmental Protection (MEP) of Ukraine, Raevsky Publishers, Kiev, Ukraine;

82. MEP (1996). Water Quality Standards. Ministry of Environmental Protection (MEP) of Ukraine, Raevsky Publishers, Kiev, Ukraine;

83. MEP (1997). Environmental Protection in the Ukraine in 1994-1995. Ministry of Environmental Protection (MEP) of Ukraine, Raevsky Publishers, Kiev, Ukraine;

84. MEP (1998). National Report on the State of the Environment in the Ukraine in

1996. Ministry of Environmental Protection (MEP) of Ukraine, Raevsky Publishers, Kiev, Ukraine;

85. Merrett S (1997). Introduction to the Economics of Water Resources: An International Perspective. UCL Press Limited, London;

86. Miletitch N. (2000). Drink, Disease and Depression Eat Away at Russian Population. Agence France Presse, News release on 22 February 2000;

87. Ministry of Statistics of Ukraine (1995). Statistical Yearbook of Ukraine, 1994. Kiev, Ukraine;

88. MLSP (1998). The Results of Expert Polling of Heads of Economic Agents in Dnepropetrovsk, Lvov, Kharkov and Vinnitza. Ministry of Labour and Social Politics, "The Centre of Productivity", Journal "Productivity", №2, 1998, Kiev, Ukraine;

89. Nazarov N, Cook H., Woodgate G. (2000). Water Pollution Control Issues in an Independent Ukraine. Journal of Water and Environmental Management. Chartered Institution of Water and Environmental Management, Terence Dalton Ltd, Lavenham, Suffolk, UK;

90. NBU (2001). General Principles of the Monetary Policy. National Bank of Ukraine, Kiev, Ukraine;

91. Nichols P. (1991). Social Survey Methods: A Fieldguide for Development Workers. Development Guidelines № 6, Oxfam, Oxford;

92. NRA (1994). Water nature's precious resource an environmentally sustainable water resource development strategy for England and Wales. Bristol National Rivers Authority publication, Bristol, UK;

93. NRA (1995). Upper Thames Catchment Management Plan - Consultation

Report. National River Authority (NRA), NRA Publications Services, UK;

94. Obadina T. (2000). The Myth of Neo-colonialism. Africa Economic Analysis, Bridgnorth, UK;

95. OECD (1999). Agricultural Policies in Emerging and Transition Economies: Monitoring and Evaluation 1999. Volumes I and II, Organisation for Economic Co-operation and Development, Paris, France;

96. Ofwat (1998). Ofwat annual report 1997. House of Commons paper 740, London;

97. Palamarchuk V. (1998). Changes of the Living Standards of People of Ukraine: Comparative Analysis with Russia. Ukraine: Work Aspects N^{o} 4, 1998, Firm "Pratsya", Kiev;

98. Pavlyuk A. (1997). Ecological Inspection Informs. Green World, No 22, 1997, Kiev, Ukraine;

99. Pavlyuk V. (1999). History of Ukraine. Vyshya Shkola, Kiev, Ukraine;

100. Pearce D. (1990). Economics of Natural Resources and the Environment. Harvester Wheatsheaf, Hemel Hempstead, Hertfordshire;

101. Posdnyakova L. (1998). Growth of Consumer Prices in Ukraine. Businessinform, N^{o}16, Kharkov, Ukraine;

102. Pozhivanov M. N. (1995). Ecological Problems of the Azov Sea. *Schid*, N^{o} 3, Donetzk, Ukraine;

103. Rapawy S. (1996). Standards of Living in Ukraine. Poverty in Ukraine; Report No. 15602, The World Bank, USA;

104. Reid A. (1997). Borderland: A Journey Through the History of Ukraine.

Phoenix, Orion Books Ltd., London, UK;

105. Reuters Ltd (1999). The War Russia Can Not Afford to Fight. Russia Today news on 25.10.1999, 1995-2000 European Internet Network Inc., http://www.russiatoday.com/.

106. Reuters Ltd (2000). Clinton Trip a Boost to Troubled Ukraine. Russia Today news on 6.06.2000, 1995-2000 European Internet Network Inc., http://www.russiatoday.com/.

107. Romanov N. A., *et al* (1977). Differential Oscillographic Polarograph. Zavodskaya Laboratory. 43. Nº 3. P. 651-653, USSR;

108. SCLRU (1996). Report on the Land Use in Agriculture. State Committee on Land Resources of Ukraine (SCLRU), Kiev, Ukraine;

109. SCRFEP (2000). State Report on the Condition of Environment of Russian Federation in 1999. Moscow: State Committee of Russian Federation on Environmental Protection (SCRFEP);

110. Semchuk G. (1997). Modern State of Water Supply and Sewage Treatment Enterprises of Ukraine. Collection of Reports of International Congress "Ecology, Technology and Economics and Water Supply and Sewage Treatment, 15-19 April 1997, Yalta, Ukraine;

111. Semenov, G., Kudina E. (1998). Features of Contemporary Development of Ukraine's Economy. AO Businessinform, Nº16, Kharkov, Ukraine;

112. Semichaevsky A (1995). Environmental Information Systems in Ukraine: Environment Assessment Technical Reports. United Nations Environment Programme (UNEP), Geneva;

113. Semichaevsky A (1996). State of the Environment and Activities in Ukraine. Department of Environmental Sciences and Policy, Central European University, Budapest, Hungary;

114. Serageldin I. (1995). Water resource management: a new policy for a sustainable future. International Journal of Water Resources Development, 11: 3, 221-232;

115. Shevchenko T. (1814-1861). Complete Collection of Works in Six Volumes. AN URSR, 1964, Kiev, Ukraine.

116. Sokolyk M. (1998). Tendencies and Special Features of Differentiation of Ukrainians by Average Income. Ukraine: Work Aspects Nº 4, 1998, Firm "Pratzya", Kiev;

117. SSU (1995). Water Code of Ukraine. In effect since 6 June 1995, Supreme Soviet of Ukraine, newspaper "Voice of Ukraine", 5 October 1995, Kiev, Ukraine;

118. SSU (1996). Law of Ukraine on Environmental Protection. Supreme Soviet of Ukraine, Newspaper "Voice of Ukraine", 9 April 1996, Kiev, Ukraine;

119. SSU (1998a). Taxation Legislation of Ukraine. Collection of official documents, Supreme Soviet of Ukraine, Parliament Press, Kiev, Ukraine;

120. SSU (21.01.1994). The Forest Code of Ukraine. Supreme Soviet of Ukraine (SSU), Newspaper "Voice of Ukraine", 21 January 1994, Kiev, Ukraine;

121. SSU (27.07.1994). The Mineral Resource Code of Ukraine. Supreme Soviet of Ukraine, Newspaper "Voice of Ukraine", 27 July 1994, Kiev, Ukraine;

122. Sudman S., Bradburn N. (1982). Asking Questions: A Practical Guide to Questionnaire Design. Jossey-Bass Inc, California, USA & Jossey-Bass Ltd,

Oxford, UK;

123. TACIS (1996). Annual report 96. Technical Assistance to Commonwealth of Independent States, Office for Official Publications of the European Communities, Luxembourg;

124. TACIS (1997). European Union Co-operation with the Ukraine. Technical Assistance to Commonwealth of Independent States, Special Report Nº 6/97, Brussels, Belgium.

