JOURNAL OF AGRIBUSINESS MARKETING
e-ISSN: 2289-5671
Volume 10, Issue 1, January 2023
DOI: 10.56527/fama.jabm.10.1.5

Open Access

Sustainability in the Western Australian cattle industry: implications for Malaysia

Peter J. Batt[ab]*, Graham McAlpine[b], Norshamliza Chamhuri[c]

[a]Institute of Agriculture, University of Western Australia, Australia; [b]Perth NRM, Australia; [c]Center for Sustainable and Inclusive Development Studies, National University of Malaysia, Malaysia.

*Correspondence: peter.batt@uwa.edu.au

ABSTRACT:
Beef plays an important role in the Malaysian diet. However, Malaysia currently has a low self-sufficiency ratio for red meat, with imports of frozen Indian buffalo meat accounting for almost 80 percent of the market. Australia is the second largest beef supplier to Malaysia, with a market share of approximately 12 percent. Most Australian imports are utilised by the modern retail chains and middle to upper tier foodservice suppliers, where Australian beef is the meat of choice for most middle to high-income families. However, beef production in Western Australia faces numerous political, economic, social, technological, legal and environmental challenges. This paper discusses the various constraints and outlines some of the actions that Western Australian beef producers are undertaking to meet community expectations and thereby assure the supply of both live cattle and chilled beef to consumers in Malaysia.

KEYWORDS: climate change, biodiversity, social licence, diet, nutrition

MANUSCRIPT TYPE:
Research Paper

PUBLICATION DETAILS:
Received: 10 Nov 2022
Revised: 3 Jan 2023
Accepted: 13 Jan 2023

INTRODUCTION

In 2021, Malaysia was Western Australia's (WA) eighth largest trading partner (Department of Jobs, Tourism, Science and Innovation, 2022). While petroleum, alumina and iron ore were the dominant export commodities, by volume, Malaysia accounted for around 5 percent of the export market for the chilled and frozen beef produced in WA (Agriculture and Food, 2021). Equally significant was the strong demand for live cattle in Malaysia, attributed, in part, to the high level of government support for domestic feedlot industries, as well as a lack of cold storage throughout the supply chain (MLA, 2020). WA has approximately two million head of beef cattle distributed throughout the state (Agriculture and Food, 2021). The herd is equally distributed between the extensive pastoral stations in the north and east of WA and the smaller, more intensive farms in the Agricultural Region in the south-west.

The distribution and size of cattle properties across WA is largely determined by the productivity of the land types, climate, and the pattern of rainfall distribution (Agriculture and Food, 2021). Properties in the pastoral or rangelands region are generally much larger than the southern properties and predominantly run *Bos indicus* (Brahman type) cattle. Most of these properties are leasehold, grazing cattle on native grasses and shrubs. Stocking rates typically range from 1-3 cattle units per square kilometre (a standard cattle unit is equivalent to a 400 kg steer at maintenance).

Conversely, properties in the Southern Agricultural Region tend to be smaller in size, with many operating as mixed farming enterprises with cropping and livestock. Due to more reliable rainfall, a

longer growing season and better quality forage, these properties not only operate with higher stocking rates, but cattle are predominantly *Bos taurus* (European), with stocking rates typically between 1-3 cattle units per hectare (Agriculture and Food, 2021). Cattle are grazed on improved pastures including annual rye grasses, subterranean clover and sub-tropical perennial grasses.
While the Southern Agricultural Region has a Mediterranean climate with cool wet winters and hot dry summers, the north of WA traditionally experiences summers that are hot and wet with high humidity and cyclonic rainfall. Annual rainfall in the north of WA can vary between 400-1500 mm, and is highly variable (Agriculture and Food, 2021).

It is this variability in rainfall, attributed primarily to climate change, that is adversely affecting WA's natural environment and the agricultural systems it supports (Sudmeyer et al., 2016). Since 1910, the average temperature in WA has increased by 1.3^{o}C (Climate Change in Australia, 2021). By 2050, WA can expect an average annual temperature increase of around 1.5-2.4^{o}C. While extreme rainfall events are expected to increase over most of northern WA, rainfall in the Southern Agricultural Region is expected to significantly decline. Drought conditions are expected to increase by up to 20 percent across Australia by 2030 and in the southwest of WA by up to 80 percent by 2070 (Perth NRM, 2019). Furthermore, WA will experience a longer fire season, with around 40 percent more very high fire danger days.

