Lessons learned from post Chernobyl measures and stakeholder involvement in Norway

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Introduction

The Chernobyl accident caused significant radionuclide fallout over southern and central Norway (Fig.1). Since the accident took place early in spring, while the cattle in Norway were still indoors, no milk had to be discarded due to high ^{131}I concentrations. However, later in the summer and in the years that followed, reindeer herding and traditional farming using forest and mountain pastures for grazing of livestock, suffered dramatic and lasting consequences of the fallout [2-4]. Twenty years after the accident, measures against radiocaesium contamination are still needed in production of cow's and goat milk, mutton and reindeer meat in Norway.

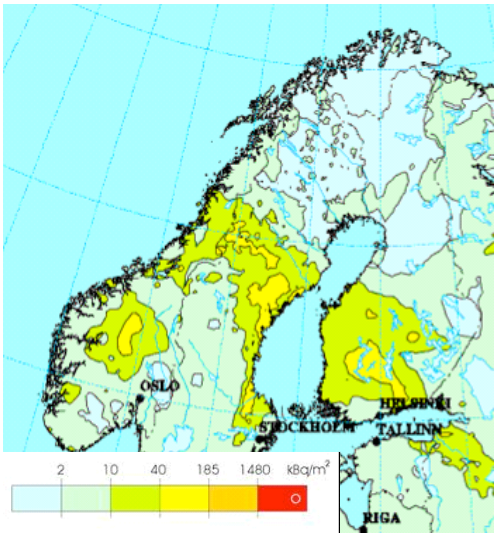

Figure 1: The Chernobyl fallout in Norway, Sweden and Finland (from [1]).

Short term management of the Chernobyl fallout

In 1986 there was no monitoring system in Norway that could give the national authorities an overview of the Chernobyl deposition, and different initiatives therefore had to be taken to collect samples for analyses. After an initial collection of snow and rainwater at military camps and by local police etc., local agricultural offices were involved in sampling of soil and vegetation. By Mid June the regional extent of the fallout over Norway was emerging. Contamination of milk was continuously monitored, but concentrations of radiocaesium in cow's milk from dairies never exceeded the intervention levels. At individual farms where concentrations exceeded the intervention level in 1986, the milk was used as animal feed.

Sheep and reindeer were not focussed immediately after the fallout since slaughtering normally occurs in autumn and winter, respectively. However, based on the experience with nuclear weapons tests fallout from the 1960s onwards, the authorities realized that reindeer herding

would be vulnerable to the fallout, and in Mid June the authorities therefore engaged reindeer herders in sampling of vegetation and reindeer tissues for monitoring purposes. By end July large-scale and significant contamination of pastures and reindeer was revealed, with up to 90 000 Bq kg^{-1} observed in reindeer meat, and it was realized that reindeer herding could be affected for decades. On 31 July 1986 the Government of Norway passed the principal resolution that every producer (both farmers and reindeer herders) should be economically compensated for all losses due to measures introduced by the authorities because of the Chernobyl deposition.

In early autumn 1986 monitoring results also showed significant contamination of sheep. Roughly 3% of all sheep contained above 2000 Bq kg^{-1} and was banned, totally 2300 tons. About 70% of the total national production could be slaughtered without use of countermeasures, while the remaining 27% of the sheep were clean fed before being slaughtered.

In the autumn it became evident that no reindeer meat from central and southern Norway could comply with the intervention level, then 600 Bq kg^{-1}, and all reindeer meat from these areas was condemned, totally 545 tons. In November, when reindeer slaughtering commenced in northern Norway, measurements showed that reindeer also in this area generally exceeded 600 Bq kg^{-1}. Maintaining this intervention level would result in condemnation of 85% of total Norwegian reindeer production in 1986, and the Government therefore decided to raise the level to 6000 Bq kg^{-1} (see more on justification below).

Long term consequences and countermeasures

The extent of condemnation of meat in 1986 made the authorities prioritize development of efficient measures to reduce the societal costs. Especially live monitoring of meat producing animals before slaughtering, avoiding slaughtering of animals that could instead be clean fed before slaughtering, was given priority. During 1986-1987 monitoring equipment was purchased, monitoring procedures developed and local monitoring personnel trained, and live monitoring has been routine procedure from 1987 onwards.

