



Risk Assessment: A Regional Approach

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A danger to human health, to the environment and to material values is present at any place on our planet. However, the extent of the danger and the severity of consequences widely differ.

In Europe, we can hardly find a region presenting greater risk to all living organisms including man, than the region of North Bohemia. The black triangle of North Bohemia suffers not only from the consequences of the forty-year socialist economy, but also from heavy emissions from German and Polish factories and power stations.

Air pollution in this region reaches average concentrations of SO_2 and airborne dust of approximately $150 \mu\text{g}/\text{m}^3$ per year. Czechoslovak emissions participate in the deposition of sulphur by 53% in a long-term average. The highest proportion coming from abroad is 14% from the lands of the former German Democratic Republic and 11% from Poland.

This region is also a source of emissions for neighbour states. These are largely sulphur oxides and nitrogen oxides. Total emissions of SO_2 in this region are approximately 1 million tons per year, and as for solid emissions, the number is 280 thousand tons per year. Emissions of CO are not negligible either. The high energy consumption of our industries and the use of fossil fuels for heating, which is still widespread, as well as the density of transport in this region result in average emissions of CO_2 exceeding $12.7 \text{ tons per km}^2$.

The situation is not better in the water economy. The quality of surface waters is affected not only by the emissions, but also by the inefficient agricultural industry applying excessive quantities of industrial fertilizers and pesticides. Monitoring of residual pesticides is at the same time very scarce due to the sophistication of analytical methods and technical equipment required. The low quality of surface water results also in the deterioration of ground water. In addition to overall contamination caused by agricultural activities, the worsened quality of ground water is affected also by leakages from sites, storages and pipings as well as by infiltration of polluted water from irrigations, water flows and, last but not least, by industrial accidents.

In the area of the river Labe, for instance, the concentration of nitrates in ground water is $700\text{-}800 \text{ mg}/\text{l}^{-1}$, the permissible content of NO_3 in standard drinking water being $50 \text{ mg}/\text{l}^{-1}$. Also considerably high are contaminations caused by chlorinated compounds.

The situation is adversely influenced by the fact that in a number of localities there are inadequate, if any at all, sewage disposal plants. And where they exist, there are problems with the treatment of sludges. The sludges containing heavy metals cannot be used in agriculture and their processing is not possible due to the lack of the appropriate processing plants. In a number of cases, the sludges are let out back to water flows.

The impact of industrial waste sites and sewage waste sites is not negligible either. In most cases, the waste sites are not adequately and safely protected against a release of contaminants to the environment. In most cases, the data about properties and quantities of deposited wastes are not available.

In the North Bohemian region, there are 112 waste sites of the total area of 1423 ha, containing 150 million tons of deposited waste. The capacity of the waste sites is 70% filled at present.

The North Bohemian region is also a very dangerous area with respect to potential hazards of industrial accidents or emergencies with possible consequences to health and environment.

The developed industry, the density of both railway and road transport, river transport, storage and transport of manufactured or processed materials — all this creates serious hazards to the environment.

For instance, leakages of oil products present 50% of all accidents causing water pollution. Leakages of chemicals represent 15% of this number and in 12% of the cases, these are accidental leakages of waste water.

The accidents endangering ground and surface water are mostly caused by human factor failures — due to negligence, carelessness, wrong handling or ignorance of workers. Technical causes often lie in obsolete and non-satisfactory conditions of plants and equipment.

Extraordinary atmospheric effects in this region, the effects of many sources of air pollution as well as the emissions from neighbour states result in frequent temperature inversions associated with a slow dispersion of pollutants. At the time of the inversion, daily concentrations of sulphur dioxide reach over $500 \mu\text{g}/\text{m}^3$. However the industrial accidents connected with the release of harmful substances into the air are not as frequent as the leakages to soil and water, e.g. in 1990 two accidental releases of generator gas occurred in the plants of the firm Glass Union and an explosion took place in the industrial waste site of the Company for Chemical and Metallurgical Manufacturing.

