

Radiation monitoring and implemented countermeasures in Norway



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Outline

Present monitoring

- Foodstuffs
- Milk and live animals during summer grazing
- Whole body counting

Countermeasures

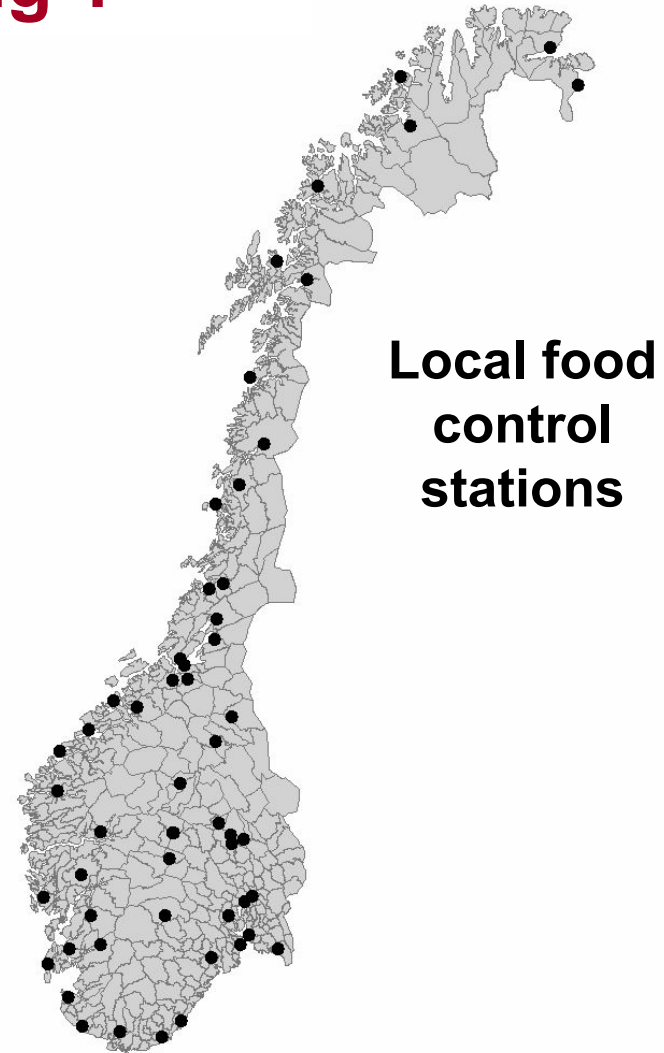
- CMs implemented annually
- Practicability
- Compensation schemes
- Who pays?

Stakeholder/public perception

Foodstuff monitoring 1

Food basket programme

- Cooperation between NRPA and Norwegian Food Control Authority
- 1 basket purchased per ~40 000 inhabitants / totally ~100 baskets annually
- Comprises goat whey cheese, lamb, beef, reindeer meat, game meat, wild mushrooms and honey
- Samples analysed by local food control stations
- Objectives: to follow long term trends of radioactivity in foodstuffs, act as a control of whether the countermeasures are sufficiently implemented and form a basis for dose estimations for the general public



Results food basket 2002

Foodstuff	Median (Bq/kg)	Highest (Bq/kg)
Beef	10	50
Goat whey cheese	74	331
Game	34	350
Wild mushrooms	10	416
Honey	172	470
Lamb meat	47	590
Reindeer meat	201	3511

LOD=10 Bq/kg, uncertainty ~10%

Foodstuff monitoring 2

Random sampling of animals in slaughterhouses

- **1% of all carcasses from intervention zones, 0.1% from other zones**
- **Sampled and analysed by local food control stations**
- **Any values over 600 Bq/kg (sheep, beef) or 3000 Bq/kg (reindeer) shall immediately be reported to the Norwegian Animal Health Authority**
- **Objectives: to control whether the countermeasures are sufficiently implemented**

Results random sampling

Animal	Number of samples	Geometric mean Bq/kg	Highest value Bq/kg
Sheep			
Free zone	1309	59	1259
Intervention zone	756	192	5269
Beef			
Free zone	337	10	512
Intervention zone	142	17	293
Reindeer			
Free zone	92	569	2672
Intervention zone	110	2298	7860

Foodstuff monitoring 3

Dairy milk

- **Analyses performed by the Norwegian food analysis lab**
- **Dairy samples of cow`s milk and goat`s milk from the most contaminated areas taken once every month in June to September**
- **Samples taken in all other dairies twice a year (August and October)**
- **Samples of powdered milk and whey products 3-6 times a year (May to December)**
- **Approximately 200 samples per year**
- **Paid by the Norwegian Food Control Authority**

