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What will Sustainable Livestock Systems Look Like in the 21st Century and Beyond?

(Sistem Peternakan Berkelanjutan Seperti Apa pada Abad 21 dan Selanjutnya)

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ABSTRACT

A sustainable system may be thought of as one which can be maintained at a certain rate or level, without degrading itself, its functionality or its environment. In the context of livestock and in particular ruminant livestock systems, we are immediately faced with two challenges – firstly in some (but not all) of the world, livestock systems are currently degrading the environment. Secondly, in parts of the world, particularly those we refer to as developing economies, demand for Animal Source Protein (ASP) is rising rapidly and hence capacity to produce ASP and do so sustainably needs to be increased, not just maintained. Demand for ASP in western countries has peaked and in some places is starting to decline. By comparison demand for ASP in much of Asia and Africa, while still low on a per capita basis, is growing strongly, driven by increasing population and an increased desire to consume dairy, beef and other red meats. Ruminant productivity is low, but has the potential for great and rapid improvement – but there is no one, simple fix. Short, medium and long term goals need to be established and pursued independently but collaboratively. Improving animal husbandry by reducing age at first parturition, decreasing birthing intervals and decreasing infant mortality, along with improving the available feed base, have the capacity to produce almost immediate, sustainable increment in livestock productivity. Beyond that, developing locally adapted and productive animal phenotypes is an important step in achieving improved, sustainable animal productivity. Ultimately however we need to fundamentally change our approach to feeding ourselves. It is now estimated that over half of the world's population live in cities. Quite apart from any social implications, this results in a massive translocation and concentration of resources. Likewise, huge quantities of energy, protein and minerals daily leave cities in the forms that we refer to as “waste”. Much of this is potentially suitable for capture and transformation to animal feed. This is a new and challenging area of applied research, but one that can't be ignored. It will potentially define our ability to create truly sustainable livestock systems.

Key Words: Sustainable, Livestock, Animal Source of Protein, 21st Century

ABSTRACT

Suatu sistem yang berkelanjutan dapat dianggap sebagai salah satu yang dapat dipertahankan pada laju atau tingkat tertentu, tanpa mengabaikan fungsi atau lingkungan itu sendiri. Dalam konteks peternakan dan khususnya sistem peternakan ruminansia, kita langsung menghadapi dua tantangan - pertama di beberapa (tapi tidak semua) negara di dunia, sistem peternakan saat ini mengabaikan lingkungan. Kedua, di belahan dunia, terutama yang kita sebut sebagai negara berkembang, permintaan akan protein asal ternak meningkat dengan cepat dan karenanya kapasitas untuk memproduksi protein asal ternak dan mengembangkannya secara berkelanjutan perlu dilakukan dan ditingkatkan. Permintaan protein asal ternak di negara-negara barat telah mencapai titik puncak dan di beberapa negara mulai menurun. Sementara permintaan protein asal ternak per kapita di sebagian besar wilayah Asia dan Afrika, masih rendah dan tumbuh dengan cepat, didorong oleh meningkatnya populasi dan meningkatnya kebutuhan mengonsumsi susu, daging sapi dan daging merah lainnya. Produktivitas ruminansia masih rendah, namun memiliki potensi untuk ditingkatkan dan dikembangkan - namun tidak mudah dan tidak sederhana. Tujuan jangka

pendek, menengah dan panjang perlu ditetapkan dan dicapai secara jelas dan terintegrasi. Memperbaiki sektor peternakan dengan menurunkan umur pertama kali beranak, mengurangi jarak beranak dan mengurangi angka kematian pedet, serta memperbaiki ketersediaan pakan basal, yang memiliki kemampuan untuk meningkatkan produktivitas ternak secara berkelanjutan. Selain itu, pengembangan ternak yang adaptif terhadap lingkungan setempat dan produktif merupakan langkah penting dalam peningkatan produktivitas ternak yang berkelanjutan. Namun pada akhirnya kita perlu mengubah pendekatan kita secara fundamental untuk pemberian pakan itu sendiri. Sekarang diperkirakan bahwa separuh dari populasi dunia tinggal di kota. Terlepas dari implikasi sosial apa pun, ini menghasilkan perubahan lokasi dan konsentrasi sumber daya secara besar-besaran. Dalam hal ini sejumlah besar energi, protein dan mineral dimobilisasi dari kota-kota dalam bentuk yang kita sebut sebagai "limbah". Sebagian besar limbah ini berpotensi untuk digunakan sebagai pakan ternak. Ini adalah bidang penelitian terapan yang menantang, tapi satu hal yang tidak dapat diabaikan, karena menentukan kemampuan kita untuk menciptakan sistem peternakan yang benar-benar berkelanjutan.

