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Current Outlook of Livestock Industry in Malaysia and Ways Towards Sustainability

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Abstract: This paper reviews the current status of livestock industry in Malaysia and the measures taken to direct this industry towards sustainability. The statistics related to the number of animals and farms, self-sufficiency ratio, and consumption of livestock products are presented. The largest population of livestock in Malaysia goes to non-ruminant where chicken dominates by 95.9%. However, the largest percentage of registered livestock farms in West Malaysia is dominated by ruminant farmers of which 56.3% are beef cattle farms. The meat consumption in Malaysia is inclined towards white meat where poultry meat has self-sufficiency ratio of over 100% for the past five years. The manure excreted from the livestock in Malaysia is estimated to be 17.745 million tons for the year 2020 which is largely contributed by chicken, followed by cattle. The current practices and policies adopted to emphasize sustainability in this industry are also reviewed. Current policies in Malaysia that are related to livestock industry adopt sustainable practices which is important to expand the livestock industry without harming the environment.

Keywords: Meat consumption, self-sufficiency ratio, manure, waste management, waste to wealth

1. Introduction

Livestock refers to the animals raised primarily for the production of commodities such as meat, milk, eggs, leather, and wool. Livestock industry makes up 40% of worldwide income under agriculture sector [1]. In Malaysia, the livestock industry accounts for 1/10 of agriculture sector Gross Domestic Product (GDP) with the whole sector contributing 8.9% of national GDP [2]. This industry also employs about 20% of labor in the national agriculture sector [3]. Livestock in Malaysia comprises of ruminants (buffalo, cattle, goat, and sheep) and non-ruminants (swine and poultry: chicken and duck). Majority of the ruminant livestock producers in Malaysia are smallholders while the non-ruminants are represented by commercial enterprises which raise the livestock in large scale [4].

The noble contributions of livestock industry are for food consumption and income source. Livestock products cater for 1/3 of protein intake globally and can help with malnutrition and hunger problems [5-6]. Besides that, livestock industry can generate energy and plant nutrients, as well as serves as an asset function [7]. More than a billion people keep livestock where 60% of it is rural household, making it a major source of income for the poor especially women in developing countries [8]. It provides income through the sale of livestock and livestock products, as well as providing raw material for agro-industries [3]. A great amount of funding for the agriculture and livestock industry is also continually available to improve the livelihood of the farmers. For Budget 2022, the government allocated RM1.5 billion for the subsidies and incentives related to the industry and also initiated the Ruminant Feed Incentive Assistance Program to allow small ruminant farmers to purchase affordable animal feed.

Unfortunately, livestock industry is also a major contributor to climate change and environmental issue, while also consumes a significant amount of natural resources especially land and water. Greenhouse gases (GHG) emitted from livestock industry are methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2). Ruminants produce CH_4 through a digestive process called enteric fermentation. CH_4 and N_2O are also produced during manure storage and they have a

global warming potential of 28 times and 265 times higher than CO_2 respectively [9]. This is why the livestock industry is contributing a major amount of 18% (7.1 giga-tons of CO_2 equivalent) for anthropogenic GHG emission [5, 10]. The livestock industry also causes deforestation by converting land to arable land for feed crops [5]. The total cereal grain consumption in the world goes to feeding ruminants for 40%, while 70% of the grains used in developed countries are dedicated for animal feed [11]. As deforestation occurs, CO_2 are released to the atmosphere and therefore contributes to global warming and climate change.

Around 70% of blue water (surface and groundwater) is used for agriculture globally [12]. It is estimated that the livestock industry uses about 11,900 km³ of fresh water annually where 20% of blue water goes for feed production [13]. From the total amount of water footprint in livestock industry, a hefty amount of 98% is used for the animal feed while only 2% is used for drinking and service [14]. On top of that, livestock industry also causes water pollution and eutrophication. The water pollution caused by livestock industry can be traced to the animal wastes, antibiotics and hormones, chemicals from tanneries, fertilizers and pesticides used for feed crops, and sediments from eroded pastures [5]. Coastal eutrophication also occurs due to the nutrient runoff and leaching from livestock waste that is affecting marine ecosystem [6].