Results dairy milk 2003

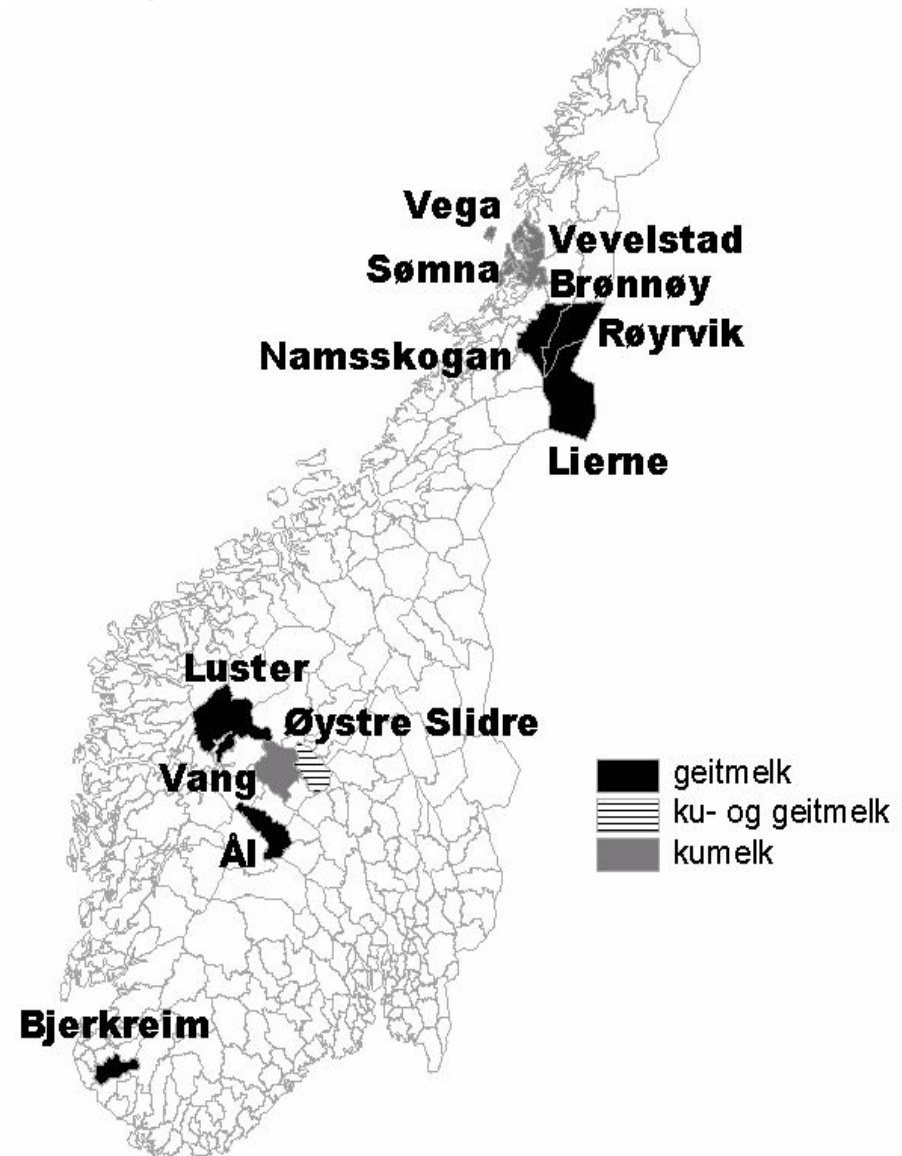
- **Dairy milk: average 2 Bq/L, highest 14 Bq/kg**
- **Whole milk: average 1 Bq/L, highest 11 Bq/L**
- **Goat`s milk: average 16 Bq/kg, highest 54 Bq/L**

- **Food intervention limits: 370 Bq/L for milk, 600 for dairy produce and 50 Bq/L for goat`s milk to be used in production of brown whey cheese**

- **No dairy products have been discarded since 1996, but as late as in 2002 one dairy refused to accept goat`s milk from a producer due to high concentrations of Cs-137**