125. Ukraine.com (1995). Http://www.ukraine.com/facts/land.html;

126. Umanetz M. (1995). Electricity and nuclear power in Ukraine. Goscomatom, Kiev, Ukraine;

127. UNOU (1996). About Ukraine; Ukraine: Human Development Report 1996; Ukraine: Habitat and the Human Environment. United Nations Office in Ukraine, United Nations Internet Project Documents, Kiev, Ukraine;

128. WHO (1995). Health Consequences of the Chernobyl accident. Summary report. World Health Organisation (WHO), Geneva;

129. Winpenny J. (1994). Managing Water as an Economic Resource. Routledge, London;

130. Zatula A. I. (1996). The Role of Ecological and Analytical Control in Water Protection. USCPW, Kharkov, Ukraine.

Interview survey (in Ukraine):

1. Alexander Z. (1998). Head of USCPW laboratory of ground water quality;
2. Alexei K. (1998). Manager of small painting enterprise;
3. Alla G. (1999). Medical servant;
4. Dima M. (1999). Psychology scientist;
5. Georgy S. (1998). Scientific director of USCPW. Head of laboratory of water quality monitoring;
6. Georgy S. (2000). Scientific director of USCPW. Head of laboratory of water quality monitoring;
7. Maxim B. (1998). Scientific worker at USCPW laboratory of water quality monitoring;
8. Olga N. (1999). Pensioner;
9. Victor G. (1998). Scientific worker at USCPW laboratory of economic and mathematics modelling;
10. Vladimir K. (1999). Head of USCPW department of International Scientific and Technical Co-operation;
11. Vladimir T. (1999). District Land Manager (agriculture);
12. Zoya M. (1999). Head of biomechanics laboratory at the Institute of Orthopedy and Traumatology.

APPENDIX 2.1 Ukraine and its neighbours



Source: Frontier Vision Technologies Inc. (FVT), 1996. Welcome to Ukraine.

APPENDIX 2.2 Oblasts of Ukraine



0 90 km

|——|

Source: Nazarov N, *et al* (2000). Water Pollution Control Issues in an Independent Ukraine.

APPENDIX 2.3 Taxes in Ukraine: names and sizes (in per cent of income)

The common taxes include	%
Capital gain	30
The excise[1]	10-300
Income tax on organisations and enterprises [2]	30-60
Permanent income tax[3]	0-40
Custom duty	Varies
Property tax	Varies
Payment for land	Varies
Rent payment	Varies
The tax from transport owners	Varies
The value added tax (VAT) for sales	20
Import VAT	20-28
The payment for geological explorations	Varies
Fee for transfer of immovable property	4-5
Outside income tax	20
Dividends; interest; royalties and rent	15
The payment for using natural resources	Varies
The payment for pollution of environment	Varies
Payroll taxes[4]	52
The profit tax in agriculture	15
Fixed fee for individual entrepreneurship	100 Hryvnias

[1]- 150-300 % excise is levied on imported goods, such as alcohol beverages and cigarettes. 10-30 % is usually levied on domestically produced goods;

[2] - Production profits are charged with 30 %, intermediary activities and auctions – 45 %, gambling activities – 60 % of tax;

[3]- 0 % bracket for monthly income equal to 1, 10 % - for 5, 15 % - for >5 to 10, 20 % - for >10 to 60, 30 % - for >60 to 100, 40 % - for >100 minimum monthly deductions;

[4]- Mandatory payments into: Pension and Social Security Fund – 37 %, Chernobyl Fund – 12 %, Employment Fund – 2 %, Innovation Fund – 1%;

APPENDIX 2.3 (Continued)

The local taxes, established by local authorities	%*
The advertising tax	Varies
The municipal tax	Varies
The market payment	Varies
The payment for parking	Varies
The resort tax	Varies
The payment for taking part in hippodrome races	Varies
The payment for owning dogs	Varies
The payment for local lotteries and auctions	Varies
Border transit tax (by means of car or truck)	Varies
Fee for issuance of trade permits	Varies
Fees for right to conduct filming	Varies
Hotel fees	Varies
Fee for permits on trade objects location	Varies
Fee for participation in game called "Totalisator"	Varies
Fee for an authorisation to an apartment	Varies
Fee for use of municipal symbols and emblems	Varies
Tax on sale of imported goods	Varies

*- Total amount of all imposed local taxes should not be greater then 10 % of gross profits;

Source: Supreme Soviet of Ukraine (1998). Taxation Legislation of Ukraine.

APPENDIX 2.4 Public campaign on household water bills. Placate in the centre of Kharkov city says: "Water has to be paid for". Many similar placates are located throughout the city



APPENDIX 2.5 Household (A) and mining (B) waste dumping sites on the edge of watercourse valleys in Kharkov and Donetzk Oblasts

A.



B.



APPENDIX 2.6 The technogenic overstrain of the Donetzk-Dnipropetrovsk region

The Donetzk-Dnipropetrovsk region covers an area of 112,300 km^2 (18.6% of the territory of Ukraine, 28% of the population) occupied by some 5,000 metallurgy, chemistry, energetics, machine-building, mining and other enterprises. Some enterprises are enormous. Land use for agriculture is also intensive. 70.4% of the region consists of arable land, 71% of which is in a degraded condition. In some places soil is contaminated by remnants of fertilisers and pesticides. The industry in the region is emitting 70% of the oxides of carbon and nitrogen, sulphur anhydride and hydrocarbons.

To date no solution has been implemented to deal with the industrial waste that has accumulated in the region, it amounts to more than 10 billion tons. Degradation of some industrial facilities has reached 60-70%. Because of this accidents are becoming frequent, resulting in the pollution of the environment. It is very difficult to implement resource-saving and ecologically favourable technologies, or highly effective purification facilities.

The most polluted cities are Donetzk, Makiyivka, Horlivka, Dnipropetrovsk, Yenakievo, Kryviy Rih, Alchevsk, Dzerzhinsk, Kramatorsk, Lugansk, Zaporizhzhya, Mariupol.

The ecological condition of the region is in such a state that urgent measures should be worked out and implemented to improve the quality of the environment. Structural changes in industry are necessary and emphasis should be placed on resource use, energy-saving and advanced scientific technologies.

It cannot be ruled out that some heavily polluting enterprises will be closed down or ordered to slow down production. At the same time, new jobs could be created by developing a waste recycling industry. Sustainable development could also be promoted by implementing stricter regulations concerning the payment for natural resources and fines for discharging pollutants to the environment. In this context, international collaboration, including expertise and financial support from the international community is likely to be of great significance.

