CHAPTER 4
AGRO-INDUSTRIAL PRODUCTION UNDER THE CONDITIONS OF RADIOACTIVE CONTAMINATION

4.1. Radiation situation on the agricultural lands

More than 1,8 million hectares of agricultural fields that makes up 20,8 % of the available area was exposed to radioactive contamination with Cs-137 contamination density over 37 kBq/m^2, including 2,65 thousand km^2 with Cs-137 contamination density over 1480 kBq/m^2, by Sr-90 - more than 111 kBq/m^2, Pu - over 3,7 kBq/m^2 excluded from economic turn-over. The annual incomplete harvest of plant products only from alienated territories is estimated in US$ 69,000,000 and the cost of the left production fund is many times higher.

The agricultural production is conducted on the territory of 13,6 thousand km^2 with Cs-137 contamination density of 37-1480 kBq/m^2 , 4,78 thousand km^2 are simultaneously contaminated by Strontium-90 as well (11-111 kBq/m^2). The most complicated is the organizing of agricultural production on the areas with Cs-137 content - 185-1480 kBq/m^2 (4,20 thousand km^2), 1,13 thousand km^2 are contaminated with Sr-90 with density 37-111 kBq/km^2.

The main areas of contaminated arable and meadow lands are concentrated in Gomel (66 %) and Mogilev (24 %) regions. In Brest, Grodno and Minsk regions their share in the total contaminated area in the republic makes up 4,5, 3,0, and 2,5 % correspondingly.

The system of soil radiation monitoring has been formed and the situation on agricultural lands contamination is verified periodically.

4.2. The radionuclides behavior in soil and their transfer to the plant - growing products

In order to study the radionuclides transfer to plants and work out measures aimed at its reduction the scientific research programme "Agroradiology" has been worked out.

It is established that Cs-137 and Sr-90 vertical migration in soil is very slow. On the uncultivated lands practically all radionuclides are situated in the upper part of the root-inhabited layer of humus horizons (Fig.4.1.). On the arable soils radionuclides are distributed comparatively equal in all the depth of the cultivated layer. In the nearest perspective the self-cleaning of the root-inhabited soil layer at the expense of radionuclides vertical migration will not take place.

At the same time, there are observed processes of local secondary contamination at the expense of radionuclides horizontal migration due to wind and water soil erosion. The radionuclides content in the arable horizon on different relief elements in the result of water erosion on the annual culture sowings have changed 1,5-3 times for 9 years. On permanent sowings of perennial herbs, with absence of hard drainage this effect is not observed (Fig. 4.2.).

In this connection the system of soil-protecting crop rotation and special soil cultivating with periodical deep (up to 40cm) plow footing cultivation is proposed as protective measure. This allows to reduce humus waste and the scales of the secondary contamination of lands.

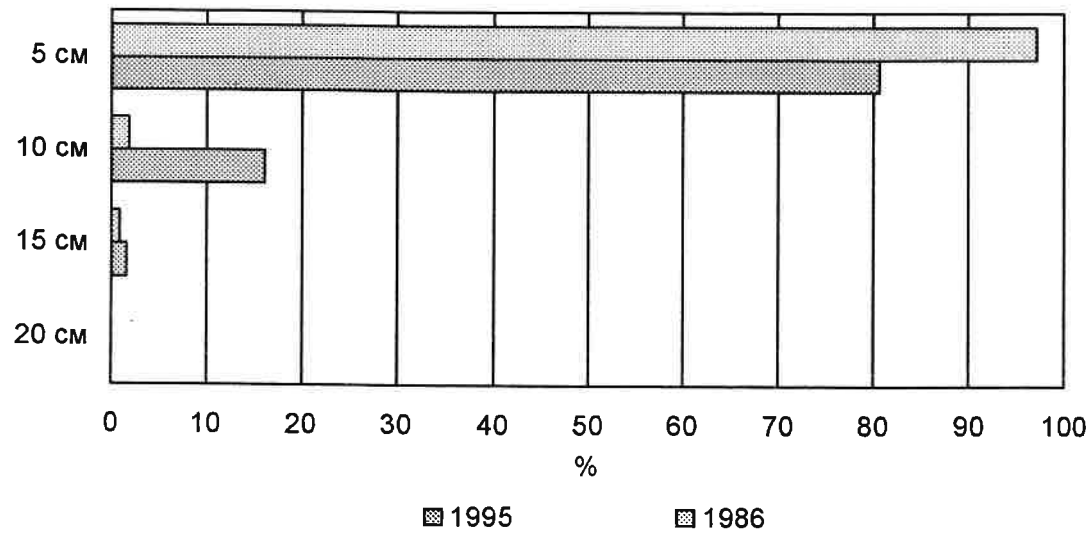

Fig. 4.1. Dynamics of Cs-137 migration by the profile of non-cultivated soddy-podzolic loam soils (% from total content)

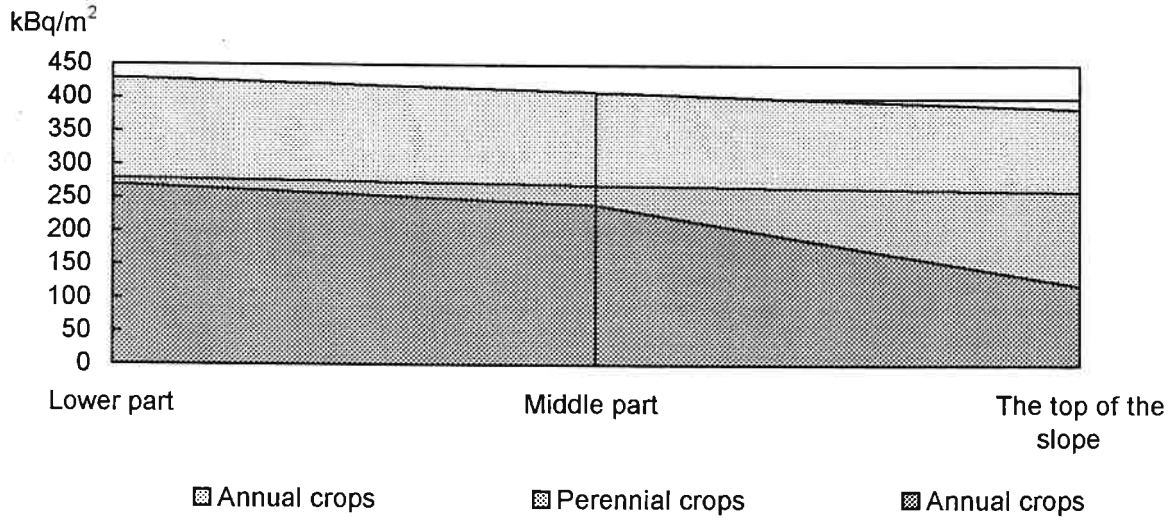

Fig. 4.2. The influence of water erosion on Cs-137 contamination of different relief elements of arable soils (Vetka district), kBq/m^2

The radionuclides availability to plants and the products contamination level depends on Cs-137 and Sr-90 stabilization strength in soil. The radionuclides accessibility degree is estimated by various extracts (Fig.4.3.). Radionuclides forms easily accessible for plants are extracted by water (water-soluble form) and ammonium acetate monomolar solution (exchange form). Migratory radionuclides extracted by 1M HCI, can be partially absorbed by plants but represent their potential accessible reserve. Radionuclides fixed forms are inaccessible to plants and are released only within the 6M processing by HCI solution.