Healthy soils are critical in improving soil porosity, water infiltration and storage, and nutrient retention, with a diverse soil biota supporting healthy plant growth (Soil and Land Conservation Council, 2020). However, most soils in WA are vulnerable to some form of land degradation, with many already in a state unsuitable for agriculture. Most soils in WA are intrinsically susceptible to wind and water erosion, acidification and salinisation, waterlogging, compaction, and soil water repellence.

Under current conventional cropping regimes, soils with low pH buffering capacity are becoming more acidic. Extensive surveys of soil pH profiles across the Southern Agricultural Region show that more than 70 percent of surface soils and almost half of subsurface soils are below appropriate pH levels (DPIRD, 2017). Others are becoming more prone to wind erosion and compaction, while others have become too salty through rising water tables. At present, some 4.5 million hectares of agricultural land in the Southern Agricultural Region are severely affected by salinity (DPIRD, 2021).

Food production is widely acknowledged to be the principal source of environmental degradation and to have the greatest detrimental impact on biodiversity (Lancet Commission, 2019). The diversity and richness of all living organisms is necessary for the stability of eco-systems, enhancing productivity and the resilience of food production systems. Biodiversity enhances food production through facilitating pollination, pest control, heat regulation, the provision of carbon sinks, and its impact on rainfall patterns.

To facilitate the adoption of more sustainable agricultural practices in WA, with funding from the Commonwealth of Australia, Perth NRM has recently completed a comprehensive study to analyse the capability of WA and its food supply chains to meet the needs of both domestic consumers and customers in the ASEAN region. This paper reports on the results achieved from an analysis of the WA cattle industry and the implications for Malaysia.

BACKGROUND

A food system may be simply described as a process that turns natural and human-made resources and inputs into food (Pinstrup-Andersen, 2011). However, our food systems are under considerable

stress. With the world's population predicted to reach 9 billion by 2050, recent estimates suggest that food production will need to increase by 60-70 percent (World Bank, 2008).

However, food production is also the largest cause of global environmental change. Agriculture occupies about 40 percent of the land available and utilises up to 70 percent of the freshwater available (Lancet Commission, 2019). The conversion of natural ecosystems to croplands and pastures is responsible for the greatest loss of biodiversity, with the overuse and misuse of nitrogen and phosphorus fertilisers causing eutrophication in lakes and coastal zones. Furthermore, agriculture is responsible for approximately 30 percent of all anthropogenic greenhouse gas emissions.

Food production is the primary source of methane and nitrous oxide, which respectively, have 56 times and 280 times the global warming potential of carbon dioxide (Lancet Commission, 2019). Methane is produced during digestion in ruminant livestock, such as cows and sheep, or during the anaerobic decomposition of organic material. Nitrous oxide is produced primarily from soil microbes in croplands and pastures, whereas carbon dioxide is released from the tillage of soils, burning to clear land of organic matter and agricultural residues, and from the burning of fossil fuels by farm machinery, the production of fertilisers, and the transport of agricultural inputs and outputs.

While contributing to climate change, agriculture and food production is also directly impacted by a changing climate, with yields projected to fall by as much as 7 percent as a consequence of global warming (Godfray and Garnett, 2014). Garnaut (2008) concluded that climate change was likely to affect agricultural production in Australia through changes in water availability, water quality and temperature. While an increase in carbon dioxide concentration may increase the rate of photosynthesis in some plants, the positive impacts of carbon fertilisation are likely to be restricted by higher temperatures and lower rainfall. Further reductions in productivity are anticipated to arise from the more frequent occurrences of severe weather events including bushfires and flooding, and the higher incidence of pests and diseases.

The extent to which agriculture can continue to feed a growing world population sustainably will largely be determined by the ability of the sector to adapt to climate change (Wreford, Ignaciuk and Gruère, 2017). This will require significant changes throughout the sector at all levels of the value chain, through changes in agricultural practices and land use, more efficient value chains, and reduced food loss and waste.

One sector that has been targeted, perhaps unfairly, is animal production. The livestock sector has been identified as a major contributor to climate change, for it generates significant emissions of carbon dioxide, methane and nitrous oxide, either directly from enteric fermentation and manure management, or indirectly through the production of animal feeds (FAO, 2021a).

Cattle are the main contributor of emissions from the sector, for they are believed to be responsible for 65 percent of the emissions (FAO, 2013). Beef cattle (producing meat and non-edible outputs) and dairy cattle (producing both meat and milk, in addition to non-edible outputs) generate similar amounts of greenhouse gas emissions. However, pigs, poultry, buffalos and small ruminants have much lower emission levels, with each representing between 7 and 10 percent of the sectors total emissions.

