Overviews of milk recording and recording devices in sheep and goats in Italy

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Introduction

Sheep and goat farming has a long history in Italy, thanks to the unique environment with a large part of hills and mountains and a dry climate where these two species can thrive better than cattle. The most common rearing system is grazing on pasture with some periods in stable. Many dairy products are linked to Italian breeds and environment, such as Pecorino cheese. The latest demographic census, done by the Italian Ministry of Health Veterinary Services, reports about 6.1 million sheep and 0.9 million goats belonging to more than 100 breeds distributed in 81,262 and 51,056 flocks, respectively; the main breeds are Sarda, Massese, Valle del Belice, Langhe, and Comisana for sheep and Saanen, Camosciata delle Alpi, Sarda, Aspromontana for goats.

Milk performance recording

Official milk performance recording for sheep and goats has been active in Italy since the second half of the last century and is run by the Italian DHI organization (A.I.A., Associazione Italiana Allevatori) using ICAR approved recording methods. Official technicians perform milk recording methods monthly ("A" method, recording every 4 weeks). The methodologies used are AC4 and AT4 for sheep and AT4 for goats. Milk performance recording is done using ICAR-approved devices. In 2022,(A.I.A., *http://bollettino.aia.it*) 153,367 ewes and 55,671 goats were recorded for milk production in 962 and 642 flocks, respectively, spending about 10,000 working days. Milk analyses were more than 255,000 (69,000 in primiparous Sarda sheep only and 186,000 for goats).

Milk sheep

In 2022, 153,367 ewes were officially recorded for milk production in 962 flocks. Figures 1 and 2 show the distribution of recorded ewes and flocks in the period.

Figure 1: Milk sheep, recorded ewes in Italian Regions. Source: A.I.A. (http:// bollettino.aia.it).

Figure 2: Milk Sheep, recorded flocks in Italian Regions. Source: A.I.A. (http:// bollettino.aia.it).

Central and Southern Italy, along with the islands (Sicily and Sardinia) have the highest concentration of heads compared to northern Italy. Sardinia is the region with the highest number of heads (93,870).

The distribution of recorded flocks follows the proportions of recorded ewes; Sardinia has the highest number of recorded flocks (more than 50%), followed by Sicily. The distribution of ewes and flocks by breed is shown in Table 1, in which only breeds with more than 100 heads are included.

The most important breed is Sarda (72% of total recorded ewes and 61.2% of total flocks), followed by Valle del Belice and Lacaune. The average number of heads per flock in Sarda is 182.8. Recorded milk productions by breed are shown in Table 2.

Table 1. Distribution of ewes and flocks by breed.

Breed	Recorded ewes	% on total	Recorded flocks	% on total	Average ewes per flock
Sarda	107.694	72,0	589	61,2	182,8
Valle del Belice	11.649	7,8	184	19,1	63,3
Lacaune	7.487	5,0	55	5,7	136,1
Massese	6.700	4,5	83	8,6	80,7
Comisana	3.846	2,6	41	4,3	93,8
Delle Langhe	2.369	1,6	29	3,0	81,6
Assaf	1.325	0,9	12	1,2	110,4
Nera di Arbus	1.226	0,8	36	3,7	34,0
Carsolina	200	0,1	1	0,1	200,0
Barbaresca	101	0,1	3	0,3	33,6

Source: A.I.A. (http://bollettino.aia.it)

Table 2. Recorded milk productions by breed.

	Primiparous			Secondiparous			Third Parity And Over			All Ewes		
Breed	Milk Lt.	Fat %	Protein %	Milk Lt.	Fat %	Protein %	Milk Lt.	Fat %	Protein %	Milk Lt.	Fat %	Protein %
Lacaune	215			321			330			304		
Assaf	187			276			302			271		
Sarda	153	5.08	5.01	231			237			225		
Valle Del Belice	152			234			227			225		
Massese	117			125			132			129		
Nera Di Arbus	101			181			189			177		
Delle Langhe	87			138			154			142		
Comisana	76	6.51	5.06	173			151			156		
Pinzirita	75	6.07	5.31	120	5.86	4.80	129	5.96	4.78	117	5.93	4.85
Noticiana	53	6.47	5.28	105	5.70	5.23	101	5.93	5.10	97	5.82	5.20
Carsolina				119			106			114		

