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REGULATION OF NITROGEN INPUT IN DANISH AGRICULTURE

<table>
<thead>
<tr>
<th>Time</th>
<th>Plan</th>
<th>Significant elements in legislation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>NPO-plan</td>
<td>Max. livestock units per ha. Storages capacity</td>
</tr>
<tr>
<td>1987</td>
<td>Water Environm. Plan I</td>
<td>50 percent reduction in N-leaching. 65 percent wintecrops/catch crops</td>
</tr>
<tr>
<td>1992</td>
<td>Sustainable agriculture</td>
<td>Min. utilisation of nitrogen in animal manure N-quota per farm. Fertilizer plans and accounts. No slurry in autumn except for grass and oilseed rape</td>
</tr>
<tr>
<td>1998</td>
<td>Water Environm. Plan II</td>
<td>10 pct decrease of the N-quota. 6 pct catch crops in autumn. 15 pct higher utilization of N in animal manure</td>
</tr>
<tr>
<td>2003</td>
<td>Water Environm. Plan III</td>
<td>Target for decrease of P surplus. 13 percent reduction in N leaching, 10/14 pct catch crops</td>
</tr>
<tr>
<td>2016-17</td>
<td>Water Area Plans II</td>
<td>More area specific regulation plans are used to obtain &quot;Good Ecological Quality&quot;</td>
</tr>
</tbody>
</table>
NITROGEN QUOTA

- The quotaes for each crop is based on optimal rates
- The optimal quotaes are reduced with a percentage to give the "Maximum national quota"
- The reduction from optimal rates is 18.2 percent in 2015
- The farm quota is used by N in animal manure, organic manure or in mineral fertilizer

FERTILISER PLAN AND -ACCOUNTS

- All farms must do a fertiliser plan
- All farms must do and report a fertiliser account
- The fertilizer account is based on:
  - The N-qouta on the farms calculated from crop distributions, soil types and nitrogen quota for each crop
  - Mineral fertilizer reported to the ministry by the sales companies
  - The amount of nitrogen in animal manure calculated from standards for each type of animal

- If the quota is exceeded the farmer will have a ticket.
A SIMPLE EXAMPLE

<table>
<thead>
<tr>
<th>Crop</th>
<th>Ha</th>
<th>Quota per ha</th>
<th>N-Quota total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter wheat after oilseed rape</td>
<td>20</td>
<td>129</td>
<td>2580</td>
</tr>
<tr>
<td>Winter wheat</td>
<td>20</td>
<td>138</td>
<td>2760</td>
</tr>
<tr>
<td>Winter barley</td>
<td>20</td>
<td>136</td>
<td>2720</td>
</tr>
<tr>
<td>Winter oilseed rape</td>
<td>20</td>
<td>175</td>
<td>3500</td>
</tr>
<tr>
<td>Spring barley</td>
<td>20</td>
<td>110</td>
<td>2200</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
<td>13760</td>
</tr>
<tr>
<td>Effect of mandatory catch crops:</td>
<td>14</td>
<td>25</td>
<td>350</td>
</tr>
</tbody>
</table>

Net quota 13410

<table>
<thead>
<tr>
<th>Animal manure</th>
<th>Kg N per 10 pigs</th>
<th>Kg N total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total N from 5,000 produced pigs (31-107 kg)</td>
<td>25,1</td>
<td>12550</td>
</tr>
<tr>
<td>Minimum utilization (75 percent)</td>
<td>9413</td>
<td></td>
</tr>
</tbody>
</table>

Rest quota for mineral fertilizer 3998
Rest quota for mineral fertilizer per ha 40