Kata Kunci: Berkelanjutan, Peternakan, Sumber Protein Hewani, Abad 21

INTRODUCTION

To imagine future, or the future of, sustainable livestock systems, we must define, not only what we mean by system(s), but also what we mean by sustainability. This is our first challenge. Sustainability, is frequently conflated or confused with terms such as climate-smart, eco-friendly and the ubiquitous green, all of which are meant to convey a sense of wellness to our agricultural practices, and by extension, to our world. Unlike these other terms, sustainability does have a real, and definable meaning – one which we can benchmark and assess against discrete criteria.

A sustainable system may be thought of as one which can be maintained at a certain rate or level, without degrading itself, its functionality or its environment. In the context of livestock and in particular ruminant livestock systems, we are immediately faced with two challenges – firstly in some (but not all) of the world, livestock systems are currently degrading the environment – clearly, this is not sustainable. Secondly, in some parts of the world, especially those we refer to as developing economies, demand for Animal Source Protein (ASP) is rising rapidly and will continue to do so for the foreseeable future, but the indications are that this demand will not be met by using agronomic practices currently in use in those regions (Tarawali et al. 2011). Thus, Sustainable Livestock Systems (SLS) of the future will need to not maintain, but produce more ASP than currently and do so in a way that will not cause further environmental degradation.

Historically, until recently, increasing demand for food was met by increasing the amount of land under cultivation and grazing. In Europe in particular, food production was increased by bringing forest and other unexploited environments under crop, then increasingly, by colonization and exploitation of other lands (Crosby 2015). Those easy gains, the low hanging fruit of food production have been exhausted and while there is still land available to be converted to food production, we have experienced painful lessons of the consequences of unfettered exploitation of natural resources through events as the Mid-western Dust Bowl (Cook et al. 2009), the desertification of the Aral Sea (Micklin 2007) and the damage wrought to the Murray-Darling Basin (Adamson et al. 2009). It is recognized that further wholesale land use change is not environmentally sustainable and comes with a cost that cannot be comfortably borne (Foley et al. 2005). In many parts of the world, this is not even practically possible – there is so little of the natural world left that we have reached the limit of potential exploitation. This is probably our best indicator that past paradigms can no longer be employed and relied upon to satisfy our collective need for more resources – a new approach is needed.

In parts of Asia human population density has been high for generations and with no tradition of large-scale migration or colonizing of other areas, land for food production has been at a premium for many years – and is carefully managed to ensure maximum utilization and output. Comparatively though, the productivity of livestock systems, especially ruminant production systems, has been low. The reasons for this are not clearly defined, but are likely due to a combination of factors, including low levels of consumption of ASP and a reliance on monogastrics, pigs and poultry, to supply that limited need. However, unlike the West, where demand for ASP has plateaued and in some places is in decline demand for ASP in much of Asia and Africa, while still low on a per capita basis, is growing strongly, driven by increasing population and an increased desire to consume dairy, beef and other red meats (Delgado 2003). Ruminant productivity is similarly low, but has the potential for great and rapid improvement (Moran 1985). The need for increased production – and attendant efficiencies is similarly great – it has been forecast that increasing demand for human food will result in the clearing of all arable land on the globe by 2050, under a business-as-usual scenario (Tilman et al. 2011). We can't do this.

Solutions exist, but may yet to be discovered, or more likely yet to be recognized. The issue facing us in the first instance, is what will these solutions look like, how can we facilitate the creation of the solution? We need to understand that there is no one, simple fix: a silver bullet solution is highly improbable. Just as the Green Revolution, while producing huge scientific and technical gains in important grain crops has not solved the world's food problems (Evenson & Gollin 2003) – we must recognize that more than scientific advances alone are required and the task of improving livestock productivity sustainably is an evolving one. Improvement is and needs to be, multifactorial, integrative and ongoing and is in no way dependent on livestock science alone. Creating the SLS of the future cannot simply be about improving animal productivity. I have grouped areas where I believe we can and must make radical improvements in the next decades to deal sustainably with the large increases in the consumption of ASPs we know to expect in the developing world. There is considerable overlap between areas, confusingly so, but this is to be expected in complex systems. In all instances comments are confined to ruminant livestock systems, but can generally be applied to other species.

