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DIRECTORATE STATUS

FROM: BHATTI, N.: ARGONNE NATIONAL LABORATORY

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 10/24/91

SUBJECT: RE: A PROPOSAL ON THE ENVIRONMENTAL AND ECONOMIC
EFFECTS OF THE NORTH AMERICAN FREE TRADE AGREEMENT.

DIRECTORATE
ASSIGNED:

STAFF
ASSIGNED:

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COPIES TO: D. Allan Bromley
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4539

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October 24, 1991

The Honorable D. Allan Bromley
Science Advisor to the President
Executive Office of the President
Office of Science and Technology Policy
Old Executive Office Building, Room 360
17th and Pennsylvania Ave., NW
Washington, DC 20500

Dear Dr. Bromley:

It was wonderful talking to you on the phone earlier today - it certainly has been a while since we have been in touch.

As promised, I am sending you a copy of the proposal and letter that I sent to Deborah Wince-Smith outlining a study of how passage of the North American Free Trade Agreement would impact the United States and Mexico, from both environmental and economic perspectives. I firmly believe that such a study is urgently needed if the United States is to maintain and strengthen its leadership role in global environmental issues and take full advantage of the enormous economic opportunities that such issues offer to U.S. firms producing environmental and clean energy technologies. I would greatly appreciate any comments you may have on this proposal and any assistance you could provide in helping get such a study funded.

I have also enclosed a copy of the report I wrote on my return from my World Bank mission to Romania. It is obvious that this country (along with all of the Eastern European region) needs a tremendous amount of help in integrating into the world economic system and in ameliorating the legacy of environmental degradation left by its Communist heritage. If you ever have an opportunity to talk to the higher-ups in the World Bank about our study it would be a great help in alerting them to the need to pursue this project in greater detail. (I, of course, have an ulterior motive in this regard, as it would enable me to continue to go on missions for the Bank!)

I hope to be able to see you in the very near future, either here or in Washington. Looking forward to hearing from you.

Affectionately yours,

Neebo

NB:aoc
attachments

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October 9, 1991

The Honorable Deborah L. Wince-Smith
Assistant Secretary for Technology Policy
United States Department of Commerce
Washington, D.C. 20230

Dear Assistant Secretary Wince-Smith:

I very much enjoyed meeting you on your visit to Argonne National Laboratory last June and again in Washington at your environmental conference entitled "Challenge of the Environment: New Technologies-New Markets". I want to thank you for inviting me to serve on the panel on Poland, which I found very stimulating. I believe your conference very clearly illustrated the tremendous opportunities available to U.S. businesses for commercializing federally-funded environmental technologies and in marketing environmental products and services to the heavily polluted nations of Eastern Europe.

In going through my notes on this conference on my return to Argonne, I realized that much of what was discussed could easily be applied to other newly developing nations. One country which immediately comes to mind is Mexico, which is currently involved, along with Canada and the United States, in negotiating the terms of a North American Free Trade Agreement (NAFTA). I believe that the passage of such a NAFTA will greatly increase Mexico's need for environmental and energy technologies, thus creating an enormous opportunity for U.S. firms producing such goods and services.

As a consequence of this conclusion, I (along with some of my colleagues at Argonne) have prepared a proposal which would assess the impact that passage of the NAFTA would have on economic activity in Mexico and the resulting effect on energy consumption and production of environmental contaminants. From the results of such an analysis, it would be possible to determine the impact that such an increase in pollutant load would have on bordering areas in the United States. More importantly, such a study would make it possible to identify the nature and extent of the potential opportunities for U.S. businesses in marketing environmental technologies and services to Mexico. This study would also assess the need for including environmental considerations in the actual negotiation of the NAFTA.

I have enclosed an outline of this proposed study as well as a schematic representation of this research for your review. I would greatly value your comments on this proposal and would appreciate any suggestions on how best to obtain funding to carry out such a study. I am also sending a copy of this proposal to Dr. Allan Bromley for his comments/advice.

I look forward to hearing from you in the near future and would relish the opportunity to meet with you in Washington to discuss this proposal in greater detail if you think that would be helpful.

Sincerely,

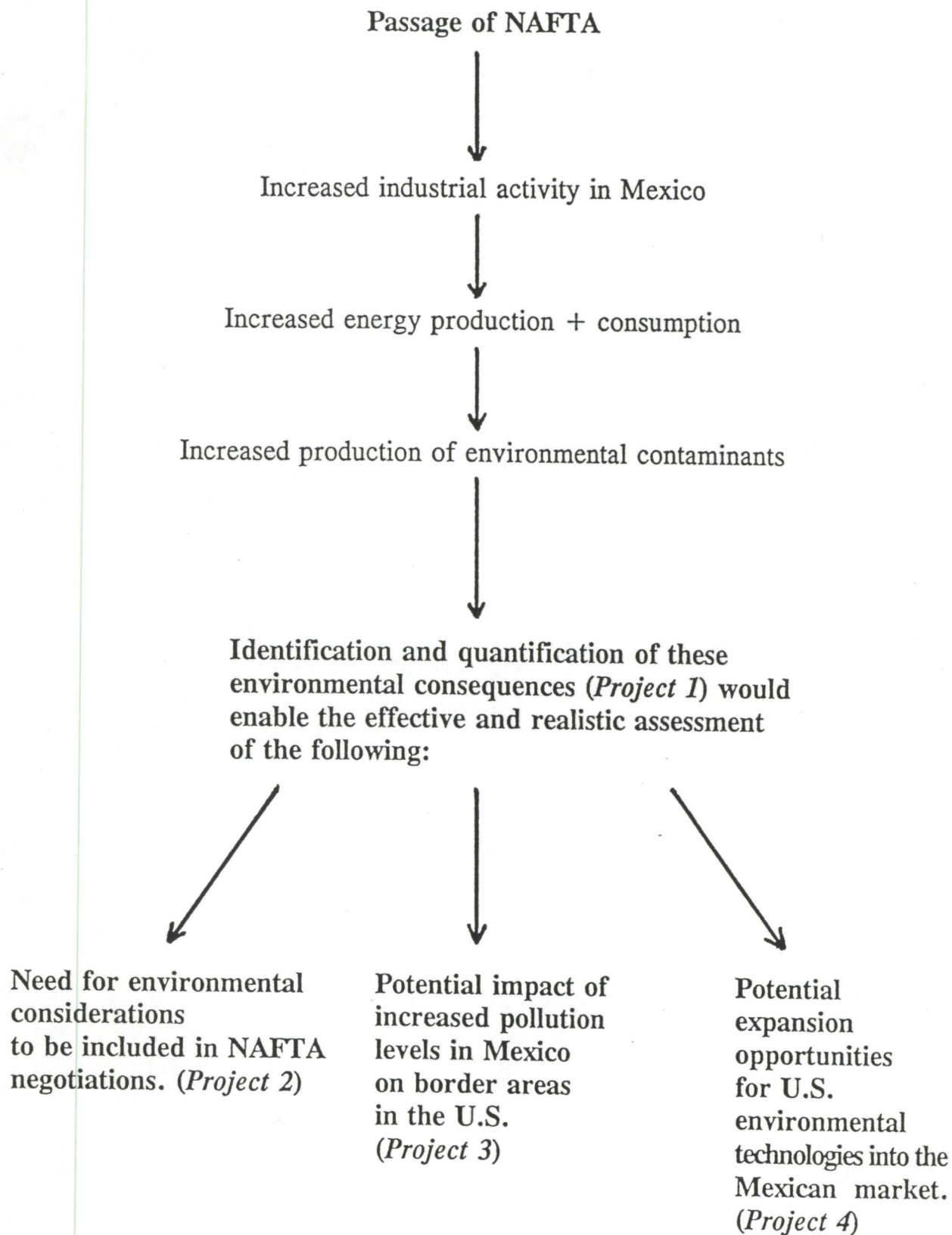
A handwritten signature in cursive script, appearing to read "Neeloo Bhatti".

Dr. Neeloo Bhatti, Scientist
International Environmental Studies
Environmental Assessment and
Information Sciences Division

NB:aoc
enclosure

cc: The Honorable D. Allan Bromley

PROPOSED NAFTA RESEARCH PROGRAM



IMPLICATIONS OF NORTH AMERICAN FREE TRADE AGREEMENT ON ENERGY AND ENVIRONMENTAL CONDITIONS IN MEXICO

PROPOSED RESEARCH PROGRAM by ARGONNE NATIONAL LABORATORY

Background:

Canada, Mexico, and the United States are currently in the midst of negotiations that could lead to a trilateral North American Free Trade Agreement (NAFTA). One result of the NAFTA could be that industrial activity in Mexico will be significantly increased. Consequences of increased industrial activity include increased energy consumption and subsequent increased environmental emissions.

The United States has an interest in these issues from at least two perspectives. First - there would be increased markets in the energy sector for U.S. companies to design and build energy development and distribution systems, as well as the industrial facilities or power plants that will be needed. The second perspective is that of the environment. Increased energy consumption will typically translate into increased releases of pollutants. This situation is particularly true in countries such as Mexico where emission controls are not widely used. Any increases in the release of pollutants is of concern to the United States not only from the standpoint of worsening the Mexican domestic pollution situation, but also from the viewpoint that some of this pollution may drift into the United States. Market potential also exists in the environmental and energy arena where control technologies and services, cleanup activities, environmental monitoring, and other environmentally-related issues are addressed.

Argonne National Laboratory (ANL) proposes that a research program addressing the energy and environmental implications and opportunities associated with the NAFTA be undertaken. This research program could be divided into two phases. The first phase consists of one project in which the energy and environmental implications in Mexico would be estimated. The results from this project could be used as input to the second phase which could have three projects. These three projects could help to frame the NAFTA with respect to environmental issues (or at least help to make the negotiators aware of energy and environmental implications) and/or to help to identify and quantify the markets for energy and environmental services that could open up for U.S. companies. Any or all of the three projects in phase two could be done as part of this overall research program. A schematic representation of this program is shown in the enclosed figure. Specific components of this research program are outlined below.

Phase 1:

Task 1: The initial task of this project would be to identify a number (maybe 3-5) of industries for which it can be reasonably expected that the NAFTA will stimulate increased production in Mexico and to estimate the magnitude of these increases. This information will be collected

from contacts with the U.S. Departments of Commerce, State, and/or Energy as well as from published literature.

Task 2: After obtaining information on the potential increases in industrial output, ANL will translate this data into increased energy requirements through the use of average coefficients relating energy input per unit of output. If feasible, adjustments in these energy/output ratios that reflect Mexican experience will be made. The energy requirements will then be divided into fuel types (e.g., heavy oil, distillates, and coal) in accordance with typical practices for the selected industries, tempered by the availability of various fuels in Mexico.

Task 3: Having estimated the increased energy consumption attributable to the NAFTA, the increases in environmental releases can be estimated. These estimates can be made in at least two ways. The first would be based on current Mexican practice with respect to emission controls. The second would be based on the use of emission control technologies as practiced in the U.S. and/or as dictated by various state or federal pollution control agencies. Results from these two cases should provide the most likely range of emission increases attributable to the NAFTA and would illustrate the reductions that could be achieved through the use of modern control equipment.

Phase 2:

The second phase of this proposed research effort would involve using the information and data obtained via the completion of Project 1 (Tasks 1-3) to conduct an effective and realistic assessment of issues directly related to the passage of the NAFTA. An assessment of each of the three issues discussed below would comprise a separate project. The potential areas of research include:

PROJECT	ISSUE
Project 2	The need to include environmental considerations in the NAFTA negotiating process.
Project 3	Potential impact of elevated levels of air, water, and ground pollutants arising from increased industrial activity in Mexico (due to the passage of the NAFTA) on the environment in border areas in the United States.
Project 4	The potential opportunities for expansion of U.S. environmental and energy technologies into the Mexican market as a result of the passage of the NAFTA. Also, the possibility of increased U.S. investment opportunities in Mexico.

Deliverables:

There would likely be two major deliverables from Phase 1 of this research effort. The first would be a list identifying the industries to be considered. Concurrence from the sponsor on these industries would be obtained before doing a significant amount of work on subsequent tasks.

The second deliverable from Phase 1 would be a final report in which the analyses, data, results, and conclusions are presented in detail. This deliverable would first take the form of a draft report which would then be finalized for printing following sponsor review.

The information emanating from the completion of the first phase of this research program will be used to carry out the objectives of the second phase. A draft report will be written for each of the projects evaluated (as noted above, any or all of the three projects could be considered in this phase of the program) with a final report prepared and published for each project after sponsor review and approval.

ENVIRONMENTAL OVERVIEW OF ROMANIA

Prepared by:

Neeloo Bhatti

(based on information compiled during a July 19-31, 1991
World Bank mission to Romania)

This is a copy of the
report I wrote on my
return from Romania. It
was incorporated into the
full report by the World
Bank.

8, 1991

ENVIRONMENTAL OVERVIEW OF ROMANIA

A. REGULATORY ACTIVITIES

1. INSTITUTIONAL SETTING

Like most of its neighbors in Eastern Europe, Romania has been relatively slow in adopting and implementing environmental protection laws. Under the centrally-planned economy of the Ceausescu regime, environmental concerns were not considered a priority (and, in fact, were regraded as a severe hindrance to economic development) and, thus, were neglected in planning activities.

Nevertheless, environmental protection laws did exist in theory and have been in place in Romania since 1973. Separate ministries were set up for each environmental sector (air, water, soil, forests) and a national Council of Environmental Protection was formed to deal with environmental issues. However, these ministries had little power compared to the strength and clout given to the industrial and economic sectors. This led to a complete neglect of environmental matters and the virtual lack of enforcement of any environmental protection laws that did exist in this country.

In 1990, after the fall of the Ceausescu regime, and in response to heightened public awareness and concern for environmental issues, the newly-formed Romanian government created a new Ministry of the Environment. This ministry consolidated the activities of the individual environmental sector departments and was given authority for all environmentally-related matters. The Ministry of the Environment operates 41 regional environmental agencies in various districts throughout the country which carry out the day-to-day monitoring, assessment, and implementation functions of the central ministry. In addition, a number of departments in other ministries (eg. health, industry) and research institutes have been given mandates to participate in environmental protection activities. Environmental education has also been given priority and an Ecological University was recently established in Bucharest to train students in the field of environmental management.

Currently, the government is considering changes to the existing environmental laws so as to make them more effective in protecting human health and environmental resources. These new laws, expected to be passed in the next few months, emphasize enforcement activities and integration of the various components of environmental protection. Some of these changes have already been made. For example, starting in 1990, the government required all new firms to obtain a permit before beginning operation. Before such a permit is granted, an 'Environmental Impact Assessment' (EIA) must be prepared by the Ministry of Environment's Institute of Environmental Engineering. Eleven different impacts (eg. soil, air, water, health, forest, etc.) are considered in this EIA. The Ministry of Environment then decides whether or not the firm in question needs to implement controls (personal communication). In addition, all new

industrial plants are required to install sewage treatment plants approved by the Ministry of Environment.

Some of the main objectives of the newly created Ministry of Environment are the following:

- 1) establish more resource-efficient and less wasteful economic policies - involves structural reform, additional policy analysis and research, incorporation of environmental objectives into national planning process
- 2) develop stronger national environmental regulations and enforcement procedures
- 3) increase government and non-government participation in environmental education
- 4) draft and promote ecological recovery projects for those areas damaged by pollution and other anthropogenic activities
- 5) increase the size and number of nature preserves and national reserves
- 6) diminish pollution in the Danube and the Black Sea regions through international programs

(Ministry of Environment 1991)

Thus, it is evident that environmental policies in Romania are directed toward both the restoration of those areas severely degraded by past human activities and in protecting relatively cleaner areas from future damage. Also, Romania has, in the past year, attempted to reintegrate itself into the international environmental community by participating in regional and global environmental protection activities and by joining international conventions and treaties relating to environmental issues.

2. MONITORING/IMPLEMENTATION ACTIVITIES

Environmental monitoring activities in Romania have been conducted since the 1950s. However, most of these endeavors were not done in a continuous and/or consistent manner. In addition, it is suspected that, under the Ceausescu regime, monitoring results that showed significant deterioration of environmental quality, particularly near industrial and energy-producing complexes, were probably destroyed. Thus, although considerable data are available on environmental quality, these must be viewed with caution.

Air Pollution

At the present time, there are three air pollution monitoring networks in operation in Romania, all of which now function within the Ministry of Environment. These are:

- 1) the four stations that operate as part of the World Meteorological Organization (WMO) Background Air Pollution Monitoring Network (BAPMON). These stations have been working since 1976 at Rarau, Fundata, Stina De Vale, and Semenik, all of which are located at altitudes above 1000 meters. The species measured include daily mean concentrations of SO₂, NO₂, and O₃ as well as NH₃, H₂S, HCl, Cl₂, and particulate levels. In addition, wet deposition is collected weekly and monthly and physical and chemical parameters such as pH, conductivity, acidity, alkalinity, atmospheric turbidity,

and ionic concentrations of Na^+ , K^+ , Ca^{2+} , Mg^{2+} , SO_4^{2+} , NO_3^- , Cl^- , and F^- are measured (Ministry of Environment 1991, Loscutoff and Shafer 1991). Examples of the methods used in analyzing the concentrations of these parameters and species include potassium iodide colorimetric for O_3 and pararosaniline for SO_2 (Loscutoff and Shafer 1991).

- 2) Impact Pollution Monitoring Network - this network consists of 50 sites located mainly around industrial/urban areas. Some of these sites belonged to the Ministry of Health (the Institute of Hygiene and Public Health) but are now integrated with the sites operated and coordinated by the Ministry of Environment. All of these sites have been in operation since 1988/1989 except for three locations which have 20 years of operating history. Monitoring of SO_2 , NO_2 , NH_3 , suspended matter, and particulates is conducted at all sites. In addition, in highly industrialized areas, specific pollutants such as H_2S , CS_2 , phenols, formaldehyde, lead, cadmium and HCl are also routinely measured (Ministry of Environment 1991).
- 3) Acid Deposition Network - consists of 108 sites usually co-located with meteorological stations. Wet deposition samples are collected weekly and/or after every precipitation episode and the main species analyzed are pH, conductivity, and alkalinity/acidity (Loscutoff and Shafer 1991).

Water Quality

Water quality monitoring has had a longer history in Romania than air pollution measurements. The monitoring of water quality in this country is divided into two separate activities:

- 1) Black Sea monitoring (both north and south of the Danube Delta) - seven sites on the seashore and eight sites offshore are monitored with sampling conducted from March to October of each year. In general, organic matter and nutrient substances such as NO_3^- , NH_4^+ , and PO_4^- are monitored (Ministry of Environment 1991). Measurements of Danube river and delta water quality have also been conducted for the past 20 years (personal communication).
- 2) Fresh Water Monitoring - the earliest environmental monitoring activity in Romania was of fresh water quality which was initiated in 1954. However, systematic measurements of this medium were begun only in the mid-1970s. Different methods and sampling intervals are used depending on the aquatic system under investigation.
 - a) rivers: fast data flow method - water quality is monitored at 65 stations on a daily basis in order to determine critical pollution situations. A daily bulletin is issued by the Ministry of Environment specifying the location, nature, and extent of any exceedances of pollution standards as well as the name of the probable polluter. An example of this bulletin is shown in Table 1. At 15 of these stations, weekly monitoring of heavy metals is also conducted.

**TABLE 1 EXAMPLE OF A DAILY BULLETIN OF EXCEEDANCE OF WATER
QUALITY STANDARDS**

Table 1

EXAMPLE OF A DAILY BULLETIN OF EXCEEDANCE OF WATER QUALITY STANDARDS

Control station	Water course	Monitored section	Quality index	Norms mg/l used	Measured value	Potential polluting mg/l sources
1	Bistrita	Viisoara	Disolved oxygen	1.0	1.5	CGCL Bistrita
2	Somesul	Someseni mic	Disolved oxygen	1.0	3.5	Pharmaceutical plant
3	Crisul	Tarian Repede	Disolved oxygen	4.0	3.5	CGCL Oradea
4	Mures	av. Tirgu Mures	Amonia	1.0	1.9	CGCL Tirgu Mures
5	Mures	Cipao	Nitrates	10.0	10.9	IJGCL Tirgu Mures
			Amonia	1.0	2.6	CICU Tirgu Mures
			Nitrates	10.0	20.0	ISCIP Iernut
			Nitrates	1.0	1.2	
6	Mures	amonte	Minerals	1200.0	1340.0	CPS Ocna Mures
		Aiud	Chlor	300.0	372.0	
7	Mures	am. Alba India	Chlor	300.0	319.0	CPS Ocna Mures
8	Bega	Utelec	Organic substances	4.0	0.1	CGCL Timisoara
			Amonia	10.0	13.0	
9	Birzava	aval	Cyanides	0.01	0.031	CS Resita
10	Ialomita	Cosimbesti	Disolved oxygen	5.0	1.9	CICH Slobozia
		Resita	Organic substances	15.0	18.0	ISCIP
			Amonia	3.0	13.5	
11	Buzau	aval Buzau	Organic Substance	10.0	13.3	IJGCL Buzau
12	Bisirita	Rozonov	Organic	25.0	85.3	Natural Causes
13	Bisirita	Zanesti	Amonia	3.0	8.6	ICHC Piatra Neamt
						Industrial Complex
14	Bisirita	Serbanesti	Organic substance	15.0	32.0	Savinesti-Roznov
			Amonia	3.0	12.9	ICHC Piatra Neamt
15	Siret	Galbeni	Organic Substance	25.0	56.0	Platf. Industriala
			Amonia	10.0	11.7	Savinesti-Roznov
16	Trotus	aval	Chlor	300.0	319.0	EGCL Bacau; ISCIP
		Borzesti	Phenols	0.05	0.07	Bacau CICH Bacau
17	Birlad	aval	Organic substance	10.0	14.9	Petrochemicals
		Vaslui				Borzesti
18	Vasluiet	aval	Disolved oxygen	6.0	1.7	IJGCL Vaslui
		Vaslui	Organic	10.0	32.0	Animal products
			Amonia	1.0	7.3	IJGCL Vaslui
19	Birlad	aval	Organic substance	25.0	54.0	Agricultural products
		Tecuci				Vaslui
20	Bahlui	Holboca	Disolved oxygen	6.0	0.0	Alcohol proudcts
			Organic substance	10.0	72.0	ISCIP Tomesti
			Amonia	1.0	16.3	GIGCL Iasi

slow data flow method - more comprehensive monitoring than the fast flow method is conducted. 275 samples from first order control stations are analyzed on a monthly basis

(Ministry of Environment 1991, personal communication)

- b) lakes: lakes are considered to be more stable ecosystems than rivers and, thus, are monitored only on a seasonal basis. Approximately 55 artificial and man-made lakes comprise this network (Ministry of Environment 1991).
- c) ground water: ground water is sampled 4 to 5 times a year at 280 stations with approximately 10 drillings conducted at each site.

Environmental Radioactivity

A national radioactivity monitoring network was established in Romania in 1962 and currently consists of 38 stations (Ministry of Environment 1991). The monitoring activities and methodology comply with those set by the International Agency for Nuclear Energy and the WMO. Radioactivity at each site is measured in the air (both aerosol and particulate concentrations), surface and ground water, soil, and natural vegetation. Special monitoring stations are also located around major nuclear facilities.

3. MONITORING/ANALYSIS EQUIPMENT

Most of the equipment used in monitoring pollutant levels, particularly air and water quality, in Romania is of early 1970s vintage. These devices can measure most of the important and common pollutant species present in the air and water. However, they are likely in need of calibration and overhauling which has probably not been done in recent years given the low status monitoring activities have had in the past. In general, efforts have been made to conform to international standards for sample handling and chemical analysis but verification of whether or not this is the case in the field is urgently needed. When most of the monitoring equipment was installed, many of the senior technicians and scientists were trained in their use both abroad and in Romania by foreign experts. It is not clear how the subsequent generation of technicians have been trained; this needs further investigation.

Previous analysis by foreign experts on the reliability and accuracy of monitoring data, particularly that related to air and water pollutants, have, in general, concluded that the quality of such data is questionable at best. In most cases, analysis of collected samples is carried out at regional/district centers. The Ministry of Environment has under its control 41 agencies each of which controls the monitoring activities under its jurisdiction. Results of this analysis are then relayed to the Institute of Environmental Engineering in Bucharest, where this information is coordinated and compiled for the country as a whole. Although, in theory, all 41 agencies use the same techniques and equipment for sampling and analysis, in practice, it is likely that significant variations do exist. In addition, as handling of samples is critical to the quality of monitoring data, significant potential for errors exist for this step alone. For example, in the case of acid deposition monitoring, it has been noted that wet deposition samples are carried, unrefrigerated, to regional laboratories and that samples may be stored for several months in this state before undergoing analysis (Loscutoff and Shafer 1991). This method of collection and

storage could introduce significant uncertainty and errors to monitoring results.

It can be concluded that there is an urgent need for verification and comparison of samples collected and analyzed using existing Romanian equipment against those using equipment and personnel from the West. In addition, upgrading of analytic equipment, handling techniques, and sample collection processes is required along with training of scientists and technicians in the latest monitoring methods. Finally, a process needs to be implemented whereby coordination and consistency among the various sites in the network is introduced.

Thus, it can be concluded that the absolute values of monitoring data cannot be relied upon. However, the trends of air and water quality and radioactivity levels over past few decades for which data are available as well as the qualitative analysis of the collected samples are likely to prove very useful in assessing the overall environmental status of this nation.

B. ENVIRONMENTAL QUALITY

1. PHYSICAL SETTING

Romania is situated on the southeastern portion of the European continent, centered on the Transylvanian plateau around which the Carpathian Mountains form a series of crescents. Beyond these crescents, on the south and east, exist fertile plains, with the Danube forming the country's southern border and the Black Sea its southeastern boundary. The proportion of mountains, plateau, and plains are evenly divided, with one-third of the country occupied by each of these features (Ministry of Environment 1991, Encyclopedia Britannica 1979). Romania occupies a total land area of 237,000 km² and has a population of over 23.5 million. The diversity of landforms and physical features in this country has led to the presence of a wide variety of natural resources and of considerable economic development potential.

2. POLLUTANT EMISSIONS

Romania emerged from its centrally-planned, communist-oriented rule with significant environmental damage, much of which is still in progress due to the high pollutant loading in the soil, air, water, and vegetation. This situation is largely the result of the haphazard development of huge industrial complexes with no emission controls, the use of outdated, inefficient, energy-intensive equipment in the industrial and energy sectors, lack of maintenance of such equipment, use of highly polluting brown coal, and the virtual ignorance of environmental laws and concerns. Much of Romania's economic progress during the past two decades has been achieved through rapid industrial development, especially of the chemical, metallurgical, and building materials industries. The growth in importance of the industrial sector in general is illustrated in the facts that the percentage of the population employed by this sector grew from 23% in 1970 to 38.1% in 1989 and that the industrial sector contributes over 58% to the net national income of the country (Ministry of Environment 1991).

Another factor contributing to environmental degradation in Romania has been the increased use of artificial fertilizers and other chemicals in the agricultural sector. Agriculture plays an important role in the economy of this nation with 62% of the land area classified as farmland. Irrigation of these lands has also increased rapidly over the past few decades and leads to further environmental degradation.

The total quantity of environmental pollutants discharged into the air, water, and soil in 1989 was estimated to be 418 million tonnes (Ministry of Environment 1991). This represents a 15% increase from 1985 alone. Of this 418 million tonnes, 30% was emitted into the air, 68% into the soil, and 2% into water systems. The bulk of this pollution load is ash deposited in the soil and CO_2 emitted into the air. These pollutants are not deposited or emitted evenly across the country but rather are concentrated in certain parts of Romania. It is estimated that, at present, 10% of the country's surface and 4.0-4.5% of its population is directly impacted by significant levels of soil and water pollutants (Ministry of Environment 1991). In addition, 0.9×10^6 ha of land area is further affected by air pollutants from industrial sources (personal communication). This is in addition to the impact of regional air pollutants such as acid deposition and ozone which affect the country as a whole.

Air Pollutants

In 1989, approximately 138×10^6 tonnes of pollutants were released into the air in Romania from anthropogenic sources. The bulk of these substances are CO_2 , SO_2 , NO_x , NH_3 , and phenols with 65% emanating from the power sector, 11% from the metal engineering industry, and 5% each from the chemical and building materials industries (Ministry of Environment 1991). Although emitted in smaller quantities, other air pollutants such as volatile organic compounds (VOC) and particulate matter, including that containing heavy metals such as cadmium and lead, are of greater concern from a human and environmental health perspective. In certain areas, especially in the vicinity of petrochemical complexes, levels of such substances can be extremely high even reaching levels that have been shown to impact human health. The precise quantity of such air pollutants released into the atmosphere is not known due to number of factors, including the suppression of the release of such information by the previous government and the absence of compilation of accurate national inventories for such substances. Some estimates have, however, been made, particularly for emissions of SO_2 and NO_x . A Ministry of Environment report (1991) indicated that approximately 1.65×10^6 tonnes of SO_2 , 1.75×10^6 tonnes of NO_x , and 132×10^6 tonnes of CO_2 were emitted into the air in Romania in 1989. Quantities of emissions of other pollutants were also compiled and are shown in Table 2. A U.S. National Academy of Science mission to Romania in 1990, however, calculated that annual SO_2 emissions were in the order of 7.4×10^6 tonnes and NO_x emissions were approximately 0.59×10^6 tonnes annually (Loscutoff and Shafer 1991). Another study indicates that SO_2 emissions in Romania in 1982 amounted to 2.0×10^6 tonnes (Highton and Chadwick 1982). The range of these estimates indicate the large uncertainties present in determining emission levels at this time. Further, in-depth research is urgently needed to determine accurate emission inventories of various pollutants in Romania.

**TABLE 2 QUANTITIES OF VARIOUS AIR POLLUTANTS EMITTED IN ROMANIA
IN 1989 (from Ministry of Environment 1991)**

POLLUTANT	QUANTITY EMITTED (1000 tonnes)
CO ₂	132,000
NO _x	1,750
SO ₂	1,650
NH ₃	8.5
CS ₂	5.5
Phenols	2.3
Others	2,600
TOTAL	138,000

In addition to its domestically-produced emissions, Romania also receives considerable amounts of air pollutants from its neighbors, further adding to its pollutant load. It has been estimated that approximately 75% of the SO₂ deposited in Romania originates from outside the country (Dovland 1987). However, Romania also exports pollutants to its neighbors, with 59% of all SO₂ emissions emitted in the country transported to surrounding countries.

Water Pollutants

It is generally believed that the most critical environmental problem facing Romania at present is the degradation of its water quality. Approximately 6×10^6 tonnes of wastes were discharged into Romanian waterways in 1989 with the majority of these consisting of untreated human sewage, industry and mining wastes, and agricultural runoff (Ministry of Environment 1991). All of these have contributed to the severe degradation of Romania's extensive aquatic ecosystems. The dominant water pollutants are chlorides, sulfates, bicarbonates, organic matter, phenols, nitrates, detergents, pesticides, phosphates, and hydrogen sulfides. Organic matter emanates mainly from the discharge of municipal wastes whereas the other substances are mainly the result of industrial and agricultural releases. It is estimated that 60% of all discharges into water systems are inadequately treated while another 30% are not treated at all (Ministry of Environment 1991, personal communication).

Soil Pollutants

The largest quantity of anthropogenic pollutants are discharged into the soil system with 274×10^6 tonnes of such pollutants released in 1989 (Ministry of Environment 1991). The majority of such discharges consist of mine wastes, chemical fertilizers, pesticides, and acid deposition. Over 75% of such pollutants emanate from the mining industry alone. In addition, a significant quantity of untreated waste water ends up in the soil system. Soil erosion, although not a pollutant problem in the strictest sense, adds to soil degradation in many areas. Approximately 4×10^6 ha of the surface area of the country suffers from soil erosion to some extent with 1×10^6 ha having erosion rates over 10-15 tonnes/ha/yr (Ministry of Environment 1991).

3. AMBIENT POLLUTANT LEVELS

The relatively high levels of pollutant emissions, particularly in localized regions, make it inevitable that ambient pollutant concentrations in Romania would be high as well. This is true of Eastern Europe in general where air, water, and soil pollution levels are among the highest in the world.

Air Quality

Romania implemented air quality standards in 1987 for a variety of pollutants and for various time intervals. These are given in Table 3. It should be noted that these limits are, in general, within the U.S. and WHO standards. However, enforcement of these standards in Romania has not been actively pursued to date.

Air quality in Romania varies widely from region to region. Precipitation acidity has been found to average between 4.0 and 7.0 in most parts of the country with sulfate levels usually between 1.0 to 3.5 mg/l (Ministry of Environment 1991, Loscutoff and Shafer 1991). Although precipitation pH levels in Romania are much higher than those in most parts of Europe and North America where environmental damage has been noted, sulfate concentrations in precipitation in Romania are comparable to these affected areas in the West. Within Romania, highest precipitation acidity is found in the northwestern part of the country likely indicating transport of acidifying compounds from Western Europe into this part of the country. Other areas of high acid deposition levels are located in the vicinity of chemical and non-ferrous metallurgical plants. At sites near cement plants, on the other hand, alkaline rains are common with pH as high as 8.8 (Ministry of Environment 1991).

With regard to other air pollutants, in urban areas without large industrial complexes, levels of pollutants typically are as follows:

SO ₂	-	1-20 ug/m ³
NO _x	-	10-100 ug/m ³
NH ₃	-	10-100 ug/m ³
particulates	-	> 150 ug/m ³

The higher concentrations are usually found to occur in the winter months in these areas.