Source: A.I.A. (http://bollettino.aia.it)

The most productive breed is Lacaune, followed by Sarda, Valle del Belice and Massese. Milk analyses are not done in all breeds: the main activity is on Sarda primiparous ewes, and on other breeds like Comisana, Pinzirita, and Noticiana. Among native breeds, Sarda and Valle del Belice are the best milk producers.

Dairy goats

In 2022, 55,671 goats were performance recorded in 642 flocks. Figures 3 and 4 show the distribution of recorded goats and flocks in the period.

Compared to sheep, goats are more evenly distributed in the country. Northern Italy has a good number of goats, even if southern and insular regions have more than 50% of recorded heads. (Figure 4)

As before, the number of recorded flocks is proportional to recorded heads. The distribution of goats and flocks by breed is shown in Table 3, in whichonly breeds with more than 30 heads are included.

The number of recorded goat breeds is higher than sheep. In this situation, five breeds share about 80% of total heads (Camosciata delle Alpi, Sarda, Saanen and Aspromontana). Recorded milk productions by breed are shown in Table 4. The most productive breed is Saanen, followed by Camosciata delle Alpi, Bionda dell'Adamello and Roccaverano. Milk analyses are done on almost all the recorded breeds.

Figure 3. Distribution of recorded goats in 2022. Source: A.I.A. (http://bollettino.aia.it)

Figure 4. Distribution of recorded goat flocks in 2022. Source: A.I.A. (http://bollettino.aia.it)

Table 3. Distribution of goats and flocks by breed.

Breed	Recorded heads	% on total	Recorded flocks	% on total	Average heads per flock
Camosciata Delle Alpi	12.775	22,9	222	34,6	57,5
Sarda	12.551	22,5	118	18,4	106,4
Saanen	9.180	16,5	127	19,8	72,3
Aspromontana	8.005	14,4	93	14,5	86,1
Rustica di Calabria	4.697	8,4	103	16,0	45,6
Nicastrese	3.618	6,5	65	10,1	55,7
Murciana	1.122	2,0	17	2,6	66,0
Sarda Primitiva	505	0,9	15	2,3	33,7
Messinese	401	0,7	10	1,6	40,1
Maltese	291	0,5	26	4,0	11,2
Argentata Dell'etna	267	0,5	11	1,7	24,3
Roccaverano	212	0,4	6	0,9	35,3
Verzaschese	109	0,2	6	0,9	18,2
Bionda Adamello	54	0,1	4	0,6	13,5
Girgentana	49	0,1	3	0,5	16,3
Garganica	46	0,1	2	0,3	23,0
Rossa Mediterranea (Derivata Di Siria)	46	0,1	3	0,5	15,3
Jonica	37	0,1	2	0,3	18,5

Source: A.I.A. (http://bollettino.aia.it)

Table 4. Recorded milk productions by breed.