IMPROVING LIVESTOCK PRODUCTIVITY

This is core to what we are discussing today, but not so obvious as might be imagined. There are different aspects to improving animal productivity and goals which can be pursued independently, but ultimately all aspects tend to be interrelated and impact on one another.

Improving nutrition

It is not possible to consider ruminant nutrition without directly considering feed resources. Many tropical areas are constrained in two ways in this respect: There is limited areas available for the cultivation of dedicated animal feeds (e.g. pasture) and the grasses grown are typically C4, which though high in biomass production are less digestible and support lower levels of production than temperate grasses. Although fodder production can be improved – through the use of N-fixing legumes, better management and the introduction of improved cultivars and species, the current state is unlikely to improve dramatically enough to support the large increases in production required to meet future needs – we need to think outside the box. Agro-industrial by-products – that we currently

consider of little or no value will need to be identified, assessed and adjusted or transformed to become part of the ruminant feed base. It is one of the great adaptations of ruminants that they are able to utilize many foods which are not suitable for use by monogastrics, and we should be working hard to exploit this to our advantage.

Improving husbandry

This can refer to many things – in this context it is the delivery of more ASP per animal unit/time. This can be accomplished in many ways: (1) Decreasing age at 1st parturition; (2) Decreasing intervals between births; (3) Increasing the rate of multiple births; (4) Increasing survival rates to weaning; (5) Increasing daily Live Weight Gain (LWG). The effect of improving husbandry practices has been the focus of much investigation, but to date there seems to be little devoted to optimizing husbandry practices in developing and tropical environments. Optimizing animal management has the potential to greatly increase ASP output in existing systems.

Improving animal health

Control of preventable and infectious diseases will result in lower mortality and morbidity, higher animal growth and milk production, leading to an overall improvement in ASP production.

Matching the animal to the environment

Improved animal genetics is frequently seen as a quick-fix for improving animal productivity. Intromission of genes of improved breeds (especially dairy cattle) has the capacity to improve animal productivity in as little as 4-5. However, breeds developed in temperate climates are more susceptible to heat stress and external parasites, and require a high plane of nutrition to express their genetic potential. It has been demonstrated that local breeds of cattle can exhibit improved performance under better management conditions (Moran 1985) and intensive selection of better-performing individuals from within local breeds may yield comparable results to the use of cross-breeding, with the added advantage of superior climactic adaptation.

CLOSING THE CIRCLE

It is fair to say there is a general, if not acute awareness amongst agencies, policy-makers and the scientific community of the need globally to produce more food with increasingly limited resources. What we appear to be far less aware of are the resources – the food we produce and the requirements to produce it, that are dissipated and lost, before, during and after consumption.

Food losses

It has been estimated that up to 30% of food produced for human consumption is lost or wasted (Sharma & Wightman 2015). The significance of this is self-evident, yet to date there seems to have been relatively little interest in attempting to curb this at least partly avoidable waste. Losses can occur before or at harvest, or at any point in the supply chain, or even after – in Western countries it is speculated that most lost happen post-purchase. In

agricultural systems predominantly having smallholder farmers, inefficient agriculture (e.g. poor storage, hygiene, and management practices) and fragmented supply-chains contribute the greater part of the losses. Dairy products in particular are prone to spoilage and similarly losses of meat can occur because of injury during transport, lairage and handling or contamination of carcasses post-slaughter, during storage or transport to markets. The extent and origin of these losses need to be identified and quantified. Only then can steps be taken to correct and reduce losses.

