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The future of young dairy ruminants: how to conciliate livestock farming and societal expectations

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■ **In France, the dairy cattle, goat and sheep sectors together produce more than five million young animals every year. A third of these animals are used to renew the herds, while the others are either fattened in specialised operations in France, or exported. How these young animals are reared, how they are used, and what happens to them are issues of growing concern to the public, consumers, dairy farmers, and dairy value chains.[1]**

Introduction

In 2021, there were around 3,322,000 dairy cows, 943,000 dairy goats and 1,269,000 dairy ewes in France (Agreste, 2022), i.e. potentially more than 5.5 million births of young dairy ruminants per year (Table 1). On dairy cattle and goat farms, newborns are generally separated from their dam shortly after birth, and housed individually or in groups. After ingesting colostrum – usually from their dam – in the first few hours of life, they will be "artificially" fed from a bucket (with or without a teat), a feeding tray (with several teats) or an automatic calf feeder (ACF). The feed distributed is either whole milk (tank milk or unmarketable but healthy milk) or a powdered milk replacer diluted in hot water, or a combination of the two. On dairy sheep farms, lambs are separated later (at 28 days of age), and are suckled by their dams until they are able to feed themselves. Early separation of the dam and young has long been part and parcel of livestock farming, and is still widely advocated (Inosys Réseaux d'élevage caprins, 2014; Teagasc, 2017) because it causes less stress, allows better control of colostrum and milk consumption, reduces the risk of transmission of certain diseases, and increases the quantity of marketable milk. However, the practice regularly comes under challenge, singled out in media campaigns led by militant animal rights organisations or animal protection non-profits (L214, PETA, Welfarm...). It also prompts citizen concern about standards of animal welfare, and in particular the ability of all animals to fully and freely express the normal behaviours of their species (Naspetti *et al.*, 2021). Some dairy farmers opt for "natural suckling" by dams or foster dams, sometimes until weaning, as practised in suckler farming and traditionally in dairy sheep farming.

Some citizens-consumers are also becoming concerned about the fate of young dairy animals – mainly males – that are not kept on the farm and in many cases are simply culled, sold or disposed shortly after birth as they are

1 This article leads out from an invited talk delivered at the 26th Journées Rencontres Recherches Ruminants on 7-8 December 2022 (Pomiès *et al.*, 2022a).

Table 1. ***Key data on the farming of young dairy ruminants in France.***

	Dairy cows	Goats	Dairy ewes
Herd headcount in 2021 *(Agreste, 2022)*	3,322,000	943,000	1,269,000
Average renewal rate	≈ 34%	≈ 35%	≈ 24%
Number of young females kept	1,200,000/year	330,000/year	300,000/year
Suckling	≈ 0	≈ 0	28 days
Standard age at weaning	9 weeks *(12 weeks in organic farming)*	6-8 weeks	4 weeks
Age at reproduction	Between 15 and 27 months	7 months	From 8-10 months
Age at first birth	Between 24 and 36 months[a]	12-13 months[b]	13-15 months[c]
Young animals reared and slaughtered in France	1,200,000 calves *+ 270,000 young bulls* *+ 140,000 steers*	550,000	≈ 800,000
Young animals exported *(live)*	337,000 *(93% to Spain)*	0	≈ 450,000 *(to Spain and Italy)*

[a]median age of 32 months; [b]target for 90% of females; [c]24 months in Pyrenean pastoral systems.

seen as unprofitable, even if they feed other livestock sectors (Placzek *et al.,* 2021). The situation in France is not the same as in New Zealand, where there is mounting criticism over the slaughter of more than 2 million 4-7 day-old "bobby calves" every year (Van Dyke *et al.,* 2021), but there is still room to rethink current husbandry systems, borrowing inspiration from other dairy regions (Buczinski *et al.,* 2022).

The aim of this review is *i)* to restate the natural behaviours of young animals in the three major dairy species; *ii)* to inventory the current methods of rearing these young ruminants for herd renewal or meat production, and *iii)* to identify alternative practices that can meet citizen and consumer expectations around better animal welfare, but also farmers' expectations around better consideration of their work and better value-streams for their output.

1. Dams and their offspring under natural conditions

As calving approaches, cows, ewes and goats tend to isolate themselves from the rest of the group. This isolation move is very marked in wild animals, such as the mouflonne (Langbein *et al.,* 1998), but less so in domestic animals – even though a ewe may give birth in the midst of the flock. Even when housed indoors, a cow will isolate herself just before giving birth if she has access to a covered area (Proudfoot *et al.,* 2014). Under natural conditions, isolation allows the female to avoid dangers and disturbances during calving, and to provide the first bouts of suckling while starting to forge a special bond with her offspring.

In the minutes following birth, the dam sniffs and licks her newborn(s); this activity is particularly marked during the first few hours, but then decreases (Jensen, 2012; Freitas-de-Melo *et al.,* 2015). The newborn, encouraged to stand up by their dam, is attracted to the udder by essentially olfactory signals that resemble those contained in the amniotic fluid it experienced *in utero* and for which it has a manifest preference (Schaal *et al.,* 1995). The dam can help the newborn by adopting a posture that facilitates access to the udder. The newborn generally manages to suck its first milk within an hour of birth.

After the first bouts of suckling, a lamb recognises its dam not only by olfactory signals but also by bleating associated with sight of the ewe. After a few weeks, the sight of the ewe is sufficient for the lamb to recognise her (Veissier *et al.,* 1998). The preferential dam-lamb bond is established from day one (Chniter *et al.,* 2017). The dam and her one or several offspring stay close to each other and often sniff and lick each other (the offspring may also solicit a lick by standing in front of its dam and giving her a gentle headbutt on the neck), and they will show signs of distress if they get separated. In choice tests, the dam will prefer her young over another, and the young will prefer its dam over another. The dam's behaviour is often more selective than the offspring's: she will not let other young suckle her, whereas the young may attempt to "steal" milk from other dams. In certain dairy cattle breeds such as Holstein, dams often accept being suckled by an unrelated calf. This low selectivity almost certainly translates into high milkability.