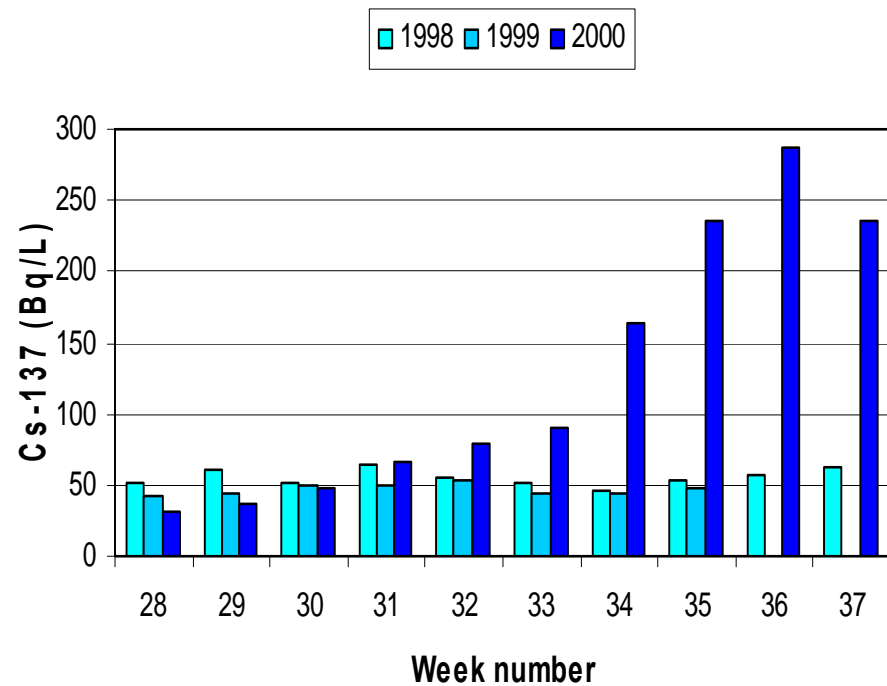
Milk and live animals during summer grazing

- Monitoring of live sheep from one flock
- Monitoring of cow`s milk from 8 herds
- Monitoring of goat`s milk from 7 herds



Milk and live animals cont`d

- Monitoring starts when animals are let out on pasture (May or June) and continues until they are stalled again in August or September
- Sampling and analyses performed by local food control stations
- High amounts of mushrooms on pastures are quickly reflected in the milk measurements
- Objectives: to give early warning concerning expected levels of radioactivity before the slaughter season in September



(Deposited Cs-137 in 1986: 17 kBq/m²)

Results Live animals 2003

Live animals	ewes	lambs
Number	19	24
Lowest , Bq/kg	10	63
Highest, Bq/kg	784	1260
Geom. mean, Bq/kg	202	590