When emissions are expressed on a per protein basis, beef is the commodity with the highest emission intensity (FAO, 2013). However, it is important to recognise that emission intensities vary greatly among producers, with different agro-ecological conditions, farming practices and differences in supply chain management explaining much of the heterogeneity.

Higher emissions are largely caused by lower feed digestibility, poor animal husbandry and lower slaughter weights and/or higher age at slaughter (FAO, 2013). Furthermore, emissions from specialized beef herds are almost four times higher than that produced from dairy herds, with the difference largely explained by the fact that dairy herds produce both milk and meat, while specialized beef herds only produce beef.

Emissions from the production, processing, and transport of feed account for about 45 percent of the sectors emissions (FAO, 2013). The application of nitrogenous fertilizers to pastures and feed crops and the deposition of manure on pastures generate substantial amounts of nitrous oxide, which collectively represents about half of the feed emissions.

Enteric fermentation is the second largest source of emissions, contributing about 40 percent of total emissions, with cattle emitting most of the enteric methane from the storage and processing of manure (FAO, 2013).

However, livestock also play a critical role in food security, supplying around 33 percent of the protein consumed (FAO, 2021a). Meat, milk and eggs, in appropriate amounts, are valuable sources of complete and easily digestible protein and essential micronutrients, with small amounts of animal-based food significantly improving not only the physical development of children but also their cognitive and learning abilities.

Across the globe, pastoralism, a traditional and extensive form of raising livestock, employs more than 200 million people in more than 100 countries (FAO, 2021b). Pastoralism is critical in both reducing poverty and providing food security in these areas. Pastoralism diversifies food production, spreading the risk of production failures, and provides affordable, high quality proteins and nutrients. Research demonstrates that pastoral landscapes have the potential to achieve carbon neutrality, as grazing can offset carbon emissions by stimulating plant growth, which helps sequester carbon in the soil. In mixed farming systems, livestock can be moved to fallow lands or fields to make use of crop residues for feed and to distribute animal manure as fertilizer. By effectively matching stock numbers to the carrying capacity of the land, pastoralists can manage natural resources more sustainably and preserve biodiversity in complex ecosystems. Furthermore, pastoral grazing systems help reduce food insecurity by reducing the competition for cereals between livestock feed and food for human consumption.

Climate-smart livestock solutions can further contribute to reducing greenhouse gas emissions through improving livestock productivity, the more efficient use of natural resources, carbon sequestration and the integration of livestock into the circular bioeconomy (FAO, 2021a). Improving livestock productivity has the potential to reduce emissions per unit of livestock product by as much as 20 to 30 percent. Some of these interventions include the use of better quality feed and feed balancing to lower enteric and manure emissions, improved breeding and animal health, better manure management practices that both recover and recycle the nutrients and energy contained in manure, and improvements in energy use efficiency along supply chains (FAO 2013).

Sustainable diets are nutritious, healthy, safe, affordable, and culturally acceptable diets that support optimal nutrition and health and cause low environmental pressure and impact (Lancet Commission 2019). Both now and into the future, climate change is expected to adversely affect diets, nutrition, and health through impacting the quantity, quality, diversity, safety and affordability of food.
At a global level, while undernourishment and micronutrient deficiencies continue to rise, the incidence of obesity is also becoming more prevalent. Both forms of malnutrition now affect about a quarter of the world's population, with some people suffering from both. Making healthy diets more affordable and influencing consumers to make healthier choices is critical in addressing climate change, for the ecological footprint of healthy diets — those without excessive consumption of highly

processed foods and red meats — has been found to be much lower than that of prevailing diets across the world, especially those in advanced countries (Lancet Commission, 2019). Replacing meat, eggs, and dairy products with plant-based foods in the diet is an effective strategy to reduce greenhouse gas emissions from animal agriculture and reduce its other harmful impacts (HSI, 2011).

Nevertheless, beef plays an important role in the Malaysian diet, with Malaysians consuming around 7 kg per person a year, compared to the region's average of just 5.4 kg (MLA, 2020). According to Statista Research Department (2022), the average Malaysian consumes approximately 5.52 kilograms of beef per year. It is anticipated that per capita beef consumption will increase to 6 kilograms by 2026.

However, Malaysia has a low self-sufficiency ratio for red meat (22.2%) where the Import Dependency Ratio (IDR) for beef is 78.1 percent (Department of Statistics Malaysia, 2021). Malaysia currently imports 80 percent of its beef, of which frozen Indian buffalo meat accounts for almost 80 percent of the market (MLA, 2020). Australia is the second largest beef supplier to Malaysia, with a market share of approximately 12 percent. Australia is also the largest supplier of chilled beef, with most Australian imports being utilised by the modern retail chains and middle to upper tier foodservice suppliers. Australian beef is the meat of choice for most Malaysian families, especially among those with middle to high-income. Australian beef is also believed to offer the highest quality steak, with 40 percent of affluent Malaysians indicating that Australian beef would be their first choice when purchasing.

