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# FROM PASTURE TO COMPOST BARN:

Smallholder Family Dairy Farmers and the Expansion  
of Industrialized Animal Production in Santa Catarina, Brazil

a Guidance Memo prepared for Tiny Beam Fund



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# Abstract

Dairy production in the state of Santa Catarina, in southern Brazil, is undergoing a rapid process of concentration. Milk is increasingly produced in fewer farms with larger herds, and higher productivity. Amid this process, compost barns, a confined system where cows are housed in a large bedded area and have no access to pasture, are growing in popularity among smallholder family farmers in the region. In this Guidance Memo we highlight some actions that can help curb the expansion of compost barns. The compost barn system is presented to farmers as a more efficient, modern way of producing milk. Potential adopters need to be made aware that transitioning to a compost barn system implies a massive investment, with no guarantee of economic return; managing a compost barn increases the demand for labor; the welfare of the animals is reduced; and farmers become more dependent on external inputs, which makes farmers vulnerable to external variations in prices. In contrast, well-managed pasture-based systems can match many of the alleged benefits of the compost barn system, such as production efficiency and thermal comfort; milk can be produced at a much lower cost, with inputs from the farm; and it is easier to provide conditions for good welfare of cows at pasture. We give some recommendations on how to reach farmers and extensionists and suggest that successful pasture-based farms may be used as model farms to inspire and incentivize other farmers to adopt or improve pasture-based systems. We also highlight that women and younger generations are key groups to include in these actions, given their growing influence in the decisions in family farms. One reason that contributes to farmers' decision to adopt intensive confined systems is the social status associated with modernity. With this in mind, one action aimed at curbing the expansion of compost barns is to promote the concept of sustainable, pasture based dairy production as a new face of modernity. Well-managed pasture-based systems can be transformed into symbols of high status and a sense of pride in being a dairy farmer. Support from consumers can be stimulated by gathering public interest in sustainable, pasture-based dairy production and helping create consumer markets for animal welfare-friendly, climate-friendly, or carbon-neutral milk. Front-liners may also get involved in lobbying for policies to incentivize payment for ecosystem services, create rural credit programs appropriate for smallholders, and purchase programs to secure a market for small farmers.



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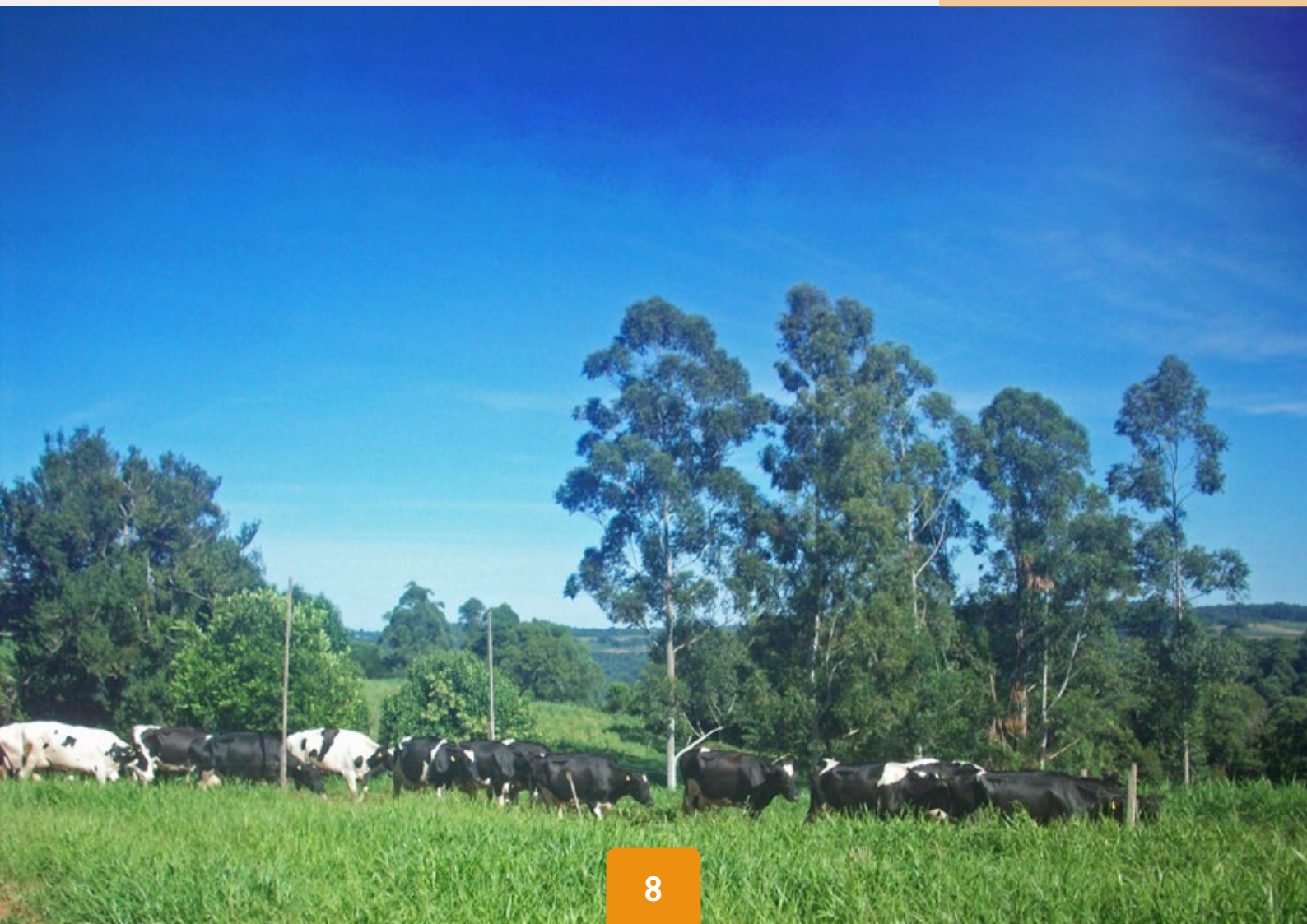
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## 01 Dairy production systems in Santa Catarina state, Brazil: from pasture to compost barns



### Key messages

- **Milk production:** Santa Catarina is one of the largest milk producers in Brazil. Milk production in the region is dominated by smallholders, who are vulnerable to external sources that pressure them to adopt new technologies and achieve economies of scale.
- **Reasons to be a dairy farmer:** Some important motivations for being a dairy farmer are a **more regular income source** than that provided by swine, poultry, or annual crops and **moving away from pesticides** in tobacco production.
- **Dairy herds are growing:** Milk production is increasing in the region, but the number of producers is decreasing. Many farmers are transitioning from smaller, pasture-based systems, to intensive confined systems, with larger herds and milk production. This is changing the whole dynamics of the systems.





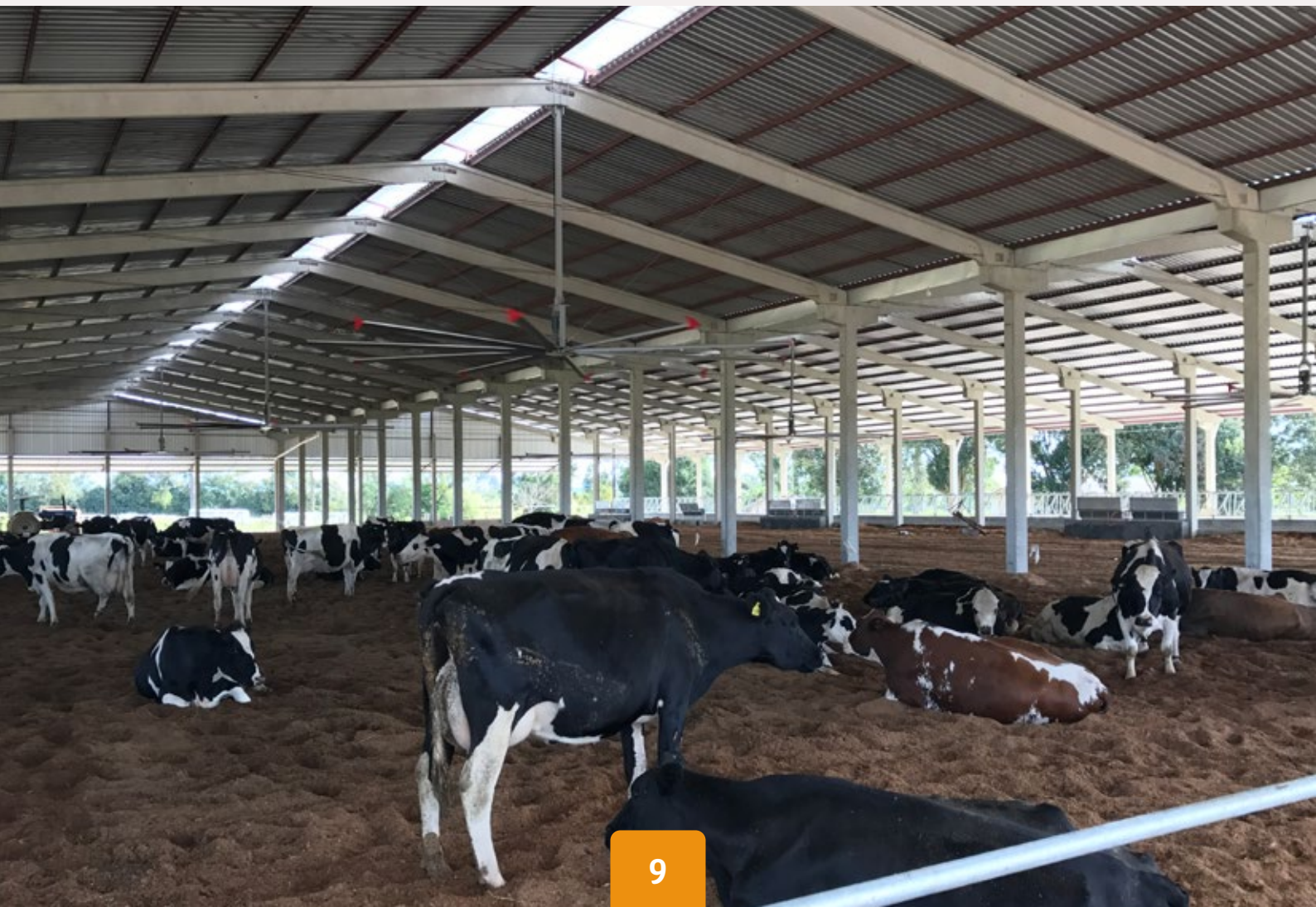
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### What is a compost barn?

A compost barn is a confined system where cows are housed in a large bedded area where their manure ends up combined with the bed. This technology is growing in popularity among smallholder family dairy farmers of the state of Santa Catarina, incentivized by private and public extension agents that present it as a more efficient way of producing milk.

