

Radioactive contamination of Norwegian foodstuffs after the Chernobyl accident

The 1986 Chernobyl accident was the worst nuclear accident in history. Norway was among the countries outside the former Soviet Union that received most radioactive fallout from the accident. Particularly the mountainous areas in southern Norway and the central Norwegian counties were highly affected. During the 20 years since the accident, extensive monitoring of radioactive contamination in foodstuffs such as dairy products, sheep, reindeer, game, wild mushrooms and freshwater fish has been performed. The results from many of these investigations show that radioactive contamination after Chernobyl is a long lasting problem in many areas and that the use of countermeasures will be necessary for several years to come.

The Chernobyl fallout comprised many different radioactive substances e.g. iodine-131, caesium-134 and caesium-137. Since iodine-131 and caesium-134 have relatively short physical half lives - 8 days and 2 years, respectively - caesium-137 is now the major contaminant. Figure 1 shows the geographical fallout pattern of caesium-137 in Norway after the Chernobyl accident. The most contaminated areas received more than 500 kBq/m².

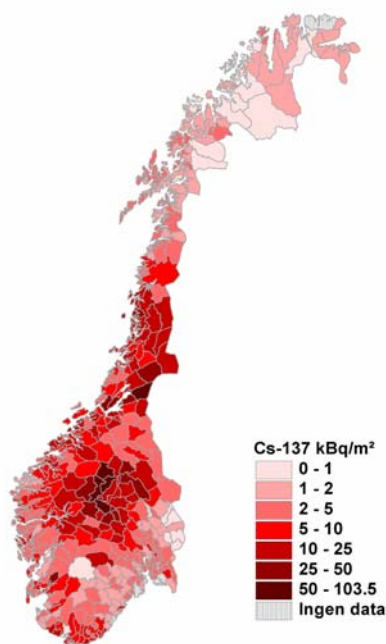


Figure 1. Activity concentrations of caesium-137 in soil in 1986 (municipality averages).

During the first couple of years after the fallout, high concentrations of radioactive caesium were measured in reindeer (150 000 Bq/kg), sheep (40 000 Bq/kg), wild mushrooms (up to 1-2 million Bq/kg), and freshwater fish (30 000 Bq/kg). The box below shows intervention levels for radioactive caesium set by Norwegian authorities.

Intervention levels

The levels state when dose limiting countermeasures have to be activated. The current limits for radioactive caesium in foodstuffs for sale in Norway are:

Reindeer and game meat:	3000	Bq/kg
Freshwater fish:	3000	Bq/kg
Milk and children's food:	370	Bq/kg
Other foodstuffs:	600	Bq/kg

In Norway, forests and mountainous areas are often used as grazing areas for sheep, goats, and cattle. Furthermore, reindeer herding is common in several mountain areas. Animals grazing in these areas often have higher concentrations of radioactive caesium than those grazing on home fields. The contamination problem also lasts longer. Prognoses based on monitoring programmes indicate that there will be problems with high concentrations of caesium-137 in animals on rough grazing – and therefore also a need for countermeasures in connection with Norwegian foodstuff production – in 10-20 years to come.

Important countermeasures still in use

1. Use of Prussian blue (AFCE) to reduce the uptake of radioactive caesium in animals.
2. Provide animals clean feed a few weeks before slaughter, often in connection with 3).
3. Measurements of live animals to avoid slaughtering of animals with concentrations above intervention levels

Cow's milk

Concentration of radioactive caesium in cow's milk varies widely with grazing area and season. For some herds concentrations of 200-300 Bq caesium-137 per litre of milk are still observed. The highest concentration (660 Bq/l) was observed in 1992. Mean concentrations in dairy milk for consumption have been low all years after the Chernobyl accident - and well below 10 Bq/l for most dairies the last 10-15 years.

Goat's milk

The concentration of radioactive caesium in goat's milk has generally been 3-5 times higher than cow's milk from the same grazing area. This is due to differences in diets and the goat's lower milk production. Concentrations of cesium-137 up to 1500-2000 Bq/l have been observed in milk from a particular herd (in 1991). Still up to 400 Bq/l are found in milk from this herd.

Sheep

Sheep slaughtered directly after returning from summer grazing areas in the mountains may contain particularly high levels of radioactive caesium. In 1988 when there were lots of wild mushrooms in the grazing areas, about 360 000 of totally 1.1 million sheep had to be provided clean feed for 2-8 weeks prior to slaughtering. Today clean feeding of sheep is still common practice in Norway and 14 500 sheep from 31 municipalities were given such feed in 2005. During the autumn of 2006 sheep with up to 7000 Bq per kg meat were registered, and some sheep were given clean feed for 9 weeks prior to slaughter.

Semi-domesticated reindeer

Reindeer herding was also seriously affected by the Chernobyl fallout, and it is still necessary with countermeasures in various areas of Norway. Concentrations of cesium-137 in reindeer from an area with considerable fallout (Vågå) are shown in Figure 2. Until the end of the 1990s there was a continuous decrease of cesium-137 in reindeer from Vågå. However, during the last few years there has been no observable decrease. During 2005 and 2006 maximum recorded concentrations were about 7000 Bq/kg in the autumn and 4100 Bq/kg in winter.

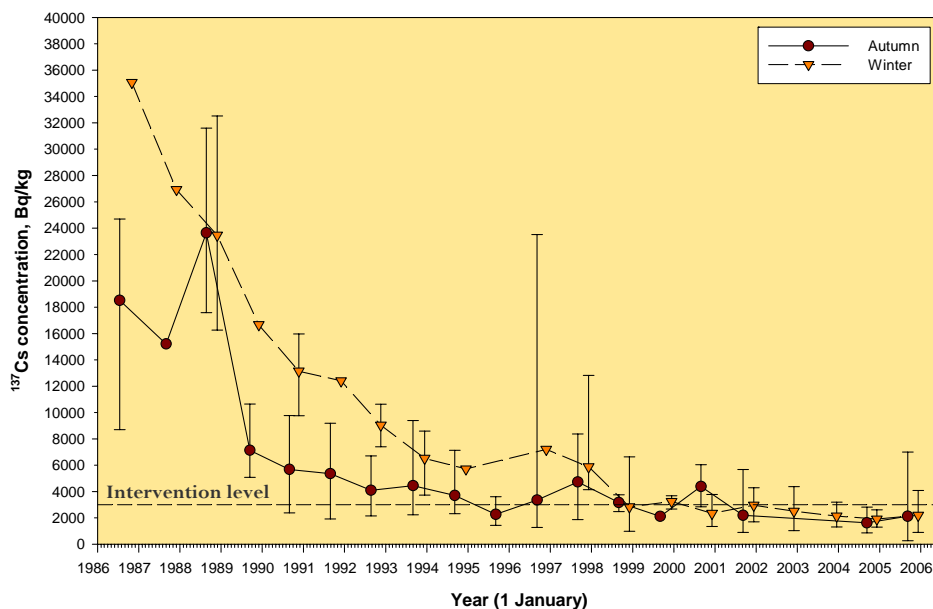


Figure 2. Cesium-137 in reindeer from Vågå measured in autumn and winter respectively. Note the clear differences in winter and autumn levels the first years after the accident. This is largely due to seasonal variations in feed preferences (with lichens in the winter). Error bars represent range (min-max).