UDC 631.438.2:631.95:633.2.03:637.07
DOI https://doi.org/10.32846/2306-9716/2025.eco.5-62.1.26

THE PROSPECTS OF USING NATURAL MEADOWS CONTAMINATED WITH ^{137}CS AS A FEED SOURCE FOR FATTENING YOUNG LIVESTOCK

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Despite the passage of nearly four decades since the incident at the Chernobyl Nuclear Power Plant, a substantial area of radioactively contaminated land persists beyond the designated exclusion zone, where agricultural production is strictly prohibited. Research conducted over the past decade has demonstrated that the radiological situation on arable land enables the production of agricultural products with a level of radioactive contamination that complies with existing state safety standards. Natural land, typically utilised for the grazing of cattle in private sector enterprises, has been identified as a potential source of additional radionuclides in livestock products and, through the products, into the human body. In light of the findings from the evaluation of the present radiological condition of natural pasturelands contaminated with radionuclides in the Narodychi united territorial community of the Korosten district in the Zhytomyr region, which have been rendered unsuitable for use in accordance with the Law of Ukraine 'On the Legal Status of Territories Affected by Radioactive Contamination as a Result of the Chernobyl Disaster', the potential for the rational utilisation of pastures for the fattening of young cattle was contemplated. This contemplation was informed by the example of natural lands situated in the vicinity of the settlement of Novy Dorogin. In light of the disparate distribution of radioactive contamination within the designated area, a challenge has been identified with regard to the procurement of beef that surpasses the prevailing state standards for ^{137}Cs content. Utilising the three-stage technology for fattening young cattle with grazing on different areas of pasture land with varying levels of radioactive contamination, in conjunction with a mathematical model that accounts for changes in intake parameters and the removal of radioactive caesium from cattle of different age groups, allows for the assurance, with 90% certainty, of meat products with a level of radioactive contamination below the stipulated state hygiene standards. The proposed approach is universally applicable and facilitates the prediction of the level of radioactive contamination of animal products outside the exclusion zone. This is achieved by leveraging the patchiness of radioactive contamination of the territory, a characteristic feature of the post-Chernobyl situation. *Key words:* radioactive contamination density, ^{137}Cs, fattening for meat, young cattle, forecast of ^{137}Cs content in meat.

Перспективи використання забруднених ^{137}Cs природних луків у якості кормової бази при відгодівлі молодняку худоби. Хомутінін Ю.В., Лазарєв М.М., Левчук С.Є., Косарчук О.В., Іллєнко В.В., Лазарєв Д.М.

Не дивлячись на те, що після аварії на Чорнобильській атомній станції пройшло майже 40 років, за межами зони відчуження залишаються десятки тисяч гектарів радіоактивно забруднених територій, де заборонено аграрне виробництво. Дослідженнями за крайні 10 років доведено, що на орних ґрунтах радіологічна ситуація дозволяє виробляти сільськогосподарську продукцію з рівнем радіоактивного забруднення відповідно до існуючих вимог державних нормативів. Природні угіддя, що використовуються, зазвичай, для випасання великої рогатої худоби приватного сектору, з точки зору радіологічного благополуччя часто є джерелом додаткового надходження радіонуклідів у продукцію тваринництва і через продукцію в організм людей. На основі результатів оцінки поточного радіологічного стану забруднених радіонуклідами природних пасовищних угідь Народицької об'єднаної територіальної громади Коростенського району Житомирської області і вилучених з використання відповідно до Закону України «Про правовий режим території, що зазнала радіоактивного забруднення внаслідок Чорнобильської катастрофи» розглянуто можливість раціонального використання пасовищ для відгодівлі молодняку великої рогатої худоби м'ясного напрямку на прикладі природних угідь навколо населеного пункту Новий Дорогинь. Враховуючи не рівномірність радіоактивного забруднення території існує проблема отримання яловичини з перевищенням вимог існуючих державних нормативів на вміст ^{137}Cs. Використовуючи раніше запропоновану триетапну технологію відгодівлі молодняку великої рогатої худоби з випасанням на різних, за радіоактивним забрудненням, ділянках пасовищних угідь і використанням математичної моделі, що враховує зміни параметрів надходження і виведення радіоактивного цезію з організму великої рогатої худоби різних вікових груп, можна, з 90% вірогідністю, гарантувати отримання м'ясної продукції з рівнем радіоактивного забруднення нижче за вимоги існуючих державних гігієнічних нормативів. Запропонований підхід є універсальним і дозволяє прогнозувати рівень радіоактивного забруднення тваринницької продукції на території за межами зони відчуження, використовуючи характерну для постчорнобильської ситуації, плямистість радіоактивного забруднення території. *Ключові слова:* щільність радіоактивного забруднення, ^{137}Cs, відгодівля на м'ясо, молодняк великої рогатої худоби, прогноз вмісту ^{137}Cs в м'ясі.