For religious reasons, where Muslims make up more than 60 percent of the population in Malaysia, halal is an important consideration in purchasing beef. In Malaysia, beef consumption typically spikes during the festive seasons, particularly around the months of Ramadan and Hari Raya Aidilfitri. As the dates for Ramadan are based on a lunar calendar, the timing of the festivities changes every year (MLA, 2020).

However, halal is more than just the slaughtering of animals according to Islamic law. Halal food follows strict quality standards which emphasize cleanness, health and food safety, the protection and care of the environment, and protecting the welfare of the animals themselves (Rezai et al., 2015).

Today, Malaysian consumers are both more knowledgeable and more discerning in choosing the food that they are about to consume. Jamaluddin and Suhaimi (2022) identified that halal, physical appearance, taste, and the safety of the meat influenced consumers' preferences when purchasing imported meat. Similarly, Chamhuri and Batt (2013) demonstrated how perceptions of freshness and halal assurance were the main factors influencing Malaysian consumers when purchasing meat from a retail outlet.

METHODS

In 2018, Perth NRM was awarded a research grant under the Regional Land Partnerships Program (2019-2023) to facilitate the development of a food security plan for the State of Western Australia. The project sought to facilitate collaboration between the key stakeholders in WA food supply chains to develop a collective and strategic approach to improve the sustainability of the WA food system. The principle objective of the study was to identify and better understand emerging food security challenges and to identify and prioritise timely actions to meet these challenges.

To obtain the desired information from primary producers and food supply chain stakeholders, a comprehensive qualitative questionnaire was developed based on the PESTLE framework. Under

each heading, respondents were asked to identify: (a) the key constraints that were impacting on their business; (b) what support their industry association was providing [where applicable]; (c) what they themselves were doing, and (d) what government [whether it be local, State or Commonwealth] was doing or needed to do to address the Political, Economic, Social, Technological, Legal and Environmental constraints they identified.

Without any means of contacting individual producers, an electronic copy of the questionnaire, accompanied by a letter of introduction, was sent to the Executive Officer of all known broadacre producer groups through the Grower Group Alliance network. Contact was also made with the two key producer associations: the WA Farmers Federation and the Pastoralists and Graziers Association. Meat processors were contacted through the WA Meat Industry Authority.

To process the data received, a spreadsheet was developed using the Statistic Package for Social Sciences [SPSS]. Although most often used to analyse quantitative data, for each of the qualitative questions, a master list was developed from the respondents' answers, thus converting qualitative responses to a metric form. The master lists were dynamic in that they could be added to continuously as respondents spoke about different issues that were relevant to their industry sector. For this paper, only the frequencies for each of the issues raised by beef producers are reported.

RESULTS

The response from the livestock industry was disappointing, with just 19 responses being received, despite multiple follow-ups with the two industry associations and the broadacre producer groups.

The most frequently mentioned political constraint was the excessive amount of bureaucracy (26%) which, where applicable, limited the farmers capacity to implement sustainable solutions (16%) and consumed an inordinate amount of time to extend leases (16%)(Table 1).

Market access (16%) and bans on live export (16%) were foreseen as reducing the capacity of farmers to meet the needs of export markets. Furthermore, government was perceived to have little understanding of the challenges facing farmers (11%) and with the high prices and royalties government was receiving from the mining industry, to be paying much less attention to the livestock industry (11%).

For most farmers, in the current post-COVID environment, the lack of labour was the most frequently cited economic constraint (Table 2). In addition, the profitability of farms was declining, as farmers were experiencing a cost-price squeeze: input costs were increasing (16%) while prices were declining (16%).

With many farmers coming out of a drought, the quality of the cattle consigned to the market had declined (11%). However, farmers also faced problems in getting their stock to market (11%) and the lack of any local or proximate meat processing facilities (11%). During the COVID pandemic, with the lack of labour in the abattoirs, the demand for live animals had fallen, but as the consumer demand for meat had remained high, the wholesale prices of meat had dramatically increased. The uncertainty in the environment made it difficult for farmers to secure the loans that they required to invest in the sustainability of their business.

Table 1: Political constraints in the WA livestock industry.