The most challenging part of the Chernobyl fallout in Norway has been the grazing of animals in vast unimproved outfields in forests and mountains with relatively poor soils and limited possibilities of implementing countermeasures at the soil – plant level. Another challenge is that freely ranging animals like sheep and reindeer cannot be administered caesium binders regularly.

Cow's milk was not interdicted after 1986, due to provision of clean feed and the addition of caesium binders in the most contaminated areas. Some goat milk was interdicted during 1986-1988 and used as animal fodder. In later years the effective use of Prussian blue (Giese salt, ammoniumironhexacyanoferrate) in concentrates has resulted in negligible goat milk interdiction.

In sheep production, live monitoring of animals gathered from outfields and subsequent clean feeding on cultivated pastures have been the most applied countermeasure. From 1989 onwards, Prussian blue containing salt licks have been distributed in the grazing areas, and in the most contaminated areas sheep and lamb have also been given Prussian blue rumen tablets (slow-release stomach boli). Prussian blue boli have also been developed for cattle and reindeer.

Due to significant increase in radiocaesium concentrations in reindeer during autumn because of changing diets, slaughtering in early autumn instead of winter represented an effective measure against contamination in reindeer meat. Together with live monitoring this has been the most applied measure. When animals could not be slaughtered in early autumn, clean feeding was

carried out in enclosures built for this purpose. Clean feeding of reindeer is however challenging [3]. Related to the countermeasures in reindeer herding are also the dietary advices provided to the reindeer herders (and other persons with high reindeer meat consumption).

Information on the division of the country into various countermeasure zones, on routines and schemes for practical countermeasure implementation, and on compensation rates have been distributed as annual letters from national authorities to the animal owners in the contaminated areas. The field guidance on implementation is delegated to regional and local agricultural authorities.

Intervention levels and ALARA

Intervention levels in Norway are laid down by the Government after advices from the Ministry of Health and Care Services, the Ministry of Food and Agriculture, the National Food Control Authority, and the Norwegian Radiation Protection Authority. The regulations related to radiocaesium contamination in animals (e.g., compensation for costs) have aimed at producing food in compliance with prevailing intervention levels, and have not aimed at the lowest possible contamination. The elevated level for radiocaesium in reindeer meat (from 1987 also for game and wild freshwater fish) of 6000 Bq kg^{-1} laid down in November 1986 was chosen to avoid interdiction of about 85 % of the total Norwegian reindeer meat production. The increase in the level was justified as a cost-effective measure due to the low average consumption of reindeer meat in the Norwegian population. It should be noted that this level did not apply to the reindeer herding families and others with reindeer meat as a dietary staple. The intervention level was reduced to 3000 Bq kg^{-1} in 1994 following assessments of the costs of the increased countermeasure application that would be needed for reindeer meat to comply with this level. A further reduction is envisaged, but the last assessment, carried out in 2002 [5] showed that a reduction to 1500 Bq kg^{-1} was not justified. The accompanying costs for intensified countermeasure application that could give a collective dose reduction of about 5 person-Sv resulted in a cost per saved dose more than twice the α value of 100,000 USD per person-Sv [6].

Established intervention levels in Norway have so far made most allowance for radiation protection principles and cost/benefit analyses. However, there are a number of other considerations, e.g. adaptation to EU directives like the “Hygiene Package” that would require a level of 600 Bq kg^{-1} in all food products (since Norway is not a member state), questioning of the need of maintaining the world’s highest intervention level and why the level in Norway should be different to Sweden, or various consequences of a reintroduction of countermeasure application for reindeer herders whom have been exempted for some years. In these considerations different national authorities are stakeholders. Otherwise the decisions on intervention levels have had no formal involvement of stakeholders.

Stakeholder involvement

In addition to the mentioned stakeholder roles of different national authorities, and their regional and local representatives, stakeholder involvement in Norway has broadly been related to implementation of countermeasures, and to negotiations on the accompanying economic compensation.

