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Comparison of the technological and building situation of Estonian cowsheds in 1999 and 2004

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Abstract. In 1999 an investigation of the situation of Estonian cowsheds was carried out under the leadership of the Institute of Rural Building of the Estonian Agricultural University. The aim of the research was to determine the dominant building structures of cowsheds and find out what kind of technologies were used there. This research helped to clarify the situation and allowed to make proposals as to which problematic areas should get the attention of help funds of the European Union.

In 2004 a similar survey was conducted about Estonian cowsheds. As a result of the research, we will be able to see what kind of changes have taken place during the past five years. It will also help us determine which problems still require the resources of the European Union in order to make the agricultural production more efficient.

Key words: dairy farm, cattle housing, milking systems, manure storage

INTRODUCTION

One of the supported agricultural sectors in the European Union is cattle-breeding. In order to plan the pre-joining subsidies (SAPARD program), the study „Modernisation of Dairy Farms“ was conducted at the end of 1999 (Modernisation…, 2000) in order to determine the constructional and technical conditions of cattle-breeding buildings. Also Jänes realised his master's thesis in 1999 on the similar area – from the aspect of cattle breeders (Jänes, 1999).

In order to get an overview of the situation five years later when Estonia is already in the European Union and cowsheds have received investments for modernisation both from European Union's structural-funds and producers themselves, a similar survey was conducted in 2004. The survey was carried out by using the same method but this time Estonian Agricultural Registers and the Information Board (ARIB) were included in the collection of data.

Since during subsidisation the main attention is directed at the welfare of the animals, the quality of production, work efficiency and ecological considerations, the analysis of the data was also focused on these points. As the buildings and their

structures are also important from the production standpoint, the building structures of the cowsheds similarly received attention during the analysis.

METHODS

Starting from 1 January 2003, the Estonian Agricultural Registers and the Information Board (ARIB) have been collecting information about cattle-breeding buildings and areas specified for animal-tenure. They also create a link between the animal and the building (Building registration regulation…, 2005).

Cattle-breeding buildings and areas specified for animal-tenure include places where the aim of the process is the following:

1. Obtaining products from animals;
2. Breeding;
3. Mediation for sale and other ways of passing the animals to others for money or free;
4. Compilation of animal-patches;
5. Public exhibition or some other entertainment orientated goal for the public;
6. Preservation of species;
7. Scientific research.

Information about the owner of the animals or the user of the building is inserted into the registry. The information to be recorded (Animal…, 2005) includes, in addition to personal particularities, the species, and production line, the building name, year of construction completion, surface area, and approximate animal-count. An ARIB official adds the geodetic coordinates of the building, assigns a number to it, and notes the type and speciality of the building. Cowsheds belong among cattle-breeding buildings.

Large farms and multiple cowsheds at close proximity are considered to be a single cowshed and are assigned a single number. This has been approved by the Veterinary and Food Board (VFB); because for infection control they form a single unit. There is virtually no information in the database about the buildings themselves and, therefore, it is impossible to perform any sort of analyses about the agricultural buildings as structures.

By means of the agricultural animals' database it is only possible to identify the number of buildings for different species of animals and the approximate number of animals housed there (Table 1). By the end of 2004 there were ~7,725 cattle-breeding buildings in Estonia housing 137,518 cows (data from the animal register unit of the ARIB).

In November 2004, with the help of the ARIB, a questionnaire was sent to almost 4,000 dairy-producers. It was created following the example of the questionnaire used in 1999 (Modernisation …, 2000). In order to avoid sending the questionnaire to every cow-owner, the limiting criterion was the possession of at least five cows. The questionnaire was sent to all cow-owners who had five or more cows. In the questionnaires presented both in 1999 and 2004, the main questions were the same: tenure, milking, milk-coolers, manure removal and storage, watering, and feeding. The other group of questions were about the structural state and material of the buildings: walls, columns, beams, ceilings, roof-structures, etc.

Table 1. The number of cattle-breeding buildings and the number of dairy cattle housed in these buildings at the end of 2004 in Estonia.

Size of herd	Number of buildings	Number of cows
1–20	6,986	20,325
21–50	295	9,343
51–100	137	10,025
101–200	163	23,611
201–300	74	17,893
Over 300	70	56,321
Total	**7,725**	**137,518**

Table 2. Comparison of the 1999 and 2004 data volumes and their processing for comparability.