The behaviour of offspring is often described according to the "*hider/follower*" dichotomy (Rørvang *et al.,* 2018). *Followers*, like lambs, follow their dam

from birth and quickly become part of the flock. This strategy appears to be adapted to wide-open environments, where it is in the female's interest to give birth in the group so as to benefit from its protection. *Hiders*, such as calves and goat kids, will remain isolated from the herd in the hours following birth, sometimes even away from the dam, and will only join the rest of the herd after one or more days. This strategy seems to be particularly well suited to environments that afford shelter, where the female can keep her young out of sight of predators. These behavioural traits are also observed to a lesser extent on farms, even though predators are rarely present.

After the neonatal phase during which it interacts mainly with its dam, the offspring starts to develop its relationships with the other members of the group. Although it will retain its preferential bond with its dam, it will more frequently interact with other offspring of the same age, by sniffing, licking, and head-rubbing play. As the offspring grows, the dam may refuse to be suckled (Fonsêca *et al.,* 2016). However, the dam-calf bond continues beyond the suckling phase. For example, a cow that gives birth in the presence of her one-year-old calf divides her activities between the newborn, which she cares for (licking, suckling), and her one-year-old calf, which she accompanies when she grazes (Veissier *et al.,* 1990a).

Relationships established at a young age with other offspring are maintained when the animals are mixed with others. Preferential relationships (resulting from non-aggressive interactions) take precedence over hierarchical relationships (resulting from aggressive interactions) between animals that got to know each other when they were young. Relationships established later on will not be as close (Raussi *et al.,* 2010). The dam plays a decisive role not only in the survival of the young (feeding, protection) but also in its behavioural development (May *et al.,* 2008; Dwyer, 2014; Théoret-Gosselin *et al.,* 2015). For example, the presence of the dam influences the offspring's food preferences (Thorhallsdottir *et al.,* 1990), prevents the development of non-nutritive oral behaviours (Veissier *et al.,* 2013), and facilitates the development of social behaviour (Waiblinger *et al.,* 2020) and even sexual behaviour (Lacuesta *et al.,* 2018). Furthermore, young animals reared without their dam appear to be more emotionally reactive (Toinon *et al.,* 2021). Separating an animal from its usual partners generates distress reactions, particularly during weaning (Mora-Medina *et al.,* 2015; Nicolao *et al.,* 2022). Three weeks after separation from its calf, a cow loses interest in it (she no longer goes towards her calf when it is presented to it again) whereas a calf and a lamb remain attached to their dam for a month (Veissier *et al.,* 1990b; Ungerfeld *et al.,* 2018).

2. Current husbandry systems

In dairy systems, rearing young animals is first and foremost a necessity to trigger milk production. Some of the young females are bred to ensure the renewal of the herd, while the other young animals are mostly destined to produce meat. The renewal rates in French dairy cattle, goat and sheep farms are 34% (Institut de l'Élevage-France Conseil Élevage, 2021), 35% (Agreste, 2022) and 24% (Morin E., Valorisation des données 2020 Inosys Réseaux d'élevage, unpublished), respectively.

■ 2.1. Herd renewal systems

a. Heifers

With a median age at first calving of 32 months (Reproscope, 2022) and current renewal rates, heifers account for almost 50% of the animals on most dairy cattle farms.

Traditional husbandry methods aim to achieve optimum mammary development to ensure good milk production at controlled cost. The usual recommendations suggest strong sustained growth during the first 6 months of life (900 g/d) then slowing (500 to 800 g/d) depending on target age at first calving and diet strategy. Weight targets are defined at standard ages (expressed as a percentage of adult weight), whatever the breed genetics (Table 2).

Pre-weaning rearing conditions are particularly important. Colostrum, which is the very first food the newborn eats, provides both the immune protection it lacks at birth and sufficient energy for its survival. A minimum of

Table 2. ***Target weight for heifers between 6 and 36 months (expressed as percentage of adult weight) according to targeted age at first calving (taken from Institut de l'Élevage, 2010).***

Age	Targeted age at first calving		
	24 months	**30 months**	**36 months**
6 months	30%	30%	30%
12 months	50%	43%	43%
15 months	60% *(mating)*[a]		
21 months		70% *(mating)*[a]	
24 months	90% *(calving)*[b]		
27 months			75% *(mating)*[a]
30 months		93% *(calving)*[b]	
36 months			95% *(calving)*[b]

[a]at the time of mating; [b]before calving

2 litres of colostrum is recommended immediately after birth, and again at 6 to 12 hours later (Le Cozler *et al.,* 2009). The calf is then fed whole milk and/or milk replacer until weaning. Conventional milk plans suggest weaning the animals once they can eat 2 kg/d of concentrates and have at least doubled their weight since birth, i.e. an average age at weaning of 9 weeks in conventional systems (INRA, 2010).

Immediately removing the calf from its dam helps control colostrum intake, facilitates postnatal veterinary care, and reduces the risk of exposure to environmental pathogens. It also helps to control milk intake, monitor calf growth, and maintain contact between calf and farmer.

The objective of sustained growth up to 6 months of age, regardless of the age-at-first-calving strategy, is to promote the bone and body development of the heifer, which is conducive to greater longevity in the cow (Le Cozler *et al.,* 2009). Subsequently, in early calving (24 months), live weights of 400 kg at 15 months of age (start of mating) and 600 kg at calving are expected in the Holstein breed, which equates to a growth gain of 750 g/d. With late first calving (36 months), the objective is moderate growth (500 g/d) from 6 months to the last third of gestation, to avoid excessive fattening.

The daily worktime devoted to heifers varies widely, but nearly half of farmers put it at less than one hour (Le Cozler *et al.,* 2012). Despite numerous technical documents and outreach training courses, farmers often see rearing heifers as a secondary task (Mathieu *et al.,* 2014). Nearly two-thirds of farmers surveyed felt that rearing heifers was a necessity, 36% found it enjoyable, and 2% felt that it was "a chore". More than 80% will raise all the females born on the farm, which represents significant additional labour and economic burden. This results in a renewal rate well above the recommended 30%, and many animals are culled prematurely after 2-3 lactations, whereas the return on investment would only become effective after 3-4 lactations. In this survey, half of the farmers left the calf with its dam for at least the first suckling, with the other half separating them immediately after calving. The calves were weaned at an average age of 11 weeks, and 70% of them used whole milk during the lactation phase. A lot of research in the past few years has focused on simplifying the management of heifers and reducing livestock costs. Feeding plans have been developed that use fermented (or "yoghurt-like") milk or 30% less milk and 6 milk-based meals per, enabling calves to reach the same weights as on conventional plans at 6 months of age, but with less work (Le Cozler *et al.,* 2009; Jurquet *et al.,* 2020).