Animal waste capture

For millennia, humans have recognized the beneficial effects of the application of manurial waste to crops. In smallholder dominated systems, animal manure is frequently the only source of added nitrogen to the system. However, this is changing. The Haber–Bosch process for converting atmospheric N₂ into NH₃ has facilitated the commercial production of cheap chemical fertilizer, which is estimated by the FAO to be responsible for up to 40% of world crop production, and thus is essential in the current era. However, as traditional agriculture moves toward industrialized food production, the different facets of agriculture to become disassociated. Because of the challenges in harvesting, storing and applying manure in large scale and largely unintegrated farming systems, manure has increasingly been overlooked as a source of fertilizer, in favour of chemical N and has been disregarded as a fertilizer and treated as waste. However failure to deal properly with animal excreta from production enterprises can have dire consequences. In its transition from traditional (smallholder) to industrial-scale food production from the 1980's to the 2000's China overlooked the need to develop a policy for treatment of production animal waste, causing 30-70% of all animal wastes being emptied to watercourses and resulting in the eutrophication of up to 50% of its water ways (Strokal et al. 2016). As developing economies move toward increasingly intensified food production, the global and local environmental costs of the inappropriate treatment of animal waste needs to be considered alongside the direct economic costs and benefits in formulating strategies for its treatment. In a world facing increasing constraints it is hard to imagine the value of manure will do anything but increase.

Urban waste capture

Sewers and garbage dumps have existed since pre-Roman times, but aside from the recognition of their importance to public health, they have remained as little more than methods of waste disposal, up to the present day (Asano & Levine 1996). But society has changed. It is now estimated that over half of the world's population live in cities and this is predicted to increase even further. Quite apart from any social implications, this results in a massive translocation of resources. Daily, hundreds or thousands of tonnes of nitrogen, potassium, and phosphorous, amongst other elements plus water and energy flow into our cities (as food). Similar amounts leave, having been converted to waste. Humans consume vast quantities of resources, but retain relatively little – our lifetime N retention has been estimated to be <0.3%. In considering management of urban generated outflows, a fundamental paradigm shift, no matter how difficult or controversial, is needed. The previous generation has been termed the throw-away society and we count ourselves much better, but we have far to go.

EDUCATION, COMMUNICATION, AND INTEGRATION

Farmers are not stupid. In fact they are managers of complex systems, working in an often hostile environment to secure their families' futures. So why don't farmers adopt best practice? We scientists do all the hard work, developing new crop varieties, finding better, more profitable ways of managing livestock, new treatments for disease and to reduce food spoilage, farmers should just listen to what we tell them. This of course is a tried and true approach for failure. So why don't farmers adopt our great ideas?

1. They are currently successful, they feed their families, pay their bills. We ask them to take a risk by acting on our advice.
2. They don't have a problem, we might be suggesting something better but they believe what they have is quite OK.
3. They don't believe us, we know we're right, but what basis does a farmer have for belief.
4. Sometimes as hard as it is to believe, we're wrong and it may take an uneducated farmer to show us that.

So what should we do?

1. Consult at least part of our efforts should be devoted to solving the problems the farmers know they have now.
2. Make the case see above. If something is demonstrated in a compelling way, some farmers will take it and then others will follow. For this a well-educated and motivated extension service is needed.
3. Decrease the risk. Almost any change will carry with it risk of failure and the fewer resources the farmer has, the greater the risk. If new breeds, technologies, practices or marketing are to be adopted, real thought needs to be given about how to decrease the financial and market risk for adopters, at least in the initial stages.

CONCLUSION

I don't know what sustainable livestock production systems of the future will look like – I am only sure that they will look dissimilar in many ways to those we presently have both in developed and developing economies, just as the societies themselves will evolve. I have highlighted where some of the key opportunities and pitfalls lie, I'm sure there will be others. I think the most important conclusion is that if we are to feed ourselves sustainably we cannot afford to be complacent, intellectually lazy, or be bound by past dogma. Feeding the future population is not a problem for agricultural scientists, it's a task for everyone. Researchers and policy-makers have the opportunity to learn from both past improvements and mistakes to create local solutions that fit local conditions. Short, medium and long term goals need to be established and pursued independently but collaboratively. It will potentially define our ability to create truly sustainable livestock systems.

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DISCUSSION

Questions

1. *Based on your statement that farmer not stupid, how to increase the production? In the case of using chemical into the feed to make growth faster or for fattening?*
2. *How to prevent food damage?*

Answers

1. *It has to improve the genetic of animal by crossing, which can be adapted with special environment to increase their productivity.*
2. *Low level antibiotic.*