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'

D R A F T

RODOS REPORT

DECISION SUPPORT FOR NUCLEAR EMERGENCIES

RODOS(WG3)-??(??)-??

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W. Raskob, ed.
FZK
Postfach 3640, 76021 Karlsruhe, Germany
Email: wolfgang.raskob@iket.fzk.de

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

Ondrej Slavik
NPP RI – 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.V. Fesenko, S.I. Spiridonov, B.I. Yatsalo, O.A. Mirzeabassov, N.I. Sanzharova, V.K. Kuznetsov

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

Draft, 29.7.99

Management Summary

Within the two INCO contracts on customisation of the foodchain and dose module (FDMT) to Eastern European countries, the present version of FDMT has been made more flexible to account for the differences in crop production und feeding habits all over Europe. It was in general agreed by all contractors that the module is able to cope with the various conditions in the individual countries of Eastern Europe. Only in case of the adaptation to Russian conditions it was pointed out that the predicted behaviour of the radionuclides in soil did not follow the measurements and therefore a modification of FDMT might be necessary for this feature. In addition, the ingestion of soil particles by grazing animals may need further investigation. Besides these two comments, parameter adaptation seems to allow a successful adaptation of FDMT to any radioecological region in Eastern Europe.

For 7 countries, radioecological regions have been defined, only for Russia, one region was selected as an example for the customisation process. Even if the number of regions as well as the selection criteria differ, this report can provide a valuable help in the methodology how to divide a certain country into the appropriate radioecological regions.

The data collection is still ongoing. This report serves as documentation of all the necessary data to adapt FDMT 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 radioecological 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 Appendix, the detailed set however can be found in the individual reports of the various countries provided. They are available as technical RODOS reports.

Contents

1 Objective of the two so called INCO contracts: 'Review of the adequacy of the present foodchain and dose calculations' and 'Collection of the data required for each radioecological region and their integration in RODOS'

Within the program of customisation of RODOS for use in Eastern Europe, the adaptation of the foodchain and dose module FDM is included. The current version of the module contains data sets which more or less are appropriate for mid Europe, in particular for the region of Southern Germany. As these default data cannot be applied over whole Europe, so-called radioecological regions are defined in FDMT which account for the differences in climate and ingestion habits. These regions define areas, with relatively uniform radioecological conditions for which the same set of model parameters can be used.

The selection of such radioecological regions, with relatively uniform radioecological conditions, is predominantly determined by prevailing agricultural production regimes, growing periods of plants, harvesting times, feeding regimes for domestic animals, human consumption habits, etc.. Typically, a country is subdivided into 1 to 5 such radioecological regions. It is unlikely that finer subdivisions can be justified since the year-to-year variations, which are unpredictable, would be higher than the variations between such fine regions. Radioecological regions have been defined for Czech Republic Hungary, Poland, Romania, one part of Russia, Slovak Republic, and Ukraine.

The task of the customisation project was first to identify whether the radioecological and dose models itself are sufficient or the application in Eastern Europe and to collect data for the model parameters appropriate to each radioecological region to enhance or replace the default data within the RODOS database for FDM. This work has been performed by the countries based on their available resources and on data bases. Therefore, the no complete harmonisation of the task could be achieved. This reflects the summary report where the selected procedure is individually described for the various countries. This allows on the other hand further customiser to select which of presented procedures fit best to their needs with respect to available data and knowledge. Finally, the necessary data to run FDMT had to be collected, however, the detailness and the reliability is quite different. This again reflects this report and there was never the idea to harmonise - which means minimise the reporting - that all the data collection procedures look similar. In contrary, the reader has still the possibility to select with the presented information his way to collect the appropriate data.

1.1 Foodchain modelling

An important task of RODOS is to predict the radiation exposure of the population during and after an accidental release of radionuclides to the environment. The transfer of radionuclides from the plume to terrestrial foods , as well as the resulting radiation exposure, are modelled in the Deposition Module, the Food Chain Modules, and the Dose Modules[1]. Besides the main Terrestrial Food Chain Module, which considers the direct transfer of radionuclides from atmosphere onto agricultural crops, additional modules have been developed for those pathways which require special modelling approaches (see Fig.1). The estimation of doses, via all exposure pathways which might be of importance during and after the passage of the radioactive plume, is performed in the subsequent Dose Modules; the endpoints are the collective and individual doses for all pathways and people of different ages.

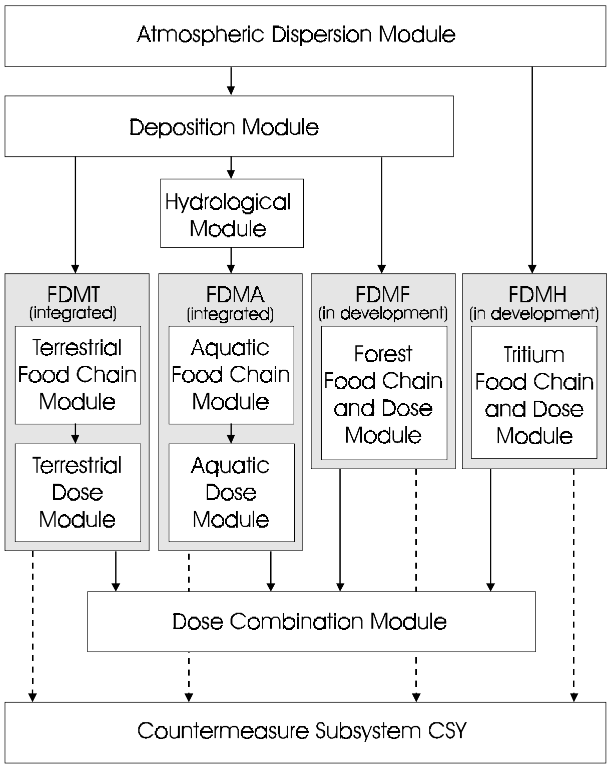

Fig. 1: Structure and data flow of the Food Chain and Dose Modules in RODOS

Following the atmospheric transport and dispersion modelling (ADM), the activity concentrations in air and the wet-deposited activity is transferred to the Deposition Module. The results of the deposition calculation, deposited activity onto plants and soil, are input to the Terrestrial Food Chain and Dose Module, FDMT. Special modules have been development for semi-natural (forest) pathways, FDMF, and for the transfer of tritium through foodchains, FDMH.

FDMT is based on the dynamic radioecological model ECOSYS-87[2]. The assessment of the activity in foodstuffs is performed in several steps:

(1) Calculation of activity deposition on soil and different species of agricultural plants: Dry and wet contamination are considered separately. Wet deposition is calculated from the total wet deposition and an interception parameter describing that the fraction of activity retained on the plants depends on the amount of rainfall and on the seasonal stage of development of the plant canopy. Dry deposition on plants is calculated using a deposition velocity, which depends on the nuclide considered, the plant type, and also on the stage of the plant development. An irrigation module has been developed to simulate the activity deposition onto crops by using contaminated irrigation water.

(2) Calculation of the time-dependent activity in the edible parts of plants: Contamination of plants results from foliar and root uptake of radionuclides and - in case of partly eaten plants like potatoes and cereals - from translocation of nuclides from the leaves to the edible part of the plant. Calculation of contamination from foliar uptake considers resuspension and activity loss due to growth dilution, weathering effects and physical decay. The estimation of root uptake is based on soil-plant transfer factors and takes into account the reduction of radionuclides available through migration of nuclides in deeper layers, fixation to the soil and physical decay.

(3) Contamination of animal products: Activity intake by animals is considered by season-dependent feeding practices, with up to five different feedstuffs per animal. Plants or products processed from plants or animal products can be considered as feedstuffs. Activity transfer from feedstuffs into animal products is estimated by using transfer factors and biological half-lives. Radionuclide intake through soil ingestion is included by applying an additional soil-plant transfer factor.

(4) Contamination of feedstuffs and foodstuffs: Time- dependent activities in feedstuffs and foodstuffs are calculated by considering activity enrichment or dilution during processing and culinary preparation. Furthermore, physical decay during processing and storage times is taken into account.

The dynamics of the agricultural food chain transfer processes (e.g., seasonality in plant growing) lead to a very pronounced seasonal dependency of the radiological consequences. For example, the same concentration of Cs-137 in air can lead to a variation of the ingestion dose of two orders of magnitude, depending on the date of deposition.

1.2 Dose estimation

All exposure pathways which might be of importance during and after the passage of the radioactive plume, are considered in the RODOS Dose Modules:

1. external exposure from radionuclides in the plume,
2. external exposure from radionuclides deposited on the ground,
3. external exposure from radionuclides on the skin and clothes of people,
4. internal exposure due to the inhalation of radionuclides,
5. internal exposure due to the inhalation of radionuclides from resuspended soil particles, and
6. internal exposure due to ingestion of contaminated foodstuffs.

The first four pathways are relevant in the early phase, i.e. during the passage of the plume, while in the long-term only (2), (5) and (6) contribute to the exposure of people.

In RODOS two types of individual doses are calculated:

- Potential doses which give an upper limit of individual doses.
- Expected doses which give a best estimate of the average exposure of the population.

The assessment of external exposure from radionuclides in the plume is based - for large distances from the source - on the time-integrated activity concentration in air, assuming a semi-infinite homogeneous cloud. For locations in the vicinity of the emission source, a three-dimensional integration over the contribution of all parts of the plume is performed in the atmospheric dispersion module of RODOS; the resulting kerma in air is passed to the Dose Module, which estimates the organ doses and/or effective dose from it.

The external exposure from nuclides deposited on ground and other surfaces of the human environment is calculated on the basis of the total deposited activity onto a standard surface (lawn). Correction factors considering different shielding and deposition patterns (especially in urban areas) are used for calculation of expected doses. For both external exposure pathways (cloud and ground) age dependent dose conversion factors are used, based on Monte Carlo calculations using human phantoms. The major problem in estimating expected doses comes from large variations of the reduction effects due to staying in different environments outside and inside houses and to residual habits of people. It is not possible to consider all actual conditions in the dose estimation. So the estimated doses can only be average doses for the average population. For all external exposure pathways, potential doses are estimated by assuming that the people stay outdoors over a lawn all the time, i.e., no shielding or filtering effects by buildings are assumed. As an additional pathway of external exposure, irradiation from radionuclides deposited onto the skin and clothes is considered. The applied model is considered to have rather big uncertainties, but the contribution of this pathway is of minor importance. External exposure from forests is modelled separately by considering the separate contribution from canopy and soil.

Inhalation doses are estimated from the concentration of activity in air by using age-dependent inhalation rates and dose factors. Long term inhalation of resuspended material is considered, but the database for the applied model is relatively poor. Potential inhalation doses assume that people stay outdoors, while expected doses consider lower concentrations of activity inside buildings and the average fractions of time when people stay in- and out-doors.

Ingestion doses are calculated from the time-dependent concentrations of activity in foodstuffs, by applying age- and season-dependent consumption rates and age-dependent dose conversion factors. A special problem with ingestion doses is that many foodstuffs are produced at a location different from that where they are consumed. Realistic consideration of food transport is hardly possible, especially in the case of an emergency, which may involve unpredictable changes of the transport pattern. In addition, spontaneous changes of peoples' consumption rates can easily occur. Therefore, only potential ingestion doses (i.e., assuming full local production of all foodstuffs and long-term-average consumption rates) are calculated in RODOS.

In RODOS also collective doses are estimated in order to quantify the effectiveness of different possible countermeasures for mitigating the radiological consequences. The collective dose of a certain population is commonly considered as the sum of individual doses of all people belonging to the population. For large populations it is not possible to take this definition as a basis for calculating the collective dose, since it is not possible to consider the living conditions of all individuals for estimating their individual doses. Within RODOS, especially the relative changes of the collective doses due to application of countermeasures are of concern. This justifies the application of an approximating method for estimation of the collective doses: the individual doses for average adults are multiplied with the total number of inhabitants living in a certain area.

In the case of ingestion doses, the summing up of individual doses is complicated by the fact that foodstuffs are normally not totally produced in the area where they are consumed (or vice versa). For reasonably estimating a collective ingestion dose for a population, it would be necessary to know where all the foods have been produced and what the level of their contamination is. This knowledge is not available, in general. Therefore another approach to calculating the collective ingestion dose is applied in RODOS: the collective dose results from consumption of all foodstuffs produced in a certain area, irrespective of where they are consumed.

2 Customisation of FDM

Each of the contractors first investigated the accuracy of FDMT for the customisation purposes. In general it was agreed that the structure and the content of the model seems to be sufficient for the use in RODOS over a wide range of environmental conditions. But it became also obvious, that the animal feeding and human ingestion habits differ widely all over Europe. Therefore, FDMT had to be made flexible enough to consider the animal feeds and human foodstuffs of importance in the countries in which RODOS will be implemented.

To this purpose, FDMT contains a basic set of feed and foodstuffs which are produced nearly all over Europe and are considered in all regions. This allows a comparison of the contamination of these standard products within the whole area under due consideration to be made. In addition, for each radioecological region the animal feeds and foodstuffs which are important for the nutrition of the average population or individual groups can be defined in the model specifically. For this purpose, several plant models are available in the food chain module which can be adjusted by an appropriate choice of model parameters to the conditions of individual crops. Similarly, region specific animal products can be defined by adapting the parameters of the model describing the transfer of radionuclides from fodder to animal products.

Besides the standard products which are common to all radioecological regions additional products - so-called variable products (feedstuffs or foodstuffs) can be defined for each of the regions. Default data are available for Central European conditions; they comprise 22 animal feeds (17 based on plants, 4 based on animal products and feeding water) and 35 foodstuffs(17 plant products, 17 animal products and drinking water). The relatively large number of products is due to the need to reflect properly the diversification of plant species in reality. Furthermore, some foodstuffs with small average consumption rates have to be included to cover the possibly high importance to critical groups, e.g., sheep or goat’s milk.

Following the agreement on the accuracy of FDMT, the contractors started to define the appropriate radioecological regions for their home countries. Thereafter, data collection started which is, however, still ongoing. According to the structure of FDMT, data collection can be subdivided into nuclide dependent and nuclide independent data sets.

- Nuclide independent parameters consist of:
    - Products to be considered (plants, animal products, feedstuffs, foodstuffs...)
    - Plant growing and harvesting times
    - Feeding habits

- Consumption habits

- Nuclide dependent parameters consist of:
  - Translocation factor
  - Soil parameters (leaching rate, fixation rate...)
  - Soil-plant transfer factors
  - Transfer factors to animal products
  - Processing of feed-/foodstuffs

The investigation about the adequacy of the models, the definition of the radioecological regions and the data collection is attached for each of the six contractors in the following chapters. The collected data cannot be presented in detail, however the information collated in the Appendix provides an overview about the available information. To be compared with, the default data set of FDMT, appropriate for Central European conditions are also attached in the Appendix.

3 Adequacy of the present foodchain module FDMT

The first task in the customisation process was to examine if the present FDMT model approach is adequate for the use in the individual countries. This was achieved mainly by comparing FDMT with local radioecological models as well as in the case of Russia, Slovak republic and Ukraine by comparing it with an extensive data base from the Chernobyl accident. In general, the modelling approaches were broadly agreed as being adequate for radioecological assessments in Eastern countries after the collection of the appropriate parameters. However the processes of leaching in soil and the uptake of soil by grazing animals have been identified as potential candidates for model improvement (Russia). Consequently FDMT will contain updated submodels for these processes in its version 4.0.

3.1 Adequacy of the present foodchain model (Czech Republic)

3.1.1 Present status of knowledge in the Czech Republic

Modeling of the radionuclide transport in food chain has a certain tradition in the Czech Republic. The foodchain model ENCONAN (Environmental Contamination Analysis) [4] was used to test the adequacy of the FDMT model for the Czech Republic. The model was successfully verified by its author within VAMP validation study for CB scenario [5].

The model considers all specific pathways. It reflects the dynamics of the time dependent deposition process on the plant surface in the various phases of vegetation period, the transport via leaves or roots to the plant and the transfer from feed to animal products. The success of the modeling is also dependent on many additional factors including feeding habits, farming practices and crop processing technology used in the Czech Republic territory to prepare foodstuffs and feeding mixtures. The model in general can be regarded as deterministic based on the method of concentration factors. However for pork contamination, a dynamic compartment model is used. Food consumption rates originated from official trade balance data and their categorisation according to various age group was done on the basis of negotiations with experts. The results of the dynamic modelling have been compared for particular cases with COSYMA and the results have been published in [21].

Many model parameters have been already investigated and data collected [6]. However, in comparison with FDMT, the ENCONAN data represented only a subset of the necessary local foodchain parameters (for only one ecological region , restricted set of products).

The following areas were already investigated in relation with application of ENCONAN model for the Czech region:

- plants considered (13 species of the most important plants)
- plant characteristics (vegetation period characteristics, yields, consumption delays)
- annual consumption rates for different age categories were found for the main foodstuffs
- feeding diets of animals were defined

Besides the items mentioned above many useful nuclide dependent and nuclide independent parameters were collected, which could be used in further FDMT customisation.

3.1.2 Conclusion related to the adequacy of FDMT for Czech Republic

On the basis of the previous experience one can conclude that FDMT represents a sophisticated tool which should substitute any former simpler models. It complies with the structure of the food chain modelling considered for Czech Republic but more local input data are needed.

FDMT has been checked for its capability to cover the variability in plant production, foodstuff consumption, processing procedures and other features specific for the Czech Republic. The dimension of the parameters are sufficient to add some additional local-specific items. Collection and construction of the FDMT data for Czech Republic are submitted to internal quality assurance procedure within the „Accreditation of the RODOS for its use in Czech Republic“ task. It should be noted, that for all data its source and future maintenance should be clearly defined and the values have to comply with the parameters explicitly defined in the corresponding obligatory governmental regulations of the Czech Republic (mainly the new Atomic Law).

3.2 Adequacy of the present foodchain model (HUNGARY)

The development of the radioecological models has accelerated in Hungary since the reactor accident in Chernobyl. Due to this work a new set of improved models was outlined until the mid nineties. These new models participated in different international environmental model validations studies (e.g. VAMP - Validation of Model Prediction; BIOMOVS Phase I and II - Biospheric Model Validation Study Phase I and II; organised by the IAEA and the Swedish Academy of Sciences), where the overall performance of radioecological models has been tested.

In case of the aquatic and terrestrial foodchain models, these new models are also based on the compartmental concept, but they are more detailed and they include more accurate and improved parameter sets.

The structure of the most recently developed terrestrial foodchain model (called as SIRATEC), has been finalised in 1994. Its parameters are updated permanently. The model predicts the concentrations in various crops and includes dose calculation due to ingestion.

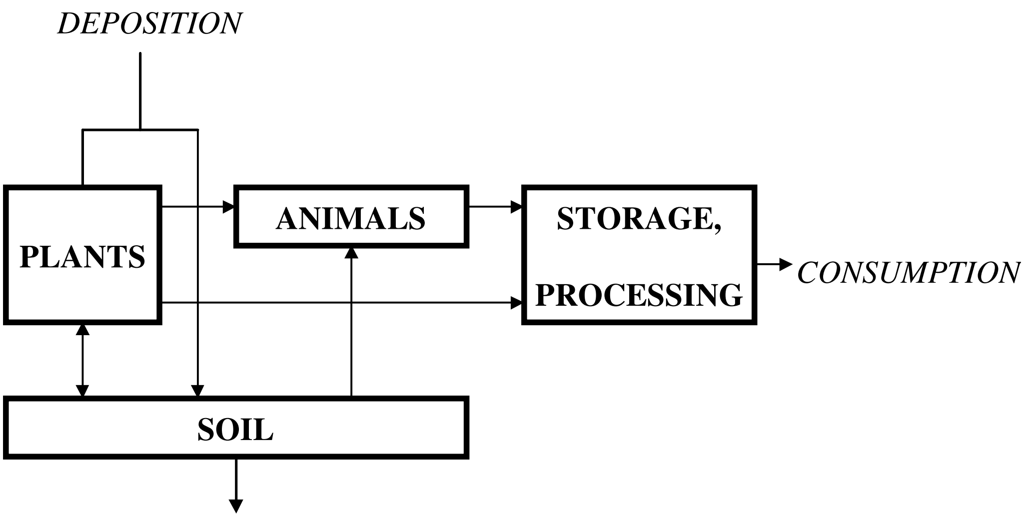

Figure 1: The structure of terrestrial foodchain model SIRATEC

The simplified structure of the terrestrial foodchain model is demonstrated on Figure 1.

Within the last years, SIRATEC has been successfully applied in the international programs BIOMOVS and VAMP. It was able to predict the concentrations in crops within the range of a factor of 3 to 5 in case of the situation in Hungary after the accident in Chernobyl.

Because SIRATEC is much more simpler than the FDMT in the present stage, it can be expected that FDMT will be able to produce as good (or more likely better) estimations as our present model.

In particular, the exercises have demonstrated that no special modification seems to be needed in FDMT to assess the level of the contamination in the terrestrial foodchain and doses due to specific conditions in Hungary.

3.3 Adequacy of the present foodchain model (Poland)

Within the process of evaluation of the applicability of FDMT to Polish conditions, the following conclusions can be formulated:
The general functional structure of FDMT is flexible enough to include local conditions through the tuning of the parameter data base. In particular, it is necessary:

1. to include other plants (alfalfa, cabbage, open area and green house cultivated lettuce) in the database,
2. to adjust parameters for some components (e.g. leafy and root vegetables), and
3. to extend the human diet and animal diets to account for Polish habits

Extension of FDMT may include the following functionalities:

1. Absorption dose conversion coefficients are currently based an ICRP30 (from 1979 year). New set of data such as of Basic Standards 115 (1996 year) would be more appropriate.
2. The radionuclide concentration in critical human organs could be calculated. It would require modification parameter database of FDMT to include parameters of functions of elements retention in critical organs.

3.4 Adequacy of the present foodchain model (Romania)

Following the Chernobyl accident, a Romanian radioecological model has been developed to be used for dose assessment. In 1989, the final product, LINDOZ-89, was applied in international model validation exercises (VAMP, BIOMOVS) showing adequate performance in various scenarios.

To test the FDMT model, also the methodology of ECOSYS - which is similar to the present FDMT module - was used to compare predictions on milk with Romanian data on dry deposition events in May 1986 . These comparisons showed good performance when the vegetation period was adapted to Romanian conditions (two weeks delay) and the animal diet was adjusted accordingly. Quite good predictions for mixed (dry and wet) deposition events were also obtained for grain.

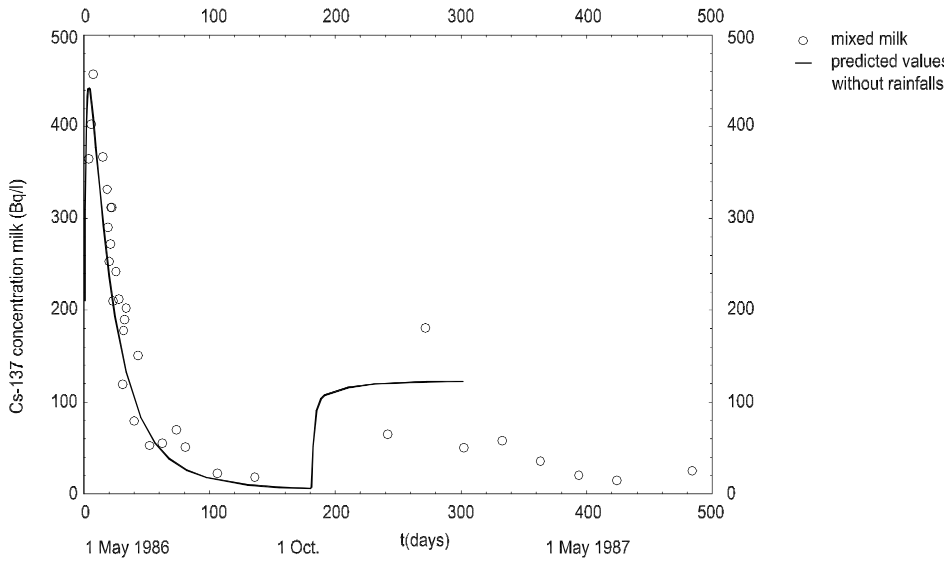

Figure 1 ECOSYS applied to Romanian - milk immediately after Chernobyl

For the basic assessment of the contamination of crops, FDMT seems to be adequate in its present structure. However, more tests may be needed in order to decide if improvements are useful from a practical point of view. For instance, a more sophisticated procedure to calculate the deposition on plants and soil, the foliar absorption and the bioavailability of the fallout may improve the model performances but can be masked by uncertainties in the source term. However, due to the new deposition modelling, parts of these improvements will be found in the version 4.0 of FDMT.

A significant modification necessary for Romanian conditions was the introduction of the straw as feedstuff. Because foliar absorption is not considered in FDMT, straw contamination has been computed using the translocation approach (plant model 5). Using experimental data from Denmark and GSF (4-5) , appropriate translocation factors have been deduced for Cs. For Sr there are no direct experimental data and a scale factor Sr/Cs has been used, derived from grain. The whole procedure has been compared with predictions from LINDOZ and reasonable agreement has been obtained.

Another modification was the introduction of maize grain as foodstuff, using the same model parameters as for maize cobs, but adjusting the yield and harvesting time. In order to simplify the assessment procedure, clover and alfalfa have been considered as ‘grass intensive’ with minor parameter modifications.

3.5 Adequacy of the present foodchain model (Russia)

The Russian Federation territory can be regarded as rather large with many different climatological and geological properties. Therefore, it can be sub-divided into a large number of radioecological regions (about 60) varying in their characteristics and, consequently, the behaviour of the radioactive substances. An area of Russia that includes the Smolensk and Kaluga administrative regions of the Russian Federation has been selected to test FDMT. This region includes a nuclear power plant (Smolenskaya NPP) and the soil, climatological, agricultural practice and dietary habits are quite uniform. The test of the adequacy and the subsequent adaptation of FDMT for the Smolenskaya NPP radioecological region provides some means to develop a procedure for the adaptation to other regions of the Russia Federation.

3.5.1 Adequacy of the model structure

To test the adequacy of FDMT for the Smolenskaya NPP radioecological region, experimental data, obtained in different periods after the Chernobyl fallout (acute and long-term periods) has been used.

Experimental data on the time function of the ^{137}Cs and ^{131}I contents in grass during the first months after the fallout were used to test the submodel that describes the interception of the fallout and the further redistribution of the radionuclides in the soil-plant system due to the processes of translocation, dilution, as well as weathering effects. It should be noted that the amount of information on the behaviour of the radionuclides in the early period after the aerial uptake is rather limited. It is, therefore, quite difficult to test the above mentioned submodel for a wide range of crop species.

To test the submodel that describes the root uptake of radionuclides a database of RIARAE on the time dependency of the transfer of ^{137}Cs to different agricultural crops in the Smolenskaya NPP radioecological region was used. The above database includes the dynamics of the transfer factors over 7-9 years following the Chernobyl fallout.

Experimental data describing the seasonal dynamics of ^{137}Cs and ^{90}Sr content in milk and meat of farm animals were used to test the submodel that calculates the contamination of animal products. This information was obtained for farms in the Bryansk region affected by the Chernobyl accident. It should be pointed out that the characteristics of the farm animals and their feeding habits in the Bryansk and Smolenskaya NPP regions are very similar.

This test of FDMT and its sub-modules has demonstrated that the structure of FDMT is suitable for the description of the behaviour of radionuclides in the agro-ecosystems of the Smolenskaya NPP region At the same time, based on the analysis of differences in farming practices between countries of Western Europe and the Russian

Federation, those areas have been identified where modification of submodels might be necessary. This comprises the behaviour of radionuclides in soil (in particular the account of root mat location of radionuclides in the meadow ecosystems in the early stage) and the radionuclide uptake by farm animals (with the consideration of the ingestion of soil particles).

3.5.2 Adequacy of the model parameters

The results from the comparison of calculated and experimental data on the ^{137}Cs and ^{131}I contents in grass in the early stage suggest that the loss rate for extensive used meadows in the Smolenskaya NPP radioecological region cannot be adequately described by using the default data set of FDMT adopted to the conditions of Central Europe. The experimental values of ^{137}Cs and ^{131}I one month after the fallout are by a factor of 8-10 lower than the calculated ones. This can be explained by differences in the climatic conditions for the radioecological regions of Germany and Central East- European areas, as well as by the different characteristics of the meadow vegetation dependent on its species composition and ways of farming.

The comparison of experimental data and calculations with FDMT for the ^{137}Cs transfer from soil to different crops cultivated within the Smolenskaya NPP radioecological region showed that the experimental transfer factors are about 2 to 7 times higher than the calculated ones. This has been observed for all crops during the period under investigation (9 years following the Chernobyl accident). The reason seems to be the low fertility of the soil in the Smolenskaya NPP region which is linked to a low humus and nutrient content. In this region (and in a number of regions of the Russian Federation) - for economical reasons -, only small amounts of fertilisers, which do not comply with the existing international standards, are applied.

RIARAE carried out specific experiments to checking of transfer parameters from deposited radionuclides to animals. In these experiments typical domestic animals received well defined quantities of radionuclides in their feeds. The observation times exceeded several biological half-life periods of the investigated radionuclides.

The differences between FDMT and the experimental data is caused by a wide range of differences in the agro-ecosystems of this radioecological region and Western Europe (soil-climatic conditions, special features of farming). Therefore, information has to be collected, dependent on the environmental conditions and specific features of the agricultural production (nuclide independent parameters), as well as radioecological parameters reflecting the rate of radionuclide migration in the various components of the specific agro ecosystem (nuclide dependent parameters).

3.5.3 Modification of FDMT model for the conditions of CIS countries and performance of validation studies with the adapted model

The model FDMT, adapted for the Smolenskaya NPP radioecological region, described quite adequately the behaviour of the radionuclides in the short and medium range after the fallout. However, it was shown that it might be necessary to improve the model for the behaviour of radionuclides in soil. The one-exponential model describing a decrease in the amount of available radionuclides in the root layer does not reflect all changes in the biological availability of the radionuclides in longer term after the fallout.

Two districts of the Bryansk region, Klimovsky and Novozibkovsky, were chosen for model testing. Countermeasures of different intensities were applied to these districts to reduce the uptake of radionuclides to farm products. The complete set of countermeasures was applied to the Novozybkovsky district whereas nearly no countermeasures were applied in the Klimovsky district, except for a few measures on animal husbandry.

Figure one illustrates the dynamics of ^{137}Cs concentration in grain either calculated with the model and obtained by experiments for the Klimovsky district. Similar results were obtained for other agriculturalal products.

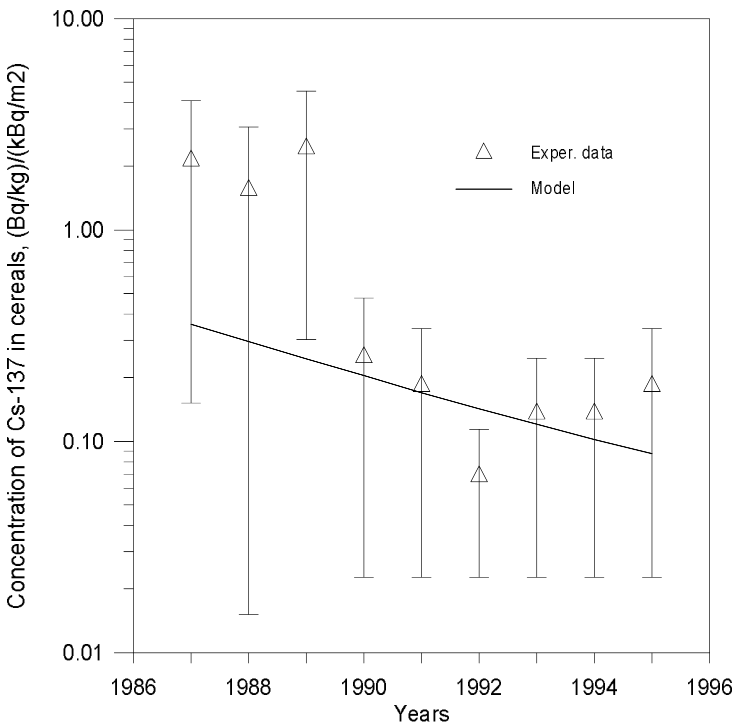

Figure 1 Dynamics of ^{137}Cs concentration in grain. Comparison of experimental data obtained after the Chernobyl accident in the

Klimovsky district with results of predictions by the modified FDMT model

To reflect the measured data, FDMT has been improved by introducing a two-exponential function for the root uptake from soil

A second point for improvement has been identified in the uptake rate of soil be grazing animals. To take into account for the specific findings, the uptake rate of soil will be explicitly models within FDMT.

3.6 Adequacy of the present foodchain model (Slovak Republic)

As a starting point, the adequacy of the original ECOSYS-87 (similar to the methods used in the RODOS project in FDMT) food chain and dose model was analysed with respect to its model flexibility and in more detail, with respect to description of the individual radioecological regions. Experience with the adaptation of the EURALERT code (which is also based on the ECOSYS-87 model) to the Slovakian Nuclear Power Plant surrounding conditions were used in these stage of works and helped to support the WG3 meeting discussions and final conclusions.

FDMT contains a basic set of feed and foodstuffs which are produced nearly all over Europe and are considered in all regions (leafy vegetables, potatoes, pasture grass and cow's milk). This allows a comparison of the contamination of these standard products within the whole area under due consideration to be made.

Besides the standard products which are common to all radioecological regions additional products - so-called variable products (feedstuffs or foodstuffs) can be defined for each of the regions. For each radioecological region, in addition, the animal feeds and foodstuffs can be defined in the model, specifically. For this purpose, several type of plant models are available in the food chain module which can be adjusted by appropriate model parameters selection to the conditions of individual crop in the region . Similarly, region specific animal products can be defined by adapting the model parameters describing the transfer of radionuclides from fodder to animal products.