	1999	**2004**
Questionnaire was sent to	all herd-owners whose dairy cattle is under performance-accountancy	all cattle-breeders with five and more cows
Total	2,897	~4,000
Replies	694	~3,000
Data processing in August 2005		2,450
How to make comparable	Both databases are filtered to include only cowsheds with five or more cow places.	
The questionnaire covers	22% of the herds under performance-accountancy	29% of cattle-breeding buildings
Remaining for analysis	641 enterprises	2,235 enterprises

Compared to the previous questionnaire, the one sent out in 2004 included additional questions mainly concerning the microclimate of the building: if and where condensate is formed, what sort of ventilation is used, etc.

The detailed questionnaire allowed in 1999 and allows now, based on the 2004 results, to identify the dairy-producers' problematic fields concerning not only the constructions but also the technology used and animal tenure.

Analysing the 2004 results and comparing them to the data from 1999 makes it possible to map the situation of Estonian milk-producers. It also enables identifying the changes and trends since 1999.

The data from the 1999 questionnaire have been analysed in two papers published in 2001 (Miljan, R. & Miljan, J., 2001; Miljan, J. & Miljan, R., 2001), where the basis of the analyses was the grouping of cows according to the number of animals in the cowshed or, in other words, the size of the herd. A later analysis has been based on the number of places for animals (Miljan, 2005), meaning buildings suitable for an established number of cows. The cowsheds have been divided into six groups: 1–20 places, 21–50 places, 51–100 places, 101–200 places, 201–300 places, and over 300 places.

The data from 1999 have also been recorded based on the number of places for animals. In the thesis by R. Miljan (Miljan, 2005), the differences of the analysis results were compared, and it appeared that the indicators of a single field (e.g. tenure, milking, feeding, etc.) varied very little. However, as soon as the indicators inside a field were observed by groups, the differences became significant.

In 1999 the questionnaire was sent to all herd-owners under performance-check. 694 answered questionnaires were returned, which formed 24% of the herds under performance-check.

In order to make the results comparable (Table 2), cowsheds for less than five animals must be removed from both sets of questionnaire results. In this case, the 1999 questionnaire leaves 641 and the 2004 questionnaire 2,235 valid replies. Now the database of 1999 contains less than 22% of the total number of herds and the database of 2004 contains 29% of the total number of buildings.

Both selections are large and represent the whole picture quite well. If we compare the structure of data set by counties gathered by the questionnaire in 2004 with the data of the Animal Recording Centre (Structure …, 2005; Table 3), the correlation coefficient $r = 0.89$. The result of F-test is 0.084, which means that the difference of variability of the two sets is not proved on the significance level $P = 0.05$. The conclusions derived from the database obtained with the questionnaire can therefore be transferred to the general whole. It is visible from Fig. 1 that, by counties, the number of cows belonging to the farmers who were questioned generally follows the number of Estonian dairy-cows under performance-check. The only discrepancy is in Hiiu County, where many cows are probably not under performance-check (it is located on an island, far from the Animal Recording Centre).