Analysis of research and publications. The utilisation of land contaminated with radionuclides, which has been decommissioned in the zone of unconditional (mandatory) resettlement (ZUB(O)V), and the resolution of its re-use are becoming increasingly pertinent due to the temporary loss of substantial areas of agricultural land in eastern and southern Ukraine. A further issue within the domain of agricultural radiology pertains to the utilisation of radioactive contaminated natural meadows within the Ukrainian Polissya region. In the Recommendations of the Ukrainian Scientific Research Institute of Agricultural Radiology [1, 2], one potential solution to this problem is proposed. This solution involves the use of radionuclide-contaminated natural meadows as a feed base for livestock when fattening young cattle for meat.

Technologies for the management of beef cattle that are scientifically substantiated and which take into account the patterns of ^{137}Cs metabolism in the animal's body enable the utilisation of natural meadows that are contaminated with radionuclides for the fattening of young cattle for meat. The Recommendations [1, 2] propose a three-stage technology for fattening cattle for meat, which allows, at the first stage of fattening (from 6 to 12–16 months), the use of feed with any level of radioactive contamination that can be obtained in areas contaminated with radionuclides outside the immediate vicinity of the Chernobyl Nuclear Power Plant. In the second intermediate stage of fattening, the use of fodder contaminated with a level of radioactive contamination of approximately 1000 Bq/kg of grass at natural moisture content is recommended. The second stage of fattening can last 1–2 months, depending on the timing of the sale of the animals. The third stage of fattening, contingent upon the degree of radioactive contamination experienced by the animals, can extend over a period of 30–60 days. This stage involves the administration of a diet whose radioactivity for ^{137}Cs should not exceed 5 kBq/per ration. This approach is designed to facilitate the reduction of the ^{137}Cs activity concentration in the muscle tissue of the animals below the stipulated requirements of Permissible Levels 2006 (PL-06) prior to slaughter (Order of the Ministry of Health of Ukraine No. 256).

In order to predict the concentration of radionuclides in cattle meat, it is necessary to consider the concentration ratio (CR), which is defined as the ratio of the ^{137}Cs activity concentration in meat and daily diet, expressed in the same units [3]. It is important to note that the CR depends on the age of the animals. This study utilises a modelling approach to elucidate the dynamics of ^{137}Cs content in the muscles of young cattle (18–20 months of age) during the process of fattening for meat. The modelling process incorporated data pertaining to the ^{137}Cs contamination parameters of natural meadows and pastures situated within the Norin River floodplain, in the vicinity of the village of Novy Dorogin. The period spanned from May to October, coinciding with the peak grass growth season. The following features will be taken into account: the intake of caesium into the body of young cattle depends on the age of the animals; the daily content of ^{137}Cs in the animals' diet is not a constant value. This is primarily attributable to the heterogeneity of pastures ^{137}Cs contamination [4].

Materials and Methods. The process of radionuclide uptake into the animal body is described in detail in the following publications: B. Prister et al. (1991, 1998, 2007, 2008), Khomutinin et al. (2022), R.S. Russell (1966) and I. Gudkov et al. (2017) [1–7]. In the context of radionuclide ^{137}Cs uptake with a daily diet, the available studies consider two options: a single uptake and a daily (constant) uptake of ^{137}Cs with a daily diet.

In the work of E. Spirin (2022), a two-compartment mathematical model of the uptake and excretion of ^{137}Cs from the body of cattle during chronic consumption of ^{137}Cs-contaminated feed is proposed [8]. This model takes into account the dependence of the ^{137}Cs absorption coefficient on the age of the animals.

In the present case, where grazing animals are present on natural meadows contaminated with ^{137}Cs, the initial conditions are found to be wholly different. The mean daily uptake of ^{137}Cs into the bodies of the animals is not significantly constant. This phenomenon can be attributed to the variability of the ^{137}Cs content in the components of the daily diet, particularly in meadow grasses. The long-term variability of the ^{137}Cs content in these grasses following the Chernobyl accident is predominantly influenced by the heterogeneity of soil contamination with ^{137}Cs and local variations in soil properties [4]. Consequently, in this instance, the ingestion of ^{137}Cs by animals through their diet can be regarded as a daily uptake of radioactive ^{137}Cs, at least in principle. In this case, the overall process of ^{137}Cs uptake into the muscle tissue of animals $\boldsymbol{C_м(t)}$ consists of two components: $C_м^0$ – the initial content of ^{137}Cs in the muscle tissue of animals (activity concentration prior to grazing) and $\Delta C_м^i(t)$ – daily uptake of ^{137}Cs radioactivity in animal muscle tissue due to the ***i***-th day of grazing on radioactively contaminated pasture. It is also hypothesised that the metabolism of each daily component (portion) of ^{137}Cs that enters the body of animals occurs independently.

