Republican Research Center for Radiation Medicine & Human Ecology
Gomel, Belarus

Radiological Zoning of the Territory of Belarus: Dose Approach

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8-9 February 2022

METHODS FOR DOSE ASSESSMENT

MODELS

DETERMINISTIC
Soil→Plants→Animals→Human

- Radioecological model ECOSYS-87 (H. Muller, G. Prőhl)
- Ecological model's elements & parameters corrected by the WBC-measurements (I.A. Likhtarev, P. Jacob)

PHENOMENOLOGICAL
Empirical data on radiological environment

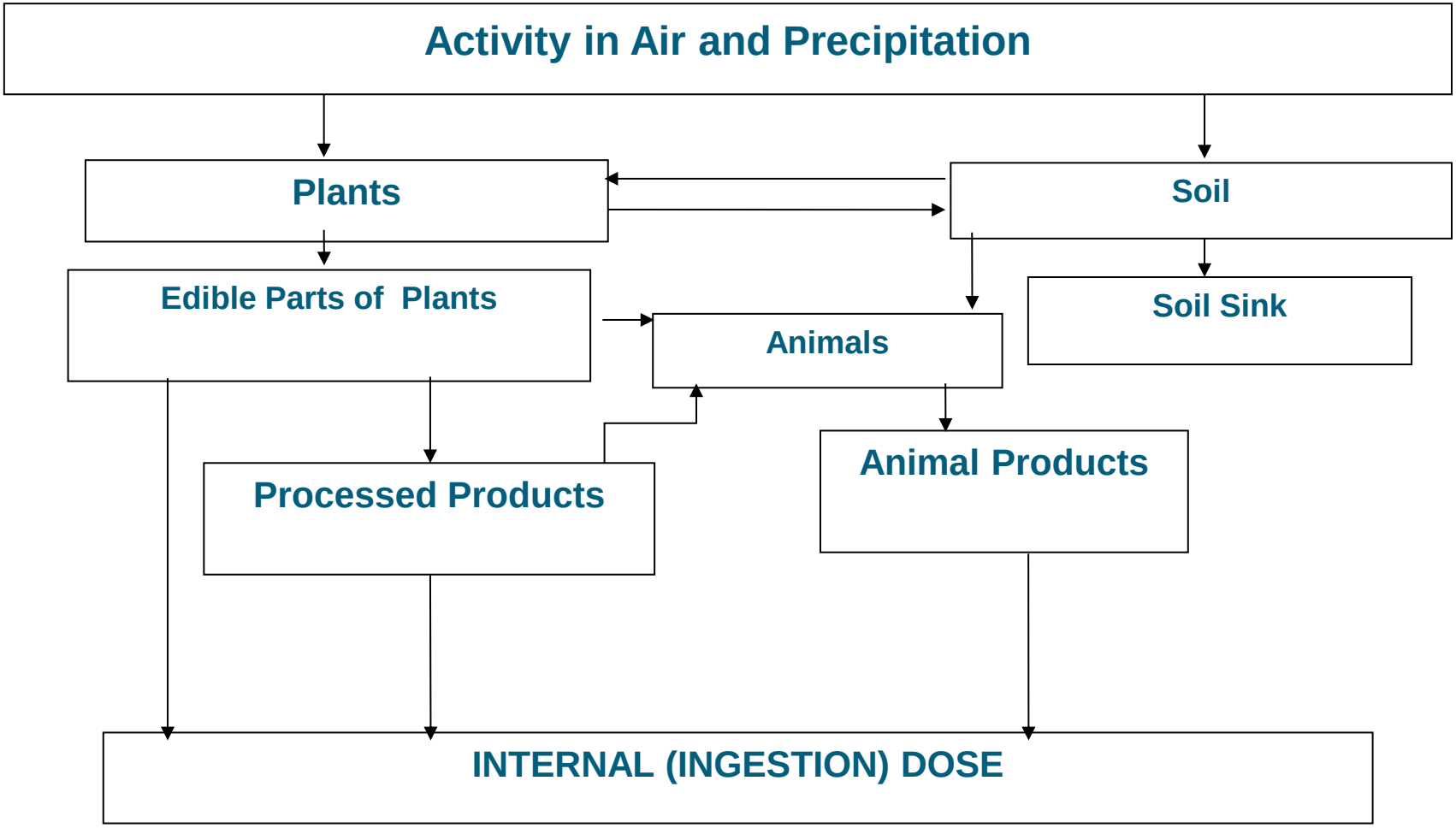
$$D = K_{milk} * C_{milk} + K_{pot} * C_{pot}$$