Cs-137 accessibility for plants is reducing considerably in the course of time along with the process of its fixation by soil. For the period 1987-1994 Cs-137 fixed fraction share increased on average more than 2 times and makes up 70-84 % of the total content. For Sr-90, vice versa, a characteristic feature is the prevailing forms easily accessible for plants that make up 53-87 % of the total content and have the tendency to increase on time.

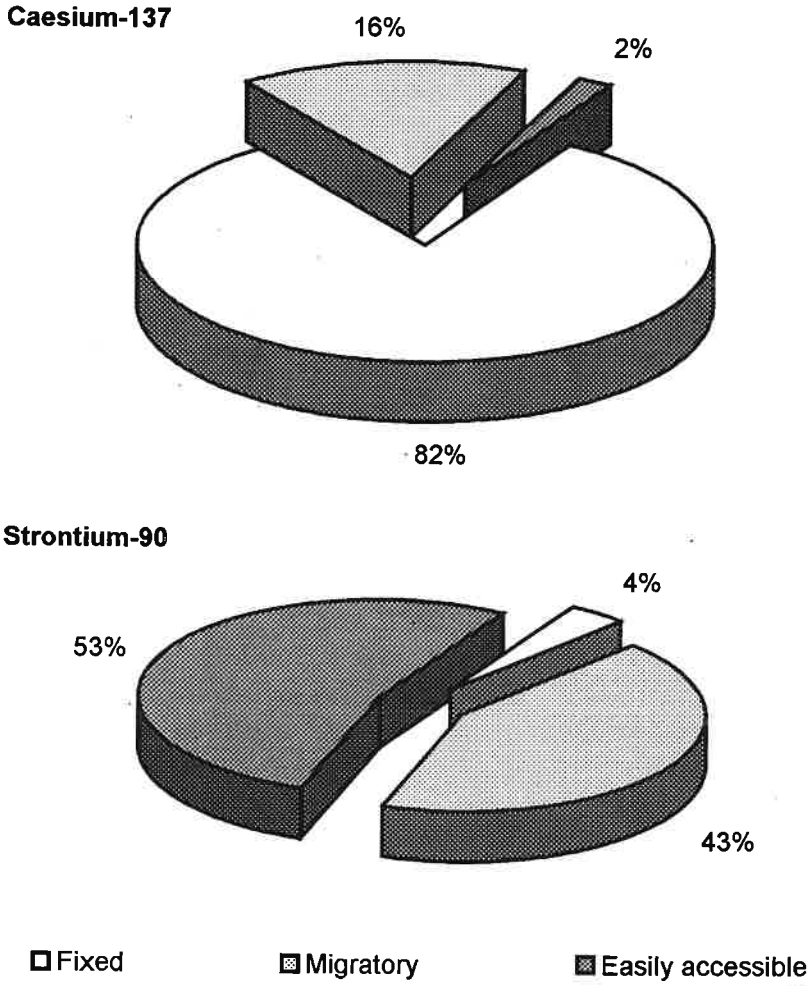

Fig. 4.3. Radionuclides forms of occurrence in soddy-podzolic sandy loamy soil (Narovlya district, 1994)

The radionuclides transfer coefficients from soil into plants are changing on time correspondingly. On average, for the period 1992 - 1994 , in comparison with the years 1986-1988 Cs-137 transfer to cereals and perennial grass hay has reduced 2-4 times and of Sr-90 - vice versa, increased by 7-11 %. To provide agricultural products contamination forecasting it is necessary to check data on the coefficients of radionuclides transfer from soil into the harvest.

Radionuclides content in the agricultural products depends not only on the contamination density but on the soiltypes as well, their granulometric composition, biological peculiarities of the cultivated crops. Soil fertility indices produce considerable effect on radionuclides accumulation by all agricultural crops and especially by perennials. With humus content increase in soil from 1 to 3,5 % radionuclides transfer to the plants is reduced 1,5-2 times and in proportion to the potassium exchange forms content in soil from low (less than 100 mg K_2O per kg of soil) to optimal (200-300 mg/kg) the change in the soil reaction from acid interval (pH 4,5-5,0)

to neutral (pH 6,5-7,0) - 2-3 times (Fig. 4.4., 4.5.).The minimal Cs-137 and Sr-90 transfer into plants is observed upon reaching optimal parameters of agrochemical features of soils.