TABLE 3 AIR QUALITY STANDARDS IN EFFECT IN ROMANIA (from Ministerul Sanatatii 1989)

Table 3

AIR QUALITY STANDARDS IN EFFECT IN ROMANIA SINCE 1987
(Ministry of Health, 1989)

Polluting substance	Maximum air admissible concentration ug/m ³			
	Short-term average 30 min	Daily	Long-term average Monthly	Annually
- Suspended particles	500	150	-	75
- Coal dust	150	50	-	-
- SO ₂	750	250	-	60
- NO ₂	300	100	-	40
- Ammonia	300	100	-	-
- Aldehyde (CH ₂ O)	35	12	-	-
- Chlor	100	30	-	-
- Chlorohydric acid	300	100	-	-
- Fluor:				
- soluble inorganic gazeous components	15	5	1,2	-
- insoluble inorganic	-	30	-	-
- Phenol	100	30	-	-
- Mercaptan methyl	-	0,01	-	-
- C ₂ SO ₃	30	5	-	-
- Plumb	-	0,7	-	-
- Crom (CrO ₃)	-	1,5	-	-
- Cadmium	-	0,02	-	-
- Deposited particles	-	-	17gm ² /month	-

In highly industrialized areas, the concentrations and characteristics of air pollutants are significantly different and are dependent on the nature of the predominant industry in the region under investigation. In non-ferrous metallurgical industrial areas such as Copsa Mica, Baia Mara, and Zlatna, ambient air quality is as follows:

- SO₂ - very high levels with average concentrations exceeding 300 ug/m³ and peaks greater than 500 ug/m³
- heavy metals - include As, Pb, Cd, Zn, Cu, and Sn - concentrations average over 0.7 ug/m³ for Pb and over 0.02 ug/m³ for Cd with peaks often reaching 140 ug/m³ for Pb and 4 ug/m³ for Cd - these peaks are 200 times the Romanian maximum admissible level
- suspended matter - often averages over 120 ug/m³ with peaks reaching 300 ug/m³

In areas with a predominance of chemical and petrochemical industries which are spread throughout the country, the concentration and mix of air pollutants is significantly different. The specific areas and their characteristic air quality patterns are as follows:

AREA	POLLUTANTS
Fagaras, Borzesti, Savinesti, Dej	High levels of SO ₂ , NO _x , HCl, H ₂ SO ₄ , NH ₃ , phenols, and organic chlorinated aldehydes.
Midia, Ploiesti, Brazi, Teleajen	Predominance of hydrocarbons, fluorine, SO ₂ , NO ₂ , soot, and phenols.
Pulp and paper mills and synthetic fiber factories - Dej, Braila, Lupeni, Suceava	SO ₂ , H ₂ , CS ₂ .
Chemical fertilizers - Arad, Tirgu Mures, Isalnita	NH ₃ mostly.
Hunedoara, Calan, Resita, Galati, Calarasi	Predominantly iron oxides with levels of non-ferrous metals such as Pb, Cd, Zn, Cu, V, and Cr often exceeding 100s of ug/m ³ .
Chlorosodium plants - Rimnicu Vilcea, Ocna Mures	High levels of chlorides and HCl (and NH ₃ in some areas which neutralizes the HCl).
Coal-burning power stations - Rovinari, Turceni, Mintia	High levels of As, Cd, Pb, Mn, Mg, V, SO ₂ , NO ₂ , CO ₂ , and CO. Also produce large amounts of ash with radionuclide concentrations 2 to 3 times levels in the soil.
Oil-burning power plants	High levels of SO ₂ with moderate levels of NO ₂ , CO, and CO ₂ .

Bucharest has its own characteristic air pollution situation. This metropolitan area has a unique combination of industries, power generating plants, mobile sources, and residential/commercial heating systems. Its air quality can be characterized as follows:

- a) moderate concentrations of SO_2 , with levels usually between 5 and 60 ug/m^3 and peaks of 130 ug/m^3
- b) relatively high levels of NO_x , especially near high volume traffic areas - levels of this pollutant often exceed 300 ug/m^3
- c) high concentrations of NH_3 , with levels often reaching 1000 ug/m^3
- d) high levels of lead, which are also associated with large concentrations of mobile sources. Concentrations are often in the 2.0 to 3.5 ug/m^3 range with peaks of 80 ug/m^3
- e) high concentrations of cadmium with average levels of 3 to 32 ug/m^3 and peaks of 250 ug/m^3
- f) high acidity levels

(Ministry of Environment 1991, personal communication)

Ambient Water Quality

Water quality conditions in Romania have deteriorated rapidly over the past few decades and pose a severe threat to both ecological and human health. The condition of water quality in Romania depends to some extent on the water resource under investigation and is as follows:

River Water - waters are divided into four categories or classes depending on their quality. Currently, 41% fall into the first or best quality, 20% into the second category, 10% into the third, and 21% into the worst or 'dead' category (Ministry of Environment 1991). Other estimates have indicated that less than 20% of waterways in Romania provide drinkable water at present (Tye 1990). The most serious river water conditions occur in the hydrographical basins of Ialomita (with 52% in the 'dead' category), Oh (43%), Siret (31%), Vadea (23%), and Mures (22%) (Ministry of Environment 1991). Over the past few years, there has been a progressive reduction in the proportion of waters falling into the first category and an increase in the share of those in the 'dead' category. High levels of NH_3 , nitrates, heavy metals, phosphates, pathogens, pesticides, and organic matter are the predominant cause of this water quality deterioration in the rivers of Romania. In the Danube, levels of petroleum-related substances are also high. Much of the river water degradation in this country is the result of the discharge of untreated sewage, mining, industrial, and agricultural wastes into river channels. Although there are 4000 sewage treatment plants in existence in Romania at present, only 25% are in good working order, with the result that only 10% of waste water from municipal, mining, industrial, and agricultural activities are adequately treated (personal communication). The majority of the existing waste treatment plants are 10 to 15 years old and many

cities, including Bucharest, still do not have any sewage treatment plants at all.

Lakes - The majority of lakes analyzed to date in Romania fall into the first water quality but a significant number can be classified as being in the third and 'dead' classes. Much of the contamination of lake water in this country is the result of high concentrations of organic substances. Most of the degraded lakes are located in Olt, Siret, and in the Deltaic lakes of the Danube (Ministry of Environment 1991).

Ground Water - From 1985 to 1989, it has been noted that concentrations of NH_3 , nitrates, and organic substances in groundwater have progressed from a diffuse impurity to widespread contamination (Ministry of Environment 1991). Also, greater concentrations of pesticides, lead, zinc, cadmium, phenols, manganese, pathogenic germs, and phosphates are currently present in these waters. In urban areas, 90% of wells investigated were found to have levels of bacteria exceeding permissible limits. In addition, 70% of these wells contain water with nitrate concentrations over 100 mg/l (maximum permissible level in Romania is 45 mg/l). An increase in groundwater temperature in urban and industrial areas has also been noted in recent years which has the indirect effect of accelerating the dissolution of rock minerals (Ministry of Environment 1991). As with the case of river and lake water, most of this contamination of ground water is due to the lack of sewage treatment plants, heavy agricultural use of pesticides and fertilizers, and untreated industrial and mining waste discharges.

Soil Quality

A significant portion of the soil in Romania has been seriously degraded through chemical pollution. This deterioration is mostly due to the heavy use of artificial fertilizers and pesticides, large discharges and emissions from chemical and metal-processing plants, and considerable use of waste water for irrigation. The latter, in addition to contaminating the soil with pollutants, also increases soil salinity concentrations. DDT residues in the soil are high in Romania and often exceed maximum admissible levels (>0.10 ppm). The highest levels of DDT have been observed in Bacau and Constanza where levels often reach 0.6 ppm (Ministry of Environment 1991). This substance was banned in Romania in 1985 and levels in the soil are beginning to decrease in most areas.

In the vicinity of non-ferrous metallurgical plants, levels of Cu, Pb, Zn, Co, Mn, and Ni are often high. These areas include the Tirnava Mare Valley, Copsa Mica, Baia Mare, and Ferneziu Valley. In the latter, lead levels exceed 3 g/kg of soil (Ministry of Environment 1991). Near oil wells, soils have been observed to contain high concentrations of oil residues. This is especially true in Arges, Braila, Teleorman, and Vilcea.

Another problem related to soil quality in Romania is that of soil erosion, which affects 2.7×10^6 ha of agricultural land, with an average erosion rate of 16.3 t/ha/yr. It is estimated that 30% of arable land in this nation is currently eroded. This high erosion rate, which, in addition to removing soil particles, also transports toxic substances contained in the soil layer, contributes to aquatic pollutant loads and eventually impacts the Danube Delta and the Black Sea.

Radioactivity Levels

The main finding of radioactivity monitoring activities over the past three decades in Romania was the 6 to 15 fold increase in atmospheric radioactivity (particularly of cesium and strontium levels) observed after the Chernobyl accident ((Ministry of Environment 1991, personal communication). Similar increases in radioactivity were noted in surface waters and natural vegetation. In addition, high levels of cesium were observed in milk and meat throughout the country, particularly in Caras-Severin (personal communication).

High concentrations of uranium and radium have also been found in river water and sediments where industrial water from uranium mines and radioactive ore processing plants are discharged. In most cases, these levels are higher than background concentrations but do not exceed maximum admissible values. In the vicinity of coal burning power plants, radioactivity levels above background values have been observed in ash and slag deposits. These deposits are often used as building and construction materials, thereby spreading radioactive contamination. Radon concentrations have also been found to be higher than background levels in many parts of Romania, especially in Alba, Buzan, and in isolated portions of Cluj, Suceava, and Bucharest (personal communication).

Ambient levels of radioactivity in uranium mines (Romania is a significant producer of uranium) are relatively high; 20% of such mines exceed industrial standards for radiation exposure, with levels up to 7.5 rad/yr. (international standards range from 2 to 5 rad/yr.) (personal communication). Radon concentrations in non-uranium mines have also been observed to be high, with 41.7% of those monitored exceeding the standard of 0.029×10^{-10} Ci/l (personal communication). Most of the highest radiation levels in non-uranium mines have been observed in Suceava, Bihor, Hunedoara, Maramures, and Tulcea, with 3.3% of these mines having radon levels from 0.30×10^{-10} to 2.04×10^{-10} Ci/l.

Finally, ground water used to pump oil out of drilling holes has been found to contain high levels of radium-236. Concentrations often reach over 1500 pCi/l (standard is 4 pCi/l) (personal communication). This water is usually reintroduced into the ground but on occasion, is spread over farmland, thereby contaminating the soil, agricultural crops, and livestock.

C. HEALTH IMPACTS

Much of the concern regarding environmental pollutants in Eastern Europe has developed in response to their potential to impact human health. The high levels of toxic substances as illustrated in the previous section coupled with the relatively large population density puts significant numbers of people at risk from the dangers of pollution. This is especially true in Romania, where rampant industrialization, lack of capital for pollution controls, high energy intensity, and the relatively large numbers of people living in urban and industrial areas have intensified the health-related hazards associated with high pollution concentrations. Damage to other components of the environment, though not studied in detail, is also likely to be severe in Romania, especially that related to aquatic and forest ecosystems. These impacts are beyond the scope of this report but it should be noted that damage to natural systems can indirectly impact human health and also impose a heavy burden on the economy of the country.

It has been estimated that approximately 4 to 4.5 million people in Romania are impacted by environmental pollution, of which 1.2 to 1.5 million are directly affected (Ministry of Environment 1991). Much of the research into health-related impacts of environmental pollutants has been conducted through the Romanian National Academy of Sciences with much of the practical and field work (i.e. epidemiological) studies undertaken by the Ministry of Health through its Institute of Hygiene and Public Health. As was the case with environmental pollution monitoring by the Ministry of Environment, the Ministry of Health operates 41 offices, one in each district, each with its own epidemiological laboratory. The data obtained by these field offices are fed to the central Institute of Hygiene and Public Health in Bucharest.

One of the main concerns relating to environmental contamination in Romania has centered on the role of pollutants as carcinogens. A study was recently undertaken to determine the number of large industries that have high levels of suspected carcinogens (termed cancer hazards). A total of 4728 registered workplaces were analyzed for the presence of such cancer hazards. 561 workplaces (12%) were found to contain such hazards. The percentage of workplaces with cancer hazards varied from place to place in the country ranging from 2.8% in Teleorman to 50.9% in Cluj. This variation could be due to a number of factors including the nature of industries dominating a given region and the method used to determine the presence of a cancer hazard (most of these studies were done by the district office in each region). The breakdown of the presence of cancer hazards by industry type was observed to be as follows:

INDUSTRY TYPE	NO. WORKPLACES OF SPECIFIC INDUSTRY TYPE WITH HAZARDS	% WORKPLACES OF SPECIFIC INDUSTRY TYPE WITH HAZARDS/TOTAL NO. OF WORKPLACES WITH HAZARDS
Chemical	104	18.5
Light industries	101	18.0
Machine building	80	14.3
Wood, building materials	55	9.9
Electronic	34	6.1
Electrical energy	30	5.3
Mining	19	3.4
Other	138	24.6
TOTAL	561	100

This study also determined that a total of 51,809 workers out of a total population of 1,434,089 working in these 4728 registered workplaces were exposed to carcinogenic substances. This represents 3.6% of the worker population examined. The majority of the exposed workforce were involved in the chemical (23.1%), machine building (13.9%), and the wood and building materials industries (12.2%) (personal communication). The main carcinogenic substances to which these workers were exposed were the following:

CARCINOGENIC SUBSTANCE	% WORKERS EXPOSED TO SUBSTANCE/TOTAL EXPOSED WORKERS
Tars, mineral oils, black carbon	29.7
Polycyclic aromatic hydrocarbons	29.3
Hexavalent chromium	14.2
Benzene	12.4
Asbestos	6.2
Vinyl chloride	2.4
Arsenic	2.4

Also observed by this study was the fact that the largest numbers of exposed workers were found in the following regions of Romania:

REGION	NO. EXPOSED WORKERS/TOTAL NO. WORKERS	MAIN CARCINOGENS
Salaj	16.8	polycyclic aromatic hydrocarbons, mineral oils
Prahova	10.9	
Vasluj	11.2	aromatic hydrocarbons, tars
Olt	13.5	
Bacau	8.9	

The distribution of workers exposed to various carcinogens compared to the total number of workers sampled for each region in Romania is given in Figure 1.

In addition to the presence of carcinogens in the workplace, ambient air, water, soil, and food concentrations of these substances must also be considered in any determination of the health hazard present in various parts of Romania. This gives an indication of the exposure of the general population rather than just the worker population to carcinogens. The levels of some of these substances in the air, water, and restaurant meals in various urban areas in each district of the country are given in tables 4, 5, and 6 respectively.

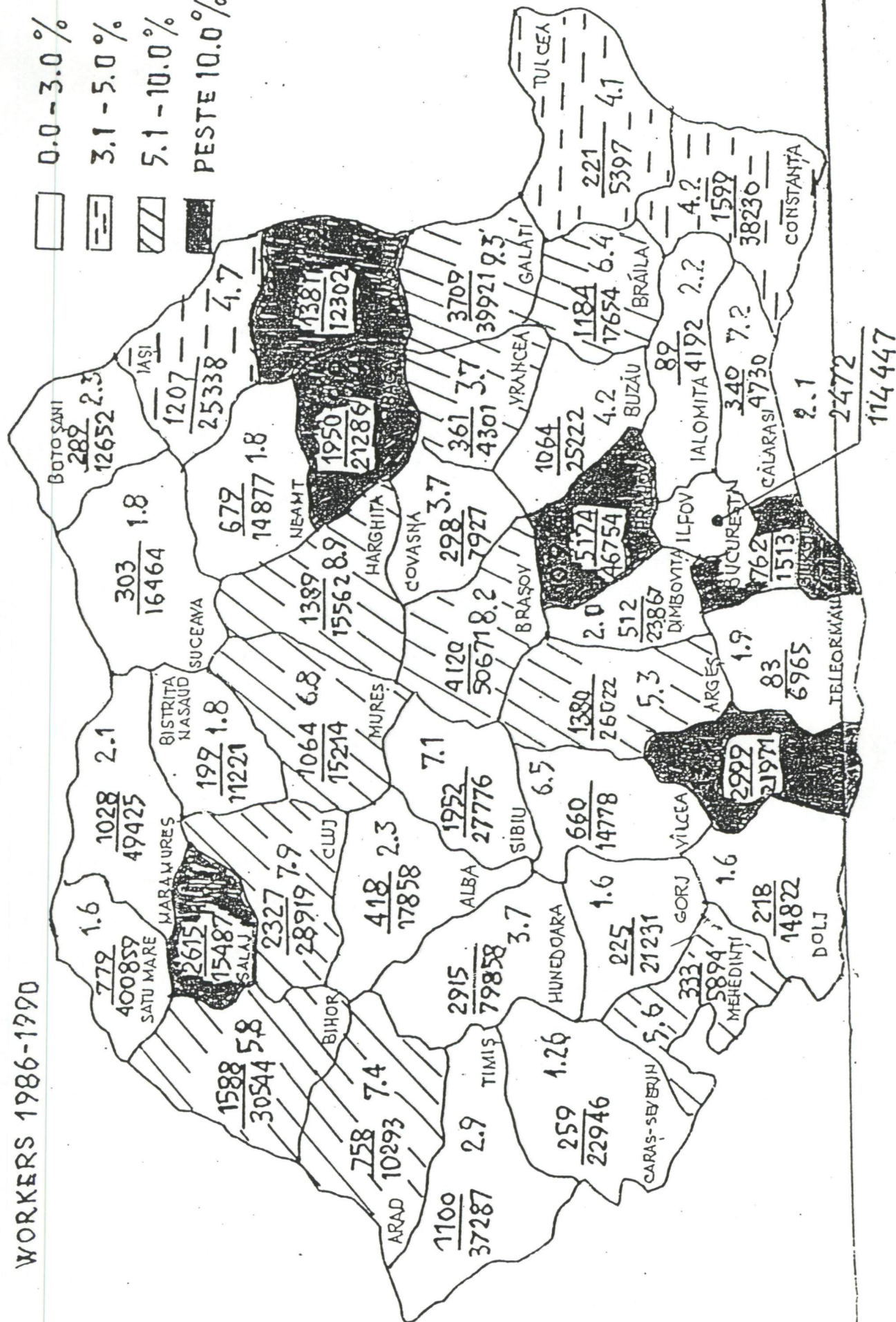
From table 4, it can be concluded that very high levels of carcinogens such as chromium, nickel, cadmium, benzopyrene, and asbestos are present in the air in Tg. Mures and Cluj Napoca. For example, cadmium levels in Cluj Napoca and Tg. Mures are 12,000 and 7000 times the national standard for this substance. In fact, cadmium levels in all urban areas except for Timisoara, Arad, and Resita, are at least 150 times the maximum permissible level. On the other hand, chromium levels in the air are within the standard in all regions.

Table 5 indicates that high levels of carcinogens in the water are found in Tulcea, Bacau, Botosani, and Suceava, particularly of nitrates in Tulcea and Suceava, benzopyrene in Botosani, and arsenic in Bacau. Table 6 concludes that high levels of carcinogens in foods are found in Pitesti and Braila, with high levels of nitrates in the former and nickel in the latter. In addition, high levels of cadmium are found in Craiova.

This information on the levels of carcinogens in various parts of the country can be superimposed on the cancer incidence and mortality data presented in other sections of this

FIGURE 1 DISTRIBUTION OF WORKERS EXPOSED TO VARIOUS CARCINOGENS

	0.0 - 3.0 %
	3.1 - 5.0 %
	5.1 - 10.0 %
	PESTE 10.0 %



DISTRIBUTION OF WORKERS EXPOSED TO VARIOUS CARCINOGENS

County	Number of Workers Exposed to											
	Carcinogenic aromatic			arsenic, azbestos, crom, aromatic, polyciclicol, hydrocarbon			Benzen			Vinyl clorids		
	a	b	c	a	b	c	a	b	c	a	b	c
Alba	-	-	-	160	45	-	4	-	-	-	-	-
Arad	-	-	-	526	468	11	-	-	-	-	-	-
Arges	52	52	-	562	69	-	11	11	-	-	-	-
Bacau	42	42	-	719	719	-	720	702	-	278	199	-
Bihor	-	-	-	1184	5	-	130	127	-	92	-	-
Bistrita	-	-	-	-	-	-	-	-	-	-	-	-
Nasau	-	-	-	78	-	-	-	-	-	-	-	-
Botosani	-	-	-	214	-	-	-	-	-	-	-	-
Brasov	60	32	4	1111	54	-	28	28	-	-	-	-
Braila	-	-	-	191	85	-	72	72	-	-	-	-
Buzau	-	-	-	850	361	16	-	-	-	-	-	-
Caras-Severin	-	-	-	-	128	-	24	-	24	-	-	-
Il	-	-	-	-	-	-	-	-	-	-	-	-
Calarasi	14	-	-	63	-	-	24	-	-	-	-	-
Cluj	-	-	-	625	469	36	441	359	-	230	230	-
Constanta	-	-	-	1086	41	-	131	-	-	-	-	-
Covasna	-	-	-	125	64	-	154	12	-	-	-	-
Dimvovita	-	-	-	313	97	-	37	37	-	-	-	-
Dolj	-	-	-	124	36	-	-	-	-	-	-	-
Galati	-	-	-	3413	-	-	286	106	-	-	-	-
Giurgiu	-	-	-	78	78	-	58	58	-	-	-	-
Gorj	-	-	-	124	57	1	-	-	-	-	-	-
Harghita	4	4	-	259	32	-	-	-	-	-	-	-
Hunedoara	-	-	-	1016	770	-	752	752	-	-	-	-
Ialomita	-	-	-	46	46	-	-	-	-	-	-	-
Iasi	-	-	-	250	17	-	605	605	2	78	35	-
Maramures	-	-	-	653	653	-	1	1	-	-	-	-
Mehedinti	-	-	-	142	137	-	-	-	-	-	-	-
Mures	30	30	-	813	292	2	30	30	-	-	-	-
Neamt	-	-	-	241	234	-	187	154	-	-	-	-
Olt	-	-	-	1770	-	-	24	24	-	-	-	-
Prahova	334	329	-	1943	324	7	463	463	14	-	-	-
Satu Mare	24	-	-	546	-	3	-	-	-	116	95	-
Salaj	79	-	-	2068	20	-	1	1	-	-	-	-
Sibiu	-	-	-	588	141	-	967	962	-	-	-	-
Suceava	-	-	-	44	44	-	-	-	-	-	-	-
Teleorman	-	-	-	49	-	-	3	3	-	-	-	-
Timis	12	12	-	172	54	-	607	607	-	-	-	-
Tulcea	-	-	-	242	228	-	-	-	-	-	-	-
Vaslui	-	-	-	163	-	-	-	-	-	-	-	-
Vilcea	-	-	-	16	16	-	164	164	-	471	471	-
Vrancea	-	-	-	89	62	-	-	-	-	-	-	-
Municipiul	-	-	-	-	-	-	-	-	-	-	-	-
Bucuresti	37	37	-	949	139	-	517	336	-	-	-	-
TOTAL COUNTRY	738	538	4	23321	5871	76	6441	5629	16	1265	1030	-

a - exposed workers
b - tested workers
c - workers found with suspicious changes

TABLE 4 LEVELS OF SELECTED CARCINOGENS IN AMBIENT AIR IN VARIOUS PARTS OF ROMANIA

CONCENTRATION OF CARCINOGENS IN AMBIENT AIR IN 36 COUNTIES

	County	Crom ug/m ³	Nichel ug/m ³	Cadmin nanog/m ³	Beaz nanog/m ³	Asbestos filing fibre/cm ³
1.	Constanta	0,08	0,11	40	8,0	0.010
2.	Ploiesti	0,09	0,12	12	6,0	0,013
3.	Giurgiu	0,09	0,06	4	4,1	0,008
4.	Braila	0,09	0,06	18	9,3	0,018
5.	Craiova	0,09	0,11	35	6,8	0,120
6.	Tulcea	0,25	0,10	27	18,1	0,006
7.	Buzau	0,03	0,05	4	7,0	0,002
8.	Tirgoviste	0,27	0,06	14	7,8	0,014
9.	Slatina	0,05	0,09	13	6,8	0,002
10.	Tg.Jiu	0,07	0,09	10	3,7	0,002
11.	Alexandria	0,04	0,04	13	0,91	0,003
12.	Bucuresti	0,09	0,07	16	5,3	0,008
13.	Pitesti	0,03	0,40	10	2,15	0,003
14.	Srasov	0,09	0,19	9,0	3,7	0,005
15.	R. Vilcea	0,15	0,81	16	0,8	0,032
16.	Timisoara	0,09	0,05	0,0	-	0,0002
17.	Arad	0,06	0,05	0,0	-	0,0003
18.	Resita	0,10	0,10	0,0	-	0,0005
19.	Oradea	0,12	0,13	24,0	1,85	0,1340
20.	Zalau	0,09	0,00	47	3,94	0,1570
21.	Bistrita	0,03	0,04	15,0	2,11	0,0320
22.	Alba Iulia	0,03	0,04	30	1,67	0,0440
23.	Sibiu	0,11	0,25	110	0,76	0,0390
24.	Satu Mare	0,04	0,89	40	0,66	0,0400
25.	Tg. Mures	0,17	0,09	147	-	0,1200
26.	Cluj Napoca	0,31	0,14	240	-	0,0600
27.	Baia Mare	0,20	0,25	45	-	0,0570
28.	Miercurea Ciuc	0,38	0,09	27	0,63	0,0710
29.	Galati	0,18	0,01	15	0,37	0,42
30.	Iasi	0,07	0,01	10	0,03	0,28
31.	Suceava	0,06	0,02	17	0,18	0,13
32.	Bacau	0,01	0,01	3	0,25	0,024
33.	Focsani	0,03	0,02	16	0,15	0,0216
34.	Vaslui	0,03	0,02	23	0,28	0,035
35.	Botosani	0,03	0,06	30	0,38	0,017
36.	Piatra Neamt	0,00	0,06	32	0,18	0,041
	Norms	0,07	0,10	5	10	0,001

**TABLE 5 LEVELS OF VARIOUS CARCINOGENS IN WATER OBTAINED FROM
VARIOUS REGIONS IN ROMANIA**

CONCENTRATION OF CARCINOGENS IN WATER OBTAINED FROM 33 COUNTIES

County	Arsen	Nitr-ates	Crom	Cad-miu	Ni-chel	Benz-piren	Pes-tici-des	Tri-halo-metane
1. Constanta	0	7,2	0,028	0,003	0,021	0,82	0,45	79,0
2. Giurgiu	0	14,7	0,019	0,002	0,016	0	0,07	13,5
3. Ploiesti	0	0	0,067	0,002	0,021	3,49	0,08	26,6
4. Tulcea	0	60,2	0,025	0,003	0,022	0,74	0,06	28,3
5. Braila	0,014	7,9	0,005	0,0001	0,015	0	0,04	43,8
6. Craiova	0	6,8	0,003	0,002	0,014	0	0,03	29,7
7. Tg.Jiu	0,017	0	0	0	0,007	67	0,07	11,5
8. Slatina	0,05	6,9	0,003	0	0,015	67	0,07	11,5
9. Tirgoviste	0	24,0	0,011	0,001	0,14	-	0,01	13,5
10. Buzau	0	0	0,019	0,001	0,15	0,3	0,03	18,8
11. Bucuresti	0,077	4,1	0,003	0,001	0,016	2,5	12,6	27,7
12. Rm. Vilcea	0	6,0	0	0,0004	0,013	0	1,09	37,5
13. Alexandria	0,16	2,3	0,006	0,0004	0,014	0	0,41	29,3
14. Brasov	0	14,0	0	0	0,014	0,70	1,05	18,8
15. Pitesti	0,015	2,7	0	0,0006	0,014	2,34	0,66	-
16. Oradea	0	3,8	0	0	0	0	0,09	-
17. Zalau	0	7,6	0,14	0	0,07	25,0	0,85	-
18. Bistrita	0	0	0,002	0	0,07	5,0	0,37	-
19. Alba Iulia	0	1,7	0,001	0	0	32,0	0,37	-
20. Iasi	0	10,0	0,002	0,0002	0,005	2,2	0,52	-
21. Galati	0,012	9,2	0,003	0,013	0,03	1,2	-	-
22. Suceava	0,012	37,8	0,012	0,047	0,04	3,3	-	-
23. Botosani	0	5,2	0,014	0,009	0,004	138,0	0,03	70,8
24. Piatra Neamt	0	7,0	0,03	0,002	0,004	40	0,07	33,5
25. Tg.Mures	0	2,0	0	0	0	-	6,86	-
26. Baia Mare	0	9,0	0	0	0	-	6,95	-
27. Cluj Napoca	0	6,0	0	0	0	-	1,12	-
28. M.Ciuc	0	-	0	0	0	-	0,82	-
29. Timisoara	-	-	0,010	0,002	0,011	-	3,0	-
30. Arad	0,02	-	0	0,101	0,02	-	-	-
31. Bacau	0,24	11,8	0,001	0,003	0,016	18,9	-	33,7
32. Pocsani	0	1,1	0,003	0,003	0,025	20,4	0,10	14,5
33. Vaslui	0	9,8	0,003	0,018	0,023	0,61	0,13	85,9
Norms	0,05 mg/l	45 m/l	0,05 mg/l	0,005 mg/l	0,10 ug/l	10 ng/l	0,5 ug/l	100 ug/l

**TABLE 6 LEVELS OF VARIOUS CARCINOGENS IN RESTAURANT MEALS FROM
VARIOUS PARTS OF ROMANIA**

CONCENTRATIONS OF CARCINOGENS IN RESTAURANT MEALS IN SELECTED CITIES IN ROMANIA

City	Nit- rates	Cd	Cr	Ni	Pesti- cides Organoclorurated	3,4-benz- piren	
	NO ³ mg/day	mg/day	mg/day	mg/day	HCH mg/day	DDT mg/day	ug/day
Ploiesti	927,5	0,030	0	-	0,050	0,075	-
Constanta	1265	0,006	0,092	-	0,010	0,075	-
Giurgiu	235	0,014	0	-	0,275	1,2	-
Braila	707,5	0,062	0,040	0,232	0,145	0,075	-
Craiova	86,25	0,8	0	0,10	0,047	0,007	-
Tulcea	81,25	0,010	0,026	0,06	0,132	0,010	-
Buzau	250	0,012	0,040	0,020	0,055	0	-
Tirgoviste	390	0,078	0,44	0,070	0,027	0,06	-
Slatina	114	0,080	0,032	0,070	0,090	0	-
Tg. Jiu	52,5	0,0016	0,004	0,046	0,007	0,25	-
Alexandria	1125	0,136	0,012	0,036	0,025	0,002	-
Brasov	0	0,026	0,012	0,026	0,092	0,025	-
Bucuresti	37,5	-	-	-	-	-	-
Pitesti	1907,5	0,1	0	0,032	0,045	0,025	-
Rm.Vilcea	-	0,1	0,020	0,10	0,15	0,1	-
Iasi	29,5	0,040	-	-	0,0158	0,059	0,186
Galati	76,3	0,018	-	-	0,388	0,084	1,357
Suceava	25	0,022	-	-	0,053	0,248	0,47
Botosani	89,5	0,012	0,186	-	-	-	0,544
Piatra Neamt	77,13	0,032	0,252	-	-	-	0,785
Bacau	46,5	0,062	0,036	-	0,06	0,17	14,7
Focsani	9,05	0,012	0,084	-	-	-	8,5
Vaslui	62,2	0,007	0	-	0,07	0,07	13,02
Norms	350	0,150	50	0,150	0,700	0,350	1

CONCENTRATIONS OF CARCINOGENS IN FOODSTUFF IN 27 COUNTIES*

County	HCH butter	mg/kg bacon	Lindan butter	mg/kg bacon	DDT butter	mg/kg bacon nina	Benz piren fish	mg/kg smoked meats
1. Ploiesti	2,0	0,27	0,29	0,19	0,8	0,07	3,50	0
2. Constanta	4,4	-	0,58	-	4,1	-	2,94	-
3. Giurgiu	0,7	0,10	0,10	0,03	0,0	0,0	-	0
4. Braila	0,9	0,42	0,63	0,90	0,6	0,5	0,18	-
5. Craiova	0,3	0,07	0,22	0,37	0,01	0,2	1,57	-
6. Tulcea	0,1	0,9	0,04	0,76	0,2	0,1	0	-
7. Buzau	0,5	0,15	1,40	0,15	0,0	0,15	0	-
8. Tirgoviste	0,05	0,10	0,02	0,03	0,0	0,10	-	0,46
9. Slatina	-	0,07	-	0,08	-	0,01	1,3	-
10. Tg. Jiu	0,02	0,05	0,02	0,02	0	0	0	-
11. Alexandria	0,24	0,04	0,06	0,06	0	0	0	0,8
12. Brasov	0,05	0,07	0,03	0,02	0,09	0,01	0	-
13. Bucuresti	0,28	0,87	0,33	0,44	0	0	0	0
14. Pitesti	0,15	0,13	0,20	0,08	0,05	0,4	-	0
15. Rm. Vilcea	0,29	1,54	0,3	0,06	0	0,06	-	-
16. Iasi	0,14	-	-	-	0,18	-	0,33	0,66
17. Galati	0,17	-	-	-	0,23	-	7,7	0,40
18. Suceava	0,46	-	-	-	0	-	4,4	0,12
19. Botosani	-	-	-	-	-	-	3,9	-
20. P. Neamt	-	-	-	-	-	-	10,4	3,27
21. Bacau	-	-	-	-	-	-	-	13,6
22. Focsani	0,05	-	-	-	0,07	-	-	2,9
23. Vaslui	0,11	-	-	-	0,08	-	-	2,4
24. Timisoara	0,03	-	0,25	-	0	-	-	-
25. Arad	0,22	-	0,63	-	0,06	-	-	-
26. Sibiu	0,03	0,06	0,16	0,08	0,46	0,37	-	-
27. Satu Mare	0,08	0,02	0,20	0,19	0,27	-	-	-
Norms	0,5	0,3	0,2	0,3	1,0	1,0	1	1

* As of July 1991 tests were carried out in only 27 out of 41 counties.

report to determine whether or not a correlation exists between the presence of these carcinogens and the incidence of cancer. However, it should be noted that many of the regions with high levels of carcinogens coincide with regions of high levels of other air, water, soil, and food pollutants (such as SO₂, ozone, and NO₂) which may act synergistically with carcinogens to impact health. Thus, levels of these non-carcinogenic substances must also be considered in any study analyzing the correlation between high cancer incidence and increased concentrations of carcinogens. In addition, the values for levels of carcinogens in various environmental media in various areas of Romania must be verified because, as mentioned earlier, the equipment and techniques used in measuring these substances may not be reliable and/or accurate. In spite of these caveats, it is obvious that a number of known carcinogens are present in many parts of Romania at levels which pose a very real threat to human health.

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ENVIRONMENT AND HEALTH OVERVIEW OF ROMANIA

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I was responsible for assessing and writing the sections concerned with environmental issues (p. 1-17, 25-37). I also participated in the development of the research proposal outlined in this report.

ENVIRONMENT AND HEALTH OVERVIEW OF ROMANIA

A. REGULATORY ACTIVITIES

1. Institutional Setting

Like most of its neighbors in Eastern Europe, Romania has been relatively slow in adopting and implementing environmental protection laws. Under the centrally-planned economy of the former regime, environmental concerns were regarded as a hindrance to economic development and were neglected in planning activities.