	N	%
Too much bureaucracy/red tape	5	26.3
Market access	3	15.8
Unable to implement sustainable solutions	3	15.8
Ban on live exports	3	15.8
Too long to extend lease	3	15.8
Diminishing government support	2	10.5
Land tenure/native title	2	10.5
Lack of government understanding	2	10.5
Government making decisions on the run	1	5.3
Short term leases	1	5.3
Business uncertainty	1	5.3
Too many audits	1	5.3
No policy on carbon	1	5.3
Too difficult to get certification	1	5.3
High cost of dealing with bureaucracy	1	5.3
Competition from mining	1	5.3
Industry bodies not unified	1	5.3
N	19	

Table 2. Economic constraints in the WA livestock industry.

	N	%
Lack of labour	5	26.3
Increasing cost of inputs	3	15.8
Low prices	3	15.8
Declining quality	2	10.5
No local/proximate meat processing facilities	2	10.5
Difficulty in securing loans	2	10.5
High cost of replacing stock	2	10.5
High cost of transport	2	10.5
Increasing administration costs	2	10.5
Global dominance of meat processors	1	5.3
Increasing cost of production	1	5.3
High cost of fencing	1	5.3
Irrigation too expensive	1	5.3
Lack of funds for investment	1	5.3
Inability to compete with wages paid by mining	1	5.3
Availability of cheap loans/drought relief	1	5.3
Emerging carbon market	1	5.3
No wholesale price competition	1	5.3
Low stock numbers	1	5.3
Cost price squeeze	1	5.3
Inability to achieve economies of scale	1	5.3
N	19	

In looking at the social constraints, the lack of labour (21%) emerged again as the most frequently cited constraint (Table 3).

Table 3. Social constraints in the WA livestock industry.

	N	%
Lack of labour	4	21.1
No social license	3	15.8
Farmers lack self belief	2	10.5
Increasing OHS legislation	1	5.3
High cost of training workers	1	5.3
Competition from mining	1	5.3
Declining rural population	1	5.3
Unskilled labour	1	5.3
Animal activists	1	5.3
Mental health	1	5.3
Poor industry perception	1	5.3
Aging workforce	1	5.3
Lack of accommodation for workers	1	5.3
N	19	

With greater urbanisation, rural townships were generally in decline, and hence it was becoming more difficult for farmers to attract the labour that they required. Furthermore, the situation had been aggravated by the inability of farmers to match the wages paid by the mining industry and the lack of suitable accommodation, especially for families, in rural WA. The workforce was aging and failing to attract young people, while in parallel, new occupational health and safety legislation was impacting on the cost of training new employees and the need to provide a safe working environment.

Other farmers spoke of the lack of any social license (16%). With most consumers residing in an urban environment, few consumers had any knowledge of farming: they simply expected their food to be available wherever and whenever they wanted to eat. Few understood that most farmers were the custodians of the land upon which they operated and most either had or were in the process of adopting more sustainable production techniques to reduce the negative impact of grazing on the environment. Animal welfare was not an option, for the productivity of the animals and the quality of the resultant meat was directly impacted by how well the animals had been treated on the farm and how they had been transported to market. Hence the actions of misinformed animal activists undermined the community's perception of farmers, impacting on their self-belief, but also threatening biosecurity on the farm.

In exploring the technological constraints, the most frequently cited constraint was the inability to access high speed internet (Table 4).

Table 4. Technological constraints in the WA livestock industry.

	N	%
Poor access to good quality internet	2	10.5
Micro-nutrient toxicity	2	10.5
Need for more research	1	5.3
Matching stocking rate to feed available	1	5.3
Low productivity	1	5.3
Wild dogs	1	5.3
Lack of feed supplements	1	5.3
N	19	

Today, most livestock producers in WA were using a variety of technologies to match the stocking rate to the availability of feed and monitoring the movement of cattle. The lack of any broadband connection meant that farmers had to use satellite communication which not unexpectedly incurred significant cost. Other farmers were experiencing difficulties in accessing appropriate feed supplements to address the micro-nutrient deficiencies and/or toxicities that are present in many WA soils.

The legal constraints related primarily to the recent legislation that had recently been passed, whereby farmers, as employers, could now be charged with manslaughter where and if an employee was killed while working on the farm (Table 5).

Table 5. Legal constraints in the WA livestock industry.