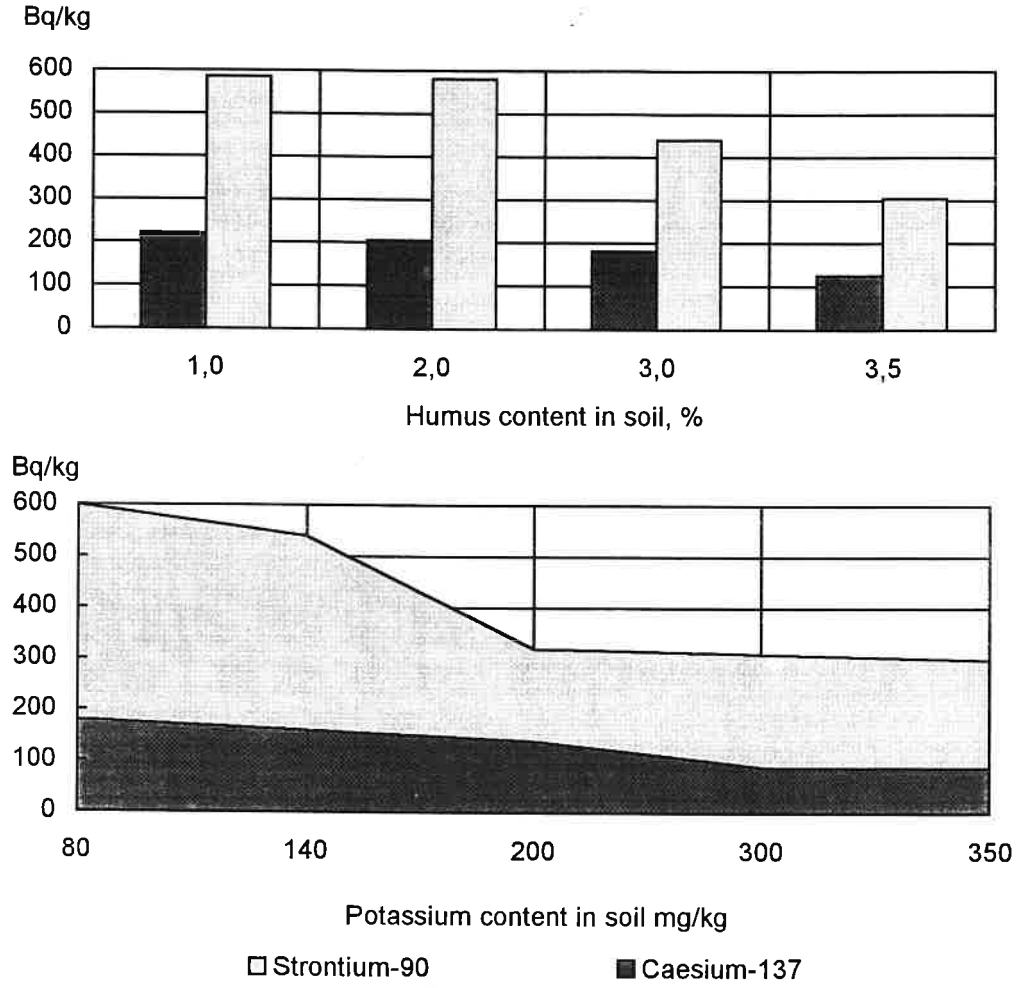

Fig. 4.4. Dependence of radionuclides accumulation in perennial Gramineae hay on the humus and potassium content in soddy-podzolic sandy-loamy soils, kBq/kg (with Cs-137 contamination density of 37 kBq/m^2)

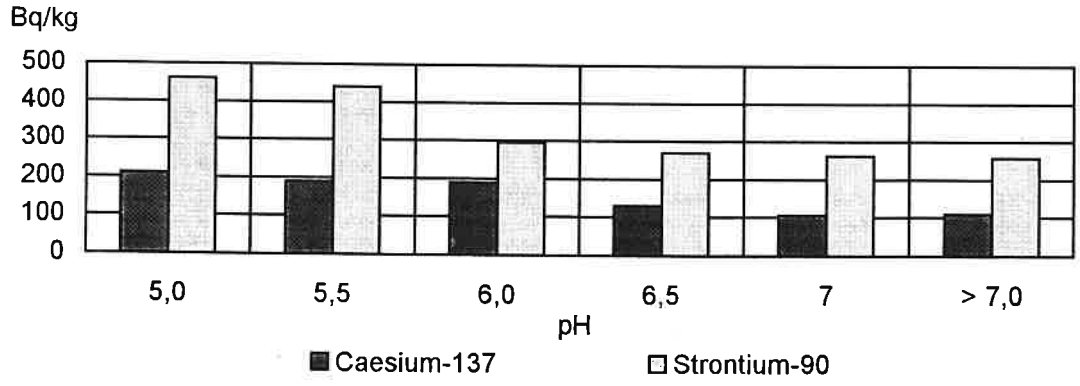

Fig. 4.5. The effect of soddy-podzolic sandy loamy soil acidity on the radionuclides inflow into perennial Gramineae, Bq/kg (with Cs-137 contamination density of 37 kBq/m^2)

The soil humidification regime has a great effect upon radionuclides accumulation in the agricultural products. Radiocaesium transfer to perennial Gramineae is 10-27 times higher on soddy-gley and soddy-podzolic-gley soils in comparison with temporarily excessively moistened (Fig.4.6.).

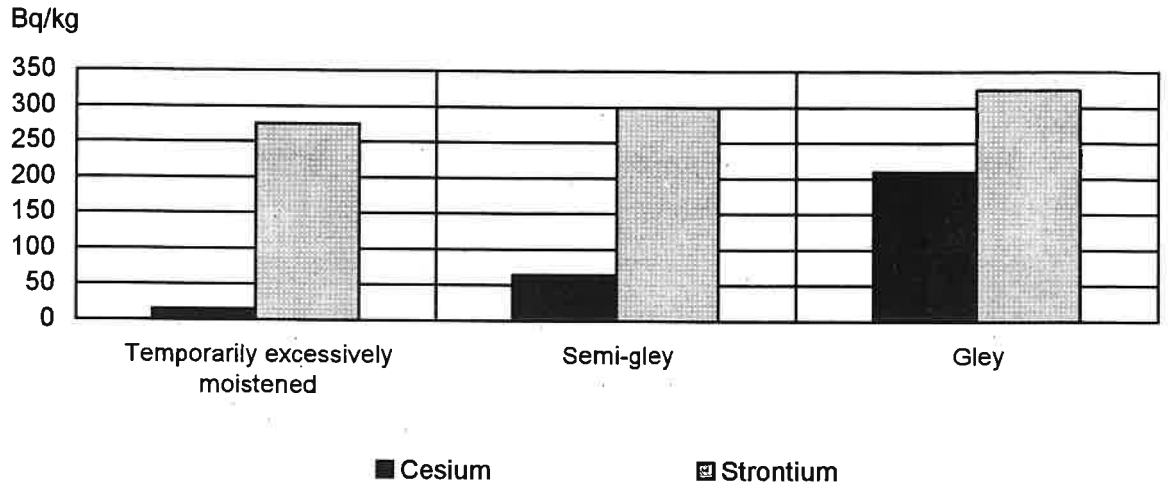

Fig.4.6. The effect of sandy soils humidification regime on the radionuclides transfer to orchard grass hay, Bq/kg (with Cs-137 contamination density of 37 kBq/m^2)

On the water-logged soddy and peaty soils, e.g. in Narovlya and Lelchitsy districts of Gomel region, the high degree of grass fodder contamination is observed even with relatively low radionuclides soil contamination density. At the same time, on the cultivated plots of soddy-podzolic soils (loeslike and fumed loams of Mogilev region) it is possible to receive products with Cs-137 permissible content and with contamination density up to 740-1110 kBq/m^2.

Radionuclides transfer depends significantly on interspecific peculiarities of agricultural crops. Cs-137 accumulation by different plants (taking into consideration dry substance) may vary up to 180 times, and Sr-90 accumulation - up to 30 times with identical soil contamination density. Variety distinctions in the radionuclides accumulation are considerable, though noticeably less (1,5-3 times) that must also be taken into account in the agricultural production on the contaminated lands.

4.3. Methods restricting radionuclides inflow into plants

After the short-lived radionuclides decay the internal component of the dose load on population is mainly determined by Cs-137 and Sr-90 content in food products. In this connection, the main task of the agricultural production on the contaminated territory is the output of products with the given radionuclides content within the permissible levels limits. For this purpose, the complex of special protection measures allowing to reduce the radionuclides concentration in the agricultural products has been worked out. The main of them are:

Selection of cultures. According to radiocaesium accumulation per dry substance unit the following diminishing order has been established: mixed grass of natural hayfields and pastures, lupus, perennial Gramineae, clover, green mass of rape, pea, oats straw, corn green mass, beet,

green mass of annual bean and grassy mixed grass, winter rye straw, oats grain, potatoes, barley straw, winter rye grain, barley grain (Fig.4.7.).