Nevertheless, environmental protection laws did exist on the books since 1973. Separate ministries were set up for each environmental sector (air, water, soil, forests) and a national Council of Environmental Protection was formed to deal with environmental issues. However, these ministries had little power over the industrial and economic sectors and were reduced to passive registration of information. This led to virtual lack of monitoring or enforcement of any environmental protection laws that did exist in the country.

In 1990, in response to heightened public awareness and concern for environmental issues, the newly-formed Romanian government created a new Ministry of the Environment. This ministry is consolidating the activities of the individual environmental sector departments and has authority for all environmentally-related matters. The Ministry of the Environment operates 41 regional environmental agencies in each county districts throughout the country which carry out the day-to-day monitoring, assessment, and implementation functions of the central ministry. In addition, a number of departments in other ministries (eg. health, industry) and research institutes have been given mandates to participate in environmental protection activities. Environmental education has also been given priority and an Ecological University was recently established in Bucharest to train students in the field of environmental management.

Currently, the government is considering changes to the existing environmental laws to emphasize enforcement activities and an integrated approach to environmental protection. Some of these changes have already been made. For example, starting in 1990, the government required all new firms to obtain an environmental permit before beginning operation. The permit is an 'Environmental Impact Assessment' (EIA) which must be prepared by the Ministry of Environment's Institute of Environmental Engineering. Eleven different impacts (eg. soil, air, water, health, forest, etc.) are considered in this EIA. The Ministry of Environment then decides whether or not the firm in question needs to implement controls. In addition, all new industrial plants are required to install sewage treatment plants approved by the Ministry of Environment.

The main objectives stated in the charter of the Ministry of Environment created in 1991 are as follows:

- (1) establish more resource-efficient and less wasteful economic policies - involves structural reform, additional policy analysis and research, incorporation of environmental objectives into national planning process
- (2) develop stronger national environmental regulations and enforcement procedures
- (3) increase government and non-government participation in environmental education
- (4) draft and promote ecological recovery projects for those areas damaged by pollution and other anthropogenic activities
- (5) increase the size and number of nature preserves and national reserves
- (6) diminish pollution in the Danube and the Black Sea regions through international programs

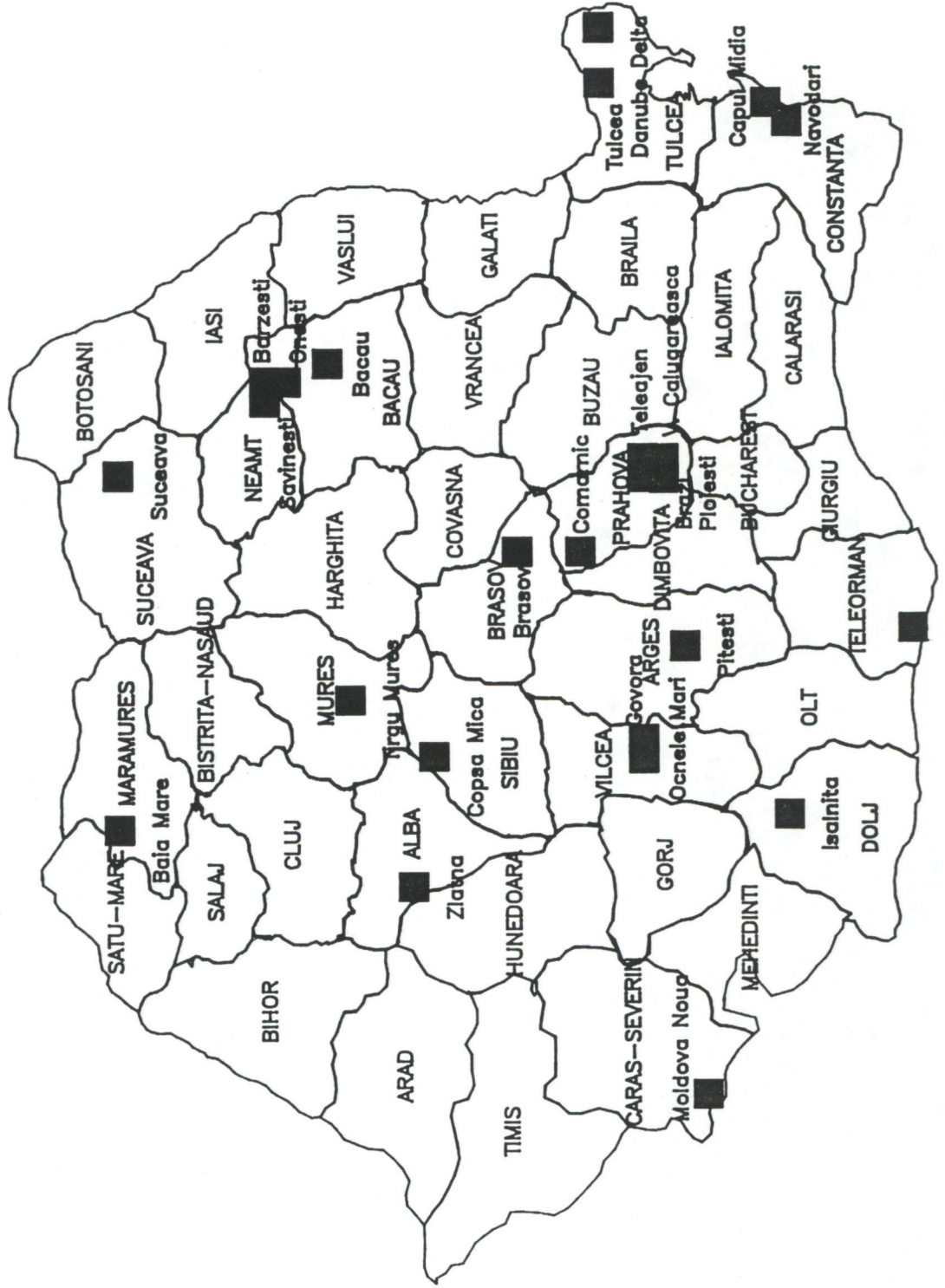
Environmental policies in Romania are directed toward both the restoration of those areas severely degraded by past human activities and in protecting relatively cleaner areas from future damage. There is a motion in parliament requesting that several regions that have been subjected to massive industrialization be declared environmental disaster zones. These are: Copsa Mica, Baie Mare, Zlatna, Moldova Noua, Ploiesti - Brazi - Teleajen - Valea Calugareasca, Comarnic, Borzesti - Onesti - Savinesti, Bacau, Dunarea - the Delta of the Danube - Northeast Coast of the Black Sea - Capul Midia - Navodari, Suceava, Pitesti, Tg. Mures, Turnu Magurele, Tulcea, Isalnita, Brasov, Govora - Ocnele Mari (see Map). Overall, the approach taken so far in environmental protection in this country is heavily leaning toward central control. While it is recognized that national environmental regulations and enforcement procedures are needed, it is important and timely that the concept of and the framework for market based incentives for environmental control be introduced in the portfolio of environmental management measures at the Government's disposal.

2. Monitoring/Implementation Activities

Environmental monitoring activities in Romania have been conducted since the 1950s. However, most of these endeavors were not done in a continuous and consistent manner. In addition, it is suspected that until recently, monitoring results that showed significant deterioration of environmental quality, particularly near industrial and energy-producing complexes, were probably destroyed. Thus, although considerable data are available on environmental quality, these must be viewed with caution.

ROMANIA

ECOLOGICAL DISASTER AREAS (PROPOSED)



Air Pollution

At the present time, there are three air pollution monitoring networks in Romania, operated by the Ministry of Environment and the Institute of Hygiene in the Ministry. These are:

- (1) the four stations that function as part of the World Meteorological Organization (WMO) Background Air Pollution Monitoring Network (BAPMON). These stations have been working since 1976 at Rarau, Fundata, Stina De Vale, and Semenice, all of which are located at altitudes above 1000 meters. The species measured include daily mean concentrations of SO_2 , NO_2 , and O_3 as well as NH_3 , H_2S , HCl , Cl_2 , and particulate levels. In addition, wet deposition is collected weekly and monthly and physical and chemical parameters such as pH, conductivity, acidity, alkalinity, atmospheric turbidity, and ionic concentrations of Na^+ , K^+ , Ca^{2+} , Mg^{2+} , SO_4^{2-} , NO_3^- , Cl^- , and F^- are measured (Ministry of Environment 1991, Loscutoff and Shafer 1991). Examples of the methods used in analyzing the concentrations of these parameters and species include potassium iodide colorimetric for O_3 and pararosaniline for SO_2 (Loscutoff and Shafer 1991);
- (2) Impact Pollution Monitoring Network - which consists of 50 sites located mainly around industrial/urban areas. Some of these sites are operated by the Ministry of Health (the Institute of Hygiene and Public Health) but there is talk of integrating them with the sites operated and coordinated by the Ministry of Environment. All of these sites have been in operation since 1988/1989 except for three locations which have 20 years of operating history. Monitoring of SO_2 , NO_2 , NH_3 , suspended matter, and particulates is conducted at all sites. In addition, in highly industrialized areas, specific pollutants such as H_2S , CS_2 , phenols, formaldehyde, lead, cadmium and HCl are also routinely measured (Ministry of Environment 1991); and
- (3) Acid Deposition Network - consists of 108 sites usually co-located with meteorological stations. Wet deposition samples are collected weekly and/or after every precipitation episode and the main species analyzed are pH, conductivity, and alkalinity/acidity (Loscutoff and Shafer 1991).

Water Quality

Water quality monitoring has had a longer history in Romania than air pollution measurements. The monitoring of water quality in this country is divided into two separate activities:

- (1) Black Sea monitoring (both north and south of the Danube Delta) - seven sites on the seashore and eight sites offshore are monitored with sampling conducted from March to October of each year. In general, organic matter and nutrient substances such as NO_3^- , NH_4^+ , and PO_4^- are monitored (Ministry of Environment 1991). Measurements

of Danube river and delta water quality have also been conducted for the past 20 years (personal communication).

- (2) Fresh Water Monitoring - the earliest environmental monitoring activity in Romania was of fresh water quality which was initiated in 1954. However, systematic measurements of this medium were begun only in the mid-1970s. Different methods and sampling intervals are used depending on the aquatic system under investigation.
 - (a) rivers: fast data flow method - water quality is monitored at 65 stations on a daily basis in order to determine critical pollution situations. A daily bulletin is issued by the Ministry of Environment specifying the location, nature, and extent of any exceedances of pollution standards as well as the name of the probable polluter. An example of this bulletin is shown in Table 1. At 15 of these stations, weekly monitoring of heavy metals is also conducted -- slow data flow method - more comprehensive monitoring than the fast flowmethod is conducted. 275 samples from first order control stations are analyzed on a monthly basis (Ministry of Environment 1991, personal communication)
 - (b) lakes: lakes are considered to be more stable ecosystems than rivers and, thus, are monitored only on a seasonal basis. Approximately 55 artificial and man-made lakes comprise this network (Ministry of Environment 1991).
 - (c) ground water: ground water is sampled 4 to 5 times a year at 280 stations with approximately 10 drillings conducted at each site.

Environmental Radioactivity

A national radioactivity monitoring network was established in Romania in 1962 and currently consists of 38 stations (Ministry of Environment 1991). The monitoring activities and methodology comply with those set by the International Agency for Nuclear Energy and the WMO. Radioactivity at each site is measured in the air (both aerosol and particulate concentrations), surface and ground water, soil, and natural vegetation. Special monitoring stations are also located around major nuclear facilities.

3. Monitoring/Analysis Equipment

Most of the equipment used in monitoring pollutant levels, particularly air and water quality, in Romania is of early 1970s vintage. These devices can measure most of the important and common pollutant species present in the air and water. However, they are likely in need of calibration and renewal that has not been done in recent years given the low status monitoring activities have had in the past. In general, efforts have been made by individual professional efforts to conform to international standards for

sample handling and chemical analysis but verification of whether or not this is the case in the field is urgently needed. When most of the monitoring equipment was installed, many of the senior technicians and scientists were trained in their use both abroad and in Romania by foreign experts. It is not clear how the subsequent generation of technicians have been trained; this needs further investigation.

Some analysis done as recently as 1990 by foreign experts on the reliability and accuracy of monitoring data, particularly that related to air and water pollutants, have, in general, concluded that the quality of such data is questionable at best. In most cases, analysis of collected samples is carried out at regional/district centers. The Ministry of Environment has under its control the 41 county agencies each of which controls the monitoring activities under its jurisdiction. Results of this analysis are then relayed to the Institute of Environmental Engineering in Bucharest, where this information is coordinated and compiled for the country as a whole. Although, in theory, all 41 agencies use the same techniques and equipment for sampling and analysis, in practice, it is likely that significant variations do exist. In addition, as handling of samples is critical to the quality of monitoring data, significant

potential for errors exist for this step alone. For example, in the case of acid deposition monitoring, it has been noted that wet deposition samples are carried, unrefrigerated, to regional laboratories and that samples may be stored for several months in this state before undergoing analysis (Loscutoff and Shafer 1991). This method of collection and storage could introduce significant uncertainty and errors to monitoring results.

Table 1

EXAMPLE OF A DAILY BULLETIN OF EXCEEDANCE OF WATER QUALITY STANDARDS

Control station	Water course	Monitored section	Quality index	Norms mg/l used	Measured value	Potential polluting mg/l sources
1	Bistrita	Viisoara	Disolved oxygen	1.0	1.5	CGCL Bistrita
2	Somesul	Someseni mic	Disolved oxygen	1.0	3.5	Pharmaceutical plant
3	Crisul	Tarian Repede	Disolved oxygen	4.0	3.5	CGCL Oradea
4	Mures	av. Tirgu Mures	Amonia	1.0	1.9	CGCL Tirgu Mures
			Nitrates	10.0	10.9	IJGCL Tirgu Mures
5	Mures	Cipao	Amonia	1.0	2.6	CICU Tirgu Mures
			Nitrates	10.0	20.0	ISCIP Iernut
			Nitrates	1.0	1.2	
6	Mures	amonte Aiud	Minerals	1200.0	1340.0	CPS Ocna Mures
			Chlor	300.0	372.0	
7	Mures	am. Alba India	Chlor	300.0	319.0	CPS Ocna Mures
8	Bega	Utelec	Organic substances	4.0	0.1	CGCL Timisoara
			Amonia	10.0	13.0	
9	Birzava	aval	Cyanides	0.01	0.031	CS Resita
10	Ialomita	Cosimbesti Resita	Disolved oxygen	5.0	1.9	CICH Slobozia
			Organic substances	15.0	18.0	ISCIP
			Amonia	3.0	13.5	
11	Buzau	aval Buzau	Organic Substance	10.0	13.3	IJGCL Buzau
						Natural Causes
12	Bisirita	Rozonov	Organic	25.0	85.3	ICHC Piatra Neamt
13	Bisirita	Zanesti	Amonia	3.0	8.6	Industrial Complex
						Savinesti-Roznov
14	Bisirita	Serbanesti	Organic substance	15.0	32.0	ICHC Piatra Neamt
			Amonia	3.0	12.9	Platf. Industriala
						Savinesti-Roznov
15	Siret	Galbeni	Organic Substance	25.0	56.0	EGCL Bacau; ISCIP
			Amonia	10.0	11.7	Bacau CICH Bacau
16	Trotus	aval Borzesti	Chlor	300.0	319.0	Petrochemicals
			Phenols	0.05	0.07	Borzesti
17	Birlad	aval Vaslui	Organic substance	10.0	14.9	IJGCL Vaslui
						Animal products
18	Vasluiet	aval Vaslui	Disolved oxygen	6.0	1.7	IJGCL Vaslui
			Organic	10.0	32.0	Agricultural products
			Amonia	1.0	7.3	Vaslui
19	Birlad	aval Tecuci	Organic substance	25.0	54.0	Alcohol proudcts
20	Bahlui	Holboca	Disolved oxygen	6.0	0.0	ISCIP Tomesti
			Organic substance	10.0	72.0	GIGCL Iasi
			Amonia	1.0	16.3	

There is urgent need for verification and comparison of samples collected and analyzed using existing Romanian equipment against those using modern equipment and technologies. In addition, upgrading of analytic equipment, handling techniques, and sample collection processes is required along with training of scientists and technicians in the latest monitoring methods. Finally, a process needs to be implemented and enforced whereby coordination and consistency among the various sites in the network is introduced.

The absolute values of monitoring data cannot be relied upon under these circumstances. However, the trends of air and water quality and radioactivity levels over the past few decades for which data are available as well as the qualitative analysis of the collected samples are likely to prove very useful in assessing the overall environmental status of this nation.

B. ENVIRONMENTAL QUALITY

1. Physical Setting

Romania occupies a total land area of 237,000 km² and has a population of over 23.5 million. The diversity of landforms and physical features in this country has led to the presence of a wide variety of natural resources and of considerable economic development potential. It is situated on the southeastern portion of the European continent, centered on the Transylvanian plateau around which the Carpathian Mountains form a series of crescents. Beyond these crescents, on the south and east, exist fertile plains, with the Danube forming the country's southern border and the Black Sea its southeastern boundary. The proportion of mountains, plateau, and plains are evenly divided, with one-third of the country occupied by each of these features (Ministry of Environment 1991, Encyclopedia Britannica 1979).

2. Pollutant Emissions

Romania emerged from its centrally-planned, communist-oriented rule with significant environmental damage, much of which is still in progress due to the high pollutant loading in the soil, air, water, and vegetation. This situation is largely the result of the haphazard development of huge industrial complexes with no emission controls, the use of outdated, inefficient, energy-intensive equipment in the industrial and energy sectors, lack of maintenance of such equipment, use of highly polluting brown coal, and the virtual ignorance of environmental laws and concerns. Much of Romania's economic progress during the past two decades has been achieved through rapid industrial development, especially of the chemical, metallurgical, and building materials industries. The growth in importance of the industrial sector in general is illustrated in the facts that the percentage of the population employed by this sector grew from 23% in 1970 to 38.1% in 1989 and that the industrial sector contributes over 58% to the net national income of the country (Ministry of Environment 1991).

Another factor contributing to environmental degradation in Romania has been the increased use of chemical fertilizers and pesticides in the agricultural sector. Agriculture plays an important role in the economy of this nation with 62% of the land area classified as farmland. Poorly planned and executed irrigation of these lands has also increased rapidly over the past few decades and leads to further soil erosion and environmental degradation.

The total quantity of environmental pollutants discharged into the air, water, and soil in 1989 was estimated to be 418 million tonnes (Ministry of Environment 1991). This represents a 15% increase from 1985 alone. Of this 418 million tonnes, 30% was emitted into the air, 68% into the soil, and 2% into water systems. The bulk of this pollution load is ash deposited in the soil and CO₂ emitted into the air resulting from uncontrolled coal burning. These pollutants are not deposited or emitted evenly across the country but rather are concentrated in certain parts of Romania. It is estimated that, at present, 10% of the country's surface and 4.0-4.5% of its population is directly impacted by significant levels of soil and water pollutants (Ministry of Environment 1991). In addition, 0.9 X 10⁶ ha of land area is further affected by air pollutants from industrial sources (personal communication). This is in addition to the impact of locally produced air pollutants such as acid deposition and ozone which affect the country as a whole.

Air Pollutants

In 1989, approximately 138 X 10⁶ tonnes of pollutants were released into the air in Romania from anthropogenic sources. The bulk of these substances are CO₂, SO₂, NO_x, NH₃, and phenols with 65% emanating from the power sector, 11% from the metal engineering industry, and 5% each from the chemical and building materials industries (Ministry of Environment 1991). Although emitted in smaller quantities, other air pollutants such as volatile organic compounds (VOC) and particulate matter, including that containing heavy metals such as cadmium and lead, are of greater concern from a human and environmental health perspective. In certain areas, especially enough in the vicinity of petrochemical complexes, levels of such substances can be high to impact human health. The precise quantity of such air pollutants released into the atmosphere is not known because of the suppression of the release of such information by the previous government and the absence of current compilation of accurate national inventories for such substances. Some estimates have, however, been made, particularly for emissions of SO₂ and NO_x.

A Ministry of Environment report (1991) indicated that approximately 1.65 X 10⁶ tonnes of SO₂, 1.75 X 10⁶ tonnes of NO_x, and 132 X 10⁶ tonnes of CO₂ were emitted into the air in Romania in 1989. Quantities of emissions of other pollutants were also compiled and are shown in Table 2. A U.S. National Academy of Science mission to Romania in 1990, however, calculated that annual SO₂ emissions were in the order of 7.4 X 10⁶ tonnes and NO_x emissions were approximately 0.59 X 10⁶ tonnes annually (Loscutoff and Shafer 1991). Another study indicates that SO₂ emissions in Romania in 1982 amounted to 2.0 X 10⁶ tonnes (Highton and Chadwick 1982). The range of these estimates indicate the large uncertainties present in determining emission levels at this time.

Further, in-depth research and analysis is urgently needed to determine accurate emission inventories of various pollutants in Romania.

In addition to its domestically-produced emissions, Romania also receives considerable amounts of air pollutants from its neighbors, further adding to its pollutant load. It has been estimated that approximately 75% of the SO₂ deposited in Romania originates from outside the country (Dovland 1987). However, Romania also exports pollutants to its neighbors, with 59% of all SO₂ emissions emitted in the country transported to surrounding countries.

Table 2

QUANTITIES OF VARIOUS AIR POLLUTANTS EMITTED IN ROMANIA IN 1989
(from Ministry of Environment 1991)

POLLUTANT	QUANTITY EMITTED (1000 tonnes)
CO ₂	132,000
NO _x	1,750
SO ₂	1,650
NH ₃	8.5
CS ₂	5.5
Phenols	2.3
Others	2,600
TOTAL	138,000

Water Pollutants

It is generally believed that the most critical environmental problem facing Romania at present is the degradation of its water quality. Approximately 6×10^6 tonnes of wastes were discharged into Romanian waterways in 1989 with the majority of these consisting of untreated human sewage, industry and mining wastes, and agricultural runoff (Ministry of Environment 1991). All of these have contributed to the severe degradation of Romania's extensive aquatic ecosystems. The dominant water pollutants are chlorides, sulfates, bicarbonates, organic matter, phenols, nitrates, detergents, pesticides, phosphates, and hydrogen sulfides. Organic matter emanates mainly from the discharge of municipal wastes whereas the other substances are mainly the result of industrial and agricultural releases. It is estimated that 60% of all discharges into water systems are inadequately treated while another 30% are not treated at all (Ministry of Environment 1991, personal communication).

Soil Pollutants

The largest quantity of anthropogenic pollutants are discharged into the soil system with 274×10^6 tonnes of such pollutants released in 1989 (Ministry of Environment 1991). The majority of such discharges consist of mine wastes, chemical fertilizers, pesticides, and acid deposition. Over 75% of such pollutants emanate from the mining industry alone. In addition, a significant quantity of untreated waste water ends up in the soil system. Soil erosion, although not a pollutant problem in the strictest sense, adds to soil degradation in many areas. Approximately 4×10^6 ha of the surface area of the country suffers from soil erosion to some extent with 1×10^6 ha having erosion rates over 10-15 tonnes/ha/yr (Ministry of Environment 1991).

3. Ambient Pollutant Levels

The relatively high levels of pollutant emissions, particularly in localized regions of the country, make it inevitable that ambient pollutant concentrations would be high as well. This is true of Eastern Europe in general where air, water, and soil pollution levels are among the highest in the world.

Air Quality

Romania adopted air quality standards in 1987 for a variety of pollutants and for various time intervals. These are given in Table 3. It should be noted that these limits are, in general, within the U.S. and WHO standards, but their enforcement has not been achieved like in most developing countries.

Air quality varies widely from region to region. Precipitation acidity has been found to average between 4.0 and 7.0 in most parts of the country with sulfate levels usually between 1.0 to 3.5 mg/l (Ministry of Environment 1991, Loscutoff and Shafer 1991). Although precipitation pH levels in Romania are much higher than those in most parts of Europe and North America where environmental damage has been noted, sulfate concentrations in precipitation in Romania are comparable to these affected areas in the West. Within Romania, highest precipitation acidity is found in the northwestern part of the country likely indicating transport of acidifying compounds from the Western direction. Other areas of high acid deposition levels are located in the vicinity of chemical and non-ferrous metallurgical plants. At sites near cement plants, on the other hand, alkaline rains are common with pH as high as 8.8 (Ministry of Environment 1991).

With regard to other air pollutants, in urban areas without large industrial complexes, levels of pollutants typically are as follows:

SO ₂	-	1-20 ug/m ³	
NO _x	-	10-100 ug/m ³	
NH ₃	-	10-100 ug/m ³	
particulates	-	> 150 ug/m ³	

The higher concentrations are usually found to occur in the winter months in these areas.

In highly industrialized areas, the concentrations and characteristics of air pollutants are significantly different and are dependent on the nature of the predominant industry in the region under investigation. In non-ferrous metallurgical industrial areas such as Copsa Mica, Baia Mara, and Zlatna, ambient air quality is as follows:

- SO₂ - very high levels with average concentrations exceeding 300 ug/m³ and peaks greater than 500 ug/m³
- heavy metals - include As, Pb, Cd, Zn, Cu, and Sn - concentrations average over 0.7 ug/m³ for Pb and over 0.02 ug/m for Cd with peaks often reaching 140 ug/m³ for Pb and 4 ug/m³ for Cd - these peaks are 200 times the maximum admissible level by Romanian standards
- suspended matter - often averages over 120 ug/m³ with peaks reaching 300 ug/m³

Table 3

AIR QUALITY STANDARDS IN EFFECT IN ROMANIA SINCE 1987
(Ministry of Health, 1989)

Polluting substance	Maximum air admissible concentration ug/m ³			
	Short-term average 30 min	Daily	Long-term average Monthly	Annually
- Suspended particles	500	150	-	75
- Coal dust	150	50	-	-
- SO ₂	750	250	-	60
- NO ₂	300	100	-	40
- Ammonia	300	100	-	-
- Aldehyde (CH ₂ O)	35	12	-	-
- Chlor	100	30	-	-
- Chlorohydric acid	300	100	-	-
- Fluor:				
- soluble inorganic gaseous components	15	5	1,2	-
- insoluble inorganic	-	30	-	-
- Phenol	100	30	-	-
- Mercaptan methyl	-	0,01	-	-
- C ₂ SO ₃	30	5	-	-
- Plumb	-	0,7	-	-
- Crom (CrO ₃)	-	1,5	-	-
- Cadmium	-	0,02	-	-
- Deposited particles	-	-	17gm ² /month	-

In areas with a predominance of chemical and petrochemical industries which are spread throughout the country, the concentration and mix of air pollutants is significantly different. The specific areas and their characteristic air quality patterns are as follows:

AREA	POLLUTANTS
Fagaras, Borzesti, Savinesti, Dej	High levels of SO ₂ , NO _x , HCl, H ₂ SO ₄ , NH ₃ , phenols, and organic chlorinated aldehydes.
Midia, Ploiesti, Brazi, Teleajen	Predominance of hydrocarbons, fluorine, SO ₂ , NO ₂ , soot, and phenols.
Pulp and paper mills and synthetic fiber factories - Dej, Braila, Lupeni, Suceava	SO ₂ , H ₂ , CS ₂ .
Chemical fertilizers - Arad, Tirgu Mures, Isalnita	NH ₃ mostly.
Hunedoara, Calan, Resita, Galati, Calarasi	Predominantly iron oxides with levels of non-ferrous metals such as Pb, Cd, Zn, Cu, V, and Cr often exceeding 100s of ug/m ³ .
Chlorosodium plants - Rimnicu Vilcea, Ocna Mures	High levels of chlorides and HCl (and NH ₃ in some areas which neutralizes the HCl).
Coal-burning power stations - Rovinari, Turceni, Minta	High levels of As, Cd, Pb, Mn, Mg, V, SO ₂ , NO ₂ , CO ₂ , and CO. Also produce large amounts of ash with radionuclide concentrations 2 to 3 times levels in the soil.
Oil-burning power plants	High levels of SO ₂ with moderate levels of NO ₂ , CO, and CO ₂ .

Bucharest has its own characteristic air pollution situation. This metropolitan area has a unique combination of industries, power generating plants, mobile sources, and residential/commercial heating systems. Its air quality can be characterized as follows:

- (a) moderate concentrations of SO₂, with levels usually between 5 and 60 ug/m³ and peaks of 130 ug/m³
- (b) relatively high levels of NO_x, especially near high volume traffic areas - levels of this pollutant often exceed 300 ug/m³
- (c) high concentrations of NH₃, with levels often reaching 1000 ug/m³

- (d) high levels of lead, which are also associated with large concentrations from mobile sources. Concentrations are often in the 2.0 to 3.5 ug/m³ range with peaks of 80 ug/m³
 - (e) high concentrations of cadmium with average levels of 3 to 32 ug/m³ and peaks of 250 ug/m³
 - (f) high acidity levels
- (Ministry of Environment 1991, personal communication)

Ambient Water Quality

Water quality conditions in Romania have deteriorated rapidly over the past few decades and pose a severe threat to both ecological and human health. The condition of water quality depends to some extent on the type of water resource under investigation and it shows the following characteristics:

River

Water -- waters are divided into four categories or classes depending on their quality. Currently, 41% fall into the first or best quality, 20% into the second category, 10% into the third, and 21% into the worst or 'dead' category (Ministry of Environment 1991). Other estimates have indicated that less than 20% of waterways in Romania provide drinkable water at present (Tye 1990). The most serious river water conditions occur in the hydrographical basins of Ialomita (with 52% in the 'dead' category), OLT (43%), Siret (31%), Vadea (23%), and Mures (22%) (Ministry of Environment 1991). Over the past few years, there has been a progressive reduction in the proportion of waters falling into the first category and an increase in the share of those in the 'dead' category. High levels of NH₃, nitrates, heavy metals, phosphates, pathogens, pesticides, and organic matter are the predominant cause of this water quality deterioration in the rivers. In the Danube, levels of petroleum-related substances are also high. Much of the river water degradation is the result of the discharge of untreated sewage, mining, industrial, and agricultural wastes into river channels. Although there are 4000 sewage treatment plants in existence at present, only 25% are in good working order, with the result that only 10% of waste water from municipal, mining, industrial, and agricultural activities are adequately treated (personal communication). The majority of the existing waste treatment plants are 10 to 15 years old and many cities, including Bucharest, still do not have any sewage treatment plants at all.

Lakes --

The majority of lakes analyzed to date in Romania fall into the first water quality but a significant number can be classified as being in the third and 'dead' classes. Much of the contamination of lake water in this country is the result of high concentrations of organic substances. Most

of the degraded lakes are located in Olt, Siret, and in the Deltaic lakes of the Danube (Ministry of Environment 1991).

Ground

Water -- From 1985 to 1989, it has been noted that concentrations of NH_3 , nitrates, and organic substances in groundwater have progressed from a diffuse impurity to widespread contamination (Ministry of Environment 1991). Also, greater concentrations of pesticides, lead, zinc, cadmium, phenols, manganese, pathogenic germs, and phosphates are currently present in these waters. In urban areas, 90% of wells investigated were found to have levels of bacteria exceeding permissible limits. In addition, 70% of these wells contain water with nitrate concentrations over 100 mg/l (maximum permissible level in Romania is 45 mg/l). An increase in groundwater temperature in urban and industrial areas has also been noted in recent years which has the indirect effect of accelerating the dissolution of rock minerals (Ministry of Environment 1991). As with the case of river and lake water, most of this contamination of ground water is due to the lack of sewage treatment plants, heavy agricultural use of pesticides and fertilizers, and untreated industrial and mining waste discharges.

Soil Quality

A significant portion of the soil in Romania has been seriously degraded through heavy use of chemical fertilizers and pesticides, large discharges and emissions from chemical and metal-processing plants, and considerable use of waste water for irrigation. The latter, in addition to contaminating the soil with pollutants, also increases soil salinity concentrations. DDT residues in the soil are high in Romania and often exceed maximum admissible levels (>0.10 ppm). The highest levels of DDT have been observed in Bacau and Constanta where levels often reach 0.6 ppm (Ministry of Environment 1991). This substance was banned in Romania in 1985 and levels in the soil are beginning to decrease in most areas, but a substitute chemical, lindan, is heavily used, and is appearing in high concentration in food.

In the vicinity of non-ferrous metallurgical plants, levels of Cu, Pb, Zn, Co, Mn, and Ni are often high. These areas include the Tirnava Mare Valley, Copsa Mica, Baia Mare, and Ferneziu Valley. In the latter, lead levels exceed 3 g/kg of soil (Ministry of Environment 1991). Near oil wells, soils have been observed to contain high concentrations of oil residues. This is especially true in Arges, Braila, Teleorman, and Vilcea.

Another problem related to soil quality in Romania is that of soil erosion, which affects 2.7×10^6 ha of agricultural land, with an average erosion rate of 16.3 t/ha/yr. It is estimated that 30% of arable land in this nation is currently eroded. This high erosion rate, which, in addition to removing soil particles, also transports toxic substances contained in the

soil layer, contributes to aquatic pollutant loads and eventually impacts the Danube Delta and the Black Sea (Rautza, Corneliu: Paper presented at the National Symposium 29.30.1991 Romanian Agriculture - Agriculture and the Environment).

Radioactivity Levels

The main finding of radioactivity monitoring activities over the past three decades in Romania was the 6 to 15 fold increase in atmospheric radioactivity (particularly of cesium and strontium levels) observed after the Chernobyl accident ((Ministry of Environment 1991, personal communication). Similar increases in radioactivity were noted in surface waters and natural vegetation. In addition, high levels of cesium were observed in milk and meat throughout the country, particularly in Caras-Severin (personal communication).

High concentrations of uranium and radium have also been found in river water and sediments where industrial water from uranium mines and radioactive ore processing plants are discharged. In most cases, these levels are higher than background concentrations but do not exceed maximum admissible values. In the vicinity of coal burning power plants, radioactivity levels above background values have been observed in ash and slag deposits. These deposits are often used as building and construction materials, thereby spreading radioactive contamination. Radon concentrations have also been found to be higher than background levels in many parts of Romania, especially in Alba, Buzan, and in isolated portions of Cluj, Suceava, and Bucharest (personal communication).

Ambient levels of radioactivity in uranium mines (Romania is a significant producer of uranium) are relatively high; 20% of such mines exceed industrial standards for radiation exposure, with levels up to 7.5 rad/yr. (international standards range from 2 to 5 rad/yr.) (personal communication). Radon concentrations in non-uranium mines have also been observed to be high, with 41.7% of those monitored exceeding the standard of 0.029×10^{-10} Ci/l (personal communication). This is mostly the case in mines, whenever ventilation is not practiced. Other than in coal mines, most of the highest radiation levels in non-uranium mines have been observed in Suceava, Bihor, Hunedoara, Maramures, and Tulcea, with 3.3% of these mines having radon levels from 0.30×10^{-10} to 2.04×10^{-10} Ci/l.