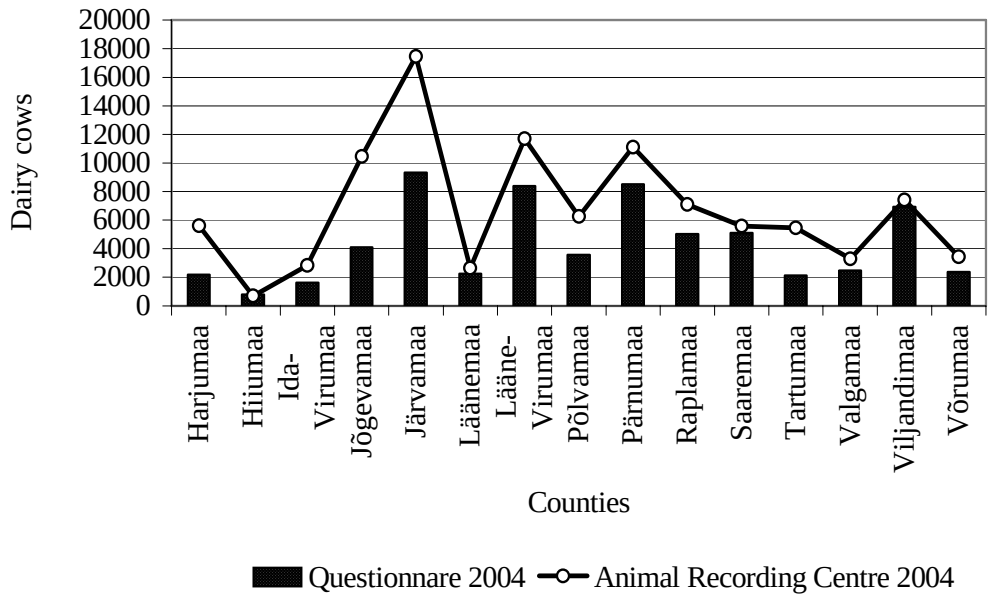


Fig. 1. Distribution of dairy cattle by counties.

Table 3. The distribution of dairy cattle by counties.

County	Questionnaire 2004	Animal Recording Centre 2004
Harjumaa	2,166	5,597
Hiiumaa	796	688
Ida-Virumaa	1,609	2,812
Jõgevamaa	4,092	10,469
Järvamaa	9,334	17,452
Läänemaa	2,242	2,641
Lääne-Virumaa	8,372	11,713
Põlvamaa	3,567	6,248
Pärnumaa	8,505	11,115
Raplamaa	5,011	7,104
Saaremaa	5,087	5,570
Tartumaa	2,098	5,448
Valgamaa	2,462	3,288
Viljandimaa	6,925	7,410
Võrumaa	2,360	3,436
Total	**64,626**	**100,991**

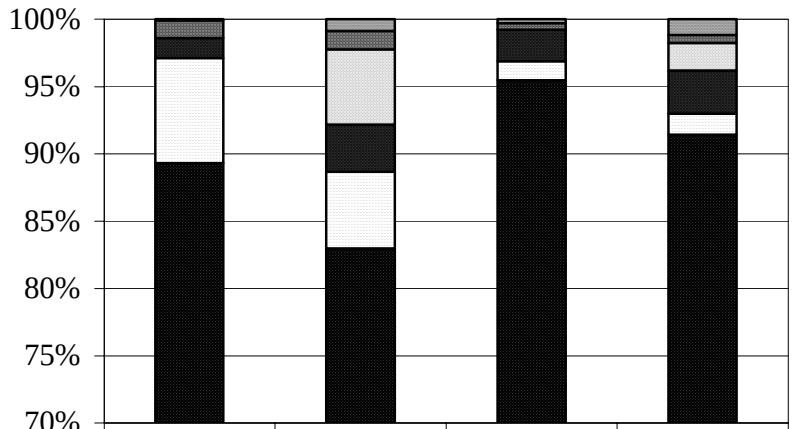
Most of the attributes in the databases are nominal (like tenure, watering, existence of a cooler, etc.), some are ordinal or sequence attributes (like the structural or technological state of the cowshed), whereas the numeral attributes are the year the cowshed was built, the year of its reconstruction, the number of cows and cow places, dimensions of the cowshed, and the number of workers in the shed.

To process the data of the questionnaire, two-dimensional frequency tables or cross-tables are used. The cross tables enable grouping and analysing the data, and interpreting the structure of the database on the assumption of different attributes. Several cross-tables are formed on the same database. The values of one field are used as row headings, the values of another attribute are used as column headings. The third attribute is usually numeric and used in table cells.

RESULTS

During the past five years, the housing systems of cows in Estonia have changed somewhat. There has been a shift from tied-up to loose housing but the change has been only 5–6% in the number of cows and 4% in the number of cowsheds (Fig. 2). Loose housing means housing in kennels, housing on deep litter and loose housing summarised.

Considering the efficiency of the milker, it is important that the number of cows and cowsheds where milking is performed on a parlour has increased. Analysing the data from the questionnaire from the aspect of milking methods, it appears that the number of cows milked into a pipeline or on a parlour (Fig. 3) has almost not changed. The number of cows milked into a churn has decreased and the number of cows whose owners could not specify the milking method has increased.