Compost barns represent a step towards the industrialization of dairy production in Santa Catarina state. The transition from pasture-based to compost barns reflects a major management change, including less space for each animal, higher dependency on fuel and external inputs, more labor, and the need for farmers to provide all the food the cows need and to keep the bed dry.

Compost barns may have better animal welfare indicators than free-stall dairy systems. For example, in compost barns cows often have fewer injuries and lameness than in free-stall systems; however, cows' welfare in compost barns is worse than in pasture-based dairy systems<sup>1</sup>. Most importantly, cows have no access to pasture and spend many hours standing on concrete ground for feeding. The welfare condition of the cows in compost barns is also highly dependent on how frequently the bed is renewed. To reduce costs, some farmers do not change it with adequate frequency.

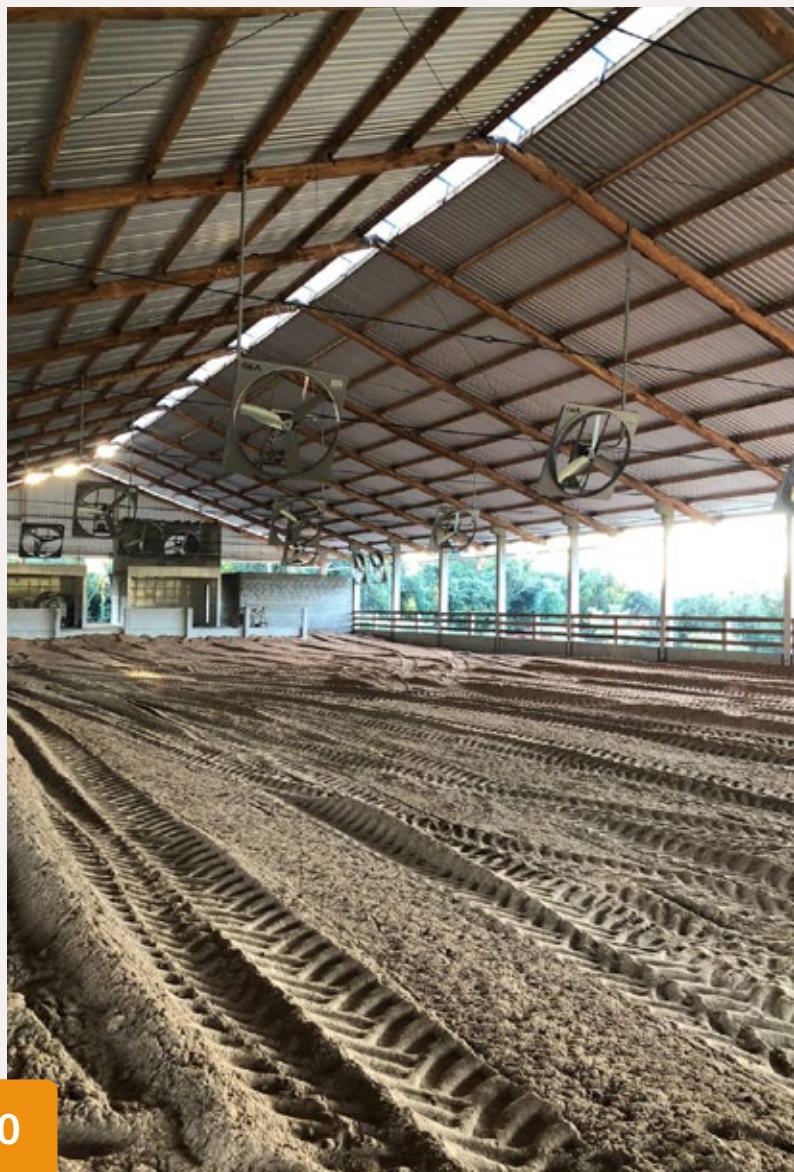


# 01 Dairy production systems in Santa Catarina state, Brazil: from pasture to compost barns

## Overview

**Brazil is the fifth world's milk producer<sup>2</sup>, and Santa Catarina is the fifth milk producer state in Brazil, with 3.13 billion liters produced in 2020<sup>3</sup>.**

In the last decades, many farmers transitioned from swine, poultry, and tobacco production to milk production. This was mainly due to economic instability of the productive sector or as a consequence of contractors demanding economies of scale and investment to keep up with technology implementation. Also, when climatic conditions and agricultural product prices are unfavorable, the smallholder family producers are unable to compete with larger producers<sup>4</sup>. Another situation, particularly in the western part of Santa Catarina, was the transition from tobacco to milk production, due to unfavorable trading conditions and smallholder family producers' motivations to avoid dangerous and inhumane working conditions<sup>5,6</sup>. In these situations, milk production also offered a more regular income. Additionally, added to the existing demand for milk from industry, the region had reusable facilities from swine production, relatively well-maintained roads, and energy supply, which made the transition to dairy production attractive to many families<sup>7,8</sup>.



A compost barn in operation.



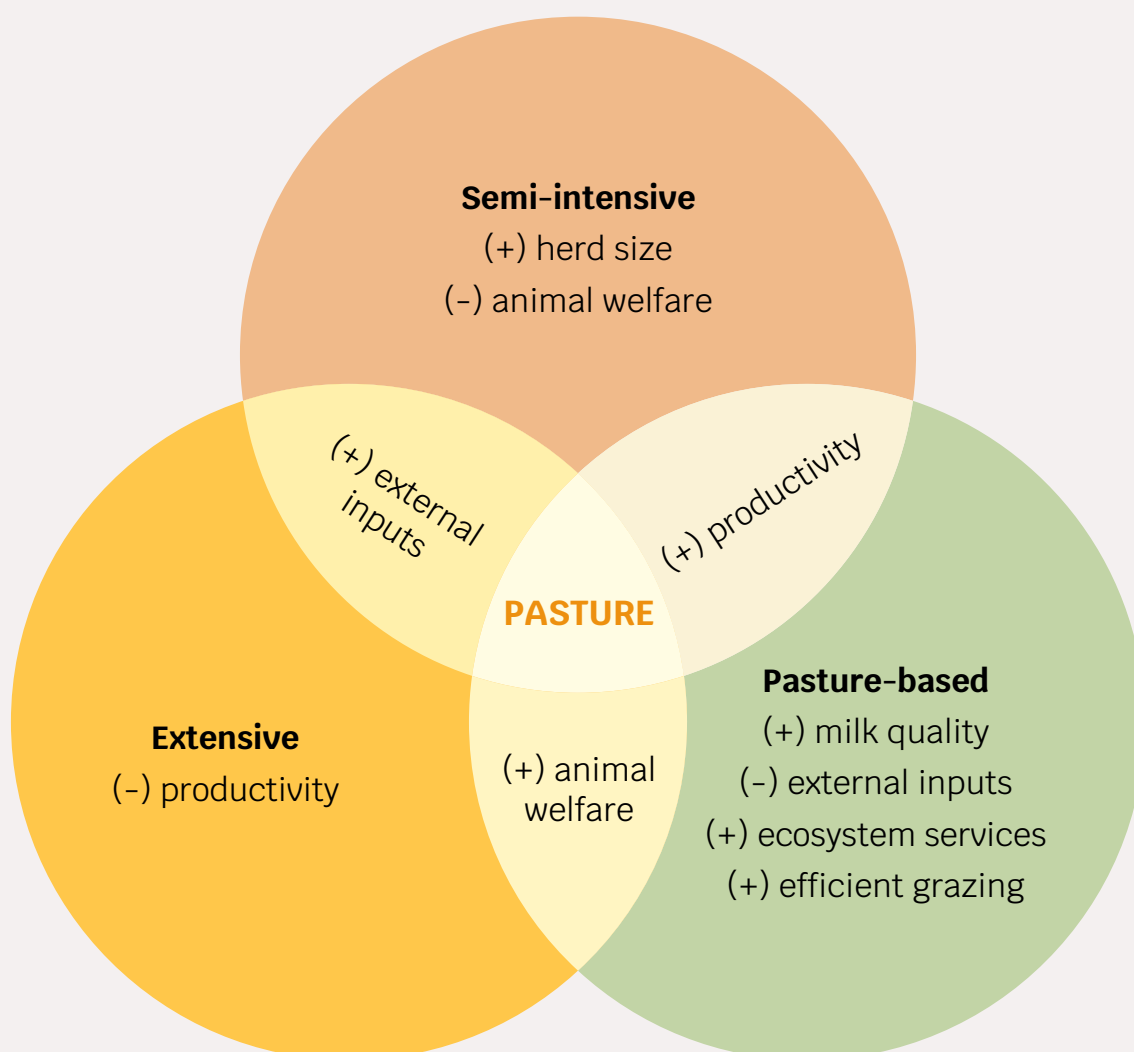
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Smallholder family farmers that transitioned from self-consumption to commercial operations dominated the milk production in Santa Catarina between the 1990s and 2010.

Following the global trend of intensification of livestock production, milk production in Santa Catarina is undergoing a rapid process of concentration in fewer, larger farms, with higher milk production and productivity.

The approximate 24,000 farms that produced milk in the state in 2020 represent 30% of the 1990's figure. Yet, smallholder dairy farms are still the majority in the region, and are essentially pasture-based, with varying amounts of supplementation, mainly with maize silage<sup>9</sup>.

There are three types of smallholder farms in Santa Catarina<sup>10</sup> based on land and herd size, management practices, main breeds used, milk productivity and quality, which have been characterized as **extensive**, **pasture-based**, and **semi-intensive**.



**Figure 1.** Characteristics of the types of smallholder family dairy farmers in Santa Catarina State. Here we highlight some characteristics that differentiate these types of farmers, as well as characteristics they share, the most relevant being the utilization of a pasture-based system.

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1. **Extensive:** The farmers in this group follow a more traditional farming style. They have smaller herds, lower access to capital and labor, and lower productivity than semi-intensive and pasture-based. Cows are often Jersey, Holstein, and their crosses, of low genetic merit.

The extensive farmers use large amounts of external inputs for animal feeding and are often inefficient in the management of their resources. This results in the lowest production per cow and per kg of supplement of the three groups, hence low-profit margins. These farmers are not likely to transition to expensive industrial production systems such as compost barns.



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2. **Pasture-based:** This group of farmers follows a more agroecological production, with more efficient rotational grazing management, improved ecosystem services, animal welfare, milk quality, and social fairness standards.

Cows are often Jersey, Holstein, and their crosses. Some of the farmers in this group have a history of agroecological production<sup>11,12</sup>. Currently, some of the farmers in this group are transitioning to industrialized systems, mainly compost barns.



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3. **Semi-intensive:** The farmers in this group follow more entrepreneurial farming, by combining highly fertilized pasture-based with substantial amounts of silage and concentrate.