Finally, ground water used to pump oil out of drilling holes has been found to contain high levels of radium-236. Concentrations often reach over 1500 pCi/l (standard is 4 pCi/l) (personal communication). This water is usually reintroduced into the ground but on occasion, is spread over farmland, thereby contaminating the soil, agricultural crops, and livestock.

C. OVERVIEW OF THE HEALTH SITUATION AND MAJOR CAUSES OF DEATH IN ROMANIA

Romania is a country characterized by low life expectancy and high infant and maternal mortality rates. A relatively high proportion of the population is middle aged; there are relatively few young adults. Although overall mortality rates are relatively stable, many environment-related diseases are increasing. Major causes of death in 1989 were cerebrovascular disease, chronic heart disease, cancer and chronic obstructive pulmonary disease.

Environment-related disease show considerable variability across regions, with extremely high rates noted in highly industrialized and environmentally polluted areas such as Arad, Buzau, Teleorman and Bihor. Stomach cancer and chronic heart disease mortality rates are among the highest in the world.

1. Health Status

Life Expectancy

The life expectancy at birth for a male Romanian in 1989 was 67; the corresponding life expectancy for females was 73. While comparable to those of surrounding countries, these figures are approximately seven years lower than those noted in developed countries.

Population Age Distribution

The age distribution has a tendency to form a rectangle, with six percent in each five year age group. Compared to developed countries, the proportion of the population who are young adults (aged 15-34) is lower and the proportion who are middle aged population (35-65) is higher - a phenomenon resulting from high mortality among younger age groups and a declining birth rate.

Birth Rate

The birth rate has decreased by an average of 1.5% a year since the early 70's to a rate of 16 births per 1,000 population in 1990. Still, Romania's birthrate is the highest in Europe except the USSR and Albania. Within Romania, Vaslui, Iasi and Botosani have the highest birth rates. Since they also have low mortality rates, these regions have the highest natural population increase.

Infant Mortality Rate:

In 1989, infant mortality rate was 27 per 1,000 live births; the under age 5 mortality rate was 34 per 1,000 person years. Both of these rates are the highest in Europe. Over one-third of these deaths were caused by disease of

the respiratory system, with a large portion of these deaths resulting from chronic obstructive pulmonary disease - an environment-related disease.

Maternal Mortality Rate:

In 1989, there were 588 maternal deaths in 1989, or 159 deaths per 100,000 live births. This rate is not only the highest in Europe, but is also more than double the rate of any surrounding country. More than 87% of maternal deaths in this country result from complications of medically-induced abortions.

2. Major Causes of Death

General Mortality

Mortality rate increased steadily from the early 1960's until 1985. Since then mortality rates have plateaued. In 1989, the overall mortality rate was 1,068 per 100,000 population. The leading causes of death in 1989 were diseases of the circulatory system, neoplasms, disease of the respiratory system, injuries and accidents and diseases of the digestive system. Arad, Giurgiu, Mehedinti and Teleorman are the regions with the highest mortality rates. Because of high mortality rates, the Arad region suffered a natural decrease of 1.4 per 1,000 population in 1989.

Disease of the Circulatory System

In the past thirty years, mortality rates for diseases of the circulatory system have increased monotonically from 369 per 100,000 to 618 per 100,000 population. Currently, circulatory disease death rates in Romania, while similar to those of surrounding countries, are approximately double those of developed countries.

Prevalence rates are highest in the Arad region, followed by the Hunedoara and Buzau regions. Other regions with an elevated prevalence of circulatory diseases are Bihor, Caras-Severin, Mehedinti and Teleorman. These regions have prevalence rates roughly double those of the national average.

Since 1980, cerebrovascular disease has become the leading cause of death in Romania. The average annual increase rate of this disease is 1.5% for the past 20 years. Although death rates for stroke are slightly lower than in surrounding countries, it is more than double those of developed countries. Unlike most developed countries which have experienced a continuous decrease, death rates for acute myocardial infarction have remained constant over the past 10 years. In fact, Romania has an acute myocardial infarction mortality rate lower than most European countries.

Chronic heart disease mortality rates are higher than those observed in most European countries as well as most of the world. In the past twenty years, chronic heart disease death rates have tripled, increasing from 40 per 100,000 to 130 per 100,000 population.

Arad has the highest chronic heart disease prevalence rate in Romania. Except for Buzau and Teleorman, which rank second and third respectively, Arad has a prevalence rate which is more than double that of any other region and is four times higher than the national average.

Mortality rates for cardiovascular disease in Romania are the highest in the world. Apart from possible errors in reporting the causes of death, this suggests either high cardiovascular disease incidence rates or low survival rates, or both. While low survival rates usually relate to the poor availability of a good health care system, high incidence rates usually indicate a high prevalence of risk factors. An epidemiological study is urgently needed to examine this issue.

Neoplasms

Cancer incidence rates in Romania, are in general lower than the world average and most European countries (see Maps). However, stomach cancer rates in Romania appear to rank higher than those of neighbouring countries. At present, cancer mortality rates in Romania rank lower than the world average, but are rapidly rising. As shown in Tables 4-7, from 1960 to 1989, the cancer mortality rate increased 30%, from 109 per 100,000 to 142 per 100,000 population.

High cancer mortality rates were clustered in the northwest and in municipiul Bucuresti. The Arad, Bihor, Maramures and Bucuresti regions not only had the largest increase in rates, but also had the highest cancer mortality rates in the country. The Maramures region experienced an extremely large increase in female cancer mortality. High stomach cancer mortality regions were clustered in the north.

These included Arad, Bihor and Bistrita-Nasaud. Bistrita-Nasaud had the most rapid growth in stomach cancer mortality for both sexes in Romania. Regions with high lung cancer mortality were dispersed throughout the country. Municipiul Bucuresti had the highest mortality rates, but Dimbovita experienced the largest increase in lung cancer mortality for both sexes. Arad and municipiul Bucuresti had the highest bladder cancer mortality, while Covasna lead the nation for kidney cancer mortality rates. Overall, the regions with the largest percent increase were in the highest or second highest quintile of mortality rates; conversely the regions with the largest percent decrease tended to be in the lowest or second lowest quintile.

Table 4

ROMANIA : CANCER MORTALITY, PERCENT CHANGE
1979-1983 TO 1984-1988, MALES

Region	Stomach	Lung	Bladder	Kidney	Colorectal
1 ALBA	-16.4	11.2	54.9	-48.4	-9.3
2 ARAD	0.3 **	23.6	92.9 **	25.6	35.7
3 ARGES	-18.0	36.9 *	-3.4	29.8	26.2
4 BACAU	-19.9	5.7	201.3 **	36.7	27.0
5 BIHOR	-11.0	33.0 *	52.9	110.0 *	13.6
6 BISTRITA-NASAUD	11.3 **	5.2	59.4 *	-37.8	20.2
7 BOTOSANI	-17.4	22.0	26.7	127.2 *	48.6 **
8 BRASOV	-17.6	22.1	30.8	28.5	39.6 *
9 BRAILA	-25.0	39.2 *	74.4 *	3.9	-44.0
10 BUZAU	-62.2	45.9 **	118.7 **	22.4	-27.8
11 CARAS-SEVERIN	-2.3 **	12.5	33.4	496.2 **	51.8 **
12 CALARASI	-24.5	8.5	36.7	-21.6	-10.7
13 CLUJ	-12.5	19.8	33.0	50.9 *	33.3
14 CONSTANTA	-11.7	5.9	26.9	40.9 *	15.8
15 COVASNA	-11.7	11.3	-36.7	66.5 *	8.7
16 DIMBOVITA	-24.2	42.3 *	18.8	-76.6	-25.1
17 DOLJ	-8.0 *	43.8 **	66.7 *	-40.9	11.5
18 GALATI	-34.9	-2.1	11.0	21.2	-4.5
19 GIURGIU	-4.3 *	14.1	-42.4	32.9	90.9 **
20 GORJ	-28.4	-17.0	20.9	-100	-1.9
21 HARGHITA	-38.9	18.9	26.7	40.2	37.0 *
22 HUNEDOARA	-41.5	19.6	-11.6	11.2	34.5
23 IALOMITA	11.9 **	16.9	-10.3	19.6	56.5 **
24 IASI	-30.5	2.1	58.9 *	14.2	43.7 *
25 MARAMURES	-7.1 *	28.6	30.2	137.3 **	68.0 **
26 MEHEDINTI	-18.5	53.3 **	20.9	27.5	-0.6
27 MURES	-28.3	8.4	-3.4	9.0	5.2
28 NEAMT	-16.5	-15.4	20.2	-1.5	-8.3
29 OLT	-29.2	27.7	0.8	-54.0	16.3
30 PRAHOVA	-55.0	22.4	-19.7	-73.9	27.2
31 SATU-MARE	-30.0	30.3	8.8	39.3	-6.7
32 SALAJ	-30.7	49.4 **	-49.1	166.1 **	26.8
33 SIBIU	-37.9	8.9	42.8	24.0	43.6 *
34 SUCEAVA	-19.4	-5.4	77.7 *	-62.5	-12.9
35 TELEORMAN	-26.8	13.4	-45.3	-48.9	-32.5
36 TIMIS	-31.4	13.1	7.7	38.4	37.6 *
37 TULCEA	-8.7 *	43.7 **	176.5 **	-27.0	34.5
38 VASLUI	-2.0 **	23.5	-39.4	326.7 **	-6.3
39 VILCEA	-20.9	39.8 *	116.9 **	260.5 **	10.7
40 VRANCEA	-10.0 *	-6.5	11.7	-19.9	-14.1
41 MUNICIPIUL BUCURESTI	-22.5	7.7	12.2	34.4	-3.8

Note: A ** indicates that the region is in the top 5 and a * indicates that it is in the top 6-10.

Table 5

ROMANIA : CANCER MORTALITY, PERCENT CHANGE
1979-1983 TO 1984-1988, FEMALES

Region	Stomach	Lung	Bladder	Kidney	Colorectal
1 ALBA	-37.3	21.5	152.7 **	60.5 *	-4.1
2 ARAD	37.5 **	30.5 *	4.2	-31.0	-11.0
3 ARGES	-1.3 **	2.8	61.8 *	-10.4	-11.2
4 BACAU	-44.6	-20.1	36.2	-64.9	-25.7
5 BIHOR	-29.1	7.4	40.2	92.0 **	9.7
6 BISTRITA-NASAUD	1.9 **	-27.3	-100	246.9 **	-12.7
7 BOTOSANI	-42.3	2.4	-67.0	11.7	-24.4
8 BRASOV	-43.4	33.5 **	101.3 *	-48.9	22.2
9 BRAILA	-6.2 *	23.8 *	70.4 *	89.3 *	50.9 **
10 BUZAU	-5.4 *	-6.4	-26.0	-19.8	46.2 *
11 CARAS-SEVERIN	-51.6	3.9	104.5 **	24.7	-12.5
12 CALARASI	-68.0	-26.3	50.8	-100	25.5
13 CLUJ	0.8 **	-11.4	38.1	-32.0	19.0
14 CONSTANTA	-29.4	-1.3	20.6	-58.1	18.9
15 COVASNA	-44.0	-51.6	-26.9	-38.7	0.0
16 DIMBOVITA	-42.4	69.7 **	59.3	-17.6	11.7
17 DOLJ	-23.6	14.1	-53.4	-7.0	-13.3
18 GALATI	-51.9	24.1 *	-32.0	-45.0	-20.3
19 GIURGIU	-58.2	3.5	47.3	43.7	-18.4
20 GORJ	-38.1	4.6	-51.3	-75.9	36.2 *
21 HARGHITA	-35.2	10.3	7.8	76.5 *	52.2 **
22 HUNEDOARA	-31.0	-13.4	10.1	-100	10.0
23 IALOMITA	40.2 **	-32.8	183.1 **	16.0	31.2 *
24 IASI	-51.6	56.1 **	-45.6	127.2 **	11.7
25 MARAMURES	-26.5	9.5	89.5 *	-10.7	22.2
26 MEHEDINTI	-17.4	-25.5	7.6	15.3	-16.9
27 MURES	-40.2	29.8 *	7.8	54.0	-0.1
28 NEAMT	-14.5 *	37.3 **	4.9	50.0	30.4 *
29 OLT	-45.8	9.3	14.1	-53.9	9.4
30 PRAHOVA	-16.6 *	-21.7	-17.6	-44.6	-20.6
31 SATU-MARE	-55.2	-10.4	-35.0	68.8 *	-19.4
32 SALAJ	-17.1	-6.4	7.1	195.4 **	48.0 **
33 SIBIU	-4.0 *	-38.9	180.5 **	64.2 *	110.4 **
34 SUCEAVA	-55.7	-35.4	91.7 *	7.0	10.8
35 TELEORMAN	-53.0	-18.2	13.4	38.2	-27.9
36 TIMIS	-49.1	26.6 *	137.3 **	-1.6	7.5
37 TULCEA	-35.6	16.9	-100	-63.7	25.7
38 VASLUI	-30.5	39.8 **	-59.6	-100	57.0 **
39 VILCEA	-45.0	8.2	-79.4	-30.8	32.1 *
40 VRANCEA	-40.9	-26.1	-40.3	729.4 **	24.7
41 MUNICIPIUL BUCURESTI	-36.0	3.2	18.4	-2.6	0.1

Note: A ** indicates that the region is in the top 5 and a * indicates that it is in the top 6-10.

Table 6

ROMANIA : CANCER MORTALITY, PERCENT CHANGE
1979-1983 TO 1984-1988, FEMALES CONT'D AND ALL CAUSES

Region	Breast	Cervix	Male All Causes	Female All Causes
1 ALBA	35.2	18.6	-3.5	-7.5
2 ARAD	28.3	18.1	21.5 **	6.9
3 ARGES	63.1 **	-8.0	7.2	8.7 *
4 BACAU	20.8	28.0 *	3.8	-6.8
5 BIHOR	2.5	63.8 **	22.1 **	7.1
6 BISTRITA-NASAUD	-0.9	26.5 *	10.2	11.2 *
7 BOTOSANI	19.4	11.1	6.3	-10.8
8 BRASOV	3.9	-27.9	4.8	-6.9
9 BRAILA	45.3 *	5.7	12.1	12.3 **
10 BUZAU	12.8	1.2	11.0	-0.1
11 CARAS-SEVERIN	29.6	115.7 **	21.5 **	16.0 **
12 CALARASI	30.7	25.4	-11.8	-4.2
13 CLUJ	18.0	-12.1	12.0	4.0
14 CONSTANTA	53.1 **	38.6 **	1.7	5.4
15 COVASNA	23.3	-27.4	4.9	-20.2
16 DIMBOVITA	47.3 *	4.6	11.4	3.4
17 DOLJ	15.8	20.7	13.6 *	-0.6
18 GALATI	13.2	-4.2	-3.9	-12.8
19 GIURGIU	32.2	75.8 **	10.8	4.6
20 GORJ	29.9	13.6	-13.3	-12.7
21 HARGHITA	-11.6	11.1	-1.0	-4.4
22 HUNEDOARA	22.2	38.5 *	10.7	-9.8
23 IALOMITA	32.0	33.0 *	15.3 *	16.8 **
24 IASI	39.7 *	-11.7	-5.2	0.5
25 MARAMURES	79.4 **	27.0 *	23.9 **	21.4 **
26 MEHEDINTI	60.2 **	49.7 **	30.6 **	22.4 **
27 MURES	23.6	19.4	3.2	8.1
28 NEAMT	58.1 **	23.3	-7.8	12.3 *
29 OLT	49.7 *	-21.7	-1.9	-1.9
30 PRAHOVA	4.4	-32.0	0.1	-12.7
31 SATU-MARE	8.0	5.0	2.4	-16.6
32 SALAJ	33.8	6.0	12.7 *	10.3 *
33 SIBIU	3.7	13.0	5.2	11.7 *
34 SUCEAVA	2.3	-6.5	-0.7	-14.6
35 TELEORMAN	-11.8	-5.8	-19.3	-26.2
36 TIMIS	10.3	7.7	6.5	-1.1
37 TULCEA	-21.0	5.3	16.3 *	-11.5
38 VASLUI	44.9 *	-7.2	0.9	4.4
39 VILCEA	22.0	-21.0	20.3 *	-18.8
40 VRANCEA	32.2	-22.0	8.3	4.7
41 MUNICIPIUL BUCURESTI	1.5	7.4	-4.1	-4.6

Note: A ** indicates that the region is in the top 5 and a * indicates that it is in the top 6-10.

Table 7

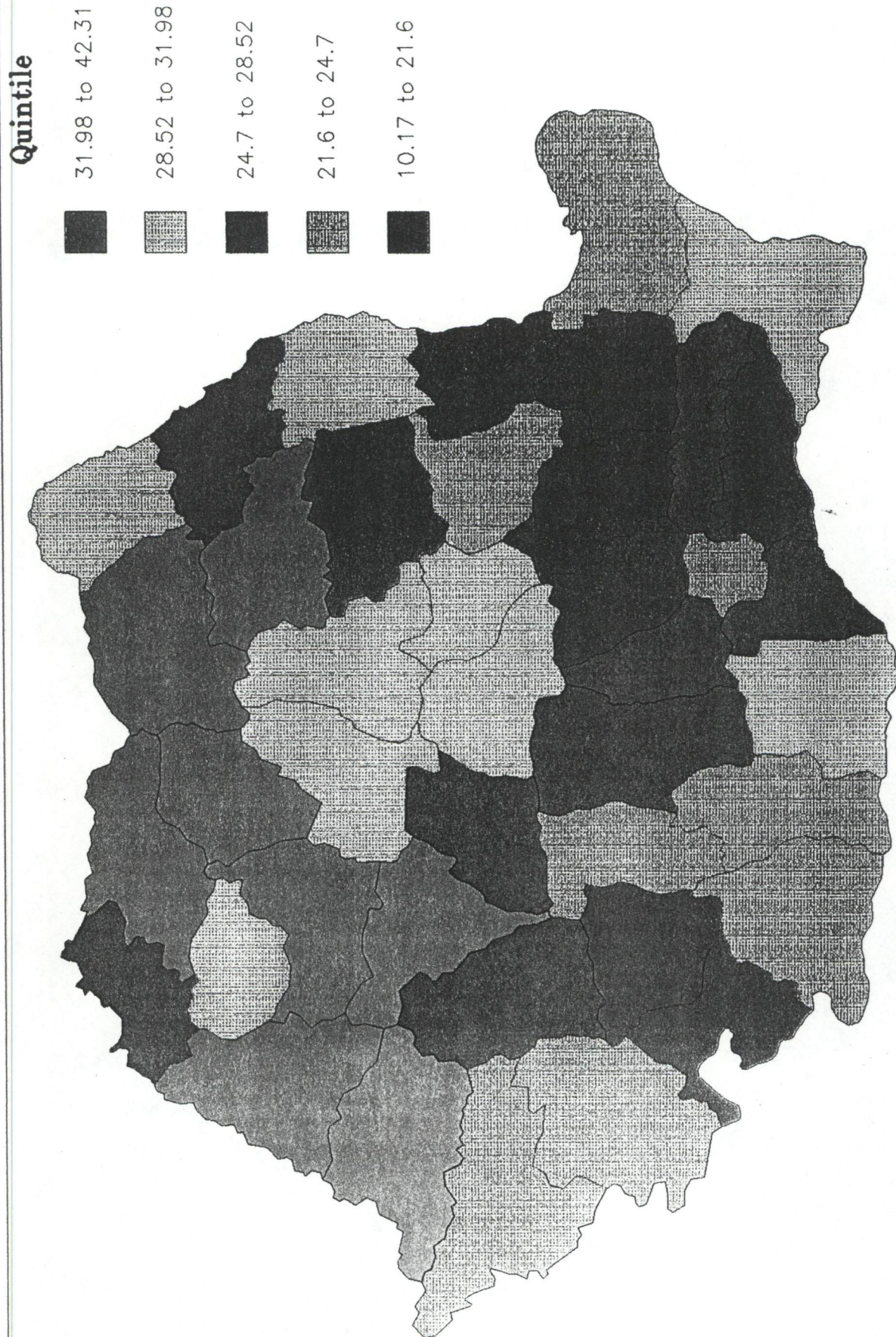
ROMANIA : CANCER MORTALITY, LARGEST PERCENT CHANGE
1979-1983 TO 1984-1988

Cancer Site	Region	Increase	Region	Decrease
		Percent Change		Percent Change
Males				
Stomach	Ialomita	11.9	Buzau	62.2
	Bistrita-Nasaud	11.3		
Lung	Mehedinti	53.0	Gorj	17.0
Bladder	Bacau	201.3	Salaj	49.1
Kidney	Caras-Severin	496.2	Gorj	100.0
Colorectal	Giurgiu	90.9	Braila	44.0
All Cancers	Mehedinti	30.6	Teleorman	19.3
Females				
Stomach	Ialomita	40.2	Calarasi	68.0
	Dimbovita	69.7	Covasna	51.6
Bladder	Ialomita	183.1	Tulcea	100.0
			Bisrtita-Nasaud	100.00
Kidney	Vrancea	729.4	Calarasi	100.0
			Hunedoara	100.0
Colorectal	Sibiu	110.4	Vaslui	100.00
			Bacau	25.7
			Vrancea	24.7
			Botosani	24.4
Brest	Maramures	79.4	Teleorman	11.8
Cervix	Giurgiu	11.8	Brasov	27.9
			Covasna	27.4
All Cancers	Mehedinti	22.4	Suceava	14.6

Examination of the period change by region revealed few patterns. For kidney cancer in males the largest percent decrease occurred in the southern regions, while for colorectal cancer in males the largest percent decrease occurred in the Southeastern regions. For females, the largest percent increases occurred in the Northeast for stomach cancer, in the East for lung cancer and in the North for kidney cancer. The largest percent decreases occurred in the east for colorectal cancer and in the Southeast for cervical cancer.

In order to plan cancer control strategies, epidemiological investigations are required to study the links between environmental contaminants and the probability of developing cancer. As a first step, descriptive epidemiology and ecological analysis results should be prepared to guide the direction of further research.

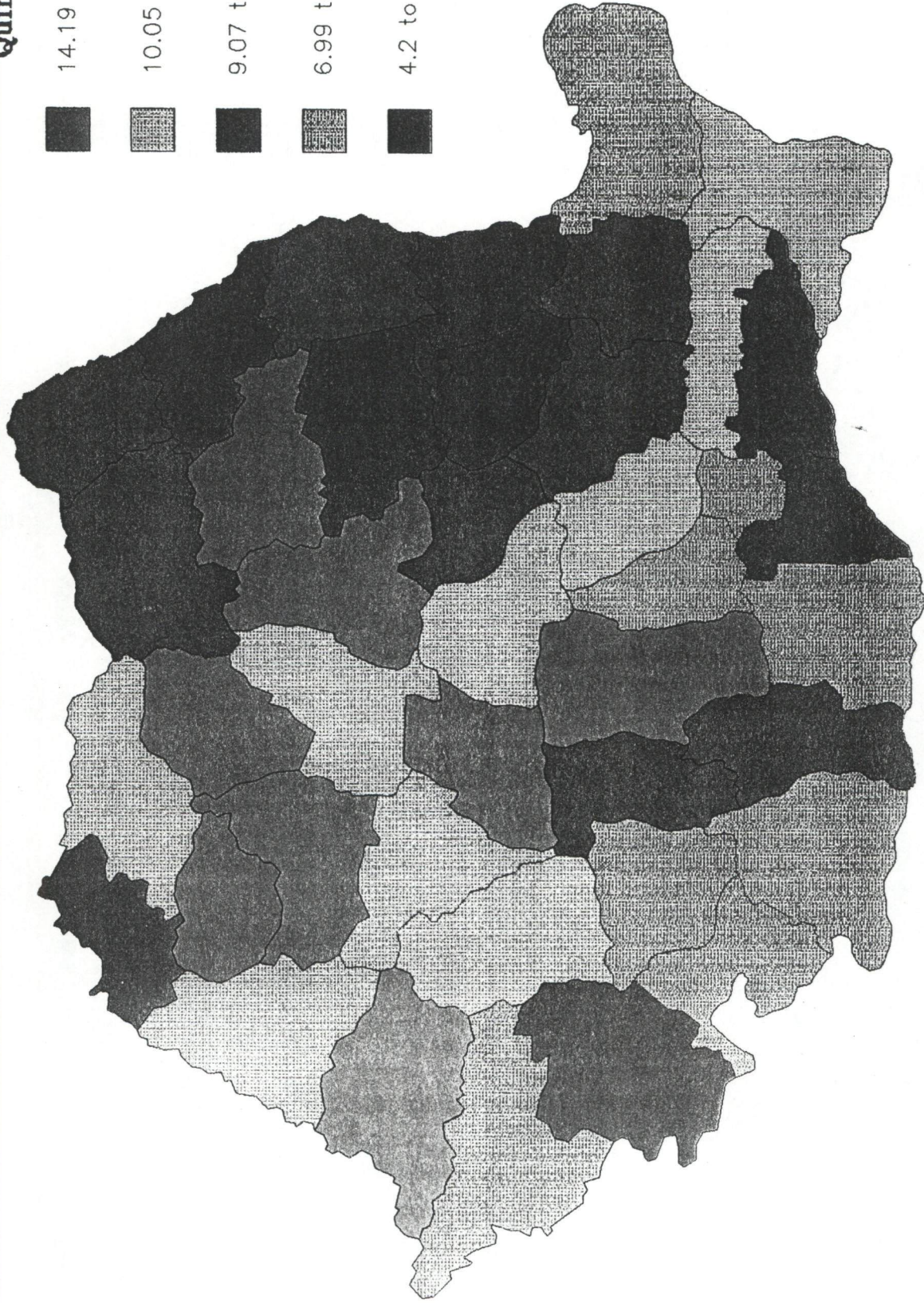
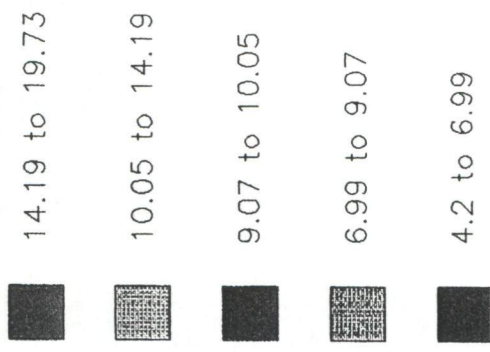
STOMACH CANCER, MEN, 1984-1988