Finally, since the phase-out of milk quotas, there has been a resurgence in farmers delegating heifers from suckler operations to fattener operations. The heifers are entrusted out at around 3-4 weeks of age, then return to their "home" farm a few weeks before calving.

b. Female goat kids

The French goat sector counts almost 330,000 replacement kids, that will birth their first kid at around one year of age (Inosys Réseaux d'élevage caprins, 2014). The kids are separated from their dam at birth. As with other ruminants, colostrum intake is essential at birth to avoid neonatal illnesses (45% of goat farms are affected by neonatal diarrhoea, which is considered problematic; Ehrhardt *et al.,* 2014). It is therefore advisable practice to give kids 400 mL of immunoglobulin-rich colostrum (measured with a refractometer > 24 BRIX) within the first 6 hours of birth. In addition, to limit the onset of adult diseases (paratuberculosis, mycoplasmosis and caprine arthritis encephalitis virus [CAEV]), it is recommended to separate the kid immediately from its dam, to not let her lick it or let the kid drink from the udder, to milk the colostrum and heat it (at 56°C for one hour) before distribution.

The kids are then mainly fed milk powder until they are 6-8 weeks old, when they will reach a weight at weaning of 14-16 kg depending on the breed. Given the spiralling price of organic milk powder, studies have shown the value of using yoghurted-like raw milk, which gives comparable daily gain rates (≈ 220 g/d; Sahlu *et al.,* 1992; Cap Pradel, 2019), but it does not prevent the transmission of CAEV and mycoplasma. During this period, kids that show < 150 g/d growth gain (≈ 5% of the population) are generally re-streamed to be butchered for meat.

As soon as the kids are ruminating, they are ready to wean. To ensure successful weaning, feed intake should be at least 200 g forage and 100 g concentrate per day (Guide pratique : L'élevage des chevrettes; Idele, forthcoming). As the objective is for at least 90% of kids to birth for the first time at around 12-13 months, they are weighed and regrouped regularly to ensure homogeneous growth. Like with heifers, there are recommended weights at standard ages, typically 25%, 40% and 50% of adult weight at 2 months (weaning), 4 months and 7 months (mating), respectively. The aim is above all to achieve optimum rumen development, without excessive fattening, to maximise the goat's intake capacity in preparation for future lactations. From mating to kidding, the growth target is set at 100 g/d. To limit feed stress at the start of lactation, production feed (particularly for silage-based rations) is gradually introduced into the ration during the last month of gestation. On farms that practice grazing, turning the kids out to pasture enables them to acquire eating habits that will enable them to make optimum use of meadows and rangeland in their future adult lives. Goat kid rearing can also be contracted out.

c. Ewe lambs

In dairy sheep farms, after lambing, lambs of both sexes are reared by their dam until around one month old, at which point they are able to feed themselves. This traditional practice concerns all five breeds of French dairy ewe and is employed by virtually all sheep farmers. It is even written into in the specifications for Roquefort and Ossau-Iraty PDO cheeses. Furthermore, since November 2020, the extension of an interprofession agreement (Interbev) has set a minimum weaning age for lambs (male and female) of 28 days for sell-on for fattening. Note too that the "Lait de brebis France" charter championed by

France Brebis Laitière commits farmers to ensure that "ewes rear their lambs by suckling at the udder".

After birth, the lambs are isolated with their dam for a few hours in a lambing pen to strengthen the bond between ewe dam and young lamb. The average number of lambs born per ewe (prolificity) varies from 1.1 to 1.6 depending on breed and method of reproduction. Dams and lambs are then reared together. Two to three weeks after lambing, the ewes go into the milking parlour for an udder health check and (if necessary) to expel any milk that the lambs have not suckled. The lambs are gradually separated from their dam for a few hours each day until weaning, which takes place at around four weeks of age, but sometimes later in Corsica and the Pyrénées-Atlantiques region. Pens that only the lambs can get into are used to provide them with concentrated starter feed.

Renewal ewe lambs represent 19% to 26% of a farm's flock, depending on the breed. At weaning, the aim is for renewal ewe lambs to weigh around 20% of their adult weight (i.e. 15 kg for an adult weight of 70 kg in the Lacaune breed). Three weeks after weaning, good-quality hay is introduced into the ration, always combined with ample free-to-eat straw and a concentrated feed. The objective is to foster forage intake to develop the rumen. Turnout to pasture should be arranged around the risk of internal parasitism. For early population control (8-10 months), ewe lambs should have reached 2/3 of their adult weight. They join the adult flock after lambing. As production in dairy sheep farming is seasonal, the farmer's objective is for their ewe lambs to birth a few days to 3 months later than the adults, so that they are sufficiently developed for the first mating. Some pastoral systems, particularly in the Pyrénées-Atlantiques, favour a first lambing at two years of age, which allows the ewe lambs to be reared more extensively and gives them ample time to reach their adult weight by the time of lambing. There are also practices that involve delegating ewe lambs for growth stages, particularly in the Pyrenees and Corsica. Lamb diarrhoea remains one of the major problems during the suckling period (45% of flocks affected out of more than half the lambs born in the Occitanie region; Gerber P., Corbière F., Rapport final du projet DIARRA : Contrôle de la diarrhée des agneaux en élevage ovin laitier; FranceAgriMer study report, unpublished).

■ 2.2. Rearing young stock not intended for renewal

a. Male dairy calves

In France, in 2020, around 60% of male calves and 10% of female calves from the national dairy herd (i.e. ≈ 1.2 million calves) were streamed into the veal calf value-chain sector (Institut de l'Élevage, cited by SPIE Normabev). This sector is organised around specialised fattening operations with an average size of 350 places, mainly concentrated in the big dairy foodshed of western France. Calves are taken in at a minimum age of 14 days and fattened for 21 to 25 weeks. They are reared mainly in closed-off forced-ventilation buildings, in 5-10 place group-lot pens on slatted wooden floors or occasionally on straw bedding. They are fed reconstituted milk (from milk replacer powder), supplemented with solid feed (a combination of cereals, oilcake, protein crops and chopped straw). The aim is to produce pale pink meat, dubbed "white meat". In 2020, the average carcass weight of Holstein veal calves was 141 kg.