According to the works [3, 5–7], the dynamics of the specific content of ^{137}Cs in cattle meat with a single uptake is described by the model:

$$C_м(t) = \begin{cases} C_{\max} \cdot \left(1 - e^{-\frac{0.693 \cdot t}{T_{1/2}^{н}}}\right) & t < t_{\max} \;; \\ C_{\max} \cdot \left(\alpha \cdot e^{-\frac{0.693 \cdot (t - t_{\max})}{T_{1/2}^{в,1}}} + (1-\alpha) \cdot e^{-\frac{0.693 \cdot (t - t_{\max})}{T_{1/2}^{в,2}}}\right) & t \ge t_{\max} \end{cases} , \quad (1)$$

where

$$C_{\max} = \left(CR \cdot A_{day} + C_0\right) \cdot \left(\alpha \cdot e^{-\frac{0.693 \cdot (t - t_{\max})}{T_{1/2}^{в,1}}} + (1-\alpha) \cdot e^{-\frac{0.693 \cdot (t - t_{\max})}{T_{1/2}^{в,2}}}\right);$$

$\boldsymbol{C_0}$ – initial concentration of ^{137}Cs in animal meat, Bq/kg; $\boldsymbol{t_{max}}$ – time when the maximum activity concentration of ^{137}Cs in animal meat is reached after a single intake (day); $T^{н}_{1/2}$ – the period of half-accumulation of ^{137}Cs in animal meat after a single intake (day); $T^{в,1}_{1/2}$, $T^{в,2}_{1/2}$ – first and second periods of ^{137}Cs excretion from the animal body (day); $\boldsymbol{\alpha}$ – the fraction of ^{137}Cs released from $T^{в,1}_{1/2}$; $\boldsymbol{t}$ – time after the start of grazing of livestock on radioactive contaminated pasture (days).

In the work [3], it is recommended to use the CC (concentration coefficient), a value related to the CR (concentration ratio), to predict the specific content of radionuclides in animal organs and tissues when they are ingested once with feed. In this instance, the concentration of ^{137}Cs in an organ is expressed as a percentage of the amount that entered the gastrointestinal tract (GIT) [3, 7].With a single uptake, $\boldsymbol{C_{max}}$ is proportional to the amount of ^{137}Cs entering the GIT (in our case the daily amount $\boldsymbol{A_{day}}$, Bq/day): $\boldsymbol{C_{max} = CC \cdot A_{day}}$. The value of CC ($\boldsymbol{C_м(t)/A_{day}}$) is contingent on the age of the animals being fattened. As demonstrated in the works [2, 5, 7], the value in question is 0.35% for animals fattened for 90 days and 0.11% for animals fattened for 3600 days of the single uptake (daily uptake). The ^{137}Cs concentration in muscle tissue was measured on the first day after the animals had been exposed to the radionuclide. In this study, the change ($\boldsymbol{\gamma}$) in the specified age interval is assumed to be linear in the first approximation: $\gamma = {-0.0024}/{(3600-90)} \cdot (t-90) + 0.0035$, where $\boldsymbol{t}$ – is the age of the animal, representing the number of days. As stated in this study, the age of young cattle at the commencement of the fattening process is considered to be 18–20 months. According to the aforementioned data, estimates of $\boldsymbol{\gamma}$ during the fattening phase are likely to fall within the range of $\boldsymbol{\gamma}$ = 0.00319–0.00308.

The values of model parameters (1) for different organs and tissues are contingent on the age of animals and the type of radionuclides. In accordance with the aforementioned parameters, the following estimates are made for the parameters describing the accumulation of ^{137}Cs in the muscle tissue of cattle under conditions of a single uptake of ^{137}Cs: $\boldsymbol{t_{max}}$ = 1 day; $T^{н}_{1/2}$ = 0.2 days; $C_0 = CC * A_{day} / 0.969$. The latter will be used in this work when modelling the fattening of young cattle.

In the work [3], the following parameters are given to describe the dynamics of ^{137}Cs excretion from the muscles of adult cattle: $T^{в,1}_{1/2}$ = 3 days; $T^{в,2}_{1/2}$ = 55 days; $\boldsymbol{\alpha}$ – 0.35. In the research conducted by N. Astasheva et al. (1991), the following parameters were utilised to describe the excretion of ^{137}Cs from the meat of young cattle: bull calves (age 18–20 months) – $T^{в,1}_{1/2}$ =11.2 days, $T^{в,2}_{1/2}$ = 36.5 days, $\boldsymbol{\alpha}$ – 0.45; heifers (age 18–20 months) – $T^{в,1}_{1/2}$ = 8.3 days, $T^{в,2}_{1/2}$ = 38.5 days, $\boldsymbol{\alpha}$ – 0.61 [9]. The dynamics of ^{137}Cs excretion from the meat of young cattle are illustrated in Figure 1.

In this study, the average value of the dynamics of ^{137}Cs excretion from the body of young cattle will be utilised in the modelling of animal fattening.

In order to obtain a model that accurately describes the dynamics of the ^{137}Cs content in animal meat, it is necessary to add expression (1) for each day of fattening and subsequently sum the result. The model in question is depicted as follows:

$$C_\Sigma(t) = C_0 \cdot \left(\alpha \cdot e^{-\frac{0.693 \cdot t}{T^{в,1}_{1/2}}} + (1-\alpha) \cdot e^{-\frac{0.693 \cdot t}{T^{в,2}_{1/2}}} \right) + \sum_{i=1}^{n} \Delta C_i(t), \quad (2)$$

where $\boldsymbol{n}$ – days of fattening;