Quintile based on ASMR per 100 000

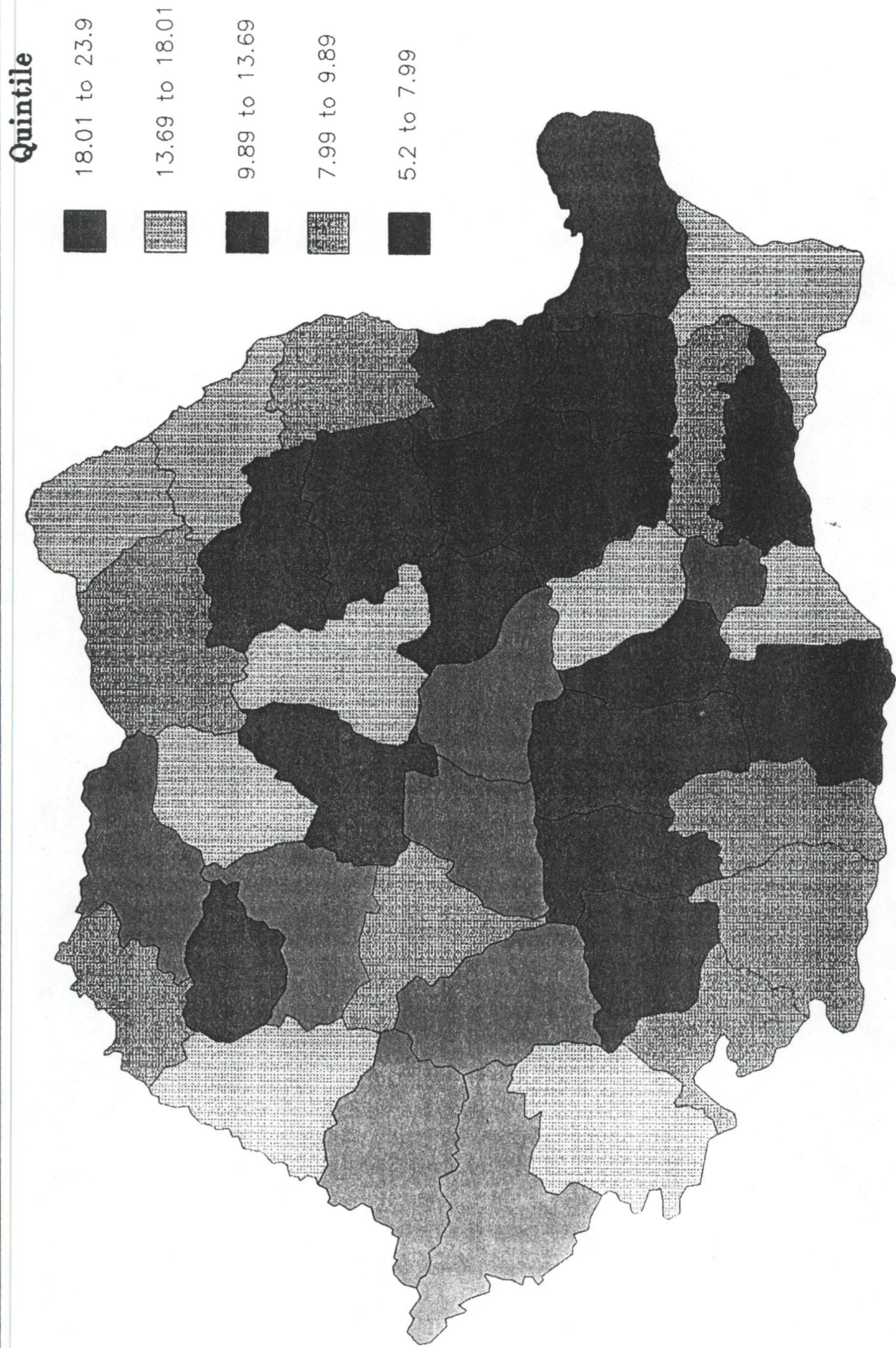
STOMACH CANCER, WOMEN, 1984-1988

Quintile



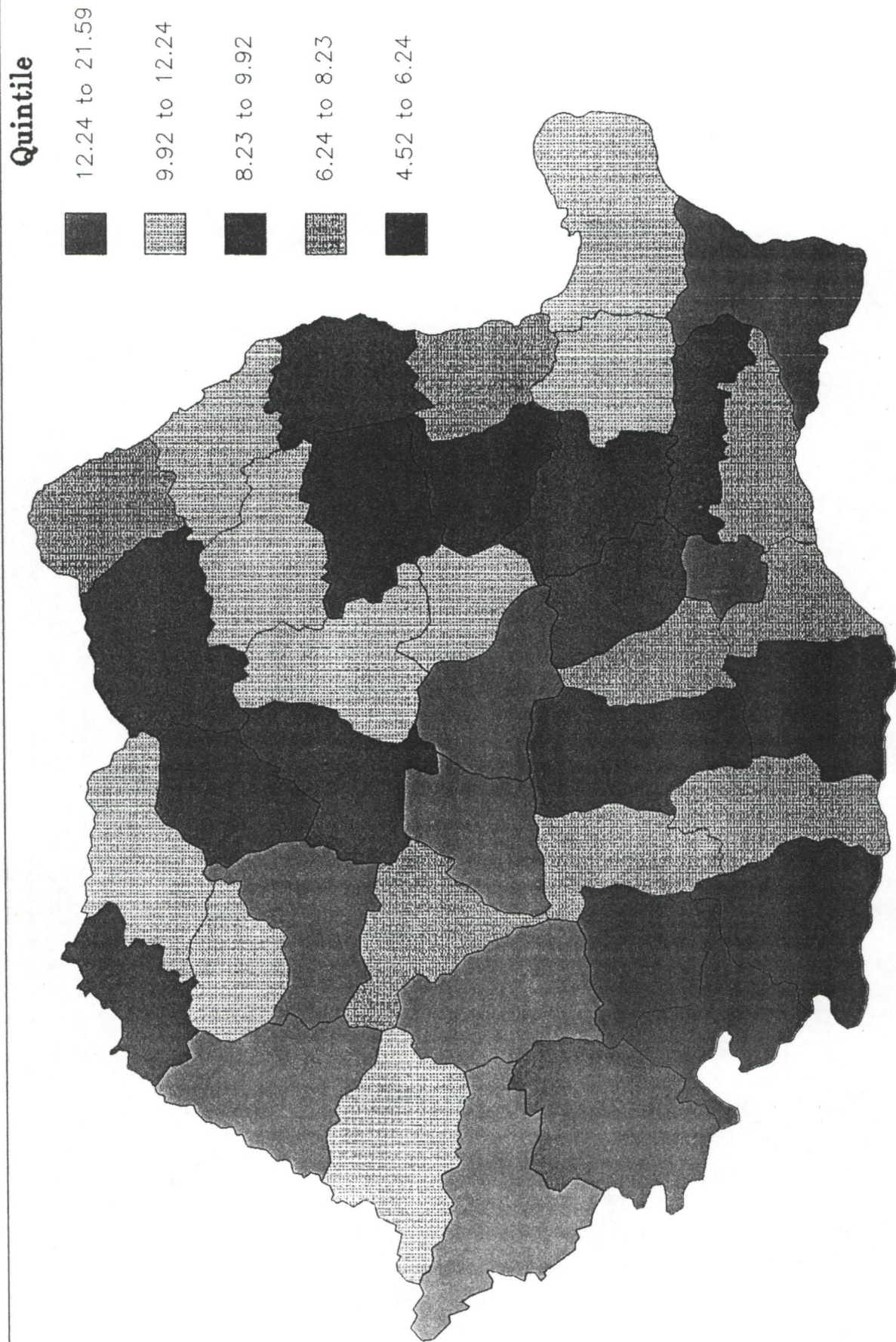
Quintile based on ASMR per 100 000

COLORECTAL CANCER, MEN, 1984-1988



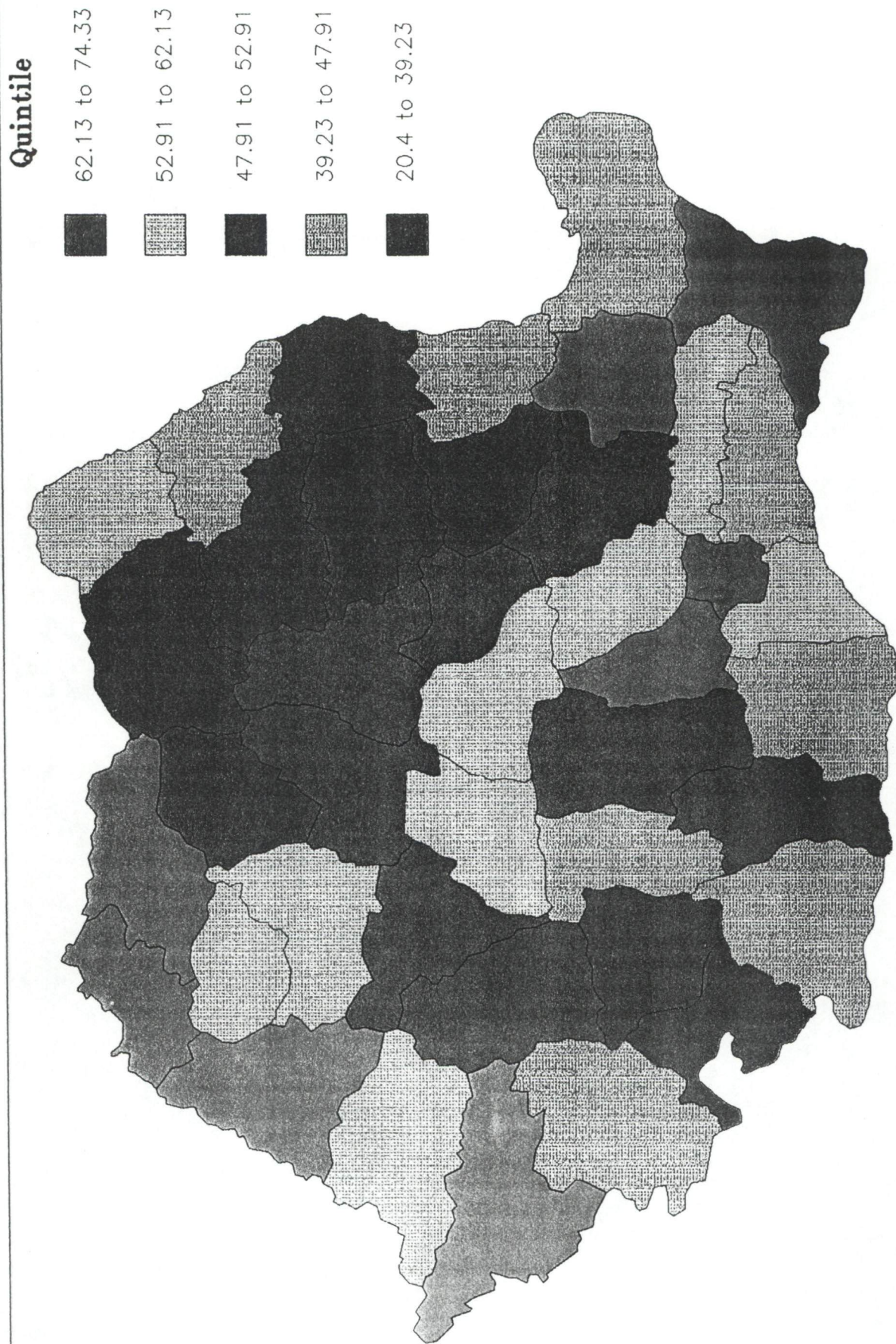
Quintile based on ASMR per 100 000

COLORECTAL CANCER, WOMEN, 1984-1988



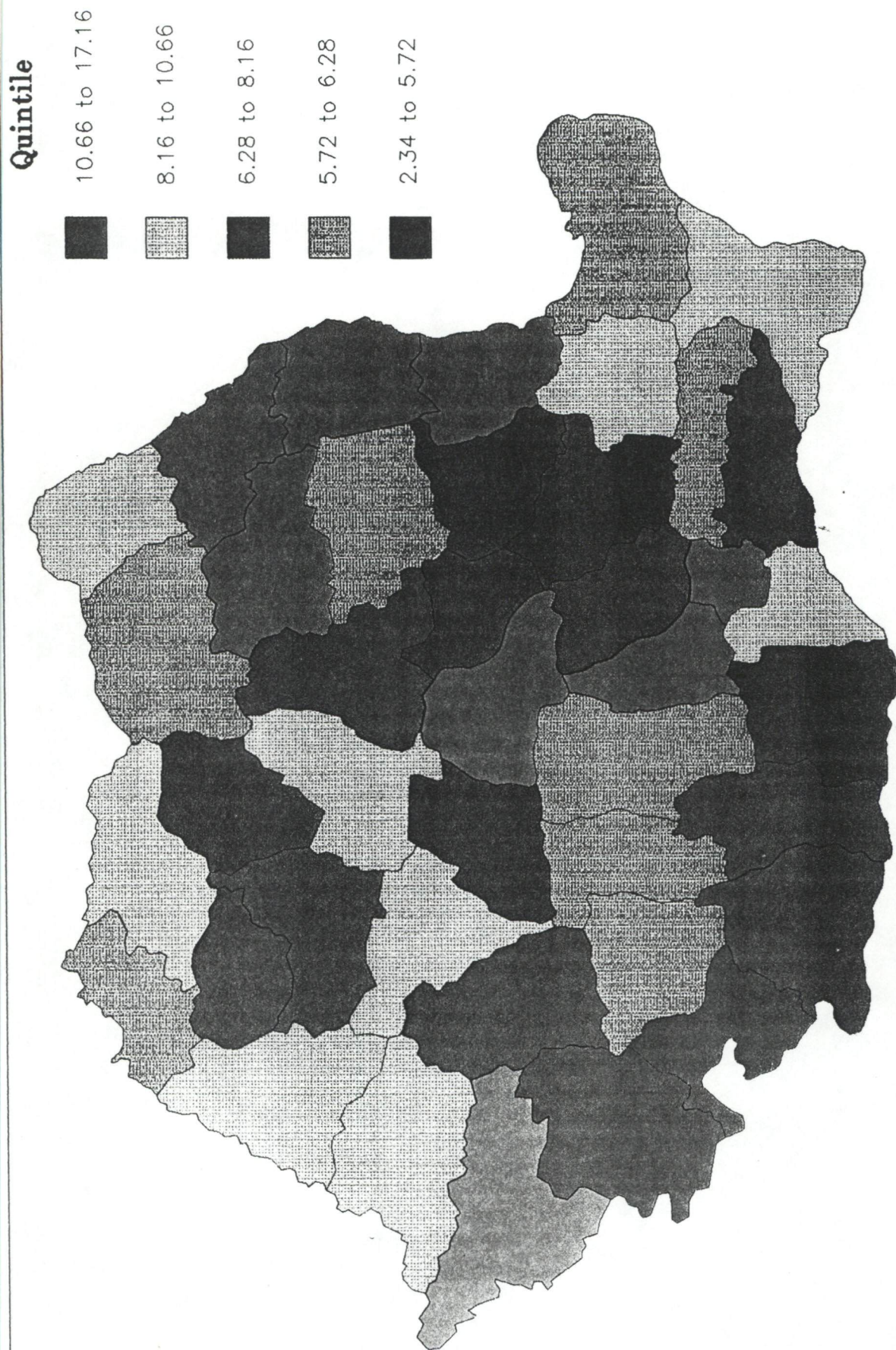
Quintile based on ASMR per 100 000

LUNG CANCER, MEN, 1984-1988



Quintile based on ASMR per 100 000

LUNG CANCER, WOMEN, 1984-1988



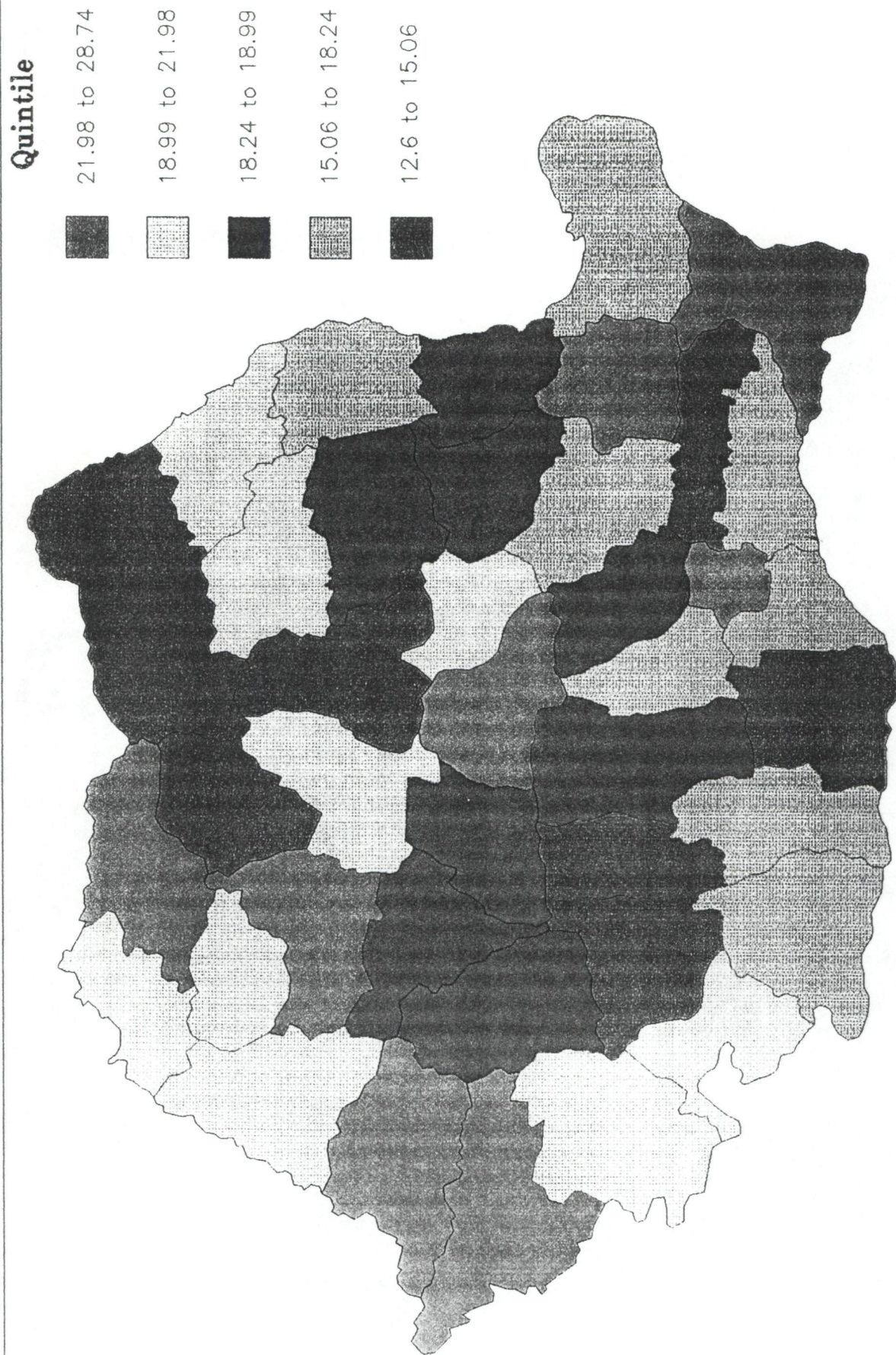
Quintile based on ASMR per 100 000

CERVICAL CANCER, WOMEN, 1984-1988



Quintile based on ASMR per 100 000

BREAST CANCER, WOMEN, 1984-1988



Quintile based on ASMR per 100 000

There are population-based cancer registries available in each of the 41 regions in Romania. Cancer records are computerized locally and then forwarded to the Institute of Hygiene and the Institute of Oncology in Bucharest for analysis. However, the quality of cancer registration data is likely to have two potential weaknesses; incompleteness and site misclassification. An international comparison of cancer incidence to mortality ratios suggested a potential 20-50% under-registration in Romania. A proportional cancer incidence rate comparison among European countries showed that Romania has a relatively high stomach cancer incidence rate and abnormally low incidence rates of colon cancer and esophageal cancer. This fact suggests the potential for misclassification within the registration system. A most serious limitation is that the national cancer registration database located in Bucharest is not organized in a way to study each region's cancer incidence. Therefore, the current system of cancer incidence data cannot be used in its present state as the basis for an ecological study.

By contrast, cancer death records collected by the Department of Statistics and Information are more reliable and information by region is available. In addition, environmental levels of many pollutants were measured by the Department of the Environment and are available at the municipal level. The use of these environmental contamination data and cancer mortality rates using regions as the basic study unit allows a crude ecological study to be conducted in a short time period. This is important for a first cut evaluation of priorities in dealing with environmental factors related to the development of cancers and of other health problems in the population.

Diseases of the Respiratory System

Respiratory disease is the third leading cause of death in Romania. In the past twenty years, mortality rates have decreased 40%, from 184 per 100,000 in 1970 to 111 per 100,000 population in 1989. Pneumonia mortality rates declined 50% (from 82 per 100,000 to 42 per 100,000) while tuberculosis rates decreased 70% (from 19 per 100,000 to 6 per 100,000). In contrast to other respiratory diseases, mortality rates of chronic obstructive pulmonary disease increased 50% in the last 10 years, from 19.5 per 100,000 in 1980 to 29.8 per 100,000 population in 1989. The prevalence of tuberculosis is highest in the regions of Calarasi, Mehedinte and Tulcea respectively. Timis also has a high tuberculosis mortality rate.

Diseases of the Digestive System

Mortality rates for diseases of the digestive tract have increased approximately 50% in the last twenty years, from 36 per 100,000 in 1970 to 54 per 100,000 population in 1989. The prevalence of ulcers is highest in Arad, Bihor, Iasi, Hunedoara and Alba regions.

Injuries and Accidents

Mortality rates for accidents, poisoning and trauma are also increasing. From 1960 to 1989, rates increased by roughly 71%, from 44 per 100,000 to 75 per 100,000.

D. ENVIRONMENTAL CONTAMINANTS AND CANCER MORTALITY

Much of the concern regarding environmental pollutants in Eastern Europe has developed in response to their potential to impact human health. The high levels of toxic substances as illustrated in the previous section coupled with the relatively large population density puts significant numbers of people at risk from the dangers of pollution. This is especially true in Romania, where rampant industrialization, lack of interest in pollution controls and concerns for the population welfare, high energy intensity, and the relatively large numbers of people living in urban and industrial areas have intensified the health-related hazards associated with high pollution concentrations. Damage to other components of the environment, though not studied in detail, is also likely to be severe, especially that related to aquatic and forest ecosystems. These impacts are beyond the scope of this report but it should be noted that damage to natural systems can indirectly impact human health and also impose a heavy burden on the economy of the country.

It has been estimated that approximately 4 to 4.5 million people or around 18% of the population in Romania are exposed to environmental pollution, of which 1.2 to 1.5 million or about 5% are directly affected (Ministry of Environment 1991). Much of the research into health-related impacts of environmental pollutants has been conducted through the Romanian National Academy of Sciences with much of the practical and field work (i.e. epidemiological) studies undertaken by the Ministry of Health through its Institute of Hygiene and Public Health. As was the case with environmental pollution monitoring by the Ministry of Environment, the Ministry of Health operates 41 offices, one in each district, each with its own epidemiological laboratory. The data obtained by these field offices are fed to the data and information center of the central Institute of Hygiene and Public Health in Bucharest.

One of the main concerns relating to environmental contamination in Romania has centered on the role of pollutants as carcinogens. A study was recently undertaken by the Ministry of Hygiene to determine the type of industries that have high levels of suspected carcinogens (termed cancer hazards) and their effects on the health of workers. A total of 4728 registered workplaces were analyzed for the presence of such cancer hazards. 561 workplaces (12%) were found to expose workers to carcinogenic hazards. The percentage of workplaces with cancer hazards varied from place to place in the country ranging from 2.8% in Teleorman to 50.9% in Cluj. This variation could be due to a number of factors including the nature of industries dominating a given region and the method used to determine the presence of a cancer hazard (most of these studies were done by the district office in each region). The breakdown of the presence of cancer hazards by industry type was observed to be as follows:

INDUSTRY TYPE	NO. WORKPLACES OF SPECIFIC INDUSTRY TYPE WITH HAZARDS	% WORKPLACES OF SPECIFIC INDUSTRY TYPE WITH HAZARDS/TOTAL NO. OF WORKPLACES WITH HAZARDS
Chemical	104	18.5
Light industries	101	18.0
Machine building	80	14.3
Wood, building materials	55	9.9
Electronic	34	6.1
Electrical energy	30	5.3
Mining	19	3.4
Other	138	24.6
TOTAL	561	100

This study also determined that a total of 51,809 workers out of a total population of 1,434,089 working in these 4728 registered workplaces were exposed to carcinogenic substances. This represents 3.6% of the worker population examined. The majority of the exposed workforce were involved in the chemical (23.1%), machine building (13.9%), and the wood and building materials industries (12.2%) (personal communication). The main carcinogenic substances to which these workers were exposed were the following:

CARCINOGENIC SUBSTANCE	% WORKERS EXPOSED TO SUBSTANCE/TOTAL EXPOSED WORKERS
Tars, mineral oils, black carbon	29.7
Polycyclic aromatic hydrocarbons	29.3
Hexavalent chromium	14.2
Benzene	12.4
Asbestos	6.2
Vinyl chloride	2.4
Arsenic	2.4

Also observed by this study was the fact that the largest numbers of exposed workers were found in the following regions of Romania:

REGION	NO. EXPOSED WORKERS/TOTAL NO. WORKERS	MAIN CARCINOGENS
Salaj	16.8	polycyclic aromatic hydrocarbons, mineral oils
Prahova	10.9	
Vaslui	11.2	aromatic hydrocarbons, tars
Olt	13.5	
Bacau	8.9	

The distribution of workers exposed to various carcinogens compared to the total number of workers sampled for each region in Romania is given in Table 8.

In addition to the presence of carcinogens in the workplace, ambient air, water, soil, and food concentrations of these substances must also be considered in any determination of the health hazard present in various parts of Romania. This gives an indication of the exposure of the general population rather than just the worker population to carcinogens. The levels of some of these substances in the air, water, and restaurant meals in various urban areas in each district of the country are given in Tables 9, 10, and 11 respectively.

From Table 9, it can be concluded that very high levels of carcinogens such as chromium, nickel, cadmium, benzopyrene, and asbestos are present in the air in Tg. Mures and Cluj Napoca. For example, cadmium levels in Cluj Napoca and Tg. Mures are 12,000 and 7000 times the national standard for this substance. In fact, cadmium levels in all urban areas except for Timisoara, Arad, and Resita, are at least 150 times the maximum permissible level. On the other hand, chromium levels in the air are within the standard in all regions.

Table 10 indicates that high levels of carcinogens in the water are found in Tulcea, Bacau, Botosani, and Suceava, particularly of nitrates in Tulcea and Suceava, benzopyrene in Botosani, and arsenic in Bacau. Table 11 concludes that high levels of carcinogens in foods are found in Pitesti and Braila, with high levels of nitrates in the former and nickel in the latter. In addition, high levels of cadmium are found in Craiova.

This information on the levels of carcinogens in various parts of the country was superimposed on the cancer incidence and mortality data presented in other sections of this report to determine whether or not a correlation exists between the presence of these carcinogens and cancer mortality data. A detailed discussion of this analysis is presented in Annex 3. However, it should be noted that many of the regions with high levels of carcinogens coincide with regions of high levels of other air, water, soil, and food pollutants (such as SO₂, ozone, and NO₂) which may act synergistically with carcinogens to impact health. Thus, levels of these non-carcinogenic substances must also be considered in any study analyzing the correlation between high cancer incidence and increased concentrations of carcinogens. In addition, the values for levels of carcinogens in various environmental media in various areas of Romania must be verified because, as mentioned earlier, the equipment and techniques used in measuring these substances may not be reliable and/or accurate. In spite of these caveats, it is obvious that a number of known carcinogens are present in many parts of Romania at levels which pose a very real threat to human health.

As shown in the table below, most of the industrialized, Western nations do not have national ambient air quality standards for carcinogenic substances. They regulate the concentrations of these pollutants mainly through emission limits from individual sources. It has been found to be very difficult to measure ambient levels of such substances as their concentrations are extremely low and, thus, vary greatly as one moves away from the source. Also because their levels are so low, they are present in concentrations at the lower limit of measuring devices. Thus, any attempt to establish ambient standards for toxic substances, such as metals and carcinogens, is unlikely to be implemented and enforced. This lack of enforcement is clearly in evidence in Eastern Europe, where standards exist but levels of these substances routinely exceed these limits many times over. Thus, the setting of ambient air standards for these substances is usually arbitrary and unrealistic.

AMBIENT AIR QUALITY STANDARDS FOR SELECTED
CARCINOGENS AND METALS (LONG-TERM STANDARDS)

Pollutant	Country	Standard (mg/m ³)
Benzene	Czechoslovakia, Romania, Hungary, Yugoslavia	0.8
	Hungary, Germany	3.0
	Israel	1.6
Arsenic	Bulgaria, Czech, USSR, Yugoslavia	0.003
	Israel	0.006
	Romania	0.01
Cadmium	Yugoslavia	0.003
Chromium	Romania	0.0015
Lead	United States	0.0015
	Bulgaria, Czech, USSR, Yugoslavia, Hungary	0.0007
	Israel	0.005
	Italy	0.01
	Poland, Romania	0.001
Manganese	Bulgaria, Czech, Yugoslavia Israel, Romania, USSR	0.01
Mercury	Bulgaria, Hungary, USSR, Yugoslavia	0.0003
	Israel, Romania	0.001

In the United States, lead is the only toxic pollutant for which there is an ambient air quality standard as levels of this substance are relatively high (at least they were when the standard for lead was established in 1977) compared to other toxic pollutants. This made it possible to easily and accurately measure levels of this substance and thus to realistically enforce this standard.

The 1990 Clean Air Act Amendments in the United States attempted to address the issue of the potential health hazards posed by toxic substances through its Title III provisions dealing with hazardous (toxic) air pollutants. In this Title, significant producers of toxic chemicals, such as those which have been shown to be carcinogenic, are required to install 'maximum achievable control technology' (MACT). The ultimate objective of this regulation is to reduce production of toxic air pollutants by over 95% during the coming decade. This would, indirectly, have the effect of lowering the levels of these substances in a manner which can be easily enforced.

The U.S. Clean Air Act Amendments of 1990 have identified 189 substances which are to be controlled by the toxic substances provisions of this Act. Of these, 17 have been given priority and emissions of these are to be reduced during the first phase of implementation of the Clean Air Act Amendments. These 17 substances are: benzene, cadmium, carbon tetrachloride, chloroform, chromium, cyanides, dichloromethane, lead, mercury, methylethylketone, methyl isobutyl ketone, nickel, tetrachloroethylene, toluene, trichloroethylene, trichloromethane, and xylene.

Table 8

DISTRIBUTION OF WORKERS EXPOSED TO VARIOUS CARCINOGENS

County	Number of Workers Exposed to									Vinyl chloride		
	Carcinogenic aromatic			arsenic, asbestos, chrom, aromatic, polycyclic, hydrocarbon			Benzene					
	a	b	c	a	b	c	a	b	c	a	b	c
Alba	-	-	-	160	45	-	4	-	-	-	-	-
Arad	-	-	-	526	468	11	-	-	-	-	-	-
Arges	52	52	-	562	69	-	11	11	-	-	-	-
Bacau	42	42	-	719	719	-	720	702	-	278	199	-
Bihor	-	-	-	1184	5	-	130	127	-	92	-	-
Bistrita	-	-	-	-	-	-	-	-	-	-	-	-
Nasau	-	-	-	78	-	-	-	-	-	-	-	-
Botosani	-	-	-	214	-	-	-	-	-	-	-	-
Brasov	60	32	4	1111	54	-	28	28	-	-	-	-
Braila	-	-	-	191	85	-	72	72	-	-	-	-
Buzau	-	-	-	850	361	16	-	-	-	-	-	-
Caras-Severin	-	-	-	-	128	-	24	-	24	-	-	-
Il	-	-	-	-	-	-	-	-	-	-	-	-
Calarasi	14	-	-	63	-	-	24	-	-	-	-	-
Cluj	-	-	-	625	469	36	441	359	-	230	230	-
Constanta	-	-	-	1086	41	-	131	-	-	-	-	-
Covasna	-	-	-	125	64	-	154	12	-	-	-	-
Dimbovita	-	-	-	313	97	-	37	37	-	-	-	-
Dolj	-	-	-	124	36	-	-	-	-	-	-	-
Galati	-	-	-	3413	-	-	286	106	-	-	-	-
Giurgiu	-	-	-	78	78	-	58	58	-	-	-	-
Gorj	-	-	-	124	57	1	-	-	-	-	-	-
Harghita	4	4	-	259	32	-	-	-	-	-	-	-
Hunedoara	-	-	-	1016	770	-	752	752	-	-	-	-
Ialomita	-	-	-	46	46	-	-	-	-	-	-	-
Iasi	-	-	-	250	17	-	605	605	2	78	35	-
Maramures	-	-	-	653	653	-	1	1	-	-	-	-
Mehedinti	-	-	-	142	137	-	-	-	-	-	-	-
Mures	30	30	-	813	292	2	30	30	-	-	-	-
Neamt	-	-	-	241	234	-	187	154	-	-	-	-
Olt	-	-	-	1770	-	-	24	24	-	-	-	-
Prahova	334	329	-	1943	324	7	463	463	14	-	-	-
Satu Mare	24	-	-	546	-	3	-	-	-	116	95	-
Salaj	79	-	-	2068	20	-	1	1	-	-	-	-
Sibiu	-	-	-	588	141	-	967	962	-	-	-	-
Suceava	-	-	-	44	44	-	-	-	-	-	-	-
Teleorman	-	-	-	49	-	-	3	3	-	-	-	-
Timis	12	12	-	172	54	-	607	607	-	-	-	-
Tulcea	-	-	-	242	228	-	-	-	-	-	-	-
Vaslui	-	-	-	163	-	-	-	-	-	-	-	-
Vilcea	-	-	-	16	16	-	164	164	-	471	471	-
Vrancea	-	-	-	89	62	-	-	-	-	-	-	-
Municipiul Bucuresti	37	37	-	949	139	-	517	336	-	-	-	-
TOTAL COUNTRY	738	538	4	23321	5871	76	6441	5629	16	1265	1030	-

a = exposed workers

b = tested workers

c = workers found with suspicious changes

Table 9

CONCENTRATION OF CARCINOGENS IN AMBIENT AIR IN 36 COUNTIES

County	Crom ug/m ³	Nichel ug/m ³	Cadmin nanog/m ³	Beaz nanog/m ³	Asbestos filing fibre/cm ³
1. Constanta	0,08	0,11	40	8,0	0.010
2. Ploiesti	0,09	0,12	12	6,0	0,013
3. Giurgiu	0,09	0,06	4	4,1	0,008
4. Braila	0,09	0,06	18	9,3	0,018
5. Craiova	0,09	0,11	35	6,8	0,120
6. Tulcea	0,25	0,10	27	18,1	0,006
7. Buzau	0,03	0,05	4	7,0	0,002
8. Tirgoviste	0,27	0,06	14	7,8	0,014
9. Slatina	0,05	0,09	13	6,8	0,002
10. Tg.Jiu	0,07	0,09	10	3,7	0,002
11. Alexandria	0,04	0,04	13	0,91	0,003
12. Bucuresti	0,09	0,07	16	5,3	0,008
13. Pitesti	0,03	0,40	10	2,15	0,003
14. Srasov	0,09	0,19	9,0	3,7	0,005
15. R. Vilcea	0,15	0,81	16	0,8	0,032
16. Timisoara	0,09	0,05	0,0	-	0,0002
17. Arad	0,06	0,05	0,0	-	0,0003
18. Resita	0,10	0,10	0,0	-	0,0005
19. Oradea	0,12	0,13	24,0	1,85	0,1340
20. Zalau	0,09	0,00	47	3,94	0,1570
21. Bistrita	0,03	0,04	15,0	2,11	0,0320
22. Alba Iulia	0,03	0,04	30	1,67	0,0440
23. Sibiu	0,11	0,25	110	0,76	0,0390
24. Satu Mare	0,04	0,89	40	0,66	0,0400
25. Tg. Mures	0,17	0,09	147	-	0,1200
26. Cluj Napoca	0,31	0,14	240	-	0,0600
27. Baia Mare	0,20	0,25	45	-	0,0570
28. Miercurea Ciuc	0,38	0,09	27	0,63	0,0710
29. Galati	0,18	0,01	15	0,37	0,42
30. Iasi	0,07	0,01	10	0,03	0,28
31. Suceava	0,06	0,02	17	0,18	0,13
32. Bacau	0,01	0,01	3	0,25	0,024
33. Focsani	0,03	0,02	16	0,15	0,0216
34. Vaslui	0,03	0,02	23	0,28	0,035
35. Botosani	0,03	0,06	30	0,38	0,017
36. Piatra Neamt	0,00	0,06	32	0,18	0,041
Norms	0,07	0,10	5	10	0,001

Table 10

CONCENTRATION OF CARCINOGENS IN WATER OBTAINED FROM 33 COUNTIES

County	Arsen	Nitr- ates	Crom	Cad- miu	Ni- chel	Benz piren	Pes- tici- des	Tri- halo- metane
1. Constanta	0	7,2	0,028	0,003	0,021	0,82	0,45	79,0
2. Giurgiu	0	14,7	0,019	0,002	0,016	0	0,07	13,5
3. Ploiesti	0	0	0,067	0,002	0,021	3,49	0,08	26,6
4. Tulcea	0	60,2	0,025	0,003	0,022	0,74	0,06	28,3
5. Braila	0,014	7,9	0,005	0,0001	0,015	0	0,04	43,8
6. Craiova	0	6,8	0,003	0,002	0,014	0	0,03	29,7
7. Tg.Jiu	0,017	0	0	0	0,007	67	0,07	11,5
8. Slatina	0,05	6,9	0,003	0	0,015	67	0,07	11,5
9. Tirgoviste	0	24,0	0,011	0,001	0,14	-	0,01	13,5
10. Buzau	0	0	0,019	0,001	0,15	0,3	0,03	18,8
11. Bucuresti	0,077	4,1	0,003	0,001	0,016	2,5	12,6	27,7
12. Rm. Vilcea	0	6,0	0	0,0004	0,013	0	1,09	37,5
13. Alexandria	0,16	2,3	0,006	0,0004	0,014	0	0,41	29,3
14. Brasov	0	14,0	0	0	0,014	0,70	1,05	18,8
15. Pitesti	0,015	2,7	0	0,0006	0,014	2,34	0,66	-
16. Oradea	0	3,8	0	0	0	0	0,09	-
17. Zalau	0	7,6	0,14	0	0,07	25,0	0,85	-
18. Bistrita	0	0	0,002	0	0,07	5,0	0,37	-
19. Alba Iulia	0	1,7	0,001	0	0	32,0	0,37	-
20. Iasi	0	10,0	0,002	0,0002	0,005	2,2	0,52	-
21. Galati	0,012	9,2	0,003	0,013	0,03	1,2	-	-
22. Suceava	0,012	37,8	0,012	0,047	0,04	3,3	-	-
23. Botosani	0	5,2	0,014	0,009	0,004	138,0	0,03	70,8
24. Piatra Neamt	0	7,0	0,03	0,002	0,004	40	0,07	33,5
25. Tg.Mures	0	2,0	0	0	0	-	6,86	-
26. Baia Mare	0	9,0	0	0	0	-	6,95	-
27. Cluj Napoca	0	6,0	0	0	0	-	1,12	-
28. M.Ciuc	0	-	0	0	0	-	0,82	-
29. Timisoara	-	-	0,010	0,002	0,011	-	3,0	-
30. Arad	0,02	-	0	0,101	0,02	-	-	-
31. Bacau	0,24	11,8	0,001	0,003	0,016	18,9	-	33,7
32. Pocsani	0	1,1	0,003	0,003	0,025	20,4	0,10	14,5
33. Vaslui	0	9,8	0,003	0,018	0,023	0,61	0,13	85,9
Norms	0,05 mg/l	45 m/l	0,05 mg/l	0,005 mg/l	0,10 ug/l	10 ng/l	0,5 ug/l	100 ug/l

Table 11

CONCENTRATIONS OF CARCINOGENS IN RESTAURANT MEALS IN SELECTED CITIES IN ROMANIA

City	Nit- rates	Cd	Cr	Ni	Pesti- cides Organoclorurated	3,4-benz- piren	
	NO ³ mg/day	mg/day	mg/day	mg/day	HCH mg/day	DDT mg/day	ug/day
Ploiesti	927,5	0,030	0	-	0,050	0,075	-
Constanta	1265	0,006	0,092	-	0,010	0,075	-
Giurgiu	235	0,014	0	-	0,275	1,2	-
Braila	707,5	0,062	0,040	0,232	0,145	0,075	-
Craiova	86,25	0,8	0	0,10	0,047	0,007	-
Tulcea	81,25	0,010	0,026	0,06	0,132	0,010	-
Buzau	250	0,012	0,040	0,020	0,055	0	-
Tirgoviste	390	0,078	0,44	0,070	0,027	0,06	-
Slatina	114	0,080	0,032	0,070	0,090	0	-
Tg. Jiu	52,5	0,0016	0,004	0,046	0,007	0,25	-
Alexandria	1125	0,136	0,012	0,036	0,025	0,002	-
Brasov	0	0,026	0,012	0,026	0,092	0,025	-
Bucuresti	37,5	-	-	-	-	-	-
Pitesti	1907,5	0,1	0	0,032	0,045	0,025	-
Rm.Vilcea	-	0,1	0,020	0,10	0,15	0,1	-
Iasi	29,5	0,040	-	-	0,0158	0,059	0,186
Galati	76,3	0,018	-	-	0,388	0,084	1,357
Suceava	25	0,022	-	-	0,053	0,248	0,47
Botosani	89,5	0,012	0,186	-	-	-	0,544
Piatra Neamt	77,13	0,032	0,252	-	-	-	0,785
Bacau	46,5	0,062	0,036	-	0,06	0,17	14,7
Focsani	9,05	0,012	0,084	-	-	-	8,5
Vaslui	62,2	0,007	0	-	0,07	0,07	13,02
Norms	350	0,150	50	0,150	0,700	0,350	1