Farmers in this group usually have larger herds and land sizes than the two others. Most often they have Holstein cows, of higher genetic merit than the two other groups. They produce more milk per cow and in total, have better milking infrastructure, apply more basic preventive and hygienic practices, and have greater access to capital. These farmers are the most likely to transition to industrial systems such as compost barns.



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Some farmers from the semi-intensive and pasture-based systems have adopted industrial confined systems like free-stall or the so-called compost bedded pack, compost barn, or composto, as it is commonly called in the region.

**In this Guidance Memo, we provide recommendations about how to disincentivize the compost barn system in Santa Catarina.**

### Recommendations to curb the expansion of compost barns

Given the scenario described above, we propose some recommendations that can be used to discourage the adoption of compost barns.

First, we show the alleged benefits and some limitations of the compost barn system and explain how it is unlikely to meet the needs of many dairy farmers.

Then, we highlight well-managed pasture-based systems as a feasible alternative to produce milk sustainably, and suggest how to overcome the limitations to its adoption. This information can be used to guide farmers' and extensionists' decisions and to inform discussions with policy-makers.

We complement the information about compost barns and well-managed pasture-based systems with quotes from farmers and extension farmers, collected by our team during on-farm research and outreach visits in 2022.

We give recommendations to emphasize the role of extension agents as key promoters of well-managed pasture-based systems; suggest some policies to strengthen more sustainable dairy production; and discuss the importance of involving consumers and groups of consumers as important agents to support pasture-based systems.

Finally, we suggest steps for those interested in reaching and engaging farmers and extension agents.





**Compost barns  
and other  
industrialized  
systems:  
exposing the  
limitations and  
questioning the  
benefits**

02

## 02 Compost barns and other industrialized systems: exposing the limitations and questioning the benefits



### Key messages

- **Increasing herd size and productivity:** One characteristic that makes the **compost barn system** attractive to farmers is the possibility of having **more cows in less space, thus increasing productivity**. However, the alleged increased productivity is often **unlikely to offset the high investment in a compost barn system**. Additionally, it is important to consider **public ethical concerns** related to denying cows access to pasture and reducing the space available per animal.
- **Investment and labor:** Compost barn systems are perceived as convenient, given that they allegedly improve productivity and farm income. However, adopting a compost barn system requires **massive investment** and **increases the need for labor**.
- **Vulnerability to external fluctuations:** This system also makes farmers more dependent on external inputs. This makes them more vulnerable to external variations related to **climate and the price of inputs**.
- **The need for a dry environment:** **Compost barns require a dry bedded pack**. Keeping the system at an optimal level requires ongoing ventilation, abundant sawdust, and relatively dry weather. The humid seasons increase the requirement for sawdust, which generates scarcity in regions with many compost barns. As a result, many farmers simply cannot maintain the bedded pack dry, reducing cow comfort and increasing sanitary problems. In summer, dry bedding produces dust, which can also negatively impact cows' and farmers' health and comfort.
- **Ventilation:** Providing **adequate ventilation** in a compost barn requires a **high investment** in equipment and involves a **high maintenance cost in energy**.
- **Drinking water and shade:** Drinking water and shade are essential for cows. When these resources are limited, especially in summer, the **animals are more prone to thermal stress, reducing cows' productivity and welfare**. The issue is critical in some farmers' decisions to adopt a compost barn system, as many find the constant provision of water and adequate shade in pasture-based systems challenging. Drinking water and good shade can be achieved on pasture, with the adequate provision of water troughs and trees and other structures in a paddock.



## 02 Compost barns and other industrialized systems: exposing the limitations and questioning the benefits

### Overview

Describing the compost barns means highlighting specific characteristics with a purpose. The characteristics can be divided into **alleged benefits and challenges** that farmers or extension agents face when adopting a compost barn system.

The purpose here is to show that many alleged benefits of compost barns are debatable, while the challenges of adopting a compost barn are less discussed by proponents of the system, and often exceed the farmers' economic and labor capacities.

We also mention some characteristics of free-stalls, as this confined system is also present in some regions in Santa Catarina.

### Relevant topics related to curbing the expansion of the compost barn system

- **The possibility of having more cows in less space:** **Land size is a dealbreaker for farmers.** For many farmers the lack of space is a major constraint to adopting or continuing with a well-managed pastured-based system. This is a reason for some to decide to adopt a compost barn.

Although a compost barn can hold more animals in less space than a pasture-based system, **increasing productivity requires high management skills to offset the high investment** of a compost barn system.

**Additionally, there are ethical and sanitary concerns related to denying access to pasture and reducing the physical space available per animal.**



## 02 Compost barns and other industrialized systems: exposing the limitations and questioning the benefits

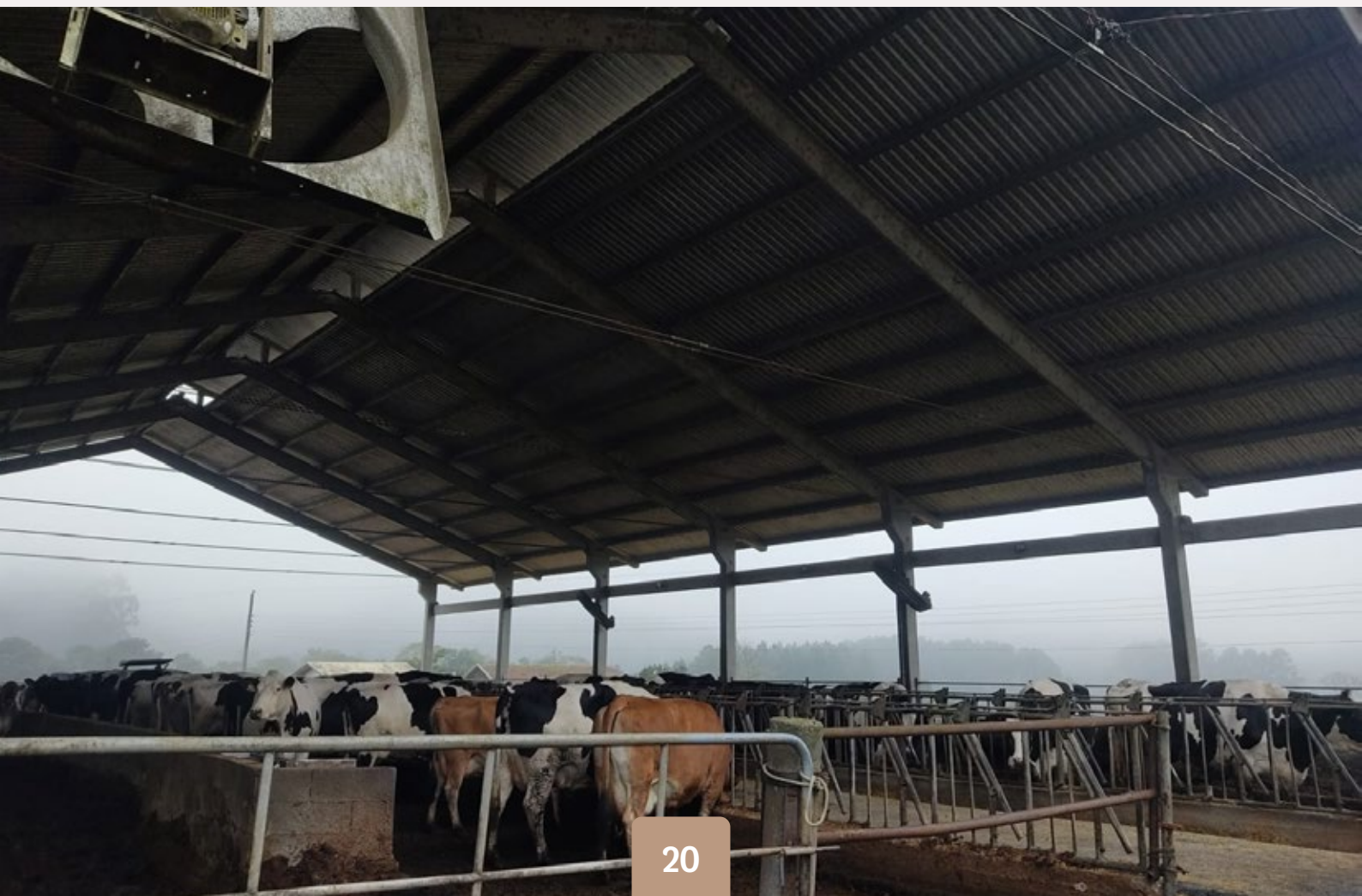
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- **Larger herds and productivity:** Milk productivity can increase in compost barn systems. This is achieved with larger herds, more productive cows and concentrated feed. However, production costs also increase, often to the point of the system not being profitable.

Additionally, cows have a shorter lifespan in compost barns than in pasture-based systems. This issue has repercussions for the sustainability of the dairy production chain and may be a concern for consumers.

- **Less labor requirement:** Some farmers believe that adopting a compost barn system will save time and work, mainly because all the cows are confined and near the house. **A well-managed compost barn is highly dependent on labor.** In fact, compost barns change the characteristics of the labor. For example, farmers spend more time in a tractor to feed the animals and clean the bedded pack than in pasture-based systems, where most of the daily tasks are done by walking. In a compost barn, **farmers must constantly revolve the bedding, clean the facilities, and provide feeding and water to the cows.**

- **Vulnerability to external (market) conditions:** **Compost barn systems increase the dependence on external inputs and farmers become highly vulnerable to price instabilities and market conditions.**



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- **Cows have less mastitis:** Not true. The bedded area in the compost barns, especially when it is humid, facilitates the **development of microorganisms associated with udder infections**.
- **Cows have less lameness:** Farmers believe that lameness is a problem typical of free stall systems and that compost barn improves it. **However, lameness will be worsened in a transition from pasture-based to compost barn**. There are opportunities to raise awareness about lameness in the different systems and the impacts on cows' welfare and productivity, which may help discourage farmers and extensionists from transitioning to confinement.
- **The possibility of constantly providing water for the animals:** Water availability is critical in some farmers' decisions to adopt a compost barn system. **Farmers report difficulties in providing water to the animals in pasture-based systems. The irregular land makes it necessary to invest in water pumps, discouraging many farmers**. We recommend working on drinking water supply programs as a priority. Providing unrestricted access to drinking water in the paddocks will enhance milk production<sup>13</sup>, and the cows will not have to spend extra energy walking long distances to the water sources. **Water provision programs for pasture-based farmers and investing in water pumps** to get water for the animals will have much lower costs than building a compost barn for the same purpose. Given the increase in milk production, investments in drinking water are paid back in 90 to 150 days.
- **Constant ventilation and thermal comfort:** **Compost barns require natural ventilation and fans to cool the cows and maintain a dry bedded pack<sup>14,15</sup>. A single fan represents a high investment, as prices vary between three and seven Brazilian minimum salaries**. The number of fans can vary depending on the size of the compost barn, but the farmer must provide at least a sufficient number of fans to cover the whole bedded pack area. Besides, constant ventilation, whether natural or artificial, does not automatically mean thermal comfort for the animals. Additionally, in wintertime, the need to keep the bedded pack dry through constant ventilation often causes thermal stress due to a decrease in the temperature.