K_{milk} , K_{pot} – coefficients of relationship between specific activity of ^{137}Cs in milk & potato and dose;

C_{milk} , C_{pot} – average specific activity of ^{137}Cs in milk, potato in a settlement

- $q = 1 * C_{milk} + 1{,}5 * C_{pot}$
- $q = 1{,}5 * C_{milk}$

SCHEME OF THE EXPOSURE PATHWAYS CONSIDERED IN ECOSYS-87



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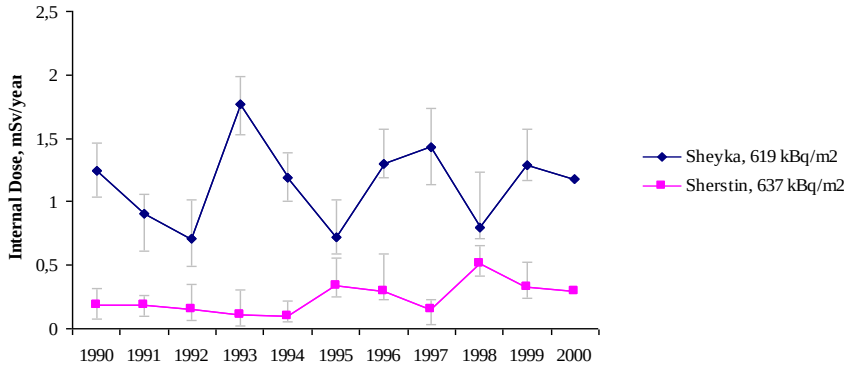
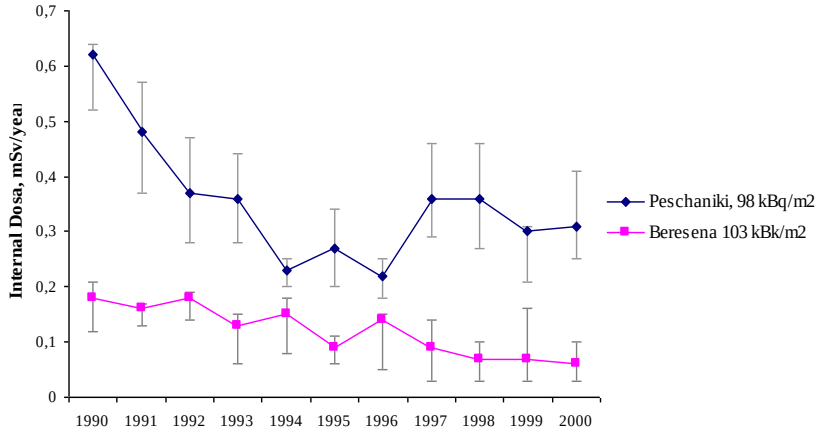
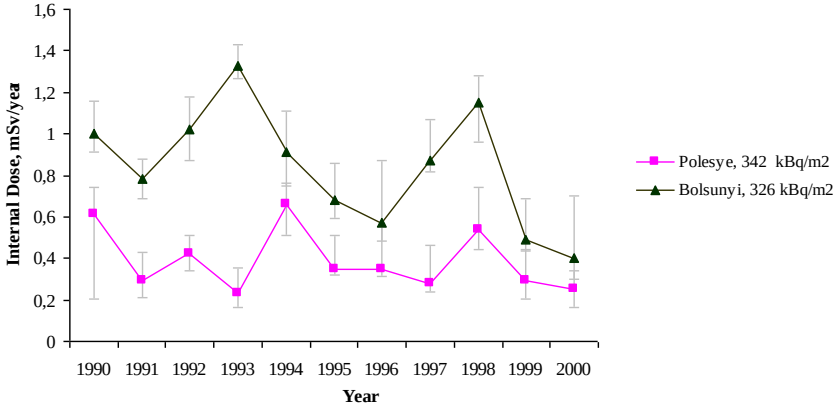
WBC in BELARUS