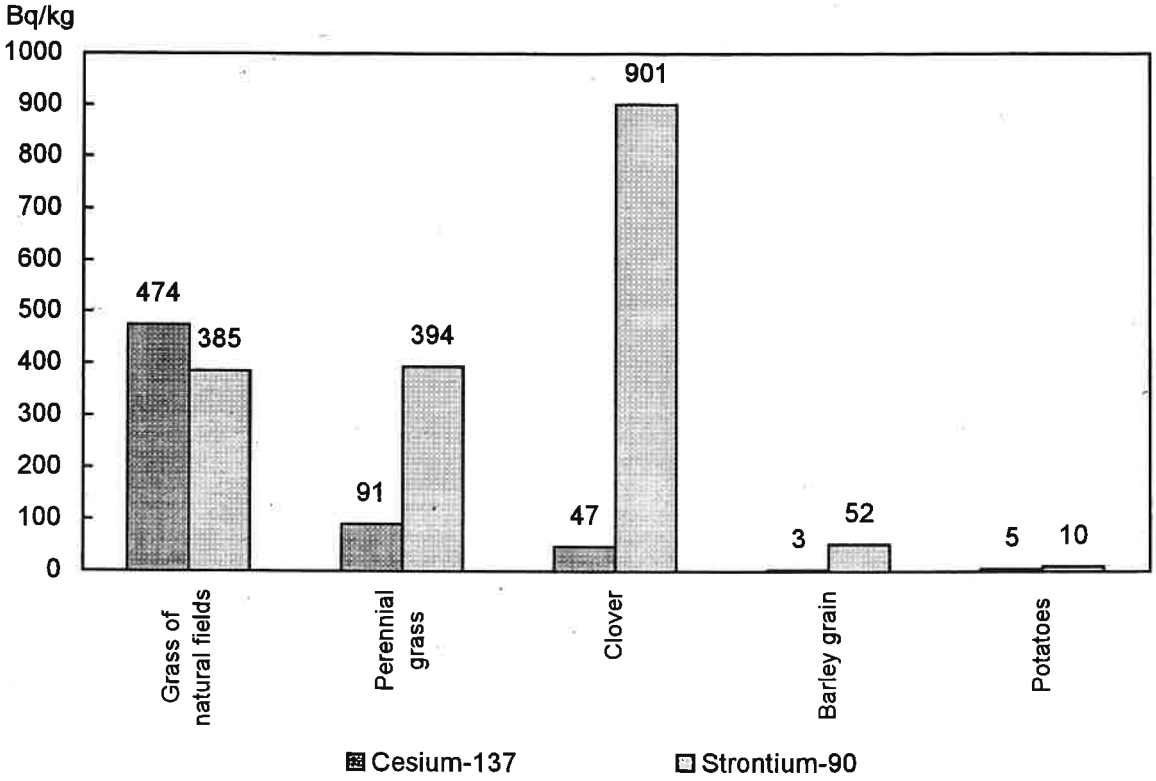

Fig. 4.7. Radionuclides inflow into various crops on soddy-podzolic loamy soils, 1987-1994, Bq/kg (with Cs-137 contamination density of 37 kBq/m^2)

According to Sr-90 content in plants dry substance correspondingly: clover, green mass of peas, rape, lupus, annual bean and grass mixed grass, mixed grass of dry valley hayfields and pastures, perennial grass, barley straw, winter rye green mass, beet, corn green mass, straw of oats and winter rye, grain of barley, oats, winter rye, potatoes.

The established regularities of radionuclides inflow into the products of different cultures are the theoretical basis for re-specialization of plant growing. They have been the base for measures in the first years after the accident (Removal of cultures with high coefficients of radionuclides transfer from crop rotation, the sowing areas structure changes , etc.).

In the republic there are 192 thousand hectares of arable soils with Sr-90 contamination density of 11-37 kBq/m^2, where there are cases of the plant growing products output with radionuclides content over permissible levels. On 113 thousand hectares of soil with contamination density over 37 kBq/m^2 there is observed the increased content of Sr-90 in all kinds of raw forage that are inadequate for skimmed milk production and can be fed to cattle only for meat-production and partially for milk-raw material. It is impossible to receive food grain and potatoes on these lands everywhere.

In this connection, typical crop rotation schemes are worked out depending on the radionuclides soil contamination level and character. The selection of cultures and species with minimal radionuclides accumulation is the most available way of reducing radionuclides penetration from soil into the harvest. At present this method is used in many farms of the contami-

nated zone and especially effective in vegetable-growing and on food potatoes growing at the individual farms contaminated with Sr-90. It is observed that tubers are less contaminated of the following varieties of potatoes: Aksamit, Altair, Sante and Sintez.

Soil cultivation. The soil cultivating system in the radioactive contamination zone is directed to the reduction of erosion processes, reduction of the time of radiation effect on those working in the fields. Meliorative deep plowing that largely reduces the radionuclides penetration into soil (up to 5-10 times) has had limited application under the conditions of Belarus. After the deep plowing the following plowings are done so that their depth is higher than the fixed contaminated layer.

On eroded and erosion-dangerous , compact and temporarily water-logged soils it is necessary to apply deep loosening and slotting. Presowing cultivation must be done by high-productive combined aggregates that provide several operations at a time that allows to reduce external dose loads on machine operators by 30-40 %.

On hayfields and pastures where the contaminated turf was plowed in after the radionuclides fall out the plowing is inadmissible on the repeated sowing to grass. It is necessary to do top milling and rolling with grass or renew herbage by undersowing of herbs to sod. Root and ground improvement of meadow lands is the efficient measure that allows to reduce half as much the radionuclides penetration from soil to perennial herbs

Liming of acid soils. Placement of lime is the effective way of the reduction of Sr-90 and Cs-137 radionuclides penetration from soil into plants. The given way provides the reduction of radionuclides penetration into the harvest within the limits of 1,5-3 times depending on the soil type and acidity degree (Fig.4.8).

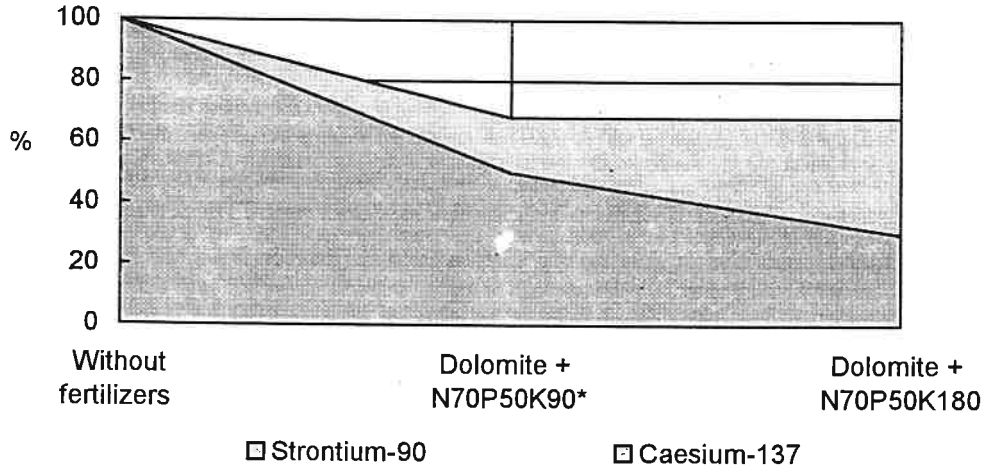

Fig. 4.8. The effect of liming and mineral fertilizers on the radionuclides transition into the hay of perennial Gramineae on peaty-boggy soils (1994)
* Note - doses kg/ha: N - of nitrogen, P - of phosphorus, K - of potassium.