ROMANIA

CONCENTRATION OF CANCER RISK FACTORS (AIR, WATER, FOOD), 1991

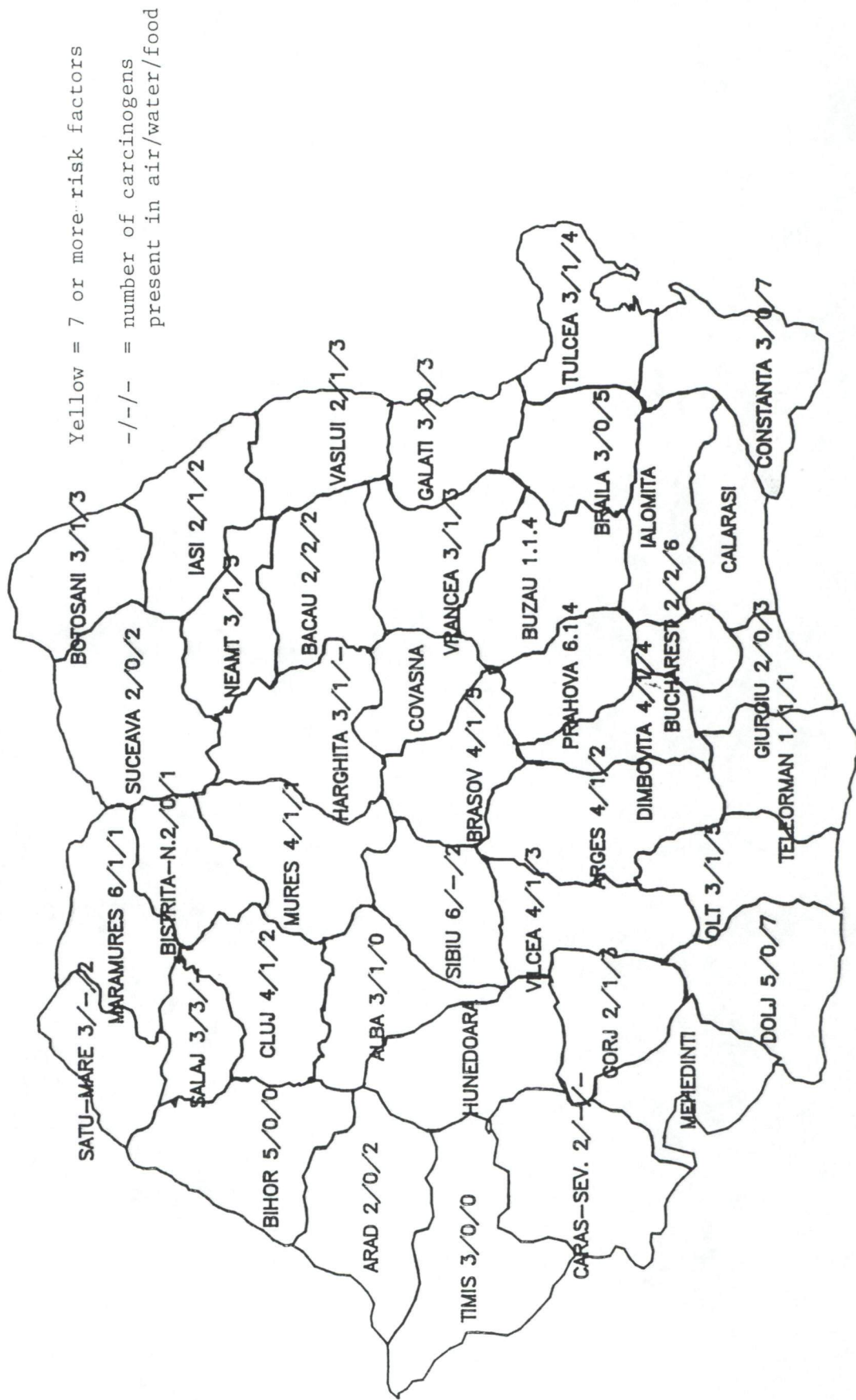


Table 12

CONCENTRATIONS OF CARCINOGENS IN FOODSTUFF IN 27 COUNTIES*

County	HCH butter	mg/kg bacon	Lindan butter	mg/kg bacon	DDT butter	mg/kg bacon nina	Benz piren fish	mg/kg smoked meats
1. Ploiesti	2,0	0,27	0,29	0,19	0,8	0,07	3,50	0
2. Constanta	4,4	-	0,58	-	4,1	-	2,94	-
3. Giurgiu	0,7	0,10	0,10	0,03	0,0	0,0	-	0
4. Braila	0,9	0,42	0,63	0,90	0,6	0,5	0,18	-
5. Craiova	0,3	0,07	0,22	0,37	0,01	0,2	1,57	-
6. Tulcea	0,1	0,9	0,04	0,76	0,2	0,1	0	-
7. Buzau	0,5	0,15	1,40	0,15	0,0	0,15	0	-
8. Tirgoviste	0,05	0,10	0,02	0,03	0,0	0,10	-	0,46
9. Slatina	-	0,07	-	0,08	-	0,01	1,3	-
10. Tg. Jiu	0,02	0,05	0,02	0,02	0	0	0	-
11. Alexandria	0,24	0,04	0,06	0,06	0	0	0	0,8
12. Brasov	0,05	0,07	0,03	0,02	0,09	0,01	0	-
13. Bucuresti	0,28	0,87	0,33	0,44	0	0	0	0
14. Pitesti	0,15	0,13	0,20	0,08	0,05	0,4	-	0
15. Rm. Vilcea	0,29	1,54	0,3	0,06	0	0,06	-	-
16. Iasi	0,14	-	-	-	0,18	-	0,33	0,66
17. Galati	0,17	-	-	-	0,23	-	7,7	0,40
18. Suceava	0,46	-	-	-	0	-	4,4	0,12
19. Botosani	-	-	-	-	-	-	3,9	-
20. P. Neamt	-	-	-	-	-	-	10,4	3,27
21. Bacau	-	-	-	-	-	-	-	13,6
22. Focsani	0,05	-	-	-	0,07	-	-	2,9
23. Vaslui	0,11	-	-	-	0,08	-	-	2,4
24. Timisoara	0,03	-	0,25	-	0	-	-	-
25. Arad	0,22	-	0,63	-	0,06	-	-	-
26. Sibiu	0,03	0,06	0,16	0,08	0,46	0,37	-	-
27. Satu Mare	0,08	0,02	0,20	0,19	0,27	-	-	-
Norms	0,5	0,3	0,2	0,3	1,0	1,0	1	1

* As of July 1991 tests were carried out in only 27 out of 41 counties.

Table 13
CONCENTRATIONS OF CARCINOGENS IN FOODSTUFF IN 29 COUNTIES*

County	Salamis			Candies			Alcoholic Beverages		
	Cd mg/kg	Cr mg/kg	Ni mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg
1. Ploiesti	0,5	7,3	-	1,1	9,8	-	-	-	-
2. Constanta	0,9	0,7	3,9	0,03	0,14	-	0,012	0,010	0,04
3. Giurgiu	0,25	1,4	-	0,4	2,8	-	-	-	-
4. Braila	0,5	0	2,5	0,8	0,2	3,9	0,1	0,7	0,17
5. Craiova	2,5	1,0	0,86	0,8	0,79	2,85	0,19	0,05	0,17
6. Tulcea	0,2	0	1,2	0,1	0	0,49	0,007	0	0
7. Buzau	0,045	0,6	0,37	0	0	0	0,006	0,04	0,04
8. Tirgoviste	0,06	18,8	2,4	1,6	5	14,6	0,5	0,02	0
9. Slatina	3	1	2,2	0,3	0,8	2,2	0,002	0,1	0,09
10. Tg.Jiu	0,045	1,3	0,27	0,12	0,4	0,6	0,01	0,04	0,05
11. Alexandria	0,27	0,2	0,3	0,5	0,4	1,48	0,05	0	0,27
12. Brasov	0,3	1	2,2	0,1	1,03	1,04	0,01	0	0,09
13. Bucuresti	0,5	2,3	0	0	0,8	0	-	-	-
14. Pitesti	-	-	-	0	0,2	0,9	0	0,05	0,12
15. Rm.Vilcea	0,12	0,8	0	1,05	1	0	0,009	0,12	0,09
16. Iasi	0,088	0,318	-	0,014	0,042	-	-	-	-
17. Galati	0,093	0,030	-	0,045	1,12	-	-	-	-
18. Suceava	0,040	0,071	-	0,110	0,310	-	-	-	-
19. Botosani	0,088	0,120	-	0,093	0,080	-	0,102	0,068	-
20. P.Neamt	0,050	0,320	-	0,011	0,040	-	0,033	0,090	-
21. Bacau	0,024	0,093	-	0,085	0,010	-	0,092	0	-
22. Focsani	0,012	0,104	-	0,033	0,022	-	0,028	0	-
23. Vaslui	0,018	0,140	-	0,011	0,006	-	0,054	0	-
24. Timisoara	0	0	0	0	-	-	-	-	-
25. Sibiu	0,097	0,309	-	0,044	0,127	-	-	-	-
26. Satu Mare	0,076	0,355	-	0,041	0,125	-	-	-	-
27. Cluj	0,091	0,215	-	0,035	0,155	-	-	-	-
28. Tg.Mures	0,097	0,201	-	0,021	0,125	-	-	-	-
29. Baia Mare	0,139	0,195	-	-	-	-	-	-	-
Norms	0,75	0,2	0,5	0,01	0,5	2	0,01	0,05	0,3

* As of July 1991 tests were carried out in only 29 out of 41 counties.

Table 14

CONCENTRATION OF CARCINOGEN IN FOODSTUFF FOUND IN 28 COUNTIES*

County	Salami NO ₂ mg/kg	Salads NO ₃ mg/kg	Carrots NO ₂ mg/kg	Apples NO ₃ mg/kg
1. Ploiesti	40	758	812	-
2. Constanta	80	1695	629	59,7
3. Giurgiu	54	986	120	-
4. Braila	60	595	1784	1406
5. Craiova	78	443	309	181
6. Tulcea	76	358	83	46
7. Buzau	132	1770	61	44
8. Tirgoviste	65	290	970	431
9. Slatina	80	1025	411	21,7
10. Tg. Jiu	60	694	1069	106
11. Alexandria	80	1213	307	102
12. Brasov	71	1257	1460	780
13. Bucuresti	81	2132	490	53
14. Pitesti	67	355	115	61
15. Iasi	17,3	52,7	66,2	1
16. Galati	6,6	440,4	66,7	-
17. Suceava	8,9	48,5	114,5	-
18. Botosani	18,4	48,5	114,5	-
19. Piatra Neamt	11,7	425,8	80,1	-
20. Bacau	35,6	774	45,8	-
21. Focsani	35,5	1693	474	-
22. Vaslui	5,1	48,7	29,1	-
23. Timisoara	52,4	588	215,4	-
24. Arad	32,5	2336	207,0	-
25. Sibiu	-	18,9	15,4	-
26. Satu Mare	-	210,3	155,0	-
27. Alba Iulia	-	653,0	381,7	-
28. Bitrita	-	311,4	1620	-
Norms	70	1500	400	80

* As of July 1991 tests are carried out only 28 out of 41 counties.

E. THE EFFECTS OF ENVIRONMENTAL CONTAMINANTS ON CANCER MORTALITY--
INITIAL RESULTS

The new study initiated by the Institute of Oncology in collaboration with the Institute of Hygiene and the Institute of Environmental Engineering is sponsored by the Ministry of Sciences and Education. It is designed to follow up the presence of carcinogenes in the air, water, and the food chain, and to link the presence of toxic substances and other pollutants to the state of health of the population exposed.

Data on air pollutants included chromium, nickel, cadmium, benzo(a)-pyrene and asbestos (Table 9). Measurements on drinking water contaminants, as shown in Table 10, included arsenic, nitrate, chromium, cadmium, nickel, benzo(a)-pyrene, pesticides and trihalomethanes, while the food contaminants measured were nitrate, cadmium, chromium, nickel, organochlorine pesticides and benzo(a)-pyrene (Tables 11-14). Data are not yet complete for all regions.

Correlations between regional cancer mortality rates and environmental variables were calculated, as were correlations among the rates and environmental variables themselves. Correlations were calculated between each cancer site and five environmental variables (cadmium in air, chromium in food, nitrate in water, cadmium in water and pesticide in water) for the data 1984-1988 (Figures 1 & 2). Correlations were then recalculated after removing the outlying values (Table 15).

A summary of correlations before and after removing the outliers is shown in Table 16. There were a total of nine outliers removed. These outliers differed for each particular environmental variable.¹ Due to the number of regions missing environmental data, only a limited number of environmental variables could be used in a multivariate analysis. Nevertheless, significant correlations between specific cancer sites and environmental variables were examined for outliers and potential confounders. Multiple linear regression analysis between mortality rates and environmental variables were performed with all points and with outliers removed.

¹ For cadmium in air, the regions of Cluj, Mures and Sibiu were removed (values of 240, 147 and 110 respectively leaving a range of 0-47 $\mu\text{g}/\text{m}^3$). For chromium in food, Dimbovita was deleted (value of .440 leaving a range of .000-.252 mg/zi) and for nitrates in water, the region of Tulcea was deleted (value of 60.2 leaving a range of 0-37.8 mg/L). The regions of Arad and Suceava were deleted for cadmium in water (values of .1010 and .0470 respectively leaving a range of 0.0000-.0180 mg/l). For pesticides in water, Municipiul Bucuresti and Timis were deleted (values of 12 and 3 respectively leaving a range of 0.01-1.12 $\mu\text{g}/\text{L}$).

Figure 1:

Cancer Mortality and Environmental Variables, Romania, 1984-1988, Males

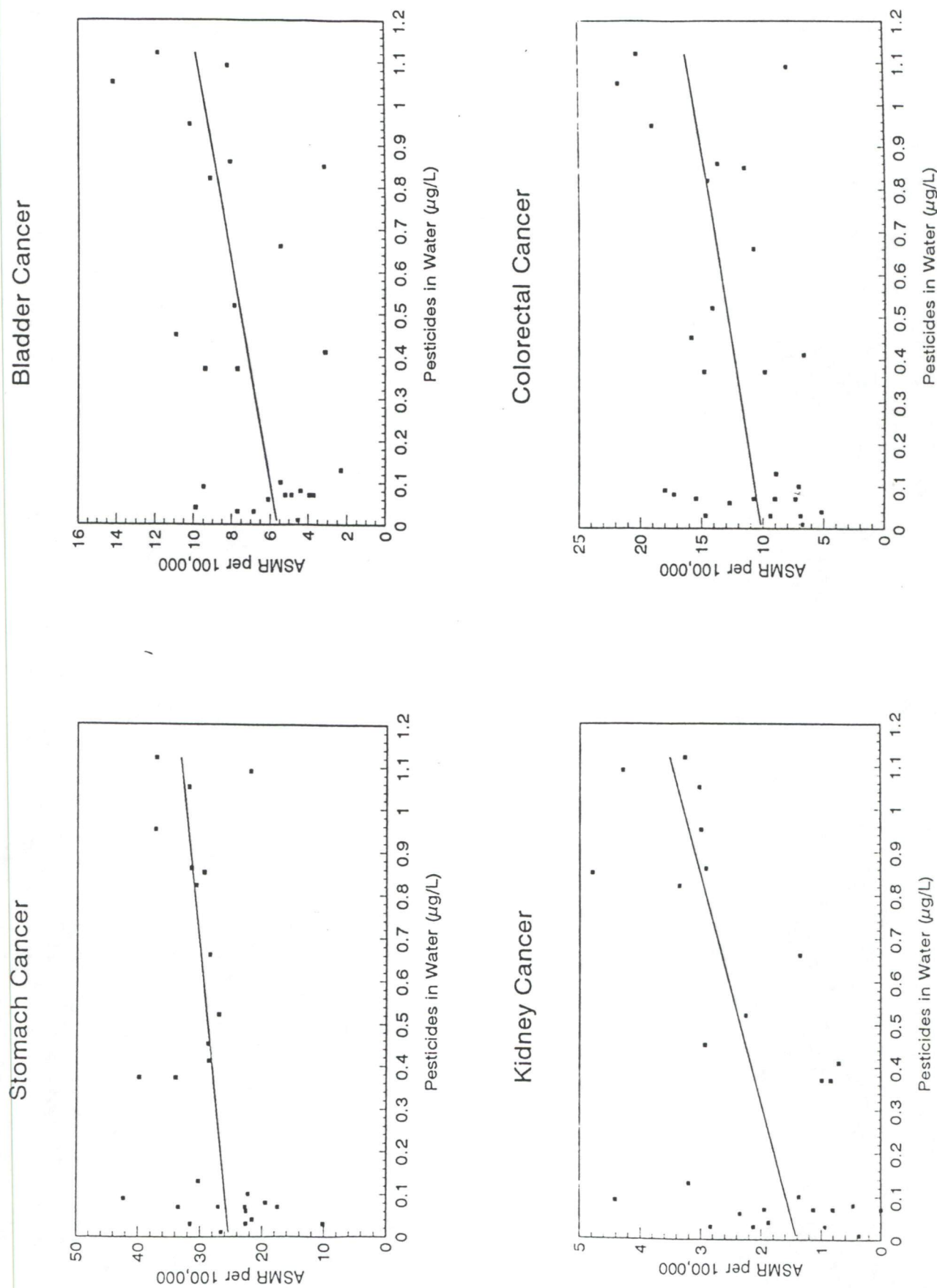
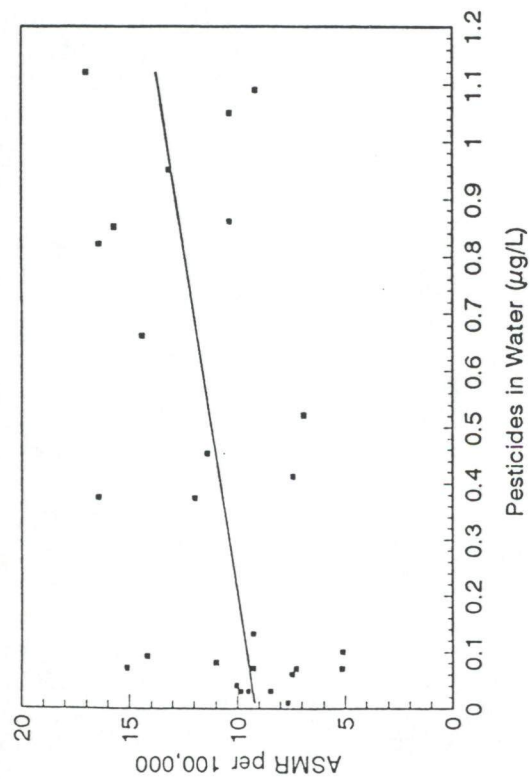


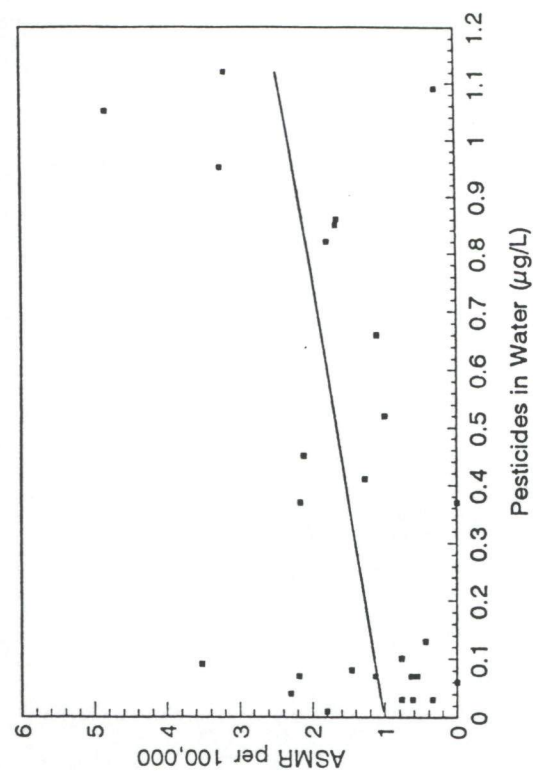
Figure 2:

Cancer Mortality and Environmental Variables, Romania, 1984-1988, Females

Stomach Cancer



Bladder Cancer



Colorectal Cancer

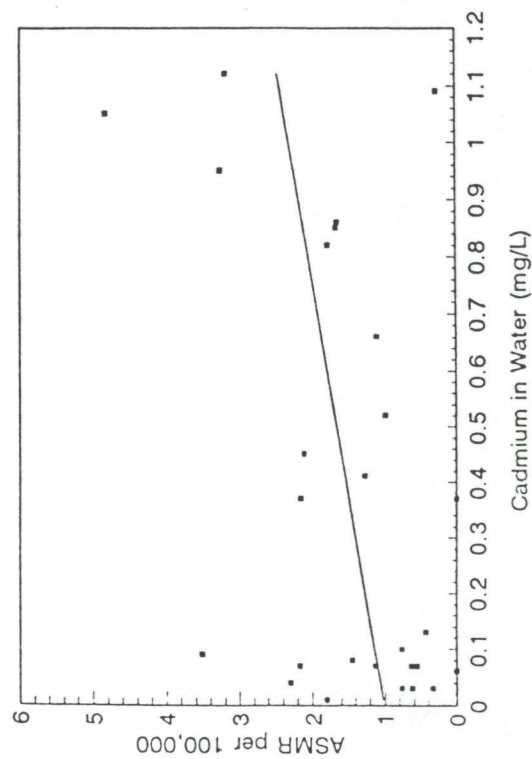


Table 15

SIGNIFICANT CORRELATIONS BETWEEN ENVIRONMENTAL VARIABLES
OUTLIERS REMOVED

Observation	p ¹	r ²	n ³
Nitrate in Food & Nickel in Air	.001	.650	22
Pesticide HCH in Food and Asbestos in Air	.003	.649	19
Pesticide in Water & Chromium in Air	.032	.412	27
Pesticide in Water & Nickel in Air	.009	.493	27
Trihalomethanes in Water & Cadmium in Air	.009	.569	20
Chromium in Water & Cadmium in Air	.027	.396	31
Cadmium in Air & and Chromium in Food	.030	.512	18
3,4 Benzo (a)-pyrene in Food & Chromium in Food	.014	-.947	5
Radon & Pesticide HCH in Food	.048	-.458	19
Trihalomethanes in Water & Nickel in Food	.027	.689	10
Benzo (a)-pyrene in Water & Chromium in Food	.018	.549	18
Pesticide in Water & Radon	.040	.397	27
Trihalomethanes in Water and Radon	.032	-.492	19
Cadmium in Water and Radon	.001	-.586	30
Trihalomethanes in Water & Cadmium in Water	.001	.743	19

¹ A two-sided p value.

² Pearson correlation coefficient.

³ n equals the number of matched observations.

Table 16

SIGNIFICANT CORRELATIONS BETWEEN ENVIRONMENTAL
VARIABLES AND CANCER SITES, 1984-1988

Observations	P	r	n ³	Outliers removed p ¹	Outliers removed r ¹	n ³
<u>Males</u>						
All Cancers & Pesticide in Water	.022	.422	29			
Stomach Cancer & Pesticide in Water	²					
Lung Cancer & Pesticide in Water	.044	.376	29	.047	.385	27
Bladder Cancer & Cadmium in Water	.040	.358	33			
Bladder Cancer & Pesticide in Water	.029	.405	29	.008	.500	27
Kidney Cancer & Pesticide in Water				.002	.559	27
Colorectal Cancer & Pesticide in Water	.008	.484	29	.015	.462	27
<u>Females</u>						
All Cancers & Pesticide in Water	.016	.444	29			
Stomach Cancer & Radon	.014	.387	40			
Stomach Cancer & Pesticide in Water				.015	.462	27
Lung Cancer & Pesticide in Water	.001	.586	29			
Breast Cancer & Pesticide in Water	.012	.458	29			
Cervix Cancer & DDT in Food	.013	.560	19			
Bladder Cancer & Pesticide in Water	.022	.422	29	.024	.433	27
Kidney Cancer and Cadmium in Water				.024	-.403	31
Colorectal Cancer & Cadmium in Air	.045	.336	36			
Colorectal Cancer & Pesticide in Water	.007	.492	29			

¹ The p values and Pearson correlations after outliers had been removed.

² A missing value indicates that the correlation is not significant.

³ n equals the number of matched observations.

Correlation Analysis

Between Environmental Variables: A correlational matrix was created for each of the twenty environmental variables; fourteen significant correlations were found (Table 15). Some of the larger correlations were between nitrates in food and nickel in the air, with a Pearson correlation of $r=0.651$, based on 22 observations. As well, there were correlations between pesticides in water and nickel in the air ($r=0.493$ with 27 observations). Radon was inversely correlated with cadmium in water ($r=-0.586$ with 30 observations). Trihalomethanes in water were found to correlate well ($r=0.689$) with nickel in food. However, this was based on 10 observations.

Between Cancer Sites: A correlational matrix was also calculated for each of the twelve sites. Many of the correlations between all sites combined and particular sites were significant, except for when correlated with kidney or cervical cancer. Most site and sex-specific cancer rates were strongly correlated with rates for the opposite sex but same site. Kidney cancer was significantly correlated with bladder cancer (males $r=0.348$, females $r=0.329$). Other interesting correlations are between bladder and colorectal cancer (males $r=0.594$, females $r=0.638$), stomach and colorectal cancer (males $r=0.422$, females $r=0.412$) and lung and bladder cancer (males $r=0.385$, females $r=0.310$).

Correlations between Cancer Sites and Environmental Variables: It was found that pesticides in water correlated with certain types of cancer, after removing outlying observations. In males, pesticides in water correlated with stomach cancer ($r=0.385$), bladder cancer ($r=0.500$), kidney cancer ($r=0.559$) and colorectal cancer ($r=0.462$). Pesticides in water were not found to correlate with all sites combined after the outliers had been removed. Figures 1 to 3 present plots of the ASMR's per 100,000 versus the levels of a particular environmental variable for which the correlation was significant with outliers removed.

Results for females were very similar to those for males, after any outliers were removed. It was found that pesticides in water were significantly correlated with stomach ($r=0.462$) and bladder cancers ($r=0.433$). Kidney cancer was not found to correlate with levels of pesticides in water and colorectal cancer no longer had a significant correlation after outliers had been removed. Kidney cancer was found to inversely correlate with levels of cadmium in water ($r=-0.403$). Multiple regression analysis indicated no confounding variables were present.

Discussion

Caution must be used in interpreting the present study findings. Environmental pollution levels were measured in municipal centres while cancer mortality data were collected for entire regions. The pollution effect may be diluted by including rural areas in the disease outcome measures. Both environmental contamination and cancer mortality were measured from the most recent year available. Ignoring the latent period between exposure and disease onset could bias the results toward the null hypothesis.

Using cancer mortality instead of incidence as the outcome of interest means that the effect of environmental pollutants could be modified by the accessibility of the health care system. The fact that environmental pollution is highly associated with industrialization could introduce confounding by occupation to the pollution effects. Different equipment and techniques used in each environment monitoring station could cause a misclassification of environmental pollution levels, which again would bias the results toward the null hypothesis.

The lack of environmental measures in several of the regions lowers study power, especially when using multivariate analysis techniques. Many environmental variables are mutually associated; a residual effect may exist in descriptive analysis and collinearity may exist in multivariate analysis. Last but perhaps most important, the migration effect resulting from the misuse of patients' current residency as their life time residency could create a bias towards the null. Most of these biases can be corrected through careful design and analysis. Study power can be much improved if cancer incidence data were used to replace mortality data.

In this study, the multiple regression analysis indicated no confounding variables were present, thus suggesting a correlation analysis of the data may be sufficient.

The significant correlation between lung and bladder cancer, which was noted for both sexes, suggest that the effect of smoking could be a factor related to both diseases. The high correlation between stomach and colorectal cancer, bladder and colorectal cancer and kidney and bladder cancer all hint at the existence of an occupational or environmental risk factor as a common etiology. Since these high correlations appear for both sexes, the positive correlation is more likely to derive from the environment rather than from occupational risk factors. However, the lack of correlation between male kidney cancer and female kidney cancer suggest that occupational effects should not be ignored.

Pesticides in water were highly correlated with stomach cancer, bladder, kidney and colorectal cancer. This finding suggests that pesticides in water should be targeted for further research. Detailed analysis should be included to examine the components of pesticides in water to identify the factor(s) responsible for the high stomach cancer rate.

F. RECOMMENDATIONS

The mission recommends that an environment-related cancer risk assessment program should be undertaken. Phase one of this program should use quality controlled regional incidence data in combination with regional historical environmental pollution data and demographic data to conduct an ecological study. In phase two of this program, a population-based cohort should be organized from regions of different pollution levels of pesticide

in water. Individual risk factors including smoking, nutrition, occupational history, environmental exposures, demographic variables and other life-style variables will be collected and updated annually to perform a long term cohort follow-up study.

Data displayed in the Cancer Mortality Atlas of Romania suggest that action should focus on high risk regions such as Arad, Bihor, Bistrita-Nasaud, Maramures, and Municipiul Bucuresti.

Air pollution levels were not significantly associated with lung cancer rates; therefore, they cannot explain the rapid increase in lung cancer in many heavy industry regions. The high positive association between lung cancer mortality and bladder cancer mortality suggest that smoking may be the factor responsible for the high rates of both cancers.

Pesticide levels in water were highly significantly correlated with cancers of the stomach, colorectum, bladder and kidney. Pesticides may contribute to the unusually high stomach cancer rate in Romania. Further study is necessary to investigate this hypothesis.

ANNEX 1

LIST OF PERSONS VISITED

Ministry of Health

Dr. Bogdan Marinescu, Minister

Institute of Oncology, Bucharest

Dr. Ion Pana, Director

Dr. Niculae Voiculescu, Scientific Director

Dr. Vasile Roman, Epidemiologist

Dr. Niculae Manolescu, Director, Carcinogenesis Research Program

Dr. Rodicre Dutzu, Director, Pathology Department

Institute of Public Hygiene, Bucharest

Dr. Manole Cucu, Director & Member of Academy of Medical Sciences

Environmental Health Department

Prof. Sergiu Manescu, M.D.

Elena Andronache, M.D.

Mihai Zamfirescu, Chemist

Mihaela Vasilescu, Chemist

Rodica Tulbure, M.D.

Dr. Constantin Mihu, Physicist

Rodica Gheorghe, Physicist

C. Fugariu, Statistician

Occupational Health Department

Vasile Paslaru, M.D.

Irma Csiki, M.D.

Social Medicine Department

Grigore Marcu, M.D.

Center for Statistics and Epidemiology

Dr. Traian Ionescu, Director

Ministry of the Environment

Ioan Jelev, State Secretary

Institute of Environmental Engineering

Vladimir Rojanski, Scientific Director

Gheorghe Constantinescu, Assistant Director

Mihai Lesnic, Scientific Director

Ministry of Education and Sciences

Dr. Andrei Tsugulea, State Secretary

Cristian Bararu

Stelian Voinea, Advisor

Committee for Research on Carcinogenic Substances in the Food Chain

Ioan Paltineanu, Research Institute for Irrigation and Drainage

Constantin Rapeanu, LCCA

Dr. Gheorghe Dinca, Occupational Medicine in Rare Metals Mining

Radu Lacatusu, ICPA

Dr. Corneliu Rauta, Director, Research Institute of Soil Sciences
and Agrochemistry, Member of the Academy of Agricultural and
Forestry Sciences

Dumitrache Sebastian, Institute of Hygiene and Public Health

Costin Vladimir, Natl. Inst. of Meteorology and Hydrology (NIMH)

Nicolae Romanoff, NIMH

Ioan Cureu, IBNA

Nona Dragujan, Institute of Research for the Protection of Plants
(IRPP)

Maia Stanculescu, IRPP

Romanian Anti-Cancer League

Eugenia Crosu Popescu, M.D.

Alexandru Gaspar, Engineer/Film Dir.

Luminitsa Plesa, Teacher

ANNEX 2

DETAILED TERMS OF REFERENCE FOR THE PROPOSED ECOLOGICAL
AND THE COHORT STUDIES

Annex 2.1

ECOLOGICAL STUDIES

Resource Requirement

Program activities are based on forty-one Romanian regional cancer registration centres, the Department of Environment, the Institute of Environmental Engineering and the Institute of Oncology in Bucharest. The resource requirements for this study are based on a two year historical data organization plan. The resources requested for the pre-requested actions of improving the data quality and the extended actions of maintaining a long term cancer surveillance system will be provided by the Romanian government with minimum help from the World Bank.

Four persons per year will be needed for the years 1992 and 1993; one from each of the Department of Environment and the Institute of Environmental Engineering and two from the Institute of Oncology in Bucharest. The office space, furniture and man years will be provided by the Romanian government.

The equipment cost is estimated at \$63,000. A total of \$43,000 will be required for the year 1992 to purchase four microcomputers (4 x \$7,000), four printers (3 x \$1,000 + \$2,000), one plotter (\$4,000) and various statistical data analysis packages (\$6,000). In 1993, \$20,000 will be needed for maintenance and upgrading the computer system.

Other foreign costs includes \$25,000 for training five scientists abroad, \$10,000 for books and journals, \$40,000 for travel, and \$10,000 for consultant fees. The costs of communications (including telephone, telegraphs, postage, fax, advertising, research assistants, stationery, and other supplies are covered under budget allocations from the Ministry of Sciences and Education. In addition, approximately \$60,000 is allocated to the preparation of an international symposium to present the first year's findings and discuss methodology.

Purpose of the Program

The descriptive epidemiology and ecological analysis phase of the environmental cancer risk assessment program will provide essential information to the Romanian Departments of Health and Environment and to the World Bank regarding the distribution of cancer risks in Romania and their associations with regional environmental pollution levels. The ultimate goal is to use this information to develop a cancer control program which will include reducing levels of environmental pollutants.

Program Description

(1) Structure:

The ecological study will produce complete information, currently unavailable, on the relationship between environmental pollutants and cancer

incidence in each region in Romania. This project will be based on the collaborative efforts of three institutes: the Department of Environment, the Institute of Environmental Engineering and the Institute of Oncology, all located in Bucharest. Cancer incidence data will be collected through the regional cancer registration centres and centrally organized in the Institute of Oncology. The environmental pollution information will be obtained by environmental monitoring stations and then summarized by either the Department of Environment or the Institute of Environment Engineering.

A data analysis unit will be located in the Institute of Oncology in Bucharest. The team members of this unit will include a project coordinator, three researchers (one from each institute) three research assistants and a consultant.

(2) Logistics:

The project coordinator and three researchers, one from each of the participating institutes, will be sent abroad to learn methods of cancer registration data collection, quality control processing, file organization, database management, analysis techniques and epidemiological interpretation. Computers of adequate capability and sophisticated computer analysis packages will be installed in each institute as well as the central analysis unit.

