

Supplementary table 1: Main characteristics of the studies, method used and discussion of the results; N/A: not available; AMS: automatic milking system; CMS: conventional milking system

Reference	Region	Year	Change in labor time	Scale/system	Comparison	Method / data	Method details	Interpretation / discussion
Sonck 1996	N/A	1996	From -37.9% to -66.1%	N/A	Before vs. after	Simulation model	A simulation model with few data from real observations.	The oldest study is also the one showing the greatest reduction in working time. - human-controlled cow traffic: -37.9% - computer-controlled cow traffic: -66.1%
Mathijs 2004	Western Europe (Belgium, Denmark, Germany and Netherlands)	2001-2002 (data)	-19.8%	Farming system?	Before vs. after	Survey face-to-face nAMS=107	Limited information – the only study which compares samples from different countries (Belgium, Denmark, Germany and the Netherlands).	'AM farmers reported an average labor saving of 19.8%, which increases to 21.3% when only farms that have kept their herd size more or less constant are considered.'
Bijl et al. 2007	Netherlands	2002-2003 (data)	-29%	Farming system (accounting data)	AMS vs. CMS	Accounting data nAMS=31; nCMS=31	A selection of accounting data to minimize differences between the two samples and maximize comparability between AMS and CMS farms.	'In our study, the AMS31 used, on average, 29% less labor (P < 0.001) than the CMS31. Labor costs for external workers were expected to be smaller for the AMS31 because less labor should be needed. However, in our study the use of external workers was almost equal between the groups. This meant that less home labor was used. This was also shown by the costs of external workers: the AMS31 was €7,982 and the CMS31 was €8,438.'
De Jong and Finnema 2003	North America (USA and Canada)	2003	No difference	Workers	Before vs. after	Interviews with farm managers nAMS=25	25 AMS farms (10 USA, 15 Canada).	'Farmers expected the robot to bring about less work hours on the farm. These expectations were not entirely met, as farmers reported no decrease in work hours.'
Gustafsson 2004	N/A	2004	-45%?	Livestock farming system	AMS vs. CMS	Observation nAMS=4; nCMS=4	Insufficient information on the method used.	
Oudshoorn et al. 2012	Denmark	2005 (data)	-43.4%	N/A	AMS vs. CMS	Questionnaire nAMS=9; nCMS=9	'These tasks were as follows: milking, fetching and registration; treatment and surveillance; feeding; providing bedding straw in the cubicles; cleaning; and miscellaneous.'	AMS = 3.0 min per cow per day CMS = 5.3 min per cow per day Tasks concerning the robot (AMS cleaning and maintenance, alarms, checking AMS system data) not considered.
Steenefeld et al. 2012	Netherlands	2010 (data)	No significant difference	Farming system (accounting data)	AMS vs. CMS	Accounting data nAMS=63; nCMS=337	Accounting data and representativeness: 'their clients can be characterized as farms who are interested in getting information about their financial performance to assist in making enhanced management decisions.'	'The number of full-time equivalents (FTEs) was not different between AMS and CMS farms, which is in contrast with the results of Bijl et al. (2007) who found a lower number of FTE on AMS farms. A possible explanation for this difference could be that the farmers who invested in 2003 (Bijl et al., 2007) invested to lower the amount of labor and to have more free time, as described by Mathijs (2004). Farms in the current data set may more focused on increasing size than on having more free time, thus showing no decrease in FTE as they plan and transition to more cows.'
Heikkilä et al. 2010	Finland	2010	-30%	Farming system (accounting data)	AMS vs. CMS	Accounting data (depending on the year under consideration: AMS from 59 to 82; CMS from 16 to 35)	'We employed data on Finnish dairy farms from the EU Farm Accountancy Data Network (FADN)'	
de Koning 2011	Netherlands	2011	-29%	Unclear	AMS vs. CMS	Simulation model (Dutch case-control study)	No information.	'AM farms saved 29% labor, and therefore when economical results were transformed to full-time equivalents (FTEs), AM farms in the case-control study had greater revenues, margins, and gross margins per FTE than the farms with conventional milking systems.'

Supplementary material

Author(s)	Country	Year	Findings	Participants	Time Point	Methodology	Study Details	Key Findings/Quotes
Butler et al. 2012	England	2012	No difference	Workers	Before vs. after	Interview and observations nAMS=3	3 case studies: - A farm with AMS for several years; - Askham Bryan Agricultural College with AMS and CMS side-by-side; - A farm in transition from CMS to 4 AMS	Martin et al. 2022 'Having a robotic milking system did change all the interviewees' lifestyles, although it did not seem to lessen the workload, "It was not a case of less work, it's just different." 'Despite this, the research showed that dairy farmers using AMS must deal with additional demands which are specific to this technology and so, whilst a robot takes away some of the hands-on work out of milking, the role of the stockperson has, as some interviewees described, increased, as more time had to be set aside to observe the cows with the aim of picking up health and welfare issues which had not been identified by the AMS.'
Hansen 2015	Norway	2014?	No difference	Workers	Before vs. after	Unstructured interviews nAMS=19	19 AMS dairy farmers in southern Norway who had invested in robotic milking from 2005 to 2011.	'Only five of the farmers mention reduced workload as an advantage with AMS. I think this female farmer in her 40s explains why many of the farmers work just as much as before. 14: "We work more hours now, but that is due to increased production. The number of cows is twice as high, with the same milk quota the workload would have been reduced." 'It is not always straightforward to tell how the AMS affects the number of working hours. 13: "I'm not quite sure about the number of working hours now as compared to before, ... it depends on whether you include the things you ought to do or not." What this farmer gives a hint of is that one cannot leave the cowshed completely to the AMS.'
Vik et al. 2019	Norway	2014	Increase	Workers	Before vs. after	Interviews nAMS=26	26 AMS farmers 'eight were husband and wife families; two were husband, wife, and son families; five were two individuals who represented the farm such as joint farmers or an accountant; ten were male farmers, and one was a female farmer'	'Farmers expected the change in work to include more flexibility. However, some farmers did not fully account for the increased workload. In short, the working hours in-house remained approximately the same as before the installation of the AMS and the expansion, but the working hours outdoors increased.'
Shortall et al. 2016	Netherlands?	2016	-36%	Activity system?	AMS vs. CMS	Capture of real time on-farm data nAMS=7 ; nCMS=10	'The list of tasks for AM were: checking AM system data, fetching cows indoors, fetching cows outdoors, robot cleaning maintenance, alarms, grass allocation, other dairy tasks, other enterprise tasks, and non-farm activity.'	'The 36% reduction in labor associated with AM as measured in our study largely represented the reduction in time associated with the milking process from 3 hours/day with CM to 40 minutes/day with AM.'
Lunner-Kolstrup et al. 2018	Sweden	2018	Increase	Workers	Before vs. after	Semi-structured interviews and transect walks nAMS=2	No measurements but open-ended questions in order to assess subjective experiences of working with AMS	'Alarms from the AMS were frequent and, especially during night-time the informants experienced the alarms as stressful, with disturbed sleep and fatigue during the following day.'
Tse et al. 2018	Canada	2018	-61.5%	Milking-related activities	Before vs. after	Survey over the phone, online and in person n = 215	'Producers who previously operated an AMS farm but later reverted back to conventional milking systems (n=3) and surveys that were terminated before completion were excluded.'	Mean number of employees: -20% Mean time spent on milking-related tasks: -61.5% 'The number of employees also decreased with the transition to AMS in the current study, although the difference was small. A reason why the difference in number of employees before and after the transition was not larger may be that farms were reducing the amount of family labor first before decreasing number of employees.'