The above mentioned resulting flexibility of the FDMT model significantly differs from the initial ECOSYS-87 model structure. It was achieved by additional input data structure allowing to select region specific crops and products. The final FDMT input data philosophy agrees well with the Slovakian experience obtained with the customisation of the EURALERT code to local.

Default data available in the FDMT model comprise 22 animal feeds (17 based on plants, 4 based on animal products and feeding water) and

35 foodstuffs (17 plant products, 17 animal products and drinking water). The relatively large number of products is necessary due to the need to reflect properly the temporal dynamic of contamination and diversification of plant species in reality. Furthermore, some foodstuffs are included to cover their possibly high importance to critical groups, e.g., sheep or goat's milk.

This flexibility of the new FDMT approach allows the customisation to Slovakian conditions with its three radioecological regions.

3.7 Adequacy of the present foodchain model (Ukraine)

The analysis of the adequacy of the model was carried out by using the aquatic version of the FDM model system. As both FDMT and FDMA do not differ in their treatment of the basic processes except that FDMA considers in addition irrigation processes, an agreement between FDMA and measurements also allows to judge that FDMT is approapriate.

Comparison have been performed in case of contamination of irrigated crops, which may be important in case of high contamination of irrigated water and especially in case of spray irrigation, when the contamination of crops may be up two orders higher than during other ways of irrigation [35, 18].

Experimental data from crops irrigated with water from the Kakhovka reservoir have been used. Being one of the regions with an extensive use of irrigation, also measurements after the Chernobyl accident were taken on a rather regular basis. Experimental data were derived from the Ukrainian Hydrometeorological Centre and synthesised together with those from [29,30, 36-38]

In addition, calculations with FDMT were carried out for the conditions of Polesie and Forest-Veld regions assuming a normalised contamination following an accident at the beginning of the vegetating period (to be close to the conditions of the Chernobyl accident). The results for unit contamination were close to Ukrainian models [16].

3.7.1 Adequacy of the model parameters

Calculations have been performed for both the basic set and for an adapted set of FDM parameters. In this case the parameter set for the Veld radioecological region was selected. In addition, the amount and frequency of irrigation was estimated and adapted in FDMA.

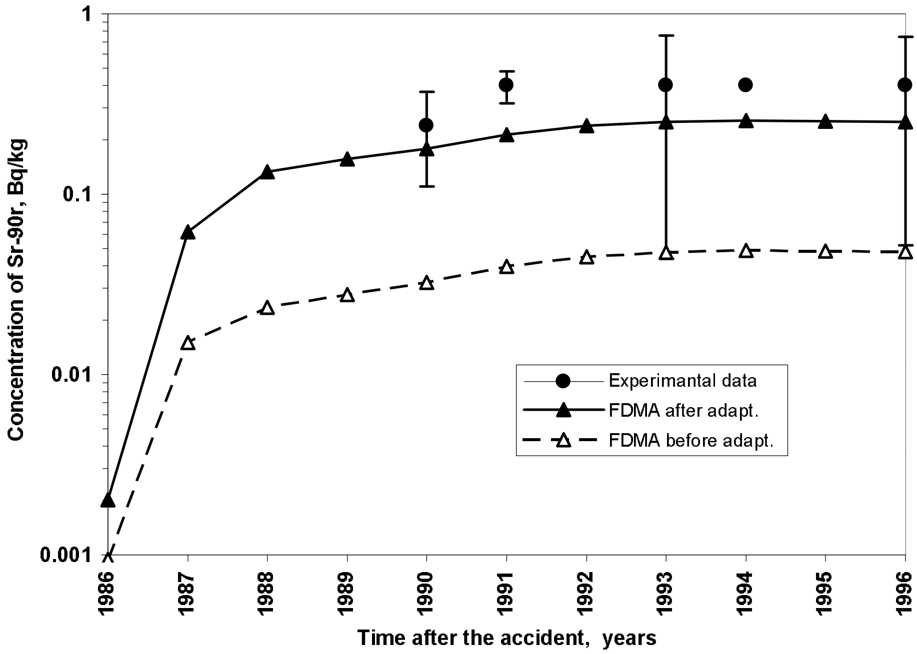

Fig 1: Time dependent ^{90}Sr concentration in irrigated winter wheat after Chernobyl accident in the South of Ukraine.

As an example from all these comparison calculation, Fig.1 shows the time dependent concentration of ^{90}Sr in winter wheat over a ten years period from 1986 - 1996. Results with the basic parameter set, the region adapted set and the measurements are presented. Calculation have been performed by using the stand-alone version of FDMA 3.1 program before and after its adaptation.

This comparison of model results and experimental data demonstrates the satisfactory predictions of the adapted model. When adapted to the ecological conditions of the Ukraine, FDM seems to be applicable for assessing of the dynamics of the contamination of agricultural products and the internal exposure of humans due to ingestion of contaminated foodstuffs for different regions of Ukraine.

It is necessary to carry out further validation tests for the later stage after an accident by using data of soil and plant contamination after the Chernobyl accident.

But in general one can conclude that the structure of the model is adequate for the description of transfer processes of radionuclides trough the food chains and subsequent internal exposure of humans due to ingestion of contaminated foodstuffs for Ukrainian conditions.

4 Radioecological regions

Within the customising process for FDMT, regions had to be defined where one set of model parameters can be used for FDMT. Thus areas of similar radioecological characteristics had to be aggregated into one radioecological region. Due to environmental reasons and also due to computational constraints, each country could only be subdivided into five different radioecological regions.

The following criteria for subdividing the countries into the radioecological regions were mainly applied:

- the climatological characteristics of the region,
- the soil types,
- the growing cycles of the agricultural crops,
- the agricultural properties,
- the feeding practices and
- the altitude.

Based on these criteria, the following number of radioecological regions have been defined for Ukraine (5), Slovak Republic (3), Romania (3), Czech Republic (3), Poland (7) and Hungary (2). Except for Russia (only one region has been exemplarily defined) and for Poland, the number of the regions lay within the requested number of maximal five.

4.1 Radioecological regions (Czech Republic)

Insufficient existing data and lack of manpower and financial resources for external cooperation led to the decision to adapt in the first stage a very simple solution. Three radioecological regions were declared on the basis of their altitudes. There are some ideas to continue a more profound analysis performed in cooperation with a special expert team, mainly on the basis of [3] where an attempt for the new regionalisation is introduced. The simplified conception of radioecological zone definition based on pure elevation basis was discussed with partners from the Czech Hydrometeorological Institute (department of agrometeorology), the Czech Agricultural University and the Research Institute for Plant Production (RICP). Definition of radioecological zones was done automatically on the basis of the corresponding elevations.

$h < 450$ m above sea => region no. 1

$450 \leq h \geq 700$ m => region no. 2

$h \geq 700$ m above sea => region no. 3

The previous definition did not more or less fit with a set of agro-climatic maps [1] for several products. In addition, some facts from [2] and [3] confirmed this approach. In [1], the selection according to the average temperature on the territory was performed. Three basic categories were introduced as:

- areas with high temperatures
- areas with mild temperatures
- areas with low temperatures

Also from there considerable resemblance with the three zone classification can be found. Strong correlation between elevation and agro-climatic characteristics confirm the latest data provided by RICP. However, extreme weather condition may shift the beginning of the growth. In particular, a dry surface layer (seed- planting bed) may delay it by a week and longer. A cold soil slows down the sprouting for all crops but very sensitive are potatoes, maize and sunflower. In 1998 winter cereals and rape started to growth already in mid February which was opposite to 1996 where it started 3-4 weeks later

The phenology of most crops can be related to the altitude and temperature and thus to the sum of the so called effective degrees. The number of days with a temperature over 5 °C amounts to about 200-250 for altitudes of less than 200m. This number decreases by 8-9 days for each increase of height by 100 m. However, the effect of the field position (frost valleys, orientation of a slope to south or north etc.) must be taking into account when applying the relation to specific fields. Some phenological data are provided in Table 1.

Crop	Sowing date	Flowering date	Harvesting date	Remarks
winter wheat	10.9-16.10	1.-23.6	22.7-27.8	
spring wheat	3.3-10.4	17.6-1.7	10.8-4.9	
winter barley	2.-20.9	26.5-18.6	13.7-10.8	
spring barley	5.3-14.4	10-28.6	20.7-25.8	
grain maize	10-28.4	15.7-4.8	10.9-12.10	
silage maize	22.4-5.5	22.7-10.8	10.9-2.10	
potato	15.3-5.5	30.6-27.7	12.6-15.10	early
sunflower	10-24.4	15.6-5.7	10.9-5.10	
winter rape	10.8-1.9	1.5-15.5	12.7-10.8	
spring rape	25.3-15.4	15.6-30.6	1.8-25.8	
sugar beet	26.3-12.4		28.9-25.10	

Table 1: Phenological calendar of the Czech republic (reasonable ranges recommended by RICP)

In [3], the new multiparametric concept for the regionalisation of the Czech Republic is described. The terrain, pedological characteristics, hydrology and climatic data are investigated together. Thirty years (1961 - 1990) of measured temperatures and precipitation correlated with relative and absolute alimetric data were used for the investigations. Distribution of thermal energy and humidity is considered as a main feature for the discrimination. This new regionalisation for the whole Czech Republic was used as basis to replace the present single - parametric definition of the radioecological regions based on elevation only. The complex approach from [3] was reduced to 3 basic categories taking into account to the differences in the period where the temperatures are above 10 degrees (the "vegetation period" in Figure 1 is defined for temperatures above 10°C).

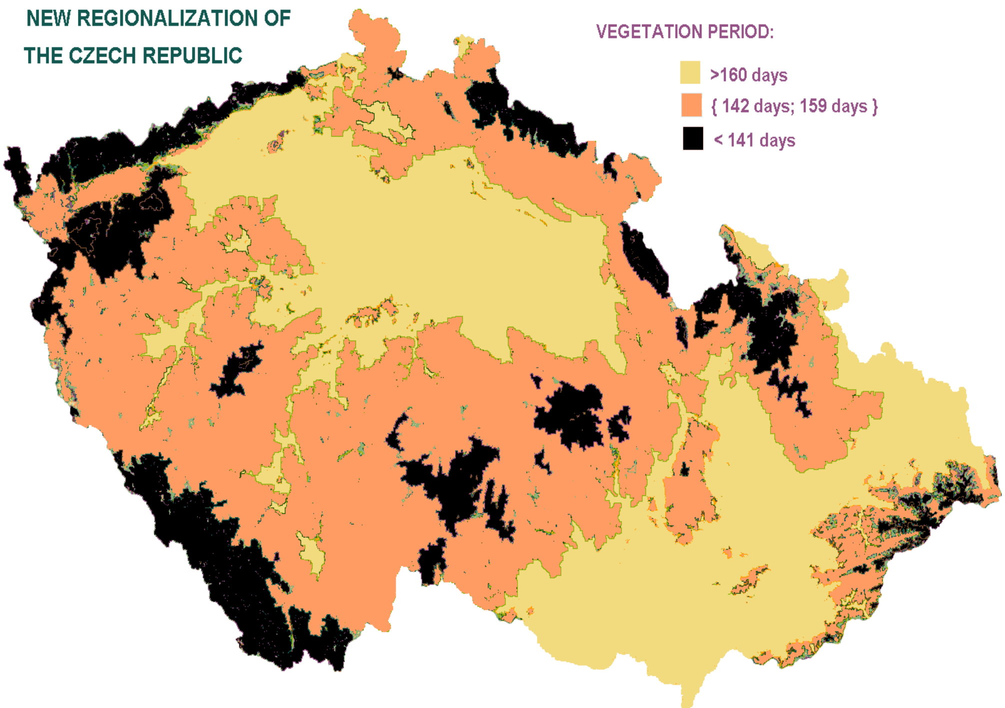

Fig. 2 : I*mproved definition of the radioecological zones for the Czech Republic based on the new methodology from [3]*

4.2 Radioecological regions (HUNGARY)

4.2.1 Selection criteria

A large amount of those parameters necessary to run FDMT in general have been collected to analyse and investigate how many radioecological regions should be defined for Hungary. The basic data set includes

- distribution of the population,
- distribution of resources of emergency managing organisations,
- human consumption rates,
- yield of agricultural plants,
- begin and end of vegetation period,
- the feeding practice of the domestic animals, and
- soil types and soil characteristics.

Analysing the large amount of data collected from all the 19 counties of Hungary, it came out that the variability of many parameters within the counties were much larger than between the counties in the most cases.

Therefore, the following criteria were used to split up the whole area into radioecological regions:

- geographical difference,
- climatically potential production of biomass,
- distribution of precipitation and monthly mean temperatures, and
- the shift in time of the beginning and end of the vegetation period.

4.2.2 Definition of the radioecological regions

According to the criteria used, two radioecological regions have been defined in Hungary with similar extension in space.

1. Region 1 includes the northern and western parts of Hungary, which is characterised by hills and small mountains Compared to the remaining part, the monthly mean temperature is lower in summer and higher in winter, the precipitation rate is higher, and the vegetation periods start later. This region contains the following counties:

    - Gyõr-Moson-Sopron,
    - Vas
    - Komárom-Esztergom,
    - Zala,
    - Veszprém,
    - Fejér,
    - Pest,
    - Nógrád,
    - Heves,
    - Borsod-Abaúj-Zemplén

2. Region 2 consists mainly of flatland and it is located in southern and eastern part of the country. Compared to the region 1, the temperature in summer is higher and in winter lower. For both seasons, the amount of precipitation is smaller. Region 2 is built up by the following counties:

- Somogy,
- Baranya,
- Tolna,
- Bács-Kiskun,
- Csongrád,
- Jász-Nagykun-Szolnok,
- Hajdú-Bihar,
- Békés
- Szabolcs-Szatmár

4.3 Radioecological regions (Poland)

Various criteria for the sub-division of Poland into radiological macro-regions have been evaluated. The basic set of parameters for defining the regions comprises:

- climate elements relevant for the growing cycle of the vegetation and the agricultural activities,
- aggregated soil characteristics, and
- the soil types in agriculture production for different crops.

Taking into account:

- the type of cattle-breeding,
- the type of human settlements and housing, and
- food consumption

The following decisive factors have been identified:

- the climate characteristic of the regions relevant to the growing cycle of the vegetation and
- the availability of the data for the selected regions, to allow for its collection and periodic updating by using routine services of national institutions.

The selection of the 7 radiological regions was mainly based on the agro-climatological properties and the long experience in Poland to collect statistical agriculture data for those regions (Table.1). However, the number of radioecological regions are still above the optimal number of five requested for the operation of FDMT inside RODOS. Therefore further adaptation seems to be necessary.

Macro-region No.	**Name of macro-region**	**Province (voivodeship prior to the administration reform in January 1999)**
I	North-western	Szczecinskie, Koszalinskie, Gdanskie, Slupskie
II	North-eastern	Elblaskie, Olsztynskie, Suwalskie, Ciechanowskie,

		Ostroleckie, Bialostockie, Lomzynskie
III	Western	Pilskie, Poznanskie, Torunskie, Gorzowskie, Zielonogórskie, Leszczynskie, Kaliskie, Bydgoskie, Koninskie, Kutnowskie, Wloclawskie
IV	South - western	Jeleniogórskie, Legnickie, Walbrzyskie, Wroclawskie, Czestochowskie, Katowickie, Opolskie, Krakowskie
V	South - eastern	Chelmskie, Lubelskie, Zamojskie, Kieleckie, Przemyskie, Rzeszowskie, Tarnobrzeskie, Tarnowskie
VI	Eastern	Radomskie, Siedleckie, Warszawskie, Bielsko-podlaskie, Lódzkie, Piotrkowskie, Plockie, Sieradzkie, Skierniewickie
VII	South (mountains)	Krosnienskie, Bielskie, Nowosadeckie

Table1: Macroregions of Poland

Based on the statistical data, available from the main Statistical Office and the Academy of Agriculture in Warsaw, the most important characteristics of the macro-regions have been collected and are summarised in the Table 2.

Parameter	Macro-regions						
	1	2	3	4	5	6	7
Mean soil bonitation index (Polish standards)	0.80	0.68	0.84	0.83	0.91	0.67	0.88
Mean annual precipitation[mm]	540	572	500	566	550	515	620
Mean annual temperature [°C]	9.5	7.9	9.5	9.0	8.5	9.0	8.6
Mean annual length of vegetation period [days]	298	271	293	291	275	286	276

Table 2. Characteristic of macro-regions

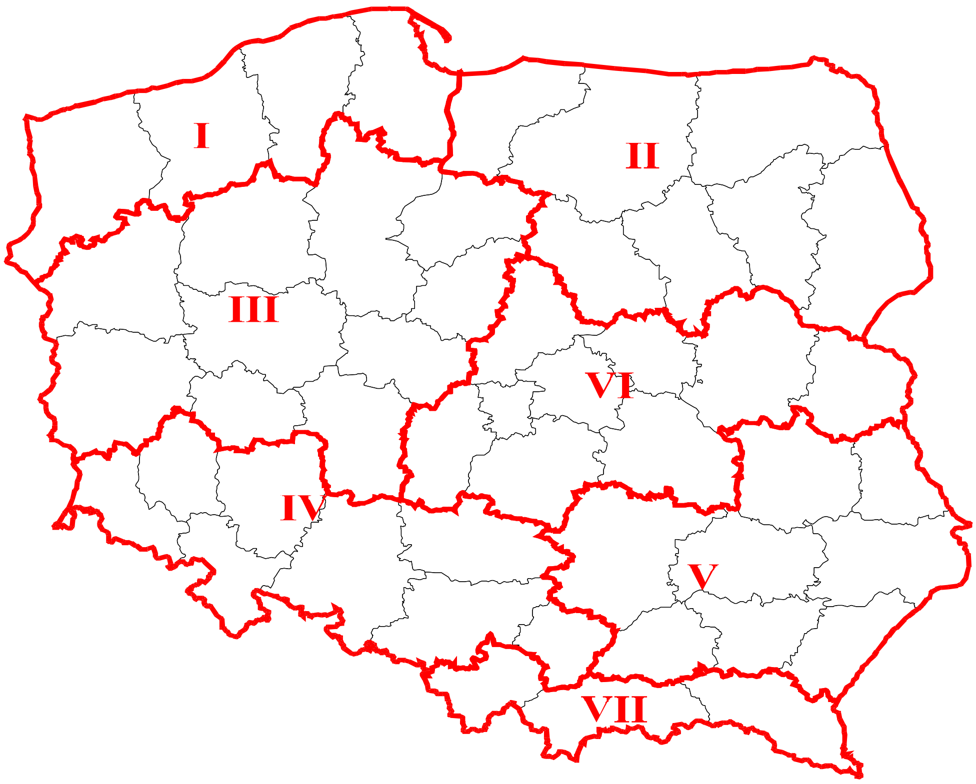

Fig. 1. Macroregions of Poland

4.4 Radioecological regions (Romania)

Following the discussions in WG3, a decision has been made to ignore the detailed soil properties in the definition of the radioecological region and to focus on attributes that decide the contamination in the acute phase, mainly vegetation status, dietary habits and major crop types.

As derived from recorded meteorological data over the last 30 years, the start and stop of the vegetation period for the same location can vary by more than ± 10 days. Because FDMT considers only the mean values as being representative, the year to year variation can not be considered as a measure of the extension of the "radioecological region". So, two radioecological regions must differ by more than 10 days in the start of the vegetation period. One measure is also the height of the location as the change by 100 m in altitude is associated by a change in the mean temperature by 0.5° C and a difference in the vegetation period by 8-9 days.

In the past, the animal farmers have divided the Romanian territory in 6 pasture zones; three of them include the main population and are intensively cultivated, the other three are mountain areas. Other agricultural experts use ten agropedo-climatic zones for Romania, including the predominant soil type. This specialised division of the agricultural system was used as a starting point, but was decided as too detailed with respect to the constraints in FDMT the absence of a complete set of accurate site specific data.

Consequently, considering the dietary habits, the main crops and according to the discussion in the framework of WG3, a decision has been made to define three radioecological regions (RER) for Romania, taking into account the climatic conditions, the predominant crops and, at the same time, combining some agropedo-climatic zones (as they were previously defined by experts). These RERs and their main features are as follows:

- RER No. 330 (Eastern, Southern and Western Romanian plains and the Romanian area between Danube river and Black Sea); this RER includes all Romanian nuclear risk zones (Cernavoda, Bechet, Pitesti and Bucharest) and is featured by: an average temperature of 21.5°C in July, an average annual precipitation of 550 mm, maize and winter wheat as predominant crops, the vegetation period ranges between 20th of March and 10th of November and an evapotranspiration deficit during summer-autumn of 200 mm.
- RER No. 331 (hilly area neighboring the chain of Carpathian mountains together with plateau of Transilvania) which is featured by: an average temperature of 20.0°C in July, an average annual precipitation of 700 mm, winter cereals, potatoes, spring barley and maize as predominant crops, the vegetation period ranges between 5th of April and 1st of November and water stress in summer-autumn (less than 50 mm);
- RER No.332 (the area of the Romanian Carpathian mountains) with a low population density, sparse agricultural plots and prevailing animal farming and forest industry. The climatic conditions vary with the altitude (however, generic values are assessed despite of the variability). In the areas used for farming, the vegetation period starts near the 20th of April and ends near the 10th of October.

The division of the mountain area in more radiological zones would imply a tremendous amount of work for data collection but that is not justified under the present conditions. In the populated mountain areas, the vegetation period starts about 20th of April and ends about 10th of October, thus this period has been considered in the data base. There is no water stress in this area and the main agricultural practice is animal farming. Few spring barley plots exist up to 1000 m altitude in some areas; local vegetable gardens and potatoes are also cultivated. Much of the cereals for human consumption are imported from the flat land as well as maize seed for human and animals.

As in FDMT it is assumed that all food is produced locally, there are problems with the proper choice of the consumption rates, as many foodstuffs are imported. In order to clarify the way to select these model parameters for this area, more work is needed as well as direct interaction with FDMT team.

4.5 Radioecological regions (Russia)

4.5.1 Selection criteria

To identify the radioecological regions in the territory of the Russian Federation, the following criteria have to be used:

- climatic zone and weather characteristics,
- topography,
- soil properties,
- structure of the agro-ecosystems (farm crops and animals),
- special features of farming (sowing and harvesting time, amount of applied fertilisers, animal feeding practice, etc.), and
- dietary habits of the population.

In addition, for the European part of the Russian Federation preference should be given to regions where nuclear power plants are located. Such a relation significantly increases the practical importance of the notion «radioecological region».

However, many of the above mentioned criteria are interconnected. Thus the agro-ecosystem structure and details of farming depend on the soil-climatic conditions of the region. Diets of the population, apart from distinctions connected with traditions and habits, though indirectly also depend on the soil-climatic conditions. Therefore, the use of criteria characterising the soil-climatic conditions provides a good basis for the division of the Russian Federation (RF) into radioecological regions.

4.5.2 Definition of the radioecological region of the Smolenskaya NPP

The soil-climatic conditions in the RF vary. For example, the time integrated temperature for periods with an air temperature above 10^0 C ranges from 1000^0 C for the north- taiga sub-zone (gley-podzolic soils) up to 4500^0 C for the desert-steppe zone (light chestnut soils). The ratio of the rate of precipitation to evaporation (over a year) varies from >1.33 for over-moistening zones to 0.22 for semiarid areas of the desert-steppe zone [5]. These relations, as well as a number of socio-economic factors, dictates the structure of agro-ecosystems and special features of farming practices in various regions of the RF.

Therefore, the territory of the RF can be sub-divided into about 60 radioecological regions based on the above mentioned criteria. However, it was agreed to first look at the region around the Smolenskaya NPP, located in the centre of European Russia. A further selection criteria, the location of a nuclear power plant was also met.

The Smolenskaya NPP radioecological region includes two districts: Smolensk and Kaluga. The area of the radioecological region amounts to 79,7 th. km^2 and the population to about 2146 thousand people (about 65% in urban areas). It consists of 31 towns and 32 urban settlements. Located in the Central East-European plain, the climate is temperate continental. Mean January temperature are about $9,5^0$ C and the mean temperature in July is 17^0 C. The mean precipitation amounts to 625 mm per year. Main rivers are Oka and Dnieper. Soils are soddy-podzolic and grey forest. Forests are coniferous and broad-leaved.

4.6 Radioecological regions (Slovak Republic)

Analysis of all the collected data resulted in a subdivision of the SR territory into regions, which differs in growing cycles and agricultural habits. These regions define areas, with relatively uniform radioecological conditions for which the same set of model parameters can be used. The selection of the radioecological regions for the Slovakian territory was predominantly determined by:

- the prevailing agricultural production practices,
- the climatic and soil conditions affecting the growing period and harvesting times of agricultural crops, and
- the feeding rates and regimes for domestic animals.

The human food consumption rates and their dynamics may significantly influence the dose assessment as well. However, these parameters could not be used in the definition of radioecological regions due to the lack of an appropriate data base.

4.6.1 Selection criteria

Five production types from two references (Hroššo, 1990) and (Kollár, 1990) have been transformed by means of integration and generalisation into three radioecological regions. They are characterised mainly by climatic conditions. However, these climatic attributes can not be used alone. In areas with fertile soils the border of the production type is shifted to less suitable climatic areas and vice versa. The derived subdivision is shown in Table 1. Borders of the regions are available, also as isolines, in the GIS/ARCINFO graphical format and are shown in Figure 1.

Region No	Production type	Agricultural type (Kollár 1990)	Average temperature [°C]	Precipitation [mm]
I.	High	Maize (type)	8-10	500 - 600
II.	Medium	Beet and potato	7-9	600 - 750
III.	Low	potato-oat and mountain	5-7	760 - 900

Table 1 Characterisation of resulted radioecological subdivision of SR territory

removed for transport

Figure 1 Characterisation of resulted radioecological subdivision of SR territory

4.7 Radioecological regions (Ukraine)

4.7.1 Selection criteria

The selection of the radioecological regions was mainly based on the following criteria:

- the climatological characteristics,
- the soil types,
- the growing cycles of the agricultural crops,
- the farming practices,
- the feeding practices of animals, and
- altitude.

It should be also mentioned that the selected subdivision reflected historical, physical-geographical and the actual agricultural classification of the present state of Ukraine.

4.7.2 Definition of the radioecological regions

Based on the selection criteria mentioned above, the following radioecological regions were defined:

1. Ukrainian Polesie.
2. Forest-Veld
3. Veld
4. Karpati region
5. Crimea

The Polesie radioecological region comprises the northern and north-western part of the Ukraine. The area covers about 14.5% of the territory of Ukraine. The climate is humid. Mixed forests are characteristic for this territory. The main soil types are soddy-podsolic, grey forest sandy and light loam.

The middle part of Ukraine contains the Forest-Veld radioecological region. The area covers about 42% of the territory of Ukraine. The climate is temperate warm and humid. Grass vegetables and the forest vegetables are the dominant vegetation cover. In the north and the middle part of this region the soils are light, middle loam whereas in the southern part they mainly consists of heavy loam

The Veld radioecological region is located in the southern part of Ukraine. The area covers about 40% of the territory of Ukraine. Veldt vegetables are characteristic for this region. The climate is warm and more or less dry. The summed up temperatures above 5° C range between 3800 and 4000° C. While in the Forest-Veld region these values are lower by about 25% (2900-3100° C). The soils consist in general of heavy loam and clay.

Karpati and Crimea regions are located in the western and southern part of Ukraine, which is covered by hills and mountains, respectively. The air humidity is high with moderate temperatures in the Karpati and high temperatures in the Crimea region. These regions only contribute very little to the overall agricultural production in comparison to the other three radioecological regions. A significant part of the areas these two regions are covered by pasture. Therefore, the collection of the data for the first three regions was started with the highest priority. In particular important are the Polesie and Veld regions, where all NPP stations of Ukraine are located. Three NPPs (Chernobylska, Rivnenska and Khmelnitska) are located in the Polesie region and two (Zaporizka and Pivdenno-Ukrainska) are located in the Veld region.

Some basic characteristics, in particular the climatological and vegetation differences, of the five radioecological are presented in Table 1.

Characteristics	Ukrainian Polesie (region 1)	Forest-Veld (region 2)	Veld (region 3)	Karpati region (region 4)	Mountain Crimea (region 5)
Annual precipitation, mm per year	500 - 630	460 - 600	310 - 520	650 - 1350	350 - 1100
Average temperature	18-19	18-20	20-23	16-20	20-23

in July, ° C					
Duration vegetation period, days	190-205	200-210	210-245	190-205	210-245

Table 1: General characteristics of radioecological regions

removed for transport

Figure 1**: Definition of the radioecological regions for Ukraine**

5 Data collection

This section of the report describes the basic steps in data collection for the East European countries. Further details together with the adapted parameter values can be found in the individual technical RODOS reports (from RODOS(WG3)-TN(99)-02 up to RODOS(WG3)-TN(98)-07). A summary of the main parameters for each of the radioecological region together with the FDMT default data set for Central European conditions can be found in the Appendices.

5.1 Data collection for the individual radioecological regions (Czech Republic)

The RODOS default values are available for mid European conditions. These default values were used when no reliable source for local conditions has been identified. Modifications have been introduced the number of plant species, foodstuffs, feeding diet and consumption rates. The experience from the data collection for the foodchain model ENCONAN was very helpful [22].

Regional statistics were collected in the Czech Republic since 1991. Before, only some nonsystematic data from individual field measurements were available. The agricultural production habits changed substantially but this resulted in a deep recession. The main problems 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

Due to these unfavorable conditions, the definition of the radioecological regions were performed either on basis of the old time series or based on new nonsystematic individual measurements and expert judgments. Therefore, the process of data collection is an continuously ongoing procedure and maintenance of these data should not be forgotten.

Differences between the individual radioecological regions arise mainly due to climatic conditions. The main effect is the shift in the vegetation period of 14 to 20 days between zone 1 and 2. The third region covers mainly highland and mountain areas with a rather low agricultural production. The change in plant production is adjusted implicitly for each tile of 1 x 1 km (e. g. zone number). Otherwise, the plant cultivation, feedstuff and foodstuff production and processing and consumption habits are assumed to be similar in all regions.

Official data related to crop production and consumption were extracted from [9, 10, 17], feeding diets of animals were taken from [7]. The number of plants, animal products, feed- and foodstuffs were selected on the basis of their relative importance [7, 9, 10, 17].

District-average production (yield) values for all plants are taken from [10]. A part of the original file is described in supplement 2 of [22]. The file is merged to an intermediate gridded file, where the averaged values are correlated with other tile entities and again distributed to gridded data structures (a more detailed description can be found in [18] where the quality assurance procedures for the local data are described).

Animal products were selected based of the information on their importance [17]. Based on information from [7] and input data of the ENCONAN model ([4, 5, 6] and supplement 3 from [22]) feedstuffs and the corresponding feeding rates were selected. By using reference [17], the gross annual consumption rates for the selected foodstuffs have been derived

5.1.1 Nuclide independent FCM parameters (region dependent)

Data related to the yield, LAI values, characteristics of the vegetation periods, soil properties, weathering rates, growth dilution rates and irrigation parameters should be defined for each radioecological zone and, in addition, the data have to be re-evaluated every time when the definition of the radioecological zones is improved. Data were collected in cooperation with expert teams from various Czech institutions:

- State Health Institute - see expert analysis [19]
- Czech Agricultural University (climatology, phenology)
- Research Institute for Soil and Water Conservation , Prague-Zbraslav
- Department of Cartographic and Geoinformatic, Faculty of Natural Sciences,
- Charles University , Prague
- Czech Institute for Hydrometeorology (dept. of agroclimatology)
- Ministry of Agricultural, Ministry of Living Environment
- RICP : Research Institute of Crop Production, Prague - Ruzyne (depts of Agroecology, Plant Nutrition, Plant Medicine, Genetics and Plant Breeding, Genebank)

In Q2/99 further studies have been condictzed, in particular comparing with the default values of FDMT for Central Europe:

Two possible ways have been identified how to generate the region dependent data:

- experimental measurements (regular systematic regional measurements have been cancelled in 1990)
- mathematical modeling in particular for plant growth and yield (results of the institute RICP are discussed in [22])

5.1.1.1 Plant parameter

There are differences in the development and in maximal values of the LAI among different years and sites. However it is difficult to separate the effect of climate, altitude and soil fertility. Cereals are not too sensitive to altitude but a decrease in LAI could be anticipated over 400-500 m height for cereals, except for oats, rye and winter rape, and above 350 m for maize, grain and sunflower. In general, soils in lower altitudes tend to be deeper and more fertile than in highlands. However, the warmer regions suffer from drought episodes during spring and summer.

The inter annual differences in LAI may be roughly estimated from differences in yields of harvested products. A good correlation between the LAI and yield can be observed for grasses and other fodder crops.

The development of the LAI is tightly related with the growth of the plant in the stage of the linear growth and there is a strong dependence on the temperature. Thus the differences in the LAI between individual years could be described by means of the accumulated temperature sum. Examples of experimental results of LAI development in Prague-Ruzyne (average values) (radioecological zone 1: altitude = 364 m) are given in Fig. 5 of [22].

The LAI in farm fields are estimated to be either in the lower part of the range for optimal condition or in the upper part of the range for less optimal conditions.

LAI values might be greater than assumed for use in FDMT in over-fertilized (especially with nitrogen), irrigated and too dense stands. However, average levels of the LAI are optimal in terms of yield formation and water consumption. Nowadays, farmers try to keep doses of nutrients and seeding rates as low as possible to increase the net profit. This suggests that the LAI in farm fields are generally rather on an average or lower range of possible values.

LAI parameters for the first and third radioecological region were developed by using data from our Slovakian RODOS colleagues [20].

During collection of the yield data for the purposes of the RODOS customisation it came out, that only some data from private farms were available. In addition, the official yield data from [10] were used.