The authorities’ preference for the development of various measures to reduce the condemnation of food products resulted in intensive experimental work from the autumn of 1986 onwards. The Chernobyl fallout represented an enormous national challenge that necessitated unified and comprehensive collaboration between various national institutes and authorities. Routines for live monitoring of animals, schemes for clean feeding, and methods of administration of caesium binders to animals are examples of measure developed as combinations of experimental work in controllable laboratory conditions and exercises with practical field implementation. The scientists carrying out the experiments themselves

demonstrated and tested their methods in the field, and the direct feedback from practitioners, animal owners etc. was crucial for the success of the practical implementation. At the local level some variability over the centrally developed routines has evolved with time, according to local knowledge, increasing experiences and personal preferences.

The principal resolution that every producer should be economically compensated for all losses because of the Chernobyl deposition necessitated a direct dialog between the responsible authority and the animal owners, in practice through their unions (different unions of farmers and reindeer herders). The costs influencing the compensation due to the various measures is dependent on the labour, equipment etc. involved, and most of these are difficult to assess without detailed knowledge of daily work and routines by the involved persons. Countermeasure costs will also influence countermeasure priorities. Negotiations on compensation etc. are arranged annually, although in practice there have been only small changes during the 20 years after the Chernobyl accident occurred. In addition to annual negotiations the Ministry of Food and Agriculture, the Reindeer Herding Administration and the reindeer herders unions thoroughly revised the countermeasure regime in 1992 and are currently undertaking another revision.

Lessons learned

The above introduction to the post Chernobyl measures in Norway gives the background for understanding the various lessons learned. However, learning is subjective, and so will any summary of lessons learned also be. The summary below must therefore not be interpreted as an official and complete list of lessons the Norwegian authorities have learned. It should also be mentioned that many of the aspects mentioned below are related and dependent on each other, and the division into separate "lessons" may be somewhat arbitrarily.

First of all, involving various stakeholders in the development of practical countermeasures is crucial for the success of their implementation, and must not be neglected. Stakeholders in this respect is anyone affected by the countermeasure, from the animal owner to the slaughterhouse or the dairy, the local authority who will be responsible for the implementation of the countermeasure, and the authority who will inspect that the implementation was successful. During the whole post Chernobyl era this has been taken care of in Norway, and it is therefore as such not a lesson learned. Its importance is nevertheless stressed.

One of the most important lessons is the acceptability and appreciation of live monitoring as an effective measure reducing condemnation of meat. Animal owners find production of meat for condemnation highly unsatisfactory when the reason is something beyond their influence, and money can only partly compensate for this. Furthermore, condemnation of food because of radioactivity can be considered especially unacceptable since intervention levels do not represent toxic levels (as demonstrated when the authorities change the levels). Live monitoring combined with other countermeasures is in most cases also considerably less expensive than condemnation.

Any involvement of stakeholders must take into account possible scepticism towards national authorities and experts. The early post Chernobyl management in Norway left central authorities in distrust due to initial minimization of the consequences (since the monitors around the capital indicated no serious consequences). The population in the contaminated areas therefore ended up dependent on advices on how to handle the situation from sources with limited confidence. The distrust that developed added to some general inherent scepticism among some rural populations towards the practical value of any regulation and advice coming from national authorities and experts. Particularly the Saamis, a minority who have been suppressed by authorities, could easily relate parts of the post Chernobyl measures to other attempts of suppression.

Another lesson learned was the importance of developing measures that leave the affected inhabitants with a set of options, thereby giving them some feeling of influence and control over their own situation, and independence. This is particularly important in a situation with lacking confidence between stakeholders and authorities. Giving directives with no room for individual freedom, meant to be followed blindly, will cause frustration. Local knowledge will develop quickly, and individuals will make improvements to the centrally developed directives.