With the increasing world population and demand for livestock products, this will increase the pressure on natural resources, emission of GHG and probable increase of zoonotic diseases [1]. Shifting to sustainable agriculture and livestock practices is therefore of paramount importance to ensure malicious effects on the environment are prevented. It will also help us to secure safe and quality livestock products for consumption. This paper reviews the current statistics related to livestock industry in Malaysia as well as the steps and policies taken to promote sustainable livestock industry.

2. Current Status

This section reviews the current statistics related to livestock industry in Malaysia. Statistics on the number of livestock population, number of registered farms, consumption of livestock products, and self-sufficiency ratio are presented.

2.1 Number of Livestock

Table 1 shows the livestock population in Malaysia based on the 2019/2020 Livestock Statistics by Department of Veterinary Services (DVS) [15]. The value for the year 2020 is an estimated value according to the cited statistics. The largest population of livestock in Malaysia belongs to the non-ruminant where most of the livestock are raised in large-scale farms. The trend over the five years shows that chicken makes up the largest livestock population followed by duck, swine, cattle, goat, sheep, and buffalo. The population of cattle and goat includes the livestock raised for meat and dairy production while the poultry is for meat (broiler poultry) and eggs (layer poultry) production. The total population of livestock in Malaysia for the year 2018 is 272 million which makes a fraction of 0.77% when compared to the global livestock population of 35,413,867,836 in 2018. This global livestock population of 35 billion counts only for buffalo, camel, cattle, chicken, goat, horse, swine, sheep, and turkey [16].

Table 1 - Population of livestock in Malaysia for 2016-2020

Type of Livestock	2016	2017	2018	2019	2020
Buffalo	119,133	114,013	106,988	101,695	100,242
Cattle	737,827	703,832	676,686	657,407	659,317
Goat	416,529	385,304	359,200	312,571	320,203
Sheep	138,479	130,658	128,298	121,677	121,173
Swine	1,654,381	1,849,351	1,967,538	1,888,460	1,876,029
Chicken	289,666,002	293,301,558	259,323,292	285,063,636	300,145,315
Duck	9,633,185	9,283,900	9,680,573	9,376,456	9,628,617
Total	302,365,536	305,768,616	272,242,575	297,521,902	312,850,896

Source: 2019/2020 Livestock Statistics by Department of Veterinary Services

The total population of livestock in Malaysia based on the statistics for the year 2020 is illustrated in a treemap as in Fig. 1. From the treemap, chicken represents the largest population of 95.94% followed by duck (3.08%), swine (0.60%), cattle (0.21%), goat (0.10%), sheep (0.04%), and buffalo (0.03%). According to Malaysian Breeding Policy (2013), the indigenous breed of livestock in Malaysia are Kedah-Kelantan (cattle), Swamp Buffalo (buffalo), Katjang (goat), Malin (sheep), and Ayam Kampong (chicken) [17]. Today, the common breeds of livestock found in Malaysia are (i) Kedah-Kelantan, Yellow Cattle Kedah-Kelantan, Nelore and Brahman for cattle; (ii) Katjang and Boer for goat; (iii) Barbados Black Belly and Damara for sheep; and (iv) Large White Yorkshire, Landrace and Duroc for swine.
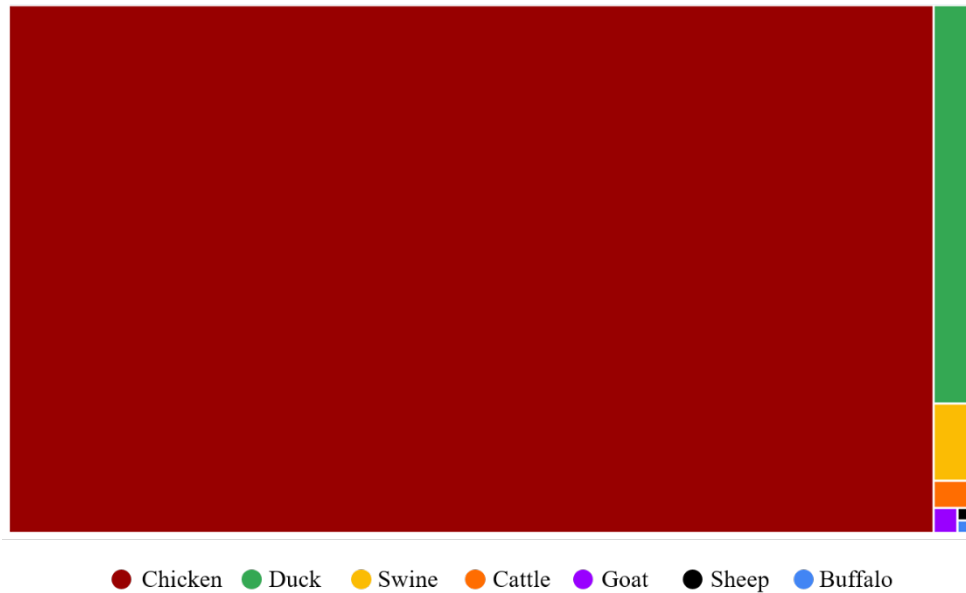
● Chicken ● Duck ● Swine ● Cattle ● Goat ● Sheep ● Buffalo

