landmark with the internal thoracic artery and vein. Thoracic ultrasonography helps to characterize the importance of lung lesions (mainly lung consolidation) that are negatively associated with health and production outcomes. Animals with lung lesions (using various thresholds and consideration for case definition) have been found at higher risk of dyingor being culled before the first calving. Other findings associated with lung consolidation are decreased average daily gain during the preweaning period and decreased hazard of first pregnancy. Finally, decreased milk production during the first lactation has also been reported. In feedlot, beef and veal calves, thoracic ultrasonography although less studied has also been associated with various negative outcomes.

This ancillary tool can be useful to assess calf lung health and to monitor implementation of mitigation strategies for respiratory disease prevention and treatment. Thoracic ultrasonography is a fast and affordable diagnostic test that can be used calf-side with no specific investment. This is an extra-tool in the bronchopneumonia diagnostic toolbox. However, this is not a magic tool and limitations should be known when trying to implement it in practice.

Sustainable Cattle Productive Systems

K71

Sustainability in action – how do we "meat" demand without "milking" the environment

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Sustainable food production is one of the most often-discussed issues within agriculture, given concerns regarding climate change, resource use, animal health and welfare, antimicrobial resistance and the provision of affordable food. Although myriad definitions of sustainable food exist, the most widely-accepted comprises a balance between economic viability, environmental responsibility and social acceptability, yet the latter component has recently become disproportionately important, as consumers have increasing questions about how their food is produced.

Livestock productivity must continue to increase in line with future population growth, so that sufficient animal source foods can be produced to fulfil consumer requirements, while lessening the impact on the environment. For example, in the USA, the move towards large-scale intensive farming conferred a reduction in the greenhouse gas emissions (GHGe) per kg of milk by 63% between 1944 and 2007, with a further 19% reduction between 2007 and 2017. Similar effects were achieved in U.S. beef systems, with an 18% reduction in GHGe per kg between 1977 and 2007; and in both pork (35% reduction between 1959 and 2009) and egg production (63% reduction between 1960 and 2010). A clear differentiation should be drawn however, between improving productivity in all livestock systems with due regard for social, economic and resource use constraints, and imposing or prescribing practices or systems with regards for sustainability impacts or trade-offs. Given the billions of smallholder and subsistence farmers across the world who rely on livestock for myriad reasons, a wholescale global transition to intensive production systems is not the solution.

Animal health is one of the key determinants of productivity, with over 20% of global animal protein lost to disease. As healthy animals produce greater yields of milk or meat, or grow at a faster rate, improving animal health reduces both the economic costs and the environmental impacts of livestock production. Animal health is also a significant consideration for many consumers, who want to be reassured that that the milk, meat and eggs that they buy come from healthy livestock. Good animal health therefore promotes social acceptability, reduces the risk of public health issues and reduces the need for veterinary medicines – a significant positive effect given the threat of antimicrobial resistance to both animal and human health. The economic benefits accruing from improved animal health, also allow improved affordability of meat, milk and eggs to the consumer.

The extent of the environmental and economic improvements conferred by improved livestock health and the quantity of data in the literature varies considerably between species and diseases. For example, the economic costs of bovine respiratory disease complex and infectious bovine rhinotracheitis are relatively well-defined, and multiple papers have quantified the reductions in GHGe conferred by improving mastitis incidence in dairy cattle; yet the economic impacts of many other diseases tend to be dated, with no quantification of associated resource use or GHGe. Considerable knowledge gaps therefore exist relating to interactions between productivity, livestock disease, economic cost and environmental impact. These gaps urgently need to be filled, both to help producers to understand the economic and environmental cost:benefit ratios of management practices or treatment decisions, and to allow downstream food industry stakeholders (e.g. processors, retailers and restaurants) to make informed decisions.

Improving livestock productivity through enhanced animal health provides a strategy to mitigate environmental impacts, increase economic viability and reassure consumers for whom health and welfare are key concerns. This triple-win approach aligns with One Health principles and provides a clear mechanism to enhance sustainability, however, the implementation of global animal health protocols and access to veterinary medicines remains an ongoing challenge.

