Documentation on the two INCO working programs: 'Review of the adequacy of the present countermeasure modelling' and 'Adaptation of the countermeasure model to local conditions'

RODOS REPORT

DECISION SUPPORT FOR NUCLEAR EMERGENCIES

RODOS(WG3)-TN(99)-39

Documentation on the two INCO working programs: 'Review of the adequacy of the present countermeasure modelling' and 'Adaptation of the countermeasure model to local conditions'

RODOS(WG3)-TN(99)-39

W. Raskob[1], J. Brown[2], eds.

[1] Forschungszentrum Karlsruhe, Institut für Energie- und Kerntechnik,
Postfach 3640, 76021 Karlsruhe, Germany
Wolfgang.Raskob@iket.fzk.de

NRPB / National Radiological Protection Board
Chilton, Didcot, GB-Leeds, LS2, 9JT, United Kingdom
Joanne.Brown@nrpb.org.uk

Nándor Fülöp, Nándor Glavatszkih and dr. Andor Kerekes
Natl. Res. Inst. Radiobiol. and Radiohyg.
H-1221 Budapest, Anna u. 5, Hungary

Alla Dvorzhack
IMMS - Institute of Mathematical Machines & Systems
National Academy of sciences of Ukraine Cybernetics Center
42, Glushkova pr., 252187, Kiev, Ukraine

Adela Mrskova
NPPRI – Nuclear Power Plant, Research Institute Trnava Inc.
Okruzna 5, 91864Trnava, Slovakia

Gh. Mateescu, D. Galeriu, N. Mocanu, C. Turcanu, A. Gheorghiu
IFIN-HH, Bucharest
Romania

S. Fesenko, N. Sanzharova, S. Spiridonov

Russian Institute of Agricultural Radiology and Ecology ,RIARAE
Obninsk, Kaluga Region, Russia

Mieczyslaw Borysiewicz, Andrzej Furtek, Slawomir Potempski, Pawel Krajewski*

Institute of Atomic Energy
05-400 Otwock-lwierk, Poland
*Central Laboratory for Radiological Protection
7 Konwaliowa str. Warsaw, Poland

Petr Pecha

IITA, Academy of Sciences of the Czech Republic
Pod vodarenskou vezi 4, CZ-18208 Praha 8, Czech Republic

Final

Management Summary

Within the two INCO contracts on customisation of the long term countermeasure module (LCMT) to Eastern European countries, investigations on the adequacy of the model approaches and data collection for the adaptation of the model to local conditions have been performed. However, it became obvious, that not all participating countries had the data base and expertise to complete the task individually, in particular the investigation on the adequacy of the present model approach. Therefore, it was agreed, that tests and validation investigations were carried out by the Russian partner RIARAE whereas all other institutions provided input in defining the necessary data bases. To support the data collection and in particular to help defining effectiveness factors, a questionnaire was developed to collect the necessary data.

All institutions agreed that the present structure of LCMT is appropriate for the use in Eastern European countries. The detailed tests performed with Russian data can be seen as an validation study for LCMT which provided confidence in the simple but robust approach selected.

The data collection is still ongoing. This report serves as documentation of all the necessary data to adapt LCMT to local conditions. It will be always updated when new data are prepared by various users of the individual countries. It can also be used for other contractors to select appropriate data if their regions show characteristics which are close to those which are already defined. Thus finally, when completed, these data collection can be used for further studies on the variability of input parameters all over Europe. The basic set of necessary parameters is presented in the report, the detailed set however can be found in the individual reports of the various countries provided. They are available as technical RODOS reports.

Contents

Objective of the two so called INCO contracts: 'Review of the adequacy of the present countermeasure modelling' and 'Adaptation of the countermeasure model to local conditions'

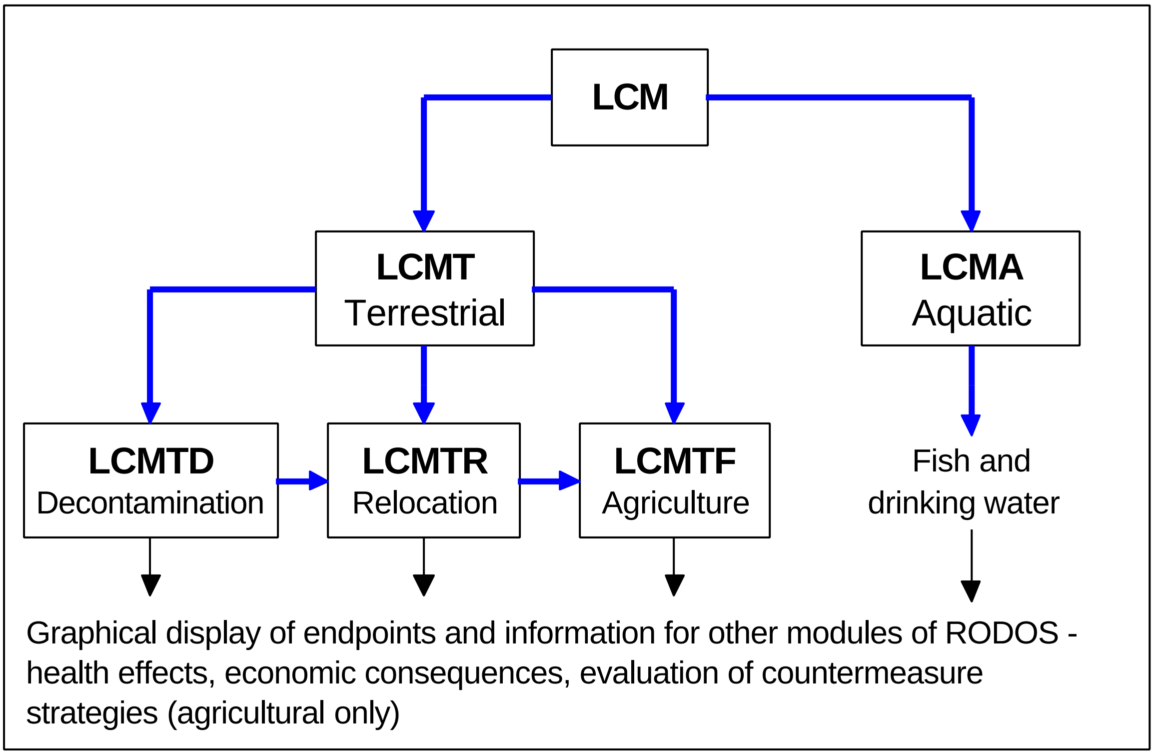
Adaptation of model parameter is important in particular for foodchain and countermeasure models as the local properties have a strong influence of model results. The adaptation of the long term countermeasure model LCMT is therefore part of the program of customisation of RODOS for use in Eastern Europe. The current version of the module contains data sets which more or less are appropriate for mid Europe, however some of these parameters have been derived from work after the Chernobyl accident. In case of the foodchain and dose module FDMT which is a precursor of LCMT in particular in estimating the concentrations in feed- and foodstuffs, so-called radioecological regions were defined which account for differences in climate and ingestion habits. These regions are areas, with relatively uniform radioecological conditions for which the same set of model parameters can be used. In case of countermeasure modelling, such a subdivision of a country might be useful for agricultural countermeasures. Therefore radiological regions were only considered for changes in the animal diet animal. Other effectiveness factors – also for soil based countermeasures – seem to be mostly independent from the region, at least in view of the data gained after the Chernobyl accident and used for the compilation of the default data base for LCMT.

The task of the customisation project was first to identify whether the long term countermeasure model is appropriate for the application in Eastern Europe and second to collect data for those model parameters where the default data set seemed to be not appropriate for the application of LCMT in a particular country.

This work has been performed by institutions from seven countries (Poland, Romania, Russia, Slovak Republic and Ukraine as main contractors; Czech Republic and Hungary joined on a voluntary basis) based on their available resources and data bases. As the resources and also the available data differ considerably from country to country, no complete harmonisation of the task could be achieved. This allows, on the other hand, that in further customising work that procedure can be selected which fits best to the needs with respect to available data and knowledge. In addition, the detailness and the reliability of the collected data is quite different from country to country, which again is reflected in this summary report.

1 Long term countermeasure modelling

The late countermeasures module (LCM)[1, 2] comprises two primary sub-modules addressing countermeasures in the terrestrial environment (LCMT) and the aquatic environment (LCMA). Within LCMT, three major groups of countermeasures are considered: relocation of the population, decontamination of inhabited and agricultural land and agricultural countermeasures. The overall structure of LCM is shown in the figure below. LCM links closely with other modules of RODOS, particularly the Foodchain and Dose Modules (FDM) which provide input on activity concentrations in air, foods and animal feedstuffs, deposition rates as a function of location, nuclide and time, and models to calculate doses from the relevant exposure pathways without countermeasures. In addition, LCM requires information on the countermeasures criteria to be considered and on the effectiveness of countermeasures both in reducing external gamma doses from material deposited on the ground and in reducing activity concentrations in foods; a database of default values has been created for use with LCM.



1.1.1 Terrestrial countermeasures

The general approach to the modelling of countermeasures within LCMT is illustrated below. The initial aim of the module is to determine if there is a need for intervention, i.e., whether, on the basis of user-supplied criteria, there is a need for the implementation of relocation or food restrictions. If intervention is indicated, the objective is then to identify appropriate countermeasures and to provide sufficient information on their consequences to assist in the development of a practical countermeasure strategy. The information provided includes: the degree to which a given measure avoids the need for additional intervention, the amount of produce/number of people affected, the length of time for which the measure would be implemented. The interaction between countermeasures can also be considered to varying extents. For food countermeasures, combinations of two different, but complementary, measures can be investigated so that strategies of countermeasures for individual foods can be evaluated within RODOS. For decontamination, the effect of decontamination on both the extent and duration of relocation and the need for, and duration of, food restrictions can be considered. For relocation, the implications of relocation on the further use of agricultural land in the relocated area can be studied.

Prediction of need for intervention: extent and duration

↓

Prediction of effectiveness of decontamination and agricultural countermeasures

↓ ↓

Identification of countermeasures that may be effective in short - medium term (< 1 year)	Identification of countermeasures that may be effective in long term and worth further investigation
↓	↓
Dismissal of options not worth further investigation	Dismissal of options not worth further investigation

LCMT provides information at two levels: rapidly produced summary information on the extent and duration of any required interdiction, and more detailed information on possible countermeasures which may be promising, both in the short - medium term and in the longer term. Early screening of countermeasures is a valuable part of any decision support system, in that it allows the more detailed consideration of options to be focused on those most likely to be of benefit. The more detailed calculations have a two-fold use: the provision of information to aid early discrimination between countermeasures options, and, in the longer term, and to contribute to the development of practical, site-specific advice on countermeasure strategies alongside measurement programmes and experimental research.

The principal endpoints evaluated within LCMT include, for each countermeasure, the extent (area, quantities of food, population numbers) and duration of restrictions, doses received and saved and additional data required for evaluating the costs of countermeasure implementation. A selection of key results are transferred to the RODOS graphical system for presentation to the user in the form of maps, plots of information as a function of time etc. Information is also passed to the economics and health modules of RODOS. For agricultural countermeasures, a mode of running LCM, called the 'decision mode', has been defined to provide information on a number of countermeasure options and combinations of these options for a single food to the Evaluating subsystem (ESY) of RODOS. This enables countermeasure strategies to be evaluated using a wide range of information including effectiveness, costs, health effects and feasibility considerations.

1.1.1.1 Modelling of Relocation

Within LCMT, endpoints related to the imposition of relocation in the presence or absence of land decontamination are modelled. Two types of relocation are considered, temporary and permanent. Permanent relocation is defined as the removal of people from an area with no expectation of their return; however, the land may be released at a later stage and resettled by different individuals. Temporary relocation is the removal of people from an area for an extended but limited period of time. The model uses criteria for the imposition and relaxation of relocation, defined in terms of dose. The user can consider relocation both as an extension of evacuation or as a separate countermeasure in areas where evacuation has not been implemented. Issues which require consideration when implementing relocation have been documented based on published experience from previous situations where relocation has taken place.

1.1.1.2 Modelling of Decontamination

Decontamination is considered as a means to prevent or reduce the extent of relocation, and as a countermeasure in its own right. The reduction of doses due to external exposure from deposited material, inhalation of resuspended material and ingestion of contaminated foods is modelled. The influence of decontamination on relocation can be evaluated for decontamination occurring either before or after relocation is implemented.

The impact of decontamination on external exposure from deposited material is modelled using dose reduction factors for a selection of decontamination techniques and implementation times as a function of wet and dry deposition, time following deposition and radionuclide. Added flexibility is provided within LCM in two respects. The user is enabled to explore the reductions in external exposure that could be expected, given a specified level of decontamination achieved on a particular surface and at a particular time, within an urban environment. The user is also enabled to explore the level of decontamination that would be required to reduce or remove the need for other countermeasures. Underpinning the decontamination model is a comprehensive data file of information on the dose-effectiveness of decontamination. The information is provided as a function of decontamination factor, surface type and time of implementation. Data libraries have also been prepared containing information on resources and quantities of waste arising.

The impact of decontamination on doses from inhalation of resuspended material is modelled taking into account the reduction in activity concentrations on the surface being decontaminated and the contribution of that surface to the total contamination in the area as a function of time. Assumptions are also made on the availability of the remaining activity on the surface for resuspension. Due to the sparcity of information on the impact of decontamination on resuspension from urban surfaces, this availability is either assumed to be zero or the same as before decontamination is implemented, depending on the technique being considered

The impact of decontamination measures on the ingestion of contaminated foods is modelled by estimating the reduction in activity concentrations in foods achieved by the decontamination of agricultural land. Two measures are evaluated; ploughing and soil removal.

1.1.1.3 Modelling of Agricultural Countermeasures

Within LCMT, endpoints related to the imposition of countermeasures on food are evaluated. The criteria for banning the consumption of food are defined in terms of activity concentrations in foods, which the user of the system can change. The predicted activity concentrations in foods are compared with the criteria as a function of time, radionuclide and spatial grid point, to determine whether intervention is required. If intervention is not required for a food, then no further measures are considered. If intervention is required, a number of countermeasure options are considered for each food. If, following the implementation of a countermeasure option, additional intervention is still required, the user of the system will be informed of this requirement, together with the length of time for which activity concentrations would continue to remain above the chosen criteria.

The countermeasures considered are:

1. The banning of foods linked with food disposal and/or the stopping of food production.
2. Food processing and the storage of food.
3. Changes in the dietary composition of grazing animals. Factors that can be evaluated include the effect of administering clean feed for a chosen period at various times following deposition, changes in the proportion of contaminated feedstuffs in the diet and the use of different feedstuffs.
4. Administration of sorbents or boli.
5. Soil treatments such as the addition of fertilisers.
6. Change of the crop variety or crop species grown.
7. Change in land use from agriculture to forestry.

The implementation of an individual countermeasure option may not remove the need to restrict the consumption of food, or, the duration of the intended countermeasure may result in an unacceptable cost, be it monetary or other, for a given level of benefit. In this case, undertaking a combination of countermeasures may remove the need for or further reduce the duration of food restrictions. In order to explore the effectiveness of combinations of countermeasures, selected combinations of two options can also be considered for each food with the underlying constraint that the combination is broadly feasible.

Factors such as the timing of the implementation of an option or the duration of a given husbandry or farming practice can be changed by the user so that a range of possible scenarios can be considered.

2 Adequacy of the present long term countermeasure module for the application in Eastern Europe

The first working package contained the task to investigate the adequacy of the long term countermeasure module LCMT for the use in Eastern European countries. However, only in the countries of the former Soviet Union (FSU) enough information was available to test the present modelling approach quantitatively. Therefore it was agreed that mainly the Russian institute RIARAE will carry out detailed investigations about the accuracy of LCMT whereas the other contractors will use their resources mainly to collect the appropriate data sets.

2.1 Adequacy of LCMT (Czech Republic)

When discussing late countermeasures with the relevant institutions of the Czech Republic it became obvious that their main effort was concentrated on the treatment of early countermeasures, which so far represent the highest priority in the emergency planing. No overall systematic strategies for late countermeasures are defined and there exist only some vague ideas on ad-hoc application of some specific countermeasures.

The following institutions were contacted:

- Governmental Board on Emergency Planing
- Ministry of Living Environment
- Institute of Civil Protection of CR
- Czech Army

The Governmental Board on Emergency Planing is responsible for emergency management close to the nuclear power point (up to 15 km from NPP). Their main interest is related to the optimisation of early countermeasures. Late countermeasures have lower priority and their application will depend on the real situation. The co-operation with chemical troops of the Czech Army and civil protection is planned.

The Ministry of Living Environment has its own database system “HAVARIE” for emergency management of chemical incidents. The main goal of this system the to minimise the early effects whereas late effects are not treated in detail at the moment. Some specific decontamination techniques are included but no detailed information was provided.

In the Institute of Civil Protection and the corresponding department of the Czech Army, the process of harmonisation of emergency planing with relevant NATO and EU practices has just started. So far, only old and obsolete data form the period of the “cold war” are available.

The advanced structure of the LCMT module is far ahead in comparison with the simple and non-complete regulations and practices implemented at present in the Czech Republic. Therefore, the LCMT methodology can be used as an efficient and instructive guidance in further developing late countermeasure strategies in the Czech Republic. During the communication with the Czech institutions, the LCMT concept was appreciated and no objection against its future application was raised. Therefore, the adequacy for its use in the Czech Republic is uncontradicted.

2.2 Adequacy of LCMT (Hungary)

Model parameter were not adapter for Hungarian conditions, however the questionnaire was completed for evaluation. Data have to be collected before a RODOS installation in Hungary.

The modelling approach itself is appropriate for Hungarian conditions.

2.3 Adequacy of LCMT (Poland)

The countermeasure model and data have been validated for the application in Poland. All the necessary corrections have been proposed. Seven radioecological regions have been defined taking into account various aspects of model parameters and the availability of the data. In general it could be concluded that the countermeasures model LCMT is adequate for operational use in Poland.

2.4 Adequacy of LCMT (Romania)

The investigation on the appropriateness of the RODOS countermeasure model and their databases in Eastern Europe was performed on the basis of five reports issued by NRPB in 1995 and 1996 (agricultural countermeasures), two LCMT reports issued in 1997 (user guide and databases regarding late countermeasures module) and the Proceedings of a seminar on radioactivity transfer during food processing and culinary preparation (CEA-IPSN/DERS, CEC-DGXI, 1989).

The information collected from the above mentioned documentation was analysed with respect to the usefulness of individual agricultural countermeasures, to their cost efficiency, to the possibility and circumstances of their use and their adaptation to the prevailing conditions in Romania, taking into account the soil structure, the structure of agricultural production, the agricultural practices, and the Romanian experience achieved in the post-Chernobyl period.

Due to differences in soil properties, the effectiveness of agricultural countermeasures (routine or special soil-based chemical treatments of agricultural areas, land management, alternative crops, alternative land use, mechanical treatment of soil) may not be assessed quantitatively in the absence of a large experimental local data base; however, the following general conclusions may already be outlined:

- food banning criteria in Romania are similar to the criteria considered by LCMT;

- food processing factors for radiocaesium, radiostrontium and radioiodine given in the LCMT data base differ only by 20-30% from post-Chernobyl data in Romania (for other radionuclides there are no local data, so that the values from LCMT will be used);

- for removal of animals from radioactive contaminated feedstuffs, the LCMT strategies are compatible with the local data and practice in Romania;

- addition of sorbents was not yet tested in Romania, and LCMT values will be considered as default;

- values for land amelioration used by the United Kingdom are more appropriate for Romania than those resulted from the experience of the former Soviet Union, as soil types are closer to those in the United Kingdom;

- for change of crop variety or species, default data from LCMT will be considered;

- decontamination of land is limited in Romania by its cost and this aspect will be periodically reanalysed consulting the local civil protection headquarters;

- relocation criteria are similar to the recommended practice of the European Communities.

In general, the model approach and many of the default data sets of LCMT are appropriate for the use of RODOS in Romania.

2.5 Adequacy of LCMT (Russia)

2.5.1 Introduction

The first step in customising the countermeasure module LCMT was to investigate the appropriateness of the RODOS countermeasure models and their databases in Eastern Europe. In a second step, test were carried out by tuning of countermeasure models and the corresponding databases to get an impression about the accuracy of LCMT when the data bases were adapted to a specific region.

Much information regarding the effectiveness of agricultural countermeasures was gathered and analysed in 1993-1995. The RIARAE institute was also participating in the development of the database of LCMT, in particular data were provided on the effectiveness of agricultural countermeasure options. This database contains information for each countermeasure option for two soil types: mineral and organic.

These data are mainly based on the information derived from the studies performed in Belarus, Russia and Ukraine in 1987-1994[1-4]. Their effectiveness and cost vary considerably and depend on the time elapsed after the accident and the situation of their application. Therefor, their re-evaluation and extension of the existing database on the basis of information on the time dependence of the effectiveness of countermeasures, i.e., countermeasure after-effects, the necessary resources and their limitation and applicability are necessary.

2.5.2 Evaluation of the appropriateness and tuning of LCMT and the corresponding data bases

<u>The approach used for tuning of LCMT and the corresponding data bases</u>

The purpose of LCMT is to calculate endpoints related to the imposition of countermeasures on food. The food countermeasures considered are: banning and disposal, food storage, food processing, supplementing animal feedstuffs with uncontaminated, less contaminated or different feeds, use of sorbents in animal feeds or boll, changes in crop variety and species grown, amelioration and change in land use[5]. When analysing these endpoints it should be noted that most options (like banning, disposal, food storage or change in land use) are not dependent on the conditions of application and there is no need to check their appropriateness for use in Eastern Europe. However, effectiveness of countermeasures such as amelioration of agricultural lands or use of Prussian blue in animal feeds can vary in a large range depending on agricultural practice.

The input of LCMT is the activity concentrations of foodstuffs and feedstuffs, which are passed from FDMT. Taking into account that the PC version of FDMT was modified and adopted to the conditions of the territory of the Russian Federation subjected to contamination after the Chernobyl accident(6,7) it was decided to reproduce the methodology of LCMT in a separate program and to compare the results obtained with the monitoring data where available.

The reason for this approach was the following. Within the adaptation of FDMT to the conditions of the Russian Federation it was indicated that some modifications in FDMT model are needed for use in conditions of extensive agricultural practice. It has been demonstrated that these modifications improve the adaptability of the module. The proposed(7) modifications were realised by GSF in the present version of the FDMT module. Simultaneously, these modifications were introduced in PC version used by RIARAE. This modified FDMT module was tested using independent data, which describe the contamination of agricultural products after the Chernobyl accident taking several regions of the Russian Federation as an example. The model verification has indicated that the adapted FDMT version describes quite well the dynamics of the activity concentration in the majority of foodstuffs.