The adverse conditions and development of environmental factors together with bad economic, industrial and agricultural policies as well as bad planning and management are also reflected in the state of the soil in the region.

Vast areas of the soil are endangered by water and wind erosion. Chemical degradation of the soil appears as a result of an increased content of acid substances present in rains, fog and ice accretions, as well as of a direct absorption of SO_2 , NO_x and NH_4 . The content of heavy metals and toxic organic compounds is increasing. A part of these contaminants comes from the air, a part from preparations for plants protection and from phosphate fertilizers of a poor quality.

It can be summarized that the North Bohemian region has an undisputed primacy in the extent and intensity of the environmental impairment. The percentage of territories with satisfactory conditions does not reach even 20% of the region's area. However, only 4% of the population of the region are living in this territory. 96% of the population are living in the environment adverse to human health and half of them even in the extremely impaired environment.

This enormous environmental impairment has resulted in the greatest damages to forests and soils in the European scale, as well as in great losses of agricultural production.

The most threatening is, however, the fact that the population of the region lives in the extremely impaired environment with all the implications, known only in part, to their health and their life-span.

The mean life expectancy in the North Bohemian region, compared to the average of the whole population of the Czech Republic, is by more than 1.5 years shorter. Compared to the Czech region with the relatively highest level of environmental factors, it is shorter even by more than two years. For a comparison the average mean life expectancy in the North Bohemian region is 69.5 years, in the whole Czechoslovakia 71.0 years, in Denmark or Germany 74.5 years while in Sweden and Switzerland it is 76.5 years.

In Europe, the Czech Republic ranks among the countries with the highest mortality rate of both men and women.

The adverse influence of the worsened environment is manifested mostly in the health of children. In the region considered, the prevalence of allergic diseases is considerably higher – more than 40 cases per 10,000 children in comparison with 15-20 cases in other regions of the Czech Republic.

The high number of endangered pregnancies and the high infant mortality rate can be also attributed to the worsened environmental factors.

Results of investigations also show a significant correlation between the extent of the environmental impairment and the incidence of some negative social phenomena, such as a high suicide incidence rate, alcoholism, drug addiction, divorce rate and abortion rate. The North Bohemian region has, above all, the highest drug addiction incidence rate (16 and more identified cases per 10,000 inhabitants older than 15 years). The suicide incidence rate shows the highest frequency in this region in men, it reaches 50 times higher than the European standard per 10,000 inhabitants. In women, the suicide incidence rate is lower, approximately half of the number of men.

The extreme number of divorces in this region together with other incidences are evidence of the instability of the social environment. The relatively high abortion index reaching in some localities of the region even 111 abortions for every 100 live-born child is further evidence of the unsatisfactory state of the environment.

The long-term and deep impairment of all components of the environment produces parallels in the sphere of social processes. The negative development of these processes is consequently endangering the function and future of the whole region. The devastation of the environment as a consequence of the inadequate and inconsiderate management at all levels cannot be simply stopped by changing the economic structure, increasing environmental investments and introducing more perfect technologies. The principal change must be that at the social level.

It is evident that the problem of the region is a complex problem requiring an overall solution.

In our opinion, the solution should be based on an integrated risk assessment stemming from the idea that all the health and environmental risks in the region should be identified, analysed and evaluated so that a reasonable decision about the risk reduction could be made.

At the same time, the social and economic consequences of such risks should be considered, as well as the benefits of their reduction, cost of the reduction or possible elimination of risks. We think it necessary to formulate principle approaches to integrated health and environmental risk control.

In Czechoslovakia, the comprehensive integrated approach to risks has not been applied in any region or locality so far. Therefore we should greatly appreciate possible participation of national and international organizations in the project, their technical aid and professional advice.

The objective of the project, a part of which dealing with the prevention of major accidents is coordinated by the Occupational Safety Research Institute in Prague, is to develop a system of prevention and disposal of accidents corresponding both to the requirements of the European Community and the needs of the regions and industries of Czechoslovakia. Considering the economic demands of the project and the shortage of experts in this field, we were forced to work out such a procedure that would enable us at least temporarily, to get over these shortcomings.