The minimal radionuclides accumulation in the plant-growing products is observed with optimal indices of the soil acidity (pH KCl) that for soddy-podzolic soils make up: argillaceous and loamy - 6,0 - 6,7; sandy-loamy - 5,8 - 6,2; sandy - 5,6 - 5,8; on peaty-boggy and mineral soils of hayfields and pastures the optimal pH indices make up 5,0 - 5,3 and 5,8 - 6,2 correspondingly.

The lime doses are differentiated according to the soil types, granulometric composition, acidity degree and Cs-137 and Sr-90 contamination density.

Fertilizers. Organic fertilizers application reduces radionuclides transition from soil to plants. The study of the action of large pack of meliorants (zeolites, bentonites, clay marl, tripolite, ligno-sulphonate, humin preparations, sapropels, etc.) has shown that Cs-137 and Sr-90 accumulation reduction in the products with their application made up 15-30 %. With small radius of transportation it is possible to apply siliceous and carbonate sapropels in doses of 60-80 t/ha for tilled cultures. With placement of the full dose of the carbonate sapropel the necessity of acid soils liming is excluded. However, liming is economically more effective.

The application of increased doses of potassium fertilizers reduces considerably radiocaesium penetration from soil to plants especially on low in potassium soils (Fig. 4.8.). The recommended doses of potassium fertilizers provide the harvest increase without products quality reduction. Placement of potassium fertilizers is differentiated in relation to the soil type, the metabolic potassium content and radionuclides contamination density.

Phosphorus fertilizers effect the radionuclides penetration reduction from soil to plant products especially on soils with the low content of mobile phosphates. Taking into account the phosphorus fertilizers deficiency and their high cost it is recommended for agriculture on the contaminated territory to provide minimum of phosphorus fertilizers necessary for balanced nourishment of agricultural crops with account of mobile phosphates content in soil.

The important role belongs to the regulation of the nitrogen feeding of plants. With the deficiency of the available nitrogen in soil the harvest reduces and radionuclides concentration in the products slightly increases. On the other part, the increased doses of nitrogen fertilizers reinforce radionuclides accumulation in plants.

For optimization of nitrogen fertilizers doses in the radioactive contamination zone it is necessary to do soil and plant diagnostics. The most effective in the sphere of harvest radionuclides and nitrates contamination reduction are new forms of slow-acting fertilizers - carbamide and ammonium sulphate with humate additives and other biologically active components produced by Grodno PA "Azot". On the Gramineae sowings the application of preparations on the basis of associative strains of nitrogen-fixing bacteria that allows to save 20-40 kg of mineral fertilizers for a hectare of sowing and reduce harvest contamination by 25-50 %.

Microfertilizers also contribute to the radionuclides penetration reduction to the agricultural crops though the mechanism of their action has been studied insufficiently. Minimal doses of microfertilizers in the form of leaf-feeding sprays depending on microelements content in soil and biological features of cultures are recommended. Into soil microfertilizers are placed only with very low content of corresponding microelements.

Protection of plants. Measures on chemical protection of plants from pests, diseases and weeds also lead to radionuclides accumulation reduction in products. The integrated plants protection system allows to reduce by 10-40 % the radionuclides transition to the plant-growing products at the expense of the harvest increase (Fig. 4.9.). This method is especially effective on cultivating potatoes on soils with Sr-90 contamination density over 18,5 kBq/m^2.

Water regime regulation. Reclamation of water-logged lands is an important method of radionuclides content reduction in the agricultural crops harvest. For the majority of peaty and mineral bogged soils minimal absorption of radionuclides by plants is achieved with the level of subsoil waters of 90-120 cm from the soil surface. The subsoil waters ascent, e.g., in the result of the damage of the drainage network up to 35-50 cm from the soil surface leads to the radionuclides accumulation increase up to 5-20 times.

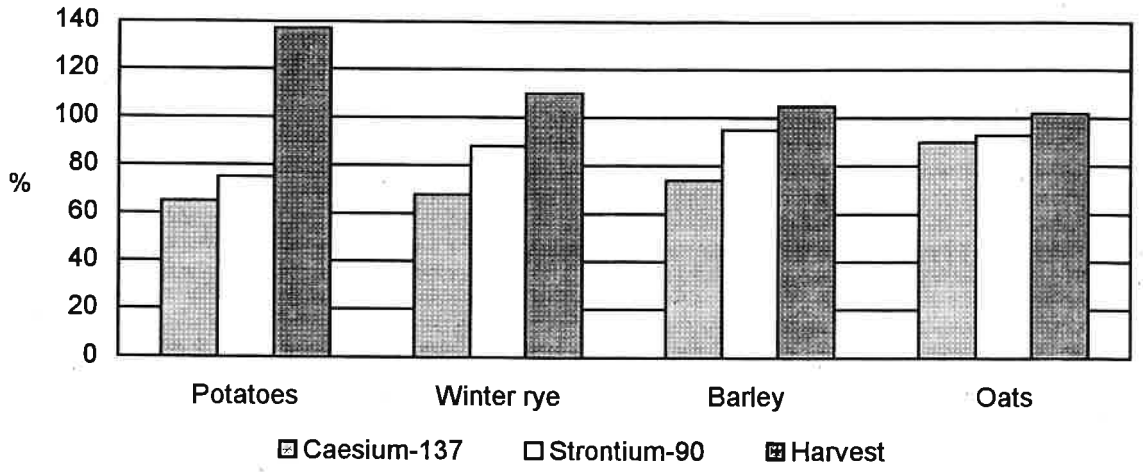

Fig. 4.9. The effect of integrated plants protection system on radionuclides accumulation by the harvest of the main agricultural crops (percent to control, 100 % - without protection, 1992-1994)

4.4. Animal production management. Rations and technologies of forage use

The scale and radioactive contamination degree of the territory by radionuclides determine the difficulties of animal production management. To prevent the production of meat and milk with Cs-137 and Sr-90 content level exceeding the permissible levels it is necessary to take into account the regularities of these radionuclides transition from forage to milk and meat of the cattle, sheep, pigs and poultry.