Red meat production (25% of male dairy calves in 2016) is in steady decline. The main production, accounting for 16% of the market, is young cattle (the "Jeune Bovin" system in French. This fattening system aims to maximise growth potential by feeding an energy- and protein-dense diet (unlimited maize silage, cereals and protein concentrate). In the Holstein breed, carcass weights are 350-380 kg for animals slaughtered before 24 months of age.

Beef cattle production (8% of the market) involves fattening the animals with cheaper feed (grass grazed/conserved and a limited amount of concentrate). In the Holstein breed, the majority of beef animals are slaughtered at 30-36 months of age, at ≈ 360 kg carcass weight.

With 337,000 calves in 2020, France has multiplied its exports of young dairy calves not intended for renewal 2.6-fold since 2012. Spain, which takes in 93% of these exports, has become a crucial market for the sector, but these long-haul animal deliveries from France down to Spain prompt equally critical animal welfare concerns.

b. Goat kids

Around 550,000 kids, both male and female, are reared each year in France, 90% of which are slaughtered in 3 specialist abattoirs (in the Deux-Sèvres, the Saône et Loire, and the Vaucluse). This output produces 3,200 tonnes of meat, 55% of which is exported chilled or frozen, mainly to Portugal and Italy. The sector is structurally vulnerable sector, due to a combination of highly seasonal production and consumption (Christmas and Easter), loss of value-added due to rising operational costs (particularly for milk powder), and heavy dependence on export markets. Fattening has been gaining ground in recent years, mainly in specialist operations that rear between 1,500 and 70,000 kids a year. There are about fifty of these in the heartland goat-producing regions of western (≈ 50%), southeastern and southwestern France. Kids are collected from farms at between 3 and 8 days of age, depending on the local region's practice. The quality of kids entering the fattening unit (robustness, quality of colostrum intake, umbilical cord care) is pivotal to minimise health risks and encourage rapid growth-start. Once in the fattening pens, the kids are housed in collective barns (50-250 places) and fed powdered milk replacer using a feeding tray. They are fattened for 4 to 7 weeks, thus producing light kids (10-11 kg liveweight for a 5-6 kg carcass yield). Heavy kids (20-30 kg live weight), which tend to be sold through short supply chains, are a relatively niche market (≈ 5% market share).

c. Dairy lambs

Like ewe lambs, male lambs are suckled by their dam until they are 28 days old. They are sold off as a co-product

that, depending on the production area, generates a 16% to 21% share of the dairy sheep farm income, excluding subsidies. However, there is substantial variability due to differences in milk productivity, prolificity, and value of lambs depending on when they are put on the market (FranceAgriMer, 2018). There are two routes to market for lambs (male or female) not intended for renewal: *i)* Lacaune-breed lambs (≈ 800,000/year) are generally fattened in specialised units until they are 120 days old, and then go to the market for finished lambs; *ii)* lambs from other dairy breeds (≈ 450,000/year), which do not fatten out as well, are mostly exported at the age of one month for sale in Spain or Italy as milk-fed lamb. Farmers and farmer organisations are working hard to promote lamb meat. Milk-fed lamb from the Pyrenees holds Label Rouge status since 1992 and Protected Geographical Indication status since 2012. These official signs of quality and origin federate more than 750 farmers and concern around 15% of the 150,000 eligible lambs. A project has been tabled to enable cross-breeding between local dairy breeds and suckler breeds from the Pyrenees, and a recent exploratory study (Ellies-Oury *et al.,* 2022) has shown that these cross-breeds add valuable benefit in terms of lamb growth and carcass weight, without any loss in quality (sensory quality, fat profile, and so on).

3. Alternative husbandry practices

■ 3.1. French and European surveys

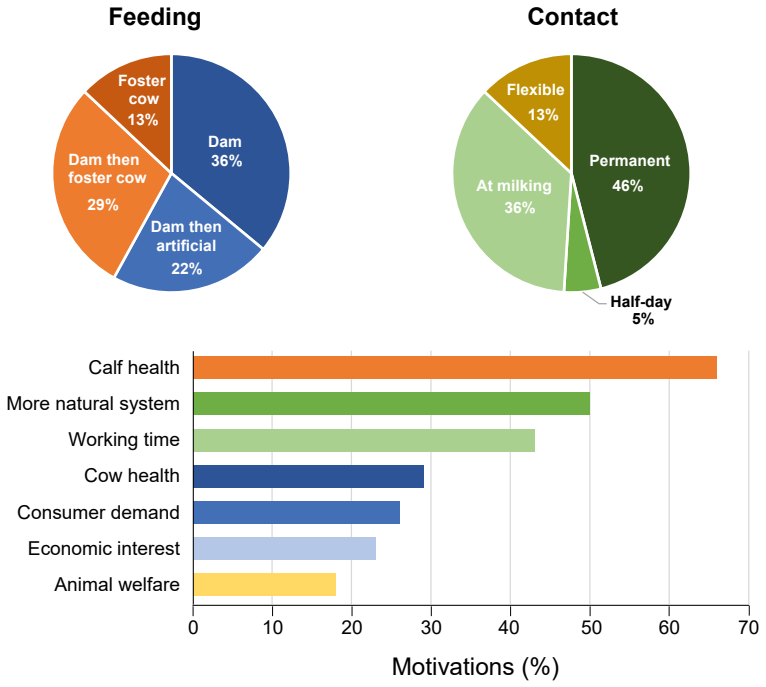
Over the last few years, surveys have been carried out in France and Europe, mainly by dairy cattle farmers, to inventory alternative farm husbandry practices for young stock. As well as describing the farms and their practices, these surveys have served to learn what motivates livestock farmers to adopt the practices, how they feel about these practices, the benefits they get and the barriers they experience.

A survey of 102 French livestock farmers in the Grand-Ouest, Massif central and Grand-Est regions who self-reported that they practiced natural suckling to at least some degree, revealed three main practices for renewal heifers as well as animals sold at 2-3 weeks of age or later: suckling alone [31%], suckling transitioning to artificial feeding [31%], and suckling transitioning to foster cow feeding [25%] (Michaud *et al.,* 2018). The same farm may sometimes work with different options, with varying lengths of suckling phases for renewal calves and calves intended for sale. Median farm size was 60 cows (8 to 210) and 56% were organic. The farmers' main motivation for adopting these practices was to improve animal health [51%] and working conditions [28%] and reduce time at work [46%] and herd costs [31%]. Of the 110 farmers initially questioned, 7% had recently abandoned natural feeding, mainly because their buildings were not suitable.