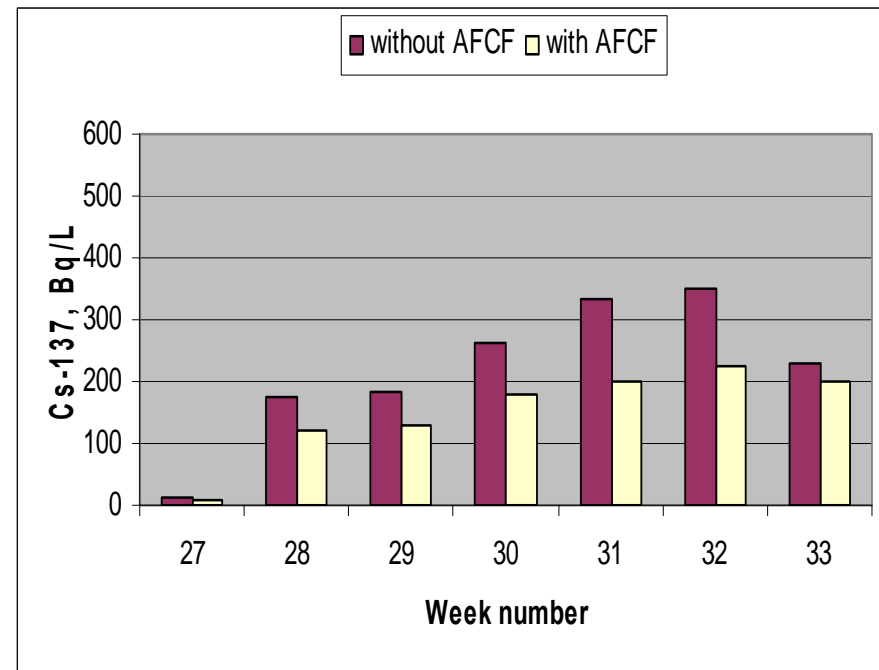
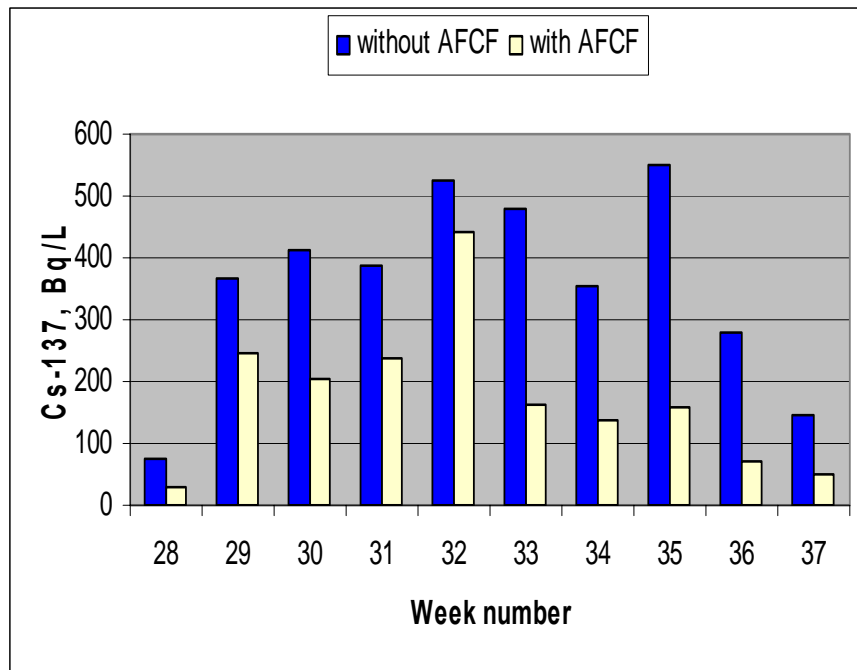