K72

Feeding the world without devouring it

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By 2050, Earth will be home to nearly 10 billion people, a tripled human population during our lifetime. Only 1.8% of the Earth's surface is arable land that can be used for growing crops, a resource not likely to increase, which means the amount of cropland per person will decline by 20%. In the face of finite resources and a changing climate, we need sustainable solutions to the 2050 food challenge. Our current food system is often criticized for not addressing chronic undernutrition, micronutrient deficiencies and obesity. And agriculture does contribute to issues of environmental sustainability. Livestock production is often seen as particularly egregious, and some people say we can better meet the 2050 food challenge by limiting or eliminating animal-source foods from our diet. Critics of animal agriculture go as far as to claim that globally, livestock produces more greenhouse gases than the entire transportation sector. Less livestock production would reduce greenhouse gas emissions, provide more food for humans by decreasing feed needed for livestock, and free up rangeland and feedlots for crop production. In short - Eat less meat to save the environment. At first glance, this simple solution seems elegant and one that should be readily adopted. However, the truth is far more complicated.

K73

Cows of the future – challenges and opportunities for sustainable cattle systems

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There is no "one-size-fits-all" sustainable cattle system – the degree to which different livestock systems are considered sustainable depends on the region, culture, market and metric of choice. Sustainable systems balance environmental responsibility, economic viability and social acceptability, yet of these three factors, the first has become disproportionately important. The widespread media coverage of climate change issues, augmented by the outcomes of the recent COP26 Conference and the publicity afforded to the primarily plant-based "Eat Lancet" diet, means that ruminant systems are often cited as being environmentally damaging. An urgent need therefore exists to improve the greenhouse gas emissions (GHGe) of all cattle operations to demonstrate, highlight and communicate our dedication to improving environmental sustainability.

Livestock industries in high-income regions have tended to reduce GHGe per kg of food produced through improvements in genetics, nutrition, health and management over the past century. Given that the USA-based dairy cow that holds the world record for 365-d milk production yielded 35,437 kg, it is clear that further genetic gains may still be available in dairy systems. The difficulty of processing and marketing larger beef carcasses means that increasing carcass weight may not be a sustainable strategy for beef production, however considerable opportunities exist through improving both age at slaughter and reproductive efficiency. If appropriate breeding goals are identified to ensure that cows and calves can make the best use of the resources available; pasture and feed are managed efficiently and with due regard for optimal production; and livestock health is made a priority; then resource use and GHGe may be reduced. Producing beef from dairy systems can also reduce GHGe, because a considerable proportion of the dam's environmental impacts can be allocated to milk production. These systems therefore may improve environmental responsibility, in addition to solving one of the major social acceptability issues of dairy production – the fate of dairy bull calves. Traditional suckler/cow-calf systems will therefore need to be proactive in communicating their role in producing food from grassland that is unsuitable for other food or fibre production, while sequestering carbon.

Technology use should be encouraged wherever possible, from basic husbandry practices (e.g. weighing cattle), to reproductive, growth and management technologies that are novel, not yet widely adopted or still under development (e.g. sexed semen, hormone implants, methane inhibitors). Crucially, this must be undertaken in combination with improved data collection, recording and benchmarking. Future consumers will demand information on a range of sustainability metrics (e.g. GHGe, biodiversity, medicines use, community support, etc), yet this will only be possible via credible data. At present there is no standard GHGe tool for use across the globe, and the tools available produce wildly differing results. With national, supply chain and product GHGe quantification becoming mandatory, a standard tool is required to ensure fair comparisons and provide insights into the effects of on-farm practices.