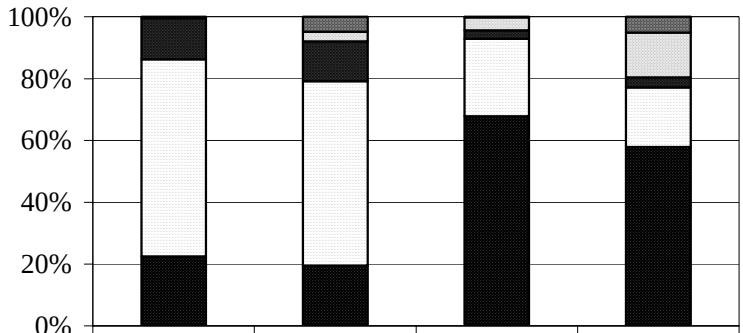
	Cows 1999	Cows 2004	Sheds 1999	Sheds 2004
Blank	0.1%	0.9%	0.3%	1.2%
Other	1.3%	1.4%	0.5%	0.6%
Loose		5.6%		2.0%
Deep litter	1.5%	3.5%	2.3%	3.2%
Kennels	7.8%	5.7%	1.4%	1.6%
Tied-up	89.4%	83.0%	95.5%	91.4%

Fig. 2. Change of systems of housing from the total number of cows in percents and from the total number of cowsheds in percents.

In the number of cowsheds separated by the milking method (Fig. 3), pipeline milking has decreased by 5.6% and parlour milking has increased by 0.5%. The number of cowsheds where cows are milked into a churn has decreased and the number of cowsheds whose owners could not specify the milking method has increased.

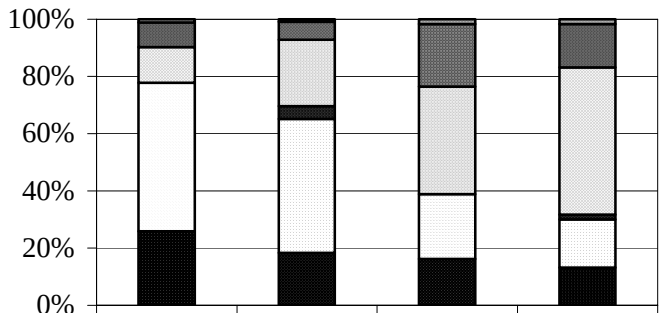
When these results are compared to the changes from September 1993 to November 1996 in Mecklenburg, Vorpommern state, it appears that we have almost nothing to compare. There the number of cows milked on a parlour rose from 30.9% to 76.6% during this time-period (Miljan, 1998).

From the environmental point of view, the method of manure storage is relevant (Fig. 4). The greatest role in manure storage is played by reinforced concrete storages and concrete grounds. This applies to both the number of cows and the number of cowsheds. Surprisingly, the relative importance of concrete storages and -grounds has significantly diminished during the past five years. The frequency of manure storage without proper facilities has increased by both the number of cows (almost two times) and the number of cowsheds (over 1.5 times). This can be caused by the fact that numerous cowsheds with storages in a poor condition were listed as ‘without storage’. This was possibly caused by a non-refundable aid project launched at the end of 2004 for improvement of manure processing. The point that in 2004 the manure of almost 5% of the cows was stored in slurry tanks should be considered a positive trend.



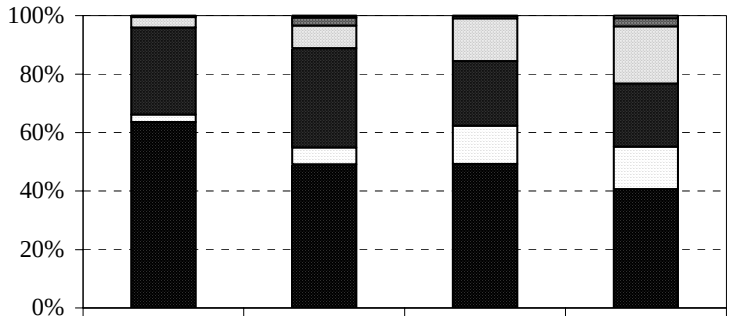
	Cows 1999	Cows 2004	Sheds 1999	Sheds 2004
Blank	0.0%	4.9%	0.2%	5.2%
Other	0.5%	3.1%	4.2%	14.4%
Parlour	13.2%	12.8%	2.8%	3.3%
Pipeline	63.8%	59.6%	25.0%	19.4%
Churn	22.5%	19.6%	67.9%	58.0%

Fig. 3. Change of systems of milking from the total number of cows in percents and from the total number of cowsheds in percents.