Furthermore, involving stakeholders in discussions on countermeasures and rehabilitation strategies does not imply that a common understanding of all decisions must of can be reached. Individuals from the same stakeholder group may have various views, stakeholders may represent more than one group (e.g. farmers can have political interests as well as personal costs) and stakeholder views may change with time. As it is nearly impossible to satisfy all stakeholders, care should be taken so that stakeholder involvement does not end with disorder. Sound, reasonable and well founded decisions are needed, so that various arguments supporting the decisions can be applied. Some detailed examples from the post Chernobyl management in Norway:

- The deposition in the Valdres area (southern Norway) resulted in the need for up to 12 weeks of clean feeding of sheep. This was regarded as impossible by the local farmers due to the demand for cultivated fodder and housing (as the clean feeding period extended into winter). The Ministry of Food and Agriculture therefore suggested exchange of animals with farmers in a less contaminated area 300 km away, in Østfold, where the Valdres sheep could subsequently be clean fed prior to slaughtering. Realizing how large costs the Ministry was prepared to carry, and that other farmers then would receive compensation for clean feeding of their sheep, the Valdres farmers agreed to feed their sheep themselves.
- Different population groups may have different views on animal welfare and what is acceptable treatment. Due to the strong position of the reindeer in the Saami culture, the Saami's views on countermeasures have for instance been different to the non-Saami reindeer herders. The first field application of bolus to reindeer partly failed because of mistakes in manufacturing, and resulted in injuries and the death of some animals. This resulted in pronounced scepticism both to the involved experts and the measure itself, and the Saamis have therefore not applied this measure despite improvements and subsequent routine application by non-Saami herders. The Saamis were initially also reluctant towards changing the slaughtering season because bonds between reindeer does and their calves are still strong in early autumn, and because this involved harassing their herd at a time when they used to graze undisturbed.
- Following the decrease in radiocaesium concentrations in reindeer, one of the reindeer herding companies complied with the intervention level when slaughtering reindeer at the traditional time during winter, without any countermeasures. As there then was no need for early slaughtering from the regulatory point of view, the Reindeer Herding Administration suggested not paying compensation for early slaughtering to this herding company. However, as the intervention level is relatively high, and contamination levels in the company's reindeer were substantially lower during early autumn than winter, the local food control authority argued that the aim should be to produce meat with as low contamination levels as possible and therefore compensation for early slaughtering should still be paid (beyond the scope of the national regulations and intervention level).
- In the 1980s there were relatively few losses of sheep and reindeer to predatory animals (i.e., lynx, wolverine, bear, wolf), and radioactive contamination was in most areas the only threat to the industries. In recent years the numbers of predators have increased and in some areas losses of sheep and reindeer due to predation are substantial, and have direct economic consequences for the sheep farmers and reindeer herders. To the animal owners these losses also minimize the seriousness of the Chernobyl contamination since; in the end the contamination challenge is defined by the intervention level, which the authorities have

demonstrated that they can “manipulate”. In a multi-stressor situation it is therefore more uncertain how the post Chernobyl management in Norway would have been perceived.

Another important aspect of stakeholder involvement is that there will always be stakeholders that are not involved. With freedom of speech and a wide variety of media, independent experts from universities, NGOs etc. will probably broadcast their views opposite of whatever views authorities or stakeholder groups may have. This challenge was probably amplified in Norway after the Chernobyl accident by the initial minimization of the consequences by some of the national authorities. Some of these independent experts made personal phone calls to the reindeer herders and told them to take different measures than those suggested by the authorities, thus adding more distrust to the relationship between herders and authorities.

Two successful measures introduced in Norway after the Chernobyl accident deserves mentioning. Firstly, the establishment of about 60 local monitoring stations made possible the development of a significant local knowledge on contamination levels. This satisfied the local population’s need for information to a larger extent than centralized laboratories alone could have achieved. The possibility for individuals to bring various foodstuffs to these monitoring stations for free radiocaesium analysis was also an important tool giving the engaged citizen the possibility to control his/hers own products. Secondly, the elevated intervention levels for radiocaesium in traded reindeer, game and freshwater fish necessitated additional countermeasures for population groups with significant intake of these products. The reindeer herding Saamis have been in a particular situation. NRPA has therefore offered and wanted to monitor the radiocaesium concentrations in this population. For NRPA this has been a individual dose control, whereas the reindeer herders see the monitoring as an important – and the only – tool to validate that their efforts with countermeasures results in lower whole body concentrations and radiation doses.

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