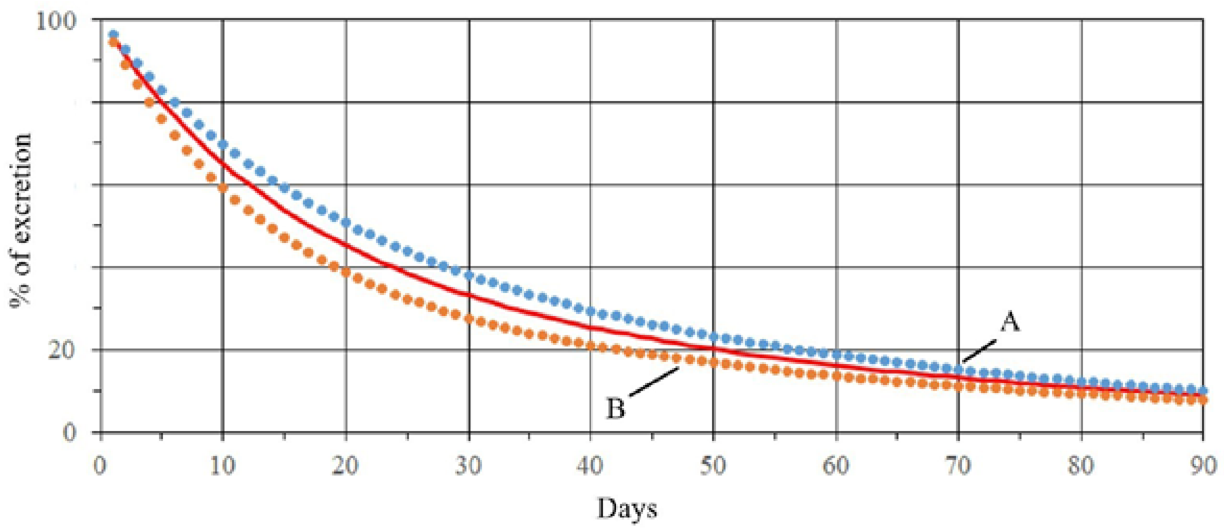

Fig. 1. The dynamics of ^{137}Cs excretion from the meat of young cattle:
••• – bull calves (A); ••• – heifers (B); ▬▬ – average

$$\Delta C_i(t) = \begin{cases} A_{0,i} \cdot \left(1 - e^{-\frac{0.693 \cdot t}{T_{1/2}^{н}}}\right) & t < t_{upt,i} + t_{max} \; ; \\ \Delta C_{max,i} \cdot \left(\alpha \cdot e^{-\frac{0.693 \cdot (t - (t_{upt,i} + t_{max}))}{T_{1/2}^{в,1}}} + (1-\alpha) \cdot e^{-\frac{0.693 \cdot (t - (t_{upt,i} + t_{max}))}{T_{1/2}^{в,2}}}\right) & t \geq t_{upt,i} + t_{max} \end{cases} ;$$

$\Delta C_{max,i}$ – addition of ^{137}Cs content in animal meat after the i-th day of fattening;

$t_{max,i}$ – time corresponding to the maximum value of ^{137}Cs content in animal meat for the i-th fattening component (day);

$t_{upt,i}$ – time corresponding which ^{137}Cs uptake the animal's body (day).

Expressions (1) and (2) facilitate the modelling of the dynamics of ^{137}Cs content in cattle meat in instances of both single and chronic uptake by animals across a range of feeding regimens.

As demonstrated in Figure 2, the dynamics of ^{137}Cs content in the meat of young cattle (aged 3 months at fattening) are illustrated, following chronic and single uptake into the animal's body for a fattening diet, in accordance with the recommendations of B. Prister et al. (2007) (uptake with a diet of 2 kBq/day) [2]. This information was obtained using models (1) and (2). As demonstrated in Figure 2, there is a strong correlation between the dynamics of ^{137}Cs content in animal meat as determined by the proposed models and the extant literature data presented in the work [3]. This finding serves to substantiate the validity of approximating the chronic uptake of ^{137}Cs into the body of animals by a combination of daily single uptakes.

In accordance with the findings [2], the process of fattening animals for meat production can be categorised into three distinct stages: initial, intermediate, and final. The temporal span of each stage is considered arbitrary and is determined by the operator. In this study, it is assumed that the duration of each stage is 30 days. As illustrated in Table 1, the feeding rations for young cattle with an initial age of 540 days (18 months) have been determined based on the recommendations [2] and the article [4] were utilised in the testing of model 2. It is hypothesised that the initial concentration of ^{137}Cs in animal meat is 100 Bq/kg ($C_м^0$ =100 Bq/kg). The content of ^{137}Cs in natural water in the vicinity of the Narodychi village was taken from the work [4] and recalculated the figures for 2025.

In the context of practical animal husbandry, characterised by either stabling or grazing, the daily uptake of radionuclides exhibits variability and is typically considered a random variable. This random variable follows a log-normal probability distribution, characterised by parameters GM and GSD [3].