Deposition in 1986:
25 kBq/m² of Cs-137

Measurement
uncertainty ~20%

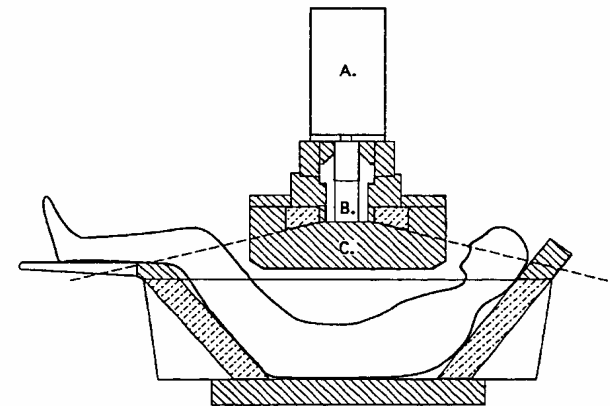
Results Milk 2003

Goat`s milk (deposition in 1986: 104 kBq/m²) Cow`s milk

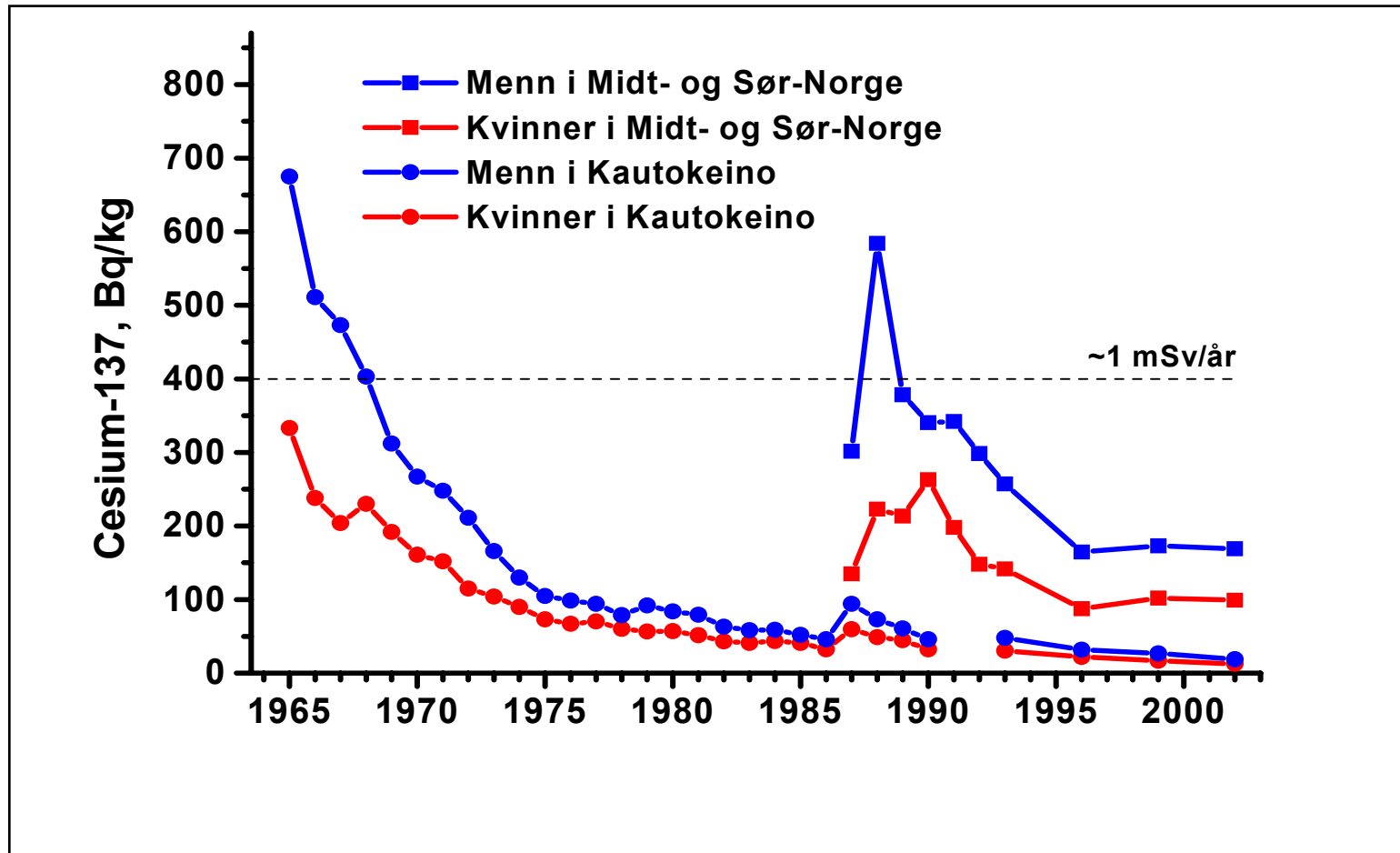


Whole body monitoring programme

- Reindeer herders are invited to be measured every three years – 40 people in Northern Norway and 46 people in middle Norway were measured in 2002
- People are measured in a mobile whole body counter for 20 minutes
- Their measurement results are compared to the last measurements performed on spot, and a letter confirming the result sent out later
- Open discussion between herders and experts from NRPA during the whole day (IMPORTANT)
- NRPA pays for travel and a light meal
- Municipality physicians involved
- Programme co-financed by NRPA and the Norwegian Food Control Authority
- Reports produced are sent to the measured people



Results whole body monitoring



Highest single measurement 2002: Man 430 Bq/kg and woman 210 Bq/kg

Countermeasures in use 2003 (1)

The use of Prussian Blue (AFCF)