Cs-137 transition coefficient from daily rations into milk makes up on average 0,01 and Sr-90 - 0,0014 Bq/l/Bq/rat. Radionuclides transition to cattle meat is characterized by coefficients 0,04 and 0,0008 Bq/l/Bq/rat. correspondingly. Radiocaesium transition coefficients from daily rations to meat of pigs and sheep make up 0,25 and 0,15 Bq/kg/Bq/rat. correspondingly. The total radiocaesium content in the ration on receiving unskimmed milk must not exceed 11 kBq per day. Sr-90 - 2,6 kBq and on production of milk-raw material for processing into butter - 37 and 13 kBq correspondingly. On production of beef the total radiocaesium contamination of the daily ration must not exceed 15 kBq.

The technological separation of forage has been recommended depending on their radionuclides contamination degree and the possibility of different products output - unskimmed milk, milk-raw material, meat. For alleviation of the practical use of recommendations there have been calculated the norms of radionuclides permissible content in concrete forage for cattle on the basis of typical rations (Table 4.1.).

For the purpose of meat output corresponding to the food products radionuclides contamination permissible levels the certain scheme of young stock breeding and cattle fattening has been used. So, on the first stage of fattening it is possible to breed young stock on grassy and raw forage with increased radionuclides content. And further, the final fattening must be done that includes cattle keeping for the period of 2-3 months before slaughtering on clean forage or with low radiocaesium content (corn silo or corn green mass and concentrates).

Table 4.1. Permissible radionuclides content in cattle feeds depending on final products, (Bq/kg)

Products	Caesium-137			Strontium-90	
	Unskimmed milk	Milk raw	Meat	Unskimmed milk	Milk raw
Hay	1480	1850	1850	259	1295
Straw	370	925	1110	185	925
Hayforage	740	888	1110	111	555
Silo	296	851	555	56	278
Vegetable root crop	370	888	370	37	185
Grain	370	888	592	111	555
Green mass	185	703	296	37	185

Separate pasturing of milk cows, fattening young stock and forage store must be carried out on the basis of the forecasting of fodder crops contamination depending on soil contamination density.

4.5. Forecasting of agricultural products contamination

The forecasting of agricultural products contamination allows to plan the placement of cultures on crop rotation fields with account of received products use (food purposes, forage, industrial processing, etc.).The forecasting is based on the radionuclides transition coefficients into harvest of different crops, results of radiological and agrochemical investigation of soils in the form of cartograms and agrochemical passports of fields. The forecasting is especially important in the use of pastures for milk herd on Sr-90 contaminated soils (Fig.4.10).

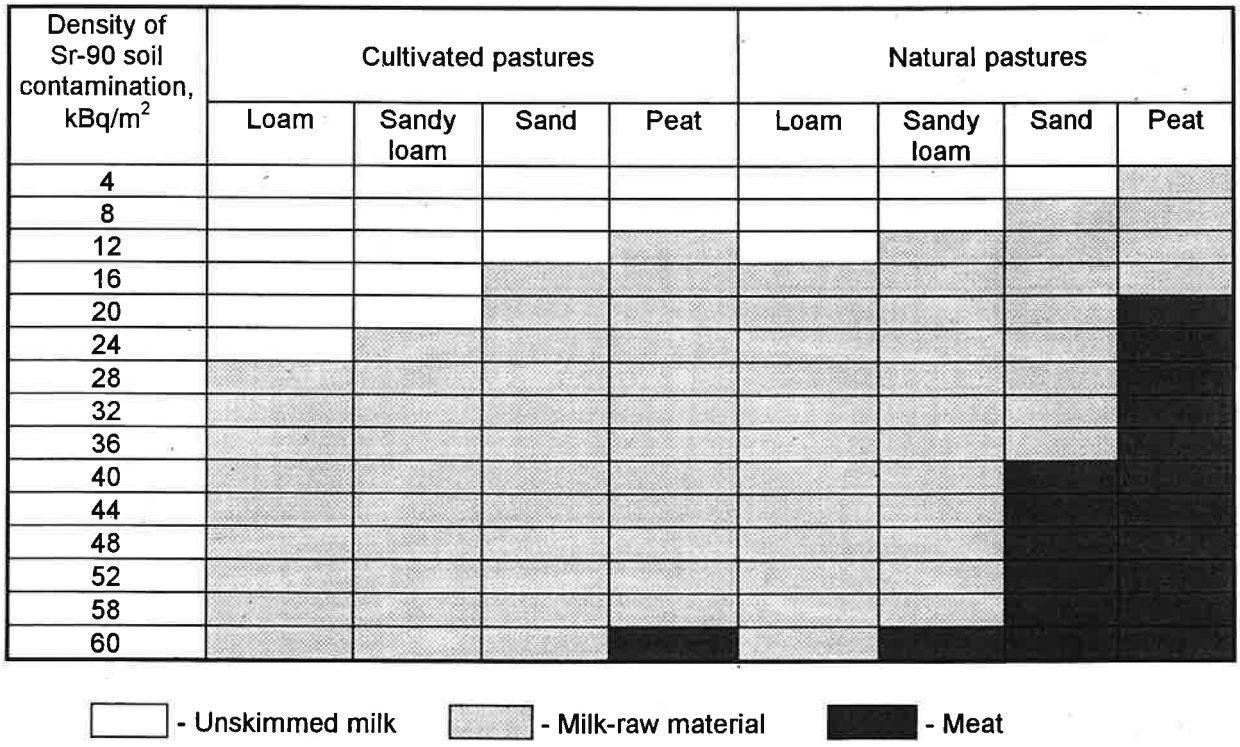

Fig.4.10. The forecasting of the possibility of the animal products output with Sr-90 permissible content depending on soil contamination density

So, with pasturing cows on natural fields unskimmed milk for immediate use can be received with soil contamination density: on loams - not less than 16 kBq/m^2, sandy-loams - 12, sands - 8 and peaty soils - less that 4 kBq/m^2. Milk-raw for further processing can be received with Sr-90 soil contamination density, up to 70, 60, 40 and 20 kBq/m^2 correspondingly. With higher density the cattle can be pastured only for fattening for meat. On the cultivated pastures the permissible Sr-90 soil contamination density for milk herd pasturing increases considerably.

The forecasting of radionuclides content in agricultural crops with account of the peculiarities of each field and cattle farm has been made for farms of 11 most contaminated districts. On this basis projects of protection measures forseeing the 1,8 - 2,0 times reduction of radionuclides penetration into food products have been prepared. The analysis of the projects has shown that forage production in the contaminated zone for milk herd and receiving of unskimmed milk with permissible radionuclides content is possible on 86,6 % of arable lands, 75,4 % of improved hayfields and pastures and 36,3 % of natural meadow lands. On the rest of the agricultural lands at present it is possible to produce forage only for meat production and milk-raw. This underlines once more the leading role of soil cultivation in the reduction of radionuclides accumulation in the products.

In case when cattle is pastured on natural fields when it is impossible to receive milk and meat with Cs-137 permissible content because of the high content in the forage, the introduction of caesium-binding preparations on the basis of Prussian blue into the cattle ration. The application of ferrocyanides together with mixed feed for 40 days in doses from 1,0 to 6,0 per head with radiocaesium content in the daily ration 37 kBq will allow to reduce 4,5 - 6,8 times the radionuclides concentration in the muscle tissue of the cattle on its fattening for meat. The results of the experiment showed also the high effectiveness of ferrocyn in salt lick for reduction of radiocaesium penetration from feed to milk (Fig. 4.11.).