Fig. 1 - Treemap of livestock population in Malaysia for the year 2020

2.2 Number of Livestock Farms

The number of registered farms according to states and types of livestock commodities in West Malaysia for the year 2018 is summarized in Table 2 based on the statistics by DVS [18]. Beef cattle farms constitute more than half of the total registered farms where Kelantan has the highest number of over seven thousand. Overall, the number of farms for ruminant are far greater than the total number of farms for non-ruminant combined. This is because the ruminant livestock farming is practiced by smallholders while non-ruminant is dominated by commercial enterprises that cater for big scale production [19-20]. The type of livestock farm is classified by the number of livestock. For cattle farming, small farm is ones with livestock less than 30 while large or commercial farm is ones with livestock more than 50 [21]. Livestock farms in Malaysia must be registered with the state DVS and are subjected to the by-laws related to farming in the state. They can also get Malaysian Good Agriculture Practice (MyGAP) certification for Good Animal Husbandry Practice. This certification reflects the excellent measures taken by the farm in producing quality livestock that are fit for human consumption [22].

Table 2 - Registered livestock farms in west Malaysia as of 2018

States	Buffalo	Beef Cattle	Dairy Cattle	Goat	Sheep	Swine	Broiler Chicken	Layer Chicken	Broiler Duck	Layer Duck
Johor	122	2,230	171	797	192	88	616	58	23	1
Kedah	191	2,262	63	2,271	191	10	200	10	2	4
Kelantan	48	7,060	16	782	287	0	209	0	41	61
Melaka	222	1,276	81	582	144	79	107	23	5	2
N.Sembilan	166	1,002	101	553	469	4	173	7	0	1
Pahang	332	1,889	29	755	169	3	193	9	10	50
Perak	446	1,959	173	1,482	116	128	349	22	74	30
Perlis	6	297	5	191	27	1	9	0	6	17
P.Pinang	47	651	35	512	75	214	89	80	9	12
Selangor	37	1,114	86	1,075	124	195	210	40	14	11
Terengganu	237	4,772	4	1,903	182	0	141	0	3	55
Total	1,854	24,512	593	10,903	1,976	722	2,296	249	187	244

Source: 2015-2018 Registered Livestock Farms Statistics by Department of Veterinary Services

Fig. 2 shows the percentage of registered livestock farms in West Malaysia based on the types of commodities. The largest percentage of livestock farms goes to beef cattle followed by goat, broiler chicken, sheep, buffalo, swine, dairy cattle, layer chicken, layer duck, and broiler duck. Cattle farming in Malaysia is done either in intensive system (feedlot), semi-intensive, or integrated farming. In feedlot system, the cattle are reared in cage while for semi-intensive, the cattle