The procedure chosen can be summarized in the following steps:

1. One model locality in the North Bohemian region was defined for the development and verification of basic methods and approaches and the second, comparative locality in the Central Bohemian region.
2. Risk identification and risk analyses in both localities are being carried out and the impact of risk within and outside the localities is being considered.

The risk identification is based on a whole range of supporting data. These are, above all, data on the quality of the environment in the region concerned as well as geographical data.

The data collected include also data about basic activities carried out in the region considered (industrial and agricultural production, storage, transport etc.), as well as related information on technical plants and equipment in which the activities take place, about hazardous materials, the transport of such materials etc.

The initial risk identification will include two areas:

- hazards presented by accidents and other abnormal events,
- hazards presented by normal operation.

3. At the same time as the risk identification, the analysis of existing safety measures, both technical and organizational, is being carried out.

4. Based on the information obtained, appropriate measures will be proposed, implemented and verified in the model localities, with the view that these measures could be adopted not only in the North Bohemian region, but also in other regions in Czechoslovakia.

The measures proposed will be aimed at the fields of

- legislation
- inspection
- education

In the process of creating the legislation, it will be necessary

- to work out a method and to establish a uniform way of identifying and recording risks connected with the construction, operation and disposal of technical installations,
- to propose suitable and effective means and measures aimed at the reduction of operational accidents hazards, and
- to develop, verify and introduce adequate analytical methods enabling us to identify causes of failures both of the technology and human factors,
- to propose effective preventive measures.

The correctness and completeness of risk identification and recording as well as the suitability and adequacy of the measures adopted must be a subject of independent inspection.

For the inspection purposes, it is necessary

- to propose and work out a system of inspection and suitable inspection methods and procedures,
- to ensure a sufficiently high professional level and qualifications of the persons carrying out inspections.

It will be necessary that the measures include a system of education and training of workers in organizations with major accidents hazards, education of inspectors and persons responsible for auditing and, last but not least, education of the public, particularly in the localities that can be affected by the consequences of these events. The educational system has to ensure, among other things a continual training of professionals and a training aimed at emergency control.

With regard to the extent and demands of the project and the shortage of experts in this field, the participation of foreign experts would be very helpful particularly in the training of our professionals in methods of risk identification and quantification, prevention of failures etc., complemented by visits of selected professionals to foreign firms and organizations so that it will be possible to fix the knowledge learned in the training and to gain practical experience.

Another field of cooperation, which we think to be of great importance, is the research and development of required methods, particularly

- methods and systems for identifying and monitoring risks,
- methods of prevention of the human factor failures, as well as technical equipment failures,
- methods and ways of increasing the preparedness and informedness of the public in emergency situations,
- methods of causal analyses of accidents and their causes,
- methods of quantifying major accidents hazards and potential consequences of accidents,
- systems of rating, classification and recording risks, accidents and their causes,
- means of reduction of the consequences of major accidents.

We should also highly appreciate help in the training of the staff of undertakings and in the education of the public to desirable and adequate behaviour in emergency situations.

These issues have been neglected for years. It will be therefore necessary not only to work out own specific procedures, but also to search for analogies and to learn from foreign experience and approaches.

One of the ways could be the training of Czechoslovak experts aimed at improving the informedness and preparedness of the public, improving the cooperation of industrial enterprises and the public, representative bodies and local authorities, as well as at creating suitable attitudes and behaviour of the public.