Source: MEP (1997). National report on the condition of natural environment in Ukraine, 1994-1995.

APPENDIX 2.7 Impact of human activities on water resources in Ukraine

In the country during 1995-1998 a steady decline has been observed in the amounts of toxic materials and waste-water being discharged to the air and natural water-bodies. However, this is actually a result of economic depression and a decline in production and transportation services. At the same time, 3286 enterprises have increased emissions of pollutants into the air to a total of 1 million tons/annum.

In 1992, the average content of sulphur in precipitation (data pooled from several monitoring sites) was the same as for the previous year 2 g m^{-2} (in most Western European countries this figure does not exceed 1 g m^{-2}). Concentrations of nitrogen have fallen from 0.9 g m^{-2} (1991) to 0.8 g m^{-2} (1992) and are considerably lower than a many year average (1.5 g m^{-2}).

Rivers and reservoirs of Ukraine are polluted mainly by organic compounds (mostly from domestic waste-water), nitrogenous compounds, heavy metals (from energy production), phenols and petroleum products (from housing and communal services and ferrous metal industries). The most heavily polluted rivers are in the catchment areas of the Zakhidny Bug and Seversky Donetz rivers and in the area of the Azov Sea.

The capacity and effectiveness of water purification facilities is not growing in line with the increase in quantity of waste-water. This means that the existing facilities are not functioning effectively and new ones are not being built in appropriate numbers. In some cases this leads to accidental discharge of polluted waste-water to the outside environment. The Dnipro River, the main watercourse of Ukraine, can serve as an excellent example: only 45% of the total amount of waste-water discharged to it is treated.

The pollution of underground water is also a growing problem, which has not been studied well yet.

Source: Kuzmenko E (1996). Report on the Environment "The state of the environment and activities in Ukraine".

APPENDIX 2.8 Water supply

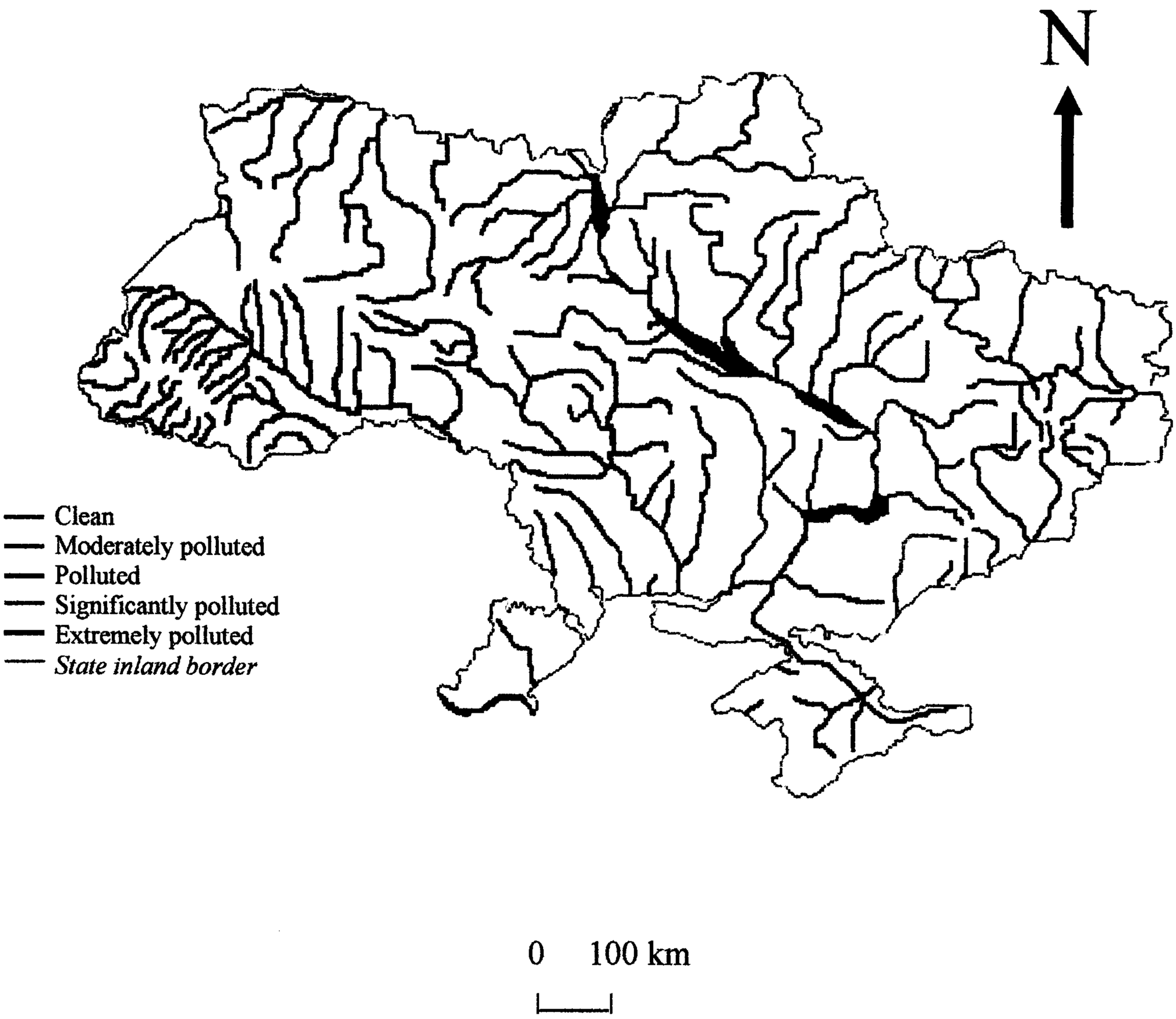
The purity and accessibility of drinking water is fundamental to human health. Problems often result from water shortages. In the steppe regions of Crimea, the shortage is chronic, especially after the drought of 1994, when water supply was drastically reduced, and where there was a sudden outbreak of cholera. The existing water supply infrastructure is in urgent need of additional capital investment for purification and filtering plants. The current state of purification equipment has made it necessary to increase chlorination and introduce aluminium sulphate as flocculants.

Sources of consumption and quality of drinking water have clear territorial differentiation. The best provided are the regions of the Carpathian Mountains, Polissia, and central Ukraine, where underground water sources are predominantly used. However, there are serious water problems in the regions along the Dnipro basin, which supplies more than two thirds of the country's needs, mainly 8from surface water. Pollution of rivers in Dnipro basin results in higher treatment costs to be met to provide for drinking water of good quality.

Economics is clearly at the bottom of the problem of water purity. A lack of funds prevents water authorities from making the necessary infrastructure improvements for both waste and drinking water delivery and treatment. Yet, part of the solution is within the grasp of the providers if more is done to reduce the substantial leakage from water distribution systems, and if metering of supplies is fully instituted. For example, amount of water (including wastewater) leaving water supply systems through leakage accounts for 30 - 40% of total water supply in most Ukrainian cities and towns.