The possibility of providing better thermal conditions for cows indoors is often presented as a key advantage of the compost barn system. Adequate shade is indeed essential and compost barns provide shade, sometimes combined with water sprinklers. However, **adequate shade can be provided in pastured-based systems without the need to invest in significant infrastructure by adding sufficient and well-distributed trees**. Well-designed silvopastoral systems can add other advantages, such as increased biodiversity and wood production.

Many farmers perceive that cows are more comfortable overall in compost barns than in pasture-based systems. However, this perception refers to the comfort of lactating cows only. The compost barn systems do not explicitly consider the care of non-productive animals, like the calves and cows in the dry stage, leaving these animals prone to poor welfare conditions.

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- **The challenge of maintaining a dry bedded pack:** A highly relevant issue for the success of compost barns is maintaining a dry bedded pack<sup>14,15</sup>. High ambient humidity will increase the microbiological hazard for the cows. Farmers must provide natural ventilation, constantly functioning fans, and plenty of clean, dry bedding material. This requires significant financial investment. Humid seasons increase the requirement for sawdust significantly and the growing demand for this material generates price rises and scarcity. With less sawdust available, **it is simply not possible to maintain the bedded pack dry. Then, compost barns are more likely to harm the cows and increase the costs related to cows' health.** In summer, dry bedding produces dust, which can also negatively impact cows' and farmers' health and comfort.

In contrast, a well-managed pasture-based system, with adequate soil water infiltration and tree provision can reduce cows' exposure to humid environments. Also, the grazing rotation can interrupt some parasites' life cycle, avoiding diseases related to ticks, flies, and others.

- **Social status and modernity:** Some farmers, especially younger and with university degrees, are motivated to adopt a compost barn to modernize their dairy production systems, which improves their self-esteem and social status. **There are successful cases of farmers that have well-managed pasture-based systems. These cases can be shown to other dairy farmers as examples of another kind of modernity, i.e., animal systems that are both productive and sustainable.** We recommend contacting extension agents with experience in well-managed pastured-based systems to conduct workshops to reinforce well-managed pastured-based systems as a viable alternative to get profitable dairy farms.



## 02 Compost barns and other industrialized systems: exposing the limitations and questioning the benefits

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### What do the farmers and extension agents have to say about compost barns?

**Extension agent:** "...Theoretically it is easier for the farmer...he has everything nearby: animals, and their water and food... less mud. But financially it does not make sense... with a well-managed grazing system, and by providing good shade, you could have the same benefits..."

**Farmer:** "... Maybe in bigger farms it is worth the shot because you can grow the food for the cows yourself. But if you have to buy everything, it just adds unnecessary costs to your system... you have to be careful with your investment decisions... otherwise, you will sink into an unpayable debt..."

**Farmer:** "... It would be good for the rainy season, the cows would not be struggling in the mud... It is not cheap... You have to be there constantly... doing everything for the cows, and if they do not produce more than 25-30 liters [of milk] per day, it is not worth the hassle [of investing in compost barns]"

**Farmer (using a pasture-based system):** "... Some neighbors went for a compost barn, hoping for more profit in the same land size, but as soon as the milk price slightly decreased, they went out of business..."

**Farmer (using a compost barn):** "Hiring someone from outside is very helpful, we can finally have some more time off. However, it is very difficult to find dependable workers... someone from outside will never take care of the system as I do".



**Well-managed  
pasture-based  
systems as an  
existing alternative  
to industrialization:  
how to overcome  
the barriers to its  
adoption**

03



## 03 Well-managed pasture-based systems as an existing alternative to industrialization: how to overcome the barriers to its adoption



### Key messages

- **Overcoming inefficiency:** The main problem of some extensive and pasture-based dairy systems is **farmers' inefficient management**. Farmers experience forage shortages in winter and summertime and have to compensate with external, expensive inputs.
- **Rotational grazing:** Many farmers use **rotational systems**. These farmers subdivide their land into several paddocks aiming to allow the grass to recover, and the animals graze these blocks for short periods. However, it is essential to improve the quality of management to enhance efficiency and reduce the need for external inputs. This includes the quality and management of the pasture and the provision of shade and drinking water.

A well-managed pasture-based system based on **Voisin Rational Grazing** is a feasible, sustainable alternative to increase productivity, reduce costs, and reduce dependency on external inputs. The Voisin Rational Grazing is an **agroecological methodology** that uses short grazing pulses, followed by recovery periods of the swards to enhance grass productivity, animal performance, and ecosystem services.

- **Water and shade:** In many regions of Santa Catarina, it is **challenging to provide water** for the animals in pasture-based systems due to the irregular land of some farms. Lack of financial capacity also precludes some farmers from adding drinking water to the paddocks. The provision of water in the paddocks can be made by enhancing water provision programs, promoting investment in water pumps, and installing drinking stations in a well-managed pasture-based system. The provision of **shade is also essential** for well-managed pasture-based systems. It is crucial to ensure the provision of shade that is adequate, with well-distributed trees among the paddocks.
- **Animal welfare:** Cows in pasture-based systems have **fewer injuries**, and better satisfaction of behavioral needs than in the compost barn and free-stall systems. Most importantly, when on pasture cows are allowed to **express all their natural behaviors**, which is not sufficient, but is an essential condition for their welfare.



## 03 Well-managed pasture-based systems as an existing alternative to industrialization: how to overcome the barriers to its adoption

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### Overview

In this section we show that pasture-based systems can be a feasible alternative to industrialized systems. Suitable extension and public support can help overcome the barriers to adopting pasture-based systems.

The majority of dairy farmers in Santa Catarina use a pasture-based system. Management practices vary among these systems, but a common characteristic is building subdivisions in the land, generating farms with multiple paddocks, and rotational grazing. **The most remarkable benefit of a rotational grazing system lies in rationing the pasture, using one paddock per day to allow the grass to recover. This rotational grazing system could be improved using Voisin Rational Grazing, an agroecological grazing system that maximizes pasture productivity and animal intake by applying four principles<sup>16</sup>.**

The improvement in productivity and animal intake can incentivize the adoption of Voisin Rational Grazing.



An example of a well-managed pasture-based system. There is a clear difference between the pasture level from both paddocks.

## Voisin Rational Grazing principles

**1. Recovery periods** It is about maintaining a sufficient interval between two successive shearings to allow the grass to:

1. Recover reserves in the plant's roots for vigorous regrowth
2. Boost the highest daily yield per hectare

**Key point: to find the optimum recovery period. This varies amongst plants and environments.**

**2. Occupation principle** Occupation periods should be short enough to avoid a regrowing plant from being grazed again before cows leave the paddock.

**Key point: short utilization times require high stocking densities, which will also contribute to the soil with manure.**

**3. Maximum performance** Animals with the highest requirements must be guaranteed the best grass.

**How?**

Split the herd according to the nutritional needs of the animals into two groups. The animals with higher requirements (lactating cows) are the first group to occupy the paddock.

**Key point: the greatest nutritional value concentrates at the top fraction of the plant.**

**4. Regular performance** Lactating cows' yields will be at their maximum if they stay in the paddock for 12 to 24 hours.

This way, they always get the best out of every paddock, leaving the rest to second grazers.

**Key point: this principle stimulates ruminant's yield evenness and allows constant nutrient intake.**

Applying these principles should be dynamic and flexible, constantly evaluating grazing times and stocking densities<sup>16</sup>.

## 03 Well-managed pasture-based systems as an existing alternative to industrialization: how to overcome the barriers to its adoption

### Determining the number of subdivisions

According to the first and second laws of the Voisin Rational Grazing, with more subdivisions, the grass can have more adequate recovery periods and the cows can use more than one subdivision per day, providing the cows with constant good quality forage.

**The correct number of subdivisions can be determined from the number of days for an optimal good recovery period of the grass.** This time can vary from farm to farm, but the farmer usually has a pretty close idea of the recovery periods. There is a general formula for calculating the number of subdivisions =  $RP$  (recovery period) /  $OT$  (occupation time)  $\times$  number of groups. So, if a pasture is ready to be grazed again in 45 days in summertime, and the farmer wants to use one subdivision per day with only one group of animals, the number of subdivisions should be  $45 + 1$ . **The subdivisions should be relatively uniform in size, have drinking stations, and a logical organization that allows the farmer to move the animals to and from the milking station with ease.**



Steep land is seen as a constraint to dairy production. This photo is to show a local dairy farm panorama, with subdivisions built in hilly terrain. Voisin Rational Grazing is possible even on steep land.



An aerial vision of a well-managed pasture-based system. The subdivisions are clearly delimited, there is an adequate corridor design and some provision of trees.

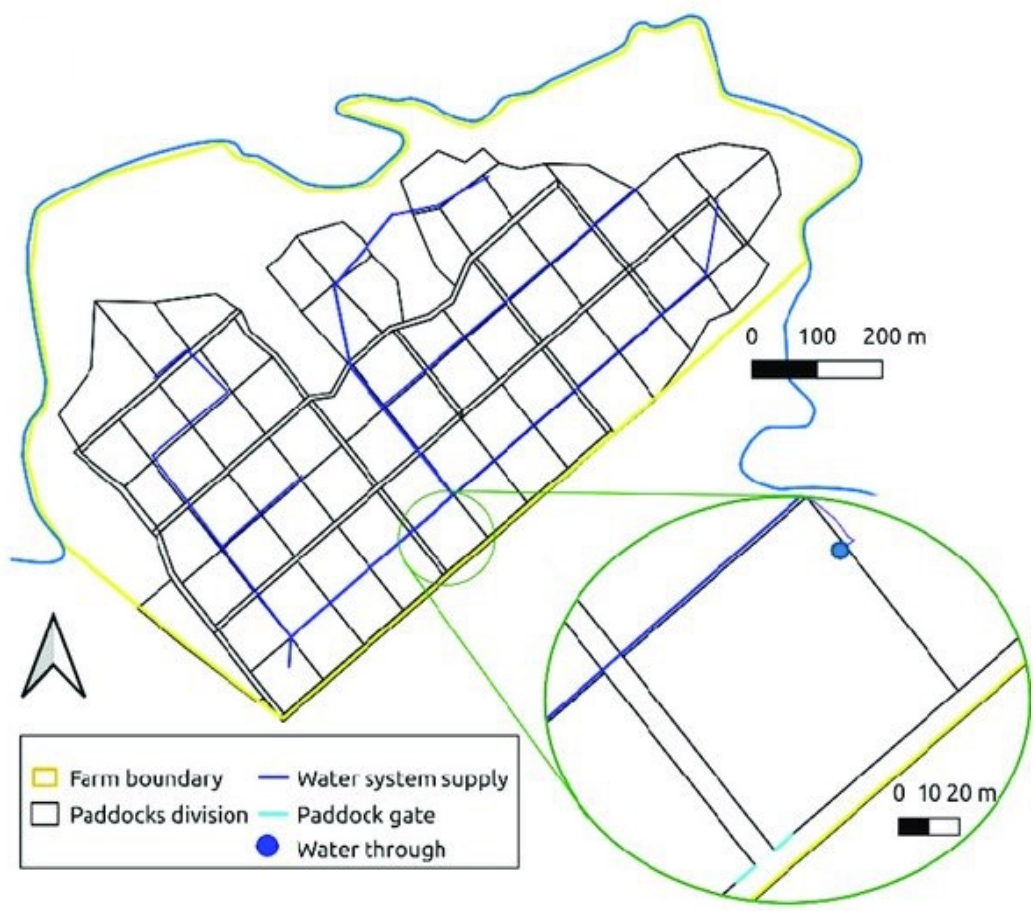


Figure 1: subdivision design in a Rational Voisin Grazing.