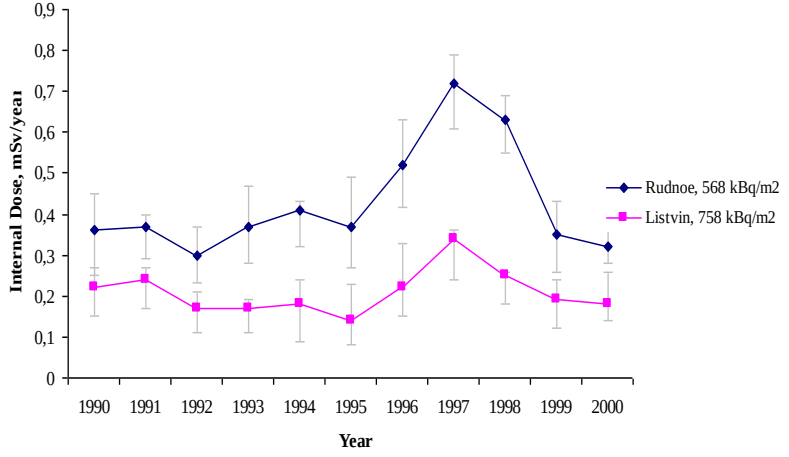
Data Base of the WBC-measurements for the period 1989 – 2020 contains more than 3 million records

AVERAGE INTERNAL DOSES IN SETTLEMENTS WITH SIMILAR DENSITY OF SOIL CONTAMINATION



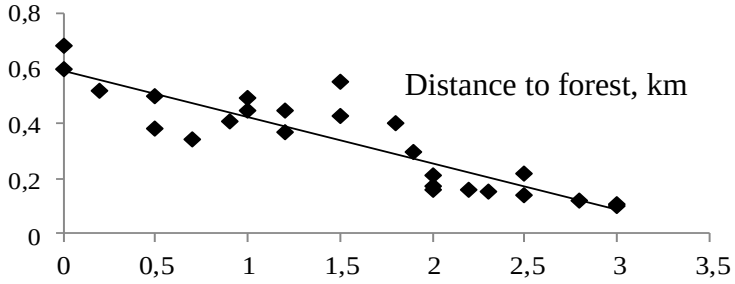


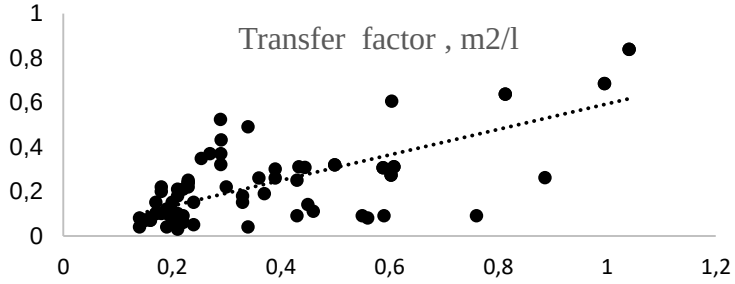




DIRECT AND INDIRECT FACTORS INFLUENCING INTERNAL DOSE FORMING

Direct Factors	Indirect Factors
• Soil contamination of agricultural lands near the settlement • Main dose-forming products activity • Consumption rate of main dose-forming products	• **Social** – Number of population in the settlement • **Natural** – access of forest food products for rural inhabitants • **Ecological** – prevailed type of soil of agricultural lands