Episode-oriented cancer registration records will be collected and their quality assessed in each regional cancer registry. These data will be computerized in the Institute of Oncology and re-organized into patient-oriented records. Under the supervision of the project coordinator, summary indices will be generated for each region by cancer site. The regional environment pollution data, prepared by the Department of Environment and the Institute of Environmental Engineering, will then be merged into the database to be used for ecological analysis.

An ongoing, long-term environment-related cancer registration and surveillance system could be organized to continue monitoring the effects of environmental pollution on cancer incidence on a regional level and to provide information to help develop a cancer control strategy for this country.

(3) Functions:

The principal investigator, located at the Institute of Oncology in Bucharest, is responsible for project organization, initiating collaboration between Institutes, personnel selection and recruitment and report publishing. The project coordinator, also located at the Institute of Oncology, is responsible for personnel training and education, data collection and quality control, workshop organization, data analysis and project report writing. The three research scientists, one from each institute, are responsible for obtaining the data from the "mother" institute, organizing and integrating the data into an analysis database, and participating in the ecological data analysis. The consultant is responsible for assisting in the preparation of the proposal, progress evaluation, training specification and the interpretation of results. The World Bank is responsible for coordinating the research funding and

experienced consultants, arranging abroad training and overall control of the progress of the project. The Romanian government is responsible for providing human resources, office space and furniture, and for maintaining, on a long-term basis, an environment-related cancer registration and surveillance system.

Rationale

1. Mortality rates from environment-related cancer are significant higher in Romania than in most European countries. Stomach cancer mortality in Romania is among the highest in the world. Mortality rates from lung cancer, bladder and kidney cancer also rank high in Europe.
2. Mortality rates of environment-related cancers are rising in many Romanian regions. Lung cancer mortality rate increased more than 25% in 14 industrialized regions, while stomach cancer mortality rates are increasing in regions with a high water contamination levels.
3. Historical environmental pollution data and population- based cancer registration data are available at regional and municipal levels. Applying appropriate quality control and data management procedures, an environmental cancer database can be established and maintained at low cost to conduct environment-related cancer surveillance and epidemiological analysis.

Time Table

This two year project is proposed to start on April 1, 1992 and to be completed on March 31, 1994. The grant should be approved within a minimum of three months before the start date of the project to allow for sufficient project collaboration initiation time.

<u>TASK NO.</u>	<u>TASK DESCRIPTION</u>	<u>COMPLETION DATE</u>	<u>RESPONSIBILITY CENTRE</u>
1	Proposal Development and initiation of collaboration between Institutes	Mar. 4/92	Principle Investigator (P.I.) & consultants
2	Select 4 research scientists, identify a project coordinator and recruit 3 research assistants	Apr. 1/92	P.I. & three institutes
3	Cancer Registration Data Quality Assessment Workshop	May 20/92	Project Coordinator (P.C.)
4	Order journals, books, computers and other capital equipment	June 17/92	P.C.
5	Four research scientists sent abroad for training and career development	July 1/92	Three inst. & World Bank
6	Computers and other capital equipment arrive and are set up in Institutes	Sept. 2/92	P.C. & three inst.
7	Three research assistants complete on-the-job training	Oct. 30/92	P.C.
8	Historical data collection & data quality assessment	Jan. 6/93	P.C. and research assistants
9	Data shipped abroad for on-the-job training of research scientists	Jan. 27/93	P.C. and research assistants
10	Prepare historical data to establish an ecological analysis file	Apr. 7/93	Researchers abroad and consultants
11	Preliminary ecological analysis	June 16/93	Researchers abroad and consultants
12	establish a Surveillance Database	Sept. 1/93	P.C. and analysis team
13	Computer equipment upgrade	Sept. 1/93	P.C.
14	Analyse ecological data and prepare report	Nov. 3/93	Analysis team
15	Conduct a workshop to evaluate Ecological analysis report	Dec. 8/93	P.C., analysis team & consultant &
16	Project report printing and circulation	Mar. 2/94	P.I.

Annex 2.2

COHORT FOLLOW-UP STUDY

Resource Requirement

The resource requirements for this study are based on an examination of the short-term health experience of a four- population-based cohorts organized in four regions of Romania: Bucharest, Cluj, Iasi and Timis. It is estimated that this part of the study will be completed in five years. The long term cancer incidence follow-up phase of this project will be planned at a later stage. The resources required for the long-term follow-up of this cohort will be provided by the Romanian government with marginal help from the World Bank.

In addition to a principle investigator, five persons will be needed every year during the period from 1993 to 1997. One field coordinator will be selected for each of the four regions. The project coordinator will come from the Institute of Oncology in Bucharest. The office space, furniture and the individuals will be provided by the Romanian Government.

Starting in 1993, \$200,000 will be necessary to purchase four workstations (4 X \$50,000), four laser printers (4 X \$2,000), four tape back-up units (4 X \$3,500), one plotter (\$4,000), and various statistical data analysis packages (\$6,000). To carry out the 1994 regional surveys, the following are necessary: 100 microcomputers (100 X \$3,000), 20 printers (20 X \$1,000), 100 copies of data entry and editing packages (100 X \$1,000), and four database management systems (4 X \$2,000). \$100,000 will be required over the years 1995-1997 for the maintenance and upgrading of the systems.

Additional costs include \$100,000 for training five scientists abroad, \$20,000 for books and journals, \$50,000 for travel, \$255,000 for technical assistance and various consultant fees, and \$200,000 for printing the questionnaires for the health survey data. The costs of stationery and supplies, communications and miscellaneous expenses are to be covered from the allocations of the budget of the Ministry of Sciences and Education.

Purpose of the Program

The cohort study phase of the environmental cancer risk assessment program will provide essential information to the Romanian Departments of Health and Environment and the world scientific community regarding the effects of the environment on the probability that an individual will develop cancer. This information is critical for the development of any nation-wide cancer control programs. In addition, the special features of a cohort design will allow the study to examine environmental pollution-related adverse health effects other than cancer, thus providing information for further health regulations and policy making.

Program Description

(1) Structure:

The cohort study phase of the environmental cancer risk assessment program will be headquartered at the Institute of Oncology in Bucharest. The risk assessment unit will consist of the four field coordinators and the project coordinator as well as two research assistants. Four field branches will be established, one in each of the four selected regional cancer registries, Bucharest, Cluj, Iasi and Timis. The field branches will be responsible for assembling the cohort and for conducting follow-up. This will be done through contracts with regional public health nurse training centres. Data will be prepared in the cancer registries and then forwarded to the risk assessment unit for analysis.

(2) Logistics:

Four project coordinators, one from each of the four selected regional cancer registries will be sent abroad for training in order to learn the principles and methods of conducting cohort studies, quality control procedures, file organization, database management and cohort follow-up data analysis.

The principal investigator will work in conjunction with the project coordinator and with consultants to develop a draft proposal including the sampling process, contact technique, questionnaire design and the data collection, coding and data entry package. The proposal will be sent to several well-established epidemiologists for constructive comments. A workshop will then be held to discuss the revised proposal.

A publicity campaign and data collection training courses will be organized by the field study branches. Five hundred thousand questionnaires will be printed in centres and shipped to the field branches. The population samples which will form the basis of the cohorts will be selected locally by the field branches. The data collection procedure will also be performed by the field branches through contracts to regional public health nurse training centre.

The data will be organized in the regional cancer registries and then forwarded to the risk assessment unit for analysis. Quarterly project progress review workshops, as well as quality control discussion group meetings, will both be organized in the central office. Consultants will also be involved in data analysis.

An annual cohort follow-up workshop will be held on a rotating basis in each field branch. The long term cohort follow-up for cancer outcome will be planned and designed in the central office with the assistance of the consultant.

(3) Functions:

The principle investigator, located at the Institute of Oncology in Bucharest, is responsible for the study's organization, to initiate collaboration, personnel selection and recruiting, the public relations campaign

and for setting up the communications system. The project coordinator, also located at the Institute of Oncology in Bucharest, is responsible for study proposal development, questionnaire design and printing, training package development, organizing project planning and progress review workshops, organizing the risk assessment unit and conducting data analysis and report preparation.

The four field coordinators, one from each selected regional cancer registry, are responsible for organizing local public relations campaigns, contracting data collection through the public health nurse training centre, performing cohort sample selection, supervising data collection and entering, organizing annual cohort follow-up workshops, and maintaining constant communications with the central office. The consultant is responsible for assisting in the design of the study proposal, field data collection, workshop organization and data analysis. The World Bank is responsible for coordinating research funding and experienced consultants, arranging abroad epidemiological training and overall control of the progress of the project. The Romanian government is responsible for providing human resources, office space and furniture, and for continuing the long-term cancer incidence follow-up of the established cohort.

Rationale

- (1) Environment-related cancer is one of the leading health problems in Romania. An ecological study noted that mortality rates of stomach cancer, lung cancer, bladder cancer and kidney are all associated with high level environmental pollution. In addition, descriptive epidemiology shows the existence of high cancer mortality clusters among industrialized regions.
- (2) Ecological studies can only provide information in relation to the effect of environmental pollution on cancer mortality at a population level. Analytic studies must be conducted to investigate the etiologic relationship between environmental pollution and cancer risk.
- (3) There has never been a nation-wide systematic study done of the environment-related cancer problems in Romania, nor has there been any attempt to identify the association between environmental pollution and individual disease risk. To provide an information base for public health policy making and to develop a strategy for cancer prevention in this country, local investigations on the individual level are essential.

TIME TABLE

This five year project is proposed to start on January 5, 1993, and to be completed on December 31, 1997. Under the assumption that the proposed budget will be granted early in 1992, the project activities will be scheduled as follows:

<u>TASK ITEM</u>	<u>TASK DESCRIPTION</u>	<u>COMPLETION DATE</u>	<u>RESPONSIBILITY MEMBER</u>
1	Receive the permission of study from	June 17/92	Ministry of Sciences and Education Department of Health Institute of Oncology
2	Initiate the collaboration with four regional cancer registries	July 15/92	Principle Investigator (P.I.)
3	Identify a project coordinator and four field coordinators	Sept. 16/92	Principle Investigator
4	Organize first project meeting	Sept. 16/92	Project Coordinator (P.C.)
5	Four epidemiologists to go abroad for training and education	Jan. 6/93	Principle Investigator
6	Order books and journals	Feb. 3/93	Project Coordinator and Consultants
7	Field test the questionnaires, conduct feasibility study	Mar. 31/93	Project Coordinator and Consultants
8	Organize a workshop to develop a detailed proposal	June 2/93	P.I., P.C and Consultants
9	Order computer and other capital equipment	July 7/93	Project Coordinator
10	Print questionnaire	Sept. 1/93	Project Coordinator
11	Obtain population list process Cohort sample selection	Nov. 24/93	Project Coordinator
12	Initiate data collection contract	Jan. 5/94	P.I., P.C. and Field Co-ord (F.C.)

<u>TASK ITEM</u>	<u>TASK DESCRIPTION</u>	<u>COMPLETION DATE</u>	<u>RESPONSIBILITY MEMBER</u>
13	Publicity campaign	Jan. 12/94	P.I., P.C. and Field co-ord.
14	Organize data collection training program	Jan. 26/94	P.C. and Field Coordinator
15	Begin data collection field work	Feb. 16/94	P.C. and Field Coordinator
16	Data collection workshop	May 18/94	P.I., P.C., F.C. & consultants
17	Data quality control software development	Sept. 14/94	P.C. and consultants
18	Data quality control workshop	Oct. 19/94	P.C., F.C. & consultants
19	Data analysis software development	Nov. 16/96	P.C. & consultants
20	Data analysis workshop	Dec. 7/94	P.C., F.C. & consultants
21	Initiate cohort follow-up contract Process cohort follow-up	Jan. 11/95	P.C. & F.C.
22	Data collection and quality control	Sept. 13/95	P.C. & F.C.
23	Data quality control workshop	Oct. 18/95	P.C. & F.C.
24	Cohort follow-up data analysis	Nov. 15/95	P.C. & consultant
25	Annual cohort follow-up workshop	Dec. 6/95	P.C. & F.C.s
26	Initiate cohort follow-up contract Process cohort follow-up	Jan. 10/96	P.C. & F.C.
27	Data collection and quality control	Sept. 12/96	P.C. & F.C.
28	Data quality control workshop	Oct. 17/96	P.C. & F.C.

<u>TASK ITEM</u>	<u>TASK DESCRIPTION</u>	<u>COMPLETION DATE</u>	<u>RESPONSIBILITY MEMBER</u>
29	Cohort follow-up data analysis	Nov. 14/96	P.C. & consultant
30	Data analysis workshop	Dec. 5/96	P.C. & F.C.s
31	Initiate cohort follow-up contract Process cohort follow-up	Jan. 8/97	P.C. & F.C.
32	Data collection and quality control	Sept. 10/97	P.C. & F.C.
33	Data quality control workshop	Oct. 15/97	P.C. & F.C.
34	Cohort follow-up data analysis	Nov. 12/97	P.C. & consultant
35	Data analysis workshop	Dec. 3/97	P.C. & F.C.s

ANNEX 3

DETAILED DISCUSSION OF STATISTICAL ANALYSIS AND PROPOSAL

Results:

A regional map showing the regions of Romania was prepared. Data for the region of Municipiul Bucuresti was used for both Municipiul Bucuresti and the region of Ilfov. Maps show these regions combined. A summary of the features of each map based on environmental data or cancer mortality rates appears below. Note that environmental data were not available for all regions.

Environmental Variables

Benzo(a)-Pyrene in Air:

Air levels of benzo(a)-pyrene were high in the Southeastern parts of the country particularly in the regions of Tulcea, Braila and Constanta.

Low levels of benzo(a)-pyrene in air were found in the Northeastern regions of Romania in Suceava, Neamt, Iasi and Vrancea.

Cadmium in Air:

Levels of cadmium in air were high in the Northwestern regions particularly in Cluj, Mures and Sibiu.

Low levels of cadmium in the air were found in the South and West regions of the country including Arad, Timis and Caras-Severin.

Nitrate (Azototi) in Water:

High levels of nitrate in water seemed to be scattered in the Eastern regions of the country. Regions with particularly high levels included Tulcea, Suceava and Dimbovita.

Regions with significantly low levels of nitrate in water were near the centre of the country, in the regions of Bistrita-Nasaud, Buzau, Gorj and Prahova.

Pesticides in Water:

Regions with high levels of pesticides in water were in the West and central regions of the county, including Timis and Municipiul Bucuresti. Low levels of pesticides in water were found in the Southern regions of Dolj, Dimbovita and Buzau and in the Northwest region of Botosani.

Radon:

High levels of radon were found in two clusters, one in the west and one in the north. Western regions of the country included Cluj, Bihor and Salaj. The Northern regions included Harghita, Neamt and Suceava. Caras-Severin also had high radon levels. Radon in low levels was found in the Northeastern regions, in Botosani, Galati, Vaslui and others.

3,4-Benzo(a)-pyrene in Food:

Although the number of available regions was limited, a high level cluster was found in the Northeast, including the regions of Bacau, Vaslui than other Northeastern regions.

Cadmium in Food:

Regions with high levels of cadmium in food were clustered in the south; especially high levels were found in Dolj and Teleorman.

Considerably lower levels of cadmium were found in the Southeastern regions of Vaslui and Constanta and in the region of Gorj in the Southwest.

Chromium in Food:

Regions with high levels of chromium in food were found widely dispersed throughout the country, regions with particular high levels were Dimbovita and Neamt.

Regions with low levels of chromium in food were clustered in the south; very low levels were found in Arges, Dolj, Giurgiu and Prahova as well as Vaslui in the Northeast.

Cancer Mortality by Site, 1984-1988
Stomach Cancer, Males:

Mortality from stomach cancer was highest in the north, particularly in the regions of Bistrita-Nasaud, Bihor and Arad. Low mortality rates occurred in the southern region of Gorj and in the eastern regions of Mehedinti, Galati and Buzau.

Stomach Cancer, Females:

High stomach cancer mortality occurred in the Northwest in the regions of Arad, Cluj, Bistrita-Nasaud and Harghita. Regions with low stomach cancer mortality were typically in the southeast; particularly low rates occurred in the regions of Giurgiu, Vrancea and Calarasi.

Colorectal Cancer, Males:

Colorectal cancer mortality was highest in the west. High rates were found in Arad and Timis as well as Municipiul Bucuresti. Regions with low mortality were in the south; especially low rates occurred in Teleorman, Braila and Dimbovita.

Colorectal Cancer, Females:

High mortality from colorectal cancer occurred in the northwest regions of Timis and Sibiu, and in the southeast regions of Municipiul Bucuresti and Constanta. Low mortality from colorectal cancer was observed in the south, particularly in Teleorman, Vrancea and Mehedinti.

Lung Cancer, Males:

Mortality rates for lung cancer were considerably higher in a group of northwest regions especially Maramures. Rates were also high in the southeastern regions of Municipiul Bucuresti and Braila.

Low lung cancer mortality rates occurred in the eastern regions of Neamt, Bacau and Vrancea as well as in the region of Gorj.

Lung Cancer, Females:

Regions with high lung cancer mortality were scattered in two clusters. Eastern regions include Iasi, central regions include Brasov and Timis in the west. Lung cancer mortality was lowest in the southern regions; especially low rates were found in Mehedinti, Vrancea and Covasna as well as Bistrita-Nasaud in the north.

Bladder Cancer, Males:

High mortality rates from bladder cancer occurred in most of the Northwest regions of the country. Particularly high rates occurred in the regions of Arad and Brasov as well as in Municipiul Bucuresti. Considerably lower mortality rates occurred in the Southeastern regions of Teleorman and Vaslui as well as Salaj in the Northwest.

Bladder Cancer, Females:

Bladder cancer mortality was highest in Brasov, Sibiu and Caras-Severin in the west as well as in Municipiul Bucuresti. Low mortality from bladder cancer was found in the Northwestern regions of Bistrita-Nasaud and Tulcea.

Kidney Cancer, Males:

Kidney cancer mortality was higher in the Northwestern regions of the country. The highest rates occurred in the regions of Covasna, Timis and Salaj. Lower mortality from kidney cancer occurred in the southern regions of Prahova, Dimbovita and Gorj.

Kidney Cancer, Females:

The highest mortality rates for kidney cancer occurred in the western regions of Mehedinti and Bihor as well as in Vrancea in the East. Low mortality rates from kidney cancer occurred in the south (Vaslui) and east (Calarasi) and also in the Southwest in Hunedoara.

Breast Cancer, Females:

Breast cancer mortality was highest in the Southeast and Northwest regions, specifically Constanta, Municipiul Bucuresti and Arad. Mortality was considerably lower in the South, central and Northern regions; especially low risk regions are in Teleorman, Harghita and Suceava.

Cervical Cancer, Females:

Regions with higher cervical cancer mortality were located in the border regions, including Caras-Severin, Giurgiu and Bihor. Mortality rates from cervical cancer were lowest in the central regions of Brasov, Covasna and Prahova.

ANNEX 4

THE INSTITUTE OF ONCOLOGY: ORGANIZATION AND PROGRAMS

1. Identity and location

Institutul Oncologic
Institute of Oncology
Fundeni street no. 252; sector 2
Bucharest - Romania; code 72435 OP 11

Fundeni street no. 252; sector 2
Bucharest - Romania. Code 72435 OP 11

Bucharest
Postal code 72435

Affiliated to: (1) Ministry of Health
(2) Academy of Medical Sciences

Romania
Phone: (90) 55.61.60 or 55.46.03
Fax 40.0.554603

The Institute of Oncology was established in 1949. But in Romania the first Institute for Cancer has been in 1929 in Cluj (Transilvania) and it is still in function as the second Institute in our Country.

The Ministry of Health has a National Cancer Program from 1977.

2. Structure

Director Ion Pana, MD, Prof.
Scientific Director Nicolae Voiculescu, Ph. D.D.Sc.

3. Major departments:

Radiotherapy
Surgery I
Surgery II
Anaesthesiology
Chemotherapy I
Chemotherapy II
Oncopediatry
Biology and Immunology of Tumores
Biochemistry and Tumors Markers
Chemical Carcinogenesis and Molecular
Biology
Earlier diagnosis-outpatients
treatment

4. Department Heads

Maricica Palade MD
Ion Balanescu, As. Prof.
Valeriu Saptefrati MD
Manuela Stanculescu MD
Nicolae Gutulescu MD
Ion Mogos MD
Sebastian Nicolau MD
Ion Popp MD
Ion Niculescu-Duvaz Ph.D.

Sabin Cinca Ph.D.

Rodica Coicea MD

Pathology
Clinical analysis
Epidemiology and methodology
Pharmacy
Radiation Physics
Rehabilitation
Monoclonal antibodies
Nuclear medicine

Rodica Dutu MD
Dorel Iordanescu MD
Vasile Roman MD
Nelly Dumitriu Ph.D.
Gheorghe Matache Ph.D.
Coralia Mirsu Ph.D.
Elvira Badea Ph.D.
Pall Albert MD

5. Personnel

Physicians	Scientists	Nurses
97	100	241

6. Annual cancer patient statistics:

- number of hospital beds from 1989	550 beds
- total number of cancer patients in 1990	9852
- number of new cancer patients registered in 1990	2081
- number of outpatient investigations in 1990	33588

7. Fields of activity (basic research)

1. - Experimentation and discovering of new pharmacological agents with anticarcinogenic properties: cancer chemoprophylaxis
2. - Molecular mechanisms of metastasis and experimental metastasis assays.
3. - Preparation and experimentation of monoclonal antibodies in diagnosis and therapy.
4. - Breast cancer: cellular and molecular biology including: hormones and other growth factors, tumor heterogeneity and malignant progression, epithelial-mesenchymal interactions, extracellular matrix.

8. Cancer treatment (list disciplines and specialized equipment available).

1. - The treatment in the following localizations: breast, cervix, ovary, colorectal, skin, lung, bone and soft tissues, etc.
2. - Cancer surgery, radiotherapy, chemotherapy, immunotherapy, hormonal treatment, combined therapy.
3. - Linear accelerator and planning treatment, radium therapy and afterloading Cobalt-60 units, conventional radiotherapy facilities.

9. Rehabilitation and continuing care (list fields of activity).
 1. - Family and social integration of patients with different cancers treated in the Institute.
 2. - Periodical control and monitoring of all patients treated in the Institute.
10. Clinical cancer research:
 1. - Cancer immunology: immune exploration of cancer patients; immunochemical treatment of cancer.
 2. - Cancer radiotherapy: combined radiotherapy and chemotherapy.
 3. - Cancer chemotherapy; and chemo-immunotherapy: non-specific immune stimulation.
 4. - Cancer surgery: surgery of breast, cervix, ovary, colo-rectal, melanoma, bone sarcoma, soft tissues tumors, etc.
 5. - Radioimmunoassay in cancer diagnosis: steroid receptor detection; carcinoembryonic antigen assay.
 6. - Tumor pathology in: diagnosis, identification and evaluation of histological prognosis factors, cito and histochemical diagnosis.
11. Epidemiology, Registry Biostatistics
 1. - Epidemiological descriptive and retrospective studies concerning the situation of cancer in our country.
 2. - Cancer registry (national and hospital registry); mandatory reporting of cancer cases.
 3. - Pilot station for citological early diagnosis of cancer.
 4. - Surveillance, epidemiology and final results program (SEFR).
 5. - Public information about smoking, diet, diagnosis and cancer treatment
 6. - Experimental model for oncological assistance.
12. Cancer prevention:
 1. - The activity for cancer prevention is organized by the Institute of Hygiene and Public Health and it is addressed to the factors with noxes and from the work places.
 2. - Public education is an obligation of all health institutions.
 3. - Public information about smoking, diet, diagnosis and cancer treatment.
13. Professional education and training - Postgraduated
 1. - Oncology as a secondary specialization (3 years) following primary specialization (surgery, gynecology, radiotherapy, internal medicine).
 2. - Exfoliative cytology and fine needle aspiration in cancer diagnosis every year.

3. - Periodical refresher courses in oncology (at least once every five years).
 4. - Postgraduate course: current concepts in cancer pathology (every year).
 5. - Exchange of experience between individuals and groups.
14. Undergraduated
1. - During the medical school (in the 4th year of studies)
 2. - During the college for sanitary training.
15. Paramedical
1. - With the help of Red Cross Organization
 2. - With the help of National Ligue Against Cancer.
16. Other cancer related activities:
1. - The Institute of Oncology from Bucharest manages the National Cancer Program of the Ministry of Health since 1977 through The National Committee for Cancer.
 2. - It participates at UICC activities by Romanian Society of Oncology.
 3. - The Institute is member of European Organization of Cancer Institutes.
 4. - The Institute is involved in National Program Against Pollution.
 5. - The Institute has many contacts and co-operations with other medical or non-medical institutions from the country or from abroad.
 6. - The research staff of the Institute is member in many national and international societies or associations.
 7. - The research staff is specialized in medical institutions for abroad: Germany, Italy, France, England, United States.
 8. - The Institute organizes the seminars (in: molecular biology, chemotherapy, clinical dosimetry, cancer pathology), national conferences and congresses with international participation.

OPERATIONAL PROGRAMME FOR CANCER
PREVENTION AND CONTROL BETWEEN
1986 - 1990

The Operational Programme for Cancer Prevention and Control for the period of 1986-1990 has been elaborated by the Specialists Committee for Cancer of the Health Ministry based on technical, organizational and development principles stipulated in the Long-Term Programme for cancer prevention and control approved by the Superior Health Council in 1977.

In order to ensure a unitary system of prevention, diagnosis, treatment and medical recovery of the patients with cancer disease, to know the cancer epidemiological indicators evolution (morbidity, mortality, prevalence), to ensure the elimination of cancerigene agents from work and life background, to improve the cancer discovery means in early clinical stages, the promptitude in the complex treatment application, the utilization with high efficiency of the technical and material base from the health institutions, it was necessary to indicate the objectives and stage actions concerning the cancer prevention and control in our country.

Cancer disease is the second death reason after cardiovascular diseases, with approximately 30,000 death yearly, 38,000 new cases and over 100,000 patients in life.

Cancer discovery in early clinical stages, the cure rate and long-term survivals did not correspond to the possibilities, being under the average of the developed countries. Over 25% from new cancer cases are registered by the oncologist physician only at death.

The lack of an unitary conception in the cancer diagnosis and treatment and also the lack of technical means in some districts determine sometimes the inadequate and tardy treatments.

Health education activity is insufficient and less diversified and this explains why 33% from the patients ignore to go to the doctor in clinic stage which permit to apply an efficient treatment.

The Operational Programme comprises eight chapters with objectives and organizational measures, technical measures, material base measures, personnel measures, scientific research measures and measures for the Committee of Oncology Specialist activity improvement, necessary to be applied in the period 1986-1990, corresponding to the long-term objectives of Health Ministry.

Chapter I

**Measures for knowledge of the epidemiological indicators
of cancer disease and the accounts improvement of the
patients with cancer disease**

1. The health informational system improvement concerning the obligatory nominal declaration and the account of the patients with cancer disease - the National Cancer Register of the patients with cancer disease - corresponding to the provisions of Health Minister Order no. 219 from June 3, 1980 through the declaration at Health Statistics and Computing Centre of all new cases treated in health institutions and also of the deaths by cancer registered in territory.

Execution term: December, 1986

Execute : Medical Assistance Department
Health Departments from Districts and from Bucharest
Ministries with personal health system
Health Statistics and Computing Centre
Institutes of Oncology Bucharest and Cluj-Napoca

2. The verification through statistics and health valuation labs of the concordance between the new cases of cancer discovered and treated in health institutions with beds or in ambulatory and the ONC-1 statistics files of these patients. The analyze by the health departments (the coordinator oncologist from the territory) of the reasons which have determined the discovery at death of some patients with cancer disease and the correction of this situation.

Execution term: December 31, 1986

Execute : Health Departments from Districts and from Bucharest
Health Statistics and Computing Centre

3. The elaboration of synthesis studies concerning the morbidity evolution by cancer in territory, based on statistics data processing from the National Register of patients with cancer disease and on mortality data from the Statistics Central Department for the orientation of the cancer disease prevention and control by the Health Ministry.

Execution term: December 31, annual

Execute : Health Statistics and Computing Centre.
Institutes of Oncology Bucharest and Bluj-Napoca.

4. To establish the frequency of death by cancer in districts and other localities through the standardization of the Romania population specific mortality index:

Execution term: December 31, 1986

Execute : Institute of Hygiene and Public Health - Bucharest
Institute of Oncology - Bucharest

5. In order to make uniform the codification of the certificates of death with those ones existent in the world, it will be sollicitated from the Central Statistics Department the approval for the codification on 999 codes.

Execution term: December 31, 1986

Execute : Health Statistics and Computing Centre

Chapter II

Measures in cancer primary prophylaxis field

1. The account of work places with cancerigene noxes from industry and of the exposed workers number in correlation with the exposal intensity, through:

1.1 The drawing up in 1986, 1988 and 1990 of the situation with the work places with cancerigene noxes (Annex I), on higher bodies (Annex II) and on territorial structure, with periodic following of the taken measures.

Execution term: December 31, 1986, 1988, 1990

Execute : Antiepidemic Health Centres, with reference to the Territorial Institutes of Hygiene and Public Health
Syntheses - Institute of Hygiene and Public Health
Bucharest

1.2 The follow up of the cancerigene risk intensity in the work places through determinations of the 3,4 benz(a)pyrene content from the combustion products (resulted from coals, bituminous shales and crude oils) and of the vinyl chloride concentration from the work places atmosphere.

Execution term: December 31, annual for results appreciation

Execute : Institutes of Hygiene and Public Health
Bucharest, Iasi, Cluj-Napoca for 3,4 benz(a)pyrene

2. The estimation of the organizational manner and of the obtained results development through monitoring of professional exposed personnel at cancerigene noxes corresponding to the Health Minister Order no. 15/1982, through:

2.1 Citologic investigation of sputum in workers with over 10 years of exposal at:

- arsenic - at every second year (approximately 300 people) for the districts: Bihor, Brasov, Dolj, Maramures, Mures, Satu-Mare, Bucharest.

- asbestos - at every second year (approximately 700 people) for the districts: Bacau, Bihor, Brasov, Braila, Buzau, Dolj, Galati, Iasi, Mehedinti, Neamt, Bucharest.

- hexavalent chromium - at every third year (approximately 2000 people) for the districts: Arges, Bacau, Bihor, Dolj, Galati, Iasi, Mures, Neamt, Prahova, Satu-Mare, Sibiu, Timis, Bucharest.

- aromatic polycyclic hydrocarbons - at every second year (approximately 1500 people) for the districts: Arad, Buzau, Caras-Severin, Galati, Hunedoara, Maramures, Olt, Prahova.

- nickel metallurgy - at every second year (approximately 200 people) for the districts: Arad, Cluj, Dolj, Galati, Mures, Satu-Mare.

2.2 Citologic investigations of vesicle exfoliate in the workers with over 10 years period of annual exposal in aromatic cancerigene noxes (approximately 500 people) for the districts: Brasov, Iasi, Mures, Prahova and Bucharest.

2.3 Complex investigations of blood in the workers exposed at benzene, annual (approximately 5000 people) for the districts: Arges, Bazau, Brasov, Braila, Cluj, Galati, Hunedoara, Iasi, Neamt, Prohova, Sibiu, Timis, Vilcea and Bucharest.

2.4 Investigations of liver functions in workers exposed at vinyl chloride, annual (approximately 1500 people) for the districts: Bazau, Cluj, Sata-Mare, Sibiu, Vilcea through the determination of hepatic enzymes: gamma-glutamyl-transpherase and GPT and GOT transaminases, direct and indirect bilirubin and hepatic scintigraphy in the cases with hepatic cancer suspicion.

Execution term: December 31, annual

Execute : Antiepidemic Health Departments from district with reference to the Territorial Institutes of Hygiene and Public Health

Synthesis - Institute of Hygiene and Public Health Bucharest

3. The centralized accounts of all people professional exposed at ionizant radiations in correlation with the irradiation level, on type of exposal and activity fields, through:

3.1 The annual registering if those who are professionally exposed (approximately 20,000) at ionizant radiations, on groups of age, sex, years of service in medium with radiations, on higher bodies (Annex III).

Execution term: December 31, 1986 - Health Departments (approximately 6700 people)

December 31, 1988 - radioactive mining - (approximately 9500 people)

Execute : Antiepidemic Health Centre from Districts (with trimestrial data reference to the Health Statistics and Computing Centre of Health Ministry) and Institutes of Hygiene and Public Health from territory.

Laboratory for Radiations Hygiene and Mining Security - Dr. Petru Groza Town (centralized account of the people from radioactive mining department).

Institute of Atomic Physics - for industrial department

Synthesis - Institute of Hygiene and Public Health Bucharest.

3.2 The registering of all cases who work no more in medium with radiations because of death, professional disease or contra-indication - following to the results of the periodic medical control or to a supra-irradiation, in order to correlate the health condition of those with professional exposure.

Execute : Antiepidemic Health Centre (trimestrial reference)
Health Statistics and Computing Centre of Health Ministry

Synthesis: Institute of Hygiene and Public Health Bucharest (annual)

3.3 The investigation of all nuclear events (nuclear incidents and accidents) in order to improve the antiradioactive protection standards at professional and populational level.

Execute : Institute of Hygiene and Public Health Bucharest

4. The determination of the mutagene-cancerigene potential of new chemical substances introduced in the industrial circuit, in agriculture, in food, in therapy (drugs) in order to obtain the health advice.

4.1 The constitution of a group composed of specialists from the following research institutions: Institute of Hygiene and Public Health Bucharest, Institute "Dr. Victor Babes", Institute of Oncology, Institute "Dr. I. Cantacuzino", Institute of Hygiene and Public Health Iasi, Institute of Hygiene and Public Health Cluj-Napoca - to test the mutagene-cancerigene potential.

Execution term: March 31, 1986

Execute : The specialist from the under-mentioned institutes.

4.2 The utilization of the following tests which will be done in the under-mentioned institutes: Ames test, micronuclei test, chromosomal aberrations test on bone marrow and lymphocytes culture test, cytogenetic test on plants, cytogenetic test on testis, interchanges test between sister chromatids, spermatozoa from anomalous test with the performance of at least three tests for each investigated substance.

Execution term: December 31, annual

Execute : Institute of Hygiene and Public Health Bucharest

5. The registering of the principal cancerigene factors from the background through the determination by exploration for cancerigene agents monitoring and the comparison with the mortality by cancer with different localizations.