The values represent district average production data for 77 districts of the CR and for all products selected for FDMT. Its reconstruction on a fine grid of 1 x 1 km is described in a separate RODOS report [18].

Inter annual variability could reach as much as 100 %. The year 1998 may serve as an example, with extreme decreases of the LAI for cereals, winter rape, fodder and other crops due to a drought in some parts of Bohemia.

If no better data are available, the beginning of growth may be estimated from the day of sowing and the period to sprouting derived from the above mentioned temperature sum. However, extreme weather condition may shift the beginning: Especially dry surface layer (seed-planting bed) may delay it by a week and longer; a cold soil slows down the sprouting in all crops but very sensitive are potatoes, maize, sunflower. Again, in 1998 winter cereals and rape start to re-growth already in the mid of February in contrast to 1996 where it started 3-4 weeks later

Phenology of most crops can be related to altitude due to the correlation of both the temperature and the temperature sum. The number of days with a temperature over 5 °C is about 200-250 up to an altitude of 200 m. The number decreases by 8-9 days with an increase of the high by 100 m. The effect of the field position (frost valleys, orientation of a slope to south or north etc.) must be taking into account too.

Beginning and end of harvest is partially available from (RICP, J. Petr et al., 1987), which enables to define a basic classification. However, the task is not completely solved and collection of more precise data will continue.

The exact time of harvest in the predefined interval provided by FDMT depends strongly on agro-technical demands of the animal production in certain farms (or regions). Generally, harvest of forage grasses (and clover, alfalfa) should be performed before heading to flowering, because of the favorable proportion of leaves to stems. For alfalfa, the 1st cutting amounts to about 50 % of total yield of the year, for permanent grass to about 50-60 % and for temporary grass to about 40-60 %. The 1st cut in regions where beet is produced as forage takes place from 15.5-20.6, the 2nd from 20.7-20.8. and the 3rd from 1.9-15.9s

Data on growth dilution are partly available, but its complete preparation for RODOS has to be realised in future on a commercial basis. Season dependent growth dilution rates and half-life values for the first radioecological region (lowest altitude) were derived by using data obtained from our Slovakian RODOS colleagues [20].

Data of roots depth from where over 90 % of the nutrients and water are absorbed were also collected.

5.1.2 Further nuclide independent data

Further necessary parameters comprises fattening periods and feeding rates for animals [7, 11]. Missing information still persists for human consumption where ref. [17] is used, but only few data are available for the individual age categories. The same is the case for parameters for delays in processing and consumption where only model results are available.

Data on population distributions and soil types were collected and a gridded population data set from the official sources [14] was constructed. Further databases with information on a very local level has to be still evaluated [18].

5.1.3 Nuclide dependent FCM parameters

In the frame of the work with the ENCONAN model, many basic data were collected. Besides the data in supplement 3 of [22], detailed tables of concentration factors, transfer factors feed/animal product and other nuclide dependent data are available, however mostly derived from non site specific ICRP recommendations. An expert study [19] prepared by specialists from the State Health Institute reviewed the potential local sources for collection of the necessary parameters. One basic recommendation of this study was to take the default RODOS data in most cases and to concentrate only on those parameters which have evidently local character (for example processing factors for feedstuffs and foodstuffs).

Special attention was devoted to those parameters which are explicitly stated in the governmental regulations for nuclear safety or in the Czech Atomic Law. This comprised not only the region dependent parameters, but also the isotope dependent FDMT data. The values used in RODOS will be compared with those values obligatory in the process of RODOS accreditation for its use in the Czech Republic. Some results are included in [18].

5.2 Data collection for the individual radioecological regions (HUNGARY)

For Hungary, there exist no significant differences between the two selected regions from the viewpoint of the environmental characteristics. Region 1 only differs in the higher amount of precipitation and by the smaller temperature variation over the year. Therefore, the vegetation period in the Region 1 is about 10-20 days delayed compared to Region 2. However, no further significant differences could be found for other model parameters, i.e. the amount and structure of the feed- and foodstuff production together with their consumption is similar all over the country.

5.2.1 Nuclide independent parameters

5.2.1.1 Products to be considered

According to the analyses, the following foodstuffs can be neglected for Hungary as they have a relatively small importance:

- spring wheat,
- sheep milk,
- goat milk, and
- roe deer.

Additional products listed below have to be introduced:

- source cream
- rice
- corn (maize)
- wine, and
- mushrooms.

When investigating the consumption habits of the population, some crops can be grouped as indicated below:

- leafy vegetables = lettuce and cabbage
- root vegetables = carrot, radish, beetroot, celery and onion
- fruit vegetables = pepper, tomato, bean and peas
- fruits = cherry, sour cherry, apricot, peach, apple, pear, strawberry
- berries = raspberry, red currant and grape (consumed as fruit)
- nuts = poppy-seed, almond, walnut, peanut and chestnut.

5.2.1.2 Plant growing and harvesting times

For all plants used as human foodstuff and/or animal feedstuff, the following environmental parameters have been collected and recorded in the appropriate file format:

- begin and end of harvest,
- yield,
- LAI values and its weighting factors,
- time development of the LAI,
- begin of growth,
- soil mass per area
- weathering rates,
- growth dilution rates,
- daily amount of irrigation water,
- the begin and the end of the irrigation period, and
- the frequency of irrigation.

The data on the first harvesting period and the weighting factors for the harvesting intensity had to be modified by expert judgement. As these weighting factors vary in a wide range in case of those plants, which are harvested more than once a year, the value of 0.5, based on expert judgements, was selected for the following plants only:

- grass, hay and alfalfa,
- leafy, root and fruit vegetables
- fruits and berries.

As the use and measurements of the LAI is not common in the Hungarian agricultural practice, the actual values listed below are based on some approximations, which should be refined and corrected in future. In particular, some data sets are based on LAI values valid to Southern part of Slovakia

Concerning the irrigation practice it has to be mentioned that usually leafy, root and fruit vegetables need regular irrigation, all other plants are irrigated only if their vegetation period is very dry (in case of most plants, the natural precipitation meets the water requirement).

5.2.1.3 Feeding habits

Theoretically, all kind of nutrient sources - i.e. most natural crops, or part of crops, agricultural and industrial by-products - can be used as fodder. The main viewpoint, however, is the necessary daily amount of protein-, fat-, carbohydrate-, vitamin-, and mineral-intake, which can be covered by various types of feedstuffs.

As this concept is fixed in the present nutrition laws, rules and regulations for animal-hygiene, the actual composition of the fodder depends on many agricultural and economical factors (prices, availability, quality and production of the crops in the current and previous years, etc.). Due to this fact, the variation in the feeding practice is extremely high in Hungary.

Based on the survey, the following items are ignored as feedstuffs:

- spring wheat,
- distillation residues,
- brewing residues

however, a new one has been defined:

- alfalfa

Note that although the distillation and brewing by-products may be applied as additional nutrients if their quality satisfy the regulations, but their use have no significant importance in the current nutrition practice in Hungary.

5.2.1.4 Consumption habits

The food-consumption data for the two radioecological regions and the average for the whole country were collected for the age-groups given in FDMT.

The original data base of LAKELM (an Hungarian acronym for the words population nutrition) was established by the National Institute of Food and Nutrition and the National Research Institute for Radiobiology and Radiohygiene by the support of the National Programme for Development of Information on Infrastructure in 1994.

The data base contains consumption rates for 16 thousand adults (1985-88) based on two-day consumption period and 500 children (1993) for 5 counties based on a three-day consumption period.

The original information in the data base of the National Institute of Food and Nutrition was not based on the consumption rates of individual foodstuffs but on complete menus. The consumption rate for individual foodstuffs (about 500 kind of foodstuffs and 150 groups) was derived by analysing the recipes for all relevant menus in 1994.

The data base of FDMT was adapted to Hungarian conditions by the following means:

- the production and consumption of spring wheat is negligible in Hungary (Indices of 4,5,6),

- there is no information of consumption of rye bran (Index of 9) in Hungary,
- there is no distinction in consumption rate of beef (cow) and beef (bull) (Indices 25,26) in Hungary,
- sheep milk, goat milk and roe deer have small importance in Hungary, so they were excluded,
- additional data for sour cream are available, but this could be merged with cream (Index 34),
- rice and corn were added to the list of foodstuffs (Indices 35,36),
- nuts (including poppy- and sunflower-seeds) were added (Index 37),
- wine was added (Index 38),
- mushrooms were added (Index 39).

The consumption rates for adults are similar in the two radioecological regions which means that an average country wide value can be applied. For children of different age groups however, there are sometimes differences.

Apart from the average values the information on the possible ranges of the individual consumption rates, especially on the maximal values might be very useful for the estimation of dose to critical groups. For example, the highest consumption rates can be two to three times higher than the averag. In several cases the spreading can be even higher, e.g. for fruit vegetables and fruits consumed by 8-12 year old children.

Because country specific age dependent inhalation rates are not available, the default breathing rates have been used

5.2.2 Nuclide dependent parameters

The nuclide-specific data sets published in the international scientific publications were collected and applied as defaults, because country-specific values (e.g. translocation factors, soil-plant transfer factors, etc.) were only determined in few cases in Hungary.

5.2.2.1 Soil parameters

More than 30 soil types are available, however only 2 were used for the final grouping:

- arable soil and
- pasture soil

The soil mass (weight of the root zone below a 1 m^2 area) is calculated from the assumption that the depth of root zone is 0.15 m for pasture, and 0.20 m for cultivated crops. The density for the most typical pasture soils is 1000 kg m^{-3}, (this type of soil can be found e.g. in the Eastern part of Hungary, in the county Hajdú-Bihar) and 1480 kg m^{-3} for arable soils (e.g. in the Western part of Hungary, in the county Gyõr-Sopron-Moson).

5.2.2.2 Soil-plant transfer factors

County-specific soil-plants transfer factors were taken from literature.

5.2.2.3 Transfer factors to animal products

Reliable experimental transfer factors to animals are unavailable in most of cases, thus data published in the open literature were collected.

5.2.2.4 Processing of feed-/foodstuffs

In case of cereals, potato and wine a 180 days processing period is used, because there is only one harvesting period for these products in one year. In most other cases, shorter periods have been selected and put into the FDMT data base.

5.3 Data collection for the individual radioecological regions (Poland)

5.3.1 Nuclide independent data

The data collected for all 7 regions and 49 provinces includes the following 5 data sets:

i. leaf area index
ii. plant production
iii. vegetable production
iv. fruit production
v. animal products

The data comprises the leaf area indices of grass, winter wheat, potatoes, intensive and extensive cultivated grass and beet for the central region of Poland. The most reliable data are for the central - metropolitan region of Poland. The seasonal variation of LAI for other groups of plants and regions needs still further modelling, assessment and additional measurements. The work will be continued in co-operation with the Faculty of Poland Physiology of the Agriculture Academy in Warsaw. The structure of data sets i - v, developed for each macro-region is presented in Tables 1-3.

Group of data	**Elements of the group**
Plants for grain production	winter wheat, spring wheat, rye, barley, winter barley, spring barley oats, winter wheat-rye hybrid, spring wheat-rye hybrid, grain mixtures maize-bulb, other grains
Selected plants	Potatoes, white beet, ape and agrimony, edible leguminous plants
Grasslands	permanent meadow, lawn-pasture
Plants for green forage production	leguminous fodder plants, clover, lucerne, serradella, other pastures and grass, grassland, pastures, maize
Root fodder plants	
Seeds production	leguminous fodder plants, lupine, clover, lucerne , serradella and others pasture
Green manure	
Plant groups production	fodder plants, root crops, leguminous fodder plants, papilionaceous fodder plants, industrial plants, hemp and flax, meadow, lawn-pasture
	Vegetables
Root vegetables (total)	
Selected vegetables	carrot ,red beet, cabbage, cauliflower, onion, cucumber, tomato
Other vegetables	
	Fruit production
Tree fruits	apples , pears , plums, cherry, sweet cherry, other tree fruits
Berries	strawberry, raspberry, currant, gooseberry, other berries

Table 1. Plant production (without vegetables and fruits)

Milk production	cow's milk, sheep's milk , goat's milk,
Meat production	beef, pork veal, poultry
Cattle for slaughter	
Fresh-water fish	

Table 2. Animal production.

5.3.2 Nuclide dependent data

The nuclide dependent data (retention factor, processing factor, translocation factor, migration factor, migration rate and fixation rate) are combined with country averaged human, animal feeding rates and plant - soil characteristics to form the following three data sets:

i. Human diet

ii. Animal feeding rates (cows, sheep, goat, pigs, poultry),

iii. Plant - soil data

Data assessed for each component of the human diet are:

- consumption (per day/ month, year) by adults(man and woman) and children of age 3 and 12 months, and 5, 10, 15 years,
- yield of the food preparation.,
- retention factor for Cs, I and Sr,
- total processing factor for Cs, I and Sr.

Group of data	Elements of the group
Cereal products	bakery products, rye, mixed, wheat, pastry
Milling and noodles products	Flour, groats and flakes, , noodles, rye
Potatoes	
	Vegetables
Leafy vegetables	fresh cabbage, soured cabbage, lettuce, dill
Root vegetables	Beet, carrot, onion, leek, celery, parsley
Fruit vegetables	fresh tomatoes, fresh cauliflower, fresh cucumbers, soured cucumbers, leguminous grain
Mushrooms	
Vegetables products	
Vegetable and mushrooms products	
	fruits and fruit products
Tree fruits and berries (without southern fruits)	Apples, pears, plums, other tree fruits, berries
Southern fruits	citrus fruits, other southern fruits
Processed fruits	
	meat, pluck, fish and their products
Fresh meat	Pork, beef, veal, hen, cock, chicken, other poultry, other fresh meat
Fresh pluck	Liver, other pluck, ham, loin, durable (hard) sausages, other sausages, other smoked meat
other cured meat products, canned meat	
Bones	
Meat products, including poultry and venison products	ham, loin, durable (hard) sausages, other sausages, other smoked meat, other cured meat products, canned meat
	fish and processed fish products
Fish	sea fish and sea food, fresh water fish, salted herrings
Processed fish food	
	fat
Edible fat	butter, fresh and melted animal fat, margarine, other edible plant fat
Eggs (without shells)	
Dairy	milk and milk drinks, whey, condensed milk, powdered milk, cottage, cheese, hard and melted cheese, cream
Sugar, confectionery, sweets	sugar, candies, chocolate. confectioner's bakery products, chocolate products
Honey	
Stimulants (dry mass)	coffee, tea, cocoa
Water and soft drinks (without milk)	
Alcohol products	pure alcohol products, flavoured alcohol, wines and mead, beer

Table 3. Human diet

Group of data	Elements of the group
Cow's, sheep's , goat's diet	
Cereals (spring)	winter barley, winter wheat, oats (cow 10%, sheep 60%)
Green fodder (spring)	pasture grass, fresh alalfa, fresh clover
Hay (spring)	hay grass, alalfa hay, hay clover
Silage (spring)	silage grass, alalfa silage, silage clover
Cereals (winter)	winter barley, winter wheat, oats
Green fodder (winter)	pasture grass, fresh alalfa, fresh clover
Silage (winter)	silage grass, silage alalfa, silage clover
Hay (winter)	grass hay, alalfa hay, clover hay
Ensilaged crops (winter)	maize, pasture beets, water, milk (veal)
Pig diet	
Corn products	wheat, barley, (feeding months 1-6)
Other	whey, potatoes
Poultry diet	
Corn products	cereals, wheat, rye, barley
Other	water

Table 4. Animal feedstuffs (cows, sheep, goat, pigs, poultry)

Data for each feedstuff component included in Table 4 are:

- Processing efficiency
- Retention factor for Cs, I and Sr
- Total processing factor for Cs, I and Sr
- Feed rate for: dairy cow, beef cows, veal, sheep for milk, sheep for meat, goat for milk, goat for meat, calves, pigs (1-6 months old), hen, broiler

5.3.3 Source and format of the collected data.

The country specific data have been collected with the assistance of:

- Faculty of Poland Physiology of the Agriculture Academy in Warsaw.
- Central Laboratory of Radiological Protection in Warsaw
- Main Statistical Office in Warsaw
- Province Statistical Offices
- National agriculture inventory carried out in 1996.

For easy handling all data sets are maintained in an Excel format. Based on these data, a data set in the form required by FMDT has been developed.

5.4 Data collection for the individual radioecological regions (Romania)

From the early development and testing of the Romanian foodchain model LINDOZ, it became obvious that model parameters strongly depend on local conditions and a careful selection of model input parameters is crucial for the overall performance.

There exists a great diversity of plant vegetation parameters across the Romanian territory due to variable climate, soil and farming practice. This diversity is increased due to the transition of the social & economical system with the accompanying difficulties. Therefore it was necessary to cross check the collected data from the specialised Romanian institutions (Institute of Agrarian Economy, Institute of R&D for Cereal and Technical Plants Cultivation, Agrochemical and Pedological Institute, Research Institute for Potatoe Cultivation, Research Station for Orchard and Viticulture, National Institute for Statistics, National Institute of Meteorology and Hydrology, etc) and to complete missing data from literature or by using ecological models.

A significant modification for Romanian conditions was the introduction of straw as feedstuff. Because foliar absorption is not considered explicitly in FDMT, straw contamination has been derived by using the translocation approach (plant model 5). Following experimental data from Denmark and GSF (4-5), appropriate translocation factors have been deduced for Cs. For Sr there are no direct experimental data and therefore simply a scaling factor Sr/Cs has been used, derived from grain.

Another modification was the introduction of the maize grain as foodstuff, using the same model parameters as for maize cobs, but adjusting the yield and harvesting time. In order to simplify the assessment procedure, clover and alfalfa have been considered as ‘grass intensive’ with minor parameter modifications.

Yield of plants and production in various Romanian counties have been obtained from national statistics for a period of 5 years. Due to both insufficient irrigation and fluctuation in fertiliser supply, there exists a significant year to year variability (e.g. in 1998 a very dry summer halved the production in many area). Therefore, the mean values for last 5 years were used as default.

The plant growing and harvesting times have been obtained from specialised agricultural research institutes or taken from recommendations in recently published textbooks (6-7); information in mass media about progress in planting and harvesting was also used to adapt the specialised recommendations to the actual practice in Romania.

The leaf area index of the main plants (maize, wheat, potato, grapes, sunflower) have been obtained for various years from the agricultural research units, together with biomass dynamics, daily climatic data and soil properties. As the leaf area index can vary with weather and fertilisation, ecological models have been used to obtain the mean trend over a longer period. By using either internally developed models or also internationally agreed models (DSSAT-3, WOFOST), the biomass and LAI dynamics for the most important crops have been reproduced. Adapted to the radioecological region and with carefully selected input parameters, these models have processed meteorological data collected over a period of 30 years to obtain a representative LAI value for each of the regions.

Translocation is the main process for the contamination of the edible part of the plant in the first year. Experimental data on translocation for different plants are quite complete for Cs, sparse for Sr and cover a limited number of radionuclides for barley. Translocation, as defined in FDMT, includes cuticular absorption to leaf interior, migration into the whole leaf and transport to the edible part. The cuticular absorption depends on cuticle properties and the chemical form of the radionuclide, while the translocation from the internal leaf to the edible part depends both on the metabolic activity (partitioning of photosyntate) and the nuclide properties with respect to plant metabolism (macro-elements, micro-elements, substitutes, inert) (9). The default data base in FDMT has been modified taking into account recent publications (10-12). Radionuclides have been classified as mobile (Ag, Co, Cs, I, Mn, Zn but also Se, Eu, Rb, Sc); semimobile (Ba, Cr, Fe, Mo, Sr, but also -tentatively- Hg, Zr) and immobile (Ca, Te, Ce, Ru, Pu, Am, Cm). Mobile elements behave like Cs, semi-mobile like Sr and immobile elements do not penetrate the cuticle and do not translocate. Translocation to straw has been assessed using experimental data for barley (13).

The animal feeding rates have been derived by using standard practices (6, 14, 15) selected for the reported productivity and feedstuff availability. A mass balance has been checked for each radioecological region in order to see if the local feedstuff production covers the animal needs. Due to the large variability of the practices in private farms, difficulties have been encountered for establishing a representative diet in case of pigs which means that further investigations are necessary.

The consumption habits of the population have been established based on pre- and post- Chernobyl studies, information on the production and trade for each radioecological region and have been checked for metabolic needs. As there is no recent study on the average Romanian diet available, potential changes in the habit of rural population have not been considered in the present data base.

Soil parameters have been established using IAEA recommendations for each soil type, however, the data set has to be expanded. Cs fixation in soil has been optimised to reproduce post Chernobyl data on contamination of grains in Southern Romania. Soil to plant transfer rates have been taken from the IUR systematics (17, 18) and compared with the limited amount of data obtained for Cs after Chernobyl. The data differs by about a factor of 3.

Transfer factors to animal products and metabolic parameters have been established using literature data as no experiments have been reported for Romania (19-23). With respect to the default values in FDMT, a higher transfer to milk and meat was selected for Cs and I. Other metabolic parameters have been changed too, in order to reach a compromise with other data base (16, 24-26). In future, this data base has to be improved, in particular there are many reports available for Ruthenium (Ru is one of radionuclides of interest for CANDU type reactors). For I and Cs, the present parameter set has been tested in Romania for milk and meat products after the Chernobyl accident and was also successfully used in LINDOZ within the VAMP and BIOMOVS studies.

It is well known that the present approach for the modelling of the radionuclide transfer in fruits is very limited. Therefore, only some of the specific parameters have been adjusted by using recent publications (27, 28). Whenever the results of the fruit working group within BIOMASS will be available, the data set has to be updated.

5.4.1 Nuclide independent parameters

For the first and second radioecological region a complete list of cultivated feed- and foodstuffs, together with the yield and the production area is available for 1997, but only area averaged values for 1990-1995.

5.4.1.1 Crops

All plant parameters required in FDMT have been collected and introduced in the data base for the first and second radioecological region only.

5.4.1.2 Animal products:

As for the crops, only detailed data are available for the first two radioecological regions.

5.4.1.3 Distribution of population

Detailed information on the population distribution, by age classes is available in each settlement of the two nuclear risk zones (NRZ) Cernavoda and Bechet:

- Cernavoda - NRZ: 20 urban settlements (with population between 4500 and 250000) and 149 rural settlements (with population between 500 and 7000)

- Bechet NRZ: 12 urban settlements (with population from 4500 to 205000) and 190 rural settlements (with population from 900 to 11000)

For the rest of Romania, the age distribution is available only on a county specific basis. This information has still to be processed to be used in RODOS.

5.4.1.4 Daily human average consumption

Only for the first radioecological region detailed information is available. Beef and grain consumption have been changed according to Romanian habits, grain maize, sheep cheese, oil and wine have been added. With respect to daily quantities of each item there are no recent data available. Therefore, an optimisation procedure has been used including various data source and metabolic demands.

5.4.2 Nuclide dependent parameters

5.4.2.1 Crops

All data for the radioecological region 330 have been collected and introduced in the appropriate files of the RODOS data base. in case of the two regions 331 and 332 not all data were available. The missing data have been derived from general soil and climatological rules by modifying the available data from region 330.

5.4.2.2 Soils

In addition to the data available from the Romanian Statistical Yearbook for the whole territory, detailed data about soils have been acquired for two the main nuclear risk zones (Chernavoda and Bechet). The soils were characterised according to the US Soil Taxonomy:

a) Soils of the nuclear risk zone in Chernavoda and Bechet

The soil data (fluvaquents, ustifluvents, ustipsaments, ustarents, litic, ustorthents, calcinstolls, haplustolls, arginstolls, rendolls, hapustalfs, natrustalfs and aquisalidis) comprises the map of their geographical distribution at a scale of 1 : 500 000, their morphological and physical & chemical properties, their spatial distribution and area, their texture in the upper horizon (0 ÷ 20 cm), their thickness, their content of humus, N and P, and their pH and CEC (Cationic Exchange Capability, only for Chernavoda).

b) Soils of Romania

The pedological map of Romania at a scale of 1:1 000 000 has been acquired and translated in an appropriate electronic form in order to identify the soil type for each RODOS cell

c) Soil to plant transfer

For the main radionuclides (Cs, Sr, I, Ru), the soil to plant transfer factor has been established for the four major soil class (sand, loam, clay, peat) by using recent systematic. Some post Chernobyl data in Southern Romania have been compared with this systematic and a difference of up to a factor of 3 has been observed. It is assumed that the transfer rates do not depend on the soil type for other radionuclides.

5.5 Data collection for the individual radioecological regions (Russia)

The amount of information necessary for the adaptation of FDMT to the conditions of the Smolenskaya NPP radioecological region can be subdivided into two groups. The first group consist of data showing the components of the agro-ecosystem depending on the environmental conditions and farming practices. The second group contains a set of radioecological parameters representing the radionuclide migration rate in soil, in the soil-plant system, and the body of the farm animals.

5.5.1 Nuclide independent parameters.

The soil and climatological conditions of the region have an effect on the selection of the farm crops as well as on the sowing and harvesting times. This set of cultivated crops has also influence (along with different economic factors) on the dietary habits of the population living in the radioecological region. Thus the region is more or less uniform (at the accepted level of aggregation) not only in terms of ecological conditions but also with respect to the social characteristics (e.g. dietary habit and living conditions).

The information on the yield of pasture grass (kg m^{-2} fresh weight) and leaf area indices (all other plants: m^2 m^{-2}) for the region as a function of time and the corresponding time of harvesting and yields was derived from the analysis of literature data [2-5] and in consultations with agricultural specialists in the Smolensk and Kaluga regions. Ingestion rates for rural and urban population are based on the information submitted by regional statistical committees.

5.5.2 Nuclide dependent parameters

5.5.2.1 Foliar uptake of radionuclides

It should be noted that a correct description of the foliar uptake including weathering can only be given after performing experiments for a given location. In the absence of detailed experimental information, the two-exponential model describing the radionuclide contents in vegetation may be the best approximation available.

As described earlier, comparison between the adapted FDMT and experimental values showed that the FDMT can be used to predict the dynamics of ^{137}Cs and ^{131}I contents in meadow during the first period following an accidental release in the Smolenskaya NPP region.

5.5.2.2 Root uptake of radionuclides

The analysis of experimental data on the dynamics of ^{137}Cs content in agricultural plants in the area of the Smolenskaya NPP region suggested that soil to plant transfer factor (TF) of this radionuclide is higher than the TF value of FDMT [1]. At the same time, the ^{137}Cs concentration in plants decreased faster during 10 years after the Chernobyl fallout than proposed by FDMT. This indicated that the biological availability of ^{137}Cs in soil is being reduced with time.

Therefore, an adjustment of the parameters describing ^{137}Cs behaviour in the soil-plant system (TF) and fixation rate constant (λ_f) has been performed. The values of λ_f was set to 4 10^{-4} day^{-1}. Taking into account that this region is dominated by soddy-podzolic soils, which belong to the category of loam soil, the value of soil density was assumed to be 1150 kg m^{-3}. The root zone depth amounted to 0.1 m for grass stands and 0.2 m for arable land.

5.5.2.3 Contamination of animal products

For the adaptation of parameters of the submodel describing the radionuclide metabolism in the body of farm animals and radionuclide accumulation in animal products literature data were used [6-8]. The collected parameters are typical for the Smolenskaya NPP radioecological region and reflect the characteristic features of the animal production in the this region.

Adaptation of the model parameters and use of feeding diets which are typical for the conditions of Smolenskaya NPP radiological region allow to obtain a satisfactory agreement between the model and the experimental results.

To improve the estimation of the biological transfer rates and the fractionation of the biological transfer rates, experimental data on the contamination of animal products with a daily time step (most experimental data have been obtained with monthly time steps) are necessary.

5.5.2.4 Integration of the adapted parameters of the FDMT model into the RODOS system.

As a result of this task, a database has been compiled that contains information on all necessary features of the Smolenskaya NPP radioecological region in terms of the characteristics of the agro-ecosystem and the farming practice. Moreover, radioecological information was obtained including the FDMT model parameters that describe the radionuclide migration rate in all components of the agro-ecosystems.

The information derived was systematised and presented in the form of files (in ASCI codes) which were integrated into the database of the RODOS system.

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

5.6.1 Nuclide independent (region specific) data

The agricultural input data such as data on growing cycles of plants, on harvesting times, yields and information on feeding diets of domestic animals and food and feed production technology have been taken from a wide range of literature reference sources. For two of these regions these data are available in electronic form in EURALERT-89/ASCII structured format as well.

5.6.1.1 Plant to be considered

The selection of representative crops and plant varieties for animal feeding have been made considering the production data of the main crops (statistical yearbook) and their importance in the food chain of man.

5.6.1.2 Yield data

The yield data have been taken from the database of the Institute of Agricultural Economy, Bratislava, from statistical yearbooks (1980-1993) and from other literature (Kollár, 1990). The representativeness of the mean values is slightly limited, as the agricultural practice in the Slovak Republic is changes due to agricultural policy, market conditions and agro-technical approaches; All of them have made the yield to a subjected of significant variations in last five years.

	Slovak maize type production region SK-I			
crops	applied in the model	1986	„Zitný ostrov“ region 1986	1988
w. wheat	4,9	4,6	5,4	7,2
winter rye	3,2	-	-	-
spring barley	4,7	4,5	4,7	5,6
oat	3,0	-	-	
corn	5,2	-	6,3	6,8
silage maize	30,0	-	36,4	34,4
sugar beet	33,0	31,0	33,7	33,9
potato	12,0	13,4	-	
winter fodder	25,0	-	-	
alfalfa	8,5	-	10,5	10,4

For Trnava district in 1988y: wheat 6.5, barley 5.1, oat 4.1, rye 4.4 t/ha

Table 1 Average and local yields in [$t.ha^{-1}$] for some crops according to local production sub-regions and years

Table 1 provides a comparison between parameters for local crop yields and the average yield data used in FDMT for the Slovak lowland region (SK-I). The differences, however seem to be in any case below a factor of two.

5.6.1.3 LAI data

The LAI data are rather limited in the Slovak Republic. However, the values for the most important crops are available. The existing range of values is a consequence of the seeding density applied as well as of the agro-technical and natural conditions prevailed in the past. Most of the values (whet, barley, oats, maize, sugar beet, potatoes, alfalfa, clover, rape) have been taken from Kostrej et al. (1992); the rest from Petr et al. (1988). Special attempt was made to derive best estimate values.

The data on time development of the LAI are based on the fenological studies of Kurpelová (1966, 1968, 1972). A set of fenological maps of very high quality (1:1,000,000) can be found in this reference, but the data are rather old. Since that time the fenological situation has been significantly changed partly due to changing of agro-technical approaches partly due to the introduction of new crop varieties. Therefore, the data have been adjusted according to Špaldon et al. (1982), Petr et al. (1988) and by consulting crop science specialists and managers from several typical agricultural enterprises.

Due to the lack of region specific data, the storage and processing times of the original EKOSYS-87 model data have been taken in most cases.

5.6.1.4 Animal feeding rates

The simplified animal feeding diet in the default Central European data set of FDMT was considered to be also relevant for the Slovakian agricultural conditions.

Data on feeding practices and their seasonality in Slovakia are available from plenty of sources. But, it is well known, that feeding approaches are very variable and they differ from farm to farm, in particular during a period of agriculture transformation.

Data on characteristic feeding rates for domestic animals can be found in references: Kovac et al. (1989), Labuda and Krácmar (1987), Cupka et al.. These data had to be generalised and, after consulted with the experts, also corrected. In particular the use of green fodder had to be adjusted.

As the parameters for the sub-mountain region are less region sensitive (e.g. processing factors and times or the animal feeding rates), the same data as for the adapted lowland region SK-I could be applied.

5.6.1.5 Storage and processing times

The storage and processing times applied in the customised FDMT for Slovakian conditions are nearly the same as the default FDMT data for Central European conditions.

5.6.1.6 Adult and age-dependent Slovak consumption rates

Average slovak consumption rates for adults were deduced from the Czechoslovak Statistical Yearbook (1986) and the data published by Kliment and Bucina, (1988).

Since 1990, the current consumption habits in the Slovak Republic have changed considerably due to the new economical and social conditions. Due to the lack of detailed and sufficiently representative data, the default age dependent consumption rates from FDMT (except for adult) have been applied.

Consumption of sheep milk is considered as zero for an average Slovakian individual. However, drinking of sheep milk with respect to critical groups cannot be omitted (e.g. sheep keeper in the sub-mountain region). If these critical groups are of further interest, the standard data have to be replaced by specialised data covering the diet of these critical groups.

5.6.2 Nuclide dependent parameters

5.6.2.1 Soil-to-plants transfer factors

Only for soil-to-plant transfer factors, nuclide dependent parameters have been collected (Table 2).

SR Region	SK-I	SK-II	SK-III
Main soil type	middle loam, heavy loam	middle loam	middle loam
pH KCl	6.5 - 7.8	5,5-6,5	4,5-6,5
CEC	high	middle	middle
extracteble K	good	good	insufficient
extractable P	good	insufficient	insufficient
humus [t/ha]	200-400	100-200	100-300

Table 2 The basic properties of the prevailing types of soil in the SlovakRepublic (SR)

No soil-to-plant transfer effect was observed by measurements during post-accidental monitoring in Slovakia. The default FDMT data for Central European conditions have been recommend to be applied in the FDMT customised to the Slovak conditions because they seem to be sufficiently relevant for the prevailing soil types in Slovakia.

5.7 Data collection for the individual radioecological regions (Ukraine)

The customisation of the RODOS foodchain and dose model FDM for Ukraine required the adaptation of the input parameter to the local condition. For each of the five selected radioecological regions the necessary data has been collected and put into the RODOS data base. The most complete set of information has been collected for the Polesie and the Veld region where all the Ukrainian NPPs are located.