One of the greatest sustainability issues that the cattle industry needs to overcome is the gap in knowledge and understanding between the producer and the consumer, which, when hitherto-underknown practices are exposed, may lead to accusations that farmers lack transparency or are cruel to animals. This is challenging in an era where television, internet and social media have overtaken traditional print media and literature as information sources and arguments against livestock production that appeal to aesthetic or ethical values are sometimes more successful than science-led information. Rather than trying to combat anthropomorphic or ethical claims with scientific facts, we need to combine the two, acknowledging that we share consumer desires for affordable healthy food, excellent animal health and welfare and reduced environmental impacts, and demonstrating a clear commitment to systems and management practices that promote these.

Ultimately, consumer trust is key to maintaining the social acceptability of cattle production. A sustainable future for cattle production will be independent of either economic viability or environmental responsibility if the market ceases to exist for milk and meat. However, if we improve livestock productivity, technology adoption and data recording in conjunction with improved consumer communication, we should be able to balance the three pillars of sustainability and ensure that milk and meat are still on the menu in years to come.

K74

Livestock and climate change – Facts and fiction

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Animal agriculture is often shouldered with a large part of the blame when it comes to climate change, and that's in part to the fact that we haven't been looking at all greenhouse gases correctly. While methane – the main greenhouse gas associated with animal agriculture – is a potent climate pollutant that we can and need to reduce, it warms our atmosphere differently than other gases because of its short lifespan. Methane persists in our atmosphere for about a dozen years before it's broken down via oxidation, and it's that atmospheric removal that is often neglected when trying to characterize methane's warming impact. Furthermore, if we can reduce methane emissions to the point where more is being broken down in the atmosphere than is being emitted, we'll see animal agriculture go from being blamed for climate change to being recognized as a major climate solution. By rethinking methane, we can see that animal agriculture's path to climate neutrality is within reach as scalable solutions offer the global community tools to fight global climate change.

Surgery

K76

Cesarean section in cattle

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Introduction: Dystocia in dairy and beef cattle are fairly common (1.1-6.8% of all calvings). Vaginal manipulation can resolve the dystocia. However, in cases of fetal disproportion, cervical inertia, malformation or complicated malposition, a c-section will be necessary.

Preoperative treatments: Preoperative antibiotics, such as procaine penicillin, should be given. It is also appropriate to give a NSAID, such as meloxicam. The surgery site is clipped and prepared appropriately for surgery (washed and scrubbed). Most c-sections are done with the cow standing and restrained in a contention chute. Sedation is rarely needed.

For a standing procedure, the flank is anesthetized by paravertebral block (proximal or distal), inverted L or line block. The technique chosen is often based on surgeon experience.

Surgical approaches: Typically, the left paralumbar fossa is used to access the uterus. From this approach, the rumen acts as a barrier to keep the jejunum in the abdomen. Exteriorization is crucial with a dead calf. However, with a live calf that had minimal obstetrical manipulation, the uterus can be opened within the abdomen.

Ventral approaches are possible in cattle. They are usually performed on dead or emphysemateous calves. The ventral-midline and the right paramammary have been described in beef cattle. Those are more difficult to execute on dairy cattle because of the size of the udder and the massive vascular network. The para-mammary/inguinal approach can be used in dairy cattle. The ventral approach provides a more direct access to the uterus.

Surgical techniques: Hysterotomy is performed on the greater curvature. The calf is extracted gently to avoid tearing the uterus. With the uterus still exteriorized, the uterus is checked for another calf. The placenta, if detached, is removed. If it is still attached, scissors are used to remove the part that comes out of the hysterotomy. A double inverting pattern is the technique of choice for closure of the uterus. The patterns that can be used are continuous Utrech, Cushing or lembert. On the second layer, it is important to burry the knots to avoid adhesions. Absorbable suture material of USP 1 is appropriate. Some advocate the use of monofilament instead of multifilament to decrease the drag effect. If the latter is used, it is important to push the tissue over the suture rather than pull the suture through the tissue to avoid the dragging effect and tearing of the uterus.

Before being returned in the abdomen, the uterus is cleaned of blood clots and debris. If the surgery was contaminated and if possible, the abdomen should be thoroughly lavaged with sterile isotonic solution. Ideally, the lavage solution is evacuated, by massage or by suction prior to closing the abdomen.