Source: Semichaevsky Andrey (1996). State of the Environment and Activities in Ukraine.

APPENDIX 3.1 IWP assessment of river water quality in Ukraine



Source: Gritzenko A. V. (1995). Regional Aspects of Improving Efficiency of Water Protection Measures in the Ukraine.

APPENDIX 3.2 Charging scheme for discharges

Recovery of costs of monitoring and issuing consents

The Environment Agency operates a charging scheme to recover the costs of administering the issue of consents and monitoring compliance with those consents. The charging scheme does not cover the costs of more general environmental monitoring nor pollution prevention and control work that is not directly related to specific discharges **(DETR, 1998)**.

The scheme includes both an application charge (payable on application for a new or revised consent) and an annual charge which is based on three factors: volume, content and characteristics of receiving waters.

Volume

Cubic metres per day	Weight		
0 – 5	0.3	>1,000 - 10,000	3.0
>5 – 20	0.5	>10,000 - 50,000	5.0
>20 – 100	1.0	>50,000 - 150,000	9.0
>100 - 1,000	2.0	>150,000	14.0

For each factor a series of bands has been established to each of which a different weight applies which reflects the monitoring costs associated with that band.

The charging system gives greater weight to larger volumes (although this is not a linear projection), more sophisticated effluents (since higher monitoring costs are incurred due to greater complexity) and the complexity of monitoring given the nature of the

receiving waters (sampling and analytical problems being most associated with estuaries).

The product of the weights assigned to each of these three factors for the relevant discharge represents the number of chargeable units for monitoring costs associated with that discharge. The amount to be paid by the discharger is the product of a number of units and the financial factor for each such unit for the year concerned.

Content

Band	Weight
A - complex organic, pesticides	14.0
B - potentially toxic, metals etc	5.0
C - organic sewage/trade effluent	3.0
D - general trade effluent	2.0
E - site drainage	1.0
F - low environmental effect	0.5
G - minimal environmental impact	0.3

Receiving waters

Band			
Ground	0.5	Surface	1.0
Coastal	0.8	Estuarial	1.5

User charges are also levied by sewerage treatment works for effluent treatment. To some extent these charges are related to the volume and type of effluent treated both for domestic sewage and certain forms of trade effluent.

The trade effluent charging system

All occupiers of trade premises in England and Wales making a discharge of trade effluent to a public sewer are charged by the relevant sewerage undertaker for treatment of that discharge. Currently, these charges are largely based on so called the MOGDEN formula, which apportions a charge to each stage of the treatment process - reception, conveyance, treatment and disposal - and reflects differences between the trade effluent discharged by a particular firm and the average composition of sewage in the region concerned. The MOGDEN formula is:

C = R + V + (Ot/Os) B + (St/Ss)s, where:

C is the total charge per metre^3 for trade effluent;

R is the unit cost per metre^3 of reception and conveyance of trade effluent in the public sewer system;

V is the unit cost per metre^3 of preliminary and primary treatment of sewage treated and disposed of in treatment works;

Ot is chemical oxygen demand (COD) in mg l^{-1} of the trade effluent after one hour quiescent settlement;

Os is COD in mg l^{-1} of average strength of settled sewage;

B is unit cost per m^3 of biological oxidation treatment of settled sewage;

St is the total suspended solids, measured in mg l^{-1} of the trade effluent at pH7 or at the pH of the mixed sewage;

Ss is the suspended solids in mg l^{-1} of average strength crude sewage;

s is the unit cost per metre^3 of treatment and disposal of primary sludge;

In some cases additional elements may be added, for example, an additional charge per metre^3 where there is biological treatment or a supplement to cover treatment and disposal where effluent goes to a sea outfall (which may in turn be supplemented in cases of designated long sea outfalls).

APPENDIX 4.1 Time scale table

Contents	Country of study	Period (duration)
Section 1 (MPhil)		
1. Scoping study of UK, EU, North American water policy, available information on Ukraine and other East European countries.	UK	10/1997-12/1997 (2 months)
2. Detailed study of Ukrainian socio-economic and natural environment as well as approaches and methods of river pollution control through all personal sources as well as all other relevant information sources available in UK.	UK	12/1997-3/1998 (3 months)
3. Detailed study of water policy in England, Scotland and Wales including impact of water protection policy, socio-economic, historical, cultural and political background.	UK	3/1997-5/1998 (2 months)
4. Detailed study of EU water policy including impact of water protection policy, socio-economic, historical, cultural and political background.	UK	5/1998-7/1998 (2 months)
5. Emphasis to be given to study all aspects of carrying out social science research, its methodological, analytical and procedural guidelines.	UK	7/1998-9/1998 (2 months)
6. Information search in Ukraine, review of river pollution control problems, data availability, current policies. Study of socio-economic, historical, cultural and political aspects of society, which influence environmental pollution.	Ukraine	9/1998-12/1998 (3 months)
7. Analysis of data on river pollution and other available and relevant information.	UK	12/1998-5/1999 (6 months)
8. Collation of information for publication, review of written Section of the thesis, preparation of the report for transfer to PhD.	UK	5/1999-9/1999 (4 months)
Section 2 (transfer to PhD)		
1. Another information search in Ukraine with emphasis on socio-economic and political issues, which influence the field of environmental protection. Collection of available enterprise-specific information. Search for updated environmental information.	Ukraine	9/1999-12/1999 (3 months)
2. Review and analysis of research findings in the context of socio-economic conditions and legal framework.	UK	12/1999-7/2000 (7 months)
3. Review of technical outcomes (waste water treatment, monitoring water quality, etc.) and financial implications of river pollution prevention in UK and EU.	UK	7/2000-10/2000 (3 months)
4. Assessment of UK river pollution prevention policies for importation and recommendation including publication of findings.	UK	10/2000-2/2001 (4 months)
5. Preparation of PhD thesis, its defence, more work on publication of findings.	UK	2/2001-9/2001 (7 months)
Total:		48 months

APPENDIX 4.2 Core interview questions

1. What is your name, age and occupation (note: personal information was/was not released upon consideration of interviewee)?

2. What do you think about environmental quality in the country?

3. What is your opinion about water quality and pollution of rivers?

4. There are complaints that poor quality of drinking water is largely due to water source pollution (for instance, Pechenezhskoe water reservoir on the Seversky Donetz river supplies 70% of our city of 2 000 000 inhabitants). What are your ideas?

5. In your opinion what are the main reasons of river pollution in the country?

6. Now some water protection experts in the country say that river pollution may be better prevented through further development of legislation and improvement of enforcement mechanisms, while others argue that there can only be a technical solution to the problems through more investment in treatment facilities. And the third party backs the wise and economically rational combination of both. What do you think about it? In your opinion what should be improved in the river (environment) pollution protection system?