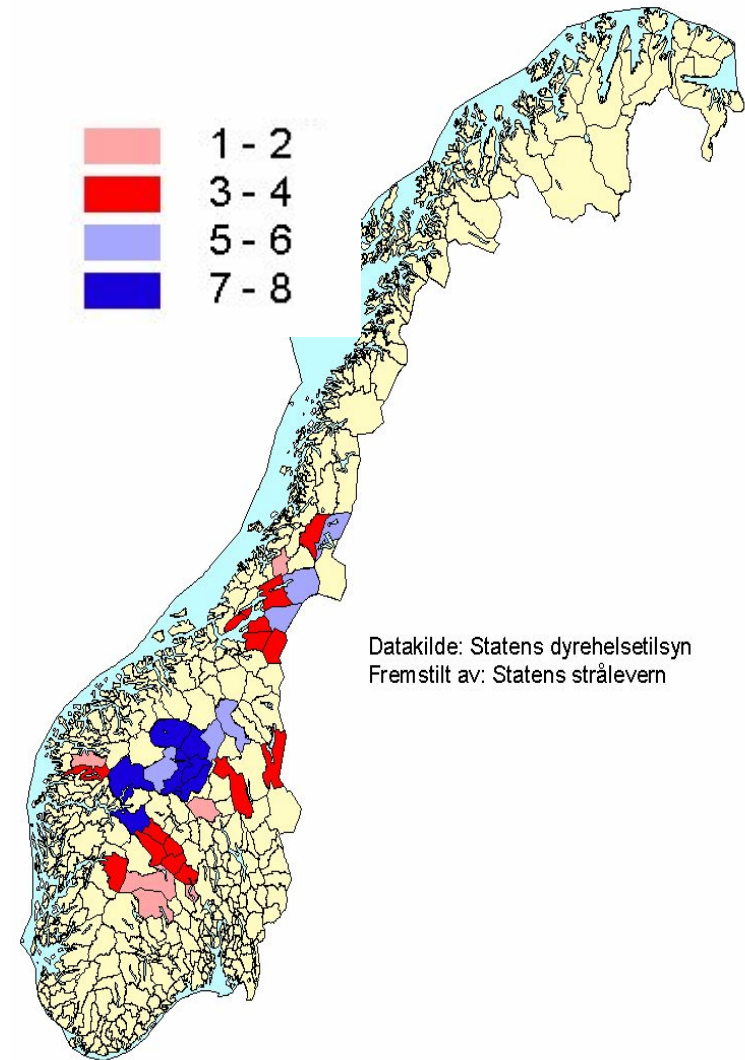
- Widely used in concentrates, saltlicks and boli during summer grazing for sheep, goats and cows. Limited use for reindeer, too.
- AFCF is bought as a powder from a German producer
- The Ministry of Agriculture keeps a rolling 2 year stock of AFCF powder
- Concentrates and saltlicks with AFCF are mixed in Norway by the Norwegian agricultural purchasing and marketing Co-Op
- The boli are made by hand at the Norwegian University of Agriculture
- The Ministry of Agriculture pays the additional price for purchase and incorporation of AFCF
- Boli put down by farmer who is compensated for the work
- For reindeer the boli are put down by a veterinarian

Countermeasures in use 2003 (2)