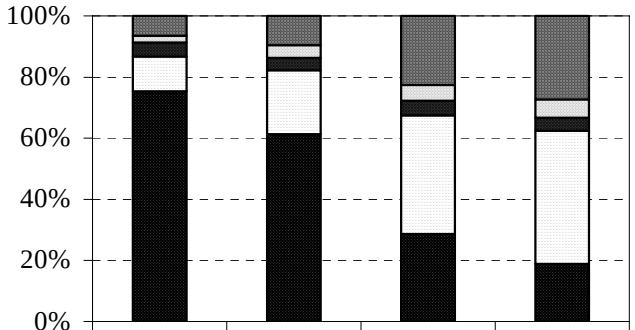
	Cows 1999	Cows 2004	Sheds 1999	Sheds 2004
Blank	1,1%	0,9%	1,7%	1,7%
Other	8,6%	6,3%	21,8%	15,2%
Not in existence	12,6%	23,2%	37,6%	51,4%
Slurry tank		4,5%		1,7%
Concrete ground with concrete	51,9%	46,8%	22,6%	16,9%

Fig. 4. Manure storage from the total number of cows in percents and from the total number of cowsheds in percents.



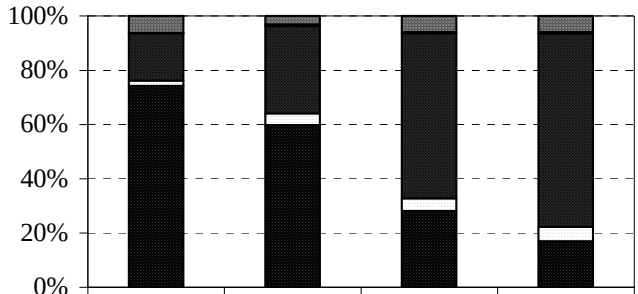
	Cows 1999	Cows 2004	Sheds 1999	Sheds 2004
Blank	0.2%	0.7%	0.2%	0.9%
Other	0.3%	2.7%	0.8%	2.8%
Quarry stone	3.6%	7.8%	14.5%	19.5%
Brick	29.7%	33.9%	22.2%	21.6%
Timber	2.5%	5.7%	13.1%	14.6%
Panels	63.6%	49.2%	49.3%	40.6%

Fig. 5. Material of walls from the total number of cowsheds and from the total number of cows in percents.



	Cows 1999	Cows 2004	Sheds 1999	Sheds 2004
Blank	6.5%	9.5%	22.6%	27.3%
Other	2.1%	4.2%	5.1%	6.0%
Brick	4.6%	4.0%	4.8%	4.3%
Timber	11.4%	21.0%	38.7%	43.5%
Reiforced concrete	75.3%	61.3%	28.7%	18.9%

Fig. 6. Material of columns (from the total number of cowsheds and from the total number of cows in percents).



	Cows 1999	Cows 2004	Sheds 1999	Sheds 2004
Blank	6.2%	3.1%	5.9%	5.9%
Other	0.2%	0.6%	0.5%	0.6%
Timber	17.3%	32.2%	60.7%	71.1%
Steel	2.0%	4.3%	4.7%	5.3%
Reiforced concrete	74.3%	59.9%	28.2%	17.0%

Fig. 7. Material of beams (from the total number of cowsheds and from the total number of cows in percents).

In 2004, 40.6% of Estonian cowsheds housing more than five animals had wall-structures of gas-concrete (Fig. 5). In five years their significance fell by over 9%. By the number of cows, over 50% were still in buildings made of panels but here also a decrease of the relative importance is considerable – over 15%. The number of cowsheds with wooden walls has risen, but mainly among the smaller cowsheds.

In regard to bearing structures, cowsheds with reinforced concrete columns have lost their significance (Fig. 6). By the number of animals, however, most cows (61.3%) are still housed in buildings with reinforced concrete columns. The importance of cowsheds with wooden columns has risen, but primarily among smaller cowsheds as 43.5% of the cowsheds have wooden columns but they all house only 21% of the cows.

By the number of cowsheds, buildings with wooden beams have achieved a clear majority and, by the end of 2004, they included 71.1% of the cowsheds with five or more animals (Fig. 7). By the number of animals, however, most cows (59.91%) resided in cowsheds with reinforced concrete beams. Here also, a decrease of over 14% has taken place during the past five years. About one third (32.2%) of the cows are still held in cowsheds with wooden beams. An important trend to be noticed is an increase of cowsheds with steel beams and also an increase in the number of cows housed in cowsheds with steel beams.