As part of the European ProYoungStock project, a survey of 104 farms in 6 countries (Austria, Switzerland, Germany, France, Italy and Sweden) that let their calves suckle for at least 7 days produced materially similar results in terms of practices (Figure 1; Eriksson *et al.*, 2022). Median farm size of farms ranged from 25 cows in Austria to 85 in Sweden, and 67% were organic. On 46% of the farms, the calves were permanently with the cows suckling them, on 5% they were together for half a day (day or night), and on 36% they were only together around milking (before, during, or after). On the remaining 13% of farms, length of cow-calf contact varied with age of the calf. Farmers' motivations were to improve calf health [66%], adopt a more natural system [50%], and reduce time at work [43%], followed by other factors, such as cow health, consumer demand, profitability, and animal welfare.

In addition, a synthesis of 7 surveys (in Denmark, France, the Netherlands and Norway) based on 73 interviews with organic dairy farmers practicing (or interested in) natural feeding was carried out as part of the European GrazyDaiSy project (Vaarst *et al.,* 2020). It showed that the positive feelings associated with this natural-feeding practice (more "natural" system, growth, learning and calf health, more rewarding work) are partly counterbalanced by negative aspects (reduction in quantity of milk sold, animals considered to be more "wild", visible stress during cow-calf separation).

Figure 1. ***Natural feeding system, daily duration of cow-calf contacts, and motivations of 104 farmers in 6 European countries (Germany, Austria, France, Italy, Sweden, Switzerland) who let their dairy calves suckle for at least 7 days after birth (Eriksson* et al., *2022).***



■ 3.2. Alternative husbandry system for replacement females

a. Maternal rearing of future heifers

This descriptor covers a wide range of practices (Sirovnik *et al.,* 2020) that differ in a number of ways:

- *The type of dam-calf contact*, which may be limited (in time, by a barrier, a fence, an anti-suckling brace, an udder cover, etc.) or not;

- *The duration of daily contact allowed*, which can be the whole day (except during milking), half a day (between morning and evening milking or vice versa), or short periods before or after milking;

- *The choice of contact* if the animals are not housed together, which can be calf-driven (access to the cow pen), cow-driven (access to the calf pen), or farmer-driven (opening/closing doors);

- *The period of contact,* which may be short (from a few days to 2-3 weeks) or long (until weaning at 8-12 weeks), or even very long (as long as the dam is producing milk).

According to a recent review of the literature (Nicolao, 2022), the many combinations of these methods have significant, sometimes contradictory, effects on the herd performance and economics of these systems. For example, calves suckled by their dam generally grow out better until weaning, but weaning is less gradual than with bucket or ACF feeding, resulting in a temporary weight loss due to a sudden dietary transition. If colostrum intake and quality are satisfactory, then suckling has no negative impact on calf health (see §3.2.3), and observation of their behaviour (social, feeding, grazing, etc.) shows an improvement in their welfare. On the cow performance front, although lactating cows yields a lower quantity of milk sold, the literature does not firmly conclude that there is a reduction in quantity of milk produced. The impact would therefore appear negligible for farmers who feed their calves tank milk, as is the case with organic farming. Conversely, the composition of the milk collected in the milking parlour fluctuates greatly with the presence of calves: milk fat content is lower (up to -8 g/kg) because calves tend to consume fat-rich alveolar milk, but milk protein content is higher (up to +2 g/kg), probably reflecting a better energy balance on the dam side of the equation. The presence of calves appears to improve udder health, with a reduction in the number of mastitis cases but not necessarily in number of cells. Sudden, late separation (at around 2 to 12 weeks of age) causes a great deal of stress for both the calf and its dam that is generally characterised by several days of frequent mooing and overactivity. The calf's growth may also temporarily halt, and the dam's milk production may fall. The economic impact of this practice has been under-researched, due to the wide range of possible conditions and the diverse profiles of dairy farms (Knierim *et al.,* 2020). To be worthwhile, the switch to natural feeding must not involve costly alterations to the buildings, and the work-related benefits (in terms of duration, fatigue, arduousness, etc.) must at least compensate for the decrease in milk production.

From 2017 to 2019, the INRAE Herbipôle farm in Marcenat (Cantal) (https://doi.org/10.15454/1.5572318050509348E12) tested five modalities of contact between female calves and their dam, either until weaning (for 20 min before morning milking; 2.5 h after morning milking; 9 h between morning and evening milking; 6 h between morning and evening milking) or until 4 weeks of age (6 h between morning and evening milking). These five modalities (5 groups of 14 dam-calf pairs) were compared with a control group of contemporaries reared in a conventional system (calves separated at birth and fed on tank milk with an ACF). The main results in terms of herd performance (≈ 30% less milk milked during the period, milk fat content lower by ≈ 3.0 g/kg, milk protein content higher by ≈ 1.5 g/kg, calf gain higher by ≈ 100 g/d; Table 3), health (no impact), reproduction (little impact) and stress at weaning (high in calves and dams) are in line with the literature (Nicolao, 2022).

However, three original results were obtained during these experiments:

- *A milk output deficit of around 300 kg at peak lactation* was observed in cows suckling their calves (Figure 2). This value was calculated by subtracting the milk produced by the cows in the control group from the milk produced by the cows suckling their calves (milk collected in the milking parlour + milk fed by the calves [weekly weighing before and after controlled suckling in 2017, or estimation based on calf weight in 2018]). The amount of milk drunk by a calf that can suckle freely since birth represents ≈ 11% of its daily liveweight, which equates to ≈ 450 kg for weaning at 9 weeks or ≈ 700 kg at 12 weeks in organic farms.

- *Suckling improved reproductive performance in primiparous cows* (-30 days in calving interval; $P<0.05$; unpublished) but not in multiparous cows. This result, which is particularly promising given that primiparous cows generally have difficulty reproducing quickly after calving, seems to be linked to a better energy balance.