7. Do you think that the present economic crisis significantly influences the levels of river pollution?

8. Do you believe river pollution has increased, remained stable or declined over the last eight years of deepening economic crisis in the country?

9. The economic crisis in the country lowered the purchasing power of incomes of over 85 % of households by 6-14 times (estimates differ). Worse living standards also sharpen such social problems as alcoholism, drug addiction (and AIDs) and criminality. For you personally, what are the main adverse consequences of the crisis that you have witnessed and experienced?

10. What do you think are the reasons for this crisis?

11. What do you believe is necessary to stop the crisis from getting worse and improve the situation?

12. Do you think that the political system in the country may change if the crisis continues getting worse? In your opinion what would be the political future of the country in the next 5-10 years?

13. Do you think it would be easier to solve environmental problems including river pollution if the national economy were to improve?

Note: This is general list of core interview questions. Not all of them are expected to be answered. Additional questions can be asked during free discussion, which may follow each question.

APPENDIX 4.3 Public opinion questionnaire: environmental and water issues

Name _____

Age ___

Occupation _____

<u>Please, give your answers to the following questions</u> :

1. What do you think about the quality of drinking water?

1a. In the district _____ (name of the district) where you live

□ Very good □ Good □ Satisfactory □ Poor □ Very poor

□ Comments_____

1b. In the district _____ where you work or study if different from 1a.

□ Very good □ Good □ Satisfactory □ Poor □ Very poor

□ Comments _____

2. What is your opinion about quantity of water supplied?

□ Sufficient for all needs □ Sufficient for basic needs □ Insufficient for basic needs □ Not applicable

□ Comments _____

3. What do you think of the regularity of water supply?

□ Always regular □ Reasonably regular □ Rather irregular □ Completely irregular □ Not applicable

□ Comments _____

4. What do you think about ecological and amenity quality of water in water bodies in the Ukraine?

□ Very good □ Reasonably good □ Satisfactory □ Poor □ Very poor

□ Comments_____

5. Please, rank the above mentioned issues according to their importance for you from the most important (1) to the least important (4). Tick only one box for each column.

Issue	Ranks			
	1	2	3	4
Drinking water quality	□	□	□	□
Water quantity for domestic needs	□	□	□	□
Regularity of water supply	□	□	□	□
Ecological and amenity quality	□	□	□	□

□ Comments _____

6. How much would you be willing to pay, extra to what you pay for water services now, from your monthly income to address one or more of the following issues of likely concern to you? Please tick only one box for each line. If you choose "Other amount" option, please specify what in the bottom row.

Issue	Amount in Hryvnias						
	0	1-3	4-7	8-12	13-18	Other amount	Σ
Drinking water quality	□	□	□	□	□	□	
Water quantity for domestic needs	□	□	□	□	□	□	
Regularity of water supply	□	□	□	□	□	□	
Ecological and amenity quality	□	□	□	□	□	□	
Total							

□ Comments _____

7. Do you think that the water resource management system in the Ukraine should be improved?

□ Yes □ No

□ Comments _____

8. If you have answered "Yes" for the Question 7, what do you think the improvements should be (please, tick as appropriate):

□ Introduction of market economy mechanisms for water supply and prevention of pollution of water bodies;
□ Development of existing economic mechanisms;
□ Environmental and water legislation development;
□ Environmental and water legislation enforcement;
□ Institutional arrangements and executing powers;
□ Privatisation of water bodies;
□ Privatisation of water industry enterprises;
□ Flood prevention and protection;
□ Other, please specify _____
□ Comments _____

Notes:

Respondent:

1. Social group _____
2. Gender:

□ Male □ Female

Surveyor:

Name _____

Signature_____ Date _____

APPENDIX 4.4 Public opinion questionnaire: river pollution, relevant political and socio-economic issues

Name _____

Age ___

Occupation _____

<u>Please, give your answers to the following questions</u> :

1. Do you think present economic crisis is one of the main reasons of river pollution by untreated or poorly treated industrial and sewage effluents?

□ Definitely yes □ Probably yes □ Difficult to say □ Probably not □ Definitely not

2. These are some suggestions on lacks in the system of protection of water bodies from pollution. Please, use digits 1, 2, 3, 4, 5 to range the issues according to their significance. Use "×"for an issue which, in your opinion, is not applicable.

□ Poorly developed legislation □ Lack of economic incentives □ Lack of state funding □ Public ignorance and/or unawareness of environmental matters □ Insufficient staff in environmental authorities and lack of expertise

3. Generally, ecological conditions of water resources in the country are categorised as "stressed"(in total there are five categories: catastrophic, critical, stressed, satisfactory and good).

3a. How much would you be willing to pay per month extra to what you are paying now to have "satisfactory" ecological water quality in the country?

□ 1-3 Hryvnias □ 4-6 Hryvnias □ 7-10 Hryvnias □ 11-15 Hryvnias □ Other amount: __Hryvnias

3b. How much would you be willing to pay extra per month to what you are paying now to have "good" ecological water quality in the country?

□ 1-3 Hryvnias □ 4-6 Hryvnias □ 7-10 Hryvnias □ 11-15 Hryvnias □ Other amount: __Hryvnias

3c. What is the maximum amount you would be willing to pay extra per month to what you are paying now to have improvements in ecological water quality in the country?

□ 1-3 Hryvnias □ 4-6 Hryvnias □ 7-10 Hryvnias □ 11-15 Hryvnias □ Other amount: __Hryvnias

4. Please list the following issues according to their priority to you. Use digits 1, 2, 3, 4, 5 to mark the sequence of prioritisation.

□ Civil peace □ Economic stability □ Environmental quality □ Low crime rates □ Other (please state what in Comments)

□ Comments _____

5. ***What do you think about the reasons for the present economic crises in the country? Using digits 1, 2, 3, 4, 5, please, range the issues according to their significance. Use "×"for an issue which is not applicable in your opinion.***

□ Failures of free market reforms	□ Corruption and inefficiency of operation of state authorities	□ Lack of Soviet style command and control economic mechanisms	□ "Criminalisation" of national economy through power structures	□ Inability of most people to adapt to free market challenges after living under Soviet regime

□ Comments_____

6. ***What do you think is the socio-economic future of the country within the next 5-10 years?***

□ Economic revival and civil peace	□ Some economic revival, but internal military conflicts	□ Further economic decline and civil peace	□ Further economic decline and internal military conflicts	□ Difficult to say

□ Comments _____

7. ***What do you think about the country's political future within the next 5-10 years?***

□ Liberal and democratic rule	□ Command-and-control (Communist type) rule with pro-Western attitude	□ Nationalistic and/or dictatorial rule with pro-Western attitude	□ Command-and-control (Communist type) rule with anti-Western attitude	□ Nationalistic and/or dictatorial rule with anti-Western attitude

□ Comments _____

Respondent:

1. Social group _____

2. Gender:

□ Male □ Female

Surveyor:

Name_____

Signature_____

Date: _____

APPENDIX 5.1 Schematic location of river basins in Ukraine



Source: Gritzenko A. V. (1995). Regional Aspects of Improving Efficiency of Water Protection Measures in the Ukraine.