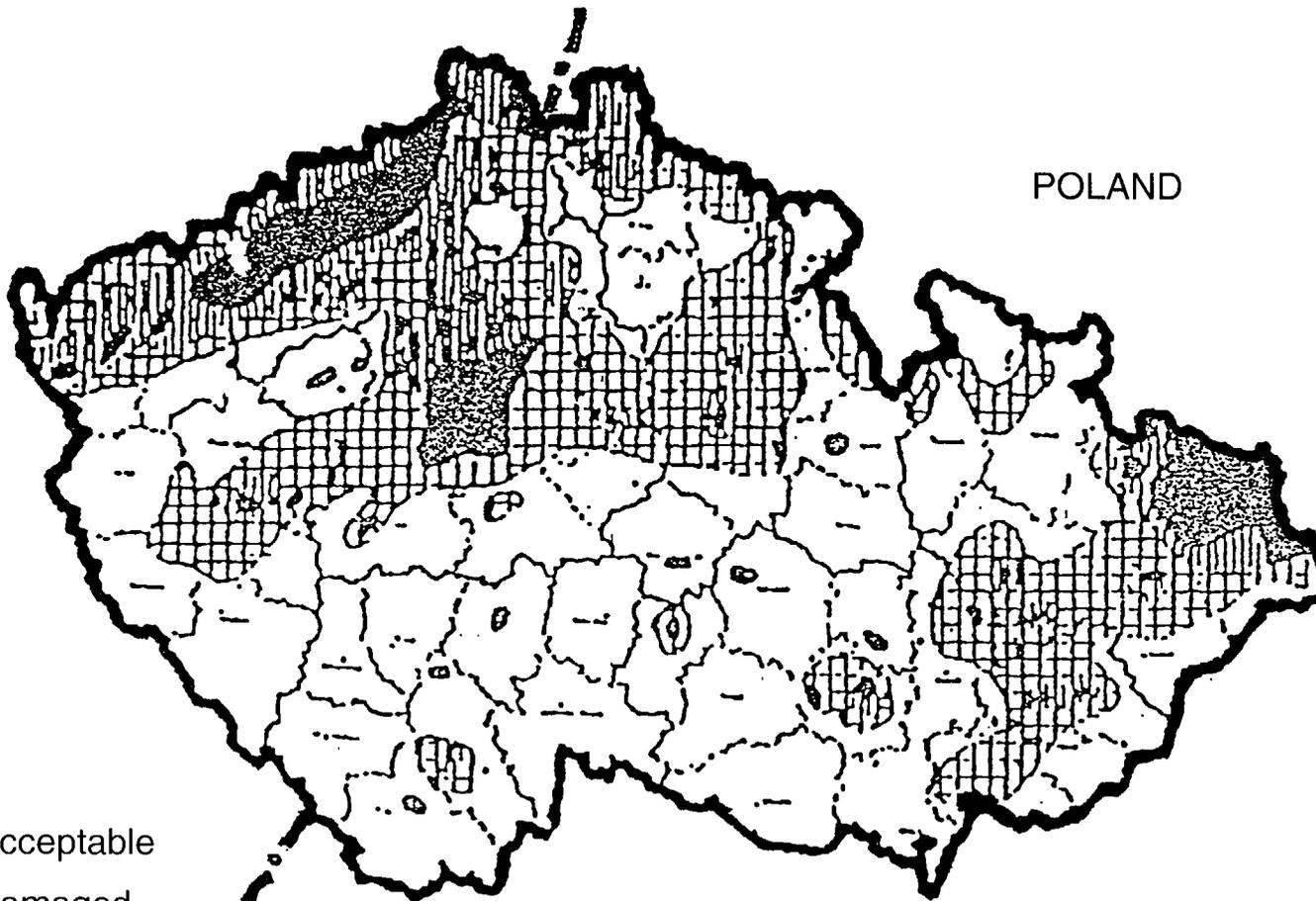
As can be seen from the characterization of the problem, an improvement of environmental conditions in the black triangle of North Bohemia is a very demanding challenge. Its successful solution depends on a thorough and comprehensive analysis and assessment of health and environmental risks.

Considering the nature and severity of the problem, we think that there is not only considerable space for the cooperation here, but the international cooperation is necessary for its solution.