Two types of information were used for tuning. The information of the first type was collected at the level of individual collective farms and information of the second type was gathered for individual districts. In the first case information on activity concentrations for individual foodstuffs and feedstuffs as well as different types and countermeasures applied over varying timescales is available. In case of the district level, however, it is more difficult to find a clear dependency between the countermeasures effectiveness and the dynamics of concentrations in agricultural products due to overlapping of the different countermeasure effects. However, these data are still useful to test the robustness of the model.

Tuning of LCMT and the corresponding data bases at the collective farms level

Fifteen collective farms were selected at the territory of the Novozybkovsky district for estimating the effect of soil based countermeasures i.e. liming, application of mineral fertilisers and radical improvement of pastures and haylands. The criteria for this selection were:

I. Presence of data on concentrations of ^{137}Cs in appropriate agricultural products and feedstuffs obtained from the monitoring program over several years before and after the implementation of countermeasures;

II. Documentation on countermeasures: area of applications, dose of ameliorates and fertilisers;

III. Information about land use and soil properties.

When discussing this approach it should be noted that application of countermeasures was rather uniform in the period under consideration (1992-1997) which allows the comparison of information for years with intensive countermeasures application with data for years where practically no countermeasures were applied.

As it was noted earlier, validation studies with a modified FDMT showed a satisfactory agreement between predicted values and measurements. Ratios of the prediction to measurements normally varied in a range from 0,5 to 1,5 which is a rather good agreement for this type of assessment. However, these variations are too big to estimate the effect of countermeasures application from reproducing both actual concentrations and effect of countermeasures application. To avoid this problem, a new adaptation of FDMT model parameters describing transfer of ^{137}Cs from soil to plant were performed for each collective farm considered. This was realised by taking into account the observations obtained before the application of countermeasures.

Liming

Liming as a countermeasure was applied in the most contaminated regions of the Russian Federation in the years 1989-1993 and the information obtained from that period can be effectively used for tuning of any countermeasure model.

The time dependent ^{137}Cs concentrations in seedlings of rye grown at the collective farm Krutoberezka (Novozubkovsky district of Bryansk region) before and after lime application is shown in Fig. 1 as an example of these calculations. Here, liming of all fields used for grain production was carried out in 1990.

As it can be seen from Fig. 1 this option has some after effect i.e. the effectiveness of liming can be observed at least within 3 years after its application. It is also clear that the effectiveness of this option decreases with time after its application. Calculations of the effect of this countermeasure according to the methodology of LCMT(5) show that the values in the LCMT database are in a good agreement with the measurements.

The results obtained for the other collective farms (c.f. Mithchurina, Zlunkovsky district, c.f. Novozubkovsky, c.f. Resheyetelny, c.f. VIUA and c.f. Boevik) confirm this conclusion (difference between predictions and measurements is less than 40%) however, the after effect of some countermeasures such as liming, should be taken into account. A more detailed description of soil based countermeasures characterised by their effectiveness with time is given further down.

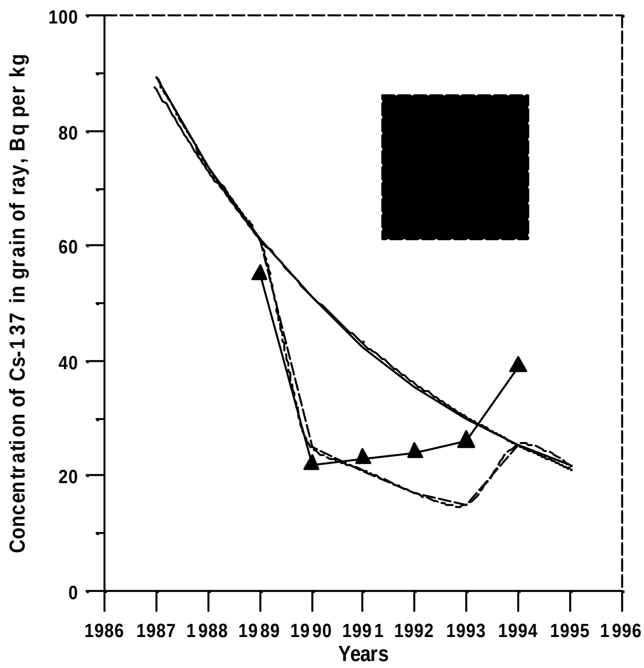


Figure 1. Dynamics of ^{137}Cs concentrations in seedlings of rye before and after liming. 1 - results of calculation by FDMT; 2 - data of monitoring observation; 3 - results of calculation by LCMT.

Application of mineral fertilisers

To estimate the appropriateness of the data in the LCMT database to describe the effectiveness of the application of mineral fertilisers, data from 1998 were used. Due to economic problems in 1995-1997, the rates of application of mineral fertilisers in the contaminated regions were drastically decreased which resulted in a sharp decrease of the contamination of agricultural products. In 1998, this countermeasure was applied again which allowed to use this data for validation of LCMT. As before, information for five collective farms of the Novozybkovsky district were used for tuning of countermeasure models and the corresponding data bases.

Table 1. Results of the validation of LCMT predictions on the effectiveness of mineral fertilisers application.

Name of the collective farm	Ratio of predicted by LCMT module to estimated based on actual data
Novozubkovsky	0,73
Rodina	0,85
Boevik	0,94
Udarnik	0,68
Resheyetilny	0,78

When analysing the results from Table 1 it is obvious that predictions by LCMT underestimate the evaluation made on the basis of actual data.

However, it is clear that the application of mineral fertilisers after a break for several years should be up to 1.5 times more effective than under normal practice. Taking this into account, the agreement between calculations and measurements is satisfactory.

Amelioration

The test of LCMT and the data bases describing the effectiveness of amelioration was carried on at the basis of the information obtained from settlements noted earlier (c.f. Krutoberezka c.f. Mithchurina, Zlunkovsky district, c.f. Novozubkovsky, c.f. Resheyetelny, c.f. VIUA and c.f. Boevik).

As a good example of the effectiveness of radical improvement of land used as pastures or haylands can be seen in Figure 2 where information for c.f. Krutobereska is displayed. As noted earlier FDMT was tuned to the conditions of this c.f. to have a base line for the LCMT calculations.

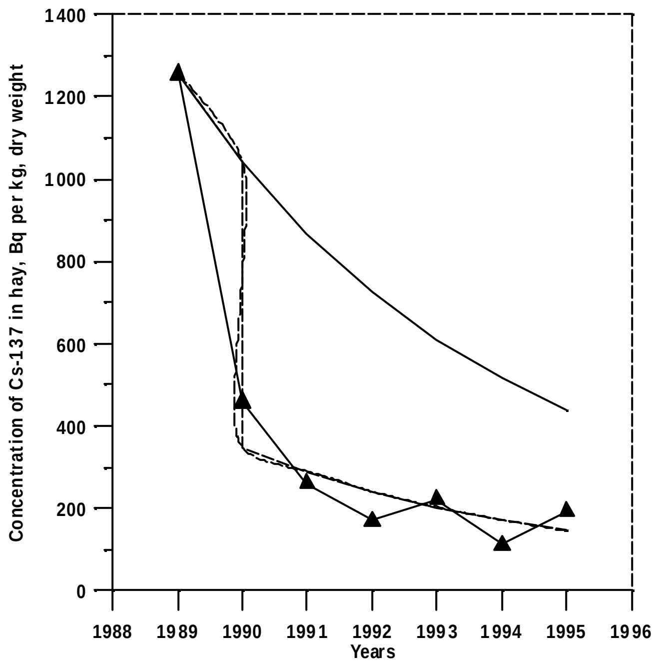


Figure 2. Estimation of the effectiveness of pastures and haylands radical improvement in collective farm Krutoberezka

Here, radical improvement was implemented in 1989 and the first effect was achieved in 1990. The results of these calculations allow the conclusion that the prediction of the effectiveness of amelioration provided by LCMT is rather close to the experimental data and there is no need for additional tuning of the database and model.

Application of sorbents in animal feeds

The comparison of LCMT predictions with measurements for the estimation of the appropriateness of the effectiveness factors for the application of sorbents in animal feeds was performed in a similar way as for plant products.

It should be noted that the selection of the collective farms, which meet requirements formulated earlier, was a complicated task. However, intensive application of Prussian Blue in the contaminated districts of the Russian federation allowed to find several example areas with a clear effect of this countermeasure. A special feature of this application was that in each case this option was applied for a short time when a sharp increase of milk contamination was observed. This phenomenon was observed mainly in the late spring and in autumn.

Therefore, information on monthly dynamics of ^{137}Cs in milk as well as data about the composition of feeds for milk cows and the detailed information about special features of the animal husbandry were used for a more accurate adaptation of FDMT to local conditions. The data for c.f. Petrovobudskoe, used for the adaptation exercises, are shown in Figure 3.

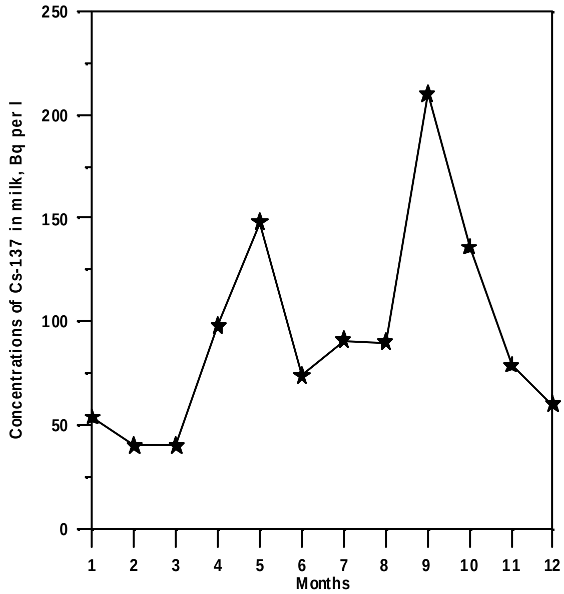


Figure 3. Dynamics of ^{137}Cs concentrations in milk of cows of c.f. Petrovobudskoe

Figure 4 illustrates the results of the tuning of LCMT for c.f. Mirny a part of the Gordeyevsky district in the Bryansk region.

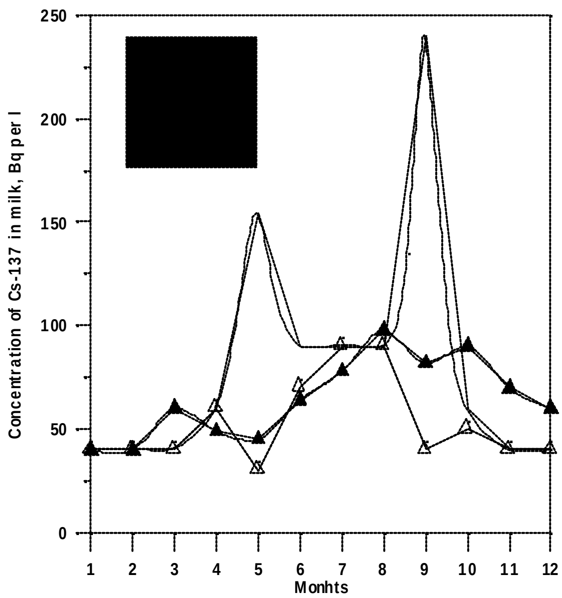


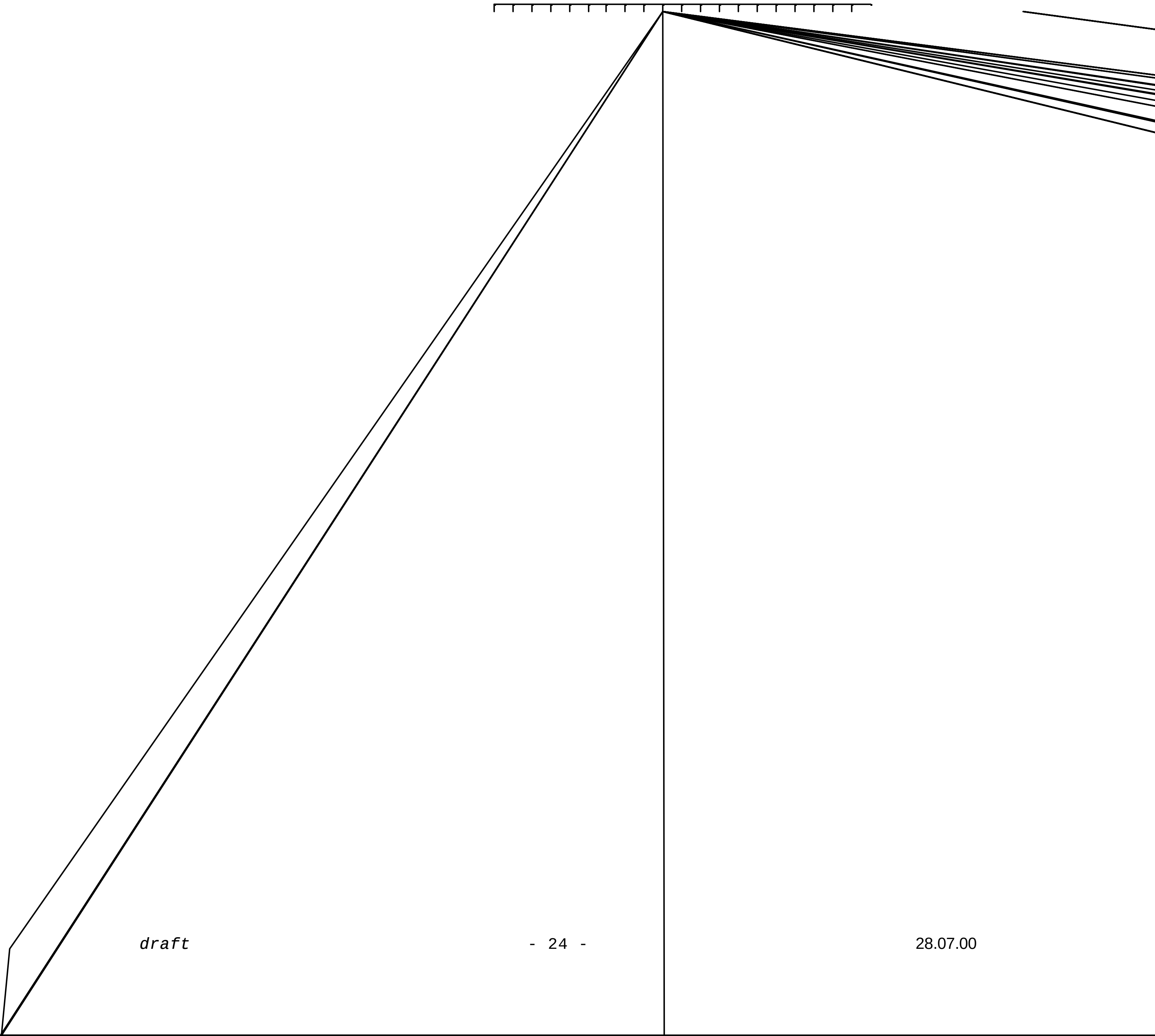
Figure 4. Tuning of LCMT for collective farm Mirny. 1 - data of monitoring of milk contamination; 2 - results of the calculation by FDMT; 3 - results of the calculation by LCMT

The comparison shows that LCMT partly overpredicts the effect of applied countermeasure. The main reason of these differences might be explained by the fact that under field conditions the recommended technology is not completely provided by workers of collective farms. This effect is also noted in IAEA studies carried out in this region. Therefore, for a realistic estimation, a reduction factor of 3 describes the decrease of ^{137}Cs in milk after the application sorbents more appropriate than using the factor 5 from the default data base.

Tuning of LCMT and the corresponding data bases at the district level

The Novozybkovsky and Klimovsky districts, for which adaptation of FDMT exist, were used for testing. It should be noted that the estimation of the appropriateness of LCMT at the district level is a more complicated task. The main reason is that for larger areas only results of combinations of different countermeasure applications can be observed, as the introduction of individual countermeasures in individual settlements differs.

The results of the estimation of the effectiveness of liming at a background application with increased doses of mineral fertilisers are shown in Figure 5. Figure 6 illustrates a comparison of data on the effectiveness of application of countermeasures against milk contamination.



These results demonstrated that in all cases LCMT, at least for countermeasures against ^{137}Cs in agricultural products, calculates similar concentrations as obtained from measurements after the application of countermeasures. This shows that the RODOS countermeasure module and its databases is appropriate for modelling the effectiveness of countermeasures. However, the default values used for the application of sorbents in animal feeds need revising.

2.5.3 Limitation and applicability of countermeasures

The limitations or applicability of countermeasures depend on the type of applied ameliorates, soil properties, landscape type and crop.

Ameliorates-dependent limitations:

- -increased doses of N fertilisers are not applied, since treatment with acid N fertilisers results in soil acidulation and increased radionuclide transfer to plants.

Soil-dependent limitations:

- deep ploughing cannot be applied when soil has a thin humus horizon (less than ploughing depth);
- liming should be omitted on soil with high pH values, i.e. soil having neutral or alkali reaction of soil solution;
- manure or other types of organic fertilisers should not applied on peaty soils.

Landscape-dependent limitations:

- no radical improvement of meadows or ploughing of annually flooded lands should be performed;
- no ploughing or radical improvement of meadows should be applied on slopes where active erosion processes occur.

Crop-dependent limitations:

- under some crops, which grow well on acid soils, no lime is applied, in particular under potato, flax, etc.
- in accordance with the traditional cultivation technologies, organic fertilisers are applied for potato and other tilled crops; in the second year – rotation - these lands grow cereal crops, i.e. directly under cereals organic fertilisers are not usually applied.

Consequently, for the key countermeasure options schemes of their implementation have been developed with due account of the resources, limitations, applicability and costs.

2.5.4 Conclusions

One major purpose of LCMT is to calculate endpoints related to the imposition of countermeasures on food. The input of LCMT are the activity concentrations in foodstuffs and feedstuffs, which are passed from FDMT. Therefore, the study concentrated on the reproduction of the normal operation of these modules and the comparison of the results of these calculations with data of the monitoring program being currently under way in the region subjected to contamination after the accident at the Chernobyl NPP. These data were used for the evaluation of the appropriateness and – if necessary - for the tuning of LCMT and the corresponding databases.

It was demonstrated that for the majority of the countermeasures options considered by LCMT, the model predictions are in good agreement with the observations. The conclusion can be drawn that LCMT and its default data base provided to the RODOS user is appropriate for the conditions of the Russian Federation. However, minor changes should be made in the database concerning the information on effectiveness of the use of sorbents in animal feeds for realistic use of LCMT for the conditions of the Russian Federation.

Some changes might be also suitable in the approach of the effectiveness of soil based countermeasures in particular for the option amelioration, which have an after effect. At present this group of food countermeasure options within LCMT includes both types with an after effect as well as countermeasures which have no after effect. In both cases it is assumed that the activity concentration in plants will be reduced immediately following the application by a constant factor over a user defined period during which the countermeasure is effective. However, in the case of application of some options such as liming, that has an after effect, the effectiveness can be also observed over a longer period. In addition the effectiveness factor of the ameliorate application may not be constant with time. Therefore, the subdivision of amelioration into two groups taking into account this phenomena and allowing time dependent reduction factors can provide more accurate estimations.

On the whole the results presented allow the conclusion that the countermeasure module of RODOS and its databases are appropriate for the use in CIS countries and the default values can be used (with the minor changes) for robust estimates of the effectiveness of possible countermeasures options in the case of radioactive contamination of agricultural areas.

2.6 Adequacy of LCMT (Slovak Republic)

The module LCMT can be adapted to the Slovak conditions. There is no need for modification, except that some of the data bases have to be adapted to local conditions.

2.7 Adequacy of LCMT (Ukraine)

The LCMT module has been developed by using experience gained from work after the Chernobyl accident. In particular, databases on the effectiveness of agricultural countermeasures for use within RODOS have been compiled from data collected in Ukraine, Russia and Belarus as result of the EU JSP1 project. Therefore, the structure and also the main database is appropriate for Ukraine. The basic data in Ukraine were received from investigations in the Polesie region, which was highly contaminated after the Chernobyl accident and showed higher soil-plants transfer factors as in other radioecological regions of the Ukraine. One of the reason seems to be that soddy-podzolic sandy and peat soils are dominant in this region. Some countermeasures are not applicable in other region, for instance, liming is not applicable in the Veld region where soils are not of an acid type.

3 Extension of existing databases for agricultural countermeasures

3.1 Databases

A default database containing the underlying data required to estimate the effectiveness of implementing the groups of countermeasures considered in LCM has been compiled for use in RODOS. The spatial resolution of the data is appropriate for providing advice to persons who make broad, policy decisions. The database contains robust, representative data that can be applied generally to relatively large areas. To achieve this, cautious values have been chosen, where necessary, so that the radiological impact will not be significantly underestimated. The database has been regularly reviewed throughout the project to utilise the most recent, relevant data and to provide the necessary information for the capability of LCM. The user has full access to the database to enable more relevant data for the situation under consideration to be used.

Robust dose reduction factors and surface activity concentration reduction factors for decontamination in urban areas have been determined using an urban dose model. Two data libraries have been created; the first containing dose reduction for a selection of feasible decontamination techniques and implementation times; the second containing dose reductions for a wide range of decontamination factors, surface types and implementation times. Data on the resource requirements, both personnel and equipment and the quantities of waste arising have been compiled to accompany the data library containing feasible decontamination techniques. General guidance on the applicability of the data libraries within Europe as a whole has been provided taking into account compiled data on building types, levels of urbanisation and population habits, where possible.

A database on the effectiveness of the decontamination of agricultural land and other agricultural countermeasures in reducing activity concentrations in crops has been compiled from a review of available data, primarily from the Ukraine, Russia and Belarus following the Chernobyl accident, supplemented where possible with data from western Europe, and the use of a dynamic foodchain model.

Not all of the measures implemented in the Former Soviet Union (FSU) will be effective in Western Europe and care is needed in the use of this database for wide application outside the FSU.

3.2 Adaptation of the data bases and criteria for Czech Republic

The problem with the proper local data collection still persists. The situation is described in more detailed in the chapter 4 ("Comment on LC data collected in the Czech Republic") of the final report RODOS(WG3)-TN(98)-14 on FDMT Customisation for the CR.

3.3 Adaptation of the data bases and criteria for Hungary

There was no adaptation of data performed for Hungary.

3.4 Adaptation of the data bases and criteria for Poland

The data required by LCMT have been collected and adapted for use in the RODOS system. The following information have been included in data files, in particular for quantifying agriculture countermeasures:

- derived limit for various nuclides with account of dietary habits in Poland,
- agriculture production for radioecological regions and for each province,
- animal diets (composition and quantities)
- for each major soil category in each radioecological regions the soil-based countermeasures including availability of materials and equipment needed, labour resources and the disposal of any waste.

For easy handling of the spatial information, the collected data are linked with digital maps of soils in the administrative unites.

This work was performed in co-operation with groups of experts from the Academy of Agriculture and other agricultural institutes.

As a consequence all the countermeasures options in LCMT can be applied in Poland.