spend time in the cage and outside for feeding. For integrated cattle farming, the cattle graze in plantation such as palm oil, rubber or coconut plantations [21]. The non-ruminant farming in Malaysia is dominated by broiler chicken and swine which reflects the demand for white meat. There are two types of chicken and swine farming in Malaysia which are open house system and closed house system [23-24]. The closed house system is considered to be more superior in terms of controlling pollution compared to the open house system.
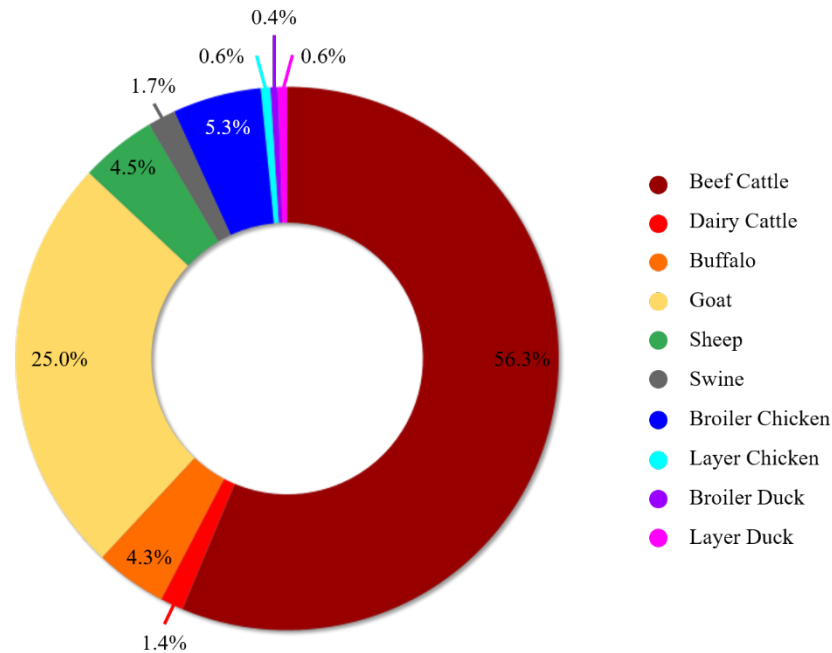

Fig. 2 - Percentage of registered livestock farms in West Malaysia as of 2018

2.3 Consumption

Table 3 displays the consumption of livestock commodities in Malaysia from 2016 to 2020 based on the 2019/2020 Livestock Statistics by DVS [15]. Meat can be divided to two groups; red meat (beef, mutton) and white meat (pork, poultry) [25]. The statistics showed that people in Malaysia consumed more white meat compared to red meat with the total meat consumed per capita in 2020 is 61.5 kg. On the global scale, the average meat consumption per person in a year is 43 kg in 2014 [16]. The type of meat most consumed in Malaysia is poultry meat, which is why the population of poultry in Malaysia is the largest compared to other livestock. Poultry meat is the preferred meat among Malaysian diverse ethnicities is also because it has no religious prohibition such as beef and pork [26]. Even though the pork consuming population in Malaysia is only 40% [27], pork ranks the second highest types of meat consumed in Malaysia and followed closely by beef. Besides meat, poultry sub-sector also provides egg as another vital source of protein. The consumption of egg in Malaysia which is between 290 to above 300 per year is higher than the world average egg consumption of just 153 [28]. Looking at the dishes commonly eaten by Malaysian, this figure brings no surprise as we usually add egg to everything; nasi lemak, roti canai, fried rice, bakery products, desserts, and many others.

Table 3 - Per capita consumption of livestock commodities in Malaysia for 2016-2020

Commodities	2016	2017	2018	2019	2020
Beef (kg)	6.6	6.5	6.4	6.1	6.1
Mutton (kg)	1.2	1.3	1.3	1.1	1.2
Pork (kg)	6.8	7.4	7.6	7.4	7.4
Poultry Meat (kg)	53.7	50.1	49.1	48.9	46.8
Eggs (pcs)	376.4	392.6	362.5	291.2	360.9
Fresh Milk (L)	1.8	2.0	1.9	2.0	2.1

Source: 2019/2020 Livestock Statistics by Department of Veterinary Services

Over the last five years, the consumption of poultry meat in Malaysia is seeing a decreasing trend, but still maintaining a value over 45 kg/year. It is estimated that for the year 2021, about 48.7 kg of poultry meat will be consumed per person in Malaysia, making this country one of the top global consumers of poultry meat [29]. The meat consumption

trend in the world has also been shifting towards poultry where it is a cheaper option for developing countries and reflects a healthier option for high-income countries [30]. The cost of production for poultry is cheaper as the livestock are raised in large scale compared to cattle that are mostly run by smallholders. Besides that, poultry has lower feed conversion ratio compared to cattle which means that lower amount of feed is needed to increase the animal's weight [31].