5.1 The determination of cancerigene substances from air (chromium, nickel, asbestos, cadmium, and HPA, 3,4 benz(a)pyrene and soot (black dust).

Execution term: December 31, annual

Execute : Institutes of Hygiene and Public Health Bucharest, Iasi and Cluj-Napoca
Antiepidemic Health Centres from Districts

5.2 The determination of cancerigene substances from water (arsenic, cadmium, chromium, nickel, nitrites, pesticides, HPA, 3,4 benz(a) pyrene) and halometans.

Execution term: December 31, annual

Execute : Institutes of Hygiene and Public Health Bucharest, Iasi, Cluj-Napoca
Antiepidemic Health Centres from Districts

5.3 The determination of cancerigene substances from food: nitrates, nitrites - in meat preparation, fruits and vegetables.

Execution term: December 31, annual

Execute : Antiepidemic Health Centres from Districts
mycotoxins, aflatoxins, sterigmatocystine, patuline,
lutheoskirine) in milk and cereals derivatives.

Execute : Institutes of Hygiene and Public Health from territory
for aflatoxins
Institute of Hygiene and Public Health Cluj-Napoca for
other mycotoxins

- H.P.A. (3,4 benz(a)pyrene in smoked meat preparations, fish, fried
coffee and coffee substitutes.

Execute : Institute of Hygiene and Public Health Iasi

- H-nitroso amines in meat preparations

Execution term: December 31, annual

Execute : Institute of Hygiene and Public Health Cluj

- pesticides - in potatoes, milk products, lard and vegetable oil

Execution term: December 31, annual

Execute : Institute of Hygiene and Public Health Cluj
Antiepidemic Health Centres from Districts

- metals and metalloids with cancerigene potential in preserved food,
sugar products, alcoholic drinks (arsenic, cadmium, selenium)

Execution term: December 31, annual

Execute : Institutes of Hygiene and Public Health from territory.

- chemical pollutants (nitrites, nitrates, HPA, pesticides, heavy metals)
in food in order to determine daily ingestion.

Execution term: December 31, annual

Execute : Institute of Hygiene and Public Health Iasi

- colouring matters, conserving substances, substitutes

Execution term: December 31, annual

Execute : Institutes of Hygiene from territory

5.4 Determinations of natural radionuclids (Ra-222, Ra-226, U,K) and
artificial ones (Cs-137, I-131, St-90) in water and in some alimentary products
(milk) and of radon and it's products in free air and in residences.

Execution term: December 31, annual

Execute : Antiepidemic Health Centres
Institutes of Hygiene and Public Health from territory

- 1986 - 3 districts, 2-3 towns and selected depending on the mortality
by cancer in 3 territorial areas of Institutes of Hygiene and Public Health
Bucharest, Iasi and Cluj-Napoca

- 1987-1990 - 2-3 towns yearly.

Execution term: December 31, annual

Execute : Synthesis elaborated by the Institutes of Hygiene and
Public Health Bucharest, Iasi, Cluj-Napoca, Timisoara.

5.5 Data correlation concerning cancerigene factors from the background
with mortality by cancer with different localizations.

Execution term: December 3, 1990

Execute : Institute of Hygiene and Public Health Bucharest
Institute of Oncology Bucharest

6. Health education concerning cancer prevention and control through:

6.1 Popularization actions of the cancerigene risk and of prophylaxis measures through all mass-media means (press, radio, television, etc.) and through the organization of some complex health-educational conferences for all people with priority for the problem of periodic medical control, the early detection importance, the medical self-control, the early treatment, the discovery and the treatment of precancerous diseases, the increasing of unspecific body resistance. For this purpose, it will be published yearly, 10 articles in central press and it will be realized yearly two transmissions at radio-television. Also, it will be organized yearly in Bucharest, 10 health-educational meetings.

Execution term: December 31, annual

Execute : Institute of Hygiene and Public Health
Bucharest (Health Education Laboratory)

6.2 It will be made actual again the normative elaborated by the Institute of Hygiene and Public Health Bucharest concerning the tabacism control in Romania, and it will approved by the Health Superior Council.

Execution term: December 31, 1986

Execute : Institute of Hygiene and Public Health
Bucharest (Health Education Laboratory)

6.3 The inclusion in the research programme of the Health Education Medicine History of a subject about health culture level of the population concerning cancer prevention and elaboration on this base of a complex educational system which must be applied in territory.

Execution term: December 31, 1986

Execute : Institute of Hygiene and Public Health
Bucharest (Health Education Laboratory)

6.4 The publication of five works concerning the population oncologic education and also a method guide "Health education for cancer prevention and control" for medical stuff.

Execution term: December 31, 1987, 1988, 1989, 1990

Execute : Institute of Hygiene and Public Health Bucharest

6.5 The realization of three health-educative short films (10-15 minutes) concerning the primary and secondary prophylaxis of cancer disease. In 1986 it will be realized a film, in 1988 another film, and 1990, another one.

Execution term: December 31, 1986, 1988, 1990

Execute : Institute of Hygiene and Public Health Bucharest

Chapter III

Measures in the field of cancer secondary prophylaxis

1. The elaboration of unitary methodologies for cancer diagnosis and complex treatment on clinical stages for the following localization: cervix, ovary, lung, malignant melanoma, stomach, colon, pharynx-larynx, urinary bladder, prostate, malignant lymphomas and cancer immunologic treatment.

The methodologic booklets will be elaborated thus:

1.1 Cervix cancer and ovary cancer

Immunity and cancer

Leukemias and lymphomas in children.

Execution term: December 31, 1986

Execute : Institute of Oncology Bucharest
Clinic Hospital Fundeni Bucharest

1.2 Bronchopulmonary cancer

Skin malignant melanoma

Execution term: December 31, 1987

Execute : Institute of Oncology Bucharest
Clinic of Dermatology Berceni Bucharest
Institute of Phitisiology Bucharest

Digestive tract cancer (stomach, colon, rectum-annus).

Execution term: December 31, 1987

Execute : Clinic Hospital Fundeni Bucharest
Surgery department

1.3 Thyroid cancer.

Execution term: December 31, 1988

Execute : Institute of Oncology Cluj-Napoca
Institute of Endocrinology

Pharynx and larynx cancer

Execution term: December 31, 1988

Execute : Institute of Oncology Bucharest;
Clinic Hospital Coltea Bucharest
ORL department

1.4 Genito-urinary system cancer in male (prostate, urinary bladder, testis, penis).

Execution term: December 31, 1989

Execute : Institute of Oncology Cluj-Napoca
Clinic Hospital Fundeni Bucharest -
Hematology department

2. Early detection of cervix cancer through exfoliative cytology method for female population aged between 25-65 years, from towns, by screening.

For this purpose, Health Departments will organize at the health units from Annex 4, in the pathological anatomy laboratories, exfoliative cytology nucleus with a biologist and two nurses, corresponding to the rate setting criteria, chapter 1/B from Annex 3, to the Decree no. 296/1973 with the subsequent modifications.

The organization of detection actions will be done by the oncology physician together with the pathologic anatomy laboratories and with gynecology departments. Each woman from the group with increased risk will be examined at every third year. Gynecology departments from the districts hospitals will ensure the finalization with suspicious cases through the specialized department from the polyclinic health centre.

Execution term: December 31, annual

Execute : Health Departments from Districts and from Bucharest

3. The obligatory examination through exfoliative cytology method of all women with gynegologic diseases.

Execution term: December 31, annual

Execute : Health Departments from Districts and from Bucharest

4. In order to verify the application manner of Health Minister Order no. 490/1981 it will be elaborated yearly by the Health Departments a statistics report about the number of people oncological investigated between their hospitalization (passive screening and the number of new cases with cancer discovered between these people, on clinical stages.

Health statistics and computing centre will solicit the approval from the Statistics Central Department.

Execution term: December 31, annual

Execute : Medical Assistance Department
Health Statistics and Computing Centre
Institute of Oncology Bucharest
Health Departments from Districts and from Bucharest

Chapter IV

Measures to improve cancer diagnosis and treatment

1. The interdistrictual centres for diagnosis, complex treatment and medical recovery of patients with cancer disease, established by Health Ministry

Order no. 117/1982 will give specialized medical assistance in ambulatory or by hospitalization to all patients from the affiliated districts; interdistrictual centres will be methodologic directed by the Institutes of Oncology (Annex 5).

Execution term: December 31, annual

2. In all institutions for cancer diagnosis and treatment, the diagnosed patients will be obligatory investigated by the Committees of Diagnosis and Therapeutic indication established by Health Ministry Order no.219/1980.

Execution term: December 31, annual

Execute : Health Departments from Districts and from Bucharest

Chapter V

Measures for specialized stuff training

1. In the Institutes of Oncology Bucharest and Cluj-Napoca will take place training post-university courses of biology, diagnosis and complex treatment of cancer disease for all specialized stuff inclusive for dosimetry physicists who take care of patients with cancer disease from the hospitals appointed for cancer disease diagnosis and treatment corresponding to Annex 10. The recruiting of the superior trained personnel will be done through Health Department by the Training Centre of the Superior Health Personnel. For the medical stuff with secondary training Health Departments will organize yearly courses.

Execution term: Training Centre for superior medical personnel

Execute : Training Centre for superior medical personnel
Training Centre for secondary trained personnel
Health Departments from Districts and from Bucharest

2. Health Ministry in accord with Education Ministry will establish the generalization of oncologic education for students; it will be organized clinical stage in specialized institutions.

Execution term: December 31, 1986

Execute : Education, Personnel, Control and Coordination Department

Chapter VI

Measures to ensure material resources

1. Districts' Hospitals which have installations of radiotherapy with high energy, telecobaltotherapy and curietherapy, and which are appointed like interdistrict centres for diagnosis, complex treatment and medical recovery of patients with cancer disease, will organize the followings:

a) unit of therapy with high energy, inclusive dosimetry nucleus;

b) department with 50 beds for radiotherapy from which 10 beds for curietherapy;

c) department with 30-50 beds for chemotherapy and immunotherapy.

Execution term: December 31, 1986

Execute : Medical Assistance Department
Health Departments from Districts: Bihor, Constanta,
Dolj, Galati, Iasi.

2. In the structure of hospitals from the districts Alba, Giurgiu, Caras-Severin, Calarasi, Covasna, Gorj, Harghita, Hunedoara, Satu-mare, Salaj it will be organized departments of oncology with 30 beds at least (from the existent number of beds) in order to ensure the chemotherapy and immunotherapy treatments and also for convention radiotherapy and curietherapy.

Execution term: December 31, 1986

Execute : Health Departments from appointed Districts

3. In the structure of the hospitals from the districts Cluj, Dolj, Mures, Timis and from bucharest, it will be organized departments for patients with cancer disease in advanced stages (from the existent number of beds). In other districts these departments will be organized in the sections for chronic patients.

Execution term: December 31, 1990

Execute : Medical Assistance Department
Health Departments from Districts and from Bucharest.

4. To finish the building of the new National Institute of Oncology from Bucharest endowed with:

- irradiation centre
- polyclinic health centre type II
- specialized clinic departments with 500 beds
- citostatics syntheses centre
- animals hose

Execution term: December 31, 1987

Execute : Enterprise for Building and Equipment no. 3 Bucharest
Pharmaceutical and Medical Installations Department
Health Ministry and Institute of Oncology Bucharest

5. The endowment, corresponding to the existent fund with an installation "Mammomat" for breast cancer radiologic diagnosis, of the interdistrictual centre and of the polyclinic health centres form Bucharest sectors.

Execution term: December 31, 1990

Execute : Plan and Finances Department
Pharmaceutical and Medical Installations
Departments from Districts and from Bucharest

6. The endowment - corresponding to the allocated funds by the Health Ministry - of the Institutes of Oncology Bucharest and Cluj-Napoca with a Computer "CORAL" type, which must permit the automatic data processing and storage concerning medical scientific research and medical observation codified files (Hospital Cancer Register). The Institutes of Oncology Bucharest and Cluj-

Napoca will elaborate the project of a codified oncologic clinic observation file which must be approved by Statistics Central Department.

Execution term: December 31, 1987

Execute : Plan and Finances Department
Pharmaceutical and Medical Installations Departments
Institutes of Oncology Bucharest and Cluj-Napoca
Medical Statistics and Computing Centre.

7. The development of microproduction bases from the Institutes of Oncology Bucharest and Cluj-Napoca, in order to ensure citostatics quantities which must satisfy the internal necessities and also to enlarge the scale of realized products. Health Ministry must ensure the necessary of reagents and chemicals for citostatics syntheses.

Execution term: December 31, 1987

Execute : Plan and Finance Department
Pharmaceutical and Medical Installations Department
Institutes of Oncology Bucharest and Cluj-Napoca.

Chapter VII

Cancer scientific research development

For a pluridisciplinary approach of the research problems and for the grouping of research forces of all institutions for oncological research - during the five years period 1986-1990, will be elaborated epidemiological clinical and experimental research programmes on following investigation ways:

1. Lung cancer; epidemiological, clinical and experimental mental aspects.
2. Cutaneous malignant melanoma; epidemiological and experimental aspects.
3. Preparation, purification and testing with diagnosis and therapeutic purpose of monoclonal antibodies for oncological use.
4. Modification and modulation of genetics information in cancerization in order to introduce recombinant ADN technics.
5. Researches of immunology and moleculuar biology concerning metastatic process.
6. Researches concerning cancer chemoprevention.
7. To obtain new products with reversor and immunomodulator potential.
8. The researches will be coordinated by the Institute of Oncology Bucharest in collaboration with Institute of Oncology Cluj-Napoca in order to a pluridisciplinary subjects approach, with common methodologies and for a better verification of the results.

Chapter VIII

Activity improvement of the Committees and Subcommittees of specialist for cancer

1. Committee of Specialist for Cancer of the Health Ministry

1.1 The annual analyse by the Committee of the situation and tendencies of cancer disease in our country, of the conclusions about guidance, control and technical assistance actions in the appointed institutions, of the interdistrictual centres activity and also of the subcommittees of specialists for diagnosis and treatment of the patients with cancer disease, presenting to the Health Ministry concrete measures for the existent defficiencies improvement.

Execution term: December 31, annual

Execute : Health Ministry Committee of Specialist for Cancer

1.2 The participation of the Committee of specialists for cancer members to the actions for guidance, control and technical help in territory, in order to improve the activity of cancer prevention and control.

Execution term: November 30, annual

2. The Subcommittee of Specialist for Comparative Oncology

2.1 The introducing of the obligatory declaration system for all cancer forms in animals.

Execution term: December 31, 1989

Execute : Health Veterinary Department from Agriculture and Alimentary Industry Ministry.
Health Veterinary Inspectorates.

2.2 The drawing up of maps and studies about the animals leukosis spreading areas and also about the territories with exposure at certain cancerigene noxes, correlated with the increased incidence of the cancers discovered in animals. Based on the obtained results, the Agriculture and Alimentary Industry Ministry (MAIA) will take measures to reduce or to remove the disease risk.

Execution term: December 31, 1988

Execute : Health Veterinary Department from the Agriculture and Alimentary Industry Ministry
Health Diagnosis Veterinary Laboratory.

2.3 The drawing up of some studies concerning the admitted minimal doses of pesticide substances with substances with cancerigene effect in animals, in order to take the necessary measures to remove or to reduce the disease risk.

Execution term: December 31, 1986

Execute : Health Veterinary Department from the Agriculture and Alimentary Industry Ministry through the Central Laboratory for Foods Control and Specialized Laboratory from Health Veterinary Inspectorates in districts

2.4 It will be developed scientific research in comparative oncology field through:

2.4.1 Epidemiologic and epitozoologic comparative study of some tumoral localizations with increased incidence in men and in animals in certain country areas.

2.4.2 Researches concerning the discovery of antitumor specific antibodies (bovin and aviar antilekosis) in patients serum, especially of those with tumors of system, in order to discover some common etiological factors.

Execution term: December 31, 1988

Execute : Institute "Pasteur" Bucharest
Veterinary Central Laboratory for Diagnosis
Health Veterinary Department from Agriculture and
Alimentary Industry Ministry

Institute of Oncology Bucharest will deliver the biologic materials.

3. Subcommittee of specialist for immunomodulation.

3.1 The stimulation and supporting of specialists activity concerning the production and the use of biologic response modifiers with application in cancer disease prevention and treatment in order to assimilate during five years period of at least three biologic preparations and two syntheses preparations.

Execution term: December 31, annual

Execute : Committee for immunomodulation

3.2 The elaboration of a preclinic and clinic testing methodology of biologic response modifiers.

Execution term: Preclinic testing: December 31, 1986

Clinic testing : June 30, 1987

Execute : Subcommittee for immunomodulation

3.3 The drawing up of a standardized laboratory immunological technics handbook which will be used in the estimation of modulation effects of some products.

Execution term: December 31, 1986

Execute : Subcommittee for immunomodulation

4. Subcommittee of specialists for cancer radiotherapy and curietherapy.

The objectives of radiotherapy subcommittee:

4.1 The increasing of cobaltotherapy services efficiency in whole country and of the optimal treatment efficiency under the control of the Institutes of Oncology from Cluj and Bucharest in the appointed territories. In this sense of view it will be analyzed the number of new patients who receive treatment during the one year, in order to an optimal appointment with radiotherapy physicians and endowment with installations corresponding to the WHO recommendations;

- approximately 400 new patients/year for a cobaltotherapy installation;

- approximately 200 new patients/year for a radiotherapy physician.

Execution term: November 30, 1987

Execute : Subcommittee of radiotherapy and both Institutes of Oncology Bucharest and Cluj

4.2 To ensure the continuous working of the installations required, the setting up of a Tehnab-export Company service, because of the great number of existent Rocus installations. In the same time, the cobalt sources will be settled so as to do a good planning of their exchange at three years, with the planning of necessary funds from the institutions budget.

Execution term: December 31, 1987

Execute : Pharmaceutical and Medical Installations Department
Radiotherapy Subcommittee

4.3 The development of curietherapy sections with the radioactive necessary sources and especially of iridium wires.

Execution term: December 31, 1987

Execute : Pharmaceutical and Medical Installations Department
Subcommittee of radiology

4.4 The making actual of the republican standards for the protection against the radiations and for radiotherapy installations setting up in collaboration with CSEN. The warning of some installations setting up in the security conditions and in accord with radiotherapy committee and CSEN.

Execution term: December 31, 1987

Execute : D.A.M. and Radiotherapy Committee

4.5 The annual analyse of cobalt services activity and the carrying out of the conferences begun in 1981. The programme comprises:

- 1986 - Bronchopulmonary cancer irradiation protocol
- 1987 - Malignant lymphomas irradiation protocol
- 1988 - ORL cancers irradiation protocol
- 1989 - Genito-urinary cancers irradiation protocol
- 1990 - Radiotherapy results in cervix cancer from the period 1981-1985.

During this annual meeting it will be analyzed the activity corresponding to the following criteria:

- number of new patients
- characteristics structure on localizations
- therapeutical results after a minimum three years period for the main localizations.

Execution term: November 30, annual

Execute : Radiotherapy Subcommittee

5. Subcommittee of Oncopediatry.

5.1 The organization of the national register for the children cancer account (age 0-14 years).

Execution term: 1986-1990

Execute : D.A.M.-O.M.C.T.

Health Statistics and Computing Centre
Clinic of Pediatrics Fundeni Bucharest

5.2 The adaptation of the oncological declaration file to the child.

Execution term: March 31, 1986

Execute : Clinic of Pediatrics Fundeni Bucharest
Health Statistics and Computing Centre

5.3 The elaboration of a methodologic booklet concerning the discovery, diagnosis and treatment of leukemias and malignant lymphomas in child.

Execution term: December 31, 1986

Execute : Institutes of Oncology Bucharest and Cluj
Clinics of Pediatrics Fundeni, Iasi II, Timisoara
C.C.S.S.

5.4 The organization of a conference concerning malignant tumors epidemiology, discovery, diagnosis and treatment in child.

Execution term: Trimester IV, 1986

Execute : Institute on Oncology Cluj-Napoca
Clinic of Pediatrics Fundeni Bucharest

5.5 The study of risk factors in acute and chronic leukemias in child.

Execution term: December 31, 1986 to establish the research methodology 1987-1990 for research

Execute : Clinic of Pediatrics Fundeni Bucharest
Clinic of Pediatrics Timisoara

5.6 The elaboration and testing of some therapeutic programmes in acute and chronic leukemias, in malignant lymphomas, in nervous cancer, in kidney cancer and in bone cancer in child.

Execution term: Clinic of Pediatrics Fundeni Bucharest
Clinic of Pediatrics Timisoara

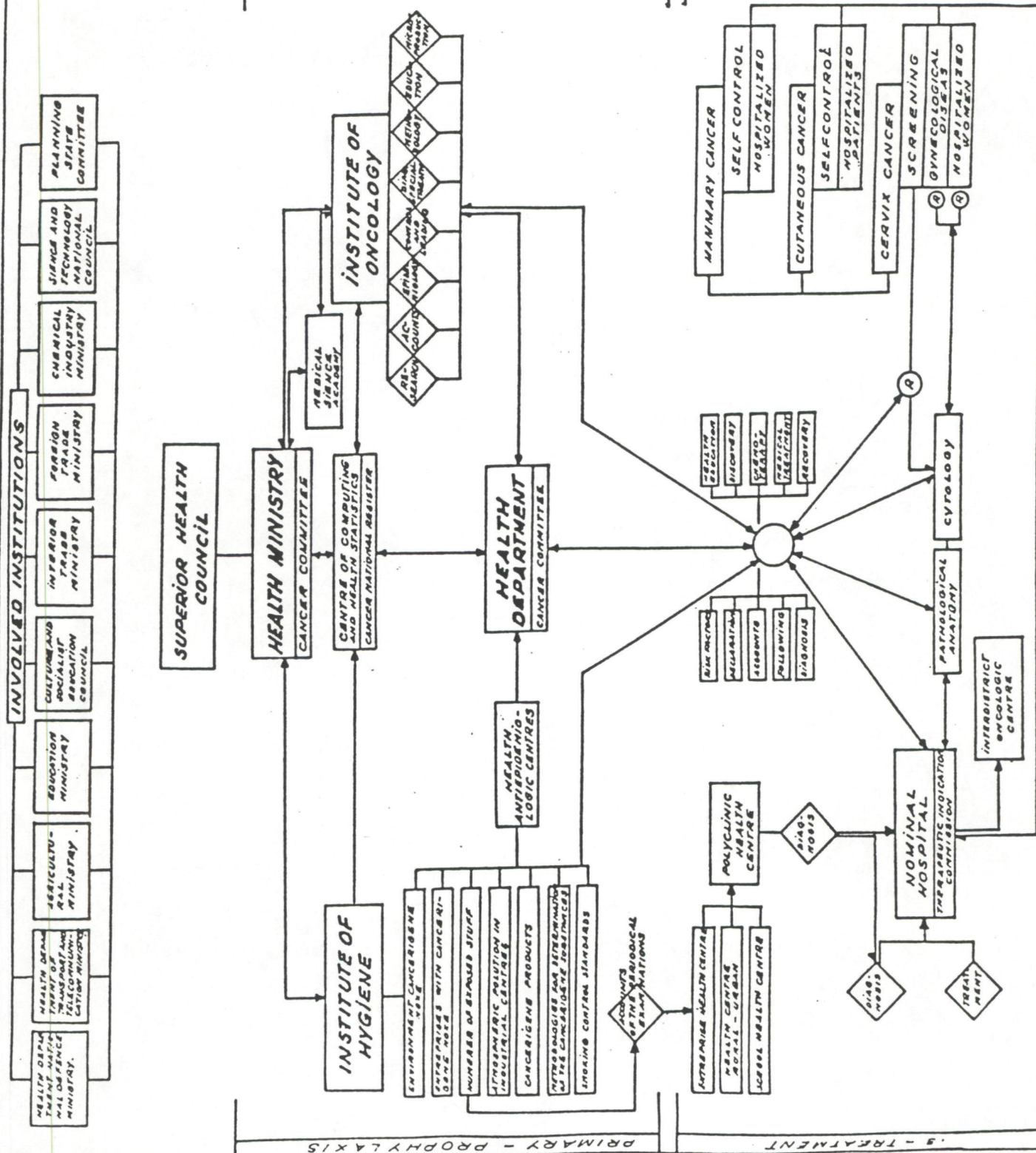
Clinic of Pediatrics Iasi
Institute of Oncology Cluj-Napoca

6. Subcommittee for the study of mutagen-cancerigen action of new substances introduced in foods, agriculture, industry and therapy.

6.1 The testing of all pesticide substances, alimentary additives, drugs, etc., produced in order to be introduced in fabrication, concerning their mutagen, cancerigen potential and the communication to the Health Ministry of the recommendations concerning their utilization.

Execution term: 1986-1990

SECONDARY - PROPHYLAXIS



Substances with Cancerigene Action Used in Industry
Proposed to be Studied

1. Alpha, Beta, Naphtyl Amine
2. Arsenic
3. Asbestos
4. Benzene
5. 1,1 Dichloromethyl-methyl ether
6. Cadmium
7. Chromium
8. Nickel
9. Nickel-charbonyl
10. Colourings
11. Preservation Substances
12. Substitutes

Environmental Health Study
Summary of Research Proposal

A World Bank environmental health mission was organized at the invitation of the Institute of Oncology in Bucharest in the month of July. The mission was led by Iona Sebastian, Economist, Environment Department; it included Dr. Yang Mao, Director of the Cancer Section of the Bureau of Chronic Disease and Epidemiology of the Ministry of Health in Canada, and Dr. Neeloo Bhatti, Environmental Policy Scientist at the Argonne National Laboratory.

Its objective was to evaluate the feasibility of an environmental health study, to be carried out by Romanian scientists, to determine the linkages between cancer incidence and environmental socio-economic factors. Such a study, in the light of similar ones carried out elsewhere in the world, especially in Central and Eastern Europe, can help the World Bank formulate general principles on environmental and health policies relevant to countries making the transition to market economies.

For the Romanian scientists, researchers, and health managers involved in the proposed study, this should become a vehicle to coordinate the efforts of various local institutions that are already addressing either the environmental or the health issues covered by the study, and to bring the information technology up to date to create databases that can be further used to analyze, understand, and formulate economic and environmental measures that have a bearing on environmental policies and public health management.

The mission visited the following institutions: the Ministry of Health, the Institute of Hygiene and its departments, the Institute of Oncology, the Ministry of the Environment, the Institute for Environmental Engineering, and the Ministry of Education and Sciences, and the Romanian Cancer League. The list of people visited is attached in Annex 1 of the draft report.

The mission recommends that the ongoing efforts initiated by the Romanian health institutions, the Ministry of the Environment, and the Ministry of Education and Sciences be supported by the World Bank and other potential bilateral donors by providing overseas working fellowships for young mathematicians, biologists, environmental engineers, and specialists in the natural sciences; expert technical assistance; and modern equipment as needed to organize, manipulate, and analyze large-scale databases.

In particular, the mission recommends that such support be provided within the framework of activities already initiated by the Romanians, to be enhanced and expanded to benefit other countries in the area, namely: an ecological study extended over two years and a cohort study backed by foreign assistance in its initial stages, to be carried out subsequently by the Romanian researchers over a five-year period.

The Ecological Study

To carry out both the ecological and cohort studies, it is recommended that about ten (10) recent graduates in mathematics, biology, environmental

engineering, and natural sciences, be received for a period of six to nine months by western institutions currently involved in environmental health work, to train the Romanians in modern methods and techniques applied to data collection, control, and analysis in both environmental and public health fields, in data organization using computer technology, and in the formulation of health and environmental policy.

The trainees would bring the available Romanian data to the training institution and, as a part of the training program, would organize it under the supervision of the foreign experts so that the cancer data correspond to the spatial distribution of the environmental factor data. The resulting databases would be brought back to the Coordinating Center of the study in Romania and, after their integration into the databases of the various participating Institutes, they would become the core of these Institutes' environmental health surveillance systems.

About three months after their return, and based on the results of the analyses, the team would formulate health and environmental policy recommendations with technical assistance help from foreign experts in various fields. The recommendations would be transmitted to the Ministries of Health, Environment, and all other affected government agencies, to be translated into a coherent environmental policy strategy including measures for disease prevention and environmental protection.

The data will be further used to assess cancer risks in specific areas. The regions and the areas with the highest incidence will be followed up with detailed analysis of the life styles, exposure to various pollutants of the population and of the history of the economic and social conditions prevailing throughout the year. This information will serve as the core of data to be used in a separate analysis of correlations between economic conditions, levels of pollutants, health risks, and measures to lower the risks, residual or integral. This second stage of the study should last about six months. The detailed terms of reference of the follow up economic/environmental analysis and of the risk management proposals will be developed at a later stage in the course of the ecological study.

The trainees will proceed, for about one year, with the dissemination among the regional units of the Institutes the techniques acquired overseas. The control unit of this study is the Ministry of Education and Sciences, which has already approved the local program and has assigned a budget to the Institute of Oncology, which has the role of coordinating the ongoing efforts of several specialists in the environmental, veterinary, public health, and cancer research fields.

The Cohort Environmental Health Study

This study should cover about 30,000 to 50,000 subjects in the main cities of Bucharest, Timisoara, Cluj, and Iasi, which are University centers and could use part-time help to carry out the surveys. The objectives of the study are to set a rational basis for long-term public health policy, and to guide future public health management programs and activities in the context

of the environmental factors affecting the health and welfare of the population, to emphasize disease prevention in public health.

In order to carry out the study, the team of experts participating in the overseas training program described above also will be trained in the conduct of cohort studies. The core team for this study should be placed with the Institute of Hygiene, in collaboration with the Institute of Oncology, the Ministry of the Environment, and the Institute of Environmental Engineering. The team will design and organize the survey stage of the study. Survey data will be collected through personal interviews focused on the distribution of environmental and life-style risk factors in the population of the main urban centers and their surroundings. The study will explore the prevalence of chronic disease by age group and, through follow-up surveys, how disease development relates to social, environmental, and economic conditions.

The interview phase should use about 100 part-time help in each city, and should last about one year. Preparation of the interviews includes the following tasks and their estimated duration: Setting rules for collection of the sample (about six months); training the interviewers (about one week); and setting up a media campaign (to begin about one month prior to starting the survey). The survey implementation should extend over one year and will include conducting the interviews, coding the information, entering the data, editing the information, and organizing the data.

The first report, covering the distribution of risk factors in the population and the prevalence of chronic disease by age groups, should be expected three years after beginning the program. The follow-up activities will be carried out annually by mail and personal interviews. At the end of five years, a special report will be issued showing the major causes of chronic diseases and death in relation to risk factors. At the end of seven years, a special report will be issued showing correlations between cancer and risk factors. A detailed proposed timetable for the study implementation is given in Annex 2.2 of the draft report.

Resources to be Provided

The estimated total cost of the proposed Environmental Health and Cancer Risk Assessment studies is approximately US\$1.7 million. These are to be borne as follows:

1. By the Romanian counterpart:

- include the proposed studies in the program of activities of the Institute of Oncology, Institute of Hygiene, and the Institute of Environmental Engineering;
- provide laboratory space and equipment as needed;
- assure local salaries of scientists, administrating staff, research assistants, and survey staff and expenses for internal travel;

- provide secretarial, research assistance, and administrative support staff.
- cover the costs of communications, stationary, supplies and miscellaneous expenses.

2. By External Grant Financing:

- travel expenses and working fellowships for about 10 specialists in the field of biological, medical, and environmental engineering, and biostatistics, and travel expenses for Romanian scientists to participate in international symposia, and to exchange information with counterparts in the West (US\$315,000);
- modern computing equipment, software, and support systems (US\$823,000);
- the foreign costs of an international workshop to be organized in Bucharest one year after the initiation of the program, to present and discuss the results of the ecological study and a progress report on the cohort study (US\$60,000);
- consultant fees for technical assistance to supervise and assist the programs, or about three staff months per year;
- technical assistance from various fields of expertise to conduct, in cooperation with Romanian counterparts, the economic/environmental and the risk management study (US\$295,000); and
- subscriptions to scientific journals related to the subject matter of the projects (US\$35,000).

Annualized details of the cost estimates are provided in the Table attached.

(In US\$)

TOTALS

THE WHITE HOUSE
WASHINGTON

December 3, 1991

Dear Deborah:

Some time ago, at my suggestion, one of my former graduate students, Dr. Neeloo Bhatti, now at the Argonne National Laboratory, forwarded to you a proposal entitled **Applications of North American Free Trade Agreement on Energy and Environmental Conditions in Mexico**. Having promised to contact you on her behalf, I have been remiss in not doing so sooner.

Dr. Bhatti has had a rather unusual background in that she completed the requirements for the MD degree at McGill in Canada before coming to Yale where she joined the Forestry School, the oldest one in the United States. During the course of her studies there, she decided to enroll in my course on **Science and Public Policy** and did an outstanding job so that she came very much to my attention. As a result of our discussions and interactions during that particular course encounter, she subsequently asked me to serve as supervisor of her PhD thesis which focussed on the acid rain problem and its impact on U.S.-Canadian relations. She did, I think, an outstanding PhD thesis in which she applied the Q-sort technique to search for regions of consensus among opinion leaders in both Canada and the United States so that we were able to change the focus of the discussion from one of tension and disagreement to that where the focus was on the very large and surprising areas of agreement. In addition, of course, she provided a very unusual biological underpinning for the discussion -- an underpinning of science drawing on her medical and biological background that had been strikingly absent in most of the discussions up to that point in the acid rain controversy.

In short, she is a very bright woman and one with very strong motivations. Since going to the Argonne National Laboratory on the completion of her work at Yale, she has been involved in a number of international studies that I have found to be persuasive. She was sent on loan from Argonne to the World Bank to do a study on the environmental situation in Romania and, I know, has been discussing with AID the possibility of a similar study in Poland. Right at the moment, she is in Bangkok doing some similar studies, this time with the backing of the Argonne.

Because the rather parlous state of the Mexican environment, particularly in the vicinity of Mexico City, will undoubtedly play a significant role as we move forward toward a free trade agreement, it seems to me that a systematic study would be very much in order and, for that reason, I agreed to contact you in support of Dr. Bhatti's proposal.

I simply do not know whether this is the sort of thing that you and Commerce would consider supporting, but if it fits at all within your mandate, I think that I can assure you that the proposed activity would be carried out with excellent scientific and technical credentials and that the resulting report would be very well written and researched.

With all best wishes,

Sincerely yours,

A handwritten signature in dark ink, appearing to read "D. Bromley", with a stylized, flowing script.

D. Allan Bromley
The Assistant to the President
for
Science and Technology

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