Figure 1 Quality of Environment in CSR

GERMANY

POLAND



AUSTRIA



- I acceptable
- II damaged
- III very damaged
- IV extremely damaged

Figure 2 Transfer of SO₂
SO₂ 10³t/ year

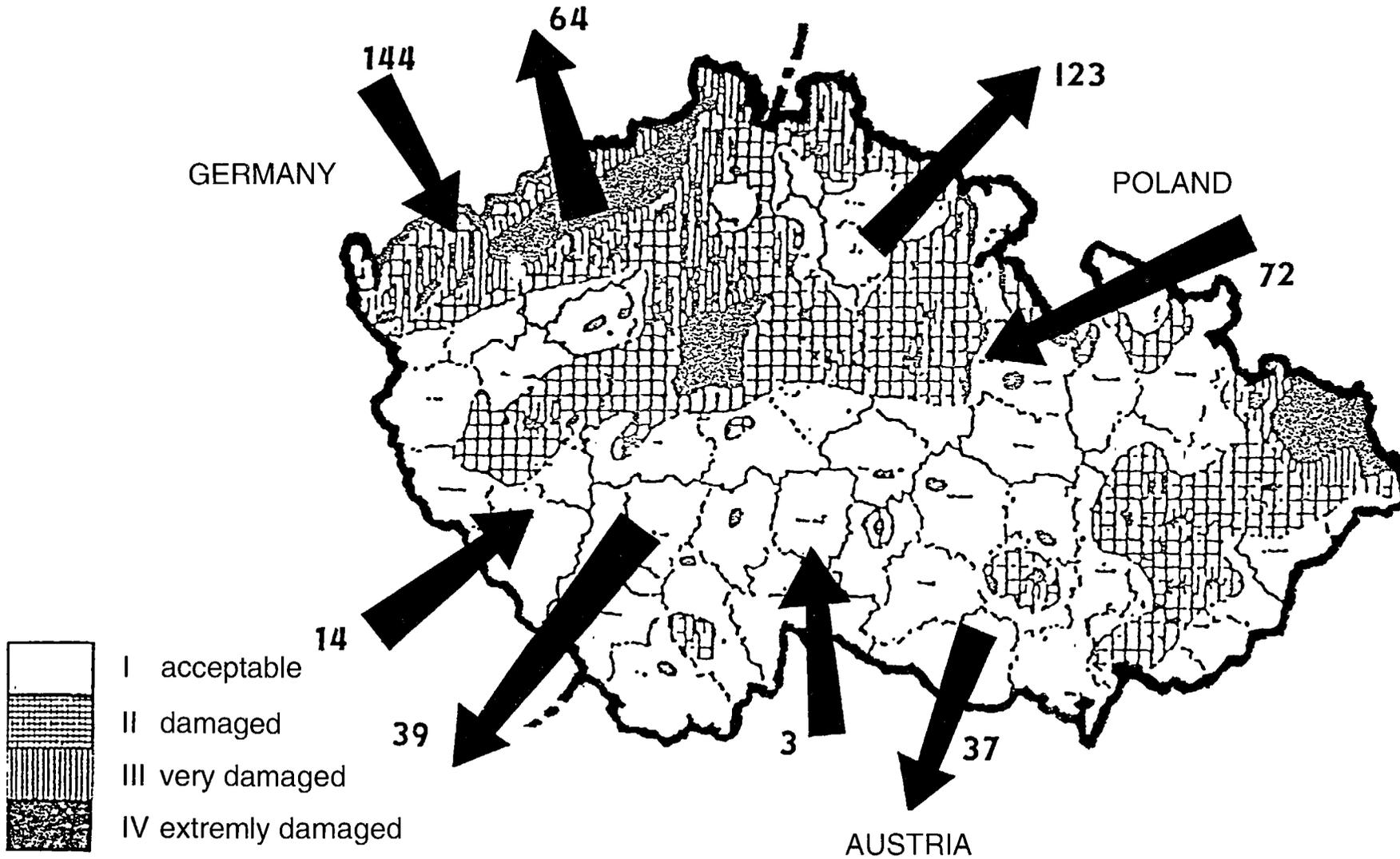
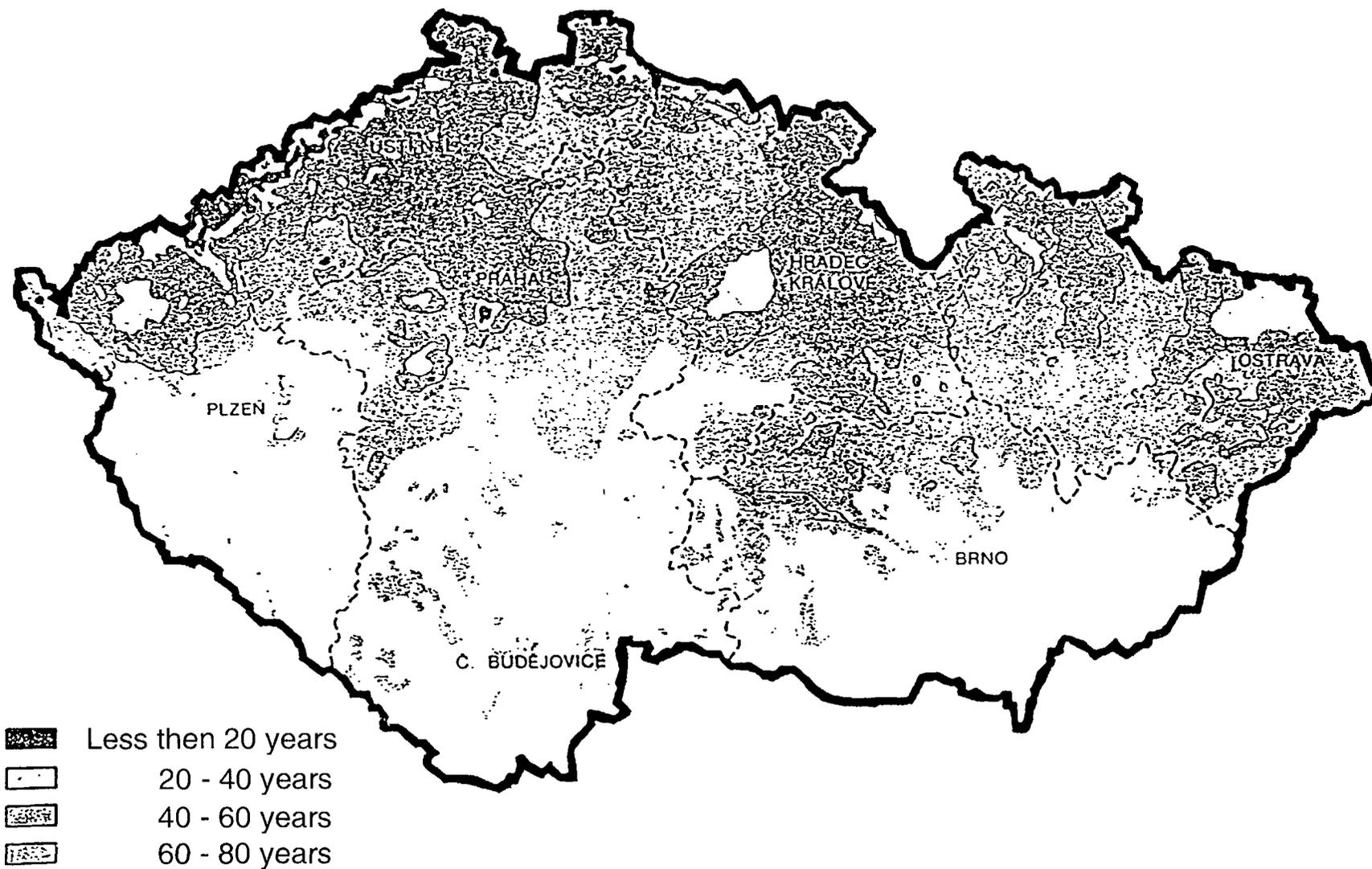