As illustrated in Figure 3, the results of modelling the ^{137}Cs content in the meat of young cattle were obtained, with the feeding rations given in Table 1 being taken into account, and the statistical characteristics of the ^{137}Cs content in the diet components being considered. It is imperative to consider the daily variability of ^{137}Cs content in diet components in order to derive a set of random functions (possible realizations) that accurately describe the dynamics of ^{137}Cs content in the meat of young cattle during the fattening process. Consequently, when determining the ^{137}Cs content in cattle meat, taking into account the daily variability of ^{137}Cs in diet components, it is recommended to employ the median ***Med($C_м$(t))***, the upper ***Max($C_м$(t))*** and the lower ***Min($C_м$(t))*** limits

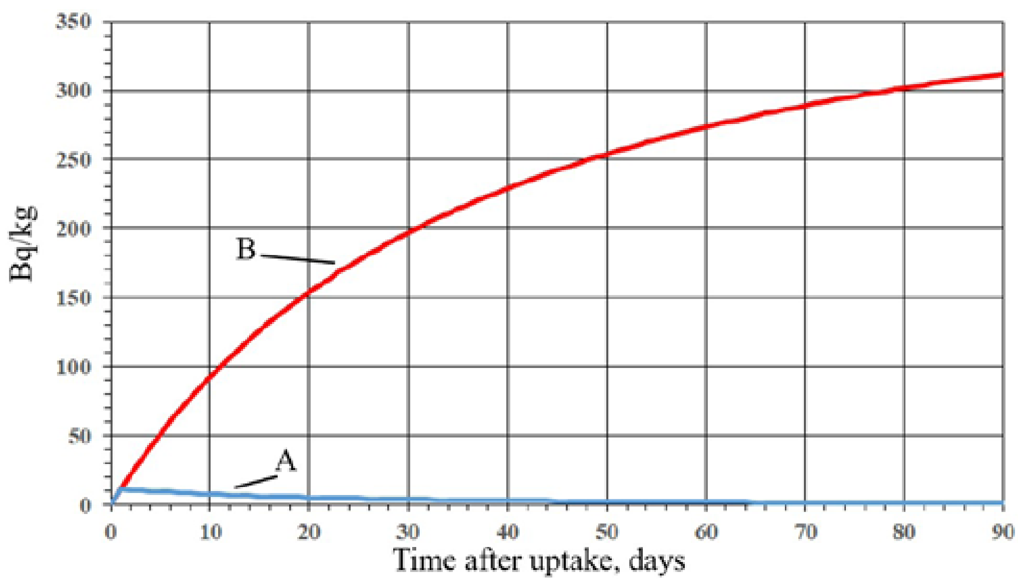

Fig. 2. The dynamics of ^{137}Cs content in animal meat are presented herewith: ▬ the results of a single uptake of ^{137}Cs (only on the first day of fattening)(line A); ▬ a long-term uptake of ^{137}Cs with a daily activity of 2 kBq are obtained using models (1) and (2) (line B)

Table 1

Test diets for fattening young cattle

Fattening period	Dietary component	Quantity, kg(l)	Activity concentration of ^{137}Cs	
			GM, Bq/kg	GSD
Initial	Water for watering	50	0.0048	1.34
	hay	4	740	2.2
	silage	30	148	2.2
	compound feed	1.3	37	1.8
Medium	Water for watering	50	0.0048	1.34
	hay	3	185	2.2
	silage	25	148	2.2
	compound feed	1.6	37	1.8
Final	Water for watering	50	0.0048	1.34
	hay	3	185	2.2
	silage	20	148	2.2
	compound feed	1.9	37	1.8

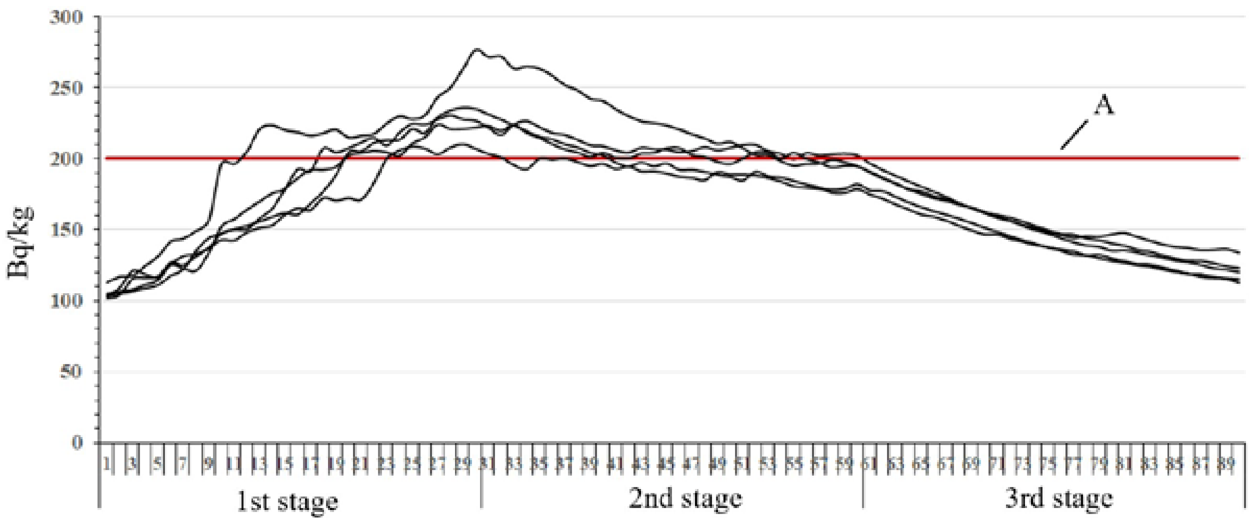

Fig. 3. Dynamics of ^{137}Cs content in young cattle meat: —— permissible ^{137}Cs content in meat (A) [10]

of possible values of ^{137}Cs content in cattle meat at a specified confidence level.