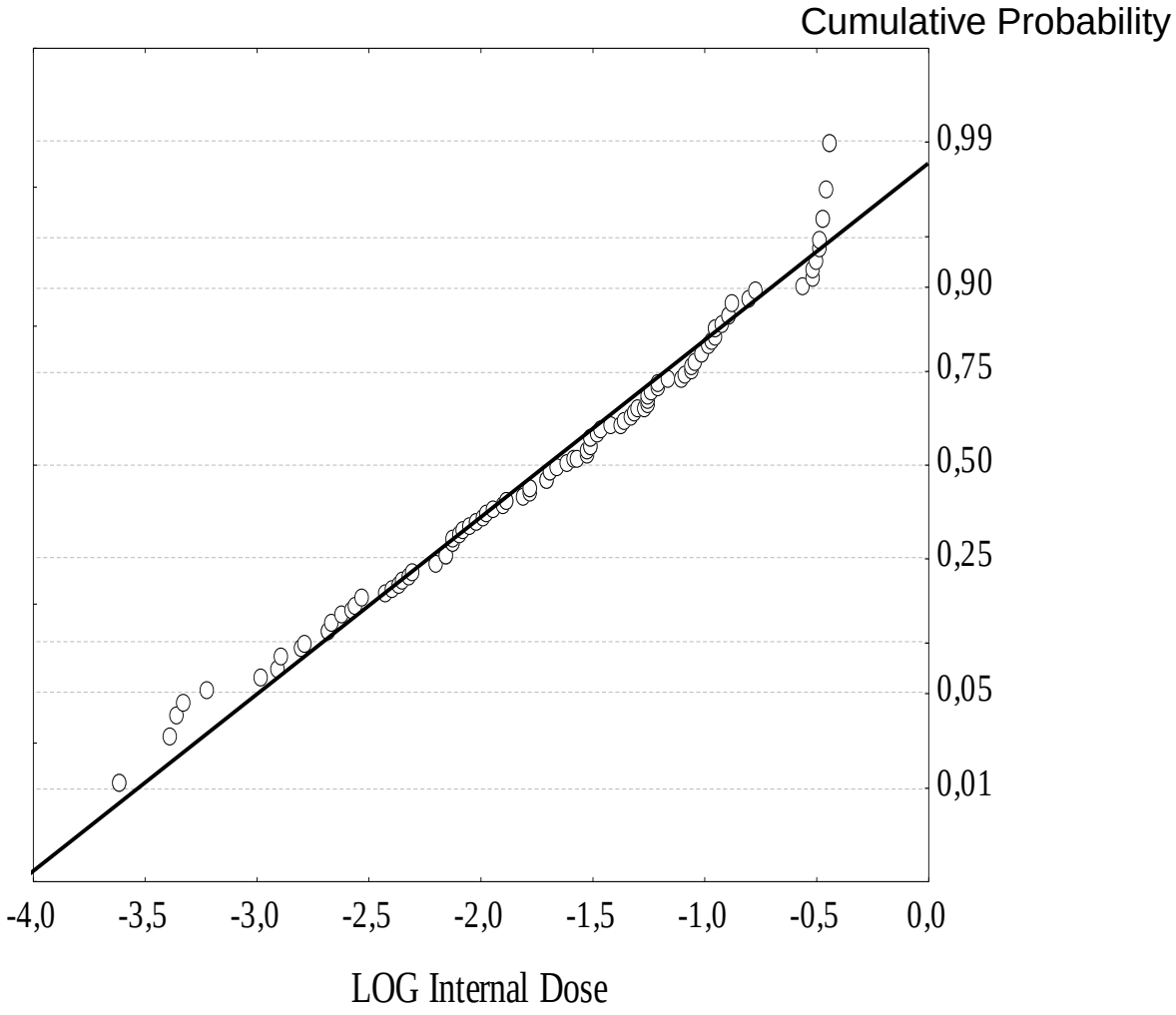


REPRESENTATIVE PERSON

According to the Recommendation of ICRP the representative person is equivalent to, and replaces, the average member of the critical group recommended previously by the Commission.

So the exposure dose of a representative person is the average dose of the critical group

INTERNAL DOSE DISTRIBUTION

- 

INTERNAL DOSE OF THE REPRESENTATIVE PERSON

Percentile value of the dose distribution corresponding to the average dose of the critical group, %	Share of the settlements, with the corresponding value of percentile of the dose distribution, %	Dose rate of the representative person to the average value of the settlement
94	1	3,03
95	2	3,18
96	17	3,89
97	**59**	**4,10**
98	18	4,98
99	3	5,24

In almost 60% of settlements, the internal dose of a representative person corresponds to a 97th percentile of the dose distribution.