2.4 Self-Sufficiency Ratio

The ability of a country to produce food for domestic consumption can be measured from the self-sufficiency ratio (SSR). According to Malaysia's Third National Communication and Second Biennial Update Report submitted to the United Nations Framework Convention on Climate Change, the poultry and swine production have met the 100% SSR, while the ruminant production is still below 30% [2]. Table 4 and Fig. 3 exhibit the self-sufficiency ratio of livestock products in Malaysia for the last five years. The data was obtained from the 2019/2020 Livestock Statistics by DVS, and the value for the year 2020 was an estimation [15].

Table 4 - Self-sufficiency ratio (%) of livestock products in Malaysia for 2016-2020

Type of Livestock	2016	2017	2018	2019	2020
Beef	23.04	22.17	22.49	22.28	21.72
Mutton	13.00	10.23	10.95	11.84	10.72
Pork	90.96	92.12	90.95	92.25	91.62
Poultry Meat	103.24	103.68	104.02	104.10	104.51
Poultry Eggs	117.93	114.67	117.03	119.13	116.60
Milk	64.86	58.25	61.27	63.03	62.40

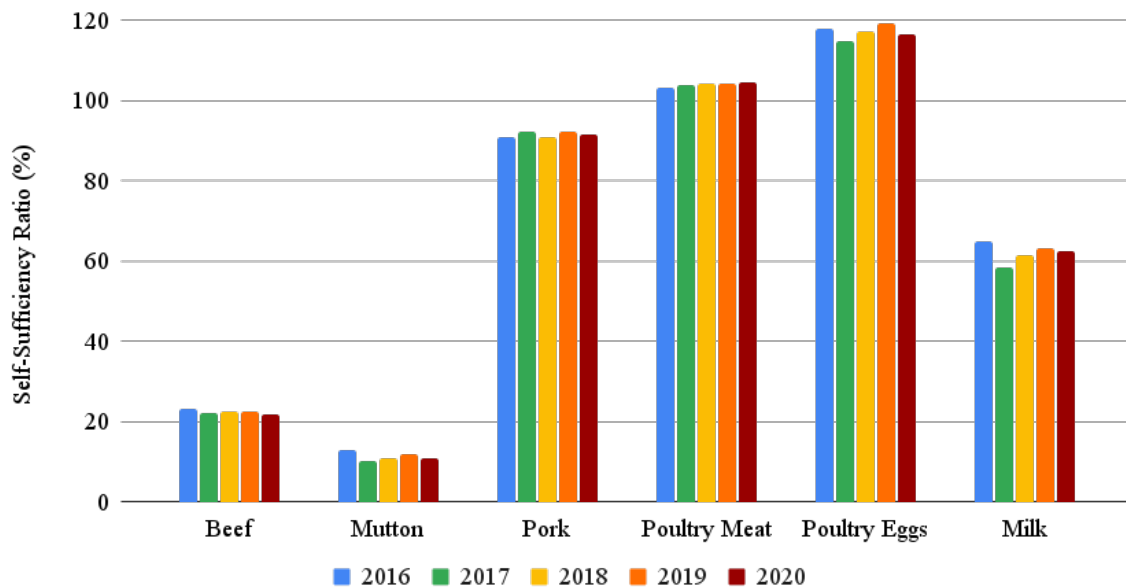*Source: 2019/2020 Livestock Statistics by Department of Veterinary Services*

Fig. 3 -Self-sufficiency ratio (%) of livestock products in Malaysia for 2016-2020

The SSR trend for livestock products in Malaysia within these five years do not exhibit any drastic changes. Based on the statistics shown, the SSR for poultry meat and eggs are over 100% while pork is over 90% for the past five years. For the ruminant commodities, milk has SSR around 60% while beef and mutton are below 30%. Low SSR value means that we have to import more livestock products to fulfill the demand. This is evident from the import amount of beef and pork on 2019 which are 159,185.1 and 20,470.1 million tons respectively [15]. Malaysia aims to achieve 50% SSR for beef and 100% for milk by the year 2030 as stated in the National Agrofood Policy 2.0 [32].