The proposed model (2) facilitates the assessment of the ^{137}Cs content dynamics in the meat of young cattle at varying initial levels, with consideration for potential subsequent daily fluctuations in ^{137}Cs content within dietary components, and accounting for the growth of cattle. Furthermore, it facilitates the adjustment of the daily feed ration of animals with respect to both the contamination of diet components with ^{137}Cs and their nutrient content. Furthermore, model (2) enables the consideration of the daily variability (i.e. random nature) of the contamination of diet components with ^{137}Cs.

Results and Discussion. The meadows and pastures surrounding the village of Novy Dorogin are situated within the alluvial plain of the Norin River. In 2024, a radiological survey of these lands was conducted. The results of these surveys form the basis of the ^{137}Cs contamination density maps. The division of meadows and pastures into discrete areas is delineated on satellite maps, with the delineation following the boundaries of forests, water bodies, forest plantations and the road network. It is hypothesised that the productivity of all areas is equivalent. As illustrated in Figure 4, the map provides a comprehensive overview of the ^{137}Cs contamination density in meadows and pastures surrounding the village of Novy Dorogin as of 2025, accompanied by the numbering of land plots. As illustrated in Table 2, the density of ^{137}Cs and ^{90}Sr contamination in the soil of each land plot is shown. Furthermore, it delineates the upper limits of contamination density for a confidence level of P=0.9 ($A_{0.9}$, kBq/m^2).

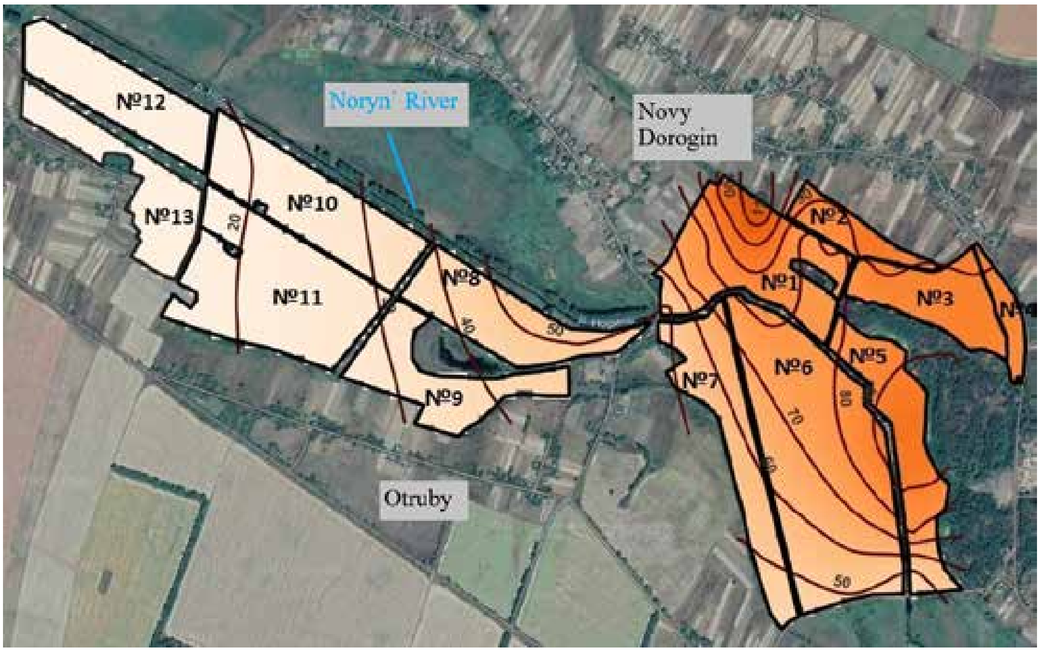

Fig. 4. Density of ^{137}Cs contamination of meadows and pastures near the village of Novy Dorogin as of 2025: – *isolines, kBq/m*^{2}

Table 2

Assessments of radioactive contamination characteristics of meadows and pastures near the village of Novy Dorogin as of 2025

No. of the site	Area, ha	^{137}Cs			^{90}Sr		
		GM, kBq/m^2	GSD	$A_{0.9}$, kBq/m^2	GM, kBq/m^2	GSD	$A_{0.9}$, kBq/m^2
1(H-1)	17.5	83.1	1.47	128.4	1.14	1.90	1.74
2(H-2)	4.3	90.0	1.43	132.6	1.22	1.86	1.80
3(H-3)	9.2	88.2	1.42	129.7	1.21	1.86	1.78
4(H-4)	2.5	88.2	1.42	129.7	1.20	1.86	1.76
5(H-5)	12.3	82.3	1.50	130.5	1.13	1.92	1.74
6(H-6)	33.1	68.0	1.48	105.8	0.96	1.90	1.48
7(H-7)	12.9	55.7	1.45	83.8	0.80	1.88	1.20
8(H-8)	12.0	45.2	1.45	68.0	0.67	1.88	1.00
9(H-9)	10.7	34.5	1.47	53.3	0.52	1.90	0.80
10(H-10)	15.6	24.8	1.50	39.3	0.39	1.92	0.61
11(H-11)	22.4	22.0	1.46	33.4	0.35	1.89	0.53
12(H-12)	12.5	18.4	1.42	27.0	0.30	1.86	0.44
13(H-13)	10.2	17.8	1.42	26.2	0.29	1.86	0.43