Figure 3 Forest's life expectancy



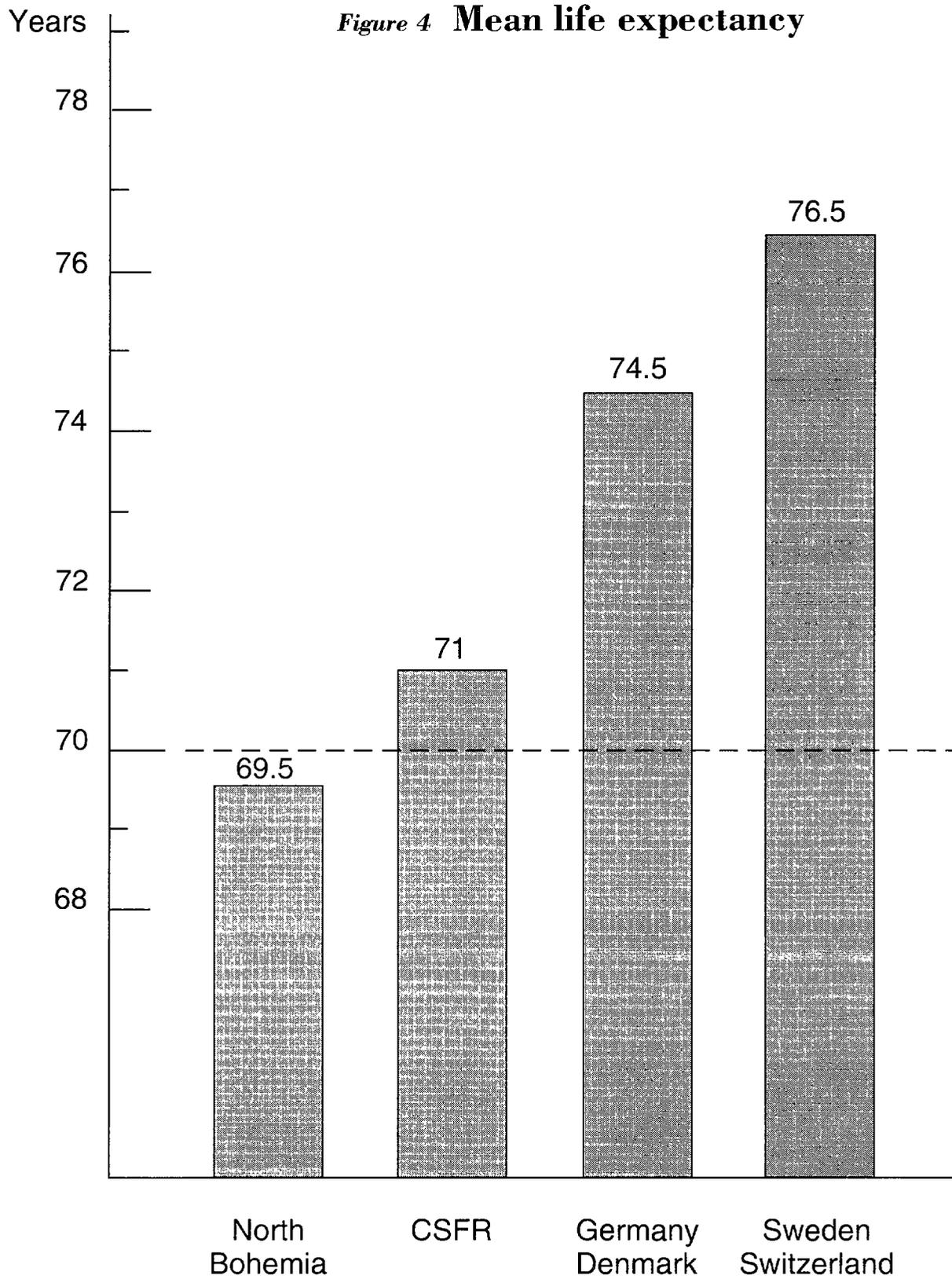


Figure 5

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1. Choice of model locality

 2. Risk assessment

 3. Analysis of existing safety measures

 4. Design, implementation and verification appropriate measures
 - legislation
 - inspection
 - education
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Figure 6

Fields of cooperation

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1. Training professionals in risk assessment

 2. Development and implementation of required methods

 3. Training and education of the public
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