Breed	Primiparous			Secondiparous			Third parity and over			All goats		
	Milk Kg.	Fat %	Protein %	Milk Kg.	Fat %	Protein %	Milk Kg.	Fat %	Protein %	Milk Kg.	Fat %	Protein %
Saanen	420	3,52	3,30	621	3,55	3,34	639	3,40	3,30	584	3,48	3,32
Camosciata Delle Alpi	405	3,72	3,37	588	3,60	3,41	618	3,55	3,39	554	3,60	3,39
Bionda Adamello	386	3,45	3,02	402	3,11	2,96	550	2,83	2,83	479	2,98	2,89
Roccaverano	351	3,87	3,17	460	3,48	3,14	459	3,46	3,30	449	3,50	3,24
Murciana	237	4,75	3,53	430	4,60	3,53	327	4,36	3,40	368	4,52	3,48
Maltese	208	4,49	3,45	324	3,89	3,42	338	4,17	3,48	314	4,08	3,45
Verzaschese	196	3,83	3,23	345	3,87	3,39	345	3,51	3,19	303	3,75	3,30
Nicastrese	191	4,66	3,77	191	5,17	3,87	197	5,14	3,84	195	5,11	3,85
Jonica	157	4,46	3,82	263	5,25	3,87	292	5,08	3,73	283	5,10	3,76
Rossa Mediterranea (Derivata Di Siria)	146	4,67	3,48	189	4,40	3,80	182	4,02	3,50	169	4,37	3,59
Garganica	144	4,92	3,47	180	4,22	3,39	189	4,34	3,46	177	4,41	3,44
Aspromontana	128	4,33	3,15	173	4,45	3,71	185	4,54	3,71	180	4,51	3,71
Sarda	115	4,62	3,74	156	5,67	4,31	157	5,57	4,36	153	5,02	3,98
Rustica di Calabria	90	5,30	3,94	128	5,30	3,94	140	4,99	3,80	133	5,14	3,87
Sarda Primitiva	79	4,90	3,90	125			140			127	4,90	3,90

The importance of correctly working milk recording devices and milking plants: AIA's Milking Control Service

The Italian DHI organization (AIA) established and developed a national service called SCM (Milking Control Service) since 1970. SCM personnel comprises more than 100 highly qualified technicians providing different services in the field of milking and milk recording activity. According to ISO regulation, SCM checks the efficiency of milking systems both in the absence (dry test) or presence (wet test) of milked animals. SCM's technicians inform owners on incorrect settings or calibration, on every working issue and, where possible, assist the farmer to fix them or to contact manufacturers for technical corrections.

These activities are crucial for milk production and animal welfare: for example, correcting vacuum levels above certain limits avoids animal stress and mammary gland' susceptibility to mastitis and increases milk yields. On the side of milk recording, SCM performs calibration checks for both milk meters installed in farms or used by technicians. With these tests is possible to detect, if any should occur, milk registration errors and whenever possible it is performed a correction of working biases or an adjustment of milk meters components.

In addition, all the calibration heck' equipment in allocation to SCM's technicians, are calibrated annually in a centralized SCM laboratory in Maccarese, near Rome. Furthermore, SCM service identifies through numbered sticky labels all the milk meters used in farms for performance recording. Within the EU-funded LEO (Livestock Environment Opendata) project, SCM acquired new-generation VaDia kit, a vacuum multisensor for evaluation of milking routine and machine efficiency and Lactocorder TT devices to analyse milking curves, animal milk ejection efficiency, and check milking routines.

The goal is to use these advanced tools to enhance service testing (e.g., assessing pulsator settings and faults) and to examine the milking systems and management efficiency thoroughly, giving farmers early alerts, advice, and extension services to improve animal welfare and milk quality and yield. The SCM will then gather innovative information and data with state-of-the-art instruments, offering the farmer integrated, practical, broad-spectrum support.

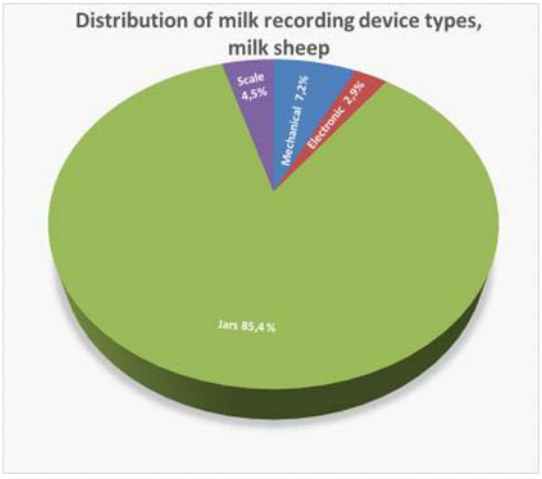

Figure 5. Percentage of milk recording devices categories used in milk performance recording for sheep in 2022