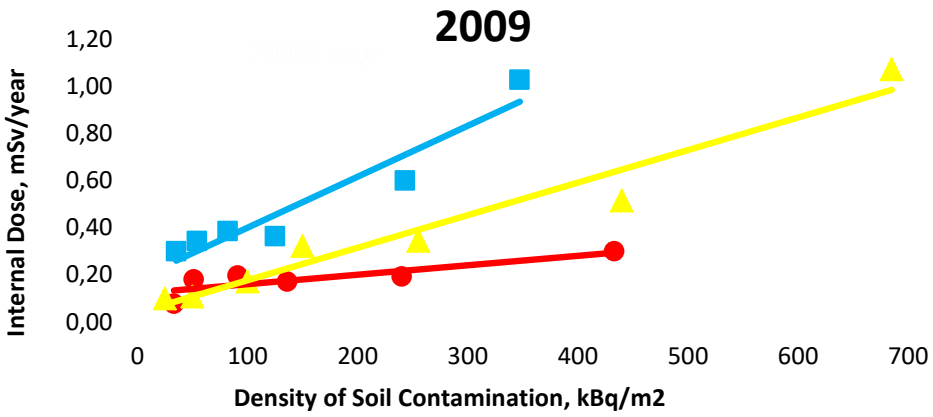
Share of other percentiles of dose distribution corresponding to the dose of a representative person is significantly low.

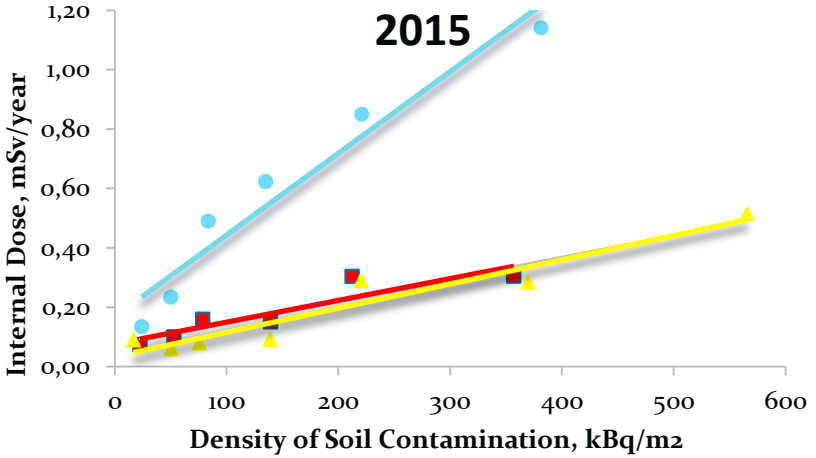
Share of settlements for which the internal dose of a representative person corresponds to the 95th percentile of the dose distribution was only 2%.

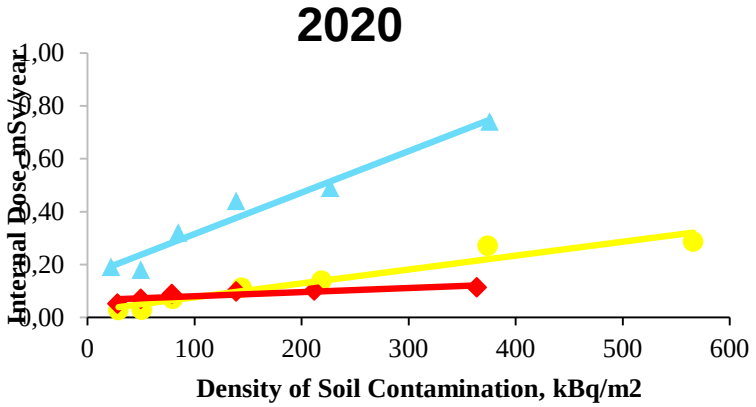
It is obvious that only 3% of the residents of the settlement will have an dose higher than that corresponding to the 97th percentile of the internal dose distribution in the settlement.

The weighted average ratio of the dose of a representative person to the average dose of the inhabitants of this settlement in whole is 4.