## 03 Well-managed pasture-based systems as an existing alternative to industrialization: how to overcome the barriers to its adoption

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### Relevant aspects about well-managed pasture-based systems

- **Lower dependence on external inputs than the compost barn and free-stall systems: Voisin Rational Grazing is less dependent on pesticides, fertilizers, and external food purchases.** This system mimics nature and animal-environment relationships to improve forage and milk productivity. Pasture must be diverse, and farmers can add legumes to decrease their dependence on N fertilizer<sup>16</sup>.
- **Water and shade:** There are opportunities to make simple changes in pasture-based systems to provide constant water to the animals without paying as much as in compost barns. Programs to subsidize water pumps and canalization to drinking stations should be recommended to local governments as a priority. The provision of adequate shade is as crucial as constant drinking water, given that high radiation in tree-less paddocks can be very uncomfortable for animals. Well-distributed trees among the paddocks will create shaded areas that enhance the animals' comfort and provide leaves as a feeding alternative. It also promotes biodiversity, creating an ecosystem suitable for harmonious coexistence between different species, including native fauna and flora.



## 03 Well-managed pasture-based systems as an existing alternative to industrialization: how to overcome the barriers to its adoption

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- **Better animal welfare than the compost barn and free-stall systems:** True. Well-managed pasture-based systems provide diversified nutritious diets, minimize injuries, and satisfy cows' behavioral needs<sup>16</sup>, including grazing, an essential behavior for ruminants. There are opportunities to identify and work on other animal welfare elements that well-managed pastured-based systems may be strengthening (for example, the promotion of positive affective states). **This can be used to add value to pasture-based systems and their final products. For example, promoting animal welfare-friendly milk or milk from healthy, happy cows.**

- **Lower milk productivity than the compost barn and free-stall systems:** Farmers adopting compost barns systems often focus their productive objective on generating more profit. The compost barn system attracts many farmers motivated by the possibility of producing more milk and, therefore, generating more income. **However, the production costs in compost barn systems are higher than in pasture-based systems. Also, well-managed pasture-based systems can be as productive as more industrialized systems.** The compost barn and free-stall systems provide higher productivity per cow, while well-managed pasture-based systems provide higher productivity per area.

- **Less lameness than in compost barns and free-stall systems:** True. Cows have more lameness in free-stall and compost barn systems. Although compost barns can reduce lameness compared to free-stall systems, lameness is still highly prevalent in compost barns<sup>17</sup>. **Cows in well-managed pasture-based systems have less lameness due to the more comfortable surface, which brings relief to knees and hooves<sup>18</sup>.** It is difficult to identify lameness in the early stages<sup>19</sup>, so we recommend conducting workshops with lameness experts to raise awareness and generate identifying tools for extensionists and farmers. Also, it is important to progressively select cows without a history of lameness.

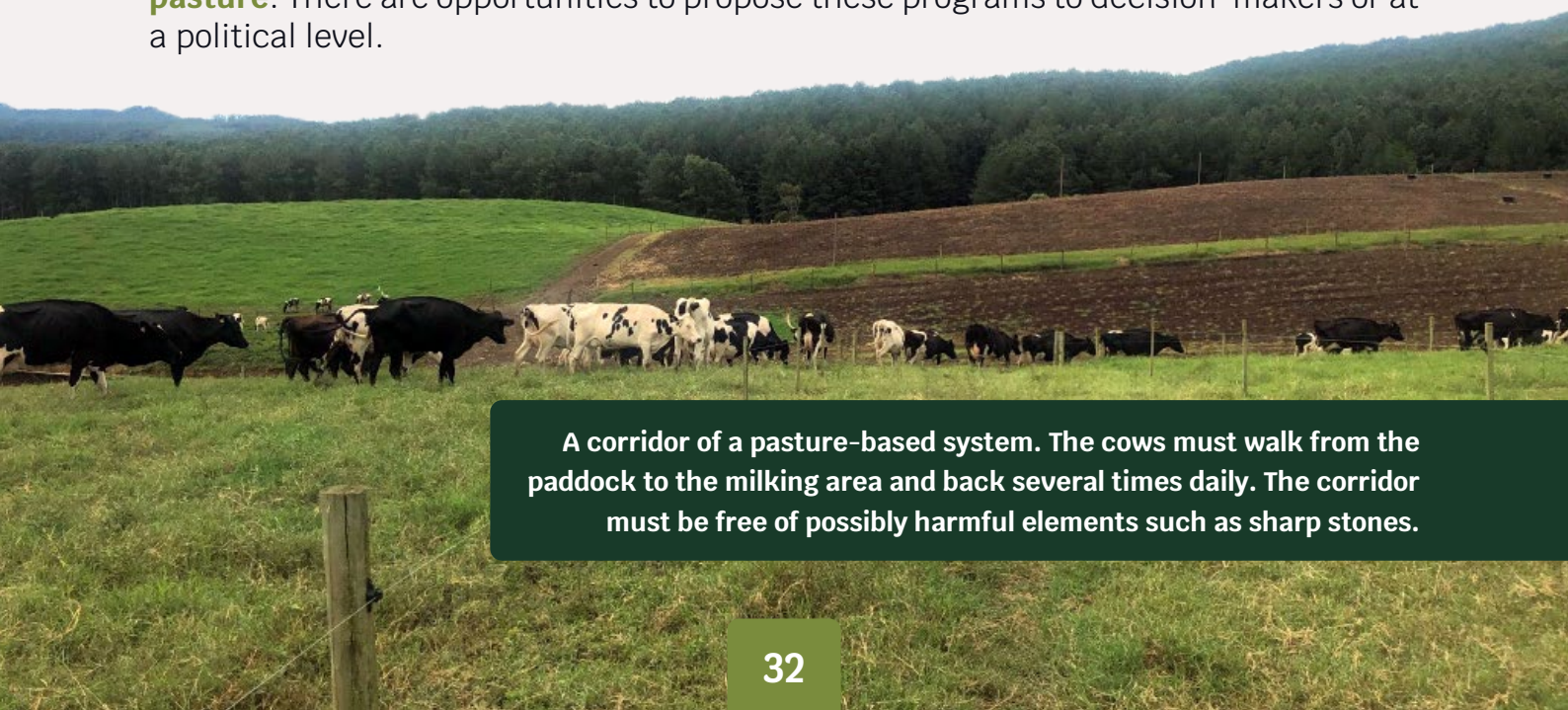
- **Pasture is outdated, underdeveloped, and less modern than a compost barn or free-stall systems:** Not true. This perception comes mostly from compost barn users, but unfortunately, some pasture-based farmers also think this way. **We propose identifying well-managed pastured-based farmers who are influential within a community and encouraging them to show other farmers that well-managed pasture-based systems can also be modern and developed.** Sometimes, recommendations are better received when coming from a peer.

**Pasture-based systems can respond to growing criticisms of ruminant production.** When well-managed, they generate ecosystem services, like sequestering and stocking carbon in the soil and enhancing biodiversity, in contrast to confined systems, which are highly dependent on non-renewable inputs.

We also recommend spreading informative content through social media and official agriculture websites, for many farmers can access the internet and use it to make decisions.

## 03 Well-managed pasture-based systems as an existing alternative to industrialization: how to overcome the barriers to its adoption

- **Higher forage yield and milk productivity than extensive systems:** True. Well-managed pasture-based systems improve forage and milk production per unit of land compared to an extensive pasture-based system.
- **High space requirements:** Many farmers complain about the space requirements of pasture-based systems. However, well-managed pasture-based systems are not inherently more space-dependent. **Well-managed systems can make the available space more efficient and productive, for example through a Voisin Rational Grazing strategy.** Compost barns and other confined systems can concentrate more animals per land unit but at the expense of increasing the dependence on external inputs. **The conversation around limited farm space, which many stakeholders use as a traction factor to adopt a compost barn, is an opportunity to disseminate optimal grazing strategies.** Front-line people can create workshops for stakeholders about efficient use of space with sustainable practices, highlighting the differences in investment, labor, and ecosystem services between well-managed pasture-based systems and compost barns.
- **Attention to the broader picture:** To promote pasture-based systems, we recommend focusing on the farmers' general living conditions. Many farmers highlight simple things that could encourage them to have a pasture-based system, like improving the roads on which their cows walk or reducing their system's labor requirement. We recommend adding road alternatives in dairy systems so the cows have at least three options to go to the milking room. This way erosion and mud can be diminished. These actions require financial support and technical assistance.
- **Modern dairy cows' genetics demand more concentrated diets. They cannot rely only on a pasture-based diet:** Cows and also forage plants have been actively selected to be more dependent on external inputs. **We recommend developing programs to introduce cows and plants suitable for well-managed pasture-based systems, looking for more resilience to harsh conditions and optimal milk productivity in the pasture.** There are opportunities to propose these programs to decision-makers or at a political level.



A corridor of a pasture-based system. The cows must walk from the paddock to the milking area and back several times daily. The corridor must be free of possibly harmful elements such as sharp stones.



Cows should have at least three options to go to the milking room. This way erosion and mud can be diminished. These actions require financial support and technical assistance.



## 03 Well-managed pasture-based systems as an existing alternative to industrialization: how to overcome the barriers to its adoption

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### What do farmers and extension agents have to say about pasture-based systems?

**Farmer (using a compost barn):** “Pasture-based dairy farms are fine if you have plenty of space.”

**Farmer (using a pasture-based system):** “The cows in my system produce less milk, but they live more than in a confined system... also, I spend much less money on feed than farmers using confined systems...”

**Extension agent:** “The overall financial benefits [of the pasture subdivision strategy] are clear. And animal health will also improve, and the farmers will have fewer veterinary expenses...”

**Farmer:** “The more subdivisions [of the land], the better, because you can constantly get the animals to a subdivision with better grass...”

**Farmer (using a compost barn):** “...cows [in pasture-based systems] spend a lot of energy moving around, looking for food and water...”