APPENDIX 5.2 Ukrainian MACs for major pollutants in water bodies used for various household and recreational purposes

Pollutant	Unit of measurement	MAC
Organic compounds	BOD_5 mg O_2/l	5
Nitrates	mg NO_3/l	10
Nitrites	μg NO_2/l	200
Ammonium compounds	mg NH_4/l	2
Oil products	μg/l	50
Phenols	μg C_6H_5OH/l	1
Synthetic surface active compounds	μg/l	500
Manganese compounds	μg Mn/l	50
Copper compounds	mg Cu/l	1
Zinc compounds	mg Zn/l	1

Source: MEP (1996). Water Quality Standards.

APPENDIX 5.3 Actual concentration of key pollutants in all river basins for years 1993, 1994-1995 and 1996 (from MEP reports for 1998, 1997 and 1994) in number of MACs

Key pollutants	River basins											
	Zakhidny Bug						Danube					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	93	94-5	96	93	94-5	96	93	94-5	96	93	94-5	96
Organic compounds	1.5	1.2	1.5	2	1.4	1.5	-	-	1	-	-	1
Oil products	7.5	1.5	-	70	2	-	5.5	5.75	1.35	58	9.5	1.7
Ammonium comp.	12.5	7.1	8.5	45	11.2	20	-	-	-	12	-	-
Nitrites	6	3.5	2.5	24	4.5	11	-	-	2	-	-	2
SSAC*	1	-	-	1	-	-	-	-	-	-	-	-
Copper compounds	10.5	4.5	3.5	38	6	5	10.5	4.5	3.5	46	5	44
Zinc compounds	32.5	7	6.5	92	7	81	13.5	6	4.5	58	38	30
Manganese comp.	12.5	8	12.5	32	8	39	3.5	5	4.5	67	46	41
Phenols	-	-	-	-	-	-	-	-	-	-	-	-
Pest. DDE , DDT	-	-	-	-	-	-	4	-	-	4	-	-
Pest. α-, γ- GKIG	-	-	-	-	-	-	2	-	-	2	-	-

Key pollutants	River basins											
	Dnistr						Pivdenny Bug					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	93	94-5	96	93	94-5	96	93	94-5	96	93	94-5	96
Organic compounds	1	1	-	1	1	-	1.5	1.5	-	2	2	-
Oil products	4.5	4	3.5	56	7	6	-	-	-	-	-	-
Ammonium comp.	3.5	1.2	4.5	5	1.4	12	6	1.5	4.4	19	2	16
Nitrites	3.5	1.2	9	66	1.4	17	2.5	2	2.7	17	24	4.4
SSAC	-	-	-	-	-	-	-	-	-	-	-	-
Copper compounds	58	1.2	11	58	20	39	9.5	3.5	7.5	45	4	13
Zinc compounds	13	3	18.5	45	3	26	9	5	6.4	42	41	10.5
Manganese comp.	12	6.5	19	64	14	35	11	13	23.5	66	56	84
Phenols	3	4	-	5	15	-	-	-	-	-	-	-
Pest. DDE, DDT	-	-	-	-	-	-	-	-	-	-	-	-
Pest. α-, γ- GKIG	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
SSAC* – Synthetic surface active compounds;
93 – abbreviation of 1993. In the same manner 94-5 means 1994-1995 and 96 -1996;
Dash "-" means "no concentration in excess of 1 MAC recorded;
"comp." means "compounds";
"Pest." means "pesticides".

APPENDIX 5.3 (Continued)

Key pollutants	River basins											
	Dnipro						Priazovie					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	93	94-5	96	93	94-5	96	93	94-5	96	93	94-5	96
Organic compounds	-	-	-	-	-	-	1.5	1.5	1.5	2	2	2
Oil products	7	-	7	7	-	7	18	21.5	4	70	96	7
Ammonium comp.	1	2	-	1	2	-	4.5	3	3	15	5	5
Nitrites	-	3	2	-	15	2	6	11.5	9.5	38	34	35
SSAC	-	-	-	-	-	-	-	-	-	-	-	-
Copper compounds	6	4	3.5	7	6	5	12	6.5	6.5	58	10	12
Zinc compounds	13	5.5	5	46	14	24	11.5	6.5	12	28	21	90
Manganese comp.	-	6	6	23	34	18	11.5	9	20.5	72	36	96
Phenols	2.5	1.5	1.5	4	2	2	17	4.5	1.5	96	8	2
Pest. DDE, DDT	-	-	-	-	-	-	-	-	-	-	-	-
Pest. α-, γ- GKIG	-	-	-	-	-	-	-	-	-	-	-	-

Key pollutants	River basins											
	Severskiy Donetz						Crimea					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	93	94-5	96	93	94-5	96	93	94-5	96	93	94-5	96
Organic compounds	2	1.5	1	3	2	1	-	-	1	-	-	1
Oil products	3	11	18.5	21	97	59	-	-	-	-	-	-
Ammonium comp.	2	2.5	1.5	20	11	2	-	1	3	-	1	23
Nitrites	2	4	13	7	13	13	-	2	3	-	3	5
SSAC	-	-	-	-	-	-	-	-	-	-	-	-
Copper compounds	7	4	5	9	5	8	-	3	9.5	-	5	18
Zinc compounds	12.5	8	8.5	64	34	28	-	-	-	-	-	-
Manganese comp.	4	7.5	12.5	64	29	31	-	-	-	-	-	-
Phenols	2	5.5	4.5	15	10	8	-	-	-	-	-	-
Pest. DDE, DDT	-	-	-	-	-	-	-	-	-	-	-	-
Pest. α-, γ- GKIG	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX 5.4 Actual concentration of key pollutants in all river basins for years 1993, 1994-1995 and1996 in μg or mg per litre (converted from Appendix 5.3 using information of Appendix 5.2)

Key pollutants	River basins											
	Zakhidny Bug						Danube					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	93	94-5	96	93	94-5	96	93	94-5	96	93	94-5	96
Organic compounds	7.5	6	7.5	10	7	7.5	-	-	5	-	-	5
Oil products	0.4	0.08	-	3.5	0.1	-	0.3	0.3	0.07	2.9	0.5	0.09
Ammonium comp.	25	14.2	17	90	-	40	-	-	-	24	-	-
Nitrites	1.2	0.7	0.5	4.8	0.9	2.2	-	-	0.4	-	-	0.4
SSAC	0.5	-	-	0.5	-	-	-	-	-	-	-	-
Copper compounds	10.5	4.5	3.5	38	6	5	10.5	4.5	3.5	46	5	44
Zinc compounds	32.5	7	6.5	92	7	81	13.5	6	4.5	58	38	30
Manganese comp.	0.6	0.4	0.6	1.6	0.4	2	0.2	0.3	0.2	3.4	2.3	2.1
Phenols	-	-	-	-	-	-	-	-	-	-	-	-
Pest. DDE, DDT	-	-	-	-	-	-	0.4	-	-	0.4	-	-
Pest. α-, γ- GKIG	-	-	-	-	-	-	0.2	-	-	0.2	-	-