DISCUSSION

The data collected with great difficulties about larger Estonian cowsheds reveal that the SAPARD subsidies that were introduced when Estonia joined the European Union, have not met the expectations. Indicators that were supposed to be affected:

- Increase of animal welfare;

- Efficiency of milking – increase in the use of milking parlour;
- Lower environmental contamination.

These indicators have not shown substantial improvements in regard to milking herds. There is, however, a slight positive change.

The EU has a set of common rules on permitting for industrial installations. These rules are set out in the so-called IPPC Directive of 1996. IPPC stands for Integrated Pollution Prevention and Control (European Integrated Pollution Prevention and Control Bureau, 2005). Environmental complex permits are compulsory for intensive livestock farms with more than 300 dairy cows and more than 400 beef cattle. The permits must be based on the concept of Best Available Techniques (or BAT) (Parim võimalik tehnika veiste intensiivkasvatuses, 2005). In many cases, BAT means quite radical environmental improvements, and sometimes it will be very costly for companies to adapt their plants to BAT.

Hope remains that investments from structural-funds started in 2004 and planned for the next three years bring considerable improvements to the modernisation process. Concerning environmental protection, the planned non-refundable aid project for the improvement of manure processing can be of considerable help.

If Estonian milk-producers cannot improve their efficiency and decrease environmental contamination with these subsidies, the competitiveness of our milk products can fall and some farms may be closed due to pollution. Therefore, it can be argued that subsidies alone will not increase the efficiency of production. This can only be achieved via normal competition. But if production leads to irresponsibility towards environment, compulsory measures should be introduced.

Our speed of upgrading to more animal-friendly tenure methods is several times slower than the speed at which the former East Germany reconstructs its cowsheds to free-housing. For example, from September 1993 to November 1996, the number of cows held in loose housing based on cowsheds in Mecklenburg, Vorpommern state, rose from 34.1% to 74.6% (Miljan, 1998).

Dairy production is one of the most important production sectors in Dutch agriculture. The last forty-five years have seen important changes in the dairy sector (Horne & Prins, 2002). Here are some moments pointed out in the development of dairy farming in the Netherlands: 1961…1965 – wide-scale introduction of milking machines; 1971…1975 – loose housing system with cubicles; 1996…2000 – introduction of milking robot. Now about 5,000 robots can be found in the Netherlands. No milking robots can be found in Estonia yet.

Lately changes can be noticed in the structures of the existing Estonian cowsheds. For example, the number of cowsheds with gas-concrete walls has decreased. There are also some changes in regard to the weight-bearing structures. The percentage of reinforced concrete columns has fallen while the percentage of wooden columns has risen. The same trend can be noted with beams, where reinforced concrete is losing its importance, and there are more and more wooden beams.

These tendencies are partly caused by the fact that, during the past five years, many of the cowsheds with reinforced concrete structures have found other uses. In the construction of new cowsheds, however, wood is very often used and lately even steel.

A good example of the use of wood in construction is the fact that one 500- place cowshed of a 1,000-animal milk-farm near Põlva was chosen the best wooden production-building in Estonia in 2003.

In Estonia cold cowsheds with un-insulated and relatively light boundary and roof structures have been built lately. This allows designing bearing structures that have greater openings and are lighter. Wood, steel and combinations of these materials are also more widely used in the design of larger cowsheds.

CONCLUSIONS

Although loose housing has increased 1.5 times in 5 years (from 1999 to 2004) for the number of cows and 1.8 times for the number of cowsheds, still only 15% of dairy cows are under loose housing system. The change is also too small for the milking methods. Replacing milking into a churn with parlour milking should get more attention than switching from milking into a churn to milking into a pipeline.

Despite the construction of several manure storage facilities in Estonia that meet European standards, the total number of manure storage facilities has diminished according to the questionnaire. As a positive fact, it can be noted that during the five years there has been a shift in the awareness of the cattle-breeders and they have answered differently to the same question about the existence of manure storage facilities in 1999 and 2004. The cattle-breeders are now aware of the European requirements on manure storage and the subsidies that are available for upgrading the facilities. Despite the increase of awareness, it will not be possible to reconstruct all the manure storage facilities during the remaining two years, by 2007.

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