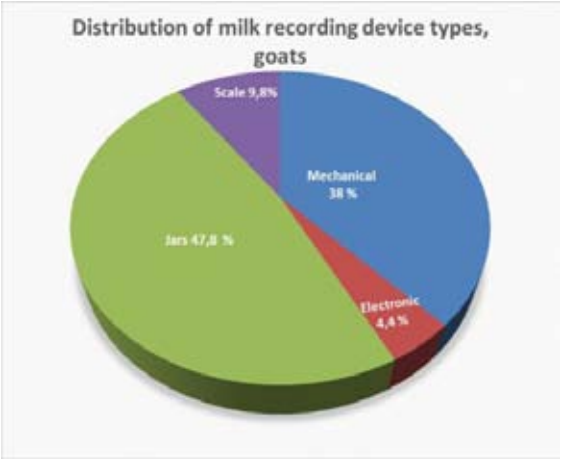

Figure 6. Percentage of milk recording devices categories used in milk performance recording for goats in 2022

Milk recording devices: types and distribution

As mentioned before, SCM service identifies all milk recording devices used in Italy, both fixed in-farm meters or portable devices to be installed on the day of the performance recording, . It is therefore possible to make some statistics on the working devices situation. The following figures show the percentage of each device type category used in sheep and goat performance recording.

Jars are the most common type of milk recording in both species but are more used in sheep (85.4% of all milk recording device types) while in goats they represent slightly less than 50%; moreover, mechanical meters are proportionally more used in goats (38%) than in sheep (7.2%, one fifth of those in goats). Scales are proportionally more widespread in goats (9.8%), while in sheep they account for half this proportion. Lastly, electronic meters are less than 5% of all device types, with a lower value in dairy sheep.

Pilot study: Influence of calibration on performance recording results

A pilot study was conducted to check if any problem of electronic milk meters could occur in calibration and subsequent milk measuring biases. For this purpose, the pilot study was set up by AIA SCM service in a Sarda flock in Tuscany. The milking plant was a milk parlour line 12 + 12, low milk line equipped with MM25 De Laval milk meters (Azienda Mesina, Pergine Valdarno, Arezzo (Tuscany)). To get rid of any effect of line length and better manage the installed devices, six MM25, three for each line (placed in start, centre and end of the line) were chosen. These devices were restored to factory default andin addition, an acid washing of the plant was done to remove any dirt in pipelines. 10 animals per meter were milked, with a total of 60 milkings. A procedure to check the milk meters calibration with real milk yields was performed. The procedure, for each milked animal, consisted in:

- Connecting 6 portable jars (MIBO) with the outlet nipple of the MM25 to correctly collect the milk, taking care that connection followed the connecting pipe inclination as reported on the manufacturer's instruction.
- Reading milk yield on the MM25.
- Collect the related milk from MIBO jar to a bucket and record the milk weights, a digital calibrated scale was used to weigh the milk collected by the jar;
- Make a comparison between recorded production and meter measurement and calculate, for each meter, the average difference between weighed and MM25 milk. Usually, this average is used to check the calibration.

For each meter and each milked animal, a difference in weight between weighted (scale) and measured milk was calculated and expressed as % deviation on scale weight (taken as reference measure). Overall results are presented in table 5.

Table 5. Overall results of the pilot study.

Meter #	Milked ewes	Recorded milk (g), average		Difference Scale - MM25, average	
		MM25	Scale (Reference)	g	% on Scale
1	10	582	543,1	**-38,9**	**-7,61**
2	10	567	548,1	**-18,9**	**-9,39**
3	10	551	530,5	**-20,5**	**-13,12**
4	10	564	564,1	0,1	-0,10
5	10	644	641,9	-2,1	-0,11
6	10	498	494,8	-3,2	-0,99

As a result, over the 6 meters used, 3 had an average % deviation within 1%, while the other 3 had very large average % deviations (Meters 1,2,3, values in bold). Following such results, a single-animal analysis was performed for the biased meters.