3.5 Adaptation of the data bases and criteria for Romania

At present the following general data for the whole territory are already collected:

- tables with the physico-chemical parameters of Romanian soils in USDA-Soil Taxonomy;
- table of soil texture of the upper horizont (0 - 20 cm);
- tables with the potassium content of Romanian soils;
- tables with root depth of cultivated plants;
- assessment of soil mass (weight) (to/ha) in root zone for main root vegetables (sugar beet and potatoes);
- tables with the main lakes and reservoirs from S and SE of Romania;
- tables with hydrochemical parameter data of lakes and reservoirs;
- soil map 1:2500000 in USDA Soil Taxonomy;
- soil map 1:2500000 in FAO-UNESCO Soil Classification;
- map of soil texture 1:2500000 at the upper horizont (0 - 20 cm);
- map with exchangeable potassium in soil;
- map with total and native fixed potassium in soil;
- data concerning the exchangeable Ca in 3 main types of soil.

Detailed data about the most important soils (11 types) of Romania were also collected; they are characterised by their:

- physical and chemical properties;
- distribution and location;
- humidity categories;
- specific types of vegetation;
- chemical parameters: humus content, pH, saturation capacity with bases (V), cationic exchange capacity (CEC);
- statistical data (frequency, areas sum, % from total area, average area;
- texture in the upper level (horizonts);
- the K supply condition of the 0 - 20 cm layer;
- rooting depth for main plants;
- soil mass of the radicular layer in case of (sugar) beet and potatoes.

In order to fit the FDMT list of products specific for Romanian radioecological regions, a number of data files located in *$RODOS_DIR/roextern/data/lcm* were modified accordingly. The files taken into consideration are: fcadds31.data, fcamel31.data, fcbans31.data, fccrop31.data, fcdbase31.data, fcdecf31.data, fcesy31.data, fcrduc31.data, fcstor31.data, fcsubs31.data. The file fdbase31.data including yield of food product per year was re-built based on the Romanian Statistic YearBook (see Table 6, Annex).

Some additional steps were followed for adaptation of the existing databases in RODOS PRTY 3.12:

1) - for each product of Romanian radioecological regions (RER), codified by a task atom of the form 'fabc' a special rif file, *cerna_npp.rif*, was included in the corresponding directory *Production_fabc*, from *$RODOS_DIR/rogis/envir*. The files named cerna_npp.rif specify, in the required format, the bounding box and mean production gridded data for the Romanian NPP Cernavoda site.

2) - the *crd* files *Production_fabc.crd* were modified by addition of a line

cerna_npp (27.4295, 43.8739) (28.6793, 44.7681)

containing the geographical coordinates of the Cernavoda Site.

3) - if a product that is specific for Romanian radioecological regions was not included in the initial 001 radioecological region list of products (such as sunflower, winter wheat-barley straw and maize grain), a dedicated directory, *Production_fabc*, with the required structure was built in *$RODOS_DIR/rogis/envir*.

Some modules (EMERSIM, EARLYCONS, FDMT and LCMT) of the CSY were run, under PRTY 3.12, in case of Cernavoda NPP using data specific to one of the most severe CANDU accidents (core disassembly with hydrogen burning and precipitation); two countermeasure scenarios were considered (sheltering followed by evacuation for short and long duration).

The main results obtained consist of:

- the determination of the degree of radioactive pollution in the neighbourhood of the Cernavoda-NPP and of the areas where countermeasures must be undertaken as soon as possible in case of a severe nuclear accident;

- the evaluation of the accident costs with or without countermeasures;

- the determination of the areas where the relocation is compulsory;

- the evaluation of the degree of radioactive contamination in case of certain vegetables and animal products.

3.6 Extension of the existing data bases (RIARAE, Russia)

Following the major radiation accidents a variety of agricultural countermeasures have been developed. Their effectiveness and cost vary considerably and depend on the time elapsed after the accident and the situation of their application. Furthermore, many soils related countermeasures produce so-called "after-effects", such that there is a reduction in contamination with time, which is not necessarily constant. The current model enables this ‘after effect’ to be taken into account but is restricted to using a constant reduction factor with time.

This activity aims at the extension of existing databases on agricultural countermeasure taking into account the time dependence on the effectiveness of countermeasures, i.e., countermeasure after-effects, the necessary resources and their limitation and applicability

The agricultural countermeasures in the contaminated areas can be divided into two groups. The first one includes countermeasures which are only effective immediately after the application, within one vegetation season, the second group consists of countermeasures the effect from witch persists over a period of time after their application, i.e., countermeasures which have an after-effect. The presence of after-effect is caused by the application of ameliorants, which are not fully used by plants during the growing season and are being transformed in soil for some time. Among these are ameliorants with low soluble dolomite powder, phosphorous fertilisers, rock phosphate powder or ameliorants which interact with soil and influence its properties over some period of time: sapropell, zeolite, etc. In practice to achieve a maximum affect from these ameliorants, they are applied in autumn in order that by the beginning of the vegetation season their major part has been transformed into available for plant uptake state (rock phosphate powder, fertilisers) or these substances exerted an expected effect on the soil properties, e.g. reduction in activity when applying lime or dolomite powder.

The account of the after-effect is necessary for a correct estimation of countermeasure costs.

Because of a different type of countermeasures applied on arable land and pastures and haylands it is appropriate to consider a potential after-effect for these types of land use separately (Table 1).

On arable land, the after-effect of countermeasures depends on the type of ameliorants. Practically no after-effect is observed following the application of mineral fertilisers at standard doses, since nitrogenous fertilisers are almost completely used by crops during the vegetation period, potassium fertilisers-up to 60-75%.Only phosphorous fertilisers have after-effect, since these are poorly soluble and are not completely consumed by plants over the growing season (on average up to 25%).

Table 1. After-effects for different countermeasures

Countermeasure	Soil group	Effect			After-effect
		max., RF	duration, year	average, RF	
Arable lands					
Application NPK 1:1,5:2	all group	3,5	1	2,0	no for N and light after-effect for P-K 2 years
Liming	all group	3,0	4	2,0	yes, 3-4 years
Zeolite, bentonite and others	all groups	2,0	2-3	1,5	yes, 2-3 years
Sapropell	all groups	4,0	2-3	2,0	yes, 2-3 years
Manure	mineral soils	2,0	2	1,5	yes, 2 years
Pastures and haylands					
Surface improvement	all groups	2,5	2-3	1,5	yes, 2-3 years
Radical improvement	all groups	8,0	4-5	3,5	years, 4-5 years

The application of increased doses of K and P-K fertilisers provides a decrease in ^{137}Cs accumulation in crops for 3 year, however in years 2 and 3 the effectiveness noticeably falls (Table 2)

Table 2. After-effect of different ameliorants on soddy-podzolic soil

Ameliorants	Reduction factor					
	Oats, grain			Maize, vegetative mass		
	1 st year	2 nd year	3 d year	1 st year	2 nd year	3 d year
$N_{70}P_{70}K_{70}$	1,2	1,0	1,0	1,3	1,0	1,1
$N_{70}P_{210}K_{70}$	1,8	1,7	1,3	1,0	0,9	1,1
$N_{70}P_{70}K_{210}$	1,9	1,3	1,1	1,8	1,2	1,2
$N_{70}P_{210}K_{210}$	1,8	1,4	1,2	1,5	1,2	1,1
Lime, 3 t/ha	1,1	1,5	1,5	1,2	1,4	1,3
Zeolite, 5 t/ha	1,2	1,7	1,3	1,3	1,4	1,2
Zeolite,10 t/ha	1,1	1,6	1,4	1,3	1,5	1,3
Peat, 30 t/ha	0,8	0,9	1,2	1,1	1,0	1,0

The application of ameliorants such as lime or dolomite powder, sapropell, zeolite, bentonite, etc. has after-effect because of the inherent mechanisms of transformation in soil (Table 2). Post effect is also observed in treatments with organic fertilisers (peat, manure), with the effect being dependent on a crop-for potato the application of peat was an effective measure, for other crops no effect was reported (Tables 2,3)

Table 3. Effectiveness of organic fertiliser for potato

Ameliorants	Reduction factor	
	1 st year	2 nd year
Manure, 60 t/ha	1,6	1,4

Experiments to assess after-effects of bentonite were conducted on leached chernozems characterised by rather high soil solution acidity. The studies have demonstrated that in the first year the application of bentonite slightly influences ^{137}Cs accumulation in yield of farm crops in the radionuclide uptake in year 2 after treatment (Table 4).

Table 4.Transfer factor of ^{137}Cs to crops after application of bentonite, n·10^{-2}

Options	1 st year (1993)		2 nd year (1994)	
	Oats		Oats	
	grain	reduction factor	grain	reduction factor
Control - $N_{60}P_{60}K_{60}$	4.3±0.7		3.8±1.1	
$N_{60}P_{60}K_{60}$+bentonite (10 t/ha)	4.0±2.1	1.08	3.2±0.7	1.19
$N_{60}P_{60}K_{60}$+ bentonite (50 t/ha)	4.0±1.1	1.08	2.9±0.7	1.31

There are two groups of agrotechnical techniques traditionally applied on fodder lands - surface and radical improvement of haylands and pastures. The former consists of surface improvement of agrotechnical cultivation of soil and root mat by means of disking. In the radical improvement soil ploughing at a depth of 20-25 cm is additionally used. Further works include application of fertilisers, ameliorants (in particular liming of acid soils), selection of grass mixtures.

As shown by the studies conducted following the Chernobyl NPP accident, the effectiveness of these measures depends on the time of their application after fallout. Thus, some studies have shown that the effectiveness of the surface and radical improvement considerably decreased within the period 1986-1989. As an example, Table 5 summarises RIARAE data on the effectiveness of radical improvement of meadows with the same characteristics in different period after the Chernobyl accident

Table 5. Decrease of ^{137}Cs content in grass stand of pastures on soddy-podzolic sandy soil after radical improvement in different period after the Chernobyl accident

Treatment	^{137}Cs content, Bq/kg	
	1986	1987
Control	26400±8700	2200±1080
Radical improvement	2100±650	600±430

reduction factor	12,57	3,67

Investigations in the distant period after the Chernobyl accident reported that a decrease in the effectiveness of radical improvement of meadows was only characteristic of the first 3-4 years after the accident, in succeeding years no differences in the effectiveness of these countermeasures were revealed.

Such a conclusion resulted from the analysis of data of the experimental studies conducted in different years after the Chernobyl accident on meadows with different characteristics in Belaruss and Russia (Table 6).

Table 6. Effectiveness of radical and surface improvement for different periods after the Chernobyl accident

Year of application	**Meadow type, soil type**	**Reduction factor**	
		Radical improvement	**Surface improvement**
1989	Dry meadow, soddy-podzolic sandy soil	4,1	2,3
	Lowland (Wet) meadow, peaty-gley light loam soil	3,9	1,9
	Flooded meadow, soddy flooded sandy soil	-	2,5
	Flooded meadow, peaty-swamp soil	-	3,7
1991	Dry meadow, soddy-podzolic sandy loam soil	2,6	1,9
	Flooded meadow, peaty-gley loam soil	-	2,1
	Flooded meadow, soddy flooded sandy soil	-	1,5
	Lowland (Wet) meadow, peaty-gley light loam soil	3,8	2,4
1997	Dry meadow, soddy-podzolic sandy loam soil	3,0	1,4
	Lowland (Wet) meadow, meadow-swamp sandy loam soil	3,7	1,9

The decrease in the effectiveness of radical improvement in the first year after fallout can be explained based on the analysis of mechanisms responsible for the radionuclide uptake by meadow vegetation. In the early period after the accident a noticeable contribution to the contamination of grass stands was made by the aerial pathway, as well as by the radionuclides transferred from the root mat. In the second year, a considerable portion of radionuclides was uptaken from soil, while the contribution of root mat was still great. The root mat is a depot of radionuclides from which they are transferred to plants via the basal part, TFs to grass stands for ^{137}Cs being on average 3 times higher than for soil uptake [1, 3, 4].

The influence of the basal pathway for ^{137}Cs was confirmed by the experimental data on the radionuclide redistribution in soil, root mat and grass stand. The half-life period of ^{137}Cs decrease in the root mat is 1,5 years, which is in a good agreement with the data on the rate of root mat mineralisation - 3 years (2). Estimates made on the basis of model calculations demonstrated that as a result of root mat decomposition its contribution to ^{137}Cs accumulation by grasses drastically reduced and amounted in the 5th year after fallout to 6% for automorphous and 11% for hydromorphous soils.

For countermeasures aimed at improving of meadows, the destruction of root mat by rototilling and disking is an obligatory element of the cultivation technology resulting in the destruction of root mat and its mixing with soil. As a consequence, the radionuclides contained in the root mat are located by the mineral soil fraction, thereby reducing their availability for plant uptake. In the early period after the accident, when a considerable portion of radionuclides (up to 60%) was contained in the root mat, the application of this method was the most effective. With time a redistribution of radionuclides between root mat and soil occurs and within 4-5 years up to 90% of radionuclides are in the upper layers of soil. In this situation the root mat destruction in radical or surface improvement of meadows to a considerably lesser extent influences a decrease of radionuclide transfer to grass stand, whereas the effectiveness of techniques remains practically unchangeable in different years after fallout.

Radical and surface improvement belong to countermeasures the effects of which (decrease in the radionuclide content in plants) is reported for several years after the application. At the same time, a decline in the radionuclide content in grasses in this period does not remain constant. Usually, the maximum effect is achieved in year 2 after the application and by years 4-5 it reduces by an average factor 0f 1,5. Therefore, it is a conventional practice to do radical improvement every 4-5 years.

This fact needs to be taken into account in calculations connected with the assessment of the effectiveness of radical improvement of haylands and pastures.

As an example, Table 7 shows results from the RIARAE investigations where the after-effects of a system of countermeasures were estimated over 5 years. In the first year after surface improvement of meadows (disking, application of mineral fertilisers, liming, re-sowing of grasses) a 1,4 fold decrease was reported in ^{137}Cs uptake by grass stands, whereas after radical improvement (disking and ploughing, application of mineral fertilisers, liming, re-sowing of grasses) - 3,5 times. The maximum effect from the radical improvement was observed in the second year after the application of countermeasures being caused by the after-effects of liming. Besides, the higher effectiveness of countermeasures in year 2 is also connected with a better grass stand, since during the first year there is an active development and deepening of the root system and only by year 2 this process is mainly completed. In later years, the effectiveness of countermeasures declined and in 2-3 years was not reported for the surface improvement and decreased 2,1-2,7 times compared to the control for the radical improvement. The effectiveness of radical improvement 5 years after the application decreased 1,5-2,0 times.

Table 7. Dynamics of reduction factor ^{137}Cs content in grass stand after radical and surface improvements

Year after treatment	Reduction factor	
	Radical improvement	Surface improvement
1	3,49	1,42
2	4,19	1,23
3	2,76	1,17
4	2,70	1,19
5	2,08	1,10

3.7 Data collection for the individual radioecological regions (Slovak Republic)

Main task of the adaptation of the late countermeasure models for RODOS project was in the customisation of the databases for LCMT module. The module LCMT is acceptable to the Slovak conditions. Its adaptation consist in modification of some of the databases.

The data related to the food products, which are the most important for adaptation for national conditions, has been prepared to be included to the RODOS database. The information on agricultural production have been obtained from the Statistical Office of the Slovak Republic. The data on the soil types were collected from maps and in collaboration with the Institute of landscape ecology in Bratislava.

These values will be defined later for every regions particularly according to our possibility. Some of the data, e.g. goats and sheep milk and roe deer, had to be substituted or omitted because these foodstuffs are not available in the Slovak Republic.

3.7.1 Agricultural Countermeasures

For food banning (basic information for the implementation of all other agricultural countermeasures), the default data are considered.

For stopping of food production (food ban implemented), the default data are considered.

For food processing, the default data are considered.

For food storage, the following storage times are used:

Table 1 Storage and processing times applied in customised FDMT for Slovak conditions

Product(s)	Storage time (d)
Grass, Alfalfa	0
Cereals and cereal products	45
Brewing residues	60
Distillery residues	45
Maize, cabbage, kole, rape	0
Barley straw	20
Potatoes and beet	7
Leafy vegetables	1
Root vegetables	3
Fruit vegetables	1
Fruit and berries	1

Product(s)	Storage time (d)
Milk	1
Butter	3
Cream	2
Condensed milk	7
Skim milk	1
Cheese (rennet coagulation)	30
Cheese (acid coagulation)	2
Whey	2
Milk substitute	15
Beef	14
Pork, veal, roe deer	2
Chicken, lamb	7
Eggs	2

For removal of animals from contaminated feedstuffs, the default data are applied. The number of food considered was been reduced to 7; goats and sheep milk are not considered.

The default data are considered for the action of addition of sorbents. As for the removal from contaminated feed, the number of the foodstuffs considered was reduced to 7; the goats and sheep milk are not considered.

For the substitution of components of default animal diets with other animal feedstuffs, the data as described in FDMT are applied.

The default data are also taken for land amelioration, e.g. application of fertilisers.

For the change of crop variety or species and the last countermeasure change of land use from agricultural to forestry, the default data are considered.

3.7.2 Decontamination of agricultural land and urban areas

The default data are applied for the decontamination of agricultural land as well as for urban areas.

3.7.3 Relocation and food consuming

Intervention levels for the relocation criteria are based on the recommendations of the Ministry of Health of the Slovak Republic.

Table 2 Intervention criteria for temporary and permanent relocation

Late countermeasure	Intervention level
Temporary relocation (up to 30 days)	30 [mSv]
Temporary relocation (up to 1 year)	140 [mSv]
Permanent relocation	1000 [mSv]
Stop food consuming	Cs, Sr89, Ru : 1 [$kBq.kg^{-1}$ or $kBq.\ l^{-1}$] I, Sr90: 0,1[$kBq.kg^{-1}$ or $kBq.\ l^{-1}$] Pu, Am: 0,001 [$kBq.kg^{-1}$ or $kBq.\ l^{-1}$]

3.7.4 Miscellaneous data required for LCMT

Agricultural production data and animals affected by countermeasures are shown in Table 3 and 4.

Table 3 Data for RODOS grids

RODOS food category	**Agricultural production, Slovak value (kg / y per km2)**
Fmis – sheeps milk	Not available (not considered)
Fmig – goats milk	Not available (not considered)
Froe – roe deer	Not available (not considered)
Fchi – chicken	1,11E+03
Fegg – eggs	3.2 E 4 (number of eggs per km2)
Frye – rye	1,71E+03
Foat – oats	9,99E+02
Fver – root vegetables	2.8 E 6
Fvef – fruit vegetables	2.5 E 7
Ffru – fruit	2,71E+03
Fber – berries	6,79E+02
Fwwf - winter wheat flour	3,85E+04
Fpot -potatoes	1,03E+04
Fvel - leafy vegetables	1,21E+04
Fmil - fresh milk	2,28E+04
Fcre - cream	Not available
Fchr - cheese (rennet	Not available
Fcha - cheese (acid)	Not available
Fbec - beef	1,10E+03
Fpor – pork	2,43E+03
Flam - lamb	2,99E+01

Table 4 Factors for converting production data to animal numbers in lcmt:frodo

Animal numbers	RODOS food category	Slovak factor	Description
Cows for milk	fmil	3.6 E 3	litres per year per cow
Sheep	fmis	Not available	litres per year per sheep
Goats	fmig	Not available	litres per year per goat
Cows for meat	fbec	2 E 2	kg of beef per cow
Bulls	fbeb	2 E 2	kg of beef per bull
Pigs	fpor	4,7 E 1	kg of pork per pig
Lambs	flam	1.5 E 1	kg of lamb per lamb
Chickens for meat	fchi	2.4 E 0	kg of chicken meat per chicken
Chickens for eggs	Fegg	2.3 E 2	number of eggs per year per chicken

Intake rates for the three radiological regions are the same as those adapted for FDMT.

3.8 Data collection for the individual radioecological regions (Ukraine)

3.8.1 Agricultural Countermeasures

For strategies not explicitly mentioned, default values are assumed.

3.8.1.1 Food banning

The regulation documents concerning radiation protection and intervention levels in FSU countries have been permanent improved and changed after Chernobyl accident [1].

Up to the year 1997 the concentrations of ^{137}Cs and ^{90}Sr in foodstuffs in the Ukraine have been controlled by the document „The temporal permitted levels of contents of $^{137,134}Cs$ and ^{90}Sr in foodstuffs and drinking water“ [2].

Since mid-1997 a new document was developed and ratified with the title: „Permitted levels of content of radionuclides ^{137}Cs and ^{90}Sr in food and drinking water“ [7]. The values for the main foodstuffs are presented in the Table 1.

	Permitted level-97 (Ukraine)		Temporal permitted levels-91 (FSU)	
Foodstuffs	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr
Bread	20	5	370	37
Potatoes	60	20	590	37
Vegetables (leaf, roots)	40	20	590	-
Fruits	70	10	590	-
Meat and meat products	200	20	740	-
Fish and fish products	150	35	740	-
Milk and milk products	100	20	370	37
Eggs	6	2	45	-
Water	2	2	18.5	3.7

Table 1: Values of permitted levels of contents of radionuclides ^{137}Cs and ^{90}Sr in food and drinking water (Bq/kg, Bq/l) [7, 2]

These values are different from maximum permissible concentrations that are in the default data base of LCMT.

Maximum permissible values can be defined for up to five food-groups, which may be not sufficient to reflect the present regulation in Ukraine. Therefor, it may be necessary to extend these groups to 8-9.

It has to be noted that these values were derived for the present situation after the Chernobyl accident. They are very rigid and may be not used in case of a further accident. Therefore it is assumed that temporary values for the maximum permissible concentrations of radionuclides in foodstuffs and drinking water will be defined.

3.8.1.2 Addition of sorbents

Administration of caesium binders is effective means to reduce the transfer of radionuclides from the diet to animal organism and animal products. The effectiveness of using such sorbents is presented in Table 2.

		Type of animal products				
Type of treatment	Indices	milk of cattle	meat of cattle	meat of pigs	meat of sheep	meet of geese
Ferrocine	Reduction factor	8-10	3-4	3-4	7-8	4-5
	Dose, g/day per head	6	6	1	1	0.15
	Time of achieving max effect, days	15	30	30	30	30
Humolite	Reduction factor	2-3.2				
	Dose, g/day per head	300-500				
	Time of achieving max effect, days	10-11				
Prussian Blue	Reduction factor	5				
	Dose, g/day per head	10				
	Time of achieving max effect, days	5				
Boli (ferrocine)	Reduction factor	3-7				
	Dose, boli per head	2-3				
	Time of achieving max effect, days	10-20				

Table 2: Effectiveness of sorbents application [3,4,13]

3.8.1.3 Substitution of component of animal diets with other animal diets.

Mainly feed-stuffs such as grass in the summer period and maize silage or beet in the winter period may be substituted with concentrated feed or other feedstuffs which are less contaminated or uncontaminated.