5.7.1 Nuclide independent parameters

5.7.1.1 Products to be considered

For the three radioecological regions Polesie, Forest-Veld, Veld, the same list of plants and animal products have been considered. In addition, rice was added due to its potential contamination from irrigation for the Veld region.

The number of plants and animal products considered in the Karpati and Crimea regions was lower as the climatological conditions do not allow to grow all types of vegetation from the basic list of crops.

5.7.1.2 Leaf area indices

The leaf area indices were derived by using the expertise of the agro-meteorological department of the Ukrainian Hydrometeorological Centre, with help of computer codes for estimating the LAI based on climatological characteristics of the region [28,29] and with information collected from various publications [1-8].

5.7.1.3 Growing cycles of crops

The begin of growth and the harvesting times were available over the last 30 years based on observation from agro-meteorological stations of the Ukrainian Hydrometeorological Centre [4,5].

5.7.1.4 Yield of crops

The yield of the various crops was taken from data derived some years ago. However recently, the efficiency of the agricultural production in the Ukraine is decreasing which means that the selected parameter represent upper limit values.

5.7.1.5 Feeding practices.

The animal diet was estimated to be identical for all radioecological regions. This was assumed due to an existing lack of detailed data. But it is planed in future to derive more precise information on the feeding practice for each radioecological region [20,21,24,34].

5.7.1.6 Human dietary habits.

Consumption rates for adults have been taken from statistical information over the last years for representative districts of each of the radioecological regions: Rovenska district for the Polesie region, Kharkivska district for the Forest-Veld region and Mikolaevska district for the Veld region. Different data for urban and rural inhabitants are taken as one single information.

5.7.1.7 Irrigation parameters.

A large fraction of agricultural crops gown in the southern part of Ukraine, the Veld region, needs regularly irrigation. Most of these irrigated crops are cereals such as rice, wheat and barley as well as feedstuffs such as maize, beet, alfalfa and clover [25]. Water from the large river Dnieper is mainly used for irrigation purposes. Therefore, the contamination of plants trough contaminated irrigation water may be important in particular for this region in the case of an accident

5.7.1.8 Parameter of weathering rate.

Based on investigations and experimental data obtained in the early period after the Chernobyl accident in Kiev district [28] and also on data from [18], the parameter of the weathering rate was set to 0.173 day^{-1}, which means a 4 days half-live. This value agrees well with data which can be found in [32].

5.7.2 Nuclide dependent parameters.

5.7.2.1 Leaching rate

The rate of the activity decrease due to migration out of the root zone has been estimated according to the methodology in FDMT for the depth of the root zone of 0.25 m and 0.1 m for arable and pasture soil, respectively. A typical distribution coefficient K_d was selected from Handbook of parameter values for the predominant soil type of each region [22].

5.7.2.2 Transfer factors soil-plant TF

Transfer factors for the soil-plant system were mainly derived from a review of available data from Ukraine, Russia and Belarus [12, 13, 14]. In addition, information from the Agricultural Radiology in Kiev has been used. This includes mainly data for radiocaesium and radiostrontium.

The types soil in the territory of Ukraine vary considerably. By using the more simpler classification scheme used in RODOS, sandy, sandy loam and peat are the predominant soil types in the radioecological region of the Polesie (code in RODOS 320).

In the Forest-Veld (code in RODOS 321) and Karpati region, the agriculture areas (code in RODOS 323) consist mainly of light loam and middle loam soils.

In the Veld (code in RODOS 322) and Crimea regions (code in RODOS 324) heavy loam and clay type soils are predominant. Transfer factors for Strontium have been derived for the predominant soil type for each of the five radioecological regions [14]. Accordingly, transfer factors for Caesium have been derived from other publications [12,13,26,27]

The default transfer factors of FDMT have been applied for all other radionuclides.

5.7.2.3 Transfer factors to animal products.

To adapt the transfer factors to animal products, various references have been analysed [18, 19, 23, 24]. In particular data for Cs, Sr, I and Ru have been collected for cows milk, beef, pork, chicken and lamb.

6 REFERENCES

6.1 References for the introduction

1. Müller and M. Bleher, 'Exposure Pathways and Dose Calculations in RODOS: Improvement of Predictions by Measured Data', *Radiation Protection Dosimetry* **73**(1-4), 61-66 (1997)
2. Müller and G. Pröhl, 'ECOSYS-87: A Dynamic Model for Assessing Radiological Consequences of Nuclear Accidents', *Health Phys.* **64**(3), 232-252 (1993).
3. Brown et al, Models for decontamination, relocation and agricultural countermeasures in RODOS, *Radiation Protection Dosimetry* 73 (1-4), pp 75-80, 1997.
4. Brown et al, Modelling of agricultural countermeasures in RODOS, IN The radiological consequences of the Chernobyl accident, Eds. A Karaoglou et al, EC, EUR 16544 EN, Luxembourg, 1996.
5. Pecha P., Nedoma P., Karny M., Kuca P.: Terrestrial Food Chain and Dose Modul of RODOS: Customisation for its Use in the Czech Republic. RODOS (WG3) - TN(98) – 14, DRAFT, Dec.1998
6. Nándor Fülöp, Nándor Glavatszih, dr. Andor Kerekes, Data Collection, NRIRR, Hungary, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999
7. "Review of the adequacy of the present foodchain and dose calculations" and "Collection of the data required for each radioecological region and their integration", IFIN-HH, Romania, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999
8. M. Borysiewicz, A. Furtek, S. Potempski, Collection of data for radiological regions of Poland and their integration into the RODOS, IAE, Poland, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999
9. 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
10. Ondrej Slavik, NPPRI, Slovakia, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999
11. A. Dvorzhack, 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', IMMS-PP, Ukraine, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999

6.2 References for the contribution from Czech Republic

1. Kurpelova M., Coufal L., Culik J.: Agro-Climatic Conditions of CSSR. Hydrometeorological Institute, Bratislava, 1975
2. Climatic Atlas of the Czechoslovak Republik, 1958, 1960, 1961
3. Moravec D., Votýpka J. : Climatic Regionalization of the Czech Republic. Charles Univ. Publishing, 1998, ISBN 80-7184-417-9

4. Kliment V.: Modelling of Radiocesium Foodchain Transport after the Chernobyl Accident. Nuclear Energy 38, 1992, No. 5 (Journal of the Czech State Office for Nuclear Safety)

5. Validation of models using Chernobyl fallout data from the Central Bohemiaregion of the Czech Republic, VAMP multiple pathways assessment WG, IAEA-TECDOC-795 (April 1995)

6. Klumpar J., Pechova E., Pecha P., Nedoma P.:Interactive program tool for assessment of the radiological cosequences of radionuclide releases used for purpose of NPP design. Safety of Nuclear Energy, 44, No. 5/6, 1998, p. 159 - 172 (Journal of the Czech State Office for Nuclear Safety)

7. Vesely Z. : Nutrition and feeding of animals State Agricultural Publisher, Prague, 1988

8. Statistical Yearbook of the Czech Republic 1997 Publ. of the Czech Statistical Office

9. Gross Agricultural Production in the Czech Republic Publ. of the Czech Statistical Office, code 1201 - 97

10. Final Figures on Crop Yields Harvested in the Czech Republic Publ. of the Czech Statistical Office, code 1202 - 97

11. Livestock Census on 1 March 1997, Publ. of the Czech Statistical Office, code 1204 - 97

12. Census of Sowing Areas in the Czech Republic on 31 May 1997, Publ. of the Czech Statistical Office, code 1205 - 97

13. Czech Republic's Municipality Nomenclature 1997, Publ. of the Czech Statistical Office, code 0401 - 97

14. Age structure of Population in the Czech Republic, Publ. of the Czech Statistical Office, code 0404 - 97

15. Population in the Czech Republic's Municipalities, Publ. of the Czech Statistical Office, code 1425 - 97

16. Gering F., Muller H. : Model Parameters of the Food Chain and Dose Modules in the RODOS database. RODOS(WG3)-TN(96)-04

17. Food Consumption in the Czech Republic (1995, 1996), Publ. of the Czech Statistical Office, code 0805 - 97

18. Pecha P. Nedoma P. Karny M. : 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 July 99)

19. Kliment V.: Expert Analysis of Input Parameters of ECOAMOR Model, Internal report ordered by UTIA, Oct. 1997

20. Slavik O. (VUJE Trnava) : Personal communication on LAI and growth dilution rate,

21. Pechova E., Pecha P., Nedoma P. : Application of PC-COSYMA code such a verification tool used in stage of NPP design. Proceedings of the 4-th COSYMA Users Group Meeting, Prague, Sept. 22-24, 1977

22. Pecha P., Nedoma P., Karny M., Kuca P.: Terrestrial Food Chain and Dose Modul of RODOS: Customisation for its Use in the Czech Republic. RODOS (WG3) - TN(98) – 14, DRAFT, Dec.1998

6.3 References for the contribution from Hungary

6.4 References for the contribution from Poland

1. Krajewski, P. (1999). Development and Validation of Models for Dose Assessment from isotopes of I and Cs released to the Environment, Ph.D. Thesis, Central Laboratory for Radiological Protection, Warsaw
2. BIOMOVS II. (1993). Guildness for Uncertainty Analisis Development for Participants in the BIOMOVS II Study, BIOMOVS II Technical Report No. 1, Swedisch Radiation Protection Institute, Stockholm, Sweden.
3. BIOMOVS II. (1995). Qualitative and Quantitative Guidelines for the Comparison of Environmental Model Predictions. BIOMOVS II Technical Report No. 3, Swedisch Radiation Protection Institute, Stockholm, Sweden.
4. BIOMOVS II. (1996). Uncertainity and Validation: Effect of Model Complexity on Uncertainty Estimates. BIOMOVS II Technical Report No. 16, Swedisch Radiation Protection Institute, Stockholm, Sweden.
5. IAEA (1995). Validation of multiple pathways assessement models using Chernobyl fallout data from the Central Bohemia of Czech Republic- Scenario CB. First raport of the VAMP Multiple Patways Assessement Group. IAEA-TECDOC-795, International Atomic Energy Agency, Vienna, Austria.
6. BIOMOVS (1991). Proceedings of a Symposium on the Validity of Environmental Transfers Models (Stockholm, 1990), Swedish Radiation Protection Institute, Stockholm Sweden.
7. Kabata-Pendias, A., Pendias, H. (1993). Biogeochemia pierwiastków sladowych, PWN, Warszawa, 334.
8. Edwards, R. R. (1962). Iodine-129: its occurrence in nature and its utility as tracer, Science 137, 853-860.
9. UNSCEAR (1995). Sources and Effects of Ionizing Radiation:Dose Asseeement for Radionuclides. United Nation Scientific Commitee on the Effects of Atomic Radiation, Forty-fourth session, E.95.IX.2.
10. UNSCEAR (1993). Sources and Effects of Ionizing Radiation: Report to the General Assembly, with scientificannexes, E.94.IX.2.
11. UNSCEAR (1995). Sources and Effects of Ionizing Radiation: Official Records of the General Assembly, Nineteen Sesion, Suplement No. 14 .
12. IAEA (1994). Handbook of Parameter Values for The Prediction of Radionuclide Transfer In Temperate Environments. Technical Reports Series No 364, International Atomic Energy Agency , Vienna , Austria
13. Frissel, M.J. (1996). Soils role in the restoration of terrestrial sites contaminated with radioactivity: Radioecology and the Restoration of Radioactive-Contaminated Sites; (eds. Luykx, F.F., Frissel, J.M.), NATO ASI Series, 2. Environment-Vol.13
14. Muller, H., Gering, F. (1997). Model parameters of the Food Chain and Dose Modules in the RODOS Data Base, GSF, TN(96)-04, Forschungszentrum für Umvelt und Gesundheit, Neucherberg, Germany.

15. Coughtrey, P. J. (1990). Radioactivity transfer to Animal Products. Report EUR. 12608 EN, Commission of the European Communities, Luxemburg.

16. Voigt, G., Prohl, G., Muller, H. (1991). Experiments on the Seasonality of the Cesium Translocation in Cereals, Potatoes and Vegetables. Radiatation and Environmental Biophysics, 30, 295-303.

17. Pietrzak-Flis Z., Krajewski P., Krajewska G., Sunderland N.R. (1994). Transfer of radiocesium from uncultivated soils to grass after the Chernobyl accident, Science of the Total Environment, 141, 147-153

18. Bucina, I., Prouza, Z., Miller, H., Malátowá, I. (1995). Estimation of Mean Eeposure in Region CB, Validation of multiple pathways assessement models using Chernobyl fallout data from the Central Bohemia of Czech Republic- Scenario CB. First raport of the VAMP Multiple Patways Assessement Group, IAEA-TECDOC-795, International Atomic Energy Agency, Vienna, Austria.

19. Krajewski, P (1995a). CLRP model descriptions and individual evaluation of model predictions. Validation of multiple pathways assessement models using Chernobyl fallout data from the Central Bohemia of Czech Republic- Scenario CB. First raport of the VAMP Multiple Patways Assessement Group, IAEA-TECDOC-795, International Atomic Energy Agency, Vienna, Austria (241-252).

20. Krajewski, P. (1996). CLRP model descriptions and individual evaluation of model predictions. Validation of multiple pathways assessement models using Chernobyl fallout data of ^{137}Cs in region Southern Finland- Scenario S- Second raport of the VAMP Multiple Patways Assessement Working Group, IAEA-TECDOC-904, International Atomic Energy Agency, Vienna, Austria (288-326).

21. BIOMOVS II (1996). An Overview of the BIOMOVS II Study and its Findings. BIOMOVS II Technical Report No. 17, Swedisch Radiation Protection Institute, Stockholm, Sweden.

22. BIOMOVS II (1996). Uncertainity and Validation: Effect of User Interpretation on Uncertainty Estimates. BIOMOVS II Technical Report No. 7, Swedisch Radiation Protection Institute, Stockholm, Sweden.

6.5 References for the contribution from Romania

1. Aarkog A. (1983) 'Translocation of radionuclides in cereal' *Ecological Aspects of Radionuclides Research* Blackwell Scientific Publ., 81-90.

2. Aarkrog A., Lippert J. (1971) 'Direct Contamination of Barley with Cr-51, Fe-59, Co-58, Zn-65, Hg-203 and Pb-210' *Radiation Botany*, **11**, 463-472, Pergamon Press.

3. Amaral E.C.S. et al (1995) 'Transfer of Cs-137 from Soil to Chicken Meat and Eggs' *J. Environ. Radioactivity*, **29** (3), 237-255.

4. Ambe S. et al (1996) 'Multitracer Study on Absorption of Radionuclides in Atmosphere-Plant System'. Japan.

5. Apostoaei I. (1994) *Modeling of the transfer processes leading to the contamination of fruits* Internal Report, D.N.E.. Univ. of Tennessee, Knoxville, TN.

6. Apostoaei I., (1983) *Processes involved in the transfer of radionuclides to fruit* ISAR, Seminar, 1993

7. Brown J., Simmonds J.R. (1995) *A Dynamic Model for the Transfer of Radionuclides through Terrestrial Foodchains.* NRPB-R273.

8. Dinu I. et al (1972) *Guidebook for Animal Farming* (in Romanian) Ed. Ceres, Bucuresti.

9. Draganescu C. (1984) *Ecological animal farming* (in Romanian),Ed. Ceres, Bucuresti.

10. Fabbri S. et al (1994) 'Transfer kinetics and coefficients of Sr-90, Cs-134, and Cs-137 from forage contaminated by Chernobyl fallout to milk and cows' *Health Physics*, **66**(4), 375-379.

11. Galeriu D. (1990) *Development of Lindoz Model through Biomovs A4 Exercises Biomovs*. Conference Proceedings Stockholm, Oct., 243.

12. Galeriu D. (1993) *Lindoz Model Results for S Scenario, IAEA-VAMP.* Working Document Viena- Austria, Sept.

13. Galeriu D., Kanyar B., Kliment V., Hinton T., Peterson S.R. (1995) *Description of models used in scenario CB. Validation of models using Chernobyl fallout data from the Central Bohemia region of the Czech Republic.* IAEA Vienna TECDOC-795.

14. Goudriaan J., Van Laar H.H. (1994) *Modelling Potential Crop Growth Process*, Kluwer Academic

15. Johnson J.O.E. et al (1988) 'Transfer coefficients of selected radionuclides to animal products. I. Comparison of milk and meat from dairy cows and goats' *Health Physics*, **54** (2), 161-166.

16. Lacatusu G. (1989) unpublished; contract work between IFIN and the Institute of Agraricultural Economy.

17. Muntean L.S. et al (1995) *Fitotehnie* Ed. Didactica si pedagogica, Bucuresti.

18. Munteanu I. (1998) *Date privind principalele soluri din Romania si din zonele de risc nuclear Bechet si Cernavoda* (unpublished). Contract work between Agrochemical & Pedological Institute and IFIN-HH.

19. Nair S. (1984) *Models for the evaluation of ingestion doses from the consumption of terrestrial foods following an atmospheric radioactive release*, RD/B/5200/N84, April.

20. Nisbet A.F. et al (1999) *Recommended Soil to Plant Transfer Factors for Radiocesiumand Radiostrontium for Use in Arable Systems* Preprint NRPB - R304.

21. Prohl G., Friedland W., Paretzke H.G. (1985) *Intercomparision of the Terrestrial Food Chain Models* FOOD-MARC and ECOSYS", December .

22. Shaw G. et al (1992) 'Retention, loss and translocation of radionuclides applied to foliar surfaces of wheat'. *Environmental and Experimental Botany*, **32** (4), 391-401.

23. Starr C., Taggart R. (1992) *Biology.* Wadsworth Publishing Company.

24. Voigt G. et al (1990) *Experimentelle Verifizierung dynamischer Radioökologiemodelle in der Folge von Tschernobyl*. Neuherberger, Aug.

25. Ward G.M. (1989) ‘Transfer of Cs-137 to milk and meat in Hungary from Chernobyl fallout with comparisons of worldwide fallout in the 1960s’ *Health Physics*, **57**, 587-592.

26. Ward Whiker F., Kirchner T.B. (1987) ‘Pathway: A Dynamic Food-Chain Model to predict Radionuclide Ingestion After Fallout Deposition’ *Health Physics*, **52** (6),717-737.

27. *** (1982) *Feedstuff ration for animal farming* Official Bulletin 19, Feb.16, Romania.

28. *** (1989)a *VI th Report of the Working Group Soil-to-Plant Transfer Factors* International Union of Radioecologists Guttannen, Grimselpass Switzerland, May 24-26.

29. *** (1989)b ‘Special Issues on Radionuclide transfer to animal products’ *The Science of the Total Environment*, **85**.

30. *** (1990) ‘Proceedings of the Seminar on Methods and Codes for Assessing the Off-Site Consequences of Nuclear Accidents’ *Radiation Protection* , **1**, Athens, 7-11 May.

31. *** (1994) *Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Temperate Environment* IAEA Technical Report Series No. 364, Vienna.

6.6 References for the contribution from Russia

1. Müller H. and Pröhl G. ECOSYS-87: A Dynamic Model for Assessing Radiological Consequences of Nuclear Accident. Health Physics, Vol.64, No 3, p.232-252.

2. Gringof I.G. (Ed.) Reference book for agronomist on agricultural meteorology. Leningrad, Gidrometeoizdat, 1986 (In Russian).

3. Gulayev G.V. (Ed.) Reference book for agronomist of nonchernozem zone. Moscow, Agropromizdat, 1990 (In Russian).

4. Tooming H.G. Ecological principles of maximum productivity of crops. Leningrad, Gidrometeoizdat, 1984 (In Russian).

5. Polevoy A.N. The theory and calculation of agricultural crops productivity. Leningrad, Gidrometeoizdat, 1984 (In Russian).

6. Alexakhin R.M. (Ed.) Recommendations on Organisation of Agriculture Under Conditions of Lands Contamination as a Result of the Chernobyl NPP Accident for the Period of 1991-1995. (State Commission of the Council of Ministers of the USSR on Food Products and Purchases, Moscow), 1991 (in Russian).

7. Korneev N.A. and Sirotkin A.N. The Fundamentals of Agricultural Animals. - Moscow, Energoatomizdat, 1987 (In Russian).

8. Alexakhin R.M. and Korneev N.A. (Eds.) Agricultural Radioecology. - Moscow, Ecology, 1991 (In Russian).

9. Prister B.S., Loschilov N.A., Nemets O.F. and Pojarkov B.A. The Fundamentals of Agricultural Radiology. - Kiev, Urozhiaj, 1988 (In Russian).

10. Vasilyev, F.P. Numerical Methods for Solving Tasks Involving Extremal Situations. Nauka, Moscow, 1980 (In Russian)

11. Fesenko S.V., Spiridonov S.I., Sanzharova N.I., Alexakhin R.M. Dynamics of ^{137}Cs bioavailability in a soil-plant system in areas of the Chernobyl nuclear power plant accident zone with a different physico-chemical composition of radioactive fallout. J. Environ. Radioactivity, Vol.34, No. 3, pp. 313, 1997.

12. S. Fesenko, S. Spiridonov, B. Yatsalo, O. Mirzeabassov, N. Sanzharova, V. Kuznetsov Adaptation of FDMT model for the conditions of the Smolenskaya NPP radioecological region. 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', RIARAE, Russia, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999

13. S. Fesenko, S. Spiridonov, N. Sanzharova. Modification of FDMT model for the conditions of CIS countries and performance of validation studies with the adapted model. 'Documentation on the two INCO working programs. 'Development of complementary models and/or modification of existing models according to the results of E.3.1; integration new or revised submodules in RODOS' and 'Compilation of independent data for the Chernobyl region for testing the dose and foodchain models modules and performance of validation studies with the adapted model'. RIARAE , Russia, Technical RODOS report RODOS(WG3)-TN(99)-??, 1999

14. Fesenko S.V., Sanzharova N.I., Lissiansky K.B., Alexakhin R.M. Dynamics of the decrease of ^{137}Cs transfer factors to agricultural plants after the Chernobyl NPP accident. // Radiobiology. Radioecology. 1998. V.38. No 2. P.256-265 (In Russian).

6.7 References for the contribution from the Slovak republic

1. Cupka V., Gálik R., Kabát L., 1990" Feeding the pigs, (In Slovak, Krmenie oshipanych), Bratislava

2. Fulajtar E., 1996 : Evaluation of agricultural input data for dynamic modelling of the nuclear accident consequences, Report, Soil Fertility RI Bratislava ..

3. Dvorzhak Alla, 1998. Customisation of RODOS FDMT module to the Ukrainian conditions

4. Hrosso F., 1958: Soil Science, (In Slovak, Podoznalectvo), Bratislava

5. Kliment V., Bucina I, 1988. Kontamination of food by radioizotopes of cesium in ÈSSR after chernobyl accident, UISJP Rez near Prague.

6. Kollár B., 1990: Agricultural systems, II. part, (In Slovak, Po_nohospodárske sústavy, II.diel), Handbook, Príroda, Bratislava

7. Kostrej A. et al., 1992: Physiology of Field Crops, (In Slovak, Fyziológia porastu po_ných plodín), Handbook, VŠP, Nitra

8. Kurpelová M., 1966: Fenological characterization, In: Petrovic S. et al.: Climatical and fenological characterization of East Slovakia, Hydrometeorology institute, Prague

9. Kurpelová M., 1968: Fenological characterization, In: Petrovic S. et al.: Climatical and fenological characterization of West Slovakia, (In Slovak, Klimatické a fenologické pomery západoslovenského kraja), Hydrometeorologický ústav, Praha

10. Kurpelová M., 1972: Fenological characterization, In: Petrovic S. et al.: Climatical and fenological characterization of Middle Slovakia, (In slovak, Klimatické a fenologické pomery stredoslovenského kraja), Hydrometeorologický ústav, Praha

11. Labuda J., Krácmar S., 1987: Feeding of the Cattle, (In Slovak, Krmenie hovadzieho dobytka), Nitra

12. Müeller H, Pröhl G (1993): ECOSYS-87: A Dynamic model for assessing radiological consequences of nuclear accidents. Health Phys. 64, pp. 232-252

13. H.Müller, F.Gering, S.Hübner (1998): Documentation of the terrestrial foodchain and dose module FDMT in RODOS PV3.1, RODOS(WG3)-TN(98)-09, GSF,

14. Mrázova M. (1990), Food consumption in SR, Nurishment and Health (Výziva a zdravie) No 1, 1996

15. Petr J. et al., 1988: Handbook of agronomist (In Czech, Rukove agronómie), SZN, Praha

16. Petr J., Cerný V., Hruška L. et al., 1988: Yield Formation in the Main Field Crops, Development in Crop Science (3), Elsevier, Amsterdam - Oxford - New York - Tokyo

17. Sommer A.,et all, Animals nurishment and feeding, Príroda, Bratislava

18. Svetlanska M., 1995: personal consultation

19. Statistical Yearbooks of the Slovak Republic, 1991 - 1993, (In Slovak, Statistická roèenka Slovenskej republiky), Statistical office of Slovak Republic, Bratislava

20. Statistical Yearbooks of Czechoslovak Socialistic Republic, 1980-1990, (In Czech, Statistická rocenka Czeskoslovenské socialistické republiky), Federal, Czech and Slovak statistical offices, SNTL Praha.

21. Spaldon E. et al., 1982: Crop production (In Slovak, Rastlinná výroba), Príroda, Bratislava

6.8 References for the contribution from Ukraine

1. Polevoy A.N. The Theory and calculation of agricultural crops productivity. - Leningrad, Gidrometeoizdat, 1984.

2. Guidance to compose agrometeorological prognoses, - Moscow, 1984.

3. Precept gidrometeorological stations. - Moscow, 1985

4. Proceeding of Ukrainian Hydrometeorological Centre 1986-1996. - Kiev.

5. Adamenko T.I., Ukrainian Hydrometeorological Centre, Department of Agrometeorology. - personal communication, 1998.

6. Nichiporovich A.A. Photosynthesis and productive process. - Moscow.

7. Chirkov Y.I. The Fundamentals of agrometeorology.- Leningrad, 1988.

8. Toming H.G. Ecological principles of maximum productivity of crops. Leningrad, Gidrometeoisdat, 1984

9. Agriculture of the Ukraine. Minstat., Kiev, 1995.

10. The Ukraine in the figures in 1995. Minstat., Kiev , Technika, 1996.

11. The Yield of crop of agriculture plants in the Ukraine. Minstat., Kiev, 1998.

12. 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 Belaruse on the effectiveness of agricultural countermeasures for use in the RODOS System, NRPB-M518, Chilton, 1994.

13. 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 Belaruse on the effectiveness of agricultural countermeasures, NRPB-M597, Chilton, 1995.

14. J.Brown, B.T.Wilkins, S.Fesenko, N.Sanzharova, L.Perepelatnikova, G.Perepelatnikov, C.Bouzdalkin. Compilation of data from the Ukraine, Russia and Belaruse on the effectiveness of agricultural countermeasures for strontium - 90. NRPB-M709, Chilton 1996.

15. Müller H. and Pröhl G. ECOSYS-87: A Dynamic Model for Assessing Radioecological Consequences of Nuclear accident. Health Physics, Vol.64, No 3, pp.232-252, 1993.

16. Georgievsky V.B. Ecological and dose models in radiational accidents. Kiev, Naukova Dumka, 1994.

17. Permitted levels of content of radionuclides ^{137}Cs and ^{90}Sr into food and drinking water. State hygienic standards. Kiev, 1997.

18. Prister B.S., Loschilov N.A., Nemec O.F. , Pojarkov B.A. The Fundamentals of agriculture Radiology.- Kiev, Urozhaj,1988.

19. Alexachin R.M., Korneev N.A. Agricultural Radiology.-Moscow, Ecology, 1991.

20. Bogdanov G.A. Feeding agricultural animals, Kiev, 1990

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

22. Handbook of parameter values for the prediction of radionuclide transfer in temperate environments. Technical reports series N 364. IAEA, Vienna, 1994

23. Gorodniy M.M., Serduk A.G., Kopilevich V.A. Kalenskiy V.P., PristerB.S., Babiyenko M.F. Agrochemistry, Kiev , 1995.

24. Transfer of radionuclides to animals, their comparative importance under different agricultural ecosystems and appropriate countermeasures. European Commission Belarus, the Russian Federation, Ukraine. International scientific collaboration on the consequences of the Chernobyl accident (1991-95). Experimental collaboration project No 9. Final report. 1996 EUR 16539 EN.

25. Voitsekhovitch O.V. (Ed.) The Radiogeoecologie of water objects of zone of the influence of the Chernobyl accident. 1998.

26. Prister B.S., Ivanov Yu.A., Perepelatnikova L.V., Pronevich V.A. Post-accident agricultural problems in Ukraine. Agricultural Science. 1996

27. Tkachenko N.V. The features of the radioactive contamination of vegetables and its roll in formation of radiation situation in the first years after the Chernobyl accident, Author's abstract of dissertation, Kiev, 1990.

28. Polevoy A.N., - personal communication, 1998.

29. Paevska L. - personal communication, 1999.

30. Voitsekhovitch O.V. - personal communication, 1999.

31. V.Berkovski, O.Voitsekhovich, O.Nasvit, M.Zhelezniak, U.Sansone Exposure from Aquatic Pathways. Proc. of the first international conference. Minsk, Belarus, 1996.

32. 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

33. Prister B.S. Radioecological aspects of managing of agriculture on the territory, contaminated after the accident on ChNPP. Scientific conference Chernobyl-94, 1996.

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

35. R.M.Aleksakhin, O.I.Bufatin, V.G.Malikov, G.P.Perepelatnikov at al. Radioecology of irrigated agriculture. Moskow, 1985

36. G.P.Perepelyatnikov, B.S.Prister, A.S.Sobolev Migration of radionuclides in system water-soil-plant irrigated from Dniper river after Chernobyl accident. Problems of agricultural radiology. Proc. of UIAR. Ed. Loschilov N.A. Kiev, 1991

37. G.P.Perepelyatnikov, B.S.Prister Migration of radionuclides of Chernobyl falloat on the filds, irrigated from Dniper river. Problems of agricultural radiology. Proc. of UIAR. Ed. Loschilov N.A. Kiev, 1992

38. G.P.Perepelyatnikov To tht question of radiation situation on irrigated filds. Problems of agricultural radiology. Proc. of UIAR. Ed. Loschilov N.A. Kiev, 1993

39. Prister B.S., Perepelyatnikov G.P., Ilyin M.I. Actual problems of forage production in the conditions of territories radiactive contamination. Problems of agricultural radiology. Proc. of UIAR. Ed. Loschilov N.A. Kiev, 1992

40. Perepelyatnikov G.P., Ilyin M.I. Radilogical aspects of usage of Ukrainian natural pastures and meadows. Problems of agricultural radiology. Proc. of UIAR. Ed. Loschilov N.A. Kiev, 1991

41. Bondar' P.F., Loschilov N.A. , Dutov A.I., Ozonov A.G., Svidenyuk N.L., Tereschenko N.L., Maslo A.V. Common regularities of plant products contamination on the territiry, subjected to radioactive contamination after the accident on ChNpp. Problems of agricultural radiology. Proc. of UIAR. Ed. Loschilov N.A. Kiev, 1991

7 Appendix

7.1 FDMT data sets for the radioecological regions of Czech Republic

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Plant species	Harvest	Yield (kg m^{-2})
Winter wheat	20.7-15.8.	0.51
Spring wheat	1.8.-15.8.	0.44
Winter barley	5.7.-20.7.	0.51
Spring barley	25.7.-10.8.	0.44
Triticale	2.8.-10.8.	0.41
Oats	1.8.-7.8.	0.33
Rye	18.7.-14.8.	0.39
Maize	10.9-30.9.	3.55
Corn cobs	1.10.-15.10	0.84
Beet	1.10-10.11.	4.25
Beet leaves	1.10.-10.11.	d
Potatoes (early)	10.6.-15.7.	1.80
Potatoes (late)	15.8.-15.9.	2.10
Rape	15.7.-30.7.	2.62
Leafy vegetables	1.6.-10.11.	2.50
Fruit vegetables	1.8.-30.10.	1.30
Root vegetables	1.8.-31.10.	2.10
Fruit	1.7.-20.10.	d
Berries	5.6.-10.7.	d

Table 3a: Times of harvest and yields Yi (fresh weight) of the crops considered in FDMT: Specific values for radioecological region 1 (lowland) of the Czech Republic, d = FDMT defaults

Note on table 3:

Source on times of harvest: available phenological data, RIAP and ARI expertise study. Source on yield values: „Final figures on Crop Yields harvested in the Czech Republic“, 1997, Czech Statistical Office. The values are derived from averaged district values, can be influenced by the flooding events in 1997.