The evaluation of the measures of single animals in the biased meters was performed. For meters 1 and 3 it was found that primiparous ewes were milked in the trial. These primiparous, according to the farmer and the SCM technician, caused some problems in milking routine because they were not yet used to mechanical milking, and they could kick and make body movements that could cause vacuum problems and abnormal milking: in table 6 the situation of meter number 1 is reported.

Table 6. Situation of a meter is reported.

Animal #	MM25, g	Scale, g	Diff MM25 - Scale, g	Diff MM25 - Scale, % on Scale
1	700	668	-32	-4,79
2	620	614	-6	-0,98
3	230	236	6	2,54
4	690	674	-16	-2,37
5	700	685	-15	-2,19
6	580	575	-5	-0,87
7	530	446	-84	-18,83
8	660	593	-67	-11,30
9	520	420	-100	-23,81
10	590	520	-70	-13,46
Average	**582**	**543,1**	**-38,9**	**-7,61**

It was found that animal 1 to 6 were pluriparous ewes, while 7 to 10 were primiparous ewes. Primiparous animals, even having regular yields, showed a significant overestimation of measured milk, that increased the overall bias (-7.61%) of the meter. When animals 7 to 10 were removed from the sample, the overall bias just went down to allowable values (-1.44%), as reported in table 7.

This means that if primiparous are included in the sample for calibration, there could be a risk of not correctly calibrate the meter.

Table 7.Overall bias variation to allowable values.

Animal #	MM25, g	Scale, g	Diff MM25 - Scale, g	Diff MM25 - Scale, % on Scale
1	700	668	-32	-4,79
2	620	614	-6	-0,98
3	230	236	6	2,54
4	690	674	-16	-2,37
5	700	685	-15	-2,19
6	580	575	-5	-0,87
Average	586,7	575,3	-11,3	-1,44

Table 8. Variation of one value out of ten that was heavily overestimated.

Animal #	MM25, g	Scale, g	Diff MM25 - Scale, g	Diff MM25 - Scale, % on Scale
1	380	366	-14	-3,83
2	660	657	-3	-0,46
3	230	224	-6	-2,68
4	230	228	-2	-0,88
5	1050	1093	43	3,93
6	220	126	-94	-74,60
7	630	642	12	1,87
8	740	657	-83	-12,63
9	480	476	-4	-0,84
10	1050	1012	-38	-3,75
Average	567	548,1	-18,9	-9,39

Another issue was found studying the single readings in meter number two. In this case, as reported in table 8, there was just one value out of ten that was heavily overestimated.

Animal # 6 was studied and identified as a low-producing animal due to trauma consequences; it was inspected and very low milk flow from udder was verified. In this case, it seemed like the meter was influenced by low milk flow and/or low milk yield, that resulted in a big individual and group bias. Should animal # 6 not be considered, meter bias would be reduced from -9.39 to -2.14%.

Results seem to indicate that if low producing ewes are included in the sample for calibration, there is a risk to calibrate with a new bias not eliminating the error. Results from this study showed that new devices (in this case, restored to factory default), if correctly installed, are working well; however, the choice of animals to be included in data for calibration is essential because if primiparous ewes or low yield ewes are included in the set of milked animals used for calibration, they can increase the error.

Conclusions

Sheep and goat milk performance recording in Italy, carried on by A.I.A. (Italian Breeders Association, Italian national DHI) have a consolidated importance due to the broad diffusion of the two species and their capacity to thrive in hilly and dry environments, particularly in the southern and insular part of the country. Performance recording is carried on using jars, scales and mechanical milk meters, with a minor use of electronic meters. All meters and milking plants used for performance recording are routinely checked and verified for calibration by A.I.A.'s Milking Control Service (SCM) that, using brand new advanced instruments like VaDia and Lactocorder, can add innovative services for the farmers. Regarding electronic milk meters, their calibration could not be effective if some categories of animals (primiparous, less used to mechanical milking) or low-producing heads are included in the sample used for calibration.

References

A.I.A. Bollettino OnLine Controlli sulla Produttività del Latte - 2021/2022 (official milk performance recording results). http://bollettino.aia.it