The extent to which these meadows and pastures can be used for fattening young cattle in the summer was analysed using statistical modelling. It is hypothesised that young cattle, with an initial age of 540 days (18 months), and a meat contamination level of 200–500 Bq/kg, graze on these areas. In the context of grazing, the ingestion of soil particles by grazing animals is an inevitable consequence of their consumption of meadow grasses. The diet and the amount of daily soil uptake by oral route with meadow grasses are taken from the work [4] and demonstrated in Table 3.

The following section presents the results of a probabilistic forecast of the dynamics of possible values of ^{137}Cs content in the meat of young cattle when fattening using onions and pastures with varying degrees of initial ^{137}Cs contamination. In accordance with the established recommendations, the initial phase encompasses the most contaminated pastures, which have been identified as those with the highest levels of ^{137}Cs contamination. The subsequent phase involves moderately contaminated pastures, while the third and final phase pertains to those pastures that have been found to be least contaminated

Table 3

Test diet for young cattle grazing on natural pastures around the village of Novy Dorogin

№	Dietary ingredients	Quantity	Activity concentration of ^{137}Cs	
			GM, Bq/kg	GM, Bq/kg
1	Water, litres	50	0.0048	1.34
2	Meadow grasses, kg	40	Calculated based on Table 2, converted to natural moisture content with a conversion factor of 1.07.	
3	Soil (air-dry weight), kg	0.8	3.79 (calculated as in the work [4])	
4	Compound feed, kg	2	37	1.8

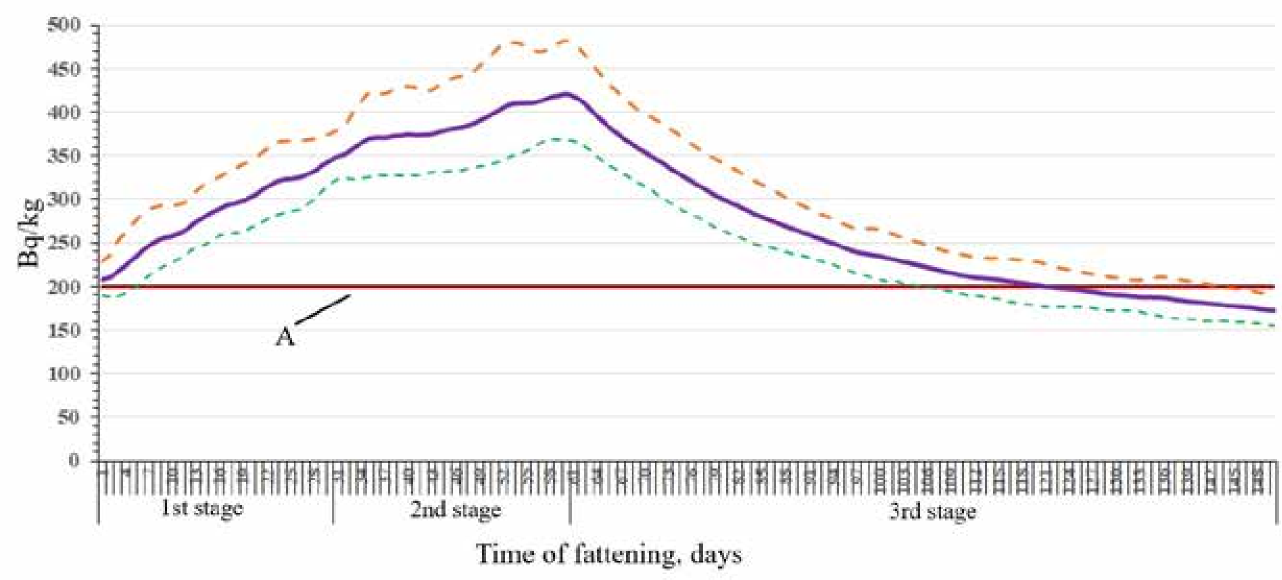

Fig. 5. Forecast of the possible values of ^{137}Cs content dynamics in the meat of young cattle when fattening using sites No. 2, No. 3, No. 11 and an initial content in meat of 200 Bq/kg: ▬▬ permissible level of ^{137}Cs in meat (A) [10]; ▬▬ median of possible values; – – – upper, ----- and the lower limit of possible values for confidence probability 0.9