Plant species	Harvest	Yield (kg m^{-2})
Winter wheat	10.8.-30.8.	0.41
Spring wheat	10.8.-30.8.	0.32
Winter barley	1.8.-15.8.	0.39
Spring barley	10.8.-30.8.	0.39
Triticale	9.8.-15.8.	0.36
Oats	20.8.-15.9.	0.37
Rye	20.8.-15.9.	0.34
Maize	20.9.-15.10.	3.00
Corn cobs	x	
Beet	10.10.-25.10.	3.85
Beet leaves	10.10.-25.10.	d
Potatoes (early)	x	
Potatoes (late)	1.9.-20.10.	2.31
Rape	1.8.-15.8.	2.45
Leafy vegetables	10.6.-10.11.	2.40
Fruit vegetables	1.8.-30.10.	1.10
Root vegetables	1.8.-31.10.	2.10
Fruit	1.7.-20.10.	d
Berries	5.6.-10.7.	d

Table 3b: Times of harvest and yields Yi (fresh weight) of the crops considered in FDMT: Specific values for radioecological region 2 (midland) of the Czech Republic; d = FDMT defaults; x = growing not recommended

Plant species	Harvest	Yield (kg m^{-2})
Oats	4.9.-15.9.	as midland - o
Rye	1.9.-15.9.	as midland - o

Table 3c: Times of harvest and yields Yi (fresh weight) of the crops considered in FDMT: Specific values for radioecological region 3 (highland) of the Czech Republic; o = reliable data not available

Radioecological zone	Plant	Harvest time 1st cut 20.5.-10.6.	Harvest time 2nd cut 15.7.-25.7.	Harvest time 3rd time 25.8.-10.10.	Total yield [kg.m^{-2}] f.w.
lowland < 450 m	grass intensive	1.85	1.55	0.80	4.20
	grass extensive	1.15	0.85	0.5	2.50
	alfalfa + clover	2.00	1.70	0.90	4.60
midland <450;700>	grass intensive	1.65	1.25	0.60	3.50
	grass extensive	0.95	0.75	0.50	2.20
	alfalfa + clover	1.7	1.4	0.70	3.80
highland > 700 m	grass intensive	1.40	1.20	0.30	2.90
	grass extensive	0.95	0.65	0.30	1.90
	alfalfa + clover	1.50	1.20	0.60	3.30

Table 3d : Times of harvest and yields for fodder crops considered in FDMT: Specific values for radioecological region 3 (highland) of the Czech Republic (Source : Research Institute for Fodder Crops, Troubsko near Brno)

radioecolo-gical region	plant	d a t e and yield						
lowland	grass i	date	1.1.	15.3.	15.5.	15.7.	10.10.	1. 11.
< 450 m		yield	0.002	0.004	1.15	0.85	0.50	0.04
	grass e	date	1.1.	15.3.	15.5.	15.7.	10.10.	1. 11.
		yield	0.001	0.002	1.00	0.50	0.20	0.02
midland	grass i	date	1.1.	15.3.	15.5.	15.7.	10.10.	1. 11.
< 450 ,700>		yield	0.002	0.004	0.95	0.75	0.50	0.04
	grass e	date	1.1.	15.3.	15.5.	15.7.	10.10.	1. 11.
		yield	0.001	0.002	0.90	0.35	0.15	0.03
highland	grass i	date	1.1.	15.3.	15.5.	15.7.	10.10.	1. 11.
> 700 m		yield	0.001	0.003	0.95	0.65	0.30	0.005
	grass e	date	1.1.	15.3.	15.5.	15.7.	10.10.	1. 11.
		yield	0.001	0.002	0.70	0.50	0.25	0.025

Table 4: Yield of pasture grass (kg.m^{-2} f.w.) as a function of the time of year for CR conditions (source: RIFC)

Table 4 : Leaf area indices for other plants :

- Radzone 1 : taken from SK-I region of the Slovak Republic
- Radzone 2 : RODOS defaults
- Radzone 3 : taken from SK-III region of the Slovak Republic

Note on table 4 : Adapted values from the Slovak republic have to be modified by the maximum LAI values - if available - as a function of yield. Corresponding table is presented in the report on FDMT customisation in CR.

Table 5 : Season dependent growth dilution rates and half-lives for grass and alfalfa (or clover) :

- Radzone 1 : taken from SK-I region of the Slovak Republic
- Radzone 2 : RODOS defaults
- Radzone 3 : taken from SK-III region of the Slovak Republic

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

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
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 deer is about 30 days shorter), b Values given are for the winter period only, c Hay only, * Bedding, not for feeding, x Lowland mainly shaded, midland mainly pasture, y Lowland 30 % pasture, midland 80 % pasture, z Spring and autumn only.

Table 8: Feeding diets for animals : values for the Czech Republic conditions

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

Table 8a: Time dependent feeding rates for pigs (former data used in CR for local ingestion model ENCONAN)

Feeding diets I_k for animals (Table 9), transfer factors feed-animal products TF_m (Table 10), the biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} (Table 11) and processing factors for feedstuffs and foodstuffs (Table 12)are taken from the default data base of FDMT (see Appendix Default)

Animal product	foodstuffs	t_{zdp} [days]	f_1 adults/ child<1
milk	fresh milk + cream	4	0,46 / 0,059
	cheese	30 - 4 x 30	0,22 / 0,028
	dry + condensed milk	30 - 9 x 30	0,14 /0,89
	curd + other	15	0,18 / 0,023
meat	beef	30	
	pork	30	
	poultry	30	
eggs	eggs	14	

Table 13 : Time delays of consumption t_{zdp} in days and consumption fraction f_1 of individual foodstuffs in relation to the basic animal product (for age categories adults + child < 1 year, Source of data: former data used in CR for local ingestion model ENCONAN

Foodstuffs [kg, l / y]	Age category [year] 0 - 1	1 - 7	7 - 12	12 - 17	adults
leafy veg. spring	1.15	2.20	2.77	3.47	3.75
leafy veg. autumn	4.37	8.36	10.53	13.19	14.25
root vegetables	7.82	14.96	18.84	23.60	25.50
fruit vegetables	9.66	18.48	23.27	29.15	31.50
cereals - wheat	14.8	61.1	101.9	140.9	157.0
potatoes	4.4	36.6	50.7	77.1	80.0
fruits	9.9	33.6	45.4	55.9	45.0
milk	242.7	360.1	383.4	333.8	248.0
beef	3.8	14.9	20.7	23.2	21.5
pork	1.1	7.6	16.3	19.7	39.5
poultry	0.3	7.3	8.3	14.3	12.0
other kinds of meat	-	2.4	3.3	3.4	3.7

Table 14 : Age - dependent Czech consumption rates (Source of data: former data used in CR for local ingestion model ENCONAN)

Inhalation rates used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.2 FDMT data sets for the radioecological regions of Hungary

7.2.1 Model parameters for the Hungarian region I.

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT (Table 3) are those from region 2 plus an increase by 10 days)

Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 m^{-2}) as function of the time (given in Julian days) of the year (between the given values linear interpolation is applied) for the plants considered in FDMT (Table 4) for region 1 are those from region 2 plus an increase by 10 days)

Month	Dilution rate (d^{-1})	Half-life (d)
January - February	0.0	-
March	1.70E-2	9
April	2.80E-2	24
May	3.90E-2	20
June	2.30E-2	20
July	2.30E-2	20
August	2.00E-2	20
September	2.80E-2	30
October	1.70E-2	40
November - December	0.0	-

Table 5: Season dependent growth dilution rates λ_b (specific values for Hungarian conditions) and according half-lives for grass (default values for Central European conditions - also applicable for Hungary)

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.)								
Plant	Ag	Ba	Ce	Cm	Co	Cr	Cs	Fe	I
Grass	$8 \cdot 10^{-2}$	$3 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$2 \cdot 10^{-4}$	$8 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$5 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-1}$
Maize silage	$1.2 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$3 \cdot 10^{-3}$	$2 \cdot 10^{-5}$	$4 \cdot 10^{-3}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-2}$	$3 \cdot 10^{-3}$	$1 \cdot 10^{-1}$
Corn cobs	$1.2 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$3 \cdot 10^{-3}$	$2 \cdot 10^{-5}$	$4 \cdot 10^{-3}$	$6 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-3}$	$1 \cdot 10^{-1}$
Potatoes	$2.5 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$7 \cdot 10^{-3}$	$3 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$6 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
Beet	$2.5 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$7 \cdot 10^{-3}$	$3 \cdot 10^{-3}$	$5 \cdot 10^{-3}$	$6 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
Beet leaves	$2.5 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$7 \cdot 10^{-3}$	$3 \cdot 10^{-3}$	$3 \cdot 10^{-2}$	$6 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
Cereals	$8.5 \cdot 10^{-2}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-3}$	$2 \cdot 10^{-5}$	$3 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-1}$
Leafy vegetables	$4 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-1}$
Root vegetables	$1 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$4 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$7 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
Fruit vegetables	$1 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$4 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
Fruit	$1 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$4 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$2 \cdot 10^{-2}$	$3 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
Berries	$1 \cdot 10^{-2}$	$2 \cdot 10^{-3}$	$4 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-3}$	$2 \cdot 10^{-2}$	$3 \cdot 10^{-4}$	$1 \cdot 10^{-1}$
K_d (cm^3 g^{-1})	90[a] 120[b] 180[c] 15000[d]	60	900	4000[a] 18000[b] 6000[c] 6000[d]	60[a] 1300[b] 550[c] 1000[d]	70[a] 30[b] 1500[c] 270[d]	1000	220[a] 800[b] 165[c] 600[d]	100

Table 8: Transfer factors soil-plant TF_i and distribution coefficients K_d (default values for Central European conditions - also applicable for Hungarian conditions - soil types: *a*=sand, *b*=loam, *c*=clay, *d*=organic);

Plant	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.) Mn	Mo	Nb	Pu	Ru	Sr	Te	Zn	Zr
Grass	$8 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$2 \cdot 10^{-4}$	$2 \cdot 10^{-2}$	$5 \cdot 10^{-1}$	$5 \cdot 10^{-3}$	$2 \cdot 10^{-1}$	$4 \cdot 10^{-4}$
Maize silage	$6 \cdot 10^{-2}$	$8 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-1}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$6 \cdot 10^{-4}$
Corn cobs	$6 \cdot 10^{-2}$	$8 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$6 \cdot 10^{-4}$
Potatoes	$2 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$5 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-1}$	$1 \cdot 10^{-4}$
Beet	$2 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$4 \cdot 10^{-1}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-1}$	$1 \cdot 10^{-4}$
Beet leaves	$2 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$8 \cdot 10^{-1}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-1}$	$1 \cdot 10^{-4}$
Cereals	$2 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$3 \cdot 10^{-3}$	$9 \cdot 10^{-1}$	$4 \cdot 10^{-4}$
Leafy vegetables	$8 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$4 \cdot 10^{-1}$	$3 \cdot 10^{-3}$	$2 \cdot 10^{-2}$	$2 \cdot 10^{-4}$
Root vegetables	$2 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$1 \cdot 10^{-1}$	$5 \cdot 10^{-5}$
Fruit vegetables	$3 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$6 \cdot 10^{-2}$	$5 \cdot 10^{-5}$
Fruit	$3 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$1 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$6 \cdot 10^{-2}$	$5 \cdot 10^{-5}$
Berries	$3 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$1 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$6 \cdot 10^{-2}$	$5 \cdot 10^{-5}$
K_d (cm^3 g^{-1})	70	10[a] 125[b] 90[c] 25[d]	400	1000	1000	100	100	40	1000

Table 8 (continued)

Animal	Feedstuff	Intake rate ($kg\ d^{-1}$ dry weight)
Lactating cow	grass	6.0
	hay	6.0
	maize	1.5
	beet	5.0
	winter barley	0.25
Beef cattle	grass	6.0
	hay	6.0
	maize	1.5
	beet	5.0
	winter barley	0.25
Veal	grass	3.0
	hay	3.0
	maize	0.75
	potato	2.5
	beet	0.13
Pig	maize	0.48
	winter-barley	1.1
	winter-wheat	1.2
	oats	0.3
Chicken	hay	0.04
	maize	0.012
	winter barley	0.04
	winter wheat	0.008
	oats	0.008

Table 9: Feeding diets I_k for animals

Transfer factors feed-animal products TF_m (Table 10) and the biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} (Table 11) are taken from the default data base of FDMT (see Appendix Default)

Raw Product	Processed Product	Element Ag, Co, Cr, Fe, Mo	Ba	Cs	I	Pu	Ru,Cm	Sr
Wheat	Wheat flour	0.5	0.5	0.5	0.5	0.2	0.5	0.5
	Wheat bran	3.0	3.0	3.0	3.0	4.0	3.0	3.0
Rye	Rye flour	0.5	0.5	0.6	0.5	0.2	0.5	0.5
	Rye bran	3.0	3.0	2.7	3.0	4.0	3.0	3.5
Spring barley	Beer	0.1	0.04	0.1	0.1	0.04	0.04	0.04
	Brewing residues	0.1	0.25	0.1	0.1	0.25	0.25	0.25
Winter wheat	Distillery residues	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Potatoes	Potatoes, peeled	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Vegetables [a]	Vegetables [a]	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Fruit, berries	Fruit and berries	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Milk (cow)	Butter	1.0	1.0	0.2	0.5	1.0	1.0	0.2
	Cream (30% fat)	1.0	1.0	0.7	0.7	1.0	1.0	0.4
	Skim milk	1.0	1.0	1.04	1.0	1.0	1.0	1.1
	Cheese (rennet)	1.0	1.0	0.6	0.6	1.0	1.0	6.0
	Cheese (acid)	1.0	1.0	0.6	1.4	1.0	1.0	0.8
	Whey (rennet)	1.0	1.0	1.05	1.05	1.0	1.0	0.4
	Whey (acid)	1.0	1.0	1.05	0.95	1.0	1.0	1.04
	Condensed milk	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	Milk substitute	8.0	9.3	8.7	9.4	8.0	8.0	9.3

[a] Root, fruit, and leafy vegetables

Table 12: Processing factors for feedstuffs and foodstuffs as applied in FDMT (specific values for Hungarian conditions)

Product(s)	Storage time (d)
Cereals and cereal products	30
Brewing residues	60
Distillery residues	45
Maize and beet leaves	30
Beet leaves	7
Corn cobs	30
Potato	7
Beet	14
Leafy vegetables	1
Root vegetables	7
Fruit vegetables	2
Fruit and berries	2
Milk	2
Condensed milk	30
Butter	3
Cream	2
Sour cream	2
Condensed milk	7
Skim milk	2
Cheese (rennet coagulation)	30
Cheese (acid coagulation)	7
Whey	2
Milk substitute	15
Beef	14
Pork, veal, roe deer	14
Chicken, lamb	14
Eggs	2
Beer	60
Nuts	7
Wine	30
Mushroom	2

Table 13: Storage and processing times t_{pk} as applied in FDMT (specific values for Hungarian conditions)

Foodstuff	Consumption rates (g d^{-1}) for age group				
	1 a	5 a	10 a	15 a	adults
Spring wheat, whole grain	0.0	0.0	0.0	0.0	0.0
Spring wheat, flour	0.0	0.0	0.0	0.0	0.0
Winter wheat, whole grain	0.0	0.0	0.0	0.0	0.0
Winter wheat, flour	98	170	155	290	210
Rye, whole grain	0.1	0.0	0.0	0.0	0.0
Rye, flour	1.7	4.9	1.3	0.2	3.3
Oats	0.0	0.0	0.0	0.0	0.0
Potatoes	38	47	81	83	119
Leafy vegetables	18.3	24	19.5	40	39
Root vegetables	18.0	27	32	49	55
Fruit vegetables	75	117	153	127	82
Fruit	310	440	480	220	132
Berries	4.4	4.8	5.4	4.6	4.6
Milk	380	260	177	200	240
Condensed milk	0.9	3.7	5.5	1.5	0.3
Cream	8.7	14.2	18.5	15.7	18.4
Butter	6.0	11.3	15.0	15.7	13.2
Cheese (rennet)	2.8	6.1	8.5	7.8	4.6
Cheese (acid)	27	24	24	10.2	11.0
Beef (cow)	3.6	9.0	37	48	45
Beef (cattle)	0.0	0.0	0.0	0.0	0.0
Veal	0.0	0.1	1.1	0.0	0.0
Pork	44	73	103	155	148
Lamb	0.0	0.3	0.6	0.0	0.2
Chicken	31	37	63	133	80
Roe deer	0.0	0.0	0.0	0.0	0.5
Eggs	13.9	27	38	22	30
Beer	0.0	0.0	0.0	11.5	55
Sour cream	1.0	2.3	3.1	9.7	12.4
Rice	3.9	7.2	10.5	16.5	13.8
Corn	3.9	8.9	14.1	0.5	0.3
Nuts	0.3	3.6	8.0	4.3	12.7
Wine	0.0	0.0	0.0	6.3	35
Mushrooms	0.6	1.5	1.9	2.1	3.3
Drinking water	280	330	420	500	136
Fish	2.2	2.5	0.5	2.1	5.7

Table 14: Age-dependent consumption rates V_k for FDMT

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.2.2 *Model parameters for the Hungarian region II*

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Plant species	Harvest [Julian days]	Yield (kg m^{-2})
Grass	136,177,187	1.4,1.6,1.2
Winter wheat	180	0.48
Spring wheat	-	-
Winter barley	181	0.41
Spring barley	232	0.37
Oats	201	0.30
Rye	191	0.21
Maize	140	2.4
Corn cobs	283	3.6
Beet	314	3.8
Beet leaves	-	-
Potatoes	283	1.8
Leafy vegetables	100,176,303	1.0, 3.0, 4.0
Fruit vegetables	186,196,209,227,237, 241,243,248,268,303	0.90, 2.6 ,2.6 ,2.6, 0.9, 1.2, 2.6, 0.90, 0.90,1.2
Root vegetables	135,145,166,176,241, 258,259,263,272	0.70, 0.70, 2.0, 0.70, 2.0, 0.70, 2.3, 3.0, 2.0
Fruit	125,166,181,232,243, 273	0.70, 2.1, 0.70, 2.1, 2.1, 2.1
Berries	206,241,243,258,272, 288,304	0.50, 0.60, 1.0, 1.5, 1.5, 1.5, 1.0
Grape	243,258,272,288,304	1.0, 1.5, 1.5, 1.5, 1.0
Alfalfa	145,201,272	0.44,0.44,0.44

Table 3: Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT (specific values for Hungarian conditions, in Region 2)

Plant	Yield or leaf area index (LAI)							
Pasture	Date	1	136	177	187	365		
	Yield	0.01	1.6	1.4	1.2	0.01		
Pasture (extensive)	Date	1	136	177	187	365		
	Yield	0.01	1.6	1.4	1.2	0.01		
Lawn	Date	1	74	135.	304.	335		
	Yield	0.01	0.05	0.5	0.5	0.05		
Winter wheat	Date	1	95	151	181	182		
	LAI	0.1	1	1	6	1.5		
Spring wheat	Date	1	365					
	LAI	0	0					
Winter barley	Date	1	91	145	196	197.	278	365.
	LAI	0.1	1	6	1	0	0	0.1
Spring barley	Date	135	155	196	231	232		
	LAI	0	1	5	1.5	0		
Oats	Date	100	118	154	200	207		
	LAI	0	1	4	1	0		
Rye	Date	1	80	146	166	191	192	
	LAI	1	1	6	8	2	0	
Maize	Date	130	171	217	243	244		
	LAI	0	1	4.5	4	0		
Beet	Date	110	138	222	312	313		
	LAI	0	1	3.5	2.5	0		
Potatoes	Date	69	130	157	176	263	264	
	LAI	0	1	3.5	1.5	0.5	0	
Root veg. fruit veg	Date	1	100	171	272	273		
	LAI	0	5	5	5	0		
Fruits	Date	100	171	253	273			
	LAI	0	5	5	0			
Berries., grape	Date	100	181	273	304			
	LAI	0	5	5	0			
Alfalfa	Date	1	145	201	272			
	LAI	0	3.0	3.0	3.0			

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 m^{-2}) as function of the time (given in Julian days) of the year (between the given values linear interpolation is applied) for the plants considered in FDMT (specific values for Hungarian conditions in Region 2;)

Season dependent growth dilution rates and according half-lives for grass (Table 5) are identical to those from region I.

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

Transfer factors soil-plant TF_i and distribution coefficients K_d (Table 8) are identical to those from region I

Feeding diets I_k for animals (Table 9) are identical to those from region I

Transfer factors feed-animal products TF_m (Table 10) and the biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} (Table 11) are taken from the default data base of FDMT (see Appendix Default)

Processing factors for feedstuffs and foodstuffs (Table 12), storage and processing rates (Table 13) as well as age dependent consumption rates (Table 14) are identical to those from region I.

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.3 FDMT data sets for the radioecological regions of Poland

7.3.1 Model parameters for the Polish radioecological macroregions.

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2), for all macroregions, are taken from the default data base of FDMT (see Appendix Default)

Plant species	Harvest (begin and end) [Julian days]	Yield (kg m^{-2})
Grass	121-304	1.4
Hay (grass)	136-258	1.4
Alfalfa	121-304	1.4
Hay (alfalfa)	136-258	1.4
Maize	227-258	6.0
Maize bulbs	288	1.5
Potatoes	227-267	1.7
Beet	263-304	4.0
Beet leaves	263-304	3.0
Winter Barley	196	0.3
Spring Barley	217	0.3
Winter Wheat	217	0.4
Spring Wheat	227	0.3
Rye	212	0.3
Oats	222	0.3
Leafy Vegetables	121-304	1.5
Root Vegetables	213-304	2.0
Fruit Vegetables	213-288	1.5
Fruits	182-288	2.0
Berries	182-288	1.5

Table 3a : Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT (specific values for Polish conditions, in Western Region III.)

Plant species	Harvest (begin and end) [Julian days]	Yield (kg m^{-2})
Grass	135-318	1.2
Hay (grass)	150-272	1.2
Alfalfa	135-318	1.2
Hay (alfalfa)	150-272	1.4
Maize	241-272	5.0
Maize bulbs	302	1.5
Potatoes	241-281	1.7
Beet	277-318	4.0
Beet leaves	277-318	3.0
Winter Barley	231	0.3
Spring Barley	231	0.3
Winter Wheat	231	0.4
Spring Wheat	241	0.3
Rye	226	0.3
Oats	236	0.3
Leafy Vegetables	135-318	1.3
Root Vegetables	227-318	1.5
Fruit Vegetables	227-302	1.2
Fruits	196-302	2.0
Berries	196-302	1.5

Table 3b : Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT (specific values for Polish conditions, in Mountains Region VII.)

Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT for macroregions I, IV, V, VI, and II, VII are those from region III (Table 3a) plus an increase by 7 and 14 days respectively.

Yields of plants as function of the time of the year in mountains region VII are significantly lower then in all other regions (Table 3b).

Plant	Yield or leaf area index (LAI)						
Grass	Date Yield	74 0.05	135 1.4	304 1.4	305 0.05	365 0.01	
Hay (grass)	Date Yield	74 0.05	135 1.4	304 1.4	305 0.05	365 0.01	
Alfalfa	Date Yield	74 0.05	182 1.4	304 1.4	305 0.05	365 0.01	
Hay (alfalfa)	Date Yield	74 0.05	182 1.4	304 1.4	305 0.05	365 0.01	
Maize	Date LAI	128 0	163 1.0	206 5.0	281 4.0	282 0	365 0
Maize bulbs	Date LAI	128 0	163 0	206 5.0	281 4.0	282 0	365 0
Potatoes	Date LAI	140 0	182 6.0	213 6.0	258 0	365 0	
Beet	Date LAI	130 0	171 1.0	213 5.0	305 4.0	306 0	365 0
Beet leaves	Date LAI	130 0	171 1.0	213 5.0	305 4.0	306 0	365 0
Winter Barley	Date LAI	91 1.0	145 5.0	196 1.0	197 0	365 0	
Spring Barley	Date LAI	105 0	166 5.0	217 1.0	218 0	365 0	
Winter Wheat	Date LAI	110 1.0	161 6.0	217 1.0	218 0	365 0	
Spring Wheat	Date LAI	105 0	171 6.0	227 1.0	228 0	365 0	
Rye	Date LAI	79 1.0	140 5.0	213 1.0	214 0	365 0	
Oats	Date LAI	105 0	171 5.0	222 1.0	223 0	365 0	
Leafy Vegetables	Date LAI	365 5.0					
Root Vegetables	Date LAI	105 0	182 5.0	274 5.0	305 0	365 0	
Fruit Vegetables	Date LAI	105 0	182 5.0	274 5.0	305 0	365 0	
Fruits	Date LAI	105 0	182 5.0	274 5.0	305 0	365 0	
Berries	Date LAI	105 0	182 5.0	274 5.0	305 0	365 0	

Table 4a: Yield of pasture and leaf area indices as function of the time (given in Julian days) of the year (between the given values linear interpolation is applied) for the plants considered in FDMT (specific values for Polish conditions in Western Region III;)

Plant	Yield or leaf area index (LAI)						
Grass	Date	88	149	311	312	365	
	Yield	0.05	1.2	1.2	0.05	0.01	
Hay (grass)	Date	88	149	311	312	365	
	Yield	0.05	1.2	1.2	0.05	0.01	
Alfalfa	Date	88	196	318	319	365	
	Yield	0.05	1.2	1.2	0.05	0.01	
Hay (alfalfa)	Date	88	196	318	319	365	
	Yield	0.05	1.2	1.2	0.05	0.01	
Maize	Date	142	178	220	295	296	365
	LAI	0	1.0	5.0	4.0	0	0
Maize bulbs	Date	142	178	220	295	296	365
	LAI	0	1.0	5.0	4.0	0	0
Potatoes	Date	154	196	227	272	365	
	LAI	0	4.0	4.0	0	0	
Beet	Date	144	185	227	319	320	365
	LAI	0	1.0	4.0	3.0	0	0
Beet leaves	Date	144	185	227	319	320	365
	LAI	0	1.0	4.0	3.0	0	0
Winter Barley	Date	97	152	203	204	365	
	LAI	1.0	5.0	1.0	0	0	
Spring Barley	Date	112	173	224	225	365	
	LAI	0	5.0	1.0	0	0	
Winter Wheat	Date	117	168	224	225	365	
	LAI	1.0	6.0	1.0	0	0	
Spring Wheat	Date	112	178	234	235	365	
	LAI	0	6.0	1.0	0	0	
Rye	Date	93	154	227	228	365	
	LAI	1.0	5.0	1.0	0	0	
Oats	Date	105	171	222	223	365	
	LAI	0	5.0	1.0	0	0	
Leafy Vegetables	Date	365					
	LAI	5.0					
Root Vegetables	Date	112	189	281	312	365	
	LAI	0	5.0	5.0	0	0	
Fruit Vegetables	Date	112	189	281	312	365	
	LAI	0	5.0	5.0	0	0	
Fruits	Date	112	189	281	312	365	
	LAI	0	5.0	5.0	0	0	
Berries	Date	112	189	281	312	365	
	LAI	0	5.0	5.0	0	0	

Table 4b: Yield of pasture and leaf area indices as function of the time (given in Julian days) of the year (between the given values linear interpolation is applied) for the plants considered in FDMT (specific values for Polish conditions in Mountains Region VII;)

Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 m^{-2}) as function of the time (given in Julian days) of the year (between the given values linear interpolation is applied) for the plants considered in FDMT for regions I, IV, V, VI and II, VII are those from region III plus an increase by 7 and 14 days respectively.

Yields of pasture grass and some leaf area indices as function of the time of the year in mountains region VII are lower then in all other regions (Table 4b).

Month	Dilution rate (d^{-1})	Half-life (d)
January - March	0.0	-
April	1.65E-2	24
May	3.85E-2	20
June	3.47E-2	20
July	3.65E-2	20
August	2.89E-2	20
September	2.57E-2	30
October	1.65E-2	40
November - December	0.0	-

Table 5: Season dependent growth dilution rates λ_b and according half-lives for grass and alfalfa (specific values for Polish conditions) .

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

Soil-to-plant transfer factors (Table 8) for all Polish regions are taken from the default data base of FDMT (see Appendix Default)

Cattle diet	Dairy cow	Beef cow	Veal-3	Sheep for milk	Sheep for meat	Goat for milk	Goat for meat
cereals -spring	4	2,5	0	0,00	0,00	0,63	0,63
green fooder -spring	45	18	0	4,50	4,50	4,50	4,50
hay -spring	0,00	0,00	0	0,00	0,00	0,00	0,00
silage -spring	2	2	0	0,50	0,50	0,50	0,50
cereals -winter	4,7	2,5	0	0,63	0,63	0,63	0,63
green fooder -winter	36,80	0	0	0,00	0,00	0,00	0,00
silage -winter	8	3	0			0,75	0,75
hay -winter	3,80	2,00	0	1,80	1,80	0,50	0,50
ensilaged crops (sugar factory) -winter	25	15	0	0,00	0,00	3,75	3,75
water	60	50	22	6,00	6,00	12,50	12,50
milk (veal)			19				

Table 9a: Feeding diets I_k for cattle [kg f.w d^{-1}]

POLUTRY DIET	Feed [kg f.w d-1] (spring)	Feed [kg f.w d-1] (winter)
Cereals	0,120	0,120
Wheat (50%)	0,060	0,060
Rye (25%)	0,030	0,030
Barley (25%)	0,030	0,030
Water	0,2	0,2

Table 9b: Feeding diets I_k for poultry [kg f.w d^{-1}]

Transfer factors feed-animal products TF_m (Table 10) and the biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} (Table 11) are taken from the default data base of FDMT (see Appendix Default)

COMPONENTS OF THE HUMAN DIET	Total processing factor	Total processing factor	Total processing factor
	Cs	**I-**	**Sr**
Cereal products	12,0	16,0	34,0
Bakery products	0,20	0,20	0,20
Rye	0,23	0,23	0,23
Mixed	0,10	0,10	0,10
Wheat	0,23	0,23	0,23
Pastry	0,16	0,16	0,16
Milling and noodles products			
Flour	0,57	0,57	0,57
Grouts and flakes	1,75	1,75	1,75
Noodles	0,18	0,18	0,18
Potatoes	0,75	0,75	0,75
Leafy vegetables			
Fresh cabbage	0,90	0,90	0,90
Soured cabbage	0,29	0,29	0,29
Lettuce	0,57	0,57	0,57
Dill	0,50	0,50	0,50
Root vegetables			
Beet	0,38	0,38	0,38
Carrot	0,63	0,63	0,63
Onion	0,30	0,30	0,30
Leek	0,63	0,63	0,63
Celery	0,63	0,63	0,63
Parsley	0,63	0,63	0,63

Table 12: Processing factors for and foodstuffs as applied in FDMT (specific values for Polish conditions)

Fruit vegetables			
Fresh tomatoes	0,70	0,70	0,70
Fresh cauliflower	0,71	0,71	0,71
Fresh cucumbers	0,50	0,50	0,50
Soured cucumbers	0,09	0,09	0,09
Leguminous grain	0,33	0,33	0,33
Mushrooms	0,30	0,30	0,30
Vegetables products	0,14	0,14	0,14
Other vegetable and mushrooms products	0,14	0,14	0,14
Tree fruits and berries without southern fruits			
Apples	0,80	0,80	0,80
Pears	0,80	0,80	0,80
Plums	0,80	0,80	0,80
Other tree fruits	0,80	0,80	0,80
Berries	0,80	0,80	0,80
Southern fruits			
Citrus fruits	0,60	0,60	0,60
Other southern fruits	0,60	0,60	0,60
Processed fruits	0,71	0,71	0,71
Fresh meat			
Pork	0,86	0,86	0,86
Beef	0,86	0,86	0,86
Veal	0,86	0,86	0,86
Hen, cock, chicken	1,00	1,00	1,00
Other poultry	1,00	1,00	1,00
Other fresh meat	1,00	1,00	1,00
Fresh pluck			
Liver	1,00	1,00	1,00
Other pluck	0,71	0,71	0,71
Bones	0,30	0,30	0,30
Meat products, including poultry and venison products			
Ham, loin	0,70	0,70	0,70
Durable (hard) sausages	0,70	0,70	0,70
Other sausages	0,70	0,70	0,70
Other smoked meat	0,70	0,70	0,70
Other cured meat products	0,70	0,70	0,70
Canned meat	0,40	0,40	0,40

Table 12: Continued.

Fish			
Sea fish and sea food	1,00	1,00	1,00
Fresh water fish	1,00	1,00	1,00
Salted herrings	1,00	1,00	1,00
Processed fish food	0,40	0,40	0,40
Butter	0,25	0,63	0,15
Eggs (without shells)	1,00	1,00	1,00
Dairy			
Milk and milk drinks	1,00	1,00	1,00
Whey	0,98	0,79	0,98
Condensed milk	3,33	3,33	3,33
Powdered milk	8,33	8,33	8,33
Cottage cheese	0,58	1,67	0,83
Hard and melted cheese	0,88	2,50	6,25
Cream	0,63	1,25	0,88

Table 12: Continued.

Missing processing factors for feedstuffs and foodstuffs are taken from the default database of FDMT (see Appendix Default)

Product(s)	Storage time (d)
Cereals and cereal products	30
Brewing residues	60
Distillery residues	45
Maize and beet leaves	30
Beet leaves	7
Maize bulb	30
Potato	7
Beet	14
Leafy vegetables	1
Root vegetables	7
Fruit vegetables	2
Fruit and berries	2
Milk	2
Condensed milk	30
Butter	3
Cream	2
Sour cream	2
Condensed milk	7
Skim milk	2
Cheese (rennet coagulation)	30
Cheese (acid coagulation)	7
Whey	2
Milk substitute	15
Beef	14
Pork, veal, roe deer	14
Chicken, lamb	14
Eggs	2
Beer	60
Nuts	7
Mushroom	2

Table 13: Storage and processing times t_{pk} as applied in FDMT for Polish conditions.