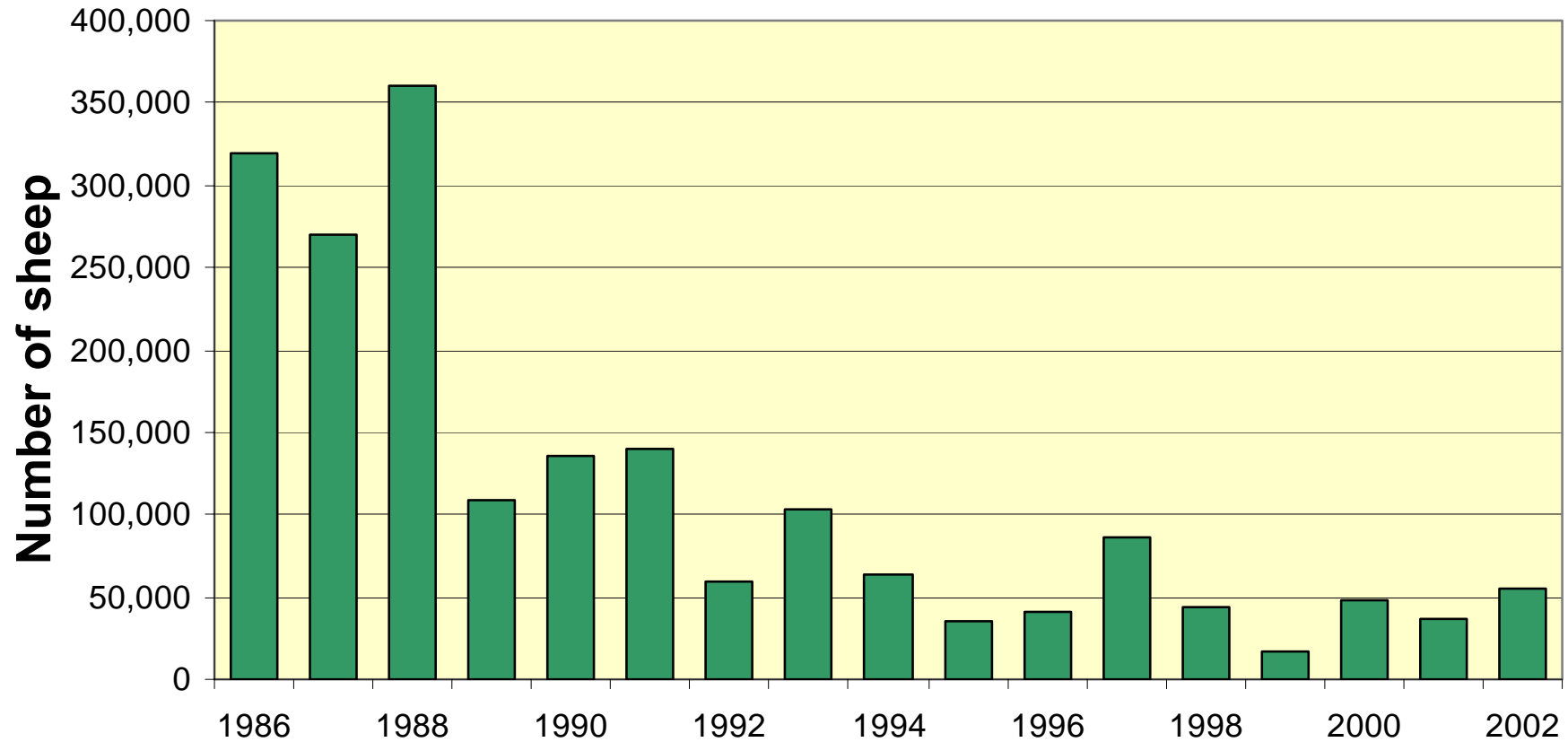
Clean feeding

combined with live monitoring of sheep

- Used for sheep in autumn
- A selection of all herds (\sqrt{N}) from earlier intervention zones are measured before September 20th by the Norwegian Animal Health Authority
- If the herd's geometric mean is above 700 Bq/kg, the animals must be clean fed before slaughter is allowed
- The biological half-life for sheep is 21 days, so the number of weeks with clean feeding imposed depends on the measured activity concentration
- The farmers are compensated from the second week of clean feeding (0.6 €/animal per day)
- The Ministry of Agriculture pays



Extent of clean feeding 1986-2002



Countermeasures in use 2003 (3)

Early slaughter combined with live monitoring

- Used for reindeer : slaughter moved forward to Oct/Nov instead of the traditional Dec/Jan slaughter due to seasonal variation in contamination level
- Compensation for lower slaughter weight paid by the Ministry of Agriculture (6-24 € per calf depending on how early)
- If measurements show that animals >3000 Bq/kg, boli with AFCF or clean feeding can be used with subsequent compensation by the Ministry