**Farmer (using a pasture-base system):** “After I improved my pasture-based system, now my cows are better... they won’t walk for hours to get their food, nor graze the pasture until reaching the ground... they have available grass all the time...”

**Farmer:** “The way I see it, the cows are fine if they are well-treated, well-fed, have nice hair, and have free access to food and drinking water. Unfortunately, I have a single water source near the milking room. It would be good to have water in the paddocks because then I wouldn’t have to take the cows to drink water twice a day...”

# The role of the extension agents

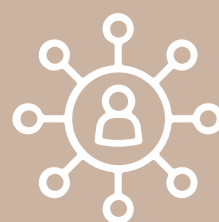


04

## 04 The role of the extension agents

### Key messages

- **Consistent visits:** Dairy farmers seek technical assistance that is personalized and consistent. A **good relationship between farmers and extension agents** is also vital to curb the dissemination of compost barns and support well-managed pasture-based systems. We recommend proposing to local stakeholders to create training and political orientation programs for extension agents to promote sustainable dairy production alternatives.
- **Model farmers:** We recommend **identifying farmers with well-managed pasture-based productions**, and push local government institutions to improve these' farmers' systems, and encourage them to turn into model farmers. It would be helpful to map farmers who are already influential within a community.
- **Promoting the love for producing milk:** Producing milk is a 24/7 job, and the farmers who decide to stay in the dairy activity often have grown positive feelings towards it. Well-managed pasture-based systems can deliver feelings of **worthwhileness and satisfaction** to farmers, related to self-awareness of producing milk more sustainably. This is less likely to appear in compost barn farmers.
- **A new face for modernity:** Extension agents can promote **sustainability as a new face of modernity**. The concept of modernity can be promoted through the model farmers, showing other farmers that well-managed pasture-based systems can be symbols of high status and a motive of being proud of having a sustainable dairy farm.



## 04 The role of the extension agents

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### Overview

Extension agents are key actors in the expansion of both compost barns and well-managed pasture-based systems. When dairy farmers validate an extension agent, the latter can influence the decision-making regarding the choice of productive systems. An opportunity for extension agents lies in the farmers' love for their activity. To produce milk is a 24/7 job, and doing it right requires loving it. To love it means having positive feelings towards the animals, the environment, and some kinship with nature. Extension agents can enhance these positive feelings by valuing well-managed pasture-based systems as sustainable. And sustainability can be shown as modernity. **Sustainable dairy systems can be very efficient and productive while they preserve and enhance ecosystem services.**

Dairy farmers often see the work of extensionists as necessary. **The characteristics they value most in technical advisors are the provision of ideas that work specifically for their systems and the consistency of the extension agent visits.** A good relationship between farmers and extension agents is vital to curb compost barns' expansion and incentivize well-managed pasture-based systems.

We recommend mapping groups where extension agents and pasture-based farmers already have long-term positive relationships. A long term positive relationship gives the extension agents a good idea of how to approach farmers and what motivates them to adopt or not a given technology.

Given the influence extension agents can have on dairy farmers, it is fundamental to have extension agents that are well-trained and politically oriented to promote sustainable alternatives. We recommend proposing to local stakeholders to create training opportunities and political orientation programs for extension agents to promote sustainable dairy production alternatives.



## 04 The role of the extension agents

### The voice of farmers and extension agents

**Farmer:** “I hear everything an extensionist or a salesman has to say, then I test everything in my own farm... if it works, I’ll buy it... our extensionist has worked really well, that is why we believe in him...”

**Extension agent:** “The first extensionist-farmer contact is with men...because it is the men who usually get off the farm to go to the city and deal with administrative procedures at the bank, or go to talk with extension agencies... so women stay in the farms, taking care of everything”

**Farmer:** “Working in dairy production is about working from Monday to Monday... no weekends, no holidays... you have to like it, otherwise, you will certainly quit...”



On-farm research and outreach visits to smallholder family dairy farmers in 2022.

# Orienting policymaking

05

## 05 Orienting policymaking

### Key messages

- **Supporting dairy farmers' business:** Milk prices oscillate significantly. Political decision-makers must be pushed to develop measures to support the dairy farmers' business.
- **Improving pasture-based systems' resilience:** A system is resilient when it can come back to normal after a perturbation. **Resilience** can be improved in several ways; for example, by promoting ecosystem services, product diversification, milk with added value, and subsidies for sustainable milk production.
- **Payment for ecosystem services:** Well-managed pasture-based systems can **contribute to ecosystem services**, especially by sequestering carbon and increasing carbon stock in the soil. Political decision-makers must engage in programs that add value to milk produced sustainably. Developing and supporting local markets or public policies to pay for ecosystem services may incentivize milk production in pasture-based systems.
- **Rural credit programs and flexible payments:** Creating and promoting **rural credit programs for pasture-based systems** with flexible payment can help farmers **enhance** their pasture-based systems.
- **Sustainable food procurement:** Strengthening existing programs to promote sustainable food procurement<sup>20</sup> from family farming using well-managed pasture-based systems. Some examples are those that aim to provide public schools with agroecological products from family farms.
- **Energy cost:** A major current economic issue for all farmers is the cost of energy, which will continue to increase. Promoting and subsidizing **photovoltaic energy systems** in small farms can enhance the **resilience of pasture-based systems** by reducing production costs and protecting them from energy price fluctuations.





### Overview

Extension agents' and dairy farmers' efforts are not enough to curb the expansion of compost barns and to promote well-managed pasture-based systems. They need public policy support.

There is a need to reduce taxes for milk farmers and promote equal payment to milk farmers regardless of size and production level. The overall costs of milk production are increasing and milk buyers often pay less to smallholder farmers than to larger dairy farms. **A tax reduction program may be proposed to the federal government, and private companies should be prompted to offer equal payments. The latter actions may enhance the farmers' financial situation.**

Milk prices fluctuate highly, and the political decision-makers must be pushed to develop supporting actions to promote milk price stability.

**Additionally, the resilience of a dairy system is essential to enhance the farmer's autonomy. There are opportunities, for example through political lobbying, to develop local markets that pay for ecosystem services.** Pasture-based farmers could receive incentives to transition towards achieving specific ecosystem services like carbon sequestration, carbon stocking, general biodiversity, and soil health improvement. Front-line people can also work on improving access to ecosystem services measuring tools.

**We also recommend creating rural credit programs for pasture-based systems with flexible payment. Subsidizing the purchasing of solar panels would enhance the resilience of pasture-based systems since they would be less vulnerable to input or milk price fluctuation.**

Additionally, we recommend incentivizing product diversification. **Farmers who produce more than just milk are less vulnerable to price fluctuation.** When the price of milk is low or the price of inputs is high, farmers will have other sources of income. There are opportunities for cattle production for meat, for example by crossing some cows with the Angus breed. Also, many farmers produce corn and soy to feed the cows. With pasture-based systems less dependent on external inputs, farmers can reorient that land to sustainably grow more grass, crops for selling, or vegetables for self-consumption.

A program of sustainable food procurement to promote food products from family farms in public schools can have a double impact. Firstly, school children will benefit from healthy, fresh, nutritious, and locally produced food from family farms; secondly, it can improve the financial situation of family farms, by securing markets for their products.

## 05 Orienting policymaking

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### The voice of farmers

**Farmer:** “Consumers only care about getting the lower price, but we struggle to compete with milk importation.”

**Farmer:** “When the prices go up, we suffer less, but the consumer does not like it.”

**Farmer:** “Milk taxes are too high. If the taxes were a bit lower, the prices would go down, which is good for the consumers, and the profit would increase reasonably. Everyone wins.”

**Farmer (using a compost barn):** “In the summer our electricity bill goes very high [about four Brazilian minimum salaries] due to the fans.”



# How to engage consumers and consumers groups



006

## 06 How to engage consumers and consumers groups

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### Key messages

- **Animal welfare:** Brazilian public is concerned about **ethical and the sustainability issues regarding animal production systems**. However, awareness of how milk is produced is still very low. Raising public awareness that milk comes from different production systems may encourage some consumers to support pasture-based milk production.
- **Consumer markets:** Front-line people can **gather public interest in sustainable dairy production** to value well-managed pasture-based systems and look for potential consumer markets for animal welfare-friendly, climate-friendly, or carbon-neutral milk.
- **Meet your dairy farmer:** Creating a meet your dairy farmer program to **bring together the community and farmers** could help value milk produced with care and passion.
- **Local brands:** One option, also within the sustainable food procurement program would be working with **local companies and institutions** to create local brands to sell products from well-managed, sustainable pasture-based systems.



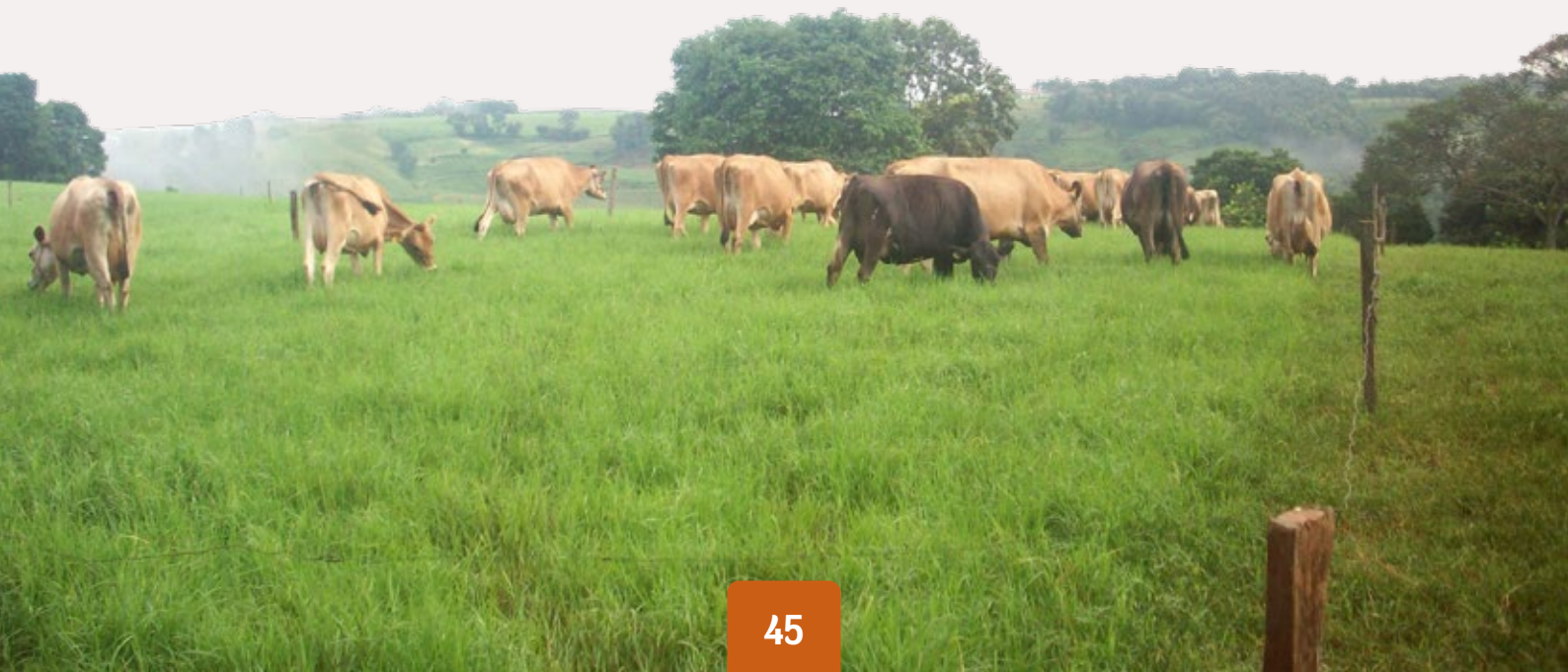
### Overview

Consumers' opinions are critical for dairy farming to maintain its social license to operate. In Brazil, like in many regions of the world, consumers prefer products and production systems that are perceived as more natural. Many consider pasture-based systems the most adequate for animals and consumers. **The concerns of the Brazilian public about the ethics and the sustainability of the animal production systems are an opportunity to raise awareness about how milk is produced.**