COMPONENTS OF THE HUMAN DIET	1 Year old	5 Year old	10 Year old	15 Year old	Adults
Spring-Wheat_whole	0.7	1.4	1.8	2.0	2.6
Spring-Wheat_flour	3.9	8.1	10.0	12.0	15.0
Spring-Wheat_bran	0.0	0.0	0.0	0.0	0.0
Winter-Wheat_whole	6.0	13.0	16.0	18.0	23.0
Winter-Wheat_flour	35.0	73.0	91.0	100.0	130.0
Winter-Wheat_bran	0.0	0.0	0.0	0.0	0.0
Rye_whole	2.2	4.8	6.0	6.9	8.7
Rye_flour	9.3	19.0	24.0	28.0	35.0
Rye_bran	0.0	0.0	0.0	0.0	0.0
Oats	2.9	3.1	3.9	4.4	5.6
Potatoes	62.0	123.0	205.0	273.0	273.0
Leafy_vegs.	8.4	17.0	27.8	37.1	43.7
Root_vegs.	14.3	28.6	47.6	64.0	74.7
Fruit_vegs.	14.0	27.1	43.0	60.0	71.0
Fruits	19.0	37.0	62.0	83.0	97.0
Berries	3.6	7.0	12.0	16.0	19.0
Fresh_milk	600.0	500.0	480.0	480.0	260.0
Condensed_milk	0.3	1.0	1.0	1.3	1.3
Cream	3.5	7.6	13.0	17.0	20.0
Butter	3.1	6.1	10.5	14.0	16.0
Cheese_(rennit)	1.4	2.8	4.7	6.2	7.3
Cheese_(acid)	3.7	7.4	12.3	16.4	19.3
Goats_milk	0.0	0.0	0.0	0.0	0.0
Sheep_milk	0.0	0.0	0.0	0.0	0.0
Beef_(cow)	1.5	18.0	19.0	23.0	27.0
Beef_(bull)	3.0	35.0	38.0	46.0	55.0
Veal	0.4	1.0	1.5	2.0	2.3
Pork	3.9	72.0	78.0	90.0	108.0
Lamb	0.0	0.0	0.0	0.0	0.0
Chicken	5.3	10.6	17.6	23.5	27.7
Roedeer	0.0	1.1	1.2	1.3	1.7
Eggs	5.0	10.0	16.7	22.0	26.0
Beer	0.0	0.0	5.3	7.0	15.0
Drinking_water	640.0	800.0	1000.0	1600.0	1600.0
Fish	1.5	2.8	4.7	6.5	7.5

Table 14: Age-dependent consumption rates V_K [g/d] for FDMT - average values for Polish conditions.

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see

7.4 FDMT data sets for the radioecological region of Romania

7.4.1 Model parameters for Romanian radioecological region 330

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Plant species	Harvest	Yield (kg m^{-2})
Grass	1.5.-31.10.	1.0
Hay	15.5.-15.9.	1.0
Maize	5.8.-15.9.	5.0
Maize bulbs	17.8-5.10.	4.5
Potatoes	5.8.-25.9.	1.5
Beet	25.9.-31.10.	3.0
Beet leaves	25.9.-31.10.	2.0
Winter barley	25.6.-6.7.	0.4
Winter wheat	5.7.-23.7.	0.4
Leafy vegetables	25.4.-31.10.	1.5
Root vegetables	20.7.-31.10.	1.5
Fruit vegetables	20.7.-15.10.	1.0
Fruit	20.6.-15.10.	2.0
Berries	20.6.-15.10.	1.5
Sunflower	27.9.	0.2
Maize grain	27.9.	0.6
Winter wheat-barley straw	30.6.-10.7.	0.5

Table 3: Times of harvest and yields Y_i (fresh weight) of the crops considered for region 330

Plant	Yield or leaf area index (LAI)						
Grass, Hay (int)	Date Yield	1.1. 0.01	15.3. 0.05	15.5. 1.0	10.11 1.0	11.11. 0.05	31.12 0.01
Grass, Hay (ext)	Date Yield	1.1. 0.01	15.3. 0.05	11.6. 1.0	10.11 1.0	11.11. 0.05	31.12 0.01
Maize	Date LAI	20.4. 0	16.6. 1	11.7. 4.5	17.8. 4	27.8. 3	2.9. 0
Maize bulbs	Date LAI	20.4. 0	16.6. 1	11.7. 4.5	17.8. 4	27.8. 3	15.9. 0
Potatoes	Date LAI	10.5. 0	15.6. 4	30.7. 3	28.8. 0		
Beet	Date LAI	20.4. 0	31.5. 1	29.6. 4	8.8. 4	2.11. 0	
Winter barley	Date LAI	11.4. 1	25.4. 5	9.6. 3	4.7. 0		
Winter wheat	Date LAI	30.4. 1	1.5. 5	19.6. 4	14.7. 0		
Leafy veg.	Date LAI	11.3. 0	10.4. 4	27.9. 4	6.11. 0		
Root veg., fruit veg.	Date LAI	15.4. 0	11.6. 5	1.10. 5	1.11. 0		
Fruit	Date LAI	15.4. 0	14.6. 3.5	27.9. 2	27.11. 0		
Berries	Date LAI	15.4. 0	14.6. 5	27.9. 5	27.11. 0		
Sunflower	Date LAI	5.4. 0	25.6. 4	19.7. 4	28.8. 0		
Maize grain	Date LAI	20.4. 0	16.6. 1	11.7. 5	17.8. 4.5	28.8 3	20.9. 0
Winter wh.-ba. straw	Date LAI	20.4. 1	30.4. 5	14.6. 4	9.7. 1	31.12. 0	

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 x m^{-2}) as function of the time of the year (between the given values linear interpolation is applied) for region 330 conditions

Month	Dilution rate (d^{-1})	Half-life (d)
January - March	0.0	-
April	$1.65x10^{-2}$	42
May	$3.85x10^{-2}$	18
June	$3.47x10^{-2}$	20
July	$3.65x10^{-2}$	19
August	$2.89x10^{-2}$	24
September	$2.57x10^{-2}$	27
October	$1.65x10^{-2}$	42
November - December	0.0	-

Table 5: Season dependent growth dilution rates λ_b and according half-lives for grass: values for region 330 conditions

Plant	Translocation factor					
Maize bulbs, sunflower, maize grain	Δt	155	115	85	45	0
	$T(\Delta t)$	0	0.001	0.1	0.1	0.02
Potatoes	Δt	128	72	55	0	
	$T(\Delta t)$	0	0.15	0.15	0	
Beet	Δt	174	122	91	0	
	$T(\Delta t)$	0	0.02	0.15	0.15	
Winter barley	Δt	150	75	50	25	0
	$T(\Delta t)$	0	0.01	0.1	0.1	0.055
Winter wheat	Δt	150	95	55	30	0
	$T(\Delta t)$	0	0.005	0.1	0.1	0.055
Root veg.	Δt	183	122	14	0	
	$T(\Delta t)$	0	0.1	0.1	0.02	
Fruit veg.	Δt	167	106	14	0	
	$T(\Delta t)$	0	0.1	0.1	0.02	
Fruit	Δt	183	106	14	0	
	$T(\Delta t)$	0	0.3	0.1	0.02	
Berries	Δt	184	183	14	0	
	$T(\Delta t)$	0	0.1	0.1	0.02	
Straw	Δt	150	80	50	25	0
	$T(\Delta t)$	0	0.04	0.2	0.35	1.0

Table 6: Translocation factors $T_i(\Delta t)$ for mobile elements as function of the time Δt (d) before harvest for region 330.

Plant		Translocation factor				
Maize bulbs	Δt	85	45	0		
	T(Δt)	0	0.02	0.02		
Potatoes	Δt	120	77	55	30	0
	T(Δt)	0	0.0009	0.0004	0.0002	0
Beet	Δt	120	77	55	31	0
	T(Δt)	0	0.0009	0.0004	0.0002	0
Winter barley, winter wheat	Δt	80	55	40	20	0
	T(Δt)	0	0.005	0.013	0.038	0.05
Leafy veg.	Δt	150	30	0		
	T(Δt)	0	0.001	0.001		
Root veg.	Δt	365	77	55	30	0
	T(Δt)	0	0.0003	0.0003	0.0002	0
Fruit veg.	Δt	150	30	0		
	T(Δt)	0	0.005	0.02		
Fruit	Δt	183	30	14	0	
	T(Δt)	0	0.005	0.01	0.02	
Berries	Δt	183	30	14	0	
	T(Δt)	0	0.005	0.01	0.002	
Sunflower	Δt	85	45	0		
	T(Δt)	0	0.03	0.03		
Maize grain	Δt	85	45	0		
	T(Δt)	0	0.02	0.02		
Straw	Δt	200	80	40	20	0
	T(Δt)	0	0.05	0.2	0.7	1.0

Table 7: Translocation factors $T_i(\Delta t)$ for semimobile elements as function of the time Δt (d) before harvest for region 330.

	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.)							
	Cs, Zn				I			
Plant\Soil	Sand	Loam	Clay	Peat	Sand	Loam	Clay	Peat
Grass, Hay I	$3\cdot10^{-2}$	$2.5\cdot10^{-2}$	$2.5\cdot10^{-2}$	$2\cdot10^{-2}$	$5\cdot10^{-2}$	$5\cdot10^{-2}$	$5\cdot10^{-2}$	$5\cdot10^{-2}$
Grass, Hay Ex	$4\cdot10^{-2}$	$3.2\cdot10^{-2}$	$3.3\cdot10^{-2}$	$2.4\cdot10^{-2}$	1.0	1.0	1.0	1.0
Maize	$3\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$8\cdot10^{-2}$	$3\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$8\cdot10^{-2}$
Maize bulbs	$1.6\cdot10^{-2}$	$1.2\cdot10^{-2}$	$1\cdot10^{-2}$	$6\cdot10^{-2}$	$1.6\cdot10^{-2}$	$1.2\cdot10^{-2}$	$1\cdot10^{-2}$	$6\cdot10^{-2}$
Potatoes	$2.4\cdot10^{-2}$	$7\cdot10^{-3}$	$7\cdot10^{-3}$	$1.2\cdot10^{-2}$	$2.4\cdot10^{-2}$	$7\cdot10^{-3}$	$7\cdot10^{-3}$	$1.2\cdot10^{-2}$
Beet	$2\cdot10^{-2}$	$7\cdot10^{-3}$	$7\cdot10^{-3}$	$1\cdot10^{-2}$	$2\cdot10^{-2}$	$7\cdot10^{-3}$	$7\cdot10^{-3}$	$1\cdot10^{-2}$
Beet leaves	$2\cdot10^{-2}$	$1\cdot10^{-2}$	$6\cdot10^{-3}$	$3\cdot10^{-2}$	$2\cdot10^{-2}$	$1\cdot10^{-2}$	$6\cdot10^{-3}$	$3\cdot10^{-2}$
Cereals	$2\cdot10^{-2}$	$1.4\cdot10^{-2}$	$1.1\cdot10^{-2}$	$4\cdot10^{-2}$	$2\cdot10^{-2}$	$1.4\cdot10^{-2}$	$1.1\cdot10^{-2}$	$4\cdot10^{-2}$
Leafy vegetables	$1\cdot10^{-2}$	$6\cdot10^{-3}$	$3\cdot10^{-3}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$6\cdot10^{-3}$	$3\cdot10^{-3}$	$1\cdot10^{-2}$
Root vegetables	$7\cdot10^{-3}$	$5\cdot10^{-3}$	$3\cdot10^{-3}$	$1\cdot10^{-2}$	$7\cdot10^{-3}$	$5\cdot10^{-3}$	$3\cdot10^{-3}$	$1\cdot10^{-2}$
Fruit vegetables	$1\cdot10^{-2}$	$1.5\cdot10^{-2}$	$5\cdot10^{-4}$	$5\cdot10^{-3}$	$1\cdot10^{-2}$	$1.5\cdot10^{-2}$	$5\cdot10^{-4}$	$5\cdot10^{-3}$
Fruit, berries	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-2}$
Sunflower	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$
Maize grain	$1.6\cdot10^{-2}$	$1.2\cdot10^{-2}$	$1\cdot10^{-2}$	$6\cdot10^{-2}$	$4\cdot10^{-3}$	$1\cdot10^{-3}$	$2\cdot10^{-2}$	$3\cdot10^{-4}$
Straw	$5\cdot10^{-2}$	$4\cdot10^{-2}$	$3\cdot10^{-2}$	$1.2\cdot10^{-1}$	$4\cdot10^{-2}$	$3\cdot10^{-2}$	$3\cdot10^{-2}$	$2\cdot10^{-1}$

Table 8: Transfer factors soil-plant Tf_i for region 330

	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.)			
	Sr			
Plant\Soil	Sand	Loam	Clay	Peat
Grass, Hay I	$2 \cdot 10^{-1}$	$1.5 \cdot 10^{-1}$	$1.2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$
Grass, Hay Ex	$5 \cdot 10^{-1}$	$4 \cdot 10^{-1}$	$3 \cdot 10^{-1}$	$5 \cdot 10^{-2}$
Maize	$3 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$8 \cdot 10^{-1}$
Maize bulbs	$2.3 \cdot 10^{-1}$	$1.5 \cdot 10^{-1}$	$7 \cdot 10^{-2}$	$3 \cdot 10^{-2}$
Potatoes	$5.2 \cdot 10^{-2}$	$5 \cdot 10^{-2}$	$2.1 \cdot 10^{-2}$	$3 \cdot 10^{-3}$
Beet	$2 \cdot 10^{-1}$	$3 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$3 \cdot 10^{-2}$
Beet leaves	$3 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$3 \cdot 10^{-2}$
Winter barley	$2 \cdot 10^{-1}$	$1.4 \cdot 10^{-1}$	$2.1 \cdot 10^{-1}$	$4 \cdot 10^{-2}$
Winter wheat	$2 \cdot 10^{-1}$	$1.4 \cdot 10^{-1}$	$1.1 \cdot 10^{-1}$	$4 \cdot 10^{-2}$
Leafy vegetables	$2 \cdot 10^{-1}$	$1.5 \cdot 10^{-1}$	$1 \cdot 10^{-1}$	$2 \cdot 10^{-2}$
Root vegetables	$1.8 \cdot 10^{-1}$	$1.9 \cdot 10^{-1}$	$1.7 \cdot 10^{-1}$	$1.9 \cdot 10^{-2}$
Fruit vegetables	$2.7 \cdot 10^{-1}$	$1.5 \cdot 10^{-1}$	$9 \cdot 10^{-2}$	$3 \cdot 10^{-2}$
Fruit	$1 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$
Berries	$2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-1}$
Sunflower	$2 \cdot 10^{-1}$	$1.4 \cdot 10^{-1}$	$1.1 \cdot 10^{-1}$	$4 \cdot 10^{-2}$
Maize grain	$2 \cdot 10^{-1}$	$1.4 \cdot 10^{-1}$	$1.1 \cdot 10^{-1}$	$4 \cdot 10^{-2}$
Straw	$6 \cdot 10^{-1}$	$3 \cdot 10^{-1}$	$3 \cdot 10^{-1}$	$2 \cdot 10^{-1}$

Table 8 (continued): Transfer factors soil-plant TF_i for region 330

Animal	Feedstuff	Period	Intake rate (d kg^{-1}, d l^{-1})
Lactating cow	grass	15.4 – 27.10	57
	hay	27.10 – 15.4	8.0
	maize	27.10 – 15.4	4.0
		15.4 – 27.10	1.0
	maize bulbs	27.10 – 15.4	1.0
		15.4 – 27.10	2.0
	straw	27.10 – 15.4	4.0
	feed.water	1.1 – 31.12	60
Lactating sheep	grass (extensive)	15.4 – 27.10	9.0
	hay (extensive)	27.10 – 15.4	1.4
	straw	27.10 – 15.4	1.0
	feed.water	1.1 – 31.12	5.0
Beef cattle	grass	15.4 – 27.10	40
	hay	27.10 – 15.4	4.0
	maize	27.10 – 15.4	2.0
	maize bulbs	27.10 – 15.4	1.0
	straw	27.10 – 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	27.10 – 15.4	5.0
	beet leaves	15.4 – 27.10	7.0
	feed.water	1.1 – 31.12	7.0
Lamb	grass (extensive)	15.4 – 27.10	5.0
	hay (extensive)	27.10 – 15.4	1.0
	feed.water	1.1 – 31.12	2.0
Roe deer	grass (extensive)	21.4 – 21.10	4.0
	hay (extensive)	21.10 – 21.4	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

Table 9: Feeding diets I_K for animals - region 330.

Transfer factors feed-animal products TF_m (Table 10), biological half-lives $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} for nuclides other than Cs, I, Ru and Sr are taken from the default data base of FDMT (see Appendix Default)

Animal product	Transfer factor feed-animal product ($d\ l^{-1}$, $d\ kg^{-1}$)			
	Cs	I	Ru	Sr
Cow milk	$5 \cdot 10^{-3}$	$5 \cdot 10^{-3}$	$4 \cdot 10^{-6}$	$3 \cdot 10^{-3}$
Sheep milk	$6 \cdot 10^{-2}$	$5 \cdot 10^{-1}$	$1 \cdot 10^{-4}$	$3.4 \cdot 10^{-2}$
Beef (cow)	$3 \cdot 10^{-2}$	$3 \cdot 10^{-3}$	$5 \cdot 10^{-2}$	$8 \cdot 10^{-4}$
Pork	$4 \cdot 10^{-1}$	$3.3 \cdot 10^{-3}$	$4 \cdot 10^{-2}$	$2 \cdot 10^{-2}$
Lamb	$5 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$1 \cdot 10^{-2}$	$1 \cdot 10^{-2}$
Roe deer	$5 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-3}$
Chicken	4.5	$5 \cdot 10^{-2}$	$7 \cdot 10^{-2}$	$8.5 \cdot 10^{-2}$
Eggs	$3 \cdot 10^{-1}$	3.0	$6 \cdot 10^{-3}$	0.2

Table 10: Transfer factors feed-animal products TF_m used in FDMT for region 330

Element	Product	a_1	$T_{b,1}$ (d)	a_2	$T_{b,2}$ (d)
Cs	milk	0.8	1.5	0.2	15
	beef (cow)	0.35	3	0.65	55
	pork	1.0	35		
	lamb	0.7	11	0.3	60
	roe deer	1.0	20		
	chicken	0.9	4	0.1	25
	eggs	1.0	3		
I	milk (cow)	0.65	0.66	0.35	21
	milk (sheep)	1.0	1.7		
	beef (cow)	1	14		
	pork, roe deer	1	20		
	lamb	1	11		
	chicken	1	10		
	eggs	1	1		
Ru	milk, beef(cow)	0.8	30	0.2	100
	pork	1	250		
	lamb	1	25		
	roe deer	1	200		
	chicken	1	40		
	eggs	1	3		
Sr	milk (cow)	0.93	1.4	0.7	40
	milk (sheep)	0.93	1.5	0.7	45
	beef (cow)	0.55	5	0.45	440
	pork	0.5	8	0.5	40
	lamb	0.7	4	0.3	40
	roe deer	0.2	10	0.8	99
	chicken	0.5	3	0.5	55
	eggs	0.5	2	0.5	20

Table 11: Biological half-lives $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} as applied in FDMT for region 330

Processing factors for feedstuffs and foodstuffs included in the default data base are taken from the default data base of FDMT (see Appendix Default)

Raw Product	Processed Product	Element	
		I	*
Straw		1.0	1.0
Grapes	Wine	0.5	0.5
Sunflower	Oil	0.02	0.02
Beet	Sugar	0.0	0.1

* All nuclides except I

Table 12: Processing factors for feedstuffs and foodstuffs as applied in FDMT for region 330

Storage and processing times for some products included in the default list of products are taken from the default data base of FDMT (see Appendix Default) and are not presented bellow.

Product(s)	Storage time (d)
Maize grain	30
Beef , pork	7
Lamb, roe deer	2
Eggs	3
Beer	15
Wine	60
Oil, sugar	30

Table 13: Storage and processing times t_{pk} as applied in FDMT

Foodstuff	Consumption rates (g d^{-1}) for age group				
	1 a	5 a	10 a	15 a	adults
Winter wheat, whole grain	0	0	0	0	0
Winter wheat, flour	81	205	240	314	373
Maize grain	33	64	73	80	97
Potatoes	39	56	93	110	136
Leafy vegetables	38	54	69	76	74
Root vegetables	35	38	59	69	65
Fruit vegetables	55	65	70	80	80
Fruit	230	245	340	245	145
Berries	0	6	8	9	9
Milk (cow)	410	320	260	180	160
Condensed milk	0.9	3	5	2	1
Cream	3.9	10.6	14	15	17
Butter	0.5	9.1	12.5	17	13
Cheese (rennet)	0	5	8	17	16
Cheese (acid)	14	16.6	11.9	18	14
Cheese (sheep)	0.4	2	5	9	12
Beef (cow)	4.5	7	22	25	24
Pork	15	23	38	55	53
Lamb	1	3	9	10	10
Chicken	16	28	31	37	41
Roe deer	0	1	2	2	4
Eggs	10	18	19	21	24
Beer	0	0	0	20	100
Wine	0	0	0	9	31
Oil	2	9	11	15	30
Sugar	12	25	28	27	27
Drink. Water	640	800	1000	1600	1600
Fish	0.5	14	27	27.5	27.5

Table 14: Age-dependent Romanian consumption rates V_k as applied as in FDMT for region 330

Inhalation rates (corresponding to light corporal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.4.2 Model parameters for Romanian radioecological region 331

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) for region 331 are taken from the default data base of FDMT (see Appendix Default).

Times of harvest and yields Y_i (fresh weight) of the crops considered for region 331 (Table 3) are identical to those from region 330.

Plant	Yield or leaf area index (LAI)						
Grass, Hay (int)	Date Yield	1.1. 0.01	31.3. 0.05	25.5. 1.0	31.10 1.0	1.11. 0.05	31.12 0.01
Grass, Hay (ext)	Date Yield	1.1. 0.01	31.3. 0.05	20.6. 1.0	31.10 1.0	1.11. 0.05	31.12 0.01
Maize	Date LAI	30.4. 0	24.6. 1	11.7. 4.5	17.8. 4	27.8. 3	2.9. 0
Maize bulbs	Date LAI	30.4. 0	24.6. 1	11.7. 4.5	17.8. 4	27.8. 3	17.9. 0
Potatoes	Date LAI	10.5. 0	25.6. 4	29.7. 3	28.8. 0		
Beet	Date LAI	20.4. 0	10.6. 1	29.6. 4	8.8. 4	2.11. 0	
Winter barley	Date LAI	21.4. 1	25.5. 5	19.6. 3	14.7. 0		
Winter wheat	Date LAI	30.4. 1	31.5. 5	24.6. 4	24.7. 0		
Leafy veg.	Date LAI	25.3. 0	25.4. 4	27.9. 4	27.10. 0		
Root veg., fruit veg.	Date LAI	25.4. 0	21.6. 5	1.10. 5	22.10. 0		
Fruit	Date LAI	30.4. 0	24.6. 3.5	27.9. 2	17.11. 0		
Berries	Date LAI	30.4. 0	24.6. 5	27.9. 5	17.9. 0		
Sunflower	Date LAI	10.4. 0	25.6. 4	11.7. 4	28.8. 0		
Maize grain	Date LAI	10.5. 0	26.6. 1	11.7. 5	17.8. 4.5	28.8 3	20.9. 0
Winter wh.- ba. straw	Date LAI	30.4. 1	10.5. 5	14.6. 4	19.7. 1	31.12. 0	

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 x m^{-2}) as function of the time of the year (between the given values linear interpolation is applied) for region 331 conditions

Season dependent growth dilution rates λ_b and according half-lives for grass for region 331 (Table 5) are identical to those from region 330 .

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and semimobile elements (Table 7) as function of the time Δt (d) before harvest and soil-to-plants transfer factors (Table 8) for region 331 are identical to those for region 330.

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

Table 9: Feeding diets I_k for animals - region 331.

Transfer factors feed-animal products TF_m (Table 10), biological half-lives $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution a_{mj} for region 331 (Table 11) are identical to those for region 330.

Processing factors for feedstuffs and foodstuffs (Table 12) for region 331 are identical to those for region 330.

Storage and processing times for region 331 products (Table 13) are identical to those for region 330.

Age-dependent Romanian consumption rates V_k as applied in FDMT (Table 14) for region 331 are identical to those for region 330.

Inhalation rates (corresponding to light corporal activity) used for estimation of inhalation doses for region 331 (Table 15) are taken from the default data base of FDMT (see Appendix Default).

7.4.3 Model parameters for Romanian radioecological region 332

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) for region 332 are taken from the default data base of FDMT (see Appendix Default).

Times of harvest and yields Y_i (fresh weight) of the crops considered for region 331 (Table 3) are identical to those from region 330.

Plant	Yield or leaf area index (LAI)						
Grass, Hay (int)	Date Yield	1.1. 0.01	20.4. 0.05	4.6. 1.0	11.10 1.0	12.10. 0.05	31.12 0.01
Grass, Hay (ext)	Date Yield	1.1. 0.01	10.4. 0.05	20.6. 1.0	11.10 1.0	12.10. 0.05	31.12 0.01
Maize	Date LAI	20.5. 0	6.7. 1	11.7. 4.5	17.8. 4	27.8. 3	2.9. 0
Maize bulbs	Date LAI	20.5. 0	6.7. 1	11.7. 4.5	17.8. 4	27.8. 3	17.9. 0
Potatoes	Date LAI	20.5. 0	4.7. 4	30.7. 3	28.8. 0		
Beets	Date LAI	10.5. 0	20.6. 1	29.6. 4	28.8. 4	2.11. 0	
Beet leaves	Date LAI	20.4. 0	10.6. 1	29.6. 4	28.8. 4	2.11. 0	
Winter barley	Date LAI	1.5. 1	25.5. 5	4.7. 3	3.8. 0		
Winter wheat	Date LAI	10.5. 1	31.5. 5	14.7. 4	13.8. 0		
Leafy veg.	Date LAI	10.4. 0	15.5. 4	27.9. 4	27.9. 0		
Root veg.	Date LAI	5.5. 0	1.7. 5	21.9. 5	7.10. 0		
Fruit veg.	Date LAI	25.4. 0	1.7. 5	21.9. 5	7.10. 0		
Fruit	Date LAI	10.5. 0	24.6. 3.5	17.9. 2	7.10. 0		
Berries	Date LAI	30.4. 0	24.6. 3.5	17.9. 2	7.10. 0		
Sunflower	Date LAI	20.5. 0	5.7. 4	1.7. 4	18.8. 0		
Maize grain	Date LAI	20.5. 0	6.7. 1	11.7. 5	17.8. 4.5	28.8 3	20.9. 0
Winter wh.-ba. straw	Date LAI	10.5. 1	30.5. 5	14.6. 4	8.8. 1	31.12. 0	

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 x m^{-2}) as function of the time of the year (between the given values linear interpolation is applied) for region 332 conditions

Season dependent growth dilution rates λ_b and according half-lives for grass for region 332 (Table 5) are identical to those from region 330 .

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and semimobile elements (Table 7) as function of the time Δt (d) before harvest and soil-to-plants transfer factors (Table 8) for region 332 are identical to those for region 330.

Feeding diets I_k for animals (Table 9) for region 332 are identical to those for region 331.

Transfer factors feed-animal products TF_m (Table 10), biological half-lives $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution a_{mj} for region 332 (Table 11) are identical to those for region 330.

Processing factors for feedstuffs and foodstuffs (Table 12) for region 332 are identical to those for region 330.

Storage and processing times for region 332 products (Table 13) are identical to those for region 330.

Age-dependent Romanian consumption rates V_k as applied in FDMT (Table 14) for region 332 are identical to those for region 330.

Inhalation rates (corresponding to light corporal activity) used for estimation of inhalation doses for region 332 (Table 15) are taken from the default data base of FDMT (see Appendix Default).

7.5 FDMT data sets for the radioecological region of the Smolenskaya NPP (Russia)

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Plant	Harvest	Yield (kg m^{-2})
Natural grasses	1.6-1.10	
Barley	1.8 (25.7-15.8)	0.15-0.2
Oats	10.8 (1.8 - 20.8)	0.15-0.2
Winter rye	25.7 (20.7-10.8)	0.2-0.3
Maize	12.9 (5.9-20.9)	5-7
Potatoes	15.9 (1.9-31.9)	0.7-1.5
Beet	5.10 (20.9-20.10)	3-4
Cabbage	15.10 (5.10-25.10)	4.5-6.5
Fruit vegetables	31.7 (10.7-30.8)	2-5
Root vegetables	15.9 (10.9-20.9)	3-4
Leafy vegetables	15.6 (31.5-15.7)	
Fruit	5.9 (1.8-10.10)	1.2-6
Berries	25.6 (31.5-20.7)	0.5-1

Table 3: Harvesting times and yields Y_i (fresh weight) of the crops considered for the region Smolenskaya NPP

Plants	Yield or leaf area index (LAI)						
Natural grasses (pasture)	Date Yield	15.4 *0.01*	15.5 *0.7*	15.6 *1.5*	15.7 *1.5*	1.9 *1.0*	15.10 *0.05*
Natural grasses (haymaking)	Date Yield	15.4 *0.01*	15.5 *1.0*	15.6 *3.0*	15.7 *3.0*	1.9 *2.0*	15.10 *0.05*
Barley	Data LAI	20.5 *0*	15.6 *1.6*	5.7 *5.2*	31.7 *1.0*	1.8 *0*	
Oats	Data LAI	20.5 *0*	15.6 *1.2*	15.7 *4.5*	9.8 *1.0*	10.8 *0*	
Winter rye	Data LAI	20.4 *1.0*	15.6 *6.0*	24.7 *1.5*	25.7 *0*		
Maize	Data LAI	25.5 *0*	30.6 *2.5*	31.7 *3.7*	20.8 *3.9*	12.9 *0*	
Potatoes	Data LAI	10.6 *0*	31.6 *1.5*	15.7 *3.5*	14.9 *0.5*	15.9 *0*	
Beet	Data LAI	10.5 *0*	31.6 *1.0*	1.8 *3.5*	4.10 *2.5*	5.10 *0*	
Cabbage	Data LAI	20.5 *0*	20.7 *2.5*	24.9 *3.5*	25.9 *0*		
Fruit vegetables	Data LAI	20.5 *0*	20.6 *4.0*	1.7 *4.0*	31.7 *0*		
Root vegetables	Data LAI	5.5 *0*	15.7 *3.0*	15.9 *0*			
Leafy vegetables	Data LAI	5.5 *0*	5.6 *3.0*	15.6 *0*			
Fruit and berries	Data LAI	15.4 *0*	1.7 *5.0*	1.9 *5.0*	1.11 *0*		

Table 4: Yield of pasture grass (kg m^{-2} fresh weight) and leaf area indices (all other plants: m^2 m^{-2}) for the region Smolenskaya NPP

Month	Dilution rate (d^{-1})	Half-life (d)
January - March	0.0	-
April	$1.73x10^{-2}$	40
May	$3.85x10^{-2}$	18
June	$3.46x10^{-2}$	20
July	$2.89x10^{-2}$	24
August	$2.57x10^{-2}$	27
September	$2.31x10^{-2}$	30
October	$1.73x10^{-2}$	40
November - December	0.0	-

Table 5: Season dependent growth dilution rates l_b and according half-lives for grass: default values for the region Smolenskaya NPP

The adapted values for λ_w and λ_t parameters are presented in Table 5a.

Radionuclide	Loss rate due to weathering - λ_w ,day-^{1}	Rate of translocation to the root zone- λ_t, day^{-1}	Fraction of activity translocated to the root zone - a
^{137}Cs	0.173	0.0173	0.01
^{131}I	0.173	0.0231	0.01

Table 5a. Parameters of the submodel "Foliar uptake of radionuclides" for the radioecological region of Smolenskaya

Translocation factors $T_i(Dt)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time D_t (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

Soil-to-plants transfer factors for main long-lived radionuclides Cs and Sr the region Smolenskaya NPP for which default values (see Appendix Default) were corrected on the basis of results of adaptation of FDMT are given in Table 8. For the other elements and plants these values can be taken from the default data base of FDMT (see Appendix Default)

Plant	Transfer factor, Bq/kg plant fresh weight per Bq/kg soil dry weight	
	Sr	Cs
Grass	1,5	0.11
Barley	0,07	0.028
Oats	0,13	0.042
Winter rye	0.15	0.03
Maize silage	0.8	0.15
Potatoes	0,16	0.025
Beet	0,3	0.04
Beet leaves	0,2	0,2
Fruit vegetables	0,1	0.036
Root vegetables	0,15	0.04

Table 8: Transfer factors soil-plant (Bq/kg plant fresh weight per Bq/kg soil dry weight) for the radioecological region of Smolenskaya NPP

Animal	Feedstuffs	Intake rate (kg/d)
Cow (grazing period)	grass	40
	concentrated feed	1.5
Cow (indoor period)	hay	2.5
	silage / haylage	24
	edible roots	6
	straw	4
	concentrated feed	1.5
Pig (>90 kg)	concentrated feed	2.5
	edible roots (or grass)	6
Pig (<90 kg)	concentrated feed	2
	edible roots (or grass)	4
Sheep(grazing period)	grass	7
	edible roots	0.4
Sheep(indoor period)	hay	2
	edible roots	0.4

Table 9: Feeding diets I_k for animals for the region Smolenskaya NPP

Transfer factors from feed to animal products for products and radionuclides for which values were changed in the comparison to FDMT default data base are given in Table 10. For the other radionuclides and products values are taken from the default data base of FDMT (see Appendix Default, Table 10)

Animal product	Transfer factors feed- animal products (d l^{-1}, d/kg),	
	^{137}Cs	^{90}Sr
Cow milk	1	0.1
Beef (cow)	4	0.06
Pork	15	0.3
Mutton	8	0.1

Table 10: Transfer factors feed- animal products TF_m

Effective half lives of ^{137}Cs and ^{90}Sr for which values were changed in the comparison to FDMT default data base on the basis of the FDMT adaptation results are given in Table 11. For the other radionuclides and products values were taken from the default data base of FDMT (see Appendix Default, Table 11)

Element	Product	a_1	T_1 (d)	a_2	T_2 (d)
^{137}Cs	beef	0.35	3	0.65	55
	pork	1.0	29.5	-	-
	lamb	0.7	10.4	0.3	68
^{90}Sr	beef	0.54	4	0.46	240

Table 11: Biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} changed to the default FDMT data set on the basis of FDMT adaptation studies.