	N	%
OHS legislation	2	10.5
Inability to cultivate alternative crops/species	1	5.3
Compliance	1	5.3
Tighter laws for trespass	1	5.3
Native title	1	5.3
Competition from mining	1	5.3
Live export regulations/constraints	1	5.3
N	19	

Other issues related to the inability to cultivate alternative crops or species under the terms of the lease agreement, native title, which required farmers to protect significant indigenous sites, competition from mining, and the increasing regulations impacting the export of live animals. Particularly with regard to confining the activities of animal activists, farmers wanted stronger laws for trespass to protect their livestock from potential disease transmission.

Finally, in addressing the environmental constraints, climate variability (26%) was the most frequently cited response, followed by the lack of rainfall (16%), which had a direct impact on the amount of feed available, and, with a drier environment, the greater threat of wildfires (11%)(Table 6). Farmers needed to look after the land to prevent over grazing, which lead to greater soil erosion. Competition from wild animals such as kangaroos reduced the amount of feed available to livestock, while wild dogs presented a direct threat to the cattle.

Table 6. Environmental constraints in the WA livestock industry.

	N	%
Climate variability	5	26.3
Lack of rainfall	3	15.8
Lack of feed	2	10.5
Fire	2	10.5
Wild dogs	1	5.3
Need to look after land	1	5.3
Over grazing	1	5.3
Erosion	1	5.3
Weak fragile soils	1	5.3
Competition for feed from wild animals	1	5.3
N	19	

In responding to the various constraints, farmers were responding in a multiple number of ways (Table 7).

Table 7. Adaptations by WA livestock farmers to overcome constraints.

	N	%
Technological innovation/R&D	5	26.3
Using C credits to enhance farm viability	4	21.1
Niche marketing	4	21.1
Solar for pumping water	3	15.8
Rotational grazing	3	15.8
Undertaking more on-farm processing	3	15.8
Improving bloodlines	2	10.5
Developing own brand/market	2	10.5
Training employees	2	10.5
Improved on-farm planning	2	10.5
Sharing information through farmer groups	1	5.3
Growing fodder crops	1	5.3
Diversifying	1	5.3
Computerised stock records	1	5.3
Benchmarking	1	5.3
Irrigating	1	5.3
Electronic ear tags	1	5.3
Using less stress stock handling techniques	1	5.3
Satellite imagery to manage grazing	1	5.3
Feed supplements	1	5.3
Feed lotting animals	1	5.3
Cull old/poor quality cattle	1	5.3
Finish stock off on a second property	1	5.3
Manage stock numbers in proportion to feed available	1	5.3
Importing skilled labour	1	5.3
Implementing more sustainable farming practices	1	5.3
Reduced number of livestock	1	5.3
Focus on quality rather than quantity	1	5.3
N	19	

Several farmers were undertaking their own research (26%) to either develop or to adapt more innovative systems for managing their livestock and/or resources. Some of these innovations included the use of solar water pumps (16%), rotational grazing (16%), improving the bloodlines (genetics) of their livestock to adapt to the changing climate and to increase productivity (11%). Others were using electronic ear tags to monitor stock movements (5%), computerised stock records (5%) or using satellite imagery to manage grazing (5%).

In looking at the profitability of the farm, some 21 percent of farmers were using carbon credits to enhance the viability of their properties. Others were engaging in niche marketing (21%), more on-farm processing (16%) and developing their own brand (11%) to differentiate their product in the market. Cognisant of the feed constraint, several farmers were growing fodder crops (5%) and either providing feed supplements (5%), feed lotting animals (5%) or moving livestock to an alternative property to finish them off (5%).

DISCUSSION AND CONCLUSIONS

Despite the rhetoric from various animal advocacy and climate action groups, beef production in WA will continue into the foreseeable future. In the northwest of the state, for the vast and largely under-developed rangelands, beef production is currently the most appropriate land use. However, much of the land is also rich in mineral resources and farmers often face competition from the mining sector and pressure from society to be more sustainable.

To be sustainable, agriculture must meet the needs of present and future generations, while ensuring profitability, environmental health, and social and economic equity (FAO, 2014). From these results, it is abundantly clear that the majority of farmers are taking appropriate action to address all three elements. While farmers can do little to directly reduce the impact of climate change, they can seek to offset or to mitigate the impact. In the case of drought, farmers are destocking to better match the stock numbers to the amount of available feed. Others are providing supplementary feed or fodder crops, and/or relocating stock to other properties where there is a greater amount of feed. However, and particularly when feed is scarce, it is also important to consider the competition from wild animals such as kangaroos, camels, and buffalos, and it is not unusual in these circumstances, to undertake controlled culls to reduce their numbers. Others were seeking to improve the genetics of their herd seeking attributes that made the cattle more resilient to a changing climate.