Example from farm with dairy cows, 0,95 Dairy cow per ha, irrigated coarse sand

<table>
<thead>
<tr>
<th>Crops</th>
<th>Hectars</th>
<th>N-from previous crop</th>
<th>Long term effect of animal manure</th>
<th>Total Quota, kg N/ha</th>
<th>Net Quota, kg N/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clovergrass</td>
<td>15</td>
<td>0</td>
<td>26</td>
<td>242</td>
<td>217</td>
</tr>
<tr>
<td>Clovergrass</td>
<td>15</td>
<td>84</td>
<td>26</td>
<td>242</td>
<td>133</td>
</tr>
<tr>
<td>Wholecrop Maize</td>
<td>15</td>
<td>0</td>
<td>26</td>
<td>157</td>
<td>132</td>
</tr>
<tr>
<td>Wholecrop Maize</td>
<td>15</td>
<td>0</td>
<td>26</td>
<td>157</td>
<td>132</td>
</tr>
<tr>
<td>Spring Barley</td>
<td>15</td>
<td>0</td>
<td>26</td>
<td>129</td>
<td>104</td>
</tr>
<tr>
<td>Spring Barley, unders</td>
<td>15</td>
<td>0</td>
<td>26</td>
<td>161</td>
<td>136</td>
</tr>
<tr>
<td>Perennial Grassland</td>
<td>10</td>
<td>26</td>
<td>127</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>13</td>
<td>26</td>
<td>176</td>
<td>138</td>
</tr>
</tbody>
</table>

Demand for utilization of animal manure
1. year effekt: 170 kg x 55 percent = 94
Long term effect: 170 kg x 15 percent = 26
Effect of catch crops: 10,4 ha x 25 kg/ha = 3

Mineral fertilizer quota 42

1 Subtracted in the net quota
OUTLINES OF LEGISLATION FOR ANIMAL MANURE

- Allowed times for application for slurry: Only spring - except until 1st of October for oilseed rape and grass
- Application technique:
  - On bare soils (before crop establishment): Injection or acidification
  - On grassland: Injection or acidification
  - On winter cereals: Trailing hoses (no demand for injection or acidification)
- Max. Livestocks Units (100 kg N) per ha:
  - Cattle 1.7
  - Other animals 1.4

OUTLINE OF LEGISLATION FOR CATCH CROPS

- Farms with animals (more than 80 kg N in animal manure per hectare): **17.4 per cent of farm area** (25 kg N per hectare reduction in fertilizer next year)
- Farms with no animals (less than 80 kg N in animal manure per hectare): **13.4 per cent of farm area** (17 kg N per hectare reduction in fertilizer next year)
- Catch crops: Undersown grass, crusifers established before the 20th of August
- Catch crops must be followed by a spring sown crop
SETTING THE N-QUOTAS

- Based on traditionel plot trials with increasing amounts of Nitrogen
- Optimal rates are calculated at average of 5 years prices for crops and nitrogen
- Values for protein is incorporated in the calculation

N for winter wheat, 19 trials 2014
**N to winter wheat, 19 fs. 2014**

- Net income, kr. per ha vs. N in mineral fertilizer, Kg N pr. ha
- Percent protein in grain
- Without protein correction
- With protein correction
- Protein

**Nitrogen for wholecrop maize, 27 trials 2005-2014**

- Optimal N-rate (102 kg N)
- Yield
- Protein
- Pct. protein DM

Scand. Yield Units, 100 F E/ha vs. N Supply (Mineral fertilizer)
Nitrogen balances for wholecrop maize based on 27 trials 2005-2014

Optimal N-rate

Crop Removal of N  Supply of N

REDUCTION OF THE N-RATE FROM OPTIMAL

Plan for Sustainable agriculture
Yield increases in different countries

Data fra Petersen, 2012

Response curve for one year and long term trials

Long term: 18-20 kg cereal pr. kg extra N

Data fra Petersen, 2012
Utilization of Nitrogen in Danish Agriculture (Field only)

Increase 0.62 pct. per year

Outlet of Nitrogen to the sea, total

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Reduction Target for N in WFD 2015-2021

- Regulation in DK is based on Nitrogen Quotas 18 pct. below optimal rates
- High demands for utilization of N in animal manure
- Mandatory catch crops and restriction in soil tillage and ploughing of grass
- The Nitrogen surplus have been reduced by 50 percent
- The protein content in danish crops are very low
- The loss of yield by restricted N-quotas is 0.5-0.7 t/ha
- The loss of N to the coast have been reduced by more than 50 percent since 1985
- New targets in WFD are a threat against farming in some areas.