For I, Cs and Sr processing factors where modified where necessary on the basis of FDMT adaptation studies. For the other radionuclides they were taken taken from the default data base of FDMT (see Appendix Default)

Raw Product	Processed Product	Element						
		Ag, Co, Cr, Fe, Mo	Ba	Cs	I	Pu	Ru, Cm	Sr
Wheat	Wheat flour	0.5	0.5	0.6	0.5	0.2	0.5	0.6
	Wheat bran	3.0	3.0	3.3	3.0	4.0	3.0	3.3
Rye	Rye flour	0.5	0.5	0.6	0.5	0.2	0.5	0.6
	Rye bran	3.0	3.0	2.2	3.0	4.0	3.0	2.2
Spring barley	Beer	0.1	0.04	0.1	0.1	0.04	0.04	0.04
	Brewing residues	0.1	0.25	0.1	0.1	0.25	0.25	0.25
Winter wheat	Distillery residues	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Potatoes	Potatoes, peeled	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Vegetables [a]	Vegetables [a]	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Fruit, berries	Fruit and berries	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Milk (cow)	Butter	1.0	1.0	0.2	0.5	1.0	1.0	0.2
	Cream (30% fat)	1.0	1.0	0.6	1.0	1.0	1.0	0.9
	Skim milk	1.0	1.0	1.0	0.9	1.0	1.0	1.0
	Cheese (rennet)	1.0	1.0	0.5	0.6	1.0	1.0	8.0
	Cheese (acid)	1.0	1.0	0.7	1.4	1.0	1.0	4.0
	Whey (rennet)	1.0	1.0	1.0	1.05	1.0	1.0	0.4
	Whey (acid)	1.0	1.0	1.0	0.95	1.0	1.0	1.0
	Condensed milk	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	Milk substitute	8.0	9.3	8.7	9.4	8.0	8.0	9.3

[a] Root, fruit, and leafy vegetables

Table 12: Processing factors for feedstuffs and foodstuffs as applied in FDMT adopted for the conditions of Smolenskay NPP region.

Storage times where modified where necessary on the basis of the analysis of the specific conditions of radioecological region.

Product(s)	Storage time (d)
Cereals and cereal products	40
Brewing residues	60
Distillery residues	45
Corn cobs	30
Potato	7
Beet	14
Leafy vegetables	1
Root vegetables	7
Fruit vegetables	2
Fruit and berries	2
Milk	2
Condensed milk	10
Butter	3
Cream	2
Sour cream	2
Condensed milk	7
Skim milk	2
Cheese (rennet coagulation)	25
Cheese (acid coagulation)	7
Whey	2
Milk substitute	15
Beef	10
Pork, veal, roe deer	10
Chicken, lamb	7
Eggs	2

Table 13: Storage and processing times t_{pk} as applied in FDMT

Foodstuffs	Rural citizens	Urban citizens
Wheat bread	103	97
Rye bread	193	151
Potatoes	370	280
Cabbage	37	45
Fruit vegetables	31	37
Root vegetables	35	35
Leafy vegetables	23	25
Fruits	32	55
Berries	3	5
Beef and veal	24	17
Lamb	3	1
Pork	35	23
Chicken	17	25
Fresh milk	291	154
Butter	11	13
Eggs, piece	0,4	0,5

Table 14: Estimated consumption rates for adult (g d^{-1}), for the age-dependent data, (with the exception of the adult) default FDMT values were applied

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.6 FDMT data sets for the radioecological regions of the Slovak Republic

7.6.1 Model parameters for Slovakian lowland (Reg. SK-I) conditions.

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

	Region SK-I	
Plant species	Harvest	Yield (kg.m^{-2})
Grass	*1.5.-30.9.*	1.0
Hay (grass)	16.5-15.9.	-
Alfalfa	*1.5-15.10.*	2.0 (0.7)
Hay (alfalfa)	20.5-15.9.	-
Winter wheat	*5.7.-30.7.*	0.5
Spring barley	*5.7.-25.7.*	0.45
Oats	25.7-10.8.	0.31
Rye	*10.7-31.7.*	0.40
Maize	*15.7.-15.9.*	3.2
Barley straw	10.7.-30.7.	0.6
Beet	*25.9.-31.10.*	3.4
Cabbage, kale	*30.9.-1.12.*	1.4
Rape	5.4-8.5.	2.2
Potatoes	*15.6.-15.9.*	1.2
Leafy vegetables	*1.1.-31.12.*	2.0
Fruit vegetables	*15.6-15.10.*	1.5
Root vegetables	*15.6-31.10.*	1.5
Fruit	*30.6-15.10.*	2.0
Berries	*5.5.-15.10.*	1.5

Table 3: Harvesting times and yields Y_i (fresh weight) of the crops considered for lowland region SK-I

Plant		Yield (kg m^{-2} f.w.) or leaf area index						
Grass	Date	*1.1.*	*6.3.*	*5.5.*	*30.9.*	*1.10.*	*31.12.*	
	Yield	*0.01*	*0.05*	*1*	*1*	*0.05*	*0.0*	
Alfalfa	Date	*1.1.*	*10.4.*	*1.5.*	*20.5.*	*5.6.*	30.9.	1.10.
	Yield	0.05	0.12	1.15	2.0	0.7	0.7	0.12
Winter	LAI	1	1	6	1.5	0		
wheat	Date	*1.1.*	*15.4.*	*10.6.*	*10.7.*	*11.7.*		
Spring	LAI	0	1	5	1.5	0		
barley	Date	*5.4.*	*30.4.*	*5.6.*	*10.7.*	11.7.		
Oats	LAI	0	1	4	1	0		
	Date	*15.4.*	*10.5.*	*15.6.*	*25.7.*	26.7.		
Rye	LAI	1	1	6	8	2	0	
	Date	1.1.	15.3.	1.5.	20.5.	10.7.	11.7.	
Maize	LAI	0	1	4.5	4	0		
(silage)	Date	*10.5.*	*10.6.*	*25.7.*	*10.9.*	*11.9.*		
Beet	LAI	0	1	3.5	2.5	0		
	Date	*20.4*	*18.5.*	*10.8.*	*30.10*	*31.10.*		
Rape	LAI	1	1	3.5	3.8	0		
	Date	1.1.	10.3.	10.4.	30.4.	1.5.		
Potatoes	LAI	0	1	3.5	1.5	0.5	0	
	Date	5.5.	20.5.	15.6.	5.7.	-	6.7.	
Root, fruit	LAI	*0*	*5*	*5*	*0*			
vegetables	Date	10.4.	1.7.	1.10.	1.11.			
Fruit and	LAI	0	5	5	0			
berries	Date	10.4.	01.7.	1.10.	1.11.			

Table 4: Yield of pasture grass and alfalfa, and leaf area indices (all other plants; m^2m^{-2}) for lowland region SK-I as function of the time of the year; between the given dates linear interpolation is applied

Month	Region I Dilution rate (d^{-1})	Half-life (d)
January – February	*0.0*	-
March	*$7.7x10^{-2}$*	*9*
April	*$1.65x10^{-2}$*	*42*
May	*$3.85x10^{-2}$*	*18*
June	*$2.77x10^{-2}$*	*25*
July	*$2.30x10^{-2}$*	*30*
August	*$1.98x10^{-2}$*	*35*
September	*$2.77x10^{-2}$*	*25*
October	*$1.65x10^{-2}$*	*42*
November-December	*0.0*	-

Table 5: Season dependent growth dilution rates λ_b and half-lives for grass and alfalfa as applied for lowland region SK-I

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

Soil-to-plants transfer factors (Table 8) for SK-I region are taken from the default data base of FDMT (see Appendix Default)

		Region SK-I	
Animal -		Period	
type of feeding	Feedstuff	Summer*	Winter*
	Dates	15.4-5.11	6.11-14.4
Cow-	Maize-silage	10	25
green	Green forage**	40	0
forage	Hay (alfalfa)	4	6
	Cereals	0	3
Beef (bull)	Green forage**	25	0
alfalfa-	Hay (alfalfa)	2	3
cereal	Cereals	0	4
	Beet silage	0	0
	Maize silage	0	15

*- include 15 day-long spring and automn transition periods when linear interpolation is applied to the summer and winter feeding rates

**- green fodder includes sequentially, rape, green rye, alfaalfa, green maize and feeding cabbages

Table 9a: Typical season dependent feeding rates (kg d $^{-1}$) for diary cows and bulls for the current period in lowland region SK-I,

			Feeding rate (kg d^{-1})
Animal	Period	Feedstufs	Region I
Pig	Winter	Hay	0.3
	6.11-14.4	Cereals	2
		Potato	5
	Summer	Alfalfa	1.5
	15.4-5.11	Cereals	2.5
Hen, chicken	Winter	Beet, carrot	0.07
	6.11-14.4	Cereals	.07
	Summer	Alfalfa	0.03
	15.4-5.11	Cereals	0.09
Sheep	Winter	Hay (grass)	1.8
	Summer	Grass	9
Goat	Winter	Hay (grass)	2.6
	Summer	Grass	13

Table 9b: Typical season dependent feeding rates (kg d -1) for pigs and other animals for current period in lowland region SK-I; for summer and winter feeding rates linear interpolation is applied during the both transition periods

Transfer factors feed-animal products TF_m (Table 10), biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} (Table 11) and processing factors for feedstuffs and foodstuffs (Table 12) are taken from the default data base of FDMT (see Appendix Default)

Product(s)	Storage time (d)
Grass, Alfalfa	0
Cereals and cereal products	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
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

Table 13: Storage and processing times applied in the customised FDMT for Slovak conditions (practically the same as FDMT default data for CEC – Tab 11 - in Mueller (1998) were applied)

Food	FDMT, adult kg/a, [ref 1]	FDMT, adult g/d
Meat –beef	21,5	-
Beef - bulls	(61%*)	36
- cows	(39%*)	23
Meat pig	39,5	108
Other meat	15,7	-
Chicken	15,0	41
Lamb	0,5	1,5
Roe-dear	0,2	0,5
Cerals	157	-
W. Wheat- (flour)	(80%)	345
(whole gr.)	-	13
Rye (flour)	(11%)	47
(whole gr.)	-	11
Oat	-	5,6
Fruits	45	-
Berries	7,3*	20
Fruits – med. climat		
Potato	37,7	103
Vegetables	80	219
Leafy veg.	75	-
Fruit veg.	24%	49
Root veg.	42%	86
Egs	34%	69
Sugar	17,3	47
Beer	37,5	-
Milk fresh		360
Milk condensed	111	304
Cream	-	4
	4.5	12
Cheese (acid)	-	48
Cheese (renet)	-	174
Goats milk	0	0
Sheep milk	0	0

* - data according to Mrazova (1996), ref 1- see Kliment V., Bucina I., (1988)

Table 14: Estimated Slovak consumption rates for adult, for the age-dependent data, (with the exception of the adult) default FDMT values were applied

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.6.2 Appendix B: FDMT parameters for the Slovak hilly land region SK-II conditions

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

	Region II	
Plant species	Harvest	Yield (kg m^{-2})
Grass	10.5.-30.9.	1.2
Hay (grass)	25.5.-30.9.	-
Alfalfa	10.5-15.10.	2.0 (0.7)
Hay (alfalfa)	30.5-31.8.	-
Winter wheat	15.7-5.8.	0.45
Spring barley	15.7-30.7.	0.4
Oats	05.8-15.8.	0.28
Rye	20.7-5.8.	0.37
Maize	25.7-15.9.	2.8
Barley straw	20.7-5.8.	0.52
Beet	25.9-31.10.	3.1
Cabbage, kale	30.9-1.12.	1.2
Rape	15.4-15.5.	1.8
Potatoes	1.7-20.9.	1.4
Leafy vegetables	1.1-31.12.	2.0
Fruit vegetables	25.6-15.10.	1.0
Root vegetables	25.6-31.10.	1.5
Fruit	15.7-15.10.	2.0
Berries	15.5-15.10.	1.5

Table 3: Harvesting times and yields Y_i (fresh weight) of the crops considered for the hillyland SK-II region

Plant		Yield (kg m^{-2} f.w.) or leaf area index						
Grass	Date	1.1.	11.3.	10.5.	30.9.	1.10.	31.12.	
	Yield	0.01	0.05	1.2	1.2	0.05	0.01	
Alfalfa	Date	1.1.	20.4.	11.5.	30.5.	15.6.	15.9.	16.9.
	Yield	0.05	0.12	1.15	2.0	0.7	0.7	0.12
Winter wheat	LAI	1	1	6	1.5	0		
	Date	1.1.	20.4.	20.6.	20.7.	21.7.		
Spring barley	LAI	0	1	5	1.5	0		
	Date	15.4.	5.5.	15.6.	20.7.	21.7.		
Oats	LAI	0	1	4	1	0		
	Date	2O.4	15.5.	20.6.	5.8.	6.8.		
Rye	LAI	1	1	6	8	2	0	
	Date	1.1.	30.3.	6.5.	25.5.	20.7.	21.7.	
Maize (silage)	LAI	0	1	4.5	4	0		
	Date	*15.5.*	*20.6.*	*5.8.*	*10.9.*	*11.9.*		
Beet silage	LAI	0	1	3.5	2.5	0		
	Date	25.4	25.5.	20.8	30.10	31.10		
Rape	LAI	1	1	3.5	3.8	0		
	Date	1.1.	15.3.	15.4.	5.5.	6.5.		
Potatoes	LAI	0	1	3.5	1.5	0.5	0	
	Date	20.5.	10.6.	5.7.	-	20.9.	21.9.	
Root, fruit vegetables	LAI	*0*	*5*	*5*	*0*			
	Date	20.4.	10.7.	1.10.	1.11.			
Fruit, berries	LAI	0	5	5	0			
	Date	20.4.	10.7.	1.10.	1.11.			

Table 4: Yield of pasture grass and alfalfa (kg m^{-2} f.w.), and leaf area indices (all other plants; m^{2}m^{-2}) for hillyland region SK-II as function of the time of the year; between the given dates linear interpolation is applied

Month	Region II Dilution rate (d^{-1})	Half-life (d)
January –February	0.0	-
March	$7.7x10^{-2}$	9
April	$1.65x10^{-2}$	42
May	$3.8x10^{-2}$	18
June	$3.47x10^{-2}$	20
July	$3.65x10^{-2}$	19
August	$2.89x10^{-2}$	24
September	$2.57x10^{-2}$	27
October	$1.65x10^{-2}$	42
November-December	0.0	-

Table 5: Season dependent growth dilution rates λ_b and according half-lives for grass and alfalfa for hillyland SK-II region

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

Soil-to-plants transfer factors (Table 8) for SK-I region are taken from the default data base of FDMT (see Appendix Default)

Animal -	Feedstuff	Period of year	
type of feeding		Summer*	Winter
	Dates	20.4-10.10.	11.10-19.4
Cow-	Maize-silage	10	25
green	Green forage**	40	0
forage	Hay (alfalfa)	0	3
	Cereals	4	6
Beef (bull)	Green forage**	20	0
alfalfa-	Hay (alfalfa)	2	3
cereal	Cereals	1	4
	Beet silage	0	15
	Maize silage	0	0

Table 9a: Typical season dependent feeding rates (kg d $^{-1}$) for diary cows and bulls for the current period in SK-II region,

			Feeding rates
Animal	Period*	Feedstufs	Region I
Pigs	Winter, 11.10-19.4	Hay	0.3
		Cereals	2
		Potato	5
	Summer, 20.4-10.10.	Alfalfa	1.5
		Cereals	2.5
Hens, Chicken	Winter, 11.10-19.4	Beet, carrot	0.07
		Cereals	.07
	Summer, 20.4-10.10.	Alfalfa	0.03
		Cereals	0.09
Sheep	Winter, 11.10-19.4	Hay (grass)	1.8
	Summer, 20.4-10.10.	Grass	9
Goat	Winter, 11.10-19.4	Hay (grass)	2.6
	Summer, 20.4-10.10.	Grass	13

Table 9b: Typical season dependent feeding rates (kg d -1) for pigs and other animals for SK-II region; linear interpolation is applied during the both transition periods

Transfer factors feed-animal products TF_m (Table 10), biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} (Table 11) and processing factors for feedstuffs and foodstuffs (Table 12) are taken from the default data base of FDMT (see Appendix Default)

Storage and processing rates (Table 13) as well as age dependent consumption rates (Table 14) are identical to those from region SK-I.

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.6.3 FDMT parameters for the Slovak sub-mountain region SK-III conditions

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

	Sub-mountain Region SK-III	
Plant species	Harvest	Yield (kg m^{-2})
Grass	20.5.-30.9.	1.0
Hay (grass)	1.6.-30.8.	0.2
Clower	11.6-10.8.	1.1
Hay (clower)	11.6.-10.8	0.23
Winter wheat	5.8-30.8.	0.37
Spring barley	10.8-30.8.	0..32
Oats	15.8-20.8.	0.25
Rye	10.8-30.8.	0.32
Maize	10.8-1.9.	2.5
Rape	20.4-15.5.	1.8
Potatoes	5.9-30.9.	1.85
Fruit vegetables	5.7-15.10.	1.0
Root vegetables	5.7-31.10.	1.5
Fruit	30.7-15.10.	2.0
Berries	10.6-15.10.	1.5

Table 3: Harvesting times and yields Yi (fresh edible weight) of the crops considered for the sub-mountain region SK-III (for grass a time dependent yield is assumed; see Table 4)

Plant		Yield (kg m^{-2} f.w.) or leaf area index (LAI [m^2/m^{-2}])					
Grass	Yield	0.01	0.05	1	1	0.05	0.0
	Date	*1.1.*	*6.3.*	*5.5.*	*30.9.*	*1.10.*	*31.12.*
Clower	LAI	1	1	4	2	3	1
	Date	*1.1.*	*30.4.*	*10.6.*	*10.7.*	*10.8.*	11.8.
Winter wheat	LAI	1	1	5	1.5	0	
	Date	*1.1.*	*30.4.*	*25.6.*	*5.8.*	*6.8.*	
Spring barley	LAI	0	1	5	1.5	0	
	Date	*25.4.*	*10.5.*	*25.6.*	*10.8.*	11.8.	
Oats	LAI	0	1	4	1	0	
	Date	*30.4.*	*25.5.*	*1.7.*	*15.8.*	16.8.	
Rye	LAI	1	1	6	8	2	0
	Date	*1.1.*	*10.4.*	*20.5.*	*10.6.*	*10.8.*	*11.8.*
Maize (silage)	LAI	0	1	4.5	4	0	
	Date	*10.6.*	*5.7.*	*10.8.*	*1.9.*	*2.9.*	
Rape	LAI	1	1	3.	3.0	0	
	Date	*1.1.*	*20.3.*	*20.4.*	*15.5.*	*16.5.*	
Potatoes	LAI	0	1	3.5	0.5	0	
	Date	*30.5.*	*5.7.*	*10.8.*	*5.10.*	*6.10.*	
Root and fruit vegetables	LAI	*0*	*5*	*5*	*0*		
	Date	1.5.	20.7.	20.9.	21.9.		
Fruit and berries	LAI	0	5	5	0		
	Date	1.5.	20.7.	1.10.	1.11.		

note: fruits- apples and plumes, fruit vegetables mainly cabages and kale, !no leafy vegetables, usual root vegetables, grass extensive

Table 4: Yield of pasture grass and alfalfa, and leaf area indices (all other plants; m^2 m^{-2}) for the sub-mountain region SK-III as function of the time of the year; between the given dates linear interpolation is applied

Month	Sub-mountain Region SK-III Dilution rate (d^{-1})	 Half-life (d)
January – February	0.0	-
March	$7.7x10^{-2}$	9
April	$1.65x10^{-2}$	42
May	$2.8x10^{-2}$	25
June	$3.47x10^{-2}$	20
July	$3.65x10^{-2}$	19
August	$2.89x10^{-2}$	24
September	$2.57x10^{-2}$	27
October	$1.65x10^{-2}$	42
November-December	0.0	-

Table 5: Season dependent growth dilution rates λ_b and half-lives for grass and clover for region SK-III (estimated on the basis of comparison with hilly land SK-II region climatic conditions)

Translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

Soil-to-plants transfer factors (Table 8) for SK-III region are taken from the default data base of FDMT (see Appendix Default)

	Diary cow		Beef catle (bulls)	
	Period		Period	
Feedstuff Dates	Summer* 15.4.-5.11.	Winter 6.11.-14.4.	Summer* 20.4.-10.10.	Winter 11.10.-19.4.
Grass *	40	0	25	0
Hay (grass)	3	4	0	2
Grass silage	0	20	0	7
Maize-silage	0	0	0	7
Barley straw	2	0	0	1
Cereals	0	4	1	5

*- also green fodder such as rape, clower, green rye and green oat is applicable

Table 9a: Typical feeding rates (kg d $^{-1}$) for diary cows and beef catle (bulls) for the current period in sub-mountain region SK-III, (summer time period include 15 day-long spring and autumn transition periods when linear interpolation is applied to the summer and winter rates)

Feeding rates for pigs and other animals for SK-III region are the same data as in the region SK-I

Transfer factors feed-animal products TF_m (Table 10), biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} (Table 11) and processing factors for feedstuffs and foodstuffs (Table 12) are taken from the default data base of FDMT (see Appendix Default)

Storage and processing rates (Table 13) as well as age dependent consumption rates (Table 14) are identical to those from region SK-I.

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses (Table 15) are taken from the default data base of FDMT (see Appendix Default)

7.7 FDMT data sets for the radioecological regions of Ukraine

7.7.1 Radioecological Region Polesie (code in RODOS 320).

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Plant species	Harvest	Yield (kg m^{-2})
Grass	15.5-15.10	1.0
Winter wheat	25.7-1.8	0.2
Winter barley	17.7-23.7	0.3
Spring barley	20.7-30.7	0.2
Oats	1.8-10.8	0.2
Rye	23.7-31.7	0.2
Maize	10.8-25.9	1.8
Corn cobs		
Beet	25.9-3.10	3.5
Beet leaves	25.9-3.10	2.1
Potatoes	25.8-25.9	1.1
Leafy vegetables	1.6-30.9	2.0
Fruit vegetables	1.8-20.8	1.0
Root vegetables	20.9-1.10	1.5
Fruits	20.7-1.10	0.5
Berries	20.7-1.10	0.3

Table 3: Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT: values for Radioecological Region Polesie conditions [4,5,9,11]

Plant	Yield or leaf area index (LAI)						
Grass	Date Yield	1.4. 0.01	1.6. 1.0	1.8. 1.0	31.10. 0.02		
Winter wheat	Date LAI	1.1. 0	1.5. 1.0	1.6. 6.0	1.7. 6.0	1.8. 0.4	2.8. 0
Winter barley	Date LAI	1.1. 0	25.3. 0.2	25.4. 1.5	15.6. 5.5	23.7. 0.3	24.7. 0
Spring barley	Date LAI	30.4. 0	25.5. 2.0	10.6. 5.0	30.7. 0.3	31.7. 0	
Oats	Date LAI	30.4. 0	20.5. 0.3	25.6. 5.0	20.7. 5.0	10.8 0.8	11.8 0
Rye	Date LAI	1.1. 0	20.4. 0.6	1.6. 6.0	1.7. 6.0	31.7. 0.1	1.8. 0
Maize	Date LAI	20.5. 0	15.6. 1.0	20.7. 6.7	20.8. 6.5	11.10. 0	
Beet	Date LAI	10.5. 0	20.6. 3.5	10.7. 6.2	1.9 6.0	4.10. 0	
Potatoes	Date LAI	1.6. 0	10.7. 5.0	1.8. 5.0	26.9 0		
Leafy vegetables	Date LAI	25.4. 0	20.6. 3.5	20.7. 3.5	1.8 0.2	1.10. 0	
Fruit vegetables	Date LAI	15.5 0	15.7 2.0	1.8 6.0	1.9 6.0	20.8 0.4	21.8 0
Root vegetables	Date LAI	20.5. 0	10.7. 4.5	1.9. 4.5	2.10. 0		
Fruit, Berries	Date LAI	20.4. 0	10.7. 6.0	1.9. 6.0	1.11. 0		

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 x m^{-2}) as function of the time of the year (between the given values linear interpolation is applied) for the plants considered in FDMT: values for Radioecological Region Polesie conditions [1-8]

Season dependent growth dilution rates λ_b and according half-lives for grass (Table 5), translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.)			
	Sandy, sandy loam		Peat	
	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr
Grass	$4 \cdot 10^{-1}$	$15 \cdot 10^{-1}$	$15 \cdot 10^{-1}$	$15 \cdot 10^{-1}$
Winter wheat	$1 \cdot 10^{-1}$	$8 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$8 \cdot 10^{-1}$
Winter barley	$5 \cdot 10^{-2}$	$8 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$8 \cdot 10^{-1}$
Spring barley	$5 \cdot 10^{-2}$	$8 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$8 \cdot 10^{-1}$
Rye	$1 \cdot 10^{-1}$	$7 \cdot 10^{-1}$	$2 \cdot 10^{-1}$	$7 \cdot 10^{-1}$
Maize silage	$2 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$2 \cdot 10^{-2}$	$2 \cdot 10^{-1}$
Beet	$4 \cdot 10^{-2}$	$3 \cdot 10^{-1}$	$4 \cdot 10^{-2}$	$3 \cdot 10^{-1}$
Potatoes	$2 \cdot 10^{-2}$	$7 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$7 \cdot 10^{-2}$
Leafy veget.	$2 \cdot 10^{-2}$	$1 \cdot 10^{-1}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-1}$
Fruit veget.	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$

Table 8: Transfer factors soil-plant TF_i: values for Polesie region. Transfer factors for other elements (see Appendix Default)

Animal	Feedstuff	Intake rate (kg d^{-1} fresh weight)	
		Winter	Summer
Lactating cow	grass	-	50
	concentrated feed	3	1
	cereals	1	0.5
	maize silage	16	-
	hay	1.0	-
	straw	5	-
	beet	19	-
Lactating sheep	green mass	-	7
	concentrated feed	-	0.3
	hay	0.4	-
	straw	1.0	-
	beet	1.0	-
Pig	cereals	1.6	2.0
	grass	-	2.5
	potatoes	4.7	-
	wheat bran	0.5	0.5
Hen, chicken	winter wheat	0.09	0.09

Table 9: Feeding diets I_k for animals: values for Polesie region

Animal Product	Transfer factor feed-animal product (d l^{-1}, d kg^{-1})		
	^{90}Sr	^{137}Cs	^{131}I
Cow milk	$1.5 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$1 \cdot 10^{-2}$
Beef	$4 \cdot 10^{-4}$	$4 \cdot 10^{-2}$	$4 \cdot 10^{-3}$
Pork	$2 \cdot 10^{-3}$	$2.5 \cdot 10^{-1}$	$3 \cdot 10^{-3}$
Lamb	$3 \cdot 10^{-3}$	$7 \cdot 10^{-1}$	$3 \cdot 10^{-2}$

Table 10: Transfer factors feed-animal products TF_m used in FDMT. Other transfer factors (see Appendix Default, Table 10)

Element	Product	a_1	$T_{b,1}$ (d)	a_2	$T_{b,2}$ (d)
Caesium	beef	0.35	3	0.65	55
	pork	1.0	29.5		
	chicken	0.9	3.8	0.1	26
Strontium	Beef	0.54 (3.1-4.8)	4 (3.1-4.8)	0.46 (0.38-0.58)	240 (178-300)
Iodine	Beef	1.0	15		
Ruthenium	Pork	0.66	1.5	0.34	27

Table 11: Biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} as applied in FDMT. Other values (see Appendix Default, Table 11)

Processing factors for feedstuffs and foodstuffs (Table 12), storage and processing rates (Table 13) are taken from the default data base of FDMT (see Appendix Default) .

Foodstuff	Consumption rates ($g\ d^{-1}$) for adults	
	Urban inhabitants	Rural inhabitants
Winter wheat, flour	173	96
Rye, flour	185	251
Potatoes	259	628
Leafy vegetables	51	68
Root vegetables	64	119
Fruit vegetables	33	28
Fruit	44	60
Berries	9	15
Milk	91	843
Cream	18	2
Butter	8	4
Cheese (rennet)	13	0.5
Cheese (acid)	2	0.7
Beef and veal	12	0.3
Lamb	0.1	0.4
Pork	42	39
Chicken	5	16
Eggs	17	15
Fish	9	4

Table 14: Consumption rates V_k: values for Radioecological Region Polesie conditions.

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses in FDMT are taken from the default data base of FDMT (see Appendix Default, Table 15).

7.7.2 Radioecological Region Forest-Veld (code in RODOS 321).

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Plant species	Harvest	Yield (kg m^{-2})
Grass	15.5-31.10	1.5
Winter wheat	16.7-20.7	0.3
Winter barley	5.7-15.7	0.3
Spring barley	15.7-24.7	0.2
Oats	25.7-30.7	0.2
Rye	25.7-31.7	0.2
Maize	15.8-20.9	2.0
Corn cobs	25.9-15.10	0.3
Beet	25.9-3.10	3.0
Beet leaves	25.9-3.10	2.0
Potatoes	25.8-15.9	1.1
Leafy vegetables	25.5-1.10	2.0
Fruit vegetables	20.7-15.8	1.0
Root vegetables	1.10-10.10	1.5
Fruits	30.7-1.10	0.4
Berries	30.7-1.10	0.2

Table 3: Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT: values for Radioecological Region Forest-Veld conditions [4,5,9,11]

Plant	Yield or leaf area index (LAI)						
Grass	Date Yield	1.4. 0.01	1.6. 1.5	1.8. 1.5	31.10. 0.02		
Winter wheat	Date LAI	1.1. 0	1.4. 0.4	25.4. 6.0	1.7. 6.0	1.8. 0.4	2.8. 0
Winter barley	Date LAI	1.1. 0	1.5. 0.5	10.6. 6.0	1.7. 6.0	15.7. 0.1	16.7. 0
Spring barley	Date LAI	25.4. 0	1.6. 2.0	20.6. 5.0	10.7. 5.0	25.7. 0	
Oats	Date LAI	1.5. 0	15.5. 0.3	20.6. 5.0	10.7. 5.0	30.7 1.0	31.7 0
Rye	Date LAI	1.1. 0	20.4. 0.3	1.6. 6.0	1.7. 6.0	20.7. 4.0	1.8. 0
Maize	Date LAI	20.5. 0	15.6. 2.0	10.7. 6.5	20.8. 6.5	10.9. 2.0	21.9 0
Beet	Date LAI	5.5. 0	15.6. 2.0	10.7. 6.0	20.9 6.0	4.10. 0	
Potatoes	Date LAI	25.5. 0	20.6. 5.0	1.8. 5.0	16.9 0		
Leafy vegetables	Date LAI	20.4. 0	1.7. 3.5	20.7. 3.5	2.10 0		
Fruit vegetables	Date LAI	15.5 0	1.7 6.0	1.8 6.0	16.8 0		
Root vegetables	Date LAI	20.5. 0	10.7. 4.5	1.9. 4.5	2.10. 0		
Fruit, Berries	Date LAI	20.4. 0	1.7. 6.0	1.9. 6.0	1.11. 0		

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 x m^{-2}) as function of the time of the year (between the given values linear interpolation is applied) for the plants considered in FDMT: values for Radioecological Region Forest-Veld conditions [1-8]

Season dependent growth dilution rates λ_b and according half-lives for grass (Table 5), translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.)	
	Light loam, middle loam	
	^{137}Cs	^{90}Sr
Grass	$2 \cdot 10^{-1}$	$5 \cdot 10^{-1}$
Winter wheat	$5 \cdot 10^{-2}$	$2 \cdot 10^{-1}$
Winter barley	$5 \cdot 10^{-2}$	$1 \cdot 10^{-1}$
Spring barley	$5 \cdot 10^{-2}$	$1 \cdot 10^{-1}$
Rye	$5 \cdot 10^{-2}$	$9 \cdot 10^{-2}$
Maize silage	$2 \cdot 10^{-2}$	$7 \cdot 10^{-2}$
Beet	$4 \cdot 10^{-2}$	$1 \cdot 10^{-1}$
Potatoes	$2 \cdot 10^{-2}$	$3 \cdot 10^{-2}$
Leafy veget.	$2 \cdot 10^{-2}$	$3 \cdot 10^{-2}$
Fruit veget.	$1 \cdot 10^{-2}$	$9 \cdot 10^{-2}$

Table 8: Transfer factors soil-plant TF_i: values for Radioecological Region Forest-Veld conditions. Transfer factors for other elements (see Appendix Default)

Animal	Feedstuff	Intake rate (kg d^{-1} fresh weight)	
		Winter	Summer
Lactating cow	grass	-	50
	concentrated feed	2.5	1
	cereals	1	0.5
	maize silage	20	-
	hay	1.5	-
	straw	4	-
	beet	12	-
Lactating sheep	green mass	-	7
	concentrated feed	-	0.3
	hay	0.4	-
	straw	1.0	-
	beet	1.0	-
Pig	winter barley	0.5	0.5
	maize silage	1.3	1.3
	grass	-	2.7
	roots (beet)	2.3	-
Hen, chicken	winter wheat	0.09	0.09

Table 9: Feeding diets I_k for animals: values for Radioecological Region Forest-Veld conditions [20,21,24].

Tables 10-13 see Polesie radioecological region.

Foodstuff	Consumption rates ($g\ d^{-1}$) for adults	
	Urban inhabitants	Rural inhabitants
Winter wheat, flour	336	445
Rye, flour	90	4
Potatoes	312	604
Leafy vegetables	76	138
Root vegetables	73	118
Fruit vegetables	53	114
Fruit	62	76
Berries	8	7
Milk	112	817
Cream	11	4
Butter	10	4
Cheese (rennet)	11	2.4
Cheese (acid)	4	0.2
Beef and veal	21	15
Lamb	0.5	0.4
Pork	23	57
Chicken	14	48
Eggs	20	35
Fish	12	4

Table 14: Consumption rates V_k: values for Radioecological Region Forest-Veld conditions.

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses in FDMT are taken from the default data base of FDMT (see Appendix Default, Table 15).