Substitution of the animal diets may be in most cases concentrated feed (potatoes) and silage (processed beet) for the Polesie region, concentrated feed (roots) and silage (roots) for the Forest-Veld region and concentrated feed and silage for the Veld region.

Animal	Feedstuff	Intake rate ($kg\ d^{-1}$ fresh weight)					
		Winter			Summer		
		Polesie	Forest-Veld	Veld	Polesie	Forest-Veld	Veld
Lactating cow	grass	-	-	-	50	50	50
	concentrated feed	3	2.5	3	1	1	1
	cereals	1	1	1	0.5	0.5	0.5
	maize silage	16	20	23	-	-	-
	hay	1.0	1.5	1.5	-	-	-
	straw	5	4	4	-	-	-
	beet	19	12	6	-	-	-
Lactating sheep	green mass	-	-	-	7	7	7
	concentrated feed	-	-	-	0.3	0.3	0.3
	hay	0.4	0.4	0.4	-	-	-
	straw	1.0	1.0	1.0	-	-	-
	beet	1.0	1.0	1.0	-	-	-
Pig	cereals	1.6	0.5	0.7	2.0	0.5	1.0
	grass	-	1.3	1.2	2.5	1.3	1.2
	potatoes	4.7	-	-	-	2.7	1.8
	wheat bran	0.5	2.3	2.3	0.5	-	-
Hen, chicken	winter wheat	0.09	0.09	0.09	0.09	0.09	0.09

Table 3: Feeding diets I_k for animals: values for Radioecological Region Polesie, Forest-Veld, Veld conditions [6,14,15]

3.8.1.4 Effectiveness of amelioration

3.8.1.4.1 Liming

Liming is one of the main agricultural countermeasure which can be applied to acidic soils. Therefore liming can be effectively used for Polesie and for some soils of the Forest-Veld regions but is not applicable in the Veld region, where soils are not acid. The structure of soils with different degree of acidity is presented in Table 4 for the two regions Polesie and Forest-Veld.

	high acidity, %	middle acidity, %	low acidity, %	neutral, %	alkaline, %
Polesie	4,1	10	17.5	66	2.4
Forest-Veld	0.8	5.5	17	75	1.7

Table 4: Degree of acidity of ploughed soils: values for the radioecological Regions Polesie and Forest-Veld [9]

Table 5 shows data for the effectiveness of liming which results in the reduction of root uptake by crops for ^{137}Cs and ^{90}Sr [3-5]. It should be noted that these values are in a good agreement with other literature data [10, 11].

	Reduction in plant uptake	
Soil type	^{137}Cs	^{90}Sr
Mineral	1.5-4	1.5(1.0-3.2)
Organic	1-2	

Table 5: Effectiveness of liming on reducing the root uptake of crops for ^{137}Cs and ^{90}Sr [3-5,12]

3.8.1.4.2 Organic fertilisers

Application of organic fertilisers is most effective for soils with little contents of humus such as light soils of the Polesie region but are less effective for other regions. Table 6 presents the contents of humus for each region and the average application of organic fertilisers in t/ha for the perid after Chernobyl accident up to 1990.

Radioecological region	Contents of humus in soil, %	Amount of organic fertilisers applied in 1986-1990, t/ha
Polesie	0.7-2.0	12.7
Forest-Veld	1-6	9.7
Veld	1.5-6	6.6

Table 6: Contents of humus in soil and application of organic fertilisers for the radioecological Regions Polesie, Forest-Veld and Veld [9].

Table 7 shows data on the effectiveness of the application of the organic fertilisers to reduce the root uptake to crops for ^{137}Cs and ^{90}Sr [3-5].

Fertiliser	Dosage, t/ha	Reduction in plant uptake	
		^{137}Cs	^{90}Sr
Manure	50	2 (1.3-4)	
Sapropell	100	2-5	4.4

Table 7: Effectiveness of application of the organic fertilisers for ^{137}Cs and ^{90}Sr [3-5,10]

The effectiveness factor of manure for ^{137}Cs is in agreement with other literature data [11] where the reduction in the root uptake ranges from 1.2-2.5 with a dosage of manure of 60 t/ha.

3.8.1.4.3 Mineral fertilisers

Mineral fertilisers were used in Ukraine as agriculture countermeasure to reduce the uptake of radionuclides from soil to crops. In the present situation after the Chernobyl accident, it is necessary to apply higher dosage of mineral fertilisers to increase the yield and also if applied as countermeasure to decrease the transfer of radionuclides to crops. Data of NPK which was applied (average in the period 1986-1990 in kg/ha) are given in Table 8 for comparison of the fertilisation of soil in different regions.

	N, kg/ha	P, kg/ha	K, kg/ha	NPK, kg/ha
Polesie	75	47	77	199
Forest-Veld	71	42	35	148
Veld	57	37	20	114
in Ukraine	65	41	42	148

Table 8: Application of the mineral fertilisers for radioecological Region Polesie, Forest-Veld and Veld in 1986-1990 [9]

The application of mineral fertilisers as a countermeasure need a special ratio of N:P:K. The optimum N:P:K ratio of 1:1.5:2 was determined experimentally [3,4,5,12]. The data of the effectiveness factor for this ratio are presented in Table 9.

	^{137}Cs	^{90}Sr

Ploughing with turnover of upper layer	10		2-3	

3.8.2.2 Decontamination of habited areas

The reduction in individual dose from external irradiation and resuspension, achieved by decontamination, is determined by dose reduction factors in LCMT derived from the urban dose model EXPURT [16-18]. This approach requires data concerning the type of surface, buildings and the level of urbanisation within the urban environment. Those input data for Ukrainian conditions, based on the expert's judgement, are presented in the chapters describing the answer to the questionnaire send out in preparing this document.

4 Resource availability and costs of implementing countermeasures

In assessing the feasibility of implementing countermeasures within the terrestrial and urban environments, it is important to identify the resources that would be required and their availability in the area in which these countermeasures are required. It is also important to be able to estimate the cost associated with the various countermeasure options.

Within LCMT, default values for resources have been included based on experience in western Europe. Information is also passed to the ECONOMICS module to enable the costs to be estimated. The default costs used for resources, both equipment and manpower are also taken from current Western Europe data.

In the customisation of LCMT to Eastern European countries it is important, therefore, to identify where these default data may require changing. In addition, it is important to evaluate what resources are available as this would influence the feasibility of applying a particular countermeasure option within a country or region of a country.

The available information collected by the East European partners on resource availability and costs for both agricultural countermeasures and decontamination of urban areas are presented below. These were collected as part of a questionnaire, full details of which are given in Section 8.

4.1 Russia

4.1.1 Agricultural countermeasures

The costs of countermeasures estimated include expenses on the preparation of soils of the agricultural land for the implementation of works, purchase of the necessary materials (lime, fertilisers, seeds) and their transportation onto the sites of application, purchase of petrol, as well as combustible and lubricating materials; expenses on the equipment amortisation, salary of workers and overheads. The estimation of countermeasures costs is one of the criteria for the justification of their utility within Russia.

Within the last several years the costs of countermeasure application could be considered as relatively stable in ECU equivalent. All the necessary information has been collected and used for the estimation of effectiveness of countermeasures. Unfortunately, this situation was drastically changed after the economic crisis on 17th of August 1998. From winter-spring period of 1998 to the end of 1998 the exchange rate of ECU to RUR increased 3.5 - 4 times. Accordingly, the prices for western goods also have been increased in similar proportion. However, the increase of prices for locally produced goods for transportation was not so pronounced (up to two times). This allows the conclusion that at present the costs of all countermeasures application expressed in ECU are cheaper in comparison to the beginning of the last year. On the whole, this resulted in the need in new estimation of the costs of countermeasures application.

The exchange rate used for conversion from RUR to ECU in this report is 25 RUR per ECU.

Current costs and resource requirements are given in Tables 1 – 3 for the application of mineral fertilisers, lime and organic fertilisers, respectively.

For radical improvement, the local administrations of the contaminated regions accepted the decision to freeze the cost for application of countermeasures (in roubles) at a level close to that for 1998. Due to this, the cost of countermeasures application in roubles can be taken to be the same as before the economic crisis. However, expressed in ECU, these becomes much lower than previously indicated values. In addition, however, for some practices, variations in the cost of individual options were observed and the new breakdown of the costs are shown in Table 4.

Table 1: Application of mineral fertilisers

1. General description	Increased of P-K fertilisers are defined by standard rates and applied following a conventional technology	
2. Doses	The rate of application depends on the type of farm crop and availability in soil of mineral nutrients.	
3. Applicability		
a - soil group	all groups	
b – crops	all crops	
4. The necessary resources	Fertilisers	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Fertilisers	576	24
Application	96	4
Transportation	120	5
Indirect expenses	192	8
Total	984	41
6. Limitation	Increased doses of N fertilisers are not applied, since it results in the increased radionuclide accumulation in crops	
7. After-effect	A weak after-effect is observed at increased P-K doses	

Table 2: Application of lime

1. General description	Lime is applied in conventional crop cultivation technologies on acid soils every 4-5 years. In the contaminated areas increased doses are recommended	
2. Doses	The liming rate is calculated based on the data on soil hydrolytic acidity. In the contaminated areas the rates are increased 1,5-2,0 times	
3. Applicability		
a- soil group	sand, loam, peat	
b – crops	all crops, which do not require acid soil for cultivation	
4. The necessary resources	Lime or dolomite powder	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Lime	240	10
Application	132	5,5
Transportation	228	12
Indirect expenses	144	6
Total	744	31
6. Limitation	Is not applied on neutral and alkali soils, as well as under crops cultivated on acid soil (eg. Flax, potato, etc.)	
7. After-effect	The after-effect persists for 3-4 years. The effectiveness declines with time	

Table 3: Application of organic fertilisers

1. General description	Organic fertilisers are applied by conventional crop cultivation technologies, mainly under potato and tilled crops	
2. Doses	The application dose is calculated taking into account a crop under which are applied	
3. Applicability		
a - soil group	sand, loam, clay	
b – crops	all crops, which do not require acid soils for cultivation	
4. The necessary resources	Manure, peat	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Fertilisers	58	2,4
Application	288	12
Transportation	360	15
Indirect expenses	168	7
Total	874	36,4
6. Limitation	Are not applied on neutral and alkali soils, as well as under crops cultivated on acid soils (e.g. flax, potato, etc.)	
7. After-effect	The after-effect persists for 3-4 years. With time the effectiveness is reduced	

Table 4: Radical improvement

1. General description	Is applied in conventional technologies for improving pastures and haylands once every 4-5 years. The technology included the destruction of root mat by disking ploughing (standard or deep with the layer turnover), application of fertilisers, liming on acid soils, reseeding of grasses with a selection of special grass mixtures	
2. Doses	The dose of lime and mineral fertilisers depends on the meadow type and soil properties. In the contaminated areas doses of liming are increased 1,5-2,0 times, the recommended rates of organic fertilisers are N:P:K =1:1,5:2	
3. Applicability		
a – soil group	sand, loam, clay, peat	
b – crops	grasses	
4. The necessary resources	Lime or dolomite powder	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Transportation	228	12
Treatment of soil	144	6
Resources		
Lime	240	10
Fertilisers	480	20
Seeds	192	8
Application and re-seeds of grass	264	11
Indirect expenses	576	24
Total	2184	91
6. Limitation	Radical improvement is not implemented on floodplain annually flooded meadows, as well as in areas where there are intensive erosion processes	
7. After-effect	The after-effect is observed over 3-4 years. With time the effectiveness is reduced	

4.2 Ukraine

4.2.1 Decontamination

Table 5: Review of available equipment resources for decontamination techniques included in LCMT.

Resource	Likely Availability [1]
Ploughs and tractors	A
Skim and burial ploughs	D
Vacuum brushing street cleaners Roads Pavements	 B B
Hand sweepers	A
Fire-engines and hoses	B
Water jet cleaners	D
Road gulley cleaners	D
Lawnmowers (with collection) Large areas Small areas	 D D
Lawnmowers (without collection)	B
Leaf vacuum sweepers	D
Large trucks, graders, bulldozers, JCB etc	B
Rotovators	A
Chainsaws	A
Cherry pickers	B
Chippers Small (up to 150 mm wood diameter) Large	 B D
Road planers	B
Abrasive blasters	D
Chemicals - detergents, strippable coatings, gels, foams and paints	A
Turf cutters - large areas	**D**

Notes:

1. A should be available locally; B should be available regionally; C should be available nationally; D availability likely to be limited; E not available

4.3 Romania

4.3.1 Agricultural countermeasures

Regarding resources and costs, countermeasures such as mechanical and chemical treatment of land, indoor stabling for animals, stored feed for animals and facilities for processing milk and food were investigated. Information on decontamination techniques and their effectiveness is available in Romania. From the decontamination techniques implemented in LCMT, most, except soil removal and sand blasting of walls, are considered to be effective and available for use in Romania.

Table 6: Review of available equipment resources and costs for agricultural countermeasures included in LCMT

Resource	Availability			Cost, US$
	Local	Regional	National	
Ploughs	Good	good	good	medium
Deep ploughs	Good	good	good	high
Lime			good	low cost
NPK fertilisers			Good	low cost
Manure	Good	good		low cost
Prussian Blue			Poor	high
Indoor stabling for animals	Average	average	Average	low cost
Stored feed for animals	Average	average	Average	medium
Facilities for processing milk	Average	average	Average	medium
Facilities for processing food	Average	average	Good	medium

4.3.2 Decontamination

Table 7: Review of available equipment resources for decontamination techniques included in LCMT

Resource	*Likely Availability*[1]
Ploughs and tractors	A
Skim and burial ploughs	A
Vacuum brushing street cleaners	
Roads	B
Pavements	BPlHd busweepe

1. A should be available locally; B should be available regionally; C should be available nationally; D availability likely to be limited; E not available

4.4 Czech Republic

4.4.1 Agricultural countermeasures

The structure of the agricultural production in the Czech Republic has changed substantially since 1991 and large changes in all areas are expected. Unfortunately, the process of restructuring is not yet well defined. The main adverse features influencing agricultural production are likely to be:

unclear owners relations of agricultural land

high prices of chemical fertilisers

lack of natural fertilisers leading to a decrease in soil fertility

decreasing of sowing areas

dramatic decrease in the numbers of animals

Reliable data on costs, availability of proper equipment and labour resources needed for various countermeasure procedures is not fully available and only some particular numbers were found (sometimes being mutually in contradiction). Some information valid for the Czech Republic on the availability and costs of lime, NPK fertilisers, manure and Prussian Blue has been collected.

4.4.2 Decontamination

Local data on decontamination techniques for LCMT customisation are not available to a full extent in the Czech Republic. The following possible sources of the data were contacted:

Governmental Board on Emergency Planing

Ministry of Living Environment

Institute of Civil Protection of CR

Czech Army

The Governmental Board on Emergency Planing is responsible for emergency management in the zone of emergency planning (up to 15 km from NPP). Their main interest is on early countermeasure optimisation. The late countermeasures have lower priority and they are assumed to be applied ad hoc, according to the real situation.

The Ministry of Living Environment has its own database system ”HAVARIE” for emergency management of chemical incidents. Their priority is on management of early effects and application of late countermeasures is not at present considered. Some special decontamination techniques are included but no detailed information was provided.

The Institute of Civil Protection of CR, Czech Army are starting the process of harmonisation of emergency planing with NATO and EU procedures. At present, only old obsolete data form the period of the ”cold war” are available.

4.5 Hungary

4.5.1 Decontamination

The most important equipment resources have been reviewed, which may have major importance for the practical execution of the decontamination in Hungary. The source of the data are the Official Hungarian Statistical Handbooks dated from 1994 to 1997.

Table 8. Availability of equipment for decontamination and human transportation

Equipment	number of equipment in whole country
Street and road cleaners	150[1]
Hand sweepers	1000[2]
Fire-engines and hoses Water-jet fire engines	410 320
Water jet cleaners	n/a
Lawnmowers	n/a
Trucks Towings, Trailers	445 000 56 000 334 000
Waggons Railway engines, locomotives	54 000 1 800
Cargo-boats, motor barges river barge (without engine)	39 210
Buses	18 000
Chainsaws	n/a
Combine harvesters for cereals and other plantcrops	94 00
Tractors, Ploughs[1]	92 000 30 000[1]

Notes:

1. Estimated value

2. Estimated value for Budapest only

From these information and based on personal judgement, the availability of the decontamination techniques in Hungary are listed below in Table 9.

Table 9: Review of availability of resources for decontamination techniques included in LCMT

Resource	Likely availability
ploughs and tractors	A, B
skim and burial ploughs	E
vacuum brushing street cleaners roads and pavements	C
hand sweepers	A
fire-engines and hoses	C
water jet cleaners	C
road gulley cleaners	- [2]
Lawnmowers	A, B
leaf vacuum sweepers	- [2]
large trucks, graders, bulldozers	A, B
Rotovators	- [2]
Chainsaws	A, B
cherry pickers	B
Chippers	B,C
road planners	B
abrasive blasters	E
Chemicals	C
turf catters	D

Notes:

1. A should be available locally; B should be available regionally; C should be available nationally; D availability likely to be limited; E not available

2. Resouce could not been identified.

4.6 Poland

The national system (PNS) is an integral part of the state security and is responsible for life, health, property and natural environment rescuing. The system comprises organisational units of the SFS, which perform the activities imposed on them by the system. Other ministries involved in the PNS include National Defence (ND) , Transport and Marine Economy, Agriculture and Food Resources, Health and Social Welfare, and Foreign Affairs. These ministries are required by various statutes to provide support in case of occurrence of a major environmental hazard incident in their area of competence. With ND, the army and the civil defence play important roles in the PNS.

The Civil Defence Organisation may, during times of peace, assist in responding to environmental emergencies. The scope of this assistance includes: alerting of populations and emergency response authorities, in case of an environmental emergency; planning emergency response actions; participating in response actions.

Existing regulations on Civil Defence state that the alerting capabilities this organisation has available may be used in times of major disasters, such as can occur during an environmental emergency.

For the purpose of both immediate intervention action planning and long term countermeasures assessment two Excel type data base have been developed: EQUIPMENT_REGION, and EQUIPMENT_LOCAL At the moment the entries of EQUIPMENT_REGION consist of information on equipment available to SFS units in different provinces of Poland. It includes: light chemical rescue vehicles; oil separator; skimmer; neutralizing chemicals; oilbooms; gas-tight (hermetic) suits; water rescue units; reconnaissance vehicle; heavy recovery truck; heavy technical rescue vehicle; heavy chemical rescue vehicle; heavy mobile crane; light chemical and radiation vehicles; heavy ecological rescue vehicle; tanker for chemicals; hose truck; pump trailer; container truck chassis; mobile unit with water barriers/booms; mobile unit with medical equipment; rescue helicopter; water rescue container with pneumatic boat; high-rise rescue vehicles; bulldozer; excavator; wheel loader; thermo chamber; coach/bus; tipper truck; lighting equipment; mobile unit with radio and cable equipment; mobile unit for earth quake rescue; mobile unit to evacuate people/clothing; mobile unit for flood rescue.

The data base EQUIPMENT_REGION will be extended to include information of equipment of VFS and IFRS which can be used to mitigation of radiological accident consequences.

4.6.1 Agricultural countermeasures

The data base EQUIPMENT_LOCAL includes information on the agriculture equipment available at forms in different districts (part of provinces) of Poland. The information for the data base were acquired from the country-wide agriculture inventory, carried out in 1996. The data base will be updated any time new information on the agriculture inventory will be available at the Main Statistical Office in Warsaw.

Table 10: Usage, production and costs of fertilisers and sorbents

	Usage in Poland, 10^3 t	Production, 10^3 t	Cost, US$ kg^{-1}
NPK and nitrogen fertilisers	1510	-	0.4 – 0.8
Nitrogen fertilisers	850	1150	
Phosphorus fertilisers	300	250	
Potassium fertiliser	360	-	
Calcium fertilisers	2200	5300	
Manure	-	-	0.2 – 0.4
Prussian Blue			2.0 – 4.0

Qualitative assessment of the availability of equipment and materials that could be required for the various agriculture countermeasure options has been made.

The fire services (FS) in Poland have responsibility for combat fires and other hazards, and for environmental hazards. In this respect, the FS is required to cooperate with ministries and other bodies of state administration in the above mentioned matter.

The fire services in Poland can broken down as follows:

State Fire Service (SFS);

Voluntary Fire Service;

On-site Fire Services of a number of large chemical establishments.

Table 11: Availability of resources for agricultural countermeasures included in LCMT

Resource	Availability: good, average, poor						
Region	I	II	III	IV	V	VI	VII
Ploughs	good	good	good	good	good	good	good
Deep ploughs	average	poor	average	average	average	average	poor
Lime	good	good	good	good	good	good	good
NPK fertilisers	good	good	good	good	good	good	good
Manure	good	good	good	good	good	good	good
Prussian Blue	average	average	average	average	average	average	average
Indoor stabling for animals	good	good	good	good	good	good	good
Stored feed for animals, eg hay	good	good	good	good	good	good	good
Facilities for processing foods, eg milk	average	poor	average	average	average	average	poor
Facilities for storing food, eg milk products	average	poor	average	average	average	average	poor

The regulations on the division of competencies to individual authorities concerning mitigation, response and recovery of environmental emergencies are included in the Acts of the Minister of the Interior on State Fire Service (SFS), on Fire Control (also in th executive regulations to these acts), on State Environmental Protection Inspectorate and in the Decree of Council of Ministers on Civil Defence.

The head of SFS is responsible for the realisation of the actions in fire control and organisation of the national rescue-fire fighting system.

According to the Fire Control Service Act the organisation and performance of the rescue action during fire fighting and removal of local hazards are one of the basic tasks of the SFS. Moreover, this act states that the SFS is the organizer of the national rescue/fire fighting system.

4.6.2 Decontamination

The Army has resources and systems in-place to assist the SFS in fire-fighting and rescue operations. In practice, agreements must be made with individual units in each province, to secure the Army's co-operation.

A number of fire fighting and rescue units are incorporated into industrial facilities. These Industrial Fire and Rescue Services (IFRS) vary in staff size and specialised equipment depending on the size of the facility.

Current fire fighting and rescue equipment and plans for its enhancement was evaluated. -future plans include establishing 14 bases through the country, which will each contain specialised rescue equipment. It should be noted, that in the case of lengthy, very difficult or large scale response actions, the SFS can mobilise additional equipment available from other government and economic entities.

A list of the available equipment is given above.