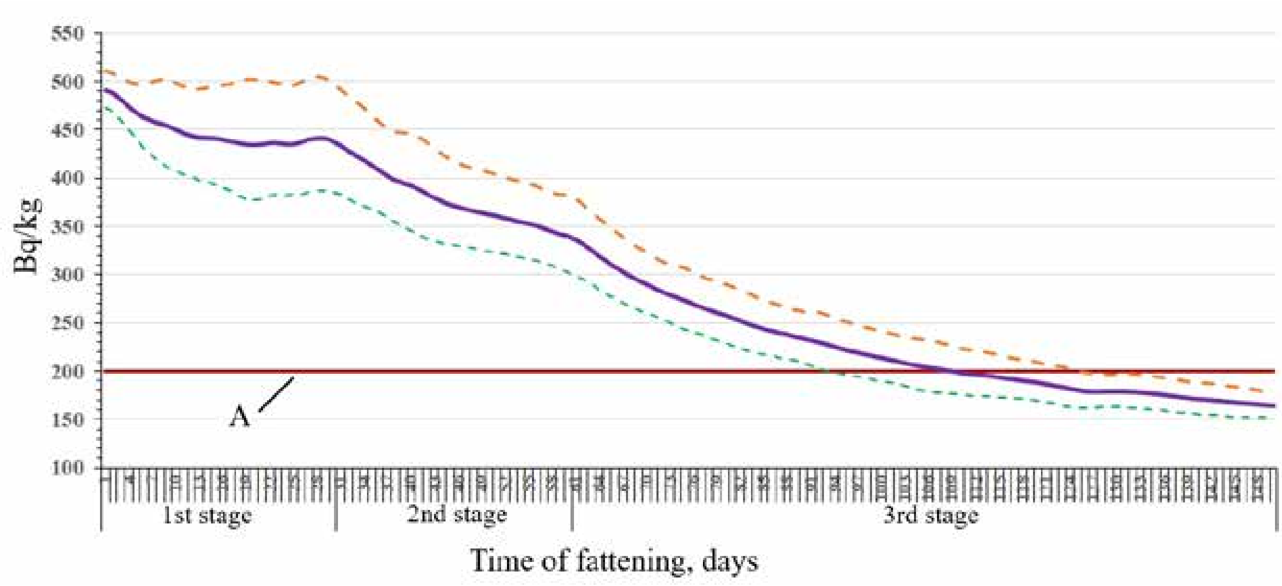

Fig. 6. Forecast of the possible values of ^{137}Cs content dynamics in the meat of young cattle when fattening using sites No. 2, No. 8, No. 11 and an initial content in meat of 500 Bq/kg: ▬▬ permissible level of ^{137}Cs in meat (A) [10]; ▬▬ median of possible values; – – – upper, ----- and the lower limit of possible values for confidence probability 0.9

with ^{137}Cs. As illustrated in Figure 5, the initial stage involved the most contaminated pasture, designated as site No. 2, which exhibited a high concentration of ^{137}Cs. The subsequent stage involved site No. 3, which exhibited a moderately contaminated pasture with ^{137}Cs. The third stage involved site 11, which was identified as one of the least contaminated.

As illustrated in Figure 6, the initial stage involved site No. 2, which exhibited the highest levels of ^{137}Cs contamination of the pasture. The subsequent stage involved site No. 8, which demonstrated moderate ^{137}Cs contamination levels. The third stage involved site No. 11, which exhibited one of the lowest levels of contamination.

Conclusions. A probable model has been proposed for estimating the ^{137}Cs content in the meat of young cattle when feeding them on radioactive contaminated natural meadows and pastures. This model takes into account the animals' daily uptake of ^{137}Cs into their bodies and their subsequent growth. The system facilitates daily monitoring of the ^{137}Cs content in animal meat, thereby enabling the estimation of the median, upper and lower limits of its possible values at a given confidence level.

The utilisation of this method facilitates the selection of diets and the duration of fattening of young cattle, ensuring the maintenance of the non-exceeding of maximum permissible level of ^{137}Cs in animal meat.

The proposed model has been subjected to rigorous testing in order to evaluate the ^{137}Cs content in the meat of young cattle during the fattening process, utilising radioactive contaminated natural meadows and pastures in the vicinity of the Novy Dorogin village. It has been demonstrated that all the meadows and pastures under consideration can be utilised for the fattening of young cattle, while ensuring the non-exceeding of maximum permissible level of ^{137}Cs in animal meat at the end of the fattening process. The duration of fattening on the meadows and pastures under consideration is determined by the initial level of ^{137}Cs in the meat of young cattle and the combination of grazing.

In accordance with the recommendations for fattening young cattle for meat using radioactive contaminated natural meadows and pastures around the Novy Dorogin village, a three-stage technology can be utilised: the first stage – 1 month (sites 1–5); second stage – 1 month (sites 6–9); third stage – 2–3 months (sites 10–13). This is guaranteed (with a confidence level of 0.9) to ensure a level of ^{137}Cs in the meat of young cattle lower than 200 Bq/kg.

Acknowledgements. The study was supported by the National University of Life and Environmental Sciences of Ukraine, the Ministry of Education and Science of Ukraine (Project 110/6-pr-2024 and No. 110/7-pr-2024).

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Дата першого надходження рукопису до видання: 20.10.2025
Дата прийнятого до друку рукопису після рецензування: 28.11.2025
Дата публікації: 15.12.2025