3. Livestock Manure

Livestock waste can be categorized into two categories; solid and liquid. They contain animal excreta (feces and urine), excess animal feed, and water used for servicing (cleaning and drinking). Ruminants and monogastric animals produce excreta in the form of feces and urine while poultry only excrete feces [33]. Livestock waste is used as manure,

which can be defined as animal waste utilized as fertilizer to enhance soil fertility and plant growth. This is because livestock manure contains significant amount of nitrogen and phosphorus which is useful to replace synthetic fertilizer [34-35].

With regards to the population of livestock in Table 1, the total manure excreted daily is tabulated in Table 5. The daily manure excreted per head per day for each livestock is adapted from the Manure Characteristics by MidWest Plan Service [36]. The value of daily manure excreted by buffalo is estimated to be similar with cattle, and the value for goat is based on the value for sheep. From the data, it reveals that the manure excreted by livestock population in Malaysia to be over 45 thousand tons every day. Hence, for the year 2020, it is estimated that the total manure excreted by the livestock in Malaysia is 17.745 million tons. This value is near to that estimated by Abdeshahian et al. (2016), which stated that the amount of livestock manure generated in Malaysia is 21.656 million tons per year [37].

Table 5 - Manure excreted by the population of livestock in Malaysia for 2016-2020

Type of Livestock	*Daily manure excreted per head (kg)	Total daily manure excreted (tons)				
		2016	2017	2018	2019	2020
Buffalo	16.78	1,999	1,913	1,795	1,706	1,682
Cattle	16.78	12,381	11,810	11,355	11,031	11,063
Goat	1.86	775	717	668	581	596
Sheep	1.86	258	243	239	226	225
Swine	3.36	5,559	6,214	6,611	6,345	6,303
Chicken	0.09	26,070	26,397	23,339	25,656	27,013
Duck	0.18	1,734	1,671	1,743	1,688	1,733
Total	40.91	48,775	48,965	45,749	47,234	48,616

*value adapted from Manure Characteristics by MidWest Plan Service

Based on the types of livestock, cattle and buffalo produced the largest individual daily manure while chicken has the littlest. Fig. 4 illustrates the estimated percentage of livestock waste in Malaysia for the year 2020 based on the value of daily manure excreted. Even though chicken produce only 0.09 kg of manure daily, but since chicken makes up the largest percentage of livestock population in Malaysia, therefore it generates the most manure. The second largest contributor of daily manure among the livestock population in Malaysia is cattle, and followed by swine, duck, buffalo, goat, and sheep.
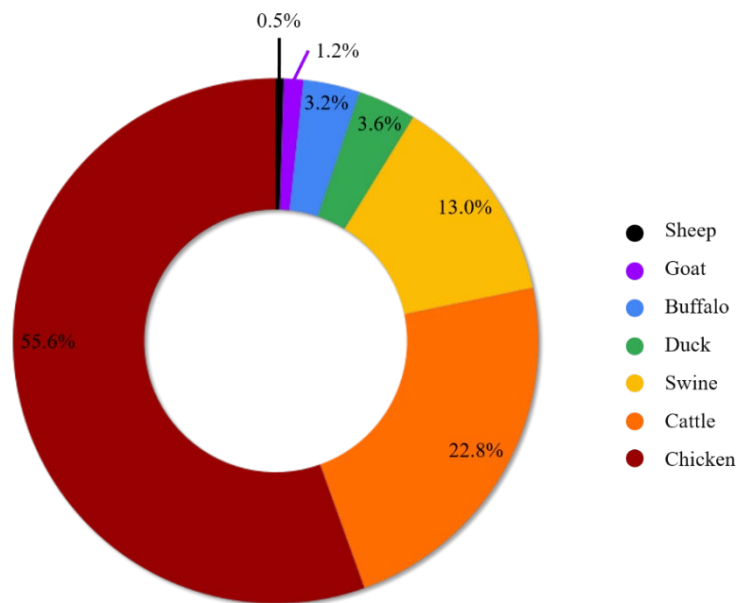

Fig. 4 - Percentage of total daily manure excreted by livestock in Malaysia based on estimated livestock population for the year 2020

Livestock manure contains valuable nutrients for crops and improves the soil productivity. Using livestock manure as fertilizer promotes sustainability and is cost-effective as it recycles the biological waste from livestock. The nutrient content in the manure and the manure properties depends on the nutrient in the animal feed, the animal species and age, digestibility, housing, environment, and stage of production [33, 36]. However, the high content of phosphorus and

nitrogen in the manure requires the application of manure to be controlled to avoid excess nutrient load and eutrophication [34]. Animal manure might also contain heavy metals from the animal feed and can cause heavy metal pollution in the soil as they are excreted in the manure [38]. Therefore, livestock manure and overall livestock waste must be properly managed to harvest its benefit without harming the environment.