4.7 Slovak Republic

4.7.1 Agricultural countermeasures

Table 12: Resource availability for agricultural countermeasures included in LCMT

Resource	Availability: good, average, poor			Cost, Sk m^{-2}
	Local	Regional	National	
Ploughs	Good	Good	Good	0,5 Sk/m^2
Deep ploughs	Good	Good	Good	0,5 Sk/m^2
Lime	Average	Average	Average	
NPK fertilisers	Average	Average	Average	
Manure	Good	Good	Good	
Prussian Blue	Poor	Poor	Poor	
Indoor stabling for animals	Good	Good	Good	
Stored feed for animals, eg hay			Good	
Facilities for processing foods, eg milk			Good	
Facilities for storing food, eg milk products			Average	

4.7.2 Decontamination

Table 13: Availability of resources for decontamination techniques included in LCMT

Resource	Likely Availability [1]
Ploughs and tractors	A
Skim and burial ploughs	A
Vacuum brushing street cleaners Roads Pavements	D
Hand sweepers	A
Fire-engines and hoses	A
Water jet cleaners	B

Road gulley cleaners	B
Lawnmowers (with collection) large areas small areas	B
Lawnmowers (without collection)	A
Leaf vacuum sweepers	D,E
Large trucks, graders, bulldozers, JCB etc	B
Rotovators	B
Chainsaws	B
Cherry pickers	E
Chippers small (up to 150 mm wood diameter) large	A,B C
Road planers	B
Abrasive blasters	D
Chemicals – detergents, strippable coatings, gels, foams and paints	A
Turf cutters - large areas	B

Notes:

1. A should be available locally; B should be available regionally; C should be available nationally; D availability likely to be limited; E not available

5 References

5.1 References for the contribution from Romania

1. Brown, C. Tournette (1997), Databases associated with the late countermeasures module (lcmt:frodo), version 3. RODOS (WG3)-TN(97)-04 (draft).
2. Dinu et al (1972), GUIDEBOOK FOR ANIMAL FARMING, (in Romanian). Ed. Ceres, Bucuresti, Romania.
3. Draganescu (1984), Ecological animal farming, (in Romanian). Ed. Ceres, Bucuresti, Romania.
4. Nair (1984), Models for the Evaluation of Ingestion Doses from the Consumption of Terrestrial Foods Following an Atmospheric Radioactive Release, RD/B/5200/N84, April.
5. Voigt et al (1990), Experimentelle Verifizierung dynamischer Radioecologiemodelle in der Folge von Tschernobyl, Neuherberger, August.
6. *** (1989), Special Issues on Radionuclide transfer to animal products. The Science of Total Environment, Vol 85, September.
7. *** (1990), Radiation Protection: Proceedings of the Seminar on Methods and Codes for Assessing.
8. ***(1996), Romanian statistical YearBook, National Commission for Statistics.

5.2 References for the contribution from Russia

5.2.1 References for chapter on model tests

1. Joint Study project no. 1: Real-time on-line decision support systems (RODOS) for off-site emergency management following a nuclear accident, EUR16533 EN, 1996.
2. NRPB-M709: Compilation of Data from the Ukraine, Russia and Belarus on the Effectiveness of Agricultural Countermeasures for Strontium-90, Brown *et al*., 1996.
3. NRPB-M518: Compilation of Data from the Ukraine, Russia and Belarus on the Effectiveness of Agricultural Countermeasures for Use in the RODOS System, Brown *et al*., 1994.
4. NRPB-M597: Comparison of Data from the Ukraine, Russia and Belarus on the Effectiveness of Agricultural Countermeasures, Brown *et al*., 1995.
5. Databases associated with the late countermeasures module (LCMT:FRODO):Version3, Draft, J Brown and C Tournette, RODOS(WG3)-TN(97)04, 1997
6. S.V. Fesenko, S.I. Spiridonov, B.I. Yatsalo, O.A., Mirzeabassov, N.I. Sanzharova, V.K. Kuznetsov, Adaptation of FDMT model for the conditions of the Smolenskaya NPP radioecological region, RIARAE, Russia, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999
7. S.V. Fesenko, S.I. Spiridonov, N.I. Sanzharova Modification of FDMT model for the conditions of CIS countries and performance of validation studies with the adapted model**.** RIARAE, Russia, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999

5.2.2 References for chapter on data base modification

1. Korneev N.A., Malysheva M.R. Role of basal part in strontium uptake by perennial grasses. Symposium «Theoretical and practical aspects of low dose of radiation», Moscow, 1973, p. 123
2. Fesenko S.V., Spiridonov S.I., Sanzharova N.I., Alexakhin R.M. Change of biological availability of ^{137}Cs in meadow ecosystems after the Chernobyl NPP accident. Doklady Akademii Nauk, 1996, v. 347, N 6, p. 847-849
3. Firsakova S.K., Grebenschikova N.V. ^{90}Sr è ^{137}Cs uptake by meadow plants from root mat. Doklady VASHNIL, 1980, N 3, p. 19-20
4. Firsakova S.K., Korneev N.A., Yudinzeva E.V., Panteleev L.I. Prediction of ^{90}Sr and ^{137}Cs transfer to meadow grasses from mat. Agrochimiaya, 1983, N 3, p. 103-107

5.3 References for the contribution from Ukraine

1. S.T.Belyaev, V.F.Demin, V.A.Kutkov, V.G.Bariakhtar, E.P.Petriaev Characteristics of the Development of the Radiological Situation Resulting from the Accident, Intervention Levels and Countermeasures. Proc. of the first international conference. Minsk, Belarus, 1996.
2. „The temporal permitted levels of contents of $^{137,134}Cs$ and ^{90}Sr in foodstuffs and drinking water“, Moscow, 1991.
3. J.Brown, B.T.Wilkins, S.M.Haywood, A.Nighingale, B.Prister, L.Perepelatnikova, Yu Ivanov, G.Perepelatnikov, P.Bondar and S.Lyaschenko. Compilation of data from the Ukraine, Russia and Belarus on the effectiveness of agricultural countermeasures for use in the RODOS System, NRPB-M518, Chilton, 1994.
4. J.Brown , Y.Ivanov, L.Perepelatnikova, B.Prister, S.Fesenko, N.Sanzharova, S.Spiridonov, R.Alexakhin, C.Bouzdalkin and S.Firsakova. Comparison of data from the Ukraine, Russia and Belarus on the effectiveness of agricultural countermeasures, NRPB-M597, Chilton, 1995.
5. J.Brown, B.T.Wilkins, S.Fesenko, N.Sanzharova, L.Perepelatnikova, G.Perepelatnikov, C.Bouzdalkin. Compilation of data from the Ukraine, Russia and Belarus on the effectiveness of agricultural countermeasures for strontium - 90. NRPB-M709, Chilton 1996.
6. Bogdanov G.A. Feeding agricultural animals, Kiev, 1990
7. Permitted levels of content of radionuclides ^{137}Cs and ^{90}Sr in food and drinking water. State hygienic standards. Kiev, 1997.
8. Prister B.S., Loschilov N.A., Nemec O.F. , Pojarkov B.A. The Fundamentals of agriculture Radiology.- Kiev, Urozhaj,1988.
9. Reference book af agrochemical and agroecological state of soils of Ukraine. Ed. Nosko B.S., Prister B.S., Loboda M.V., 1994
10. G.Frank, P.Jacob, G.Proel at all Optimal management routes for the restoration of territories contaminated during and after the Chernobyl accident. EC Nuclear science and technology. Final report, 1997
11. S.Firsakova, K.Hove, A.Alexakhin, B.Prister, N.Arkhipov, G.Bogdanov Countermeasures implemented in intensive agriculture. Proc. of the first international conference. Minsk, Belarus, 1996.

12. Prister B.S., Perepelyatnikova L.V., Kalinenko L.V., Ivanova T.N., Medjak R.V. The approaches to planning of application of the agricultural countermeasures on the territory of, contaminated by radionuclides Problems of agricultural radiology. Proc. of UIAR. Ed. Prister B.S. Kiev, 1996

13. G.A.Bogdanov, V.A.Pronevich, S. Syaskiy, B.S.Prister, N.M.Lazarev, A.S.Sobolev, L.M.Romanov Radioecological aspects of radiosorbents application and their place in the system of countermeasures on the contaminated territory of Ukraine. Proc. of the first international conference. Minsk, Belarus, 1996.

14. Detailed standards of feeding agriculture animals: Reference book (Eds) Nozdrin B., 1991

15. Tomme M.F. (Ed.) Typical diets for cattle, pigs and sheep in zones of country. Moscow, 1971

16. J Brown, P Mansfild, J Smith Modelling approach in the terrestrial late countermeasures module, LCMT within RODOS v3.1

17. J Brown, C Tournette Databases associated with the Terrestrial Late Countermeasures Module (LCMT) within RODOS version 3.1, RODOS(WG3)-TN(98)

18. J Brown, J R Cooper, J A Jones at al Review of Decontamination and Clean-up Techniques for Use in the UK following Accidental Releases of Radioactivity to the Environment. NRPB-R288 1996

6 Appendixes

6.1 Data from Russia

Application of mineral fertilisers

1. General description	Increased of P-K fertilizers are defined by standard rates and applied following a conventional technology	
2. Doses	The rate of application depends on the type of farm crop and availability in soil of mineral nutrients.	
3. Applicability		
a - soil group	all groups	
b - crops	all crops	
4. The necessary resources	Fertilisers	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Fertilisers	576	24
Application	96	4
Transportation	120	5
Indirect expenses	192	8
Total	984	41
6. Limitation	Increased doses of N fertilizers are not applied, since it results in the increased radionuclide accumulation in crops	
7. After-effect	A weak after-effect is observed at increased P-K doses	
8. Special remarks		

Application of lime

1. General description	Lime is applied in conventional crop cultivation technologies on acid soils every 4-5 years. In the contaminated areas increased doses are recommended	
2. Doses	The liming rate is calculated based on the data on soil hydrolytic acidity. In the contaminated areas the rates are increased 1,5-2,0 times	
3. Applicability		
a - soil group	sand, loam, peat	
b - crops	all crops, which do not require acid soil for cultivation	
4. The necessary resources	Lime or dolomite powder	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Lime	240	10
Application	132	5,5
Transportation	228	12
Indirect expenses	144	6
Total	744	31
6. Limitation	Is not applied on neutral and alkali soils, as well as under crops cultivated on acid soil (eg. flax, potato, etc.)	
7. After-effect	The after-effect persists for 3-4 years. The effectiveness declines with time	
8. Special remarks		

Application of organic fertilizers

1. General description	Organic fertilisers are applied by conventional crop cultivation technologies, mainly under potato and tilled crops	
2. Doses	The application dose is calculated taking into account a crop under which are applied	
3. Applicability		
a - soil group	sand, loam, clay	
b - crops	all crops, which do not require acid soils for cultivation	
4. The necessary resources	Manure, peat	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Fertilisers	**58**	2,4
Application	**288**	12
Transportation	**360**	15
Indirect expenses	**168**	7
Total	**874**	36,4
6. Limitation	Are not applied on neutral and alkali soils, as well as under crops cultivated on acid soils (e.g. flax, potato, etc.)	
7. After-effect	The after-effect persists for 3-4 years. With time the effectiveness is reduced	
8. Special remarks		

Radical improvement

1. General description	Is applied in conventional technologies for improving pastures and haylands once every 4-5 years. The technology included the destruction of root mat by disking ploughing (standard or deep with the layer turnover), application of fertilisers, liming on acid soils, reseeding of grasses with a selection of special grass mixtures	
2. Doses	The dose of lime and mineral fertilisers depends on the meadow type and soil properties. In the contaminated areas doses of liming are increased 1,5-2,0 times, the recommended rates of organic fertilisers are N:P:K =1:1,5:2	
3. Applicability		
a - soil group	sand, loam, clay, peat	
b - crops	grasses	
4. The necessary resources	Lime or dolomite powder	
5. Cost	RUB/ha (February, 1999)	ECU/ha (February, 1999)
Transportation	228	12
Treatment of soil	144	6
Resources		
Lime	240	10
Fertilisers	480	20
Seeds	192	8
Application and re-seeds of grass	264	11
Indirect expenses	576	24
Total	2184	91
6. Limitation	Radical improvement is not implemented on floodplain annually flooded meadows, as well as in areas where there are intensive erosion processes	
7. After-effect	The after-effect is observed over 3-4 years. With time the effectiveness is reduced	
8. Special remarks		

6.2 Data for Rumania

Resource	Availability			Cost
	Local	Regional	National	
Ploughs	good	good	good	medium
Deep ploughs	good	good	good	high
Lime			good	low cost
NPK fertilisers			good	low cost
Manure	good	good	good	low cost
Prussian Blue			poor	high
Indoor stabling for animals	average	average	average	low cost
Stored feed for animals	average	average	average	medium
Facilities for processing milk	average	average	average	medium
Facilities for processing food	average	average	good	medium

Table 1: Resources and costs

Resource	Likely Availability
Ploughs and tractors	A
Skim and burial ploughs	A
Vacuum brushing street cleaners Roads Pavements	 B B
Hand sweepers	A
Fire-engine and hoses	A
Water jet cleaners	A
Road gulley cleaners	D
Lawnmowers (with collection) large areas small areas	 D D
Lawnmowers (without collection)	D
Leaf vacuum sweepers	E
Large trucks, graders, bulldozers, JCB, etc.	A
Rotovators	A
Chainsaws	A
Cherry pickers	D

Table 2: Resources and their likely availability

Resource	Likely Availability
Chippers small (up to 150 mm wood diameter) large	 D D
Road planners	A
Abrasive blasters	A
Chemicals – detergents, strippable coatings, gels, foams and paints	A
Turf cutters – large areas	E

Table 2 (continued): Resources and their likely availability

Note: A=should be available locally; B=should be available regionally;
C=should be available nationally; D=availability likely to be limited;
E not available

Technique	Likely to be used	Unlikely to be used	Reasons
Skim and burial ploughs	X		
Shrub and plant removal	X		
Grass cutting	X		
Road planing	X		
Ploughing soil and grass areas	X		
Soil removal		X	Expenses+storage difficulties
Double digging soil and grass areas	X		
Rotovating soil and grass areas	X		
Fire hosing paved areas	X		
Vacuum sweeping paved areas	X		
Sand blasting walls		X	Equipment not available
Vacuuming indoor surfaces	X		

Table 3: Effectiveness of decontamination techniques

Soil type	Soil characteristics	
Chernozem	pH	7-8.3
	Organic matter or C content (%)	3-6%
	Soil texture	loam<35%, sand <15%
	Cation Exchange Capacity ($cmol_c kg^{-1}$)	23-38
	Base saturation (%)	92-100
	Exchangeable K ($cmol_c kg^{-1}$)	0.57-0.68
	Exchangeable Ca ($cmol_c kg^{-1}$)	22.8-30.1
Luvisol	pH	4.5-6.7
	Organic matter or C content (%)	2-4%
	Soil texture	18%<loam<35%, sand>15%or loam<18%, 15%<sand<65%
	Cation Exchange Capacity ($cmol_c kg^{-1}$)	10-50
	Base saturation (%)	20(50)-90
	Exchangeable K ($cmol_c kg^{-1}$)	0.34-0.52
	Exchangeable Ca ($cmol_c kg^{-1}$)	2.4-17.3
Cambisol	pH	3.5-7.7
	Organic matter or C content (%)	2.5-30%
	Soil texture	35%<loam<60%
	Cation Exchange Capacity ($cmol_c kg^{-1}$)	2-50
	Base saturation (%)	4 - 90
	Exchangeable K ($cmol_c kg^{-1}$)	0.05-0.72
	Exchangeable Ca ($cmol_c kg^{-1}$)	1.1-28.2

Table 4: Soil characteristics for 3 major types of soils

Radioecological region	Soil type	Fraction (approx.)
330	Chernozem Luvisol	50% 30%
331	Chernozem Luvisol	5% 80%
332	Luvisol Cambisol	5% 80%

Table 5: Fraction of major soil types for Romanian radioecological regions

Product Yield of product per year

6.3 Data for Ukraine

1. Decontamination

To assess the applicability of the decontamination database to conditions of Ukraine the needed for decontamination modelling in RODOS information was compiled. In the Tables 1-8 the information concerning the part of decontamination is given: category and building type, estimation of different part of surface, time spent outdoors and in each building type, review of the available techniques and equipment resources. The data are based on the expert's judgement.

Category of habitation	Description of category
A	cities (with densely built up areas and multi-storey buildings)
B	towns (areas of habitation where the density and size of buildings is less)
C	villages (which are typical of rural communities)

Table 1: Description of category of habitation.

Building Type for category A	Description of type, size and basic construction materials used for walls and roofs
multi-storey buildings (type 1)	based material - concrete, breeze blocks
multi-storey buildings (type 2)	based material - brick
five storey buildings (type 3)	based material - brick
one-two storey buildings (type 4)	based material - brick

Table 2: Description of building type for category A.

Building Type for category B	Description of type, size and basic construction materials used for walls and roofs
multi-storey buildings (type 1)	based material - concrete, breeze blocks
multi-storey buildings (type 2)	based material - brick
five storey buildings (type 3)	based material - brick
one-two storey buildings (type 4)	based material - brick

Table 3: Description of building type for category B.

Building Type for category C	Description of type, size and basic construction materials used for walls and roofs
one-two storey buildings (type 1)	medium country houses built of brick
one storey buildings (type 2)	small country houses built of wood

Table 4: Description of building type for category C.

	Inhabited area A	Inhabited area B	Inhabited area C
% Area covered by all buildings	35	20	10
% Area of permeable surfaces	40	60	80
% Area of impermeable surfaces	25	20	10
% of each building type	type 1 - High shielding, multi-storey building (concrete) - 35% type 2 - High shielding, multi-storey building (brick) - 35% type 3 - Medium shielding, five-storey building - 5% type 4 - Low shielding, one-storey building - 25%	type 1 - High shielding, multi-storey building (concrete) - 5% type 2 - High shielding, multi-storey building (brick) - 15% type 3 - Medium shielding, five-storey building - 20% type 4 - Low shielding, one-storey building - 60%	type 1 - Medium and low shielding, medium country houses built of brick - 80% type 2 - Low shielding, small country houses built of wood - 20%
% Population	22	15	63
Number of trees within 10 metres: 0, <10 or >10	<10	>10	>10

Table 5: Description of general inhabited area.

Percentage of population	Building type 1	Building type 2	Building type 3	Building type 4	Building type 5	Outdoors
Category A						
	30	30	5	20	-	15
Category B						
	5	10	15	50		20
Category C						
	52	13				35

Table 6: Time spent outdoors and in each building type.

Technique	Likely to be used	Unlikely to be used	Reasons
'SKIM AND BURIAL PLOUGH'	∨		
'SHRUB AND PLANT REMOVAL'	∨		
'GRASS CUTTING'	∨		
'ROAD PLANING'	∨		
'PLOUGHING SOIL AND GRASS AREAS'	∨		
'SOIL REMOVAL'	∨		
'DOUBLE DIGGING SOIL AND GRASS AREAS'	∨		
'ROTOVATING SOIL AND GRASS AREAS'	∨		
'FIRE HOSING PAVED AREAS'	∨		
'VACUUM SWEEPING PAVED AREAS'	∨		
'SAND BLASTING WALLS'	∨		
'VACUUMING INDOOR SURFACES'	∨		

Table 7: Effectiveness of decontamination techniques

Resource	Likely Availability [1]
Ploughs and tractors	A
Skim and burial ploughs	D
Vacuum brushing street cleaners roads pavements	 B B
Hand sweepers	A
Fire-engines and hoses	B
Water jet cleaners	D
Road gulley cleaners	D
Lawnmowers (with collection) large areas small areas	 D D
Lawnmowers (without collection)	B
Leaf vacuum sweepers	D
Large trucks, graders, bulldozers, JCB etc	B
Rotovators	A
Chainsaws	A
Cherry pickers	B
Chippers small (up to 150 mm wood diameter) large	 B D
Road planers	B
Abrasive blasters	D
Chemicals - detergents, strippable coatings, gels, foams and paints	A
Turf cutters - large areas	D

Table 8: Review of available equipment resources.

Notes:

A Should be available locally B Should be available regionally

C Should be available nationally D Availability likely to be limited
E Not available in the country

2. Agricultural countermeasure

The classification of soils for each radioecological region is presented in Tables 9-13.

Region 1	***Polesie*** 8 745 800 ha, 14% of Ukraine		
	soddy-podzolic (sandy, sandy loam)	soddy-meadow (light loam)	peat
	60 %	20 %	10%
pH (H2O)	6 - 6,9		
pH (KCl)	5,5 -6,5	5,6 - 7,3	
Humus, %	0,56 - 1,48	5,8	34
Clay content, % (particle size < 0.01 mm)	10 - 20	20 - 30	
Cation exchange capacity, mg-eq. per 100 g soil	2,5 - 7,1	16 - 24	
Extractable P, mg per 100 g of soil	42 -52	50	
Extractable K, mg per 100 g of soil	3 - 10		
Bulk density, g per sm3	2,6	2,6	1,9
Volume density, g per sm3	1,4	1,5	0,13

Table 9: Soil classification for Polesie radioecological region

Region 2	***Forest-Veld*** 25 152 000 ha, 41,7 % of Ukraine			
	Chernozem typical (heavy loam)	Chernozem meadow (heavy loam and light clay)	Podzolic (middle and heavy loam)	Salt-marsh (light loam)
	51%	19%	25%	5%
pH (H2O)	6,7 - 7,4	7,7 - 9,5	5,1 - 7,2	6,5 - 10,5
pH (KCl)		5,2 - 6,2	4,5 - 6,3	6,7
Humus, %	4,2 - 5,6	2,8 - 5,8	2 - 7,3	2,4 - 7,7
Clay content, % (particle size < 0.01 mm)	42 - 52,5	23,9 - 71,1	23,4 - 53	16,4 - 35,7
Cation exchange capacity, mg-eq. per 100 g soil	22,1 - 36,3		16,5 - 31,5	
Extractable P, mg per 100 g of soil	66 - 100		60 - 94	306
Extractable K, mg per 100 g of soil	17,5 - 18,6		13 - 15,3	78,7
Bulk density, g per sm3	2,55 - 2,62		2,6 - 2,7	
Volume density, g per sm3	1,13 - 1,24		1,1 - 1,4	

Table 10: Soil classification for Forest-Veld radioecological region

Region 3	Veld 25 000 000 ha, 40% of Ukraine	
	Chernozem (light clay)	Glay-soddy (light and middle clay)
	65%	
pH (H2O)	6,9 - 7,7	5,7 - 6,4
pH (KCl)	5,0 - 6,2	4,9 - 5
Humus, %	3,3 - 6,1	3,5 - 5,2
Clay content, % (particle size < 0.01 mm)	44,9 - 62,8	55,9 - 77,7
Cation exchange capacity, mg-eq. per 100 g soil	21.3 - 52	11,6 - 32,8
Extractable P, mg per 100 g of soil	72,2 - 107,5	110,6
Extractable K, mg per 100 g of soil		
Bulk density, g per sm3	2,4 - 2,7	2,7
Volume density, g per sm3	1 - 1,2	1.1

Table 11: Soil classification for Veld radioecological region

Region 4	***Karpati region***
	Burozem (middle and heavy loam)
pH (H2O)	4,1 - 5,1
pH (KCl)	3,75
Humus, %	5,7 - 11,3
Clay content, % (particle size < 0.01 mm)	27,8 - 47,2
Cation exchange capacity, mg-eq. per 100 g soil	3,5 - 12,8
Extractable P, mg per 100 g of soil	58,7 - 272
Extractable K, mg per 100 g of soil	
Bulk density, g per sm3	
Volume density, g per sm3	

Table 12: Soil classification for Karpati radioecological region

Region 4	***Mountain Crimea***
	Chernozem typical, burozem (light and middle clay)
pH (H2O)	5,6 - 7,4
pH (KCl)	
Humus, %	3,6 - 14
Clay content, % (particle size < 0.01 mm)	44,8 - 68,8
Cation exchange capacity, mg-eq. per 100 g soil	21 - 41,5
Extractable P, mg per 100 g of soil	
Extractable K, mg per 100 g of soil	
Bulk density, g per sm3	2,6
Volume density, g per sm3	1,1

Table 13: Soil classification for Mountain Crimea radioecological region

7 LCMT Questionnaire

A questionnaire was compiled by the developers of LCMT to help focus the collection of information for East European and Former Soviet Union countries on the key areas where the countermeasures data within LCMT may be different to those in the countries of concern. Questions were asked in such a way that the information provided would also help in the provision of guidance on the use of the LCM module and its associated database for different situations. The contents of the questionnaire are given in Section 7.1.