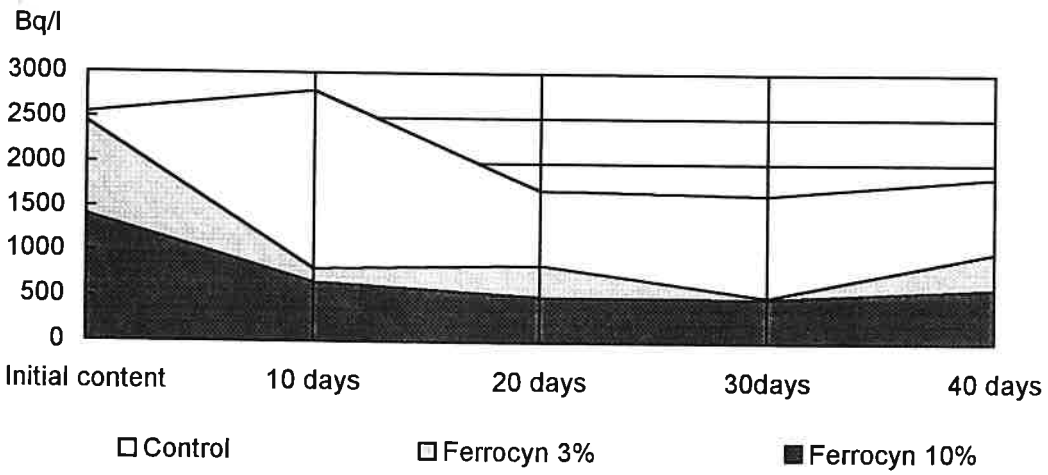

Fig. 4.11. Cs-137 content in milk in the result of use of salt lick pellets with ferrocyanide, Bq/l

In the republic there is organized the output of ferrocyanide preparations intended mainly for cattle in the private sector where natural feed fields are used more often for pasturing. This method allows to reduce radiocaesium content in milk 2-5 times.

4.6. The efficiency of protective measures

In the application of protective measures on the radioactively contaminated areas two stages can be singled out: the first one - 1986-1991 and the second - since 1992 up to present. In the first stage highly contaminated lands where it was impossible to obtain agricultural products with the permissible radionuclides content were excluded from use. Cultures accumulating a lot of radionuclides have been excluded from sowing cycle, liming of acidic soils has been conducted, increased doses of phosphorus and potassium fertilizers have been applied. On swamp sites the drainage and deep turf plowing, sowing to grass and re-sowing of hayfields and pastures has been carried out.

The conducted protective measures allowed to reduce the radiocaesium penetration into agricultural production on average 4 times. As a result production of milk with excess of permissible radiocaesium content in the public sector decreased from 524,6 thousand tons (13,8 %) in 1986 to 22,1 thousand tons (0,7 %) in 1991 and has been practically at this level (0,3 - 0,6 %) in subsequent years (Fig. 4.12.).The quantity of contaminated meat decreased from 22,1 thousand tons (4,3 %) to several tons in 1993-1994. Practically all grain and meat meet the requirements of the republican specifications, however, radionuclides content there exceeds many times the pre-accident level.

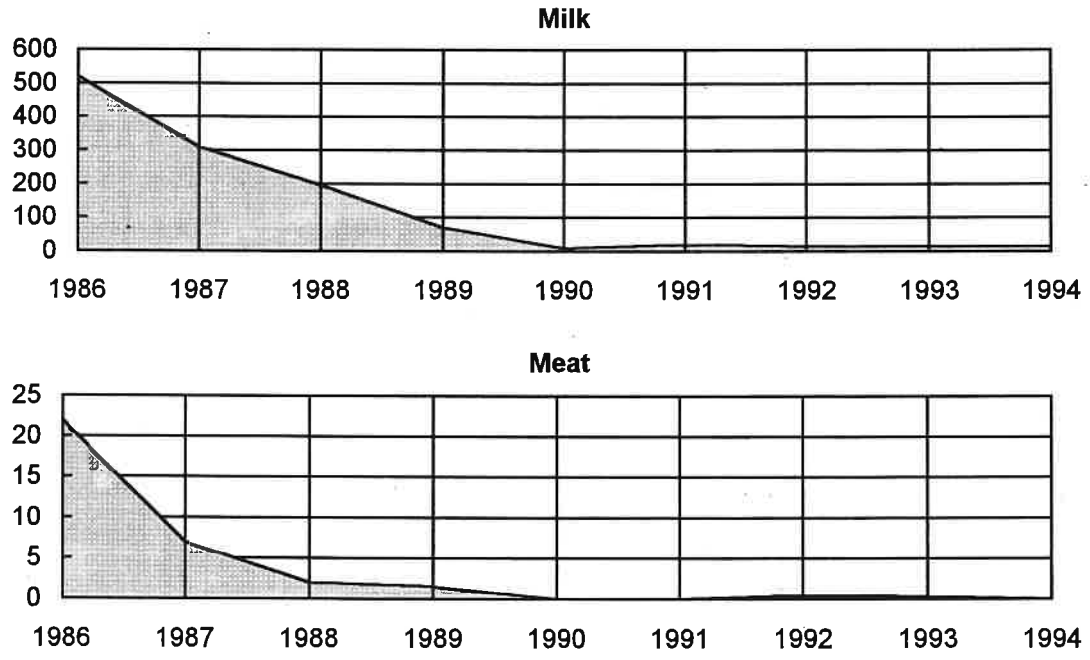

Fig. 4.12. Dynamics of milk and meat production in the social sector of Belarus with radiocaesium content over permissible levels, thousand tons

The radiostrontium penetration into food products has fallen twice for the post-accident period. Although the availability of Strontium-90 for plants still remains high, with a tendency to increase.

Thus, relatively high efficiency of the large-scale protective agricultural measures implemented primarily in the public sector of the republic is obvious. However, a problem of safe residence for population and obtaining food products of high quality is still from being solved.

The major reason is that agriculture has not been allocated sufficient resources for overcoming the catastrophe consequences. Despite a significant volume of already executed work, it is needed to neutralize increased acidity and to improve potassium conditions on the half of meadows and 20 % of arable land. It is necessary to regulate water conditions and improve surface of swamped and underproductive pastures and hayfields where primarily privately owned cattle graze.

Since 1992 the second stage of detailed oriented countermeasures in agriculture with account of the peculiarities of every field and cattle farm has been carried out. Methods of reduction of plants growing products contamination at the expense of mineral feed regulation, bacterial preparations application and new forms of fertilizers are used

In cattle breeding there is envisaged the technological separation of feed depending on their radionuclides contamination degree, rations rating with the use of additives reducing radionuclides content in milk.