- *A 26% lower hair cortisol concentration* ($P<0.05$) before weaning in calves suckled by their dam during daytime, compared with calves fed by ACF from birth (Pomiès *et al.,* 2022b). As the in-hair accumulation of cortisol from birth to weaning reflects the chronic stress experienced by calves during the suckling period, maternal rearing does seem to promote calf welfare. Work is underway to make dam-calf separation at weaning less stressful.

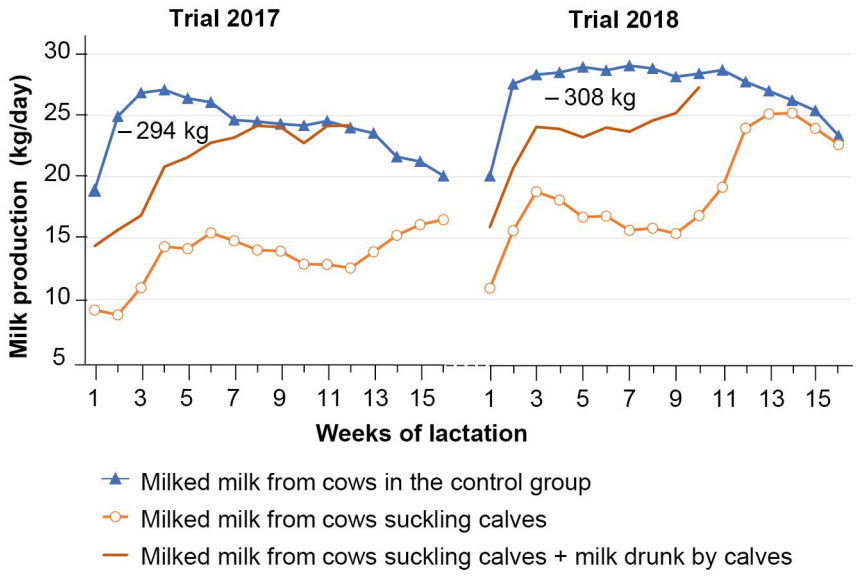
Finally, the results obtained during these experiments (quantity and composition of milk sold, calf growth gain, farmer workload, etc.) were used to simulate the economic impact of two of the practices tested until weaning (restricted suckling before morning milking or free suckling between morning and evening milking) in comparison with conventional-system practice. These simulations were carried out using the Diapason tool on three Inosys Réseaux d'Élevage case studies (representative of three French dairy farming systems, classified as

Table 3. ***Animal performance responses to different suckling practices for dairy calves compared with conventional-system husbandry (calves separated at birth and fed by ACF) in three trials carried out at the INRAE Herbipôle farm in Marcenat (Nicolao, 2022).***

	Trial 1 2017		Trial 2 2018	Trial 3 2019	
Contacts for suckling calves					
Contact period	Until weaning *(10 to 12 weeks)*				4 weeks
Duration of daily contact	20 minutes	2.5 hours	9 hours	6 hours	6 hours
Moment of contact	Before milking[a]	After milking[a]	Between morning and evening milking		
Performance of dams during the first 16 weeks of lactation *(vs. control cows)*					
Milked milk (kg/d)	-10.6 *[-45%]*	-7.0[b] *[-29%]*	-8.3 *[-31%]*	-7.8 *[-30%]*	-5.4 *[-21%]*
Fat content of milked milk (g/kg)	+3.2	-4.7[b]	-5.8	-4.0	-0.8 *(ns)*
Protein content of milked milk (g/kg)	+3.0	+0.3[b] *(ns)*	+1.3	+1.0	+1.6
Calf performance up to weaning *(vs. control-group calves)*					
Growth (g/d)	+171	-247[b]	+7 *(ns)*	+251	-34 *(ns)*

[a]At morning and evening milking for two weeks, then morning milking only; [b]during the first 8 weeks of lactation (then the trial was stopped for the group because the calves grew too slowly); ns = non-significant statistical difference.

Figure 2. ***Milk production at the beginning of lactation in cows with and without calves, in two trials carried out at the INRAE Herbipôle farm in Marcenat (Nicolao et al., 2022).***



extensive, intensive, and organic) and showed that gross milk output systematically decreases (by -2.2% on average) with suckling. However, while restricted suckling, which is very time-consuming, also penalises farmers' income through increased labour costs (+60%), free suckling appears to have no tangible economic impact (Nicolao, 2022).

b. Rearing of future heifers by foster cows

In order to gain a better understanding of the practice of rearing calves under foster cows, which has been on the rise in France since 2010, a survey was carried out in 2019 on 20 farms in the northwest of France that had introduced this practice (Constancis *et al.*, 2022b). This type of management is generally enlisted as part of an agro-ecological farming system based on grazing, with 2/3 of the farmers surveyed grouping calvings together in spring. This means that there is little difference in age between calves when they are adopted by the foster cow (< 1 week) and when they transition to pasture (< 2 months), and that heifer growth is linked to grass growth. These farms have a low turnover rate (27%) and often practice crossbreeding (75%), once-a-day milking (50%), on-farm milk processing and direct-to-consumer sales. There is no standard way of rearing future heifers, but instead a cluster of practices adapted to each farm, divided into three or four phases: *i)* after birth, the calf stays alone with its dam for a few days; *ii)* if the calf goes through a bucket-feeding phase, it stays with its dam for less than three days. This optional (≈ 9-day) phase, which was practiced by half the farmers sample, makes it possible to wait for other calves to be born so that they can be adopted together by the same foster cow. If the calf goes directly from its dam to a foster cow, it stays with its dam for about one

week; *iii)* the adoption phase consists of penning two or three calves in the cowshed with a cow removed from the dairy herd. Foster cows, which account for ≈ 12% of the dairy herd, are mostly cows set for culling due to subacute mastitis, infertility or lameness. The benefit for these cows on pasture is that they no longer have to stay on the concrete floor of the buildings or go to the milking parlour twice a day. Some foster cows are also selected for their maternal traits, as gauged by the farmer. Adoption, which farmers say goes well in 90% of cases, is the key stage in this process. It requires careful attention to make sure the calves do suckle the foster cow. If not, a headlock barrier or even a shackle can be used for the first few days; if this is not sufficient, the farmers change the foster cow. This adoption phase lasts an average of one week; *iv)* the animals are turned out to pasture early, at an average age of one month, as soon as weather and plot conditions permit. In this way, rearing calves with foster cows enables organic farmers to comply with the new regulations on calf access to an outdoor exercise area. Weaning takes place in the autumn or winter, in a cowshed, to prevent the calves (aged between 4 and 10 months) from breaking fences to get to their foster cow. Some farmers, who leave one or two dry cows with the calves to wean them less abruptly, find that the calves are calmer. The ease of management that this solution affords prompts some farmers to rear calves with future heifers that are not used to renew the herd, and sell them at around 6 months of age or even later.