7.1 Questionnaire Content

7.1.1 Agricultural countermeasures

Soils

One of the key aspects of this work is for you to consider the applicability of the effectiveness factors for agricultural countermeasures that have been compiled for use in RODOS for your selected radioecological regions.

For each major soil category in each radioecological regions

Soil characteristics	
Mechanical composition: sand, light / middle loam clay / heavy loam organic / peat	
pH (KCL)	
pH (H_2O)	
cation exchange capacity	
clay content, % (particle size ,0.01 mm)	
humus or organic matter	
bulk density, g cm^{-3}	
extractable K, cmol kg^{-1}	
extractable P, cmol kg^{-1}	

For each radioecological region, the fraction of each soil type:

Soil type	Fraction

Resources and costs

The effectiveness of a countermeasure in reducing the activity concentrations in foods is only one aspect to assessing the feasibility of a countermeasure option. Other factors include the costs and availability of any materials and equipment needed, labour resources and the disposal of any waste eg. soil or food produced. These types of data should be compiled if the overall applicability of countermeasure options to a particular radioecological region is to be assessed. The Table below gives some of the main resource requirements that could be expected - there are others, many of which can probably only be assessed at the time of implementation.

For each radioecological region

Types of equipment and materials that could be required for the various countermeasure options

Resource	Availability: good, average, poor			Cost, US$ [1,2]
	Local	Regional	National	
Ploughs				
Deep ploughs				
Lime				
NPK fertilisers				
Manure				
Prussian Blue				
Indoor stabling for animals				
Stored feed for animals, eg hay				
Facilities for processing foods, eg milk				
Facilities for storing food, eg milk products				

Notes:

The costs do not have to be exact; you just need an indication of the costs and, in particularly, the relative costs of the above, so they can be ranked in terms of which are the most expensive.

These costs should include some average cost for transportation.

Animal diets

NRPB plan to provide advice on the use of the agricultural countermeasures database and its applicability is what animal feeds are likely to be contaminated at different times of the year and their relative importance. This also depends on the importance of the feedstuffs in the diet of the animal. Please provide a summary of the default animal diets (composition and quantities) that you have compiled for use in FDMT.

7.1.2 Decontamination

Decontamination modelling in RODOS uses reductions in dose, from external exposure to material deposited on the ground and inhalation of resuspended material, that are based on a general inhabited area. This area is defined in terms of the fraction of land covered by buildings, permeable surfaces such as soil and grass and impermeable surfaces such as roads and paved areas. Three different building types are included. A brief description of the area is given below.

Land covered by buildings: 40%

Land covered by permeable surfaces: 40%

Land covered by impermeable surfaces: 20%

Building types: Low shielding, small two storey detached, 5%

Medium shielding, two storey semi-detached, 70%

High shielding, multi-storey building, 25%

Population living in this area: 100%

Time spent at each location:

Low shielding	Medium shielding	High shielding	Outdoors
7%	47%	34%	12%

This is an average across 3 population groups with different behaviours: outdoor workers, indoor workers and school children, people living at home, eg old people, pre-school children, housewives.

Typical building materials: for example, for semi-detached buildings:

External walls plaster 15 mm, breeze block 100 mm, air 50 mm, brick 112 mm.

Load baring walls brick 220 mm.

Partition walls concrete 100 mm.

Roof tiles 24 mm.

To assess the applicability of the decontamination database to your country information is needed on the different types of areas where people live and the building types within these areas. The information you compile, in addition to the general advice that NRPB provides, should enable you to assess the applicability of the default RODOS database to your country. Therefore, please answer the following questions as fully as possible.

1. Can you divide the inhabited areas in your country into categories? Typical categories are cities (which include densely built up areas and multi-storey buildings), towns (large areas of habitation outside cities where the density and size of buildings is less) and villages (which are typical of rural communities)? We suggest that you don't try and have more than 3 categories. For each category, can you identify the main types of building, for example, do most people live in multi-storey buildings or do they live in small country houses built of wood? Again, we would suggest a maximum of 5 categories chosen based on size and construction materials, both of which influence the shielding offered from gamma-emitting material outside.

Category of habitation	Description of category
A	
B	
C	

Building Type	Description of type, size and basic construction materials used for walls and roofs

2. Can you estimate the following for each category identified in (1.):

percentage of land covered by buildings, impermeable surfaces (eg pavements, roads) and permeable surfaces (eg soil, grass).

the fraction of different broad categories of building types (detached, single-storey) in each category?

the percentage of the population resident in each category

the abundance of trees in each category, eg high, medium or low.

	Inhabited area A	Inhabited area B	Inhabited area C
% Area covered by all buildings			
% Area of permeable surfaces			
% Area of impermeable surfaces			
% of each building type			
% Population			
Number of trees within 10 metres: 0, <10 or >10			

3. Can you estimate the amount of time spent outdoors (and if possible in each building type) by individuals in each of the categories of habitation? If you can break this down into different population groups this information can be useful, but an average for each inhabited area category is sufficient.

Percentage of population	Building type 1	Building type 2	Building type 3	Building type 4	Building type 4	Outdoors
Category A						
Category B						
Category C						

Effectiveness of decontamination techniques

A list of decontamination techniques currently included in the default RODOS database is given below. The applicability of these techniques is based on data from the UK (which are also broadly applicable to other western European countries) but not in East European or NIS countries. Can you make some comment as to the feasibility of carrying out these techniques in your country? For example some techniques may be unsuitable because they require specialised machinery, a lot of man power or are simply too expensive. To aid this task, an additional table is provided in which you can estimate the availability of equipment on a local, regional and national scale.

Please feel free to add any additional techniques to the list that you are aware could or have been used in your country. If you can include estimates of resource requirements and waste generated, this would enable the database of information to be expanded. Resources can be expressed in terms of the number of man days and equipment days required to decontaminate unit area, and waste generation in terms of kg of material per unit area.

Technique	Likely to be used	Unlikely to be used	Reasons
SKIM AND BURIAL PLOUGH			
SHRUB AND PLANT REMOVAL			
GRASS CUTTING			

ROAD PLANING			
PLOUGHING SOIL AND GRASS AREAS			
SOIL REMOVAL			
DOUBLE DIGGING SOIL AND GRASS AREAS			
ROTOVATING SOIL AND GRASS AREAS			
FIRE HOSING PAVED AREAS			
VACUUM SWEEPING PAVED AREAS			
SAND BLASTING WALLS			
VACUUMING INDOOR SURFACES			

Review of available equipment resources - a description of the equipment given below can be found in NRPB-R288.

Resource	Likely Availability [1]
Ploughs and tractors	
Skim and burial ploughs	
Vacuum brushing street cleaners roads pavements	
Hand sweepers	
Fire-engines and hoses	
Water jet cleaners	
Road gulley cleaners	
Lawnmowers (with collection) large areas small areas	
Lawnmowers (without collection)	
Leaf vacuum sweepers	

on the actual data collected on selected soil pits recently and it represents -0.30cumentati

	peaty-gleyed				

The table was delivered to CUA and was used such one of the selection tool during the expertise judgement. The main criterion resulting from the RODOS FCM requirements was established on the basis of characterisation of texture:

Clay .... particle size : < 0.001 mm

Loam .... particle size : 0.001 mm – 0.5 mm

Sand .... particle size : 0.05 mm – 2 mm

As a result of the expertise study was reduction of the soil types into 6 categories:

p1 .... sandy; p2 .... loamy sand; p3 .... loam; p4 .... loamy clay; p5 .... clay; p6 .... peat

The classification is more detailed then RODOS requirements, because it is assumed to be used also for other research activities. For RODOS purposes the further reduction is done:

sand .... p1 + p2; loam .... p3; clay .... p4 + p5; peat p6

The data for RODOS purposes has been delivered in two special formats:

A. Vector layers : For each category p1, p2, ... , p6 the corresponding sets of polygons covering the whole territory of the Czech Republic are available. A new p7 category has been added (other : built-up areas, water, ...). The MATLAB tool has been developed for the purposes of partial visualisation (for example see fig. 5 of [3] where complicated polygons of the p1 soil type – sandy – are demonstrated).

B. Intermediate gridded file: A special attention has been devoted to the construction of gridded environmental data necessary for the radio-ecological and countermeasure calculations within RODOS. Data on population surface density according to particular age categories, agricultural production, number of animals, soil types and other items has been extracted from various primary databases into the intermediate gridded file. It consists of 82 138 records, each record stands for tile 1 x 1 km and comprises many items characterising various properties on the tile (co-ordinates of the tile centre in JTSK system of co-ordinates, maximum altitude, identification of radioecological region, district number, average population according to age categories, surface and soil type characteristics, agricultural production data on the tile etc.). The grid continuously covers the whole surface of the Czech Republic and after its final transformation to geographical co-ordinates it should be continuously linked to neighbouring countries. The intermediate file serves partly for automatic generation of a new data item (correlation with the existing entities in IGF expressed by selection rules), partly for the final transformation to the required RODOS format and finally will facilitate the data transition to European database.

The structure of the intermediate gridded file is demonstrated in the supplement 1 of [1]. As for soil types, the variables p1 to p7and pmax valid for each file have the following meaning:

p1 .... *percentage of soil type p1 on the tile (light soil - sand)*

p2 ..... *percentage of soil type p2 (lighter middle textured soil)*

p3 ..... *percentage of soil type p3 (middle textured soil - loam)*

p4 ..... *percentage of soil type p4 (heavier middle textured soil)*

p5 ..... *percentage of soil type p5 (heavy soil - clay)*

p6 ..... *percentage of soil type p6 (peat , peaty - bogged, peaty-gleyed)*

p7 ..... *percentage of other surface (built-up and water areas, ...)*

pmax... *category of soil type from p1 to p7 prevailing on the tile*

(zero means the centre of tile is outside the Czech Rep.)

The record valid for a certain tile comprises also the number id of radioecological region and then the fraction of each soil type for each radioecological region can be computed easily.

7.2.1.1 Resources and costs

The structure of the agricultural production in the Czech Republic has changed substantially since 1991 and deep changes in all fields are expected. Unfortunately, the process of restructuralization is not so far well defined what results in deep recession of the branch. The main adverse features influencing agricultural production are: unclear owners relations; high prices of chemical fertilisers; lack of natural fertilisers and decreasing fertility of soil; decreasing of sowing areas; dramatic decrease of the numbers of animals

Then, the data on costs, availability of proper equipment and labour resources needed for various countermeasure procedures has non-systematic character. Reliable data is not available now at a full extent and only some particular numbers were found (sometimes being mutually in contradiction). An attempt has been done to gather some information valid for the Czech Republic related to availability and costs of some items (lime, NPK fertilisers, manure, Prussian Blue). The questionnaire altogether resulted to astonishment of the questioned institutions what we need the data for. A few partial results were translated to Mr. Fesenko.

The limits for various food bans (and other various intervention levels, off course) are strictly defined in the Executive Regulation no. 184 on the new Czech Atomic Law. The overview of the limits is given in [3] .

7.2.1.2 Animal diets

The Czech RODOS team joined to the project [2]. The following table summarise the data on animal diets delivered to the document [2] :

Feeding diets for animals : values for the Czech Republic conditions (Source : Research Ins. for Animal Production)

Animal	**Feedstuff**	**Intake rate** (kg.d^{-1} fresh weight)	
		low land	**midland**
Dairy cow with milk production >5000 kg.y^{-1}	Grass	4[a,c]	25[a]
	Clover	0	25[a]
	Alfalfa	30[a]	0
	maize silage	20	5
	Grain	7	5
	Pulps	5	0
	straw*	2	2
Dairy cow with milk production <5000 kg.y^{-1}	Grass	8[a,c]	30[a]
	Clover	0	20[a]
	Alfalfa	20[a]	0
	maize silage	15	0
	Grain	4	3
	Pulps	2	0
	straw*	2	2
Calf	milk substrate	3	3
	Hay	1	1
	Grain	1	1
	straw*	1	1
Beef cattle[y]	Grass	0	40[a]
	Alfalfa	10[a]	0
	Grain	6	2
	maize silage	28	5
	straw*	6[b]	6[b]
Sheep	Grass	0	10[a]
	Grain	0	1
	straw*	0	1

Animal	**Feedstuff**	**Intake rate** (kg.d^{-1} fresh weight)	
		low land	**midland**
Lamb	Grass	0	5[a]
	Grain	0	0.3
	straw*	0	0.5
Goat	Grass	0	12[a]
	Grain	0	1
	straw*	0	1
Horse	Grass	30[a]	30[a]
	Grain	1	1
	straw*	3	3
Red deer	grass ext.	10[a]	12[a]
	Grain	1	1
Fallow deer	grass ext.	5[a]	6[a]
	Grain	0.5	0.5
Rabbit ext.	Grass	0.3[a]	0.3[a]
	Grain	0.1	0.1
	straw*	0.2	0.2
Rabbit intens..	grain 0.2	0.2	
Pig	winter barley+ wheat	3	3
Hen, chicken	winter wheat	0.1	0.1

[a] Values given are for the vegetation period; during the winter (lowland 200, resp. midland 230 days) an equivalent dry matter intake with hay or silage is assumed (winter season for beef cattle and deers is about 30 days shorter), [b] Values given are for the winter period only, [c] Hay only, * Bedding, not for feeding, [x] Lowland mainly sheded, midland mainly pasture, [y] Lowland 30 % pasture, midland 80 % pasture, [z] Spring and autumn only.

Time dependent feeding rates for pigs (former data used in CR for local ingestion model ENCONAN)

month of feeding feedstuffs [kg,l/day]	1	2	3	4	5	6
Wheat	0,4	0,4	1,1	1,1	1,3	1,3
Barley	0,3	0,3	0,75	0,78	1,3	1,3
dry milk	< 0,1	0,08	-	-	-	-
Whey	-	2,5	2,5	2,5	2,5	2,5

7.2.2 Decontamination

The proper local data on decontamination for RODOS LCMT customisation are not available at full extent in the Czech Republic. The following possible sources of the data were contacted: Governmental Board on Emergency Planing; Ministry of Living Environment; Institute of Civil Protection of CR; Czech Army.

Governmental Board on Emergency Planing is responsible for emergency management in the zone of emergency planning (up to 15 km from NPP). According to information given to RODOS team the main interest is laid on early countermeasure optimisation. The late countermeasures have lower priority and they are assumed to be applied ad hoc, according to the real situation.

Ministry of Living Environment has its own database system ”HAVARIE” for emergency management of chemical incidents. The stress is laid on management of early effects and application of late countermeasures is not so far assumed. Some special decontamination techniques are included but no detailed information was provided. The first steps for possible future co-operation were rather tough.

Institute of Civil Protection of CR, Czech Army : The process of harmonisation of emergency planing with NATO and EU procedures is just starting. So far , only old obsolete data form the period of ”cold war” are available.

References:

[1] Pecha P., Nedoma P., Karny M., Kuca P.: Terrestrial Food Chain and Dose Module of RODOS: Customization for its Use in the Czech Republic. RODOS (WG3) - TN(98) – 14, Dec.1998, draft (final version in August, 99).

[2] Documentation on the two INCO working programs: ”Review of the adequacy of the present foodchain and dose calculations” and ” Collection of the data required for each radioecological region and their integration into RODOS”. RODOS(WG3) - ??(??)-?? (final version in July, 99).

[3] Pecha P., Nedoma P., Karny M., Kuca P : Status report on RODOS accreditation for its use in Czech Republic - Local Quality Assurance Process. RODOS(WG1)-TN(98)-29, Dec. 1998, draft (final version in August, 99).

7.2.3 Hungary

The collected information is presented in the format of questionnaire issued by NRPB, although in the most cases the values were available for the whole country only instead of separated radioecological regions.

7.2.3.1 Decontamination

Four different categories were established to describe the densely built up areas (the central regions of capital and larger towns), the smaller cities and the outer districts of larger towns, and two other kinds of such inhabited regions , which are quite close to the rural areas.

(Unlike the original questionnaire issued by the NRPB, these categories are marked by Roman numerals instead of capitals.)

Description of categories of habitation

Category of habitation	Short description of the category Region 1 and 2
“I"	Cantre of large towns (near to or more than 100,000 citizens) Densely built-up areas, where multi-storey buildings are located. The roads and pavements are covered by solid and unpermeable materials (asphalt, concrete, stone). The traffic is intensive during whole days and cannot be neglected even in night.
“II"	Outer districts of larger towns and central areas of cities, smaller towns (several ten thousand inhabitants) Densely built up areas, but few-storey buildings are located here, the frequency of ornamental trees, brushes and smaller parks is high. The roads and pavements are covered by solid and unpermeable materials (asphalt, concrete, stone). The traffic is expected to be high from morning to early evening, but it is calm otherwise.
“III"	Large village area (several thousand up to few ten thousand inhabitants) Usually single-storey houses are located here, most of them have yards and smaller gardens for keeping few domestic animals and horticultural production. The houses are made from bricks mainly, the other auxiliary buildings are mixture of bricks and/or wooden. The main roads and pavements are covered by solid and unpermeable materials (asphalt, concrete, stone) only, but the most roads and pathways are uncovered. Usually many trees and brushes are standing along the roads. The traffic is small during whole day.
“IV"	Small village area (includes standalone houses, farms and such small areas where several hundred of few thousand peoples live) This category is quite similar to previous one, but usually standalone farms, smaller fields also could be found here between the houses. The traffic is not significant during whole day.

Description of building types

Building type	Description of type, size and basic construction materials for wall and roofs
A	Multi-storey houses, building of settlements These buildings are made of concrete and reinforced concrete, or bricks in few cases. The buildings have a flat roof made of concrete, too, and covered by bitumen and gravel.
B	Few-storey houses, cottages The buildings are made of bricks mainly, but in some cases the entire house made of concrete. The roofs are skew and covered by tiles usually.
C	Single-storey houses The buildings are made of bricks. The roofs are skew and covered by tiles. The buildings have a little yard and/or gardens, too.
D	Rural houses The typical building is made of bricks (or adobe, or stone, sometimes), usually several another detached farm-buildings are belonging to it. These auxiliary buildings are made of brick and/or wooden. The roofs are made of tiles.

Percentage distribution of areas occupied by buildings, permeable and unpermeable surfaces and population

	Category of habitation			
	I.	II	*III**	IV
Area covered by all buildings [%]	77	29	*29*	29
Area of permeable surfaces [%]	14	70	*70*	70
Area of permeable surfaces [%]	9	1	*1*	1
Building type**				
A [%]	32.5	28.9	*1.1*	1.1
B [%]	8.2	2.7	*0.3*	0.3
C [%]	21.5	37.7	*27.2*	27.2
D [%]	1.4	7.8	*66.4*	66.4
Population [%]	38.5	25.8	*17.9*	17.8
Number of trees within 10 metres: (0, less than 10, more than 10)	n/a	n/a	*n/a*	n/a

**: the correct data related to Category III are not available. It is assumed that they are cca. same as in case of Category IV.*

***: only living houses are included.*

Time spent indoors and outdoors

	indoors building types				outdoors
Category of habitation	A	B	C	D	
I	77*	78*			5
II	78*	78*	78*		9
III		78*	78*	79*	9
IV			79*	79*	11

**: some bias of the surveying method could be the reason of the differences between the indoors values related to different building types, so it should be more reasonable if all values considered to be equal*

2 Effectiveness of decontamination techniques

In the following table the numbers of items of equipment have been reviewed, which are likely to be of most importance in the practical execution of decontamination. The source of the data are the Official Hungarian Statistical Handbooks dated from 1994 to 1997.

Availability of equipments for decontamination and human transportation

Equipment	number of equipment in whole country
street and road cleaners	150**
hand sweepers	1000**
fire-engines and hoses water-jet fire engines	410 320
water jet cleaners	n/a
lawnmowers	n/a
trucks towings, trailers	445 000 56 000 334 000
waggons railway engines, locomotives	54 000 1 800
cargo-boats, motor barges tiver barge (without engine)	39 210
buses	18 000
chainsaws	n/a
combine harvesters for cereals and other plantcrops	94 00
tractors, *ploughs**	92 000 *30 000**

** estimated value*

*** estimated value for Budapest only*

From these information and based on personal judgement, the availability of the decontamination techniques in Hungary are listed below.

resource	likely availability
ploughs and tractors	A, B
skim and burial ploughs	E
vacuum brushing street cleaners roads cleaners	C
hand sweepers	A
fire-engines and hoses	C
water jet cleaners	C
road gulley cleaners	?
lawnmowers	A, B
leaf vacuum sweepers	?
large trucks, graders, bulldozers	A, B
rotovators	?
chainsaws	A, B
cherry pickers	B
chippers	B,C
road planners	B
abrasive blasters	E
Chemicals	C
turf catters	D

?: the resource denoted by question mark could not been identified.

7.2.4 Poland

Up to now the following groups of information have been included into data files, for quantifying agriculture and decontamination countermeasures: derived limit for various nuclides with account of dietary habits in Poland; agriculture production for radioecological regions and for each province; animal diets (composition and quantities); for each major soil category in each radioecological regions the soil-based countermeasures including availability of materials and equipment needed, labour resources and the disposal of any waste); fractions of land covered by buildings, permeable surfaces such as soil and grass and impermeable surfaces such as roads and paved areas; population living in this area, time spent at each location, shielding of representative building types; feasible decontamination techniques and available equipment resources.

For easy handling space dependent data suitable digital maps have been customised and their digital versions have been completed. These maps are:

maps of Poland's soils: detailed, 1 : 500 000 and aggregated: (8 types and 11 textural groups of soils), 1 : 1 500 000,

map of Poland's soils agriculture classes (1 : 1 000 000),

maps of land cover of different scales (fine scales covers only a part of Poland),

maps of administrative divisions (provinces, districts, communes and radioecological regions defined for purposes of food chain and countermeasures models of RODOS.