The current payment scheme does not distinguish milk from the different production systems. There are opportunities to value the milk produced under sustainable systems and get an added value for farmers. Front-line people and extension agents can work with markets and milk buyers to incentivize agroecological products and look for potential consumer markets. Some examples are animal welfare-friendly, climate-friendly, or carbon-neutral milk. A possibility would be to develop a brand or a certification.

One reason for low public awareness regarding farm animal production is the distance between consumers and producers, in part related to the rapid urbanization of the country in the last generations. **If consumers and dairy farmers must get closer to each other**, consumers may see that dairy farmers' work is ethical, sustainable, and made with care and passion and farmers may listen to what the consumers expect, and their reasons. This approach could build public support for sustainable dairy production, add value to milk produced in these systems, and guarantee a market by promoting a buy-local program.

**Local markets can be promoted by organizing meetings between consumers and farmers. An option could be a meet-your-dairy farmer program or agroecological dairy fairs where the public can personally meet the farmers.** On the one hand, the public would taste the farmers' daily lives, their passion and love for dairy activity, and their concerns for the future. On the other hand, the farmers could get to know the consumers and their preferences and concerns. The resulting link between farmers and consumers can secure a market for pasture-based milk, giving the pasture-based systems an opportunity for striving.

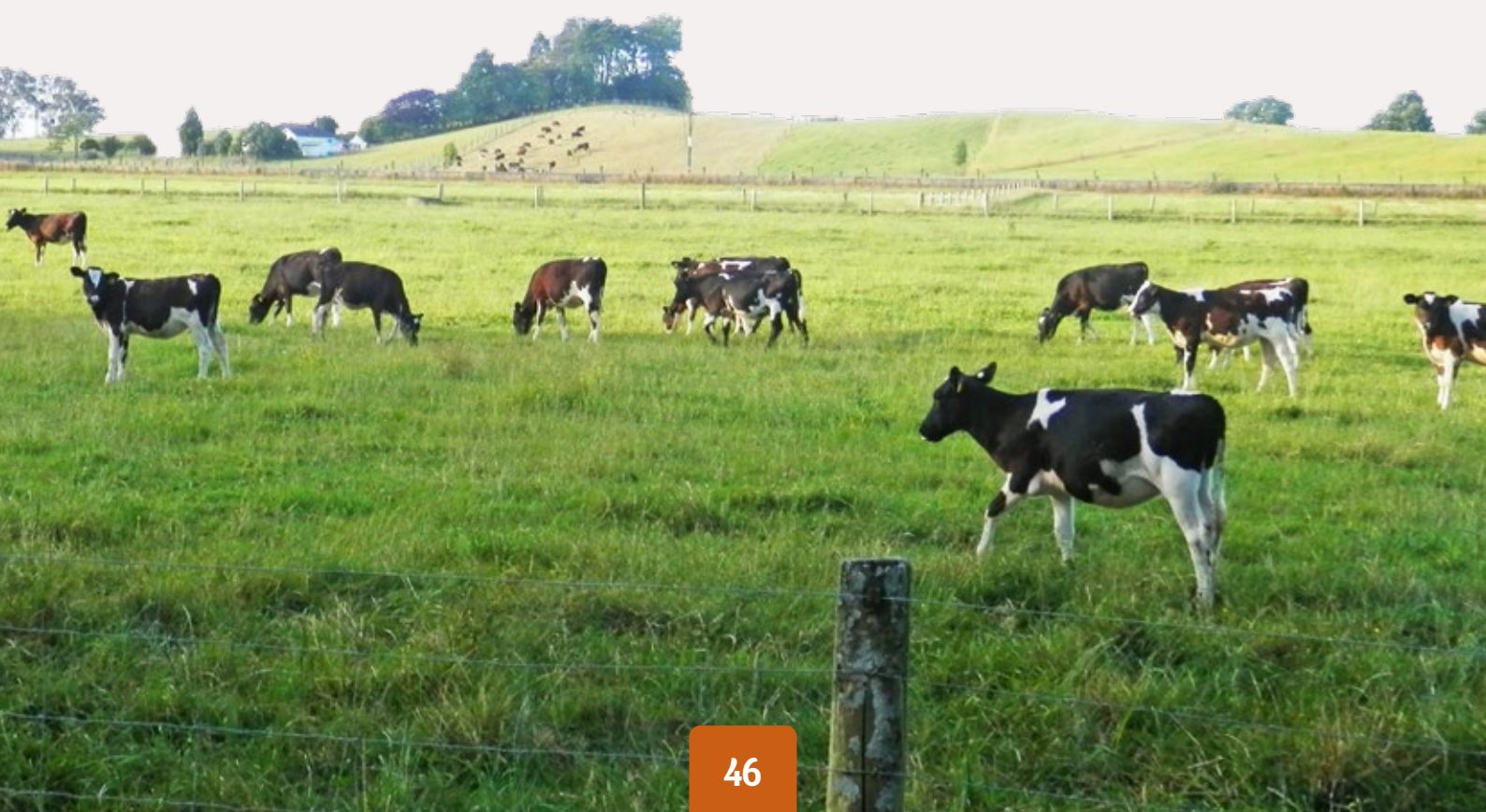


### The voice of farmers and extension agents

**Extension agent:** “In pasture-based systems, the cows are happier. They are free, running and jumping, you can see they are fine. The consumers are demanding products from animals that are free”.

**Farmer:** “We face price raises all the time, so logically we would have to add that cost in the milk price, but the consumer does not like increasing milk prices. So we have to absorb that cost, because the market always decides in favor of the consumers.”

**Farmer:** “The cows need the freedom to be happy. I want that for my animals. I don’t care to produce a bit less if they are happier. We shouldn’t put too much pressure on animals [to produce more]. They need grass, water, and shade to be comfortable.”



# Why and how to engage the farmers and extension agents to share their perceptions

07

## 07 Why and how to engage the farmers and extension agents to share their perceptions



### Key messages

- **Diverse groups:** Identifying diverse groups of extension agents with a **good relationship** with farmers will increase the chances of reaching a broader range of farmers.
- **Individual approach:** An individual approach to smallholder dairy families may expose the **different factors that influence decision-making** within a dairy system.
- **Women in dairy production: Women's role in dairy production is crucial.** Women spend more time with the animals and on the farm and have a pretty good idea of what is happening on the farms. We recommend contacting women to share their perceptions about a specific subject, or finding ways to integrate women into every decision-making process. For example, encouraging women to take the lead in workshops or other collective activities.
- **Younger generations are key:** the decision of younger generations about staying on the farm or migrating to the city is crucial in whether to continue or abandon dairy production. **If young family members migrate to the city, older generations might abandon the activity or confine the animals** (hoping to have less labor).
- **Schools and university orientations:** young members sometimes go to the city to study and return to their farms. The approach younger generations will undertake on the farms will vary depending on their school orientation. It is critical to push local government institutions to **include sustainable farm techniques in the programs of all university and college agriculture courses**.
- **Three steps to map extension agents and dairy farmers:** We recommend a **three-step strategy to reaching dairy farmers**, starting with mapping a) extension agents who work in milk production, b) farmers through these extension agents and, c) other farmers in the communities. With this strategy, dairy farmers are often open to receiving people in their houses and sharing their perceptions.





### Overview

**A general recommendation to people interested in working with dairy farmers is to get to know and understand smallholder dairy families individually.** This is essential to get a broad picture of the expansion of compost barns, given that many farmers have their own perceptions and attitudes towards dairy production and how to improve it. Factors critical for the decision whether to increase herd size and confine the cows or not vary amongst families. The age of the family members, whether younger generations are staying or leaving the farm, land size, and access to external labor are some factors that impact farmers' attitudes about adopting a compost barn system.

Reaching farmers requires a strategy. The first contact between farmers and extension agents is usually through men. Men go more often to the city to deal with the administrative matters of the farm and to extension courses and field days, while women stay on the farm, taking care of the milking and the family. However, women often make the system's important decisions and also have a very well-informed opinion about what is happening on the farms.

We recommend a three-step plan to contact dairy farmers.

- **The first step should be mapping extension agents (men and women) who work in milk production.** This can be done through personal communication, through websites from the government, or information from previous research. Many extension agents in Santa Catarina that work directly with milk production can be found in agriculture private stores called *agropecuárias*, in milk plants called *laticínios*, or in [public organizations](#) from the state of Santa Catarina like EPAGRI, CIDASC, and CEASA.
- **Step two is talking to the extension agents from these organizations, who are likely to have helpful information about the dairy sector and about farmers who might be interested in working with front-line people.**
- **Step three is to have personal communication with farmers themselves.** Some farmers will be open to talking to external people, and others will refer to someone who might be open. This way, a significant number of farmers can be mapped. In this personal communication, front-line people may also ask specifically for farms led by women.

When interviewing or doing other activities with farmers, it is helpful to reach women separately to get their perception because, in many cases, women's voice gets overshadowed by men's.

## Reaching dairy farmers effectively

### Three-step strategy

1. Mapping extension agents
2. Contacting dairy farmers through extension agents
3. Contacting dairy farmers through other dairy farmers, using a snowball technique

### Snowball technique

Is when farmers recommend peers that might be interested and open to receiving people and sharing their perceptions. The peers can be neighbors, friends, and family.

This way, the number of interested people grows.

### Be aware of the farmer's schedule

Farmers have their routines, which can vary.

However, the milking practice is where they spend most of their time. They milk two times per day.

Knowing their busy times will help plan meetings.