Key pollutants	River basins											
	Dnistr						Pivdenny Bug					
	Concentration						Concentration					
	Average			Maximum			Average			Maximum		
	93	94-5	96	93	94-5	96	93	94-5	96	93	94-5	96
Organic compounds	5	5	-	5	5	-	7.5	7.5	-	10	10	-
Oil products	0.2	0.2	0.2	2.8	0.4	0.3	-	-	-	-	-	-
Ammonium comp.	7	2.4	9	10	2.8	24	12	3	8.8	38	4	32
Nitrites	0.7	0.2	1.8	13.2	0.3	3.4	0.5	0.4	0.5	3.4	4.8	0.9
SSAC	-	-	-	-	-	-	-	-	-	-	-	-
Copper compounds	58	1.2	11	58	20	39	9.5	3.5	7.5	45	4	13
Zinc compounds	13	3	18.5	45	3	26	9	5	6.4	42	41	10.5
Manganese comp.	0.6	0.3	1	3.2	0.7	1.8	0.6	0.7	1.2	3.3	2.8	4.2
Phenols	3	4	-	5	15	-	-	-	-	-	-	-
Pest. DDE, DDT	-	-	-	-	-	-	-	-	-	-	-	-
Pest. α-, γ- GKIG	-	-	-	-	-	-	-	-	-	-	-	-

PAGINATION AS IN ORIGINAL

APPENDIX 5.5 Average concentration of key pollutants in NMACs in Ukrainian river basins during 1985-1992

River basins	Oil products	Ammonium compounds	Nitrites	Copper compounds	Phenols
Zakhidny Bug basin	1.5	0	0	7.7	3.2
Dnistr basin	3	2.3	4	3.2	2
Pivdenny Bug basin	11.5	4	7	10.5	7
Dnipro basin	0	0	1.5	2	0
Seversky Donetz basin	3	1.1	4	0	0

Source: Gritzenko A. V. (1994). Surface Waters of Ukraine and Scientific and Practical Basis to Improve the Efficiency of Their Protection.

APPENDIX 5.6 Average concentration of key pollutants in Ukrainian river basins during 1985-1992 in μg or mg per litre (converted from Appendix 5.5 using information of Appendix 5.2)

River basins	Oil products mg/l	Ammonium compounds mg/l	Nitrites mg/l	Copper compounds mg/l	Phenols μg/l
Zakhidny Bug basin	75	0	0	7.7	3.2
Dnistr basin	150	4.6	800	3.2	2
Pivdenny Bug basin	575	8	1400	10.5	7
Dnipro basin	0	0	300	2	0
Seversky Donetz basin	150	2.2	800	0	0

APPENDIX 5.7 Ecological classification of surface water quality

Pollutants	Measurement Unit	Ecological water quality classes					
		I	II	III	IV	V	VI
Organic compounds	mg O_2/l	< 2	4	8	15	25	> 25
Oil products	mg/l	0	0.05	0.1	0.3	1	> 1
Ammonium compounds	mg/l	< 0.1	0.2	0.5	2.0	5.0	> 5.0
Nitrites	mg/l	< 0.002	0.005	0.02	0.05	0.1	> 0.1
SSAC	mg/l	< 0.5	1	1	5	10	> 10
Copper compounds	mg/l	< 0.02	0.05	0.1	0.2	0.5	> 0.5
Zinc compounds	mg/l	< 0.2	1.0	2.0	5.0	10.0	> 10.0
Manganese compounds	mg/l	< 0.05	0.1	0.3	0.8	1.5	> 1.5
Phenols	μg/l	< 2	10	50	100	1000	> 1000
Pesticides (general)	μg/l	< 0.4	2	10	20	20	> 20

Source: Gritzenko A. V. (1994). Surface Waters of Ukraine and Scientific and Practical Basis to Improve the Efficiency of Their Protection.

APPENDIX 5.8 Some properties and sources of major pollutants in this research

Manganese compounds: Manganese compounds appear to be the most abundant river pollutant in Ukraine. These compounds are widely found in ores and rocks and, due to their solubility, often enter rivers through groundwater. The sources of quick manganese release can by any groundwork. Toxicity is not a factor with manganese as it will be rejected by consumers long before any danger threshold is reached. It should be noted that besides mining activities up to 80 % of land in Ukraine is in agricultural use and up to 34 % of this land is a subject to air and water erosion.

Zinc compounds: Heavy metal zinc is second most abundant pollutant. Zinc is often released into water bodies through mining and associated industrial activities.

Oil products: The main sources of pollution by oil products are illegal, negligent or accidental discharges, transport and plant failures. Also there are inputs from roads and railways, particularly in the case of traffic accidents, and discharges associated with oil extraction from inland oilfields and processing plants.

Copper compounds: Pollution by copper compounds may be associated with industrial processes such as mining and processing of metal ores, the finishing and plating of metals and the manufacture of metal objects. Compounds may also be used as pigments in paint and dye manufacture; in the manufacture of leather, rubber, textiles and paper, etc. Copper may also be released in great amount into water bodies when water or sewage goes through pipes, which are partly or completely made of copper. Especially if the pipes are old and often break down, as is the case in Ukraine. For instance about 30 % of water supplied is lost from water supply system through leakage (Semchuk, 1997).

Nitrites: Nitrites are the product of nitrate reduction, which is more toxic then nitrates. Nitrite intoxication reduces the ability of blood to carry oxygen, which can lead to asphyxiation and death. The nitrate itself is relatively innocuous to mammals. Usually nitrate enters water bodies from fertilizers or human and domestic animal sewage. Nitrate is a factor in eutrophication of surface water bodies.

Ammonium compounds: Ammonium and its compounds are a common end-product of industrial processes as well as an important by-product of others, notably the production of coke and gas from coal, from power generation and from most processes involving the heating or combustion of fuel. It is also a natural product of the metabolism of organic wastes in treatment plants and receiving waters.

Phenols: Phenols are found in a wide range of industrial effluents and are particularly associated with gas and coke production, the refining of petroleum, power generation, many branches of the chemical industry and the production of glass, rubber, textiles and plastics.

Organic compounds: The major sources of pollution by organic compounds are sewage and domestic wastes; agriculture (especially runoff from inadequately stored animal wastes and silage); various forms of food processing and manufacture; and numerous industries involving the processing of natural materials such as textile and paper manufacture. Leakage of heavy metals and products of organic waste decomposition into groundwater from landfill sites is common and difficult to assess.