The majority of farmers are satisfied with this system, which improves their working conditions. They perceive it as a more natural and more welfare-friendly solution that avoids the onset of stereotyped behaviour and favours the integration of future heifers into the dairy herd. However, the weaker farmer-calf relationship has led some farmers to fear that the calves will become "wild", and encouraged them to up their presence with the future heifers.

Calves reared under foster cows show good growth during the first three months (> 800 g/d), which then decreases temporarily to around 450 g/d in the cowshed (if weaning takes place before) or on returning to the cowshed. In the case of autumn-born calves, there is no significant reduction in growth at weaning, as weaning occurs when the calves are at pasture. The majority of farmers say that the introduction of this system means that heifers can start mating earlier, with the aim of calving at 24 months. On the other hand, the foster cows, which are mainly grass-fed and are under heavy suckling pressure, tend to lose weight. There are a number of ways to avoid this, such as using foster cows from rustic breeds or that are in good body condition and early lactation, supplementing their ration, reducing the number of calves per foster cow, and weaning earlier. Keeping calves with foster cows means less milk is sold, and possibly also less income for the farmer. However, the fact that the calves are in better health means lower veterinary costs. Furthermore, as this method promotes good growth and an early calving age, it shortens the unproductive period for heifers. Grazing heifers on pasture also means they require less straw and concentrate feed. The farmers believe that this system, which requires little in the way of start-up costs, is profitable overall, although a solid economics study is needed to confirm this belief.

c. Focus on health aspects

The majority of farmers who leave calves with their dam or a foster cow report an improvement in both calf health (diarrhoea, respiratory disease) and cow health (mastitis, fertility) (Vaarst *et al.,* 2020; Constancis *et al.,* 2022b; Eriksson *et al.,* 2022).

Leaving calves with their dam or foster cows, particularly on pasture, reduces direct contact between calves and limits the transmission of pathogens compared with calves penned together at a higher stocking density. Calves with dams or foster cows have less neonatal diarrhoea, particularly due to cryptosporidiosis, and lower mortality (Beaver *et al.,* 2019; Constancis *et al.,* 2021). However, there have been odd reports of transient diarrhoea, which farmers associated with excessive milk consumption.

Calves grazing with their dam or foster cows are less exposed to gastrointestinal strongyles, as the immunised cows clean up the plots by ingesting larvae and excreting few eggs in their faeces (Constancis *et al.,* 2022a). Furthermore, the fact that calves are mainly milk-fed for up to three months means that they ingest little grass and therefore few larvae. However, good grazing management (rotational grazing, long periods spent returning to each paddock, etc.) is necessary to reduce the risk of parasites in these calves. Calves kept with their dam or foster cows in cowsheds until they are weaned are just as exposed to parasites during grazing as in conventional heifer systems.

■ 3.3. Rearing young males for better value-capture

In France, all three dairy sectors have a surplus of young males in relation to domestic market opportunities available. While the sale of lambs accounts for a significant proportion of the milk production (see above), the price paid to farmers for 8-day-old goat kids (sometimes zero) is a real problem. In terms of market opportunity for calves, the increase in live exports (in addition to the ethical issues raised) could ultimately disrupt the sector. This is why farmers and the sector as a whole are looking for alternative ways forward.

a. Fattening goat kids on the farm

Although the majority of male goat kids are fattened in specialised operations, there are still some farmers who fatten them on their farms. A survey of 57 such farmers was carried out in 2019 as part of the ValCabri project, and it showed that there is a broad diversity of practices, kids produced, and marketing channels used, from milk-delivery farms to farmhouse cheesemakers. This diversity of practices reflects factors tied to animal health (which remains a cause for concern, even though 39% of farmers say they do not use any treatments), feed and buildings. For example, 37% of

farmers use milk replacer powder, 27% use unsaleable milk, 15% use saleable milk, and 20% leave the kids to suckle their dam. Half of the farms have a barn dedicated to fattening kids (where they fatten 210 per year on average, compared with 60 for those who do not). The kids produced are classified as "light" (fattened for 3 to 5 weeks), "heavy" (5 to 8 weeks) or "very heavy" (> 2.5 months). On 80% of farms, only one type of kid is produced, and each type has its own market: light kids tend to be sold through long supply chains, while heavy and very heavy kids are sold to butchers or to private individual buyers (direct-to-consumer sales in 2/3 of cases).

Farmers have various motivations for fattening kids: tradition, better value-capture (no longer considering them as by-products), diversification, pushing back the peak in milk production, squeezing value out of milk that cannot be sold at the beginning of lactation, intrinsic advantages (availability of barns, labour, etc.), or even out of obligation (if the farm is outside the area where 8-day-old kids can be collected from). For farmers who are able to do so, rescheduling kidding can also help them get more out of their animals, in terms of market opportunity and market d price. On-farm fattening, particularly for farmers looking to develop short or circular supply chains, is closely linked to the issue of transporting young kids and finding local slaughter facilities (125 slaughterhouses closed doors between 2002 and 2010, including 8 that specialised in goat kids; Ravaux, 2011).

In addition to on-farm fattening, and in view of current market for goat kid meat, the sector is also looking at strategies to reduce the number of kids sold to long distribution channels, in order to limit the proportion of frozen kid meat exported. For example, the use of long lactations (an average of two years without kidding) is on the increase, particularly since the Covid crisis in 2020. This could ultimately have knock-on effects on farm husbandry systems and herd management and, consequently, on the health and welfare of goats and kids (fewer culls due to poor fertility, lower mortality at kidding, and farmers with more time to devote to goat kid care).

b. The search for alternatives in dairy cattle farming

As described above, with the decline in domestic markets, young French dairy calves are increasingly being exported, which implies long-haul animal transport times that have come under fire from the general public. The interprofessional association for the veal commodity chain (Interbev Veaux) has taken these criticisms on board and incorporated them as priorities in the Strategic Programme for the French Veal Industry, as well as for delivery of the Societal Engagement Pact at the end of 2017. The CASDAR-programme [special research credits] RenouVEAU project (2020-2023) coordinated by the Institut de l'Élevage sets out to develop and test new husbandry systems for calves from dairy herds, that bring innovations in terms of housing (e.g. outdoor access,) and feeding (e.g. solid and liquid feed).