### Contacting women

Women often have a very well-informed idea of what is happening on the farm.

Getting their perception will help get better information about the farms.

## 07 Why and how to engage the farmers and extension agents to share their perceptions

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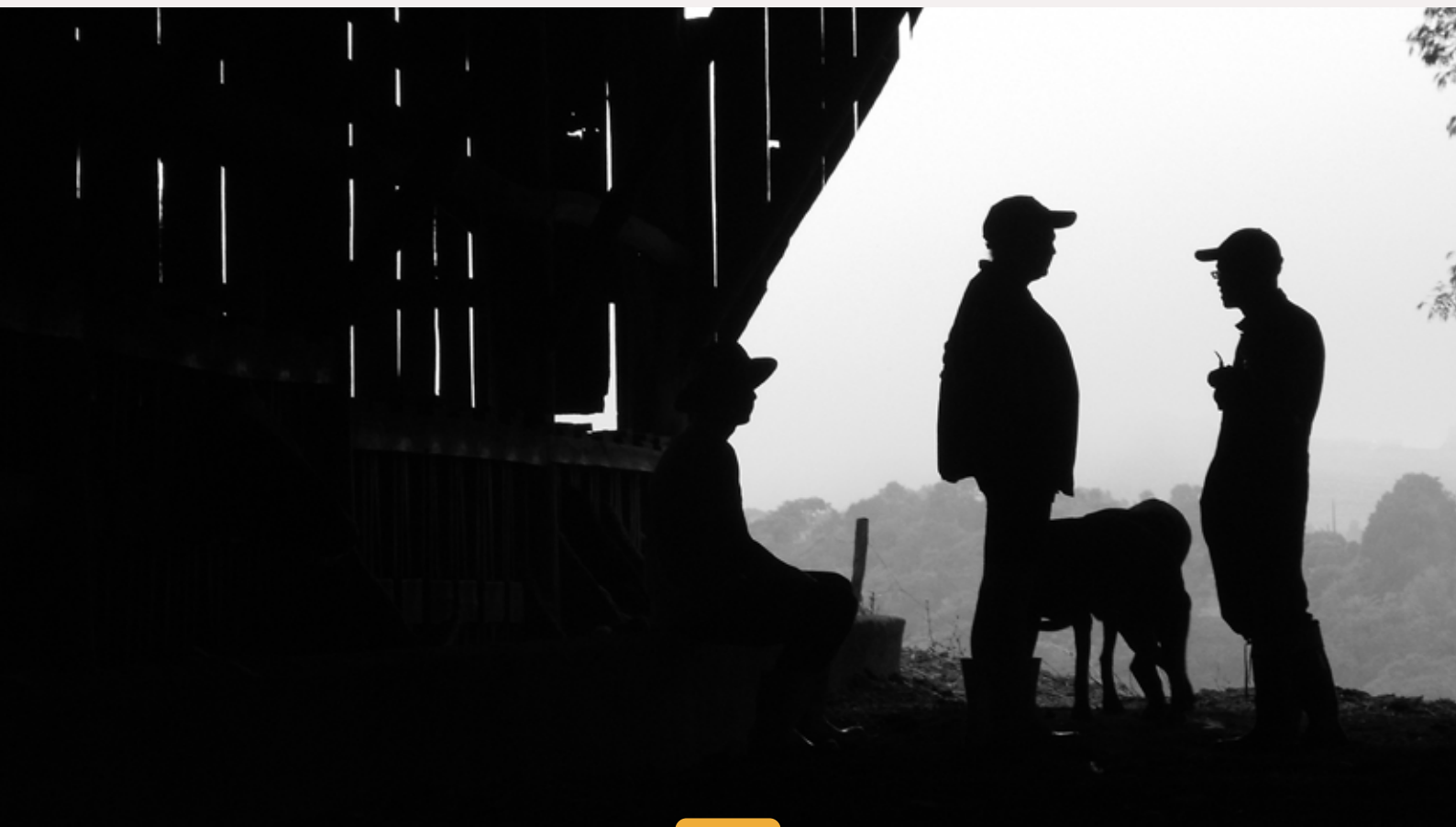
### The voice of farmers and extension agents

**Extension agent:** “Dairy farmers can be divided into three groups... the more professional ones, improving genetics and other important topics, and the medium ones, which have a reasonable production and income. Then, there are the farmers who are only surviving day by day and are likely to disappear, because the market pressure to intensify the production is too strong.”

**Farmer (using a compost barn):** “The vast majority of the community’s children do not want anything to do with dairy production. They just want to do anything else, work in the city. In our community, there are only two families left, and they invested in compost barns, as we did, in order to stay in business.”

**Farmer:** “If you are young and want to stay on the farm, you have to study. My sister and I studied. We have better tools to improve our business, especially regarding finances. I’ve discovered that we weren’t reaching our productive potential [with a pasture-based system] because our land is not big enough, so we had to confine our animals.”

**Farmer:** “We had reached the maximum number of cows our land size allowed, so we had to evolve to a confined system. Our neighbors were a big family, and after the parent’s passing, their land was split among the sons and daughters, generating smaller properties, where is not possible to sustain pasture-based dairy systems”



# References



1. Costa, J.H.C., Hötzel, M.J., Longo, C., Balcão, L.F., 2013. A survey of management practices that influence production and welfare of dairy cattle on family farms in southern Brazil. *J. Dairy Sci.* 96, 307-317.
2. FAO. 2022. Gateway to dairy production and products. Food and Agriculture Organization. <https://www.fao.org/dairy-production-products/production/en/>
3. CNA. 202. Comunicado técnico. Pesquisa pecuária municipal 2020. Confederação da Agricultura e Pecuária do Brasil. [https://www.cnabrasil.org.br/assets/arquivos/boletins/Comunicado-Tecnico-CNA-ed-30\\_2021.pdf](https://www.cnabrasil.org.br/assets/arquivos/boletins/Comunicado-Tecnico-CNA-ed-30_2021.pdf)
4. Dos Santos OV, Marcondes T, Cordeiro JL. 2006. Estudo da cadeia do leite em Santa Catarina: prospecção e demandas. Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, Centro de Estudos de Safras e Mercados – Epagri/Cepa, Florianópolis, SC, Brazil.
5. Carvalho CB. 2006. Relação socioeconômica dos fumicultores-fumageiras da região de Sombrio, SC e uma proposta de transição agroecológica (Socioeconomic relations between tobacco growers and tobacco companies in the region of Sombrio, SC and a proposal for agroecological transition). Masters Dissertation thesis, Federal University of Santa Catarina, Florianópolis, Santa Catarina, Brazil.
6. Renk A, Winckler S. 2005. The paradoxes of tobacco agribusiness among smallholder farmers in western Santa Catarina Las paradojas de fumar agroindustria entre los pequeños agricultores. *História, Debates e Tendências.* e-ISSN 2238-8885.
7. Lorenzon J. 2004. Impactos sociais, econômicos e produtivos das tecnologias de produção de leite preconizadas para o oeste de Santa Catarina: estudo de caso. Dissertação apresentada como requisito parcial a obtenção do grau de Mestre em Agroecossistemas, Centro de Ciências Agrárias, Universidade Federal de Santa Catarina.
8. Mior LC (2010) Agricultura familiar, agroindústria e desenvolvimento territorial (Family agriculture, agroindustry and territorial development). In 'I Colóquio Internacional de Desenvolvimento Territorial Sustentável. Florianópolis'. (Eds P Vieira, AA Cazella, C Cerdan, JP Carrière) pp. 235–258. (Secco: Florianópolis)
9. Wendling, A.V., Machado Filho, L.C.P., 2018. Characterization of silage production and the use by dairy farmers in the West of Santa Catarina state. *Semina: Ciências Agrárias* 39, 1639-1652.
10. Balcão, L.F., Longo, C., Costa, J.H.C., Uller-Gómez, C., Filho, L.C.P.M., Hötzel, M.J. 2017. Characterisation of smallholding dairy farms in southern Brazil. *Anim. Prod. Sci.* 57, 735-745.
11. Honorato, L.A., Machado Filho, L.C.P., Silveira, I.D.B., Hötzel, M.J., 2014. Strategies used by dairy family farmers in the south of Brazil to comply with organic regulations. *J. Dairy Sci.* 97, 1319-1327.
12. Kuhnén, S., Stibuski, R.B., Honorato, L.A., 2015. Farm management in organic and conventional dairy production systems based on pasture in Southern Brazil and its consequences on production and milk quality. *Animals* 5, 479-494.
13. Daros, R.R., Bran, J.A., Hötzel, M.J., and Von Keyserlingk, M.a.G. (2019). Readily Available Water Access is Associated with Greater Milk Production in Grazing Dairy Herds. *Animals* 9, 48.
14. Leso, L., Barbari, M., Lopes, M. A., Damasceno, F. A., Galama, P., Taraba, J. L., & Kuipers, A. 2020. Invited review: Compost-bedded pack barns for dairy cows. *Journal of Dairy Science*, 103(2), 1072-1099. <https://doi.org/10.3168/jds.2019-16864>
15. Oliveira, V. C., Damasceno, F. A., Oliveira, C. E. A., Ferraz, P. F. P., Ferraz, G. A. S., & Saraz, J. A. O. (2019). Compost-bedded pack barns in the state of Minas Gerais: Architectural and technological characterization. *Agronomy Research*, 17(5), 2016-2028. <https://doi.org/10.15159/AR.19.179>
16. Pinheiro Machado Filho LC, Seó HLS, Daros RR, Enriquez-Hidalgo D, Wendling AV, and Pinheiro Machado LC 2021 Voisin rational grazing as a sustainable alternative for livestock production. *Animals*, 11(12). <https://doi.org/10.3390/ani11123494>
17. Costa, J. H. C., Burnett, T. A., von Keyserlingk, M. A. G., & Hötzel, M. J. 2018. Prevalence of lameness and leg lesions of lactating dairy cows housed in southern Brazil: Effects of housing systems. *Journal of Dairy Science*, 101(3), 2395-2405. <https://doi.org/10.3168/jds.2017-13462>
18. Hernandez-Mendo, O., Von Keyserlingk, M. A. G., Veira, D. M., & Weary, D. M. 2007. Effects of pasture on lameness in dairy cows. *Journal of Dairy Science*, 90(3), 1209-1214. [https://doi.org/10.3168/jds.S0022-0302\(07\)71608-9](https://doi.org/10.3168/jds.S0022-0302(07)71608-9)
19. Olmos, G., Bran, J.A., von Keyserlingk, M.A.G., Hötzel, M.J., 2018. Lameness on Brazilian pasture based dairies – Part 2: Conversations with farmers and dairy consultants. *Prev. Vet. Med.* 157, 115-124.
20. Sabet, F. (2022). Sustainable school food procurement in England : when there is a will, there is a way. <https://doi.org/10.3920/978-90-8686-939-8>



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