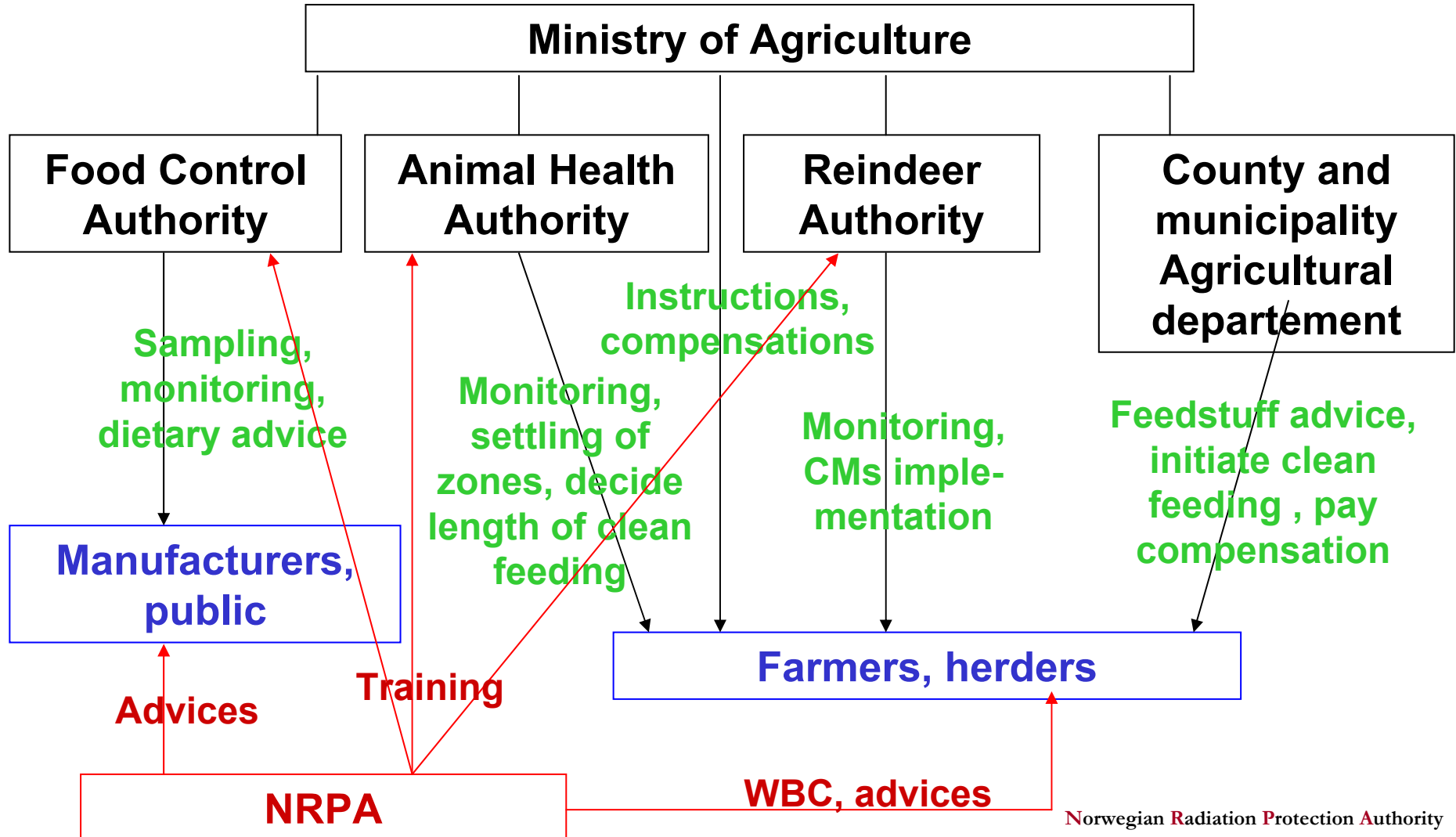


Countermeasures in use 2003 (4)

Dietary advice

- **General dietary advice is given by the Norwegian Food Control Authority relating consumption frequency and activity concentration**
- **Focuses particularly on forest food stuffs like mushrooms, reindeer and game**
- **The public can get their food samples measured for free at local food control stations**
- **Reindeer herders are advised to make sure that the reindeer meat consumed in the family is below 600 Bq/kg even though the Food Intervention Limit is 3000 Bq/kg**
- **The herders are compensated by the Ministry of Agriculture if their reindeer have activity concentrations above 600 Bq/kg (250 € per person in the household and an extra 125 € per person if above 3000 Bq/kg)**
- **The compensation should be used to clean feed reindeer for household consumption, buy reindeer meat from less contaminated area or buy other meat**

Organisation



Costs of monitoring, countermeasures and compensation

Total annual sum ~1.8 million €

- **1.25 million € for sheep, goats, cows, foodstuffs**
- **0.55 million € for reindeer, herders and WBC**

The Ministry of Agriculture pays the costs, some contribution from NRPA for WBC through the Ministry of Health

Stakeholder/public perception today

Media

- Articles locally every year, in national newspapers occasionally
- Descriptive, no exaggerated fear, concern of the long term effect

Consumers

- Rarely questions about radioactivity in foodstuffs from shops (must trust the authorities?)
- Concern in affected areas about radioactivity in self-gathered foodstuffs (mushroom, game, reindeer) – some measure their food before consumption at local food control stations

Farmer/manufacturers

- Have become part of their daily life
- Generally comply with instructions
- Discussions on amount of compensation from time to time

Stakeholder/public perception cont`d

Reindeer herders

- Less content with the situation due to their close spiritual and physical contact with nature and the animals
- Their most important food source is the most contaminated foodstuff in Norway – concern about health and the long term duration of this
- Some choose not to comply with the dietary advice

Monitoring personnel

- Most find the work interesting and important
- Complains about old equipment

Other experts

- Some researchers think the amount of money used for countermeasures is a waste of resources
- Do not believe in the 1 mSv/y recommendation for the public
- Occasionally communicates this to the media etc.

Summary

- **The system for monitoring and countermeasure implementation is working satisfactorily**
- **The contamination levels in some parts of Norway still justifies the use of countermeasures**
- **The management of radioactivity in the food chain has become part of daily practice**
- **The long term consequences are much longer than we thought, and we still cannot say when the countermeasures will be redundant – this concern is shared by producers, the public and the authorities**