Looking at the prospects in red meat, while per-capita consumption is falling, only processed products and foodservice catering are registering growth. These niche markets, mainly supplied by imported meat from dairy breeds, have demand for light (≈ 300 kg) and well-finished carcasses that do not fit with French suckler cattle. Alternatives, based on developing a line of young dairy×meat crossbred animals, could therefore be envisaged as a solution that would add value to some of the calves from the dairy sector. The work begun in 2015 at the request of Interbev Bretagne on the production of young dairy steers and heifers (15-17 months) is continuing at the CIRBEEF (Mauron, Ferme des Bouviers) as part of the Valoveau project, with support of the CNIEL. The trials current underway involve crossbred calves (dairy×meat) reared as young steers and young heifers. The crossbreds selected correspond to the main breeds used on Holstein cows (Belgian Blue, Charolais, Limousin, INRA95), and span a diversity of early-maturing traits. Crossbred Angus calves (widely used in Anglosphere countries), purebred Normande calves and Normande×Limousin crossbred calves were also studied. Two types of management, corresponding to two birth periods, were tested, with a focus on making the most efficient use of on-farm forage: *i)* autumn-season births, with the production of young steers/heifers at pasture the first year and finished in a barn; *ii)* winter-season births, with a grazing phase the first year, overwintering in the barn, then finished on pasture. Of the 167 young steers already slaughtered, growth-gain rates were 1,067 g/d for autumn-born calves and 960 g/d for winter-born calves. Average age at slaughter was 17 months and average carcass weight was 307 kg, with 68% of carcasses having the conformation required by abattoirs (scoring O+ to R= on the EUROP classification grid; Fossaert *et al.,* 2022). The results of this study, which will be made available to farmers and other sector constituencies, are expected to serve as a startpoint for discussions on new organisational schemes and to help guide approaches that are already emerging in practice.

Conclusion

New husbandry practices for young dairy ruminants are emerging in France to meet the expectations of the public, farmers, and the wider dairy sector (natural suckling, on-farm fattening, access to the outdoors, etc.). Further knowledge is still needed before they can be deployed on a larger scale: on health aspects (the problem of CAEV in goat herds), on husbandry aspects (stress caused by late dam-young separation), on the economics front (modelling the array of natural suckling practices) and on the market sales front (to grow consumption of goat kid meat). Other practices remain to be explored, such as extending lactations in cattle and goats, which would reduce the annual number of births. However, despite expectations surrounding much-needed progress, these new practices for rearing young males and females will only be able to gain ground in the dairy sector *i)* if initiatives are taken to clearly purpose-label the products (meat and milk) from these more welfare-friendly farms, and *ii)* if enough consumers are willing to pay a premium for welfare-friendly products.

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Abstract

Under natural conditions, newborn ruminants develop a special bond with their dam within just a few hours after birth. This bond lasts beyond nursing. In France, out of the 5.5 million young dairy ruminants (calves, goat kids, and lambs) born each year, the majority are separated from their dam at birth and fed "artificially", i.e. given milk or milk replacers from buckets. The practice of separating the young from its dam early in life raises welfare concerns for citizens and a segment of the livestock farming community. Artificial feeding of replacement females up until weaning is a cost-effective practice that ensures optimal mammary development and a good milk potential. However, suckling by the dams or other nursing females is on the rise, mainly on cattle dairy farms. Suckling generally results in lower quantities of saleable milk, but calf growth, health and welfare are all improved. The future of the young (mainly males) that are not kept for herd renewal is also an escalating concern. Young male ruminants usually leave the farm after a few days to be fattened in specialised units in France, or exported. Again, in order to meet consumer expectations and compensate for the low economic value of these animals, farmers and sector

value chains are looking for alternative solutions such as on-farm fattening, new farm-system methods, or new market opportunities. These alternative practices – suckling or on-farm fattening of young males – could be helped forward by purpose-labelling their system products (milk, meat) and by consumer willingness to pay a premium for them.

Résumé

Devenir des jeunes ruminants laitiers : comment concilier élevage et attentes sociétales

Dans les conditions naturelles, les jeunes ruminants développent un lien privilégié avec leur mère dans les heures qui suivent la naissance, lien qui perdure bien au-delà de l'allaitement. Or, sur les 5,5 millions de jeunes ruminants (veaux, chevreaux et agneaux) qui naissent chaque année en France dans des élevages laitiers, la grande majorité sont séparés de leur mère à la naissance et allaités « artificiellement » au seau. La séparation mère-jeune précoce interpelle les citoyens et certains éleveurs quant au respect du bien-être de l'animal. L'allaitement artificiel des femelles de renouvellement jusqu'au sevrage permet d'assurer, à un coût maîtrisé, un développement mammaire optimal et un bon potentiel laitier. Cependant, l'allaitement par les mères ou par des nourrices se développe, principalement en élevage bovin. Ce type d'allaitement entraîne généralement des quantités de lait commercialisables moindres, mais la croissance, la santé et le bien-être des veaux sont améliorés. Des questions se posent aussi sur le devenir des jeunes, mâles pour l'essentiel, non conservés pour le renouvellement du troupeau. Ceux-ci quittent généralement l'élevage quelques semaines après la naissance pour être engraissés dans des ateliers spécialisés, voire exportés. Là aussi, afin de répondre aux nouvelles attentes des consommateurs et pallier le faible intérêt économique de ces débouchés, éleveurs et filières recherchent des solutions alternatives telles que l'engraissement à la ferme, de nouveaux modes d'élevage ou de nouveaux débouchés. Ces pratiques alternatives – allaitement naturel ou engraissement sur place des jeunes mâles – pourraient se développer grâce à une identification de leurs produits (lait, viande) et au consentement du consommateur à les payer plus cher que des produits standards.

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