Acknowledging the fragility of the WA soils and the potential for erosion, better managing stocking rates was crucial to prevent over grazing. Where farmers could afford it, the use of satellite imagery could provide a valuable tool, while others were choosing to fence off at risk areas of the farm and/or to plant trees, not only restoring the environment but also enabling them to benefit from the emerging market for carbon sequestration [offsets]. The challenge however that many farmers faced, particularly those in the rangelands, was the inability to implement more sustainable solutions, for under the terms of their lease, they were restricted in what they could and could not do.

In looking at the long-term viability of their farms, as input prices continue to rise faster than output prices, profitability is generally declining. To better monitor their financial performance, farmers were recording more information to both benchmark their performance against others and to improve their on-farm planning. While some farmers were choosing to innovate and to undertake their own research and development as a means of improving productivity, others were choosing to diversify.Given the high cost of transport, the lack of processing facilities and the perceived lack of competition between abattoirs, more farmers were choosing to engage in niche marketing, which often resulted in more on-farm processing and the establishment of their own brands to differentiate their product in both domestic and export markets.

Regrettably, in addressing sustainability within the social dimension, individual farmers have few strategies at their disposal. With increasing urbanisation, more people are choosing to live in cities and a consequence, the population in small rural towns is declining and with that, the availability of services and the availability of labour. Furthermore, the labour that is available is generally unskilled, for those with a trade are generally employed by the mining industry on much higher rates of pay.

With increasing urbanisation, a greater divide is emerging between rural and urban society, where urban consumers have little understanding of where their food comes from and how it is produced. This lack of understanding leads to conflicts and misperceptions about how farmers are looking after both their land and their livestock. Consumers often have a negative view of agriculture, which is often aggravated by bad press and the misinformation posted on social media. Many farmers believe that the lack of trust is perpetuated by the inability of the industry to establish any social licence.

Croplife Canada (2022) define social licence as the level of public trust granted to a corporate entity or industry sector by the community at large and its key consumer base. Public trust is the belief that activities are consistent with social expectations and the values of stakeholders, and is earned through industry engagement, operating practices and expressed values.

Regrettably, and more so in recent times as community expectations have shifted, tensions have emerged between farmers, the government and civil society over a multitude of issues including land clearing, protecting biodiversity, the adoption of agricultural technologies such as GMOs, animal welfare and the allocation of water rights (CSIRO, 2011). The immediate challenge for industry is to educate and accurately inform consumers of the many different activities farmers and graziers are undertaking to conserve resources and to restore the landscape.

In Malaysia, the Agrofood Policy aspires to increase the self-sufficiency level of meat production to 50 percent by 2030 (Ministry of Agriculture and Food Industry Malaysia, 2021). To achieve this, the greater integration of ruminant animals with oil palm plantations is proposed to overcome the lack of suitable grazing land.

However, Jamaludin et al. (2014) note that current efforts to improve the productivity of ruminant animals in Malaysia has faced numerous constraints. The four key areas for improvement are: (i) breeding and genetic improvement; (ii) nutrition and feeding practices; (iii) the prevention and control of diseases; and (iv) promotion and incentives for farmers to develop the meat industry. Historically, the inadequate number of cows of breeding age has presented the greatest impediment to the growth of the bovine industry in Malaysia, but the lack of quality pasture and the high cost of imported feed supplements must also be overcome if profitability is to increase (Abdulla et al, 2016).

Since 2000, the global trade in agricultural products has more than tripled in value and almost doubled in volume (Wreford, Ignaciuk and Gruère, 2017). This growth has been driven, in part, by the increased demand for red meat, dairy and poultry products, and by increases in the non-food use of cereals, particularly for biofuels. International trade allows countries to obtain healthy nutritious food at the lowest possible cost and will be a key component in any strategy to help countries feed and nourish their populations. Hence, it seems that for some time to come, Malaysia will remain dependent on red meat imports from countries such as India, Australia, and Brazil to meet the growing demand.

ACKNOWLEDGEMENTS

This project is supported by Perth NRM, through funding from the Australian Government's National Landcare Program

REFERENCES

Abdulla, I., Arshad, F.M., Bala, B.K., Bach, N.L. & Mohammadi, S. (2016). Management of Beef Cattle Production in Malaysia: A Step Forward to Sustainability. *American Journal of Applied Sciences*, 13(9). DOI: 10.3844/ajas.2016.976.983,

Agriculture and Food (2021). *The Western Australian beef industry*. Government of Western Australia.