There have been worked out the programmes of agricultural production for the farms of 11 the most contaminated districts foreseeing 1,8-2,0 times reduction of radionuclides penetration into the food chain. The Ministry for Emergencies and population protection from the Chernobyl NPP catastrophe consequences for the last years has begun to realize priority financing of agriculture protection measures. However, in connection with the economic crisis the total volume of financing in 1993-1995 has been provided for only 30 % of needs.

For the last three years the volume of works on acid soils liming have been reduced. Practically within 1994 less than a half of the required territory has been limed, this work has slightly improved in 1995 as well. As a result, in every fourth farm of Gomel region there is acidification of soils, and in this connection the increase of radionuclides penetration from soil into forage grass , especially Sr-90 into perennial herbs is possible.

Due to the economic conditions the application of mineral fertilizers has reduced 4 times, organic - by 40 %. This has led to incomplete agricultural crops harvest for one-third, to the loss of soil fertility and the growth of a very dangerous tendency of the increased radionuclides transition to the plant-growing and animal products.

In the radioactive contamination zone there are large massifs of bogged and temporarily water-logged soils that make up 37 percent of all the agricultural lands. About two thirds of the bogged lands have been reclamated for the last thirty years, however, the considerable part of the drainage network needs reconstruction and repair. New meliorative construction has been reduced. In 1994 selective reclamation was planned on the territory of 30,7 thousand hectares but due to the lack of financing meliorative works have been done on the territory of only 6,5 thousand ha. More and more acute is the problem of the secondary swamping of the reclamated lands. With the lack of investments for reconstruction of drainage system in the nearest ten years considerable areas of reclamated lands can be swamped, and the radionuclides transition to grassy feed, milk and meat will many times increase. The maintenance of the drainage system in the working state on the contaminated areas is of great priority and must be under the control of the State.

Particular concern cause the food products quality produced in the private sector. For the last two years in more than 500 settlements there have been periodically registered the cases of milk production with radionuclides content over permissible levels. The specific weight of tests of milk and meat made in individual farms in 1993-1995 not corresponding to the permissible levels made up 10 %. As a whole, in 1991-1995 up to 10-25 % of food tests of local production brought by local residents for control for Cs-137 content exceed permissible level.

In the most affected Khojniki, Bragin, Narovlya and Chechersk districts and in the public sector the considerable part of feed is produced with Cs-137 content exceeding permissible levels. Mainly, (up to 80 %) feed grass contamination is observed on soils with Cs-137 contamination density over 555 kBq/m^2. The share of the produced milk with Cs-137 content over permissible index in 1993-1994 on average in 4 districts made up 11 % (Table 4.2.).

Table 4.2. Production of milk with Cs-137 content over permissible level in the public sector of some districts of Belarus

Districts	Tons produced/population		% from the total quantity of milk	
	1993	1994	1993	1994
Bragin	2167/18799	1491/17828	8,8	9,7
Narovlya	915/11921	730/11465	19,3	20,8
Khojniki	104/24908	416/24523	0,7	2,8
Chechersk	511/18455	815/18050	5,8	8,6
Total	3697	3452	10,7	11,0

Table 4.3. Plant-growing production in the public sector

Districts	1985	1990 in % to 1985	1994 in % to 1985
Grain, thousand tons			
Belarus	5719	122	100
Gomel region	987	107	89
Bragin	57	85	52
Narovlya	21	91	48
Khojniki	41	99	78
Chechersk	41	84	72
Potatoes, thousand tons			
Gomel region	1170	104	114
Bragin	78	36	14
Narovlya	28	24	12
Khojniki	50	42	21
Chechersk	46	63	21
Harvesting from plowed field, c/ha per unit			
Belarus	37,4	122	85
Gomel region	40,0	110	77
Bragin	41,4	116	72
Narovlya	36,4	122	58
Khojniki	42,6	115	86
Chechersk	41,1	103	71
Harvesting from meadows, c/ha per unit			
Belarus	18,7	108	88
Gomel region	19,5	109	80
Bragin	23,4	97	68
Narovlya	14,5	120	59
Khojniki	21,6	111	75
Chechersk	20,6	110	59

The economic crisis has aggravated the Chernobyl catastrophe consequences in Belarus. Even with the permissible radionuclides comment the agricultural products for the last years often become non-competitive. The crisis phenomena to greater extent have been revealed on the contaminated areas. Before 1990 the agricultural production did not decrease in comparison with the pre-accident 1985. The reduction of grain and potatoes production in the most affected regions is connected only with the alienation of lands, the productivity of plowed fields and meadows even grew higher. (Table 4.3.). But for the period 1991-1994 there occurred the sharp decrease of all agricultural crops productivity, especially the production of grain, potatoes and green feed on meadows. To a greater degree in the affected districts there reduced meat and milk production. For example, in Narovlya district this decrease was as twice greater than in Belarus (Table 4.4.).

Table 4.4. Milk and meat (in living weight) in the public sector production

District	Milk		Meat	
	1990 (thous.t)	1994 in % to 1990	1990 (thous.t)	1994 in % to 1990
Belarus	7457	74	1758	64
Gomel region	4213	64	282	57
Bragin	38,4	52	8,2	48
Narovlya	16,2	30	5,0	38
Khojniki	33,9	52	8,1	40
Chechersk	28,7	43	5,3	43

The main reason - is the outflow of young specialists and also the reduction of the state aid to the farms of the contaminated zone. Heavy financial state of the farms and disproportion of prices that caused unprofitableness of the animal production forced the early cattle slaughtering and to reduce livestock of cows and pigs even in the private sector of Narovlya, Khojniki and Chechersk districts whereas in the republic the number of cows in individual farms has increased (Table 4.5.).

Table 4.5. The change of livestock

District	Public sector		Private sector	
	1990 thous. heads	1994 in % to 1990	1990 thous. heads	1994 in % to 1990
Cows				
Belarus	1749	84	681	106
Gomel region	312	76	99	97
Bragin	12,1	70	2,4	96
Narovlya	5,0	46	1,1	64
Khojniki	10,3	57	1,2	67
Chechersk	10,8	54	2,7	74
Pigs				
Belarus	3569	72	1521	100
Gomel region	498	92	243	98
Bragin	15,2	34	8,2	100
Narovlya	12,5	74	4,2	93
Khojniki	7,0	44	13,1	66
Chechersk	14,8	30	7,0	86

At present there increases the importance of economic basis of the protective measures priority, in the first turn directed to the decrease of radionuclides penetration into the food products, reduction of the net cost and improvement of the produced agricultural products quality. This is possible on the basis of the State programme of protection support and increase of soil fertility.

For the purpose of reduction of exposure doses of population and production of competitive products there is conducted the study of economic and technological aspects of cultivation of technical crops on the contaminated areas - rape, sugar beet, sunflower, modernization and expansion of the available industrial plants for processing of oil-yielding crops for technical purposes, potatoes and grain for starch and alcohol. The solution of these problems requires development of international co-operation and drawing investments.