INTERNAL DOSE VS. SOIL CONTAMINATION

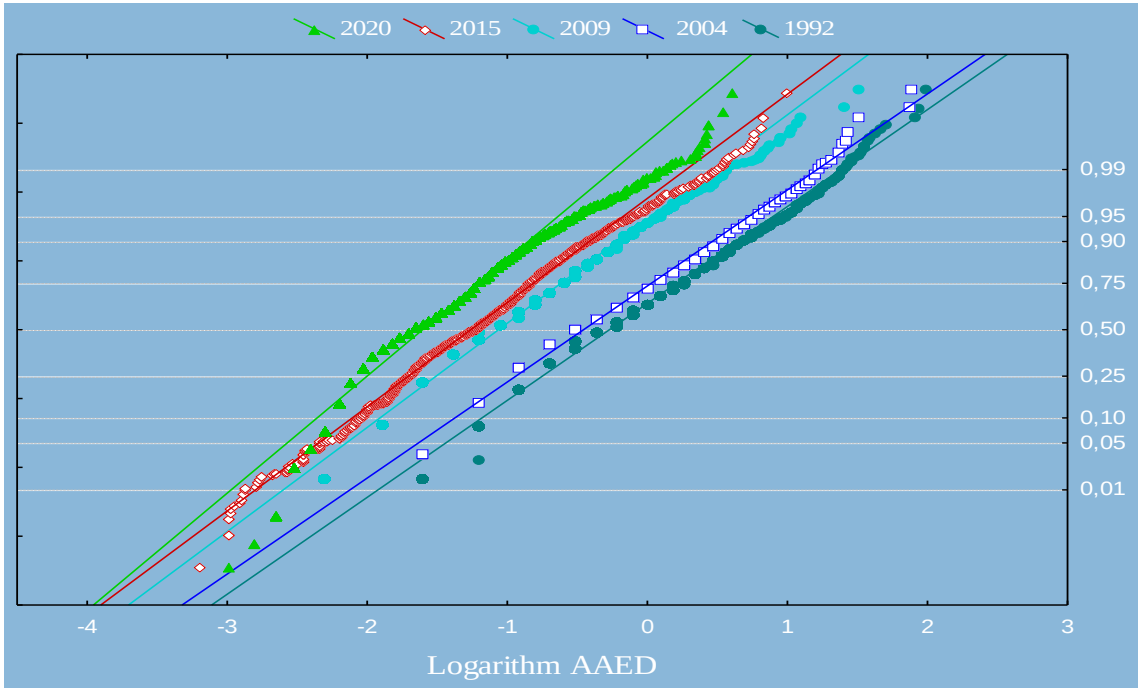






Region	Correlation Coefficient			Prediction error, %		
	2009	2015	2020	2009	2015	2020
Polesje	0,98	0,87	0,96	45	30	21
Center	0,91	0,91	0,86			
North-East	0,92	0,95	0,96			

AVERAGE ANNUAL EFFECTIVE DOSE DISTRIBUTION



Parameter	AAED				
	1992	2004	2009	2015	2020
Average, mSv/year	0,99	0,83	0,46	0,34	0,25
Median, mSv/year	0,70	0,59	0,35	0,25	0,19
Standard Geometric Deviation	2,01	1,99	1,83	1,83	1,80

NUMBER OF SETTLEMENTS AND POPULATION IN WHICH DOSE EXCEEDED AND IS EQUAL 1 mSv/year

Dose, mSv/year	Region	2015		2020	
		Number of Settlement	Number of Population	Number of Settlement	Number of Population
>1	Brest* Gomel Mogilev	**78**	**20 157**	**29**	**2261**
=1	Gomel	**4**	**932**	**5**	**145**
≥1		**82**	**21 089**	**4**	**2406**

*Only in 2015 year

IMPLEMENTATION

The Catalogue of Average Annual Effective Dose of residents of Belarus, along with the density of soil contamination of the settlements was the basis for the Decree of the Council of Ministers of the Republic of Belarus for classification of the settlements by zones of radioactive contamination.

It is actual for the period 2021 - 2025 years

THANK YOU