Climate Change in Australia (2021). climatechangeinaustralia.gov.au

Chamhuri, N. & Batt, P.J. (2013). Exploring the factors influencing consumers' choice of retail store when purchasing fresh meat in Malaysia. *International Food and Agribusiness Management Review*, 16(3), 1-24.

CSIRO (2011). *Defending the social licence of farming. Issues, challenges and new directions for agriculture.* Collingwood, Victoria.

Croplife Canada (2022). *What does social licence mean for agriculture?* https://croplife.ca/what-does-social-license-mean-for-agriculture/

Department of Jobs, Tourism, Science and Innovation (2022). Western Australian trade profiles. April. Government of Western Australia

Department of Statistics Malaysia (2021). Supply and Utilization Accounts Selected Agricultural Commodities Malaysia 2016 – 2020. https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=164&bul_id=cHgwanhNdU4vWXRvc3pnZU9xSjZTUT09&menu_id=Z0VTZGU1UHBUT1VJMFlpaXRRR0xpdz09

DPIRD (2017). https://www.agric.wa.gov.au/soil-acidity/soil-acidity-western-australia

DPIRD (2021). *Dryland salinity Western Australia*. https://www.agric.wa.gov.au/soil-salinity/dryland-salinity-western-australia-0.

FAO (1996). *Report of the World Food Summit 13-17 November*. Rome.

FAO (2013). *Tackling climate change through livestock. A global assessment of emissions and mitigation opportunities.* Rome.

FAO (2014). *Building a common vision for sustainable food and agriculture: principles and approaches.* Rome.

FAO (2021a). *Climate-smart livestock production. A practical guide for Asia and the Pacific region*. Bangkok. https://doi.org/10.4060/cb3170en

FAO (2021b). *Seven reasons why pastoralism supports a better future*. Rome.

Garnaut, R. (2008). *The Garnaut climate change review. Final report.* Cambridge University Press.

Godfray, H.C.J. & Garnett, T. (2014). Food security and sustainable intensification. *Phil Trans Royal Society*.

HSI (2011). *An HSI Report: The impact of animal agriculture on global warming and climate change*

Jamaluddin & Suhaimi (2022). Consumer preferences for imported beef meat purchasing in Johor Bahru. *Journal of Agrobiotechnology*, 13(1), 38-48. http://dx.doi.org/10.37231/jab.2022.13.1S.312

Jamaludin, M.H., Hassan, M.H., Amin, M.R. & Zulhisyam, A.K. (2014). The future of the Malaysian beef industry. *Journal of Tropical Resources and Sustainable Science*, 2, 23-29.

Lancet Commission (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. http://dx.doi.org/10.1016/S0140-6736(18)31788-4

Meat and Livestock Australia (2020). *Market snapshot. Beef and sheep meat. Malaysia*.

Ministry of Agriculture and Food Industry Malaysia (2021). Dasar Agromakanan Negara 2021 – 2030 (DAN 2.0). https://parlimen.gov.my/resources/files/rsaindex/pdf/Dasar%20Agromakanan%20Negara%202021-2030%20(DAN%202.0)_compressed.pdf

Perth NRM (2019). *Food security plan for Western Australia. Situation report to guide the strategic development of a food security plan for Western Australia*. September.

Pinstrup-Andersen, P. (2011). The food system and its interaction with human health and nutrition: leveraging agriculture for improving nutrition and health. 2020 conference briefing paper 13.

Rezai, G., Mohamed, Z. & Shamsudin, M.N. (2015). Can Halal be sustainable? Study on Malaysian consumers' perspective. *Journal of Food Products Marketing*. http://dx.doi.org/10.1080/10454446.2014.883583

Soil and Land Conservation Council of Western Australia (2020). *Sustaining Western Australia's agricultural, horticultural and pastoral soils.* Western Australian Soil Health Strategy: Discussion Paper.

Statista Research Department (2022). Per capita beef and veal consumption in Malaysia 2012 – 2026. Accessed December 2, 2022.
https://www.statista.com/statistics/757355/malaysia-beef-consumption-per-capita/

Sudmeyer, R., Edward, A., Fazakerley, V., Simpkin, L. & Foster, I. (2016*). Climate change: impacts and adaptation for agriculture in Western Australia.* Bulletin 4870, Department of Agriculture and Food, Western Australia, Perth.

World Bank (2008). *World Development Report: Agriculture for Development*. Washington, DC.

Wreford, A., Ignaciuk, A. & Gruère, G. (2017). *Overcoming barriers to the adoption of climate-friendly practices in agriculture.* OECD Food, Agriculture and Fisheries Papers, No. 101, OECD Publishing, Paris. http://dx.doi.org/10.1787/97767de8-en