The ArchInfo functional modules will be used to handle the data base of collected information to produce grid data for FCDMT and LCMT.

7.2.4.1 Agricultural countermeasures

SOILS

The Systematics of Polish Soils of 1989 specifies 35 soil types. However, not all types occur over areas large enough to be taken into account on a 1: 1,500,000 scale of the digital map, developed for RODOS customisation in Poland .For the needs of such map 8 basic genetic soil types and 12 textural groups are identified. They are:

Types of soils: pseudopodsolic and rusty podsolysed soils (A); pseudopodsolic and brown leached soils (AB); brown soils (proper and leached) (B); chernozems (C); black earths (D); alluvial soils (of different mechanical composition) (F); hydromorphic soils (peat, mucky soils and slime-swamp) (H);rendzina soils developed from different geological formations (R)

Soil textural groups: gravels (z); loose sands (pl); slightly loamy sands (ps); loamy sands (pg); loamy sands on loams and sandy loams (gp); light loams (gl); medium and heavy loams (gs); clays of different origin (i); silts of different origin (plz); rocky and skeletal soils (sk); loamy, silty and clayey soils (g).

The digital map of soils includes also layers, describing complexes of arable lands and complexes of stable grasslands. The following types of these complexes are identified:

Complexes of arable lands: very good wheat complex; good wheat complex; defective wheat complex; very good rye complex (wheat-rye); good rye complex; weak rye complex; cereal- fodder strong complex (mainly for wheat); cereal - fodder weak complex (mainly for rye); mountain wheat complex; mountain cereal complex; mountain oat- potatoes complex; mountain oat - fodder complex.

Complexes of stable grasslands: occasionally flooded grasslands; high situated grasslands (not flooded); peaty and post- peaty grasslands; forests.

Macroregion number	A	AB	B	C	D	F	H	R
1	44944	1852374	250907		11946	65657	229252	
2	97255	2978686	845007		52027	217483	582128	
3	59431	4063611	281735		184135	327108	438445	
4	124203	3300257	83188		80279	229979	319599	2297
5	464252	2012413	333424	159782	9569	566597	265365	169403
6	33315	2166884	351847	107444	56691	4830224	105940	62879
7		791932	89844			241943		5663

Area of types of soils in the digital map of soils of Poland (ha).

Area of textural groups in the digital map of soils of Poland (ha).

Macroregion number	g	gc	gl	gp	gs	i	pg	pl	ps	plz	z
1			159867	933220	12728	6025	376851	171536	445944	20891	54000
2		7382	1017613	1080534	103197	71746	437382	267496	853055	134570	
3			557697				2350036	342931	1302910	33077	
4			216366	1153698			425941	361837	920624	492930	
5	104901		20103	254620			303593	57735	845292	173403	
6	362021		324370	324370	28353	12188	328710	33699	550721	180829	
7	811450								1409	9080	

Soil texture group (source: *Polish standards: BN-78/9180-11*)

Soil texture group (group index)	Particle size profile [%]		
	Sand 1-0,l mm	**Dust 0,1-0,02 mm**	**Floatable particles <0,02 mm**
Sands			
- loose sand (pl)	70-100	0-25	0-5
- weakly loamy sand (ps)	65-94	0-25	6-10
- strong loamy sand (pg)	40-84	0-40	11-20
Loams			
- light loam (gl)	40-74	0-40	26-35
- medium loam (gs)	25-64	0-40	36-50
- heavy loam (gc)	10-49	0-39	51-90
Clays			
- clay (i)	0-9	0-49	51-100
Dusts			
- simply dust (plz)	0-59	41-100	0-50

Chemical composition of soils containing different fractions of floatable (< 0,02 mm) and colloidal (< 0,002) particles (source: *Siuta* and *Terelak*)

Soil textural group	Genetic horizon	Particles of diameter Size [%]		Chemical compounds [%]					
		<0,02 mm	<0,002 mm	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	P_2O_5
loose sand (pl)	A_1	4	1	95,6	2,1	1,0	0,1	0,3	0,06
	C	4	1	92,8	2,6	0,6	1,8	0,6	0,06
loose sand (pl)	A_1	7	3	90,4	3,3	0,6	0,5	0,4	0,13
	C	9	3	92,4	4,9	0,9	0,6	0,5	0,05
loose sand (pl)	A_1	14	6	83,4	5,5	1,3	0,3	0,4	0,05
	C	12	5	90,7	4,8	1,0	0,3	0,5	0,07
loose sand (pl)	A_1	17	8	86,2	5,7	1,6	0,6	0,5	0,08
	C	20	6	88,8	6,3	1,0	0,5	0,5	0,06
loam (g)	A_1	22	11	84,5	4,1	1,7	1,0	0,8	0,03
	C	21	11	85,7	8,8	1,9	0,6	0,6	0,05
loam (g)	A_1	46	17	74,2	10,3	3,4	2,8	0,9	0,10
	C	44	26	78,6	10,5	3,6	1,5	1,1	0,06
loam (g)	A_1	53	18	71,6	12,8	3,4	2,4	0,8	0,12
	C	60	34	71,0	10,8	4,0	2,6	1,0	0,08
clay (i)	A_1	75	35	60,4	16,2	5,0	1,6	0,9	0,20
	C	89	60	61,6	17,6	6,9	2,5	1,3	0,11
simply dust (plz)	A_1	49	14	73,4	9,6	2,1	0,3	1,0	0,08
	C	56	22	74,3	11,5	3,6	0,5	1,0	0,07
simply dust (plz)	A_1	28	6	88,3	5,0	1,7	0,8	0,8	0,08
	C	36	8	83,4	8,2	1,8	0,6	0,7	0,08
simply dust (plz)	A_1	41	9	78,7	7,5	2,1	0,6	0,8	0,08
	C	55	21	76,3	10,9	3,5	1,1	0,9	0,10

Exchangeable cations of representative soils in Poland (source: *Uggla*)

Soil type,	Sampling depth cm	Ca^{++}	Mg^{++}	K^{+*}	Na^{+}	*S*	*T*	*V*
		[me /100g of soil]						[%]
Proper brown soil (B)	5-10	16,84	1,12	0,57	0,50	19,03	20,71	91,88
	25-30	20,15	1,85	0,62	0,45	23,07	24,54	94,00
	75-80	16,49	3,06	0,56	0,50	20,61	20,90	98,61
	110-120	16,23	3,07	0,47	0,49	20,26	20,58	98,45
Pseudopodsolic soils (AB)	5-15	2,40	0,51	0,18	0,06	4,40	10,00	44,00
	20-30	1,40	0,38	0,08	0,04	2,15	6,65	32,33
	30-35	3,15	1,62	0,17	0,04	5,07	9,87	51,37
	40-45	3,15	1,62	0,23	0,01	5,86	9,87	59,37
	90-100	6,25	2,92	0,32	0,12	10,27	12,25	83,84
	140-150	7,25	3,00	0,28	0,17	11,85	12,75	92,94
Pseudopodsolic soils (A)	0-20	0,23	0,12	0,02	0,06	0,43	3,53	12,40
	28-35	0,09	0,08	0,00	0,04	0,21	1,45	14,40
	35-45	0,12	0,11	0,02	0,06	0,31	4,35	7,10
	60-70	0,10	0,04	0,04	0,06	0,24	1,84	13,30
Forest and steppe chernozems (C)	5-10	26,94	1,15	0,36	1,38	29,83	30,44	97,99
	40-50	22,95	1,89	1,94	1,70	28,48	28,92	98,47
	60-65	18,96	1,97	1,44	1,77	24,14	24,66	97,89
	130-135	14,97	0,49	0,78	0,93	17,17	17,61	97,50

*) me -milligram –equivalent

Specific gravity, weight by volume and general porosity of soils in Poland (Source: *monographies on pedology matters published in, Annals of Pedology vol. X-XXI.*)

Soil	Sampling depth [cm]	Specific gravity [g/cm^3]	Weight by volume [g/cm^3]	General porosity [%]
Arable **pseudopodsolic** soil formed of loamy weakly sand	5-10	2,58	1,46	43,4
	30-35	2,61	1,48	43,1
	60-65	2,63	1,58	40,0
	110-120	2,63	1,63	38,0
Arable pseudopodsolic soil formed of dusty sands	10-15	2,62	1,53	41,6
	35-40	2,67	1,63	39,0
	80-90	2,65	1,70	36,0
Arable pseudopodsolic soil formed of water- glacial dusty formations	5-10	2,62	1,50	42,8
	50-60	2,62	1,56	40,5
	90-100	2,65	1,68	36,9
Gley Arable pseudopodsolic soil formed of boulder loam	5-10	2,66	1,53	42,5
	30 40	2,66	1,63	39,1
	50-60	2,64	1,77	32,9
	110-120	2,64	1,78	32,6
Forest pseudogley pseudopodsolic soil, formed of boulder loam	3-8	2,50	1,26	49,6
	15-25	2,60	1,59	38,9
	35-45	2,68	1,69	37,4
	80-90	2,68	1,70	36,6
Arable brown soil formed of weakly loamy sand	5-10	2,61	1,43	45,2
	300	2,63	1,59	39,5
	60-70	2,67	1,50	43,8
Arable brown soil formed of light loam	5-15	2,60	1,57	39,5
	30-40	2,59	1,77	30,8
	80-100	2,60	1,75	32,7
Arable brown soil formed of dusty loam	5-10	2,65	1,35	49,0
	35-00	2,69	1,42	47,1
	60-70	2,72	1,64	39,5
	110-120	2,68	1,80	32,9
Arable brown soil formed of loess formation	14-16	2,69	1,30	51,7
	30-36	2,70	1,39	48,1
	60-66	2,70	1,48	45,0
	93-100	2,70	1,76	34,8
Arable brown soil formed of loess	14-l6	2,67	1,47	44,9
	34-36	2,71	1,50	44,6
	144-150	2,69	1,39	48,3
	250-260	2,70	1,38	48,8
Arable grey earth formed of loessoid formation	14-l5	2,65	1,25	52,8
	35-41	2,69	1,44	46,5
	60-66	2,73	1,55	43,2
	144-146	2,76	1,68	39,1
Arable black earth formed of dusty formation on loose sand	14-20	2,63	1,52	42,2
	45-50	2,62	1,56	40,4
	84-100	2,70	1,69	37,4

Specific gravity, weight by volume and general porosity of soils in Poland (Source: *monographies on pedology matters published in, Annals of Pedology vol. X-XXI.*), continued

Soil	Sampling depth [cm]	Specific gravity [g/cm^3]	Weight by volume [g/cm^3]	General porosity [%]
Arable black earth formed of dusty formation	5-10	2,62	1,22	53,4
	45-55	2,63	1,56	40,7
	60-70	2,64	1,74	34,1
	90-100	2,64	1,58	40,1
Arable black earth formed of boulder loam	2-10	2,46	1,50	40,0
	35-45	2,43	1,48	39,0
	50-70	2,60	1,74	33,1
Slime and peat soil, grassland	10-20	2,63	1,13	56,8
	30-35	2,64	1,55	41,3
	60-70	2,52	0,83	67,1
Slime and peat soil, grassland	10-15	1,93	0,31	84,5
	34-35	1,92	0,22	88,5
	60-65	2,10	0,23	93,8
Peat soil formed of lowmoor peat, Grassland	10-20	2,16	0,46	78,4
	40-45	1,63	0,16	90,2
	70-75	1,60	0,13	92,2
Mucky soil formed of detritus like gyttja, Grassland	20-30	1,60	0,15	90,2
	70-80	1,46	0,08	94,5
Arable alluvial soil on strong loamy sand, underlain by light loamy sand	5-10	2,57	1,36	47,1
	30-40	2,58	1,43	42,8
	70-80	2,60	1,54	39,1
Arable rendzina soil formed of decalcified formation on cretaceous limestone	5-10	2,53	1,27	49,8
	25-30	2,57	1,14	51,4

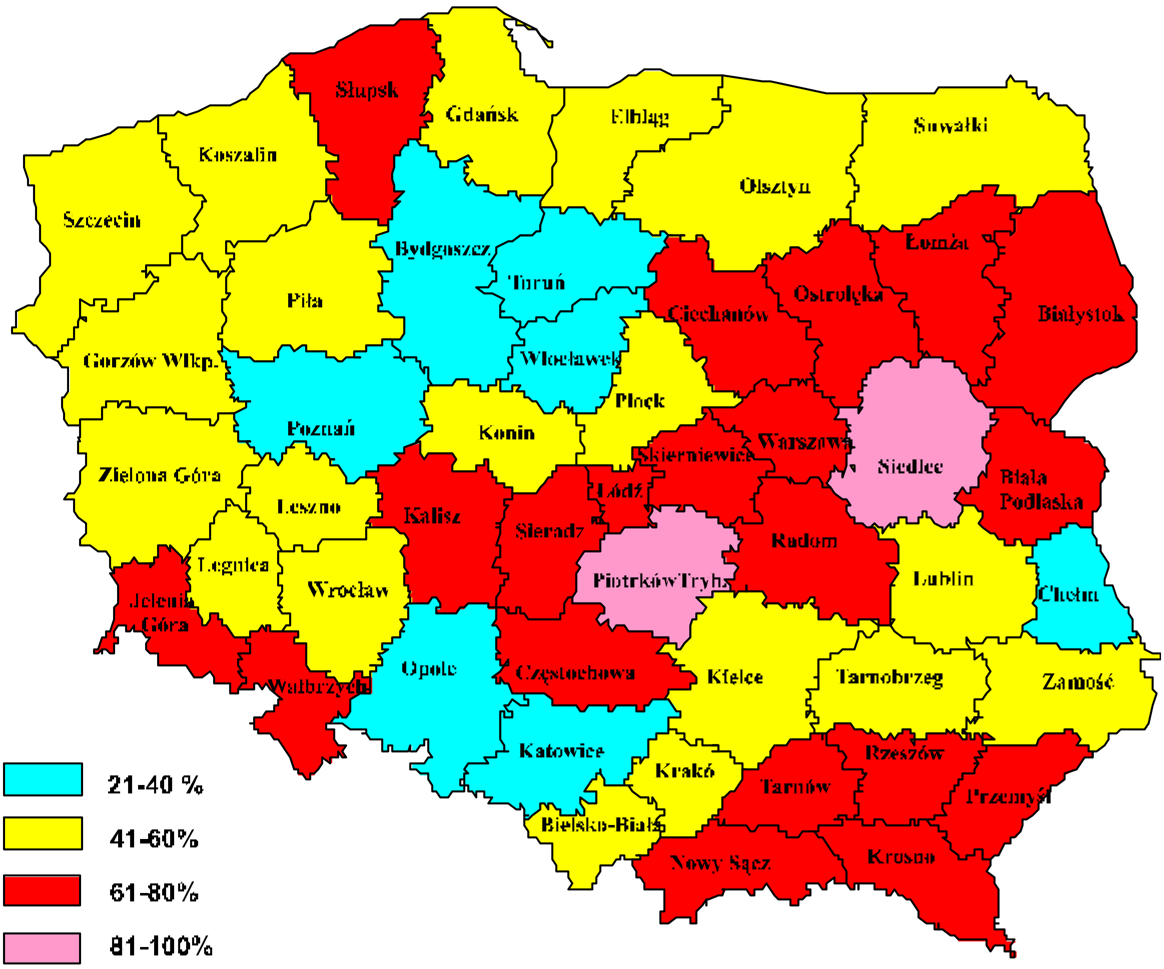
Organic matter and C content in 0-20 cm layers of representative soils of Poland (source: *A. Musierowicz*)

Name of soil	Organic matter		Carbon content (C)	
	% (weight).	ton/ha	% (weight).	ton/ha
Pseudopodsolic soils (A)	0,6-2,5	18-75	0,35-1,45	10,5-43,5
Brown soils (B)	1,5-2,5	45-75	0,87-1,45	26,1-43,5
Chernozems (C)	2,6-40	78-120	1,51-2,32	39,5-69,6
Black earth (D)	1,8-5,6	54-168	1,05-3,25	31,5-97,5
Rendzina soils (R)	2,0-6,0	60-180	1,16-3,50	34,8-105,0
Alluvial soils (F)	1,1-4,2	33-126	0,64-2,44	19,2-73,2

Cation content in sorption part of different soils [m.e] (source: *Musierowicz*)

Soil (prevailing climate conditions)	Na^+	K^+	Mg^{++}	Ca^{++}	H^+
Chernozems (semi dry) (C)	2	7	14	73	4
Pseudopodsolic soils (wet) (A)	traces	3	10	20	67

A more detailed description of chemical and physical properties of various soils representing the soils types A, AB, C, D F and R, which can be used to assess effectiveness of agricultural countermeasures has also been compiled, but is not presented here. The percentage of acid and very acid soils in each province of Poland is pictured on the map below.



Map3. Percentage of acid soils and very acid soils (pH

Animal diet

The information collected on animal diet are broken down into the following groups of country averaged data:

Animal feed rates (for cattle) (*source: Central Laboratory for Radiological Protection)*

Cattle diet	Cows-1 Dairy Feed [kg f.w d-1]	Cows-2 Beef Feed [kg f.w d-1]	Veal-3 Feed [kg f.w d-1]	Sheep for milk Feed [kg f.w d-1]	Sheep for meat Feed [kg f.w d-1]	Goat for milk Feed [kg f.w d-1]	Goat for meat Feed [kg f.w d-1]
cereals (spring)	4	2.5	0	0	0	0.63	0.63
green fooder (spring)	45	18	0	4.5	4.5	4.5	4.5
hay (spring)	0	0	0	0	0	0	0
silage (spring)	2	2	0	0.5	0.5	0.5	0.5
cereals (winter)	4.7	2.5	0	0.63	0.63	0.63	0.63
green fooder (winter)	36.8	0	0	0	0	0	0
silage (winter)	8	3	0			0.75	0.75
hay (winter)	3.8	2.0	0	1.8	1.8	0.5	0.5
Ensilaged crops (sugar factory) (winter)	25	15	0	0	0	3.75	3.75
Water	60	50	22	6.0	6.0	12.5	12.50
milk (veal)			19				

Pigs diet and feed rates (*source: Central Laboratory for Radiological Protection)*

Index	Pig diet	Feed [kg f.w d^{-1}]
1.1	Wheat- month 1-6	0.4
2.1	Barley-month 1-6	0.3
3.1	Whey-month 1-6	2.5

Poultry diet and feed rates (*source: Central Laboratory for Radiological Protection)*

Index	Polutry diet	Feed [kg f.w d^{-1}]
1	Cereals	0.120
1.1	Wheat (50%)	0.060
1.2	Rye (25%)	0.030
1.3	Barley (25%)	0.030
1.4	Water	0.2

Resources and costs

Fertilisers use, production and prices

Use

NPK and nitrogen fertilisers	1510 x 10^3t
Nitrogen fertilisers	850 x 10^3t
Phosphorus fertilisers	300 x 10^3t
Potassium fertiliser	360 x 10^3t
Calcium fertilisers	2200 x 10^3t

Production

Nitrogen fertilisers	1150 x 10^3t
Phosphorus fertilisers	250 x 10^3t
Calcium fertilisers	5300 x 10^3t

Costs of different fertilisers and caesium binders

NPK fertilisers	0.4-0.8 USD per kg
Manure	0.2÷0.4 USD per kg
Prussian Blue	2-4 USD per kg

Equipment

Qualitative assessment of availability of equipment and materials that could be required for the various agriculture countermeasure options can be summarised as in the Table below.

Resource	Availability: good, average, poor						
Region	I	II	III	IV	V	VI	VII
Ploughs	good	good	good	good	good	good	good
Deep ploughs	average	poor	average	average	average	average	poor
Lime	good	good	good	good	good	good	good
NPK fertilisers	good	good	good	good	good	good	good
Manure	good	good	good	good	good	good	good
Prussian Blue	average	average	average	average	average	average	average
Indoor stabling for animals	good	good	good	good	good	good	good
Stored feed for animals, eg hay	good	good	good	good	good	good	good
Facilities for processing foods, eg milk	average	poor	average	average	average	average	poor
Facilities for storing food, eg milk products	average	poor	average	average	average	average	poor

The fire services (FS) in Poland have responsibility for combat fires and other hazards, and for environmental hazards. In this respect, the FS is required to cooperate with ministries and other bodies of state administration in the above mentioned matter.

The fire services in Poland can broken down as follows:

State Fire Service (SFS);

Voluntary Fire Service;

On-site Fire Services of a number of large chemical establishments.

Means and Forces to Carry out Decontamination

The regulations on the division of competencies to individual authorities concerning mitigation, response and recovery of environmental emergencies are included in the Acts of the Minister of the Interior on State Fire Service (SFS), on Fire Control (also in th executive regulations to these acts), on State Environmental Protection Inspectorate and in the Decree of Council of Ministers on Civil Defence.

The Head of SFS is responsible for the realisation of the actions in fire control and organisation of the national rescue-fire fighting system.

7.2.4.2 Decontamination

According to the Fire Control Service Act the organisation and performance of the rescue action during fire fighting and removal of local hazards are one of the basic tasks of the SFS. Moreover, this act states that the SFS is the organizer of the national rescue/fire fighting system.

According to its assumptions the national system (PNS) is the integral part of the state security and serves for life, health, property and natural environment rescuing. The basis of this system are the organisational units of the SFS, which perform the activities imposed on them by the system.

Other ministries involved in the PNS include National Defence (ND) , Transport and Marine Economy, Agriculture and Food Resources, Health and Social Welfare, and Foreign Affairs. These ministries are required by various statutes to provide support in case of occurrence of a major environmental hazard incident in their area of competence.

With ND, the army and the civil defence play important roles in the PNS.

Th Civil defence Organisation may, during times of peace, assist in responding to environmental emergencies. The scope of this assistance includes:

alerting of populations and emergency response authorities, in case of an environmental emergency,

planning emergency response actions,

participating in response actions.

Existing regulations on Civil Defence state that the alerting capabilities this organisation has available, may be used in times of major disasters, such as can occur during an environmental emergency.

The Army has resources and systems in-place to assist the SFS in fire-fighting and rescue operations. In practice, agreements must be made with individual units in each province, to secure the Army's co-operation.

A number of fire fighting and rescue units are incorporated into industrial facilities. These Industrial Fire and Rescue Services (IFRS) vay in staff size and specialised equipment depending on the size of the facility.

Current fire fighting and rescue equipment and plans for its enhancement was evaluated. -future plans include establishing 14 bases through the country, which will each contain specialised rescue equipment. It should be noted, that in the case of lengthy, very difficult or large scale response actions, the SFS can mobilise additional equipment available from other government and economic entities.