7.7.3 Radioecological Region Veld (code in RODOS 322).

Deposition velocities $v_{gi,max}$ (Table 1) and the retention coefficients S_i (Table 2) are taken from the default data base of FDMT (see Appendix Default)

Plant species	Harvest	Yield (kg m^{-2})
Grass	1.5-31.10	0.9
Winter wheat	5.7-14.7	0.3
Winter barley	25.6-1.7	0.3
Spring barley	5.7-12.7	0.2
Oats	12.7-17.7	0.2
Rye	15.7-25.7	0.3
Maize	10.8-5.9	1.6
Corn cobs	15.9-5.10	0.3
Beet	25.9-3.10	2.5
Beet leaves	25.9-3.10	1.6
Potatoes	5.8-26.8	0.9
Leafy vegetables	1.5-30.9	2.0
Fruit vegetables	15.7-10.9	1.0
Root vegetables	1.10-10.10	1.0
Fruits	20.7-1.10	0.4
Berries	20.7-1.10	0.3

Table 3: Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT: values for Radioecological Region Veld conditions [4,5,9,11]

Plant	Yield or leaf area index (LAI)						
Grass	Date Yield	1.4. 0.01	1.6. 0.9	1.8. 0.9	31.10. 0.02		
Winter wheat	Date LAI	1.1. 0	20.3. 0.3	20.4. 1.0	15.6. 6.0	14.7. 0.1	15.7. 0
Winter barley	Date LAI	1.1. 0	25.3. 0.2	25.4. 1.5	15.6. 5.5	1.7. 0.3	2.7. 0
Spring barley	Date LAI	10.4. 0	15.5. 2.0	15.6. 5.0	12.7. 0.3	13.7. 0	
Oats	Date LAI	10.4. 0	15.5. 3.0	1.6. 5.0	1.7. 3.5	16.7 0.1	17.7 0
Rye	Date LAI	1.1. 0	1.4. 0.3	20.4. 0.7	20.6. 6.0	25.7. 0.1	26.7. 0
Maize	Date LAI	10.5. 0	10.6. 3.5	10.7. 6.5	5.8. 6.0	31.8. 0.4	1.9 0
Beet	Date LAI	5.5. 0	15.6. 2.0	10.7. 6.5	5.8 6.0	4.10. 0	
Potatoes	Date LAI	20.5. 0	15.7. 5.0	10.8. 3.5	27.8 0		
Leafy vegetables	Date LAI	10.4. 0	20.6. 4.0	30.7. 4.0	1.10 0		
Fruit vegetables	Date LAI	10.5 0	5.7 6.0	20.8 6.0	9.9 0.4	10.9 0	
Root vegetables	Date LAI	10.5. 0	20.6. 4.5	20.8. 4.5	11.10. 0		
Fruit, Berries	Date LAI	15.4. 0	1.6. 6.0	20.7. 6.0	1.11. 0		

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 x m^{-2}) as function of the time of the year (between the given values linear interpolation is applied) for the plants considered in FDMT: values for Radioecological Region Veld conditions [1-8]

Season dependent growth dilution rates λ_b and according half-lives for grass (Table 5), translocation factors $T_i(\Delta t)$ for mobile elements (Table 6) and immobile elements (Table 7) as function of the time Δt (d) before harvest are taken from the default data base of FDMT (see Appendix Default)

	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.)	
	Heavy loam, clay	
	^{137}Cs	^{90}Sr
Grass	$7 \cdot 10^{-2}$	$2 \cdot 10^{-1}$
Winter wheat	$2 \cdot 10^{-2}$	$8 \cdot 10^{-2}$
Winter barley	$2 \cdot 10^{-2}$	$8 \cdot 10^{-2}$
Spring barley	$2 \cdot 10^{-2}$	$8 \cdot 10^{-2}$
Rye	$2 \cdot 10^{-2}$	$6 \cdot 10^{-2}$
Maize silage	$2 \cdot 10^{-2}$	$4 \cdot 10^{-2}$
Beet	$4 \cdot 10^{-2}$	$6 \cdot 10^{-2}$
Potatoes	$2 \cdot 10^{-2}$	$1 \cdot 10^{-2}$
Leafy veget.	$2 \cdot 10^{-2}$	$1 \cdot 10^{-2}$
Fruit veget.	$1 \cdot 10^{-2}$	$3 \cdot 10^{-2}$

Table 8: Transfer factors soil-plant TF_i: values for Radioecological Region Veld conditions. Transfer factors for other elements (see Appendix Default)

Animal	Feedstuff	Intake rate (kg d^{-1} fresh weight)	
		Winter	Summer
Lactating cow [a]	grass	-	50
	concentrated feed	3	1
	cereals	1	0.5
	maize silage	23	-
	hay	1.5	-
	straw	4	-
	beet	6	-
Lactating sheep	green mass	-	7
	concentrated feed	-	0.3
	hay	0.4	-
	straw	1.0	-
	beet	1.0	-
Pig	winter barley	0.7	1.0
	maize silage	1.2	1.2
	grass	-	1.8
	roots (beet)	2.3	-
Hen, chicken	winter wheat	0.09	0.09

Table 9: Feeding diets I_k for animals: values for Radioecological Region Veld conditions [20,21,24].

Tables 10-13 see Polesie radioecological region.

Foodstuff	Consumption rates (g d^{-1}) for adults	
	Urban inhabitants	Rural inhabitants
Winter wheat, flour	440	411
Rye, flour	2	0
Potatoes	300	390
Leafy vegetables	70	82
Root vegetables	70	104
Fruit vegetables	60	71
Fruit	59	70
Berries	8	6.5
Milk	360	1000
Cream	7	2
Butter	7	1.5
Cheese (rennet)	7	0.5
Cheese (acid)	1.5	0.2
Beef and veal	15	6
Lamb	0.2	0.1
Pork	25	33
Chicken	22	36
Eggs	24	34
Fish	20	18

Table 14: Consumption rates V_k: values for Radioecological Region Veld conditions.

Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses in FDMT are taken from the default data base of FDMT (see Appendix Default, Table 15).

7.8 Default data set in FDMT for Central European conditions

Surface type	Deposition velocity (mm s^{-1})		
	Aerosol bound radionuclides	Elemental iodine	Organic bound iodine
Soil	0.5	3.	0.05
Pasture	1.5	15.	0.15
Lawn	0.5	5.	0.05
Trees	5.	50.	0.5
Other plants	2.	20.	0.2

Table 1: Deposition velocities $v_{gi,max}$ used in FDMT for soil and fully developed plant canopies

Plant species	Retention coefficient (mm)		
	I	Cs,Zr,Nb,Ru Te,Ce,Pu,Mn,Zn	Sr,Ba
Grass, cereals, maize	0.1	0.2	0.4
Other plants	0.15	0.3	0.6

Table 2: Retention coefficients S_i for different plants and elements used for calculation of wet interception

Plant species	Harvest	Yield (kg m^{-2})
Grass	1.5.-31.10.	1.5
Winter wheat	5.8.	0.5
Spring wheat	15.8.	0.5
Winter barley	15.7.	0.5
Spring barley	5.8.	0.4
Oats	10.8.	0.4
Rye	31.7.	0.4
Maize	15.8.-15.9.	5.0
Corn cobs	15.10.	1.5
Beet	20.9.-31.10.	5.0
Beet leaves	20.9.-31.10.	3.0
Potatoes	15.8.-24.9.	3.0
Leafy vegetables	1.1.-31.12.	2.0
Fruit vegetables	1.8.-15.10.	1.5
Root vegetables	1.8.-31.10.	2.0
Fruit	1.7.-15.10.	2.0
Berries	1.7.-15.10.	1.5

Table 3: Times of harvest and yields Y_i (fresh weight) of the crops considered in FDMT: default values for Central European conditions

Plant	Yield or leaf area index (LAI)							
Pasture	Date	1.1.	15.3.	15.5.	31.10.	1.11.		
	Yield	0.01	0.05	1.5	1.5	0.05		
Pasture (extensive)	Date	1.1.	15.3.	1.7.	31.10.	1.11.		
	Yield	0.01	0.05	1.5	1.5	0.05		
Lawn	Date	1.1.	15.3.	15.5.	31.10.	1.11.		
	Yield	0.01	0.05	0.5	0.5	0.05		
Winter wheat	Date	1.1.	20.4.	10.6.	5.8.	6.8.	25.10.	31.12.
	LAI	0.1	1	7	1	0	0	0.1
Spring wheat	Date	15.4.	20.6.	15.8.	16.8.			
	LAI	0	6	1	0			
Winter barley	Date	1.1.	1.4.	25.5.	15.7.	16.7.	5.10.	31.12.
	LAI	0.1	1	6	1	0	0	0.1
Spring barley	Date	15.4.	15.6.	5.8.	6.8.			
	LAI	0	5	1	0			
Oats	Date	15.4.	20.6.	10.8.	11.8.			
	LAI	0	5	1	0			
Rye	Date	1.1.	20.3.	20.5.	1.8.	2.8.	15.10.	31.12.
	LAI	0.1	1	6	1	0	0	0.1
Maize	Date	15.5.	20.6.	1.8.	15.10.	16.10.		
	LAI	0	1	5	4	0		
Beet	Date	10.5.	20.6.	1.8.	1.11	2.11.		
	LAI	0	1	4	3	0		
Potatoes	Date	20.5.	1.7.	1.8.	15.9.			
	LAI	0	4	4	0			
Root veg., fruit veg., fruit, berries	Date	15.4.	1.7.	1.10.	1.11.			
	LAI	0	5	5	0			

Table 4: Yield of pasture grass (kg m^{-2} f.w.) and leaf area indices (all other plants; m^2 x m^{-2}) as function of the time of the year (between the given values linear interpolation is applied) for the plants considered in FDMT: default values for Central European conditions

Month	Dilution rate (d^{-1})	Half-life (d)
January - February	0.0	-
March	$7.70 x 10^{-2}$	9
April	$2.89 x 10^{-2}$	24
May	$3.47 x 10^{-2}$	20
June	$3.47 x 10^{-2}$	20
July	$3.47 x 10^{-2}$	20
August	$3.47 x 10^{-2}$	20
September	$2.31 x 10^{-2}$	30
October	$1.73 x 10^{-2}$	40
November - December	0.0	-

Table 5: Season dependent growth dilution rates λ_b and according half-lives for grass: default values for Central European conditions

Plant		Translocation factor				
Winter wheat	Δt	150	95	55	30	0
	T(Δt)	0	0.005	0.1	0.1	0.075
Spring wheat	Δt	120	80	50	30	0
	T(Δt)	0	0.005	0.1	0.1	0.075
Winter barley	Δt	150	75	50	25	0
	T(Δt)	0	0.01	0.1	0.1	0.075
Spring barley, oats	Δt	110	75	50	25	0
	T(Δt)	0	0.01	0.1	0.1	0.075
Rye	Δt	150	90	65	30	0
	T(Δt)	0	0.01	0.1	0.1	0.075
Corn cobs	Δt	155	115	85	45	0
	T(Δt)	0	0.01	0.1	0.1	0.02
Beet	Δt	174	122	91	0	
	T(Δt)	0	0.02	0.15	0.15	
Potatoes	Δt	128	72	55	0	
	T(Δt)	0	0.15	0.15	0	
Root veg.	Δt	183	122	14	0	
	T(Δt)	0	0.1	0.1	0.02	
Fruit veg.	Δt	167	106	14	0	
	T(Δt)	0	0.1	0.1	0.02	
Fruit	Δt	183	106	14	0	
	T(Δt)	0	0.1	0.1	0.02	
Berries	Δt	184	183	14	0	
	T(Δt)	0	0.1	0.1	0.02	

Table 6: Translocation factors $T_i(\Delta t)$ for mobile elements as function of the time Δt (d) before harvest.

Plant		Translocation factor				
Wheat [a]	Δt	80	55	40	20	0
	T(Δt)	0	0.002	0.005	0.02	0.075
Barley [a], oats	Δt	80	50	40	20	0
	T(Δt)	0	0.002	0.005	0.02	0.075
Rye	Δt	100	75	40	20	0
	T(Δt)	0	0.002	0.005	0.02	0.075
Corn cobs	Δt	85	0			
	T(Δt)	0	0.02			
Potatoes, beet		no translocation				
Root veg.		no translocation				
Fruit veg.	Δt	150	30	0		
	T(Δt)	0	0.005	0.02		
Fruit, berries	Δt	150	30	0		
	T(Δt)	0	0.005	0.02		

[a] Winter and spring varieties

Table 7: Translocation factors $T_i(\Delta t)$ for immobile elements as function of the time Δt (d) before harvest.

	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.)								
Plant	Ag	Ba	Ce	Cm	Co	Cr	Cs	Fe	I
Grass	$8\cdot10^{-2}$	$3\cdot10^{-2}$	$2\cdot10^{-3}$	$2\cdot10^{-4}$	$8\cdot10^{-2}$	$4\cdot10^{-3}$	$5\cdot10^{-2}$	$2\cdot10^{-3}$	$1\cdot10^{-1}$
Maize silage	$1.2\cdot10^{-1}$	$5\cdot10^{-2}$	$3\cdot10^{-3}$	$2\cdot10^{-5}$	$4\cdot10^{-3}$	$6\cdot10^{-3}$	$2\cdot10^{-2}$	$3\cdot10^{-3}$	$1\cdot10^{-1}$
Corn cobs	$1.2\cdot10^{-1}$	$5\cdot10^{-2}$	$3\cdot10^{-3}$	$2\cdot10^{-5}$	$4\cdot10^{-3}$	$6\cdot10^{-3}$	$1\cdot10^{-2}$	$3\cdot10^{-3}$	$1\cdot10^{-1}$
Potatoes	$2.5\cdot10^{-2}$	$4\cdot10^{-3}$	$1\cdot10^{-3}$	$1\cdot10^{-4}$	$7\cdot10^{-3}$	$3\cdot10^{-3}$	$1\cdot10^{-2}$	$6\cdot10^{-4}$	$1\cdot10^{-1}$
Beet	$2.5\cdot10^{-2}$	$4\cdot10^{-3}$	$1\cdot10^{-3}$	$1\cdot10^{-4}$	$7\cdot10^{-3}$	$3\cdot10^{-3}$	$5\cdot10^{-3}$	$6\cdot10^{-4}$	$1\cdot10^{-1}$
Beet leaves	$2.5\cdot10^{-2}$	$4\cdot10^{-3}$	$1\cdot10^{-3}$	$1\cdot10^{-4}$	$7\cdot10^{-3}$	$3\cdot10^{-3}$	$3\cdot10^{-2}$	$6\cdot10^{-4}$	$1\cdot10^{-1}$
Cereals	$8.5\cdot10^{-2}$	$1\cdot10^{-2}$	$3\cdot10^{-3}$	$2\cdot10^{-5}$	$3\cdot10^{-3}$	$1\cdot10^{-2}$	$2\cdot10^{-2}$	$2\cdot10^{-3}$	$1\cdot10^{-1}$
Leafy vegetables	$4\cdot10^{-2}$	$2\cdot10^{-2}$	$1\cdot10^{-3}$	$1\cdot10^{-4}$	$1\cdot10^{-2}$	$2\cdot10^{-3}$	$2\cdot10^{-2}$	$1\cdot10^{-3}$	$1\cdot10^{-1}$
Root vegetables	$1\cdot10^{-2}$	$2\cdot10^{-3}$	$4\cdot10^{-4}$	$1\cdot10^{-4}$	$7\cdot10^{-3}$	$1\cdot10^{-3}$	$1\cdot10^{-2}$	$3\cdot10^{-4}$	$1\cdot10^{-1}$
Fruit vegetables	$1\cdot10^{-2}$	$2\cdot10^{-3}$	$4\cdot10^{-4}$	$1\cdot10^{-4}$	$4\cdot10^{-3}$	$1\cdot10^{-3}$	$1\cdot10^{-2}$	$3\cdot10^{-4}$	$1\cdot10^{-1}$
Fruit	$1\cdot10^{-2}$	$2\cdot10^{-3}$	$4\cdot10^{-4}$	$1\cdot10^{-4}$	$4\cdot10^{-3}$	$1\cdot10^{-3}$	$2\cdot10^{-2}$	$3\cdot10^{-4}$	$1\cdot10^{-1}$
Berries	$1\cdot10^{-2}$	$2\cdot10^{-3}$	$4\cdot10^{-4}$	$1\cdot10^{-4}$	$4\cdot10^{-3}$	$1\cdot10^{-3}$	$2\cdot10^{-2}$	$3\cdot10^{-4}$	$1\cdot10^{-1}$
K_d (g cm^{-3})		60	900				1000		100

Table 8: Transfer factors soil-plant TF_i and distribution coefficients K_d : default values for Central European conditions

Plant	Transfer factor soil-plant (Bq kg^{-1} plant f.w. per Bq kg^{-1} soil d.w.) Mn	Mo	Nb	Pu	Ru	Sr	Te	Zn	Zr
Grass	$8 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$2 \cdot 10^{-4}$	$2 \cdot 10^{-2}$	$5 \cdot 10^{-1}$	$5 \cdot 10^{-3}$	$2 \cdot 10^{-1}$	$4 \cdot 10^{-4}$
Maize silage	$6 \cdot 10^{-2}$	$8 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-1}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$6 \cdot 10^{-4}$
Corn cobs	$6 \cdot 10^{-2}$	$8 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$6 \cdot 10^{-4}$
Potatoes	$2 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$5 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-1}$	$1 \cdot 10^{-4}$
Beet	$2 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$4 \cdot 10^{-1}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-1}$	$1 \cdot 10^{-4}$
Beet leaves	$2 \cdot 10^{-2}$	$2 \cdot 10^{-2}$	$1 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-2}$	$8 \cdot 10^{-1}$	$1 \cdot 10^{-3}$	$1 \cdot 10^{-1}$	$1 \cdot 10^{-4}$
Cereals	$2 \cdot 10^{-1}$	$5 \cdot 10^{-2}$	$4 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$3 \cdot 10^{-3}$	$9 \cdot 10^{-1}$	$4 \cdot 10^{-4}$
Leafy vegetables	$8 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$2 \cdot 10^{-3}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$4 \cdot 10^{-1}$	$3 \cdot 10^{-3}$	$2 \cdot 10^{-2}$	$2 \cdot 10^{-4}$
Root vegetables	$2 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$3 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$1 \cdot 10^{-1}$	$5 \cdot 10^{-5}$
Fruit vegetables	$3 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$2 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$6 \cdot 10^{-2}$	$5 \cdot 10^{-5}$
Fruit	$3 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$1 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$6 \cdot 10^{-2}$	$5 \cdot 10^{-5}$
Berries	$3 \cdot 10^{-2}$	$6 \cdot 10^{-3}$	$5 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-2}$	$1 \cdot 10^{-1}$	$4 \cdot 10^{-4}$	$6 \cdot 10^{-2}$	$5 \cdot 10^{-5}$
K_d (g cm^{-3})	70		400	1000	1000	100	100	40	1000

Table 8 (continued)

Animal	Feedstuff	Intake rate (kg d^{-1} fresh weight)
Lactating cow	grass	70 [a]
Lactating sheep	grass	9 [a]
Lactating goat	grass	13 [a]
Beef cattle	maize silage	28
Calf	milk substitute	2.9
Pig	winter barley	3.0
Lamb	grass (extensive)	5 [a]
Hen, chicken	winter wheat	0.09
Roe deer	grass (extensive)	4 [a]

[a] Values given are for the vegetation period; during the winter an equivalent dry matter intake with hay or silage is assumed

Table 9: Feeding diets I_k for animals: default values for Central European conditions.

Animal product	Transfer factor feed-animal product ($d\ l^{-1}$, $d\ kg^{-1}$)								
	Ag	Ba	Ce	Cm	Co	Cr	Cs	Fe	I
Cow milk	$2\cdot10^{-4}$	$5\cdot10^{-4}$	$2\cdot10^{-5}$	$1\cdot10^{-6}$	$2\cdot10^{-4}$	$1\cdot10^{-5}$	$3\cdot10^{-3}$	$2\cdot10^{-4}$	$3\cdot10^{-3}$
Sheep milk	$2.5\cdot10^{-3}$	$5\cdot10^{-3}$	$2\cdot10^{-4}$	$1\cdot10^{-5}$	$2\cdot10^{-3}$	$1\cdot10^{-4}$	$6\cdot10^{-2}$	$2\cdot10^{-3}$	$5\cdot10^{-1}$
Goat milk	$2.5\cdot10^{-3}$	$5\cdot10^{-3}$	$2\cdot10^{-4}$	$1\cdot10^{-5}$	$2\cdot10^{-3}$	$1\cdot10^{-4}$	$6\cdot10^{-2}$	$2\cdot10^{-3}$	$5\cdot10^{-1}$
Beef (cow)	$1\cdot10^{-3}$	$2\cdot10^{-4}$	$8\cdot10^{-4}$	$1\cdot10^{-4}$	$2\cdot10^{-4}$	$6\cdot10^{-3}$	$1\cdot10^{-2}$	$2\cdot10^{-2}$	$1\cdot10^{-3}$
Beef (bull)	$1\cdot10^{-3}$	$2\cdot10^{-4}$	$8\cdot10^{-4}$	$1\cdot10^{-4}$	$2\cdot10^{-4}$	$6\cdot10^{-3}$	$4\cdot10^{-2}$	$2\cdot10^{-2}$	$1\cdot10^{-3}$
Veal	$3\cdot10^{-3}$	$6\cdot10^{-4}$	$2\cdot10^{-3}$	$3\cdot10^{-4}$	$6\cdot10^{-4}$	$2\cdot10^{-2}$	$3.5\cdot10^{-1}$	$6\cdot10^{-2}$	$3\cdot10^{-3}$
Pork	$5\cdot10^{-3}$	$1\cdot10^{-3}$	$4\cdot10^{-3}$	$3\cdot10^{-4}$	$1\cdot10^{-3}$	$3\cdot10^{-2}$	$4\cdot10^{-1}$	$1\cdot10^{-1}$	$3\cdot10^{-3}$
Lamb	$1\cdot10^{-2}$	$2\cdot10^{-3}$	$8\cdot10^{-3}$	$1\cdot10^{-3}$	$2\cdot10^{-3}$	$6\cdot10^{-2}$	$5\cdot10^{-1}$	$2\cdot10^{-1}$	$1\cdot10^{-2}$
Roe deer	$1\cdot10^{-2}$	$2\cdot10^{-3}$	$8\cdot10^{-3}$	$1\cdot10^{-3}$	$2\cdot10^{-3}$	$6\cdot10^{-2}$	$5\cdot10^{-1}$	$2\cdot10^{-1}$	$1\cdot10^{-2}$
Chicken	$5\cdot10^{-1}$	$1\cdot10^{-2}$	$1\cdot10^{-2}$	$2\cdot10^{-4}$	2.0	$5\cdot10^{-1}$	4.5	1.5	$1\cdot10^{-1}$
Eggs	$5\cdot10^{-1}$	$9\cdot10^{-1}$	$5\cdot10^{-3}$	$5\cdot10^{-3}$	$3\cdot10^{-1}$	$5\cdot10^{-1}$	$3\cdot10^{-1}$	1.3	2.8

Table 10: Transfer factors feed-animal products TF_m used in FDMT

Animal product	Transfer factor feed-animal product ($d\ l^{-1}$, $d\ kg^{-1}$)								
	Mn	Mo	Nb	Pu	Ru	Sr	Te	Zn	Zr
Cow milk	$1\cdot10^{-4}$	$2\cdot10^{-3}$	$4\cdot10^{-7}$	$6\cdot10^{-5}$	$1\cdot10^{-4}$	$2\cdot10^{-3}$	$5\cdot10^{-4}$	$3\cdot10^{-3}$	$6\cdot10^{-7}$
Sheep milk	$1\cdot10^{-3}$	$1\cdot10^{-2}$	$6\cdot10^{-6}$	$4\cdot10^{-4}$	$1\cdot10^{-3}$	$1.4\cdot10^{-2}$	$4\cdot10^{-3}$	$3\cdot10^{-2}$	$6\cdot10^{-6}$
Goat milk	$1\cdot10^{-3}$	$1\cdot10^{-2}$	$6\cdot10^{-6}$	$4\cdot10^{-4}$	$1\cdot10^{-3}$	$1.4\cdot10^{-2}$	$4\cdot10^{-3}$	$3\cdot10^{-2}$	$6\cdot10^{-6}$
Beef (cow)	$5\cdot10^{-4}$	$1\cdot10^{-3}$	$3\cdot10^{-7}$	$6\cdot10^{-5}$	$1\cdot10^{-3}$	$3\cdot10^{-4}$	$7\cdot10^{-3}$	$2\cdot10^{-2}$	$1\cdot10^{-6}$
Beef (bull)	$5\cdot10^{-4}$	$1\cdot10^{-3}$	$3\cdot10^{-7}$	$6\cdot10^{-5}$	$1\cdot10^{-3}$	$3\cdot10^{-4}$	$7\cdot10^{-3}$	$2\cdot10^{-2}$	$1\cdot10^{-6}$
Veal	$2\cdot10^{-3}$	$3\cdot10^{-3}$	$1\cdot10^{-6}$	$2\cdot10^{-4}$	$2\cdot10^{-3}$	$2\cdot10^{-3}$	$2\cdot10^{-2}$	$6\cdot10^{-2}$	$3\cdot10^{-6}$
Pork	$4\cdot10^{-3}$	$5\cdot10^{-3}$	$2\cdot10^{-6}$	$3\cdot10^{-4}$	$5\cdot10^{-3}$	$2\cdot10^{-3}$	$3\cdot10^{-2}$	$1\cdot10^{-1}$	$5\cdot10^{-6}$
Lamb	$5\cdot10^{-3}$	$2\cdot10^{-2}$	$3\cdot10^{-6}$	$7\cdot10^{-4}$	$1\cdot10^{-2}$	$3\cdot10^{-3}$	$7\cdot10^{-2}$	$2\cdot10^{-1}$	$1\cdot10^{-5}$
Roe deer	$5\cdot10^{-3}$	$2\cdot10^{-2}$	$3\cdot10^{-6}$	$9\cdot10^{-4}$	$1\cdot10^{-2}$	$3\cdot10^{-3}$	$7\cdot10^{-2}$	$2\cdot10^{-1}$	$1\cdot10^{-5}$
Chicken	$5\cdot10^{-2}$	$2\cdot10^{-1}$	$3\cdot10^{-4}$	$2\cdot10^{-4}$	$7\cdot10^{-3}$	$4\cdot10^{-2}$	$6\cdot10^{-1}$	6.5	$6\cdot10^{-5}$
Eggs	$7\cdot10^{-2}$	$9\cdot10^{-1}$	$1\cdot10^{-3}$	$7\cdot10^{-3}$	$6\cdot10^{-3}$	$2\cdot10^{-1}$	5	2.6	$2\cdot10^{-4}$

Table 10 (continued)

Element	Product [a]	a_1	$T_{b,1}$ (d)	a_2	$T_{b,2}$ (d)
Ag	milk	0.1	3	0.9	60
	meat	1.0	60		
	chicken	0.7	3	0.3	100
	eggs	1.0	3		
Ba	milk	0.9	3	0.1	100
	meat	0.2	10	0.8	100
	chicken	0.5	3	0.5	100
	eggs	0.5	2	0.5	20
Ce	milk	0.5	1	0.5	20
	meat, chicken	1.0	4000		
	eggs	1.0	3		
Cm	milk, meat	1.0	7000		
	chicken, eggs	1.0	1		
Co	milk	0.8	2	0.2	400
	meat	0.1	40	0.9	800
	chicken	0.5	10	0.5	200
	eggs	1.0	3		
Cr	milk	0.1	6	0.9	80
	meat, chicken	0.1	5	0.9	80
	eggs	1.0	3		
Cs	milk	0.8	1.5	0.2	15
	beef (cow), veal	1.0	30		
	beef(bull)	1.0	50		
	pork	1.0	35		
	lamb, roe deer, chicken	1.0	20		
	eggs	1.0	3		
Fe	milk, meat, chicken	1.0	2000		
	eggs	1.0	3		
I	milk, eggs	1.0	0.7		
	meat, chicken	1.0	7.5		
Mn	milk, meat, chicken	0.4	40	0.6	700
	eggs	1.0	3		

[a] meat stands for pork, beef, veal, lamb, roe deer

Table 11: Biological halflifes $T_{b,i}$ according to the biological transfer rates $\lambda_{b,mj}$ and their contribution fractions a_{mj} as applied in FDMT

Element	Product [a]	a_1	$T_{b,1}$ (d)	a_2	$T_{b,2}$ (d)
Mo	milk	0.9	40	0.1	2000
	meat, chicken	1.0	50		
	eggs	1.0	3		
Nb	milk	1.0	1		
	meat, chicken	0.02	4	0.98	200
	eggs	1.0	3		
Pu	milk, meat	1.0	7000		
	chicken, eggs	1.0	25		
Ru	milk, meat, chicken	0.1	30	0.9	1000
	eggs	1.0	3		
Sr	milk	0.9	3	0.1	100
	meat	0.2	10	0.8	100
	chicken	0.5	3	0.5	100
	eggs	0.5	2	0.5	20
Te	milk	1.0	1		
	meat, chicken	0.1	20	0.9	5000
	eggs	1.0	3		
Zn	milk	0.3	4	0.7	200
	meat	1.0	700		
	chicken	0.1	10	0.9	100
	eggs	1.0	3		
Zr	milk	1.0	1		
	meat, chicken	1.0	8000		
	eggs	1.0	3		

[a] meat stands for pork, beef, veal, lamb, roe deer

Table 11 (continued)

Raw Product	Processed Product	Element Ag, Co, Cr, Fe, Mo	Ba	Cs	I	Pu	Ru,Cm	Sr
Wheat	Wheat flour	0.5	0.5	0.5	0.5	0.2	0.5	0.5
	Wheat bran	3.0	3.0	3.0	3.0	4.0	3.0	3.0
Rye	Rye flour	0.5	0.5	0.6	0.5	0.2	0.5	0.5
	Rye bran	3.0	3.0	2.7	3.0	4.0	3.0	3.5
Spring barley	Beer	0.1	0.04	0.1	0.1	0.04	0.04	0.04
	Brewing residues	0.1	0.25	0.1	0.1	0.25	0.25	0.25
Winter wheat	Distillery residues	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Potatoes	Potatoes, peeled	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Vegetables [a]	Vegetables [a]	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Fruit, berries	Fruit and berries	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Milk (cow)	Butter	1.0	1.0	0.2	0.5	1.0	1.0	0.2
	Cream (30% fat)	1.0	1.0	0.7	0.7	1.0	1.0	0.4
	Skim milk	1.0	1.0	1.04	1.0	1.0	1.0	1.1
	Cheese (rennet)	1.0	1.0	0.6	0.6	1.0	1.0	6.0
	Cheese (acid)	1.0	1.0	0.6	1.4	1.0	1.0	0.8
	Whey (rennet)	1.0	1.0	1.05	1.05	1.0	1.0	0.4
	Whey (acid)	1.0	1.0	1.05	0.95	1.0	1.0	1.04
	Condensed milk	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	Milk substitute	8.0	9.3	8.7	9.4	8.0	8.0	9.3

[a] Root, fruit, and leafy vegetables

Table 12: Processing factors for feedstuffs and foodstuffs as applied in FDMT

Product(s)	Storage time (d)
Cereals and cereal products	45
Brewing residues	60
Distillery residues	45
Maize and beet leaves	0
Corn cobs	45
Potatoes and beet	7
Leafy vegetables	1
Root vegetables	7
Fruit vegetables	2
Fruit and berries	2
Milk	1
Butter	3
Cream	2
Condensed milk	7
Skim milk	1
Cheese (rennet coagulation)	30
Cheese (acid coagulation)	7
Whey	2
Milk substitute	15
Beef	14
Pork, veal, roe deer	2
Chicken, lamb	7
Eggs	2

Table 13: Storage and processing times t_{pk} as applied inFDMT

Foodstuff	Consumption rates (g d^{-1}) for age group				
	1 a	5 a	10 a	15 a	adults
Spring wheat, whole grain	0.7	1.4	1.8	2.0	2.6
Spring wheat, flour	3.9	8.1	10	12	15
Winter wheat, whole grain	6.0	13	16	18	23
Winter wheat, flour	35	73	91	100	130
Rye, whole grain	2.2	4.8	6.0	6.9	8.7
Rye, flour	9.3	19	24	28	35
Oats	2.9	3.1	3.9	4.4	5.6
Potatoes	45	35	60	83	160
Leafy vegetables	58	74	79	86	94
Root vegetables	21	24	29	33	33
Fruit vegetables	12	36	41	46	47
Fruit	150	72	91	100	120
Berries	0	10	12	14	14
Milk	560	140	180	210	230
Condensed milk	0	11	14	16	18
Cream	0	9.6	13	14	16
Butter	0	6.1	9.5	12	18
Cheese (rennet)	0	10	14	19	26
Cheese (acid)	0	6.6	8.9	12	17
Beef (cow)	1.5	18	19	23	27
Beef (cattle)	3.0	35	38	46	55
Veal	0.2	1.4	1.5	1.8	2.2
Pork	3.9	72	78	90	108
Chicken	1.5	11	12	14	17
Roe deer	0	1.1	1.2	1.3	1.7
Eggs	5.0	18	25	36	43
Beer	0	0	12	130	610

Table 14: Age-dependent German consumption rates V_k as applied as default in FDMT

Age group (years)	ıhalation rate (m^3 h^{-1})
1	0.18
5	0.42
10	0.60
15	0.90
Adults	1.2

Table 15: Inhalation rates (corresponding to light corporeal activity) used for estimation of inhalation doses in FDMT.

Document History

Document Title:	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 number:	RODOS(WG3)-??(??)-??
Version and status:	Version 1.0 (draft)
Authors/Editors:	W. Raskob (ed.)
Address:	
Issued by:	
History:	
Date of Issue:	29.7.99
Circulation:	
File Name:	Main_INCO_report
Date of print:	December 9, 1999