APPENDIX 6.1 Budget expenditures in 1996

Specifications	Amount, thous. $US	% of total
Social protection	1188140.5	7.88
Social and cultural establishments and organisations	1424621.6	9.45
Science	398366.5	2.64
Construction of dwellings for militaries, policemen and war veterans	24864.9	0.16
National economy altogether	2981722.7	19.78
Household sector and roads	5437.8	0.04
Restoration of architecture assets	3243.2	0.02
Environmental protection	**39902.7**	**0.26**
Measures to support the return of people illegally deported from Ukraine under Soviet regime	8108.1	0.05
National defence	795805.4	5.28
Activities of the Ministry of Emergencies	30118.9	0.20
Measures to dismount strategic nuclear forces	5405.4	0.04
Law enforcement and state security	919334.6	6.10
Additional expenditures for special police units fighting organised crime	13513.5	0.09
Local state taxation authorities	135135.1	0.90
Presidential administration	13983.8	0.09
Supreme Soviet of Ukraine	31675.7	0.21
Accounting department of Supreme Soviet of Ukraine	8108.1	0.05
State commission on stock market	4324.3	0.03
Functioning of the system of law and executive authorities	255445.9	1.69
Functioning of court system	51459.5	0.34
External affairs	207761.6	1.38
External debt	1356756.8	9.00
Other budget expenditures	947614.6	6.29
Reserve fund of the Cabinet of Ministers of Ukraine	108108.1	0.72
Expenditures from state purpose funds	1605729.7	10.65
Creation of rehabilitation centre for Chernobyl children in Crimea	3783.8	0.03
Internal debt	513729.7	3.41
Construction, re-construction and maintenance of public roads	575135.1	3.82
Funds transferred from State budget to budgets of Autonomous Republic of Crimea, oblasts and Sevastopol city	1145701.4	7.60
Structural re-organisation of economic branches through funds recovered from privatisation of state property not included in budget income	270270.3	1.79
Total	15073309.5	100

MEP (1998). National Report on the State of the Environment in the Ukraine in 1996.

APPENDIX 7.1 Part of SPSS data entry sheet for public poll 1

dwql	dwqw	ovws	rws	eqwbu	idwq	ivws	irws	iecwb	pdwq
3.00	3.00	2.00	2.00	4.00	2.00	3.00	4.00	1.00	2.00
3.00	3.00	3.00	2.00	3.00	1.00	2.00	3.00	4.00	0.00
4.00	5.00	2.00	2.00	3.00	1.00	4.00	3.00	2.00	10.00
4.00	5.00	2.00	3.00	4.00	1.00	2.00	4.00	3.00	0.00
5.00	5.00	2.00	2.00	5.00	1.00	2.00	3.00	4.00	0.00
4.00	4.00	2.00	2.00	4.00	2.00	1.00	3.00	4.00	5.50
3.00	3.00	2.00	2.00	4.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	1.00	2.00	4.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	2.00	3.00	4.00	1.00	2.00	3.00	4.00	2.00
5.00	5.00	2.00	3.00	4.00	1.00	3.00	2.00	4.00	5.50
5.00	5.00	2.00	2.00	3.00	1.00	2.00	3.00	4.00	2.00
4.00	4.00	1.00	1.00	4.00	1.00	2.00	3.00	4.00	15.50
3.00	3.00	2.00	2.00	4.00	1.00	2.00	3.00	4.00	2.00
3.00	4.00	1.00	1.00	4.00	1.00	2.00	3.00	4.00	5.50
3.00	3.00	3.00	2.00	5.00	1.00	3.00	4.00	2.00	5.50
4.00	4.00	1.00	2.00	4.00	1.00	2.00	3.00	4.00	10.00
4.00	3.00	2.00	2.00	4.00	1.00	3.00	4.00	2.00	5.50
4.00	4.00	2.00	3.00	3.00	1.00	2.00	3.00	4.00	2.00
3.00	3.00	2.00	2.00	4.00	1.00	3.00	2.00	4.00	2.00
3.00	3.00	2.00	3.00	3.00	1.00	3.00	2.00	4.00	2.00
3.00	3.00	3.00	3.00	5.00	1.00	3.00	2.00	4.00	5.50
4.00	5.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	1.00	1.00	3.00	1.00	2.00	3.00	4.00	2.00
4.00	4.00	1.00	1.00	4.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	2.00	2.00	4.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	1.00	1.00	4.00	1.00	2.00	3.00	4.00	2.00
4.00	4.00	2.00	2.00	5.00	1.00	2.00	3.00	4.00	5.50
2.00	2.00	1.00	1.00	3.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	2.00	2.00	4.00	1.00	2.00	3.00	4.00	2.00
4.00	5.00	2.00	1.00	4.00	1.00	2.00	3.00	4.00	2.00
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	5.50
2.00	3.00	2.00	1.00	3.00	1.00	2.00	3.00	4.00	5.50
4.00	4.00	2.00	1.00	5.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	2.00	2.00	5.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	2.00	2.00	4.00	1.00	3.00	2.00	4.00	2.00
4.00	4.00	1.00	1.00	4.00	1.00	2.00	3.00	4.00	2.00
4.00	4.00	1.00	2.00	4.00	1.00	3.00	2.00	4.00	5.50
4.00	4.00	2.00	2.00	4.00	1.00	2.00	3.00	4.00	2.00

APPENDIX 9.1 River ecosystem classification

Table A

General Quality Assessment chemical grading for rivers and canals

Water quality definition	Grade	Dissolved oxygen (%) saturation 10 percentile	BOD (mg N/l) 90 percentile	Ammonia (mg N/l) 90 percentile
Good	A	80	2.5	0.25
	B	70	4.0	0.6
Fair	C	60	6.0	1.30
	D	50	8.0	2.50
Poor	E	20	15.0	9.00
Bad	F	-	-	-

'F' is a quality grade not meeting the requirements of 'E' in respect to one or more parameters.

Table B

Parameters additional to those in Table A required for the River Ecosystem Classification

Class	Un-ionised ammonia (mg N/l 95 %ile)	PH; lower limit as 5 %ile, upper limit as 95 %ile	Hardness (mg/l $CaCO_3$)	Dissolved copper (µg/l 95 %ile)	Total zinc (µg/l 95 %ile)
RE1	0.021	6.0-9.0	≤ 10	5	30
			> 10 and ≤ 50	22	200
			> 50 and ≤ 100	40	300
			> 100	112	500
RE2	0.021	6.0-9.0	≤ 10	5	30
			> 10 and ≤ 50	22	200
			> 50 and ≤ 100	40	300
			> 100	112	500
RE3	0.021	6.0-9.0	≤ 10	5	300
			> 10 and ≤ 50	22	700
			> 50 and ≤ 100	40	1000
			> 100	112	2000
RE4		6.0-9.0	≤ 10	5	300
			> 10 and ≤ 50	22	700
			> 50 and ≤ 100	40	1000
			> 100	112	2000
RE5	-	-	-	-	-

Source: Cook H. (1998). The Protection and Conservation of Water Resources: A British Perspective.

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