For the purpose of both immediate intervention action planning and long term countermeasures assessment two Excel type data base were developed: EQUIPMENT_REGION, and EQUIPMENT_LOCAL

At the moment the entries of EQUIPMENT_REGION consist of information on equipment available to SFS units in different provinces of Poland. It includes: Light chemical rescue vehicle; Oil separator; Skimmer; Neutralizing chemicals ; Oil booms; Gastfight suits; Water rescue units; Reconnaissance vehicle; Heavy recovery truck; Heavy technical rescue vehicle; Heavy technical rescue vehicle; Heavy chemical rescue vehicle; Heavy mobile crane; Light chemical and radiation vehicles; Heavy ecological rescue vehicle; Tanktruck for chemicals; Hose truck; Pump trailer; Container truck Chassis; CNT with water barriers/booms ; CNT with medical equipment; Rescue helicopter; Water rescue container with pneumatic boat; High-rise rescue vehicles; Bulldozer; Excavator; Wheel loader; Thermo chamber; Coach/bus; Tipper truck; Lighting equipment; CNT radio and cable equipment; CNT earth quake rescue; CNT evacuate people/clothing; CNT flood rescue.

The base EQUIPMENT_REGION will be extended to include information of equipment of VFS and IFRS which can be used to mitigation of radiological accident consequences.

The data base EQUIPMENT_LOCAL include information on the agriculture equipment available at forms in different districts (part of provinces) of Poland. The information for the data base were acquired from the country-wide agriculture inventory, carried out in 1996. The data base will be updated any time new information on the agriculture inventory will be available at the Main Statistical Office in Warsaw.

7.2.5 Romania

7.2.5.1 Agricultural countermeasures

SOILS

Soil type	**Chernozem**
Soil characteristics:	
PH	7-8.3
Organic matter or C content (%)	3-6%
Soil texture	loam<35%, sand <15%
Cation Exchange Capacity ($cmol_c kg^{-1}$)	23-38 me/100g
Base saturation (%)	92-100
Exchangeable K ($cmol_c kg^{-1}$)	0.57-0.68
Exchangeable Ca ($cmol_c kg^{-1}$)	22.8-30.1

Soil type	**Luvisol**
Soil characteristics	
PH	4.5-6.7
Organic matter or C content (%)	2-4%
Soil texture	18%<loam<35%, sand>15%or loam<18%, 15%<sand<65%
Cation Exchange Capacity ($cmol_c kg^{-1}$)	10-50 me/100g
Base saturation (%)	20(50)-90
Exchangeable K ($cmol_c kg^{-1}$)	0.34-0.52
Exchangeable Ca ($cmol_c kg^{-1}$)	2.4-17.3

Soil type	**Cambisol**
Soil characteristics	
PH	3.5-7.7
Organic matter or C content (%)	2.5-30%
Soil texture	35%<loam<60%
Cation Exchange Capacity ($cmol_c kg^{-1}$)	2-50 me/100g
Base saturation (%)	4 – 90
Exchangeable K ($cmol_c kg^{-1}$)	0.05-0.72
Exchangeable Ca ($cmol_c kg^{-1}$)	1.1-28.2

Radioecological region	Soil type	Fraction (approx.)
330	Cernoziom Luvisol	50% 30%
331	Cernoziom Luvisol	5% 80%
332	Luvisol Cambisol	5% 80%

RESOURCES AND COSTS

Resource	Availability			Cost, US$
	Local	Regional	National	
Ploughs	good	good	good	Medium
Deep ploughs	good	good	good	High
Lime			good	low cost
NPK fertilisers			good	low cost
Manure	good	good		low cost
Prussian Blue			poor	High
Indoor stabling for animals	average	average	average	low cost
Stored feed for animals	average	Average	average	Medium
Facilities for processing milk	average	Average	average	Medium
Facilities for processing food	average	Average	good	Medium

ANIMAL DIETS

Animal	Feedstuff	Period	Intake rate (d kg^{-1}, d l^{-1})
Lactating cow	grass	30.4 – 17.10	57
	hay	17.10 – 30.4	8.0
	maize	17.10 – 30.4	4.0
		30.4 – 17.10	1.0
	maize bulbs	17.10 – 30.4	1.0
		30.4 – 17.10	2.0
	straw	17.10 – 30.4	4.0
	feed.water	1.1 – 31.12	60
Lactating sheep	grass (extensive)	30.4 – 17.10	9.0
	hay (extensive)	17.10 – 30.4	1.4
	straw	17.10 – 30.4	1.0
	feed.water	1.1 – 31.12	5.0
Beef cattle	grass	30.4 – 17.10	40
	hay	17.10 – 30.4	4.0
	maize	17.10 – 30.4	2.0
	maize bulbs	17.10 – 30.4	1.0
	straw	17.10 – 5.5	4.0
	feed.water	1.1 – 31.12	60
Pig	winter-barley	1.1 – 31.12	1.5
	maize bulbs	1.1 – 31.12	1.0
	potatoes	17.10 – 30.4	5.0
	beet leaves	30.4 – 17.10	7.0
	feed.water	1.1 – 31.12	7.0
Lamb	grass (extensive)	30.4 – 17.10	5.0
	hay (extensive)	17.10 – 30.4	1.0
	feed.water	1.1 – 31.12	2.0
Roe deer	grass (extensive)	5.5 – 31.10	4.0
	hay (extensive)	31.10 – 5.5	0.8
	feed.water	1.1 – 31.12	1.0
Chicken	winter-barley	1.1 – 31.12	0.06
	maize grain	1.1 – 31.12	0.04
	feed.water	1.1 – 31.12	0.2

7.2.5.2 Decontamination

Category of habitation	Description of category
A	cities
B	Towns
C	Villages

Building type	Description of type, size and basic construction materials used for walls and roofs
Type 1: Multi-storey building (with brick)	Size: 4 to 10 floors. Walls: brick(+concrete); roof: concrete plate
Type 2: Multi-storey building (no brick)	Size: 4 to 12 floors. Walls and roof: concrete plate.
Type 3: Small country houses	Size: one-storey house. Walls : adobe; roof: tiles or shingles.
Type 4: Country houses	Size: 1 to 3 floors. Walls: brick; roof: tiles or zinc plate.

	Inhabited area A	Inhabited area B	Inhabited area C
% Area covered by buildings	65%	50%	25%
% Area of permeable surfaces	20%	35%	70%
% Area of impermeable surfaces	15%	15%	5%
% of each building type	Type 1: 25% Type 2: 35% Type 3: 0% Type 4: 40%	Type 1: 25% Type 2: 25% Type 3: 0% Type 4: 50%	Type 1: 1% Type 2: 1% Type 3: 20-30% Type 4: 68-78%
Number of trees within 10 meter: 0, <10, >10	<10	<10	<10

Effectiveness of decontamination techniques

Technique	Likely to be used	Unlikely to be used	Reasons
SKIM AND BURIAL PLOUGHS	X		
SHRUB AND PLANT REMOVAL	X		
GRASS CUTTING	X		
ROAD PLANING	X		
PLOUGHING SOIL AND GRASS AREAS	X		
SOIL REMOVAL		X	expensive+storage difficulties
DOUBLE DIGGING SOIL AND GRASS AREAS	X		
ROTOVATING SOIL AND GRASS AREAS	X		
FIRE HOSING PAVED AREAS	X		
VACUUM SWEEPING PAVED AREAS	X		
SAND BLASTING WALLS		X	equipment not available
VACUUMING INDOOR SURFACES	X		

Resource	*Likely Availability*
Ploughs and tractors	A
Skim and burial ploughs	A
Vacuum brushing street cleaners Roads Pavements	 B B
Hand sweepers	A
Fire-engine and hoses	A
Water jet cleaners	A
Road gulley cleaners	D
Lawnmowers (with collection) large areas small areas	 D D
Lawnmowers (without collection)	D
Leaf vacuum sweepers	E
Large trucks, graders, bulldozers, JCB, etc.	A
Rotovators	A
Chainsaws	A
Cherry pickers	D
Chippers small (up to 150 mm wood diameter) large	 D D
Road planners	A
Abrasive blasters	A
Chemicals – detergents, strippable coatings, gels, foams and paints	A
Turf cutters - large areas	E

A should be available locally

B should be available regionally

C should be available nationally

D availability likely to be limited

E not available

7.2.6 Russia

7.2.7 Slovak republic

7.2.7.1 Agricultural countermeasures

SOILS

For each major soil category in each radioecological regions

Soil type 1	(national or FAO classification) middle loam
Soil characteristics:	
pH (KCl)	5.5 - 6.5
Organic matter or C content (%)	100 - 200
Soil texture*	
Particle size distribution (%)*	30%
USA system	Kachinskey system (Russian classification)
2000-200 µm	1000-100 µm
200-20 µm	100-10 µm
20-2 µm	10-1 µm
<2 µm	<1 µm
Cation Exchange Capacity ($cmol_c kg^{-1}$)	middle
Hydrolytic acidity ($cmol_c kg^{-1}$)	NA
Exchangeable P ($cmol_c kg^{-1}$)	insufficient
Exchangeable K ($cmol_c kg^{-1}$)	good
Exchangeable Ca ($cmol_c kg^{-1}$)	NA

* - you can give type of Soil texture (for example - loamy sand for USA classification) **or** Particle size distribution using the USA system or the Kachinskey system

Soil type 2	(national or FAO classification) heavy loam
Soil characteristics:	
pH (KCl)	6.5 - 7.8
Organic matter or C content (%)	300 - 400
Soil texture*	
Particle size distribution (%)*	40%
USA system	Kachinskey system (Russian classification)
2000-200 µm	1000-100 µm
200-20 µm	100-10 µm
20-2 µm	10-1 µm
<2 µm	<1 µm
Cation Exchange Capacity ($cmol_c kg^{-1}$)	hight
Hydrolytic acidity ($cmol_c kg^{-1}$)	NA
Exchangeable P ($cmol_c kg^{-1}$)	good
Exchangeable K ($cmol_c kg^{-1}$)	good
Exchangeable Ca ($cmol_c kg^{-1}$)	NA

Soil type 3	(national or FAO classification) middle loam
Soil characteristics:	
pH (KCl)	4.5 -5.5
Organic matter or C content (%)	100 - 300
Soil texture*	
Particle size distribution (%)*	30%
USA system	Kachinskey system (Russian classification)
2000-200 µm	1000-100 µm
200-20 µm	100-10 µm
20-2 µm	10-1 µm
<2 µm	<1 µm
Cation Exchange Capacity ($cmol_c kg^{-1}$)	middle
Hydrolytic acidity ($cmol_c kg^{-1}$)	NA
Exchangeable P ($cmol_c kg^{-1}$)	insuficient
Exchangeable K ($cmol_c kg^{-1}$)	insufficient
Exchangeable Ca ($cmol_c kg^{-1}$)	NA

For each radioecological region, the fraction of each soil type:

Soil type	Fraction in each Region		
	1	2	3
1	0.35	0.5	0.6
2	0.4	0.2	0.1
3	0.15	0.15	0.1

RESOURCES AND COSTS

For each radioecological region

Types of equipment and materials that could be required for the various countermeasure options

Resource	**AVAILABILITY: GOOD, AVERAGE, POOR**			Cost, US$ [1,2]
	Local	Regional	National	
Ploughs	good	Good	good	0,5 Sk/m^2
Deep ploughs	good	Good	good	0,5 Sk/m^2
Lime	average	Average	average	
NPK fertilisers	average	Average	average	
Manure	good	Good	good	
Prussian Blue	poor	Poor	poor	
Indoor stabling for animals	good	Good	good	
Stored feed for animals, eg hay			good	
Facilities for processing foods, eg milk			good	
Facilities for storing food, eg milk products			average	

7.2.7.2 Decontamination

Category of habitation	Description of category
A – Cities	cities with more than 50 000 inhabitants, industry centres, Land covered by buildings: 40% Land covered by permeable surfaces: 20% Land covered by impermeable surfaces: 40% Building types: Low shielding, small two storey detached, 15% Medium shielding, two storey semi-detached, 5% High shielding, multi-storey building, 80% Population living in this area: 30% Time spent at each location: Low shielding / Medium shielding / High shielding / Outdoors 7% / 4% / 77% / 12%
B Towns	towns with 10 000 to 50 000 inhabitants, industry and agricultural centres Land covered by buildings: 25% Land covered by permeable surfaces: 50% Land covered by impermeable surfaces: 25% Building types: Low shielding, small two storey detached, 15% Medium shielding, two storey semi-detached, 5% High shielding, multi-storey building, 80% Population living in this area: 35% Time spent at each location: Low shielding / Medium shielding / High shielding / Outdoors 9% / 4% / 72% / 15%
C Village	Small towns and villages with less than 10 000 inhabitants, agricultural centres Land covered by buildings: 10% Land covered by permeable surfaces: 80% Land covered by impermeable surfaces: 10% Building types: Low shielding, small two storey detached, 90% Medium shielding, two storey semi-detached, 5% High shielding, multi-storey building, 5% Population living in this area: 35% Time spent at each location: Low shielding / Medium shielding / High shielding / Outdoors 47% / 17% / 11% / 25%

Building Type	Description of type, size and basic construction materials used for

	walls and roofs
two storey houses semidetached and detached	External walls plaster 15 mm, brick 112 mm. Load baring walls brick 220 mm. Partition walls 100 mm. Roof tiles 24 mm.
multistorey buildings	External walls concrete blocks 220 mm Load baring walls brick 220 mm. Partition walls concrete 100 mm. Roof concrete, asphalt

	Inhabited area A	Inhabited area B	Inhabited area C
% Area covered by all buildings	40	25	10%
% Area of permeable surfaces	40	25	10%
% Area of impermeable surfaces	20	50	80%
% of each building type	1.- 17% 2.- 83%	1. - 20% 2. - 80%	1. - 95% 2. - 5%
% Population	30%	35%	35%
Number of trees within 10 metres: 0, <10 or >10	< 10	>10	>10

Percentage of population	Building type 1	Building type 2	Building type 3	Building type 4	Building type 4	Outdoors
Category A						
	11	77				12
Category B						
	13	72				15
Category C						
	64%	11%				25%

Effectiveness of decontamination techniques

Technique	Likely to be used	Unlikely to be used	Reasons
'SKIM AND BURIAL PLOUGH'	yes		
'SHRUB AND PLANT REMOVAL'	yes		
'GRASS CUTTING'	yes		
'ROAD PLANING'	yes		
'PLOUGHING SOIL AND GRASS AREAS'	yes		
'SOIL REMOVAL'	yes		
'DOUBLE DIGGING SOIL AND GRASS AREAS'		no	it is very similar to ploughing,
'ROTOVATING SOIL AND GRASS AREAS'	yes		but just for settled areas
'FIRE HOSING PAVED AREAS'	yes		
'VACUUM SWEEPING PAVED AREAS'		no	vacuum sweepers are not usual in Slovakia
'SAND BLASTING WALLS'		no	it is useful for detached buildings, but not for multistorey
'VACUUMING INDOOR SURFACES'	yes		

Resource	Likely Availability [1]
Ploughs and tractors	A
Skim and burial ploughs	A
Vacuum brushing street cleaners Roads Pavements	D
Hand sweepers	A
Fire-engines and hoses	A
Water jet cleaners	B
Road gulley cleaners	B
Lawnmowers (with collection) large areas small areas	B
Lawnmowers (without collection)	A
Leaf vacuum sweepers	D,E
Large trucks, graders, bulldozers, JCB etc	B
Rotovators	B
Chainsaws	B
Cherry pickers	E
Chippers small (up to 150 mm wood diameter) large	A,B C
Road planers	B
Abrasive blasters	D
Chemicals - detergents, strippable coatings, gels, foams and paints	A
Turf cutters – large areas	B

Notes:

A should be available locally

B should be available regionally

C Should be available nationally

D Availability likely to be limited

E Not available in the country

7.2.8 Ukraine

7.2.8.1 Decontamination

Category and building Type.

Category of habitation	Description of category
A	cities (with densely built up areas and multi-storey buildings)
B	towns (areas of habitation where the density and size of buildings is less)
C	villages (which are typical of rural communities)

Building Type for category A	Description of type, size and basic construction materials used for walls and roofs
multi-storey buildings (type 1)	based material - concrete, breeze blocks
multi-storey buildings (type 2)	based material - brick
five storey buildings (type 3)	based material - brick
one-two storey buildings (type 4)	based material - brick

Building Type for category B	Description of type, size and basic construction materials used for walls and roofs
multi-storey buildings (type 1)	based material - concrete, breeze blocks
multi-storey buildings (type 2)	based material - brick
five storey buildings (type 3)	based material - brick
one-two storey buildings (type 4)	based material - brick

Building Type for category C	Description of type, size and basic construction materials used for walls and roofs
one-two storey buildings (type 1)	medium country houses built of brick
one storey buildings (type 2)	small country houses built of wood

Description of general inhabited area.

	Inhabited area A	Inhabited area B	Inhabited area C
% Area covered by all buildings	35	20	10
% Area of permeable surfaces	40	60	80
% Area of impermeable surfaces	25	20	10
% of each building type	type 1 - High shielding, multi-storey building (concrete) - 35% type 2 - High shielding, multi-storey building (brick) - 35% type 3 - Medium shielding, five-storey building - 5% type 4 - Low shielding, one-storey building - 25%	type 1 - High shielding, multi-storey building (concrete) - 5% type 2 - High shielding, multi-storey building (brick) - 15% type 3 - Medium shielding, five-storey building - 20% type 4 - Low shielding, one-storey building - 60%	type 1 - Medium and low shielding, medium country houses built of brick - 80% type 2 - Low shielding, small country houses built of wood - 20%
% Population	22	15	63
Number of trees within 10 metres: 0, <10 or >10	<10	>10	>10

Time spent outdoors and in each building type.

Percentage of population	Building type 1	Building type 2	Building type 3	Building type 4	Building type 5	Outdoors
Category A						
	30	30	5	20	-	15
Category B						
	5	10	15	50		20
Category C						
	52	13				35

Review of available equipment resources.

Resource	Likely Availability [1]
Ploughs and tractors	A
Skim and burial ploughs	D
Vacuum brushing street cleaners Roads Pavements	 B B
Hand sweepers	A
Fire-engines and hoses	B
Water jet cleaners	D
Road gulley cleaners	D
Lawnmowers (with collection) Large areas Small areas	 D D
Lawnmowers (without collection)	B
Leaf vacuum sweepers	D
Large trucks, graders, bulldozers, JCB etc	B
Rotovators	A
Chainsaws	A
Cherry pickers	B
Chippers Small (up to 150 mm wood diameter) Large	 B D
Road planers	B
Abrasive blasters	D
Chemicals - detergents, strippable coatings, gels, foams and paints	A
Turf cutters - large areas	D

Notes:

A should be available locally   B should be available regionally

C Should be available nationally   D Availability likely to be limited

E Not available in the country

7.2.8.2 Agricultural countermeasure

Soil classification in each radioecological regions.

Region 1	***Polesie*** 8 745 800 ha, 14% of Ukraine		
	soddy-podzolic	soddy-meadow	peat
	60 %	20 %	10%
pH (H2O)	6 - 6,9		
pH (KCl)	5,5 -6,5	5,6 - 7,3	
Humus, %	0,56 - 1,48	5,8	34
Clay content, % (particle size < 0.01 mm)	10 - 20	20 - 30	
Cation exchange capacity, mg-eq. per 100 g soil	2,5 - 7,1	16 - 24	
Extractable P, mg per 100 g of soil	42 -52	50	
Extractable K, mg per 100 g of soil	3 - 10		
Bulk density, g per sm3	2,6	2,6	1,9
Volume density, g per sm3	1,4	1,5	0,13

Region 2	***Forest-Veld*** 25 152 000 ha, 41,7 % of Ukraine			
	Chernozem typical	Chernozem meadow	Podzolic	Salt-marsh
	51%	19%	25%	5%
pH (H2O) pH (KCl)	6,7 - 7,4	7,7 - 9,5 5,2 - 6,2	5,1 - 7,2 4,5 - 6,3	6,5 - 10,5 6,7
Humus, %	4,2 - 5,6	2,8 - 5,8	2 - 7,3	2,4 - 7,7
Clay content, % (particle size < 0.01 mm)	42 - 52,5	23,9 - 71,1	23,4 - 53	16,4 - 35,7
Cation exchange capacity, mg-eq. per 100 g soil	22,1 - 36,3		16,5 - 31,5	
Extractable P, mg per 100 g of soil	66 - 100		60 - 94	306
Extractable P, mg per 100 g of soil	17,5 - 18,6		13 - 15,3	78,7
Bulk density, g per sm3	2,55 - 2,62		2,6 - 2,7	
Volume density, g per sm3	1,13 - 1,24		1,1 - 1,4	

Region 3	***Veld*** 25 000 000 ha, 40% of Ukraine		
	Chernozem	Kashtan salt-marsh	Glay-soddy
	57%	8%	
pH (H2O)	6,9 - 7,2	6,4 - 7,7	5,7 - 6,4
pH (KCl)	6,1 - 6,2	5 - 5,4	4,9 - 5
Humus, %	3,3 - 6,1	3,5 - 4,1	3,5 - 5,2
Clay content, % (particle size < 0.01 mm)	60,7 - 62,8	44,9 - 62,9	55,9 - 77,7
Cation exchange capacity, mg-eq. per 100 g soil	45 - 52	21,3 - 36	11,6 - 32,8
Extractable P, mg per 100 g of soil		72,2 - 107,5	110,6
Extractable K, mg per 100 g of soil			
Bulk density, g per sm3	2,4 - 2,6	2,6 - 2,7	2,7
Volume density, g per sm3	1 - 1,1	1,1 - 1,2	1.1

Region 4	***Karpati region***
	Burozem
pH (H2O)	4,1 - 5,1
pH (KCl)	3,75
Humus, %	5,7 - 11,3
Clay content, % (particle size < 0.01 mm)	27,8 - 47,2
Cation exchange capacity, mg-eq. per 100 g soil	3,5 - 12,8
Extractable P, mg per 100 g of soil	58,7 - 272
Extractable K, mg per 100 g of soil	
Bulk density, g per sm3	
Volume density, g per sm3	

Region 5	***Mountain Crimea***
	Chernozem typical Burozem
pH (H2O)	5,6 - 7,4
pH (KCl)	
Humus, %	3,6 - 14
Clay content, % (particle size < 0.01 mm)	44,8 - 68,8
Cation exchange capacity, mg-eq. per 100 g soil	21 - 41,5
Extractable P, mg per 100 g of soil	
Extractable K, mg per 100 g of soil	
Bulk density, g per sm3	2,6
Volume density, g per sm3	1,1

Document History

Document Title:	Documentation on the two INCO working programs: 'Review of the adequacy of the present countermeasure modelling' and 'Adaptation of the countermeasure model to local conditions'
RODOS number:	RODOS(WG3)-TN(99)-39
Version and status:	Version 1.0 (final)
Authors/Editors:	W. Raskob, J. Brown (eds.)
Address:	
Issued by:	
History:	
Date of Issue:	19.02.2000
Circulation:	
File Name:	WG3_TN99_39
Date of print:	July 28, 2000