4. Towards Sustainability

This section gathers the current practices and efforts including national policies that are introduced in the country to ensure sustainable livestock industry.

4.1 Waste Management

Livestock makes 85% of global animal fecal waste which is substantially larger than the total amount generated by human [6]. Even though livestock waste is a valuable source of nutrients for soil and plants, but if not managed properly it can cause pollution. Besides high content of nutrient, livestock waste also contains organic matter, suspended solids, air pollutants, pathogens, trace metals, antibiotics and pharmaceuticals [39]. These pollutants can cause high turbidity value, high chemical oxygen demand and biological oxygen demand readings, and bioaccumulation which will affect water quality and aquatic life if not properly treated before being discharged to the environment.

The livestock waste management practices in Malaysia are summarized in Fig. 5 based on the guidelines by DVS [21, 23, 24]. Generally, the solid waste is processed into organic fertilizer while the liquid waste is treated to meet the water quality standard before being discharged to public drainage. The livestock waste can also be processed into biogas which is a sustainable practice as it controls the emission of methane and utilizes it to generate electricity. This will provide millions of people with affordable and sustainable electricity as well as mitigates environmental pollution, bad odor and flies problems [6].
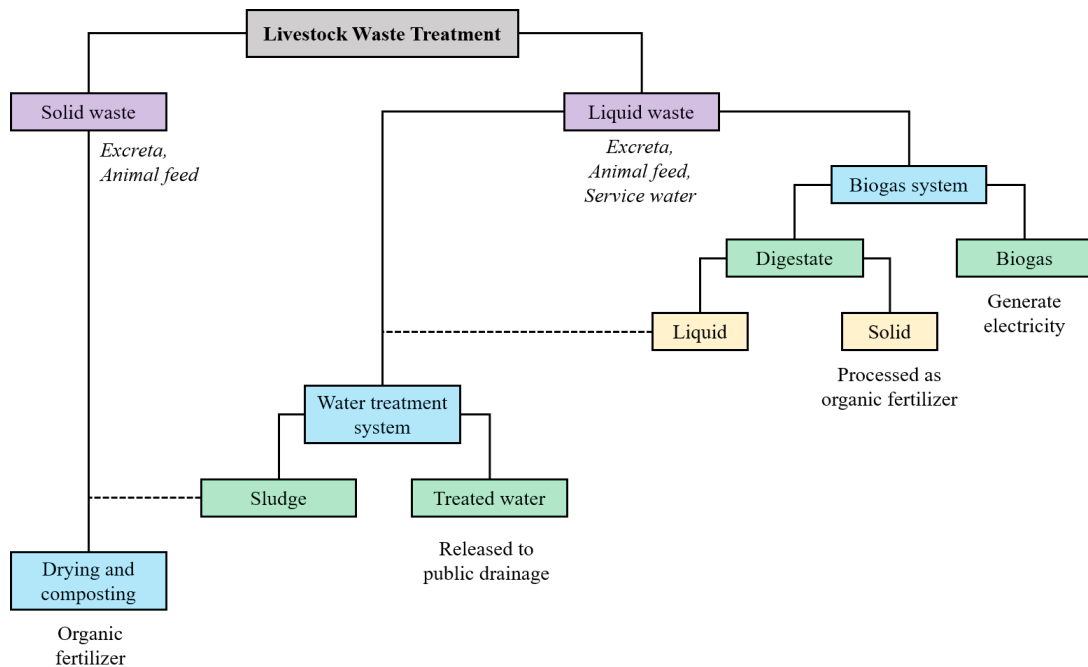

Fig. 5 - Waste management practices in livestock farms

For ruminant waste management, the solid and liquid waste can be managed based on the Ruminant Farming Waste Management Guideline (DVS, 2019) [21]. The solid waste which consists of feces and excess animal feed are processed as manure by drying and composting. The liquid waste which is the water from farm cleaning process that contains animal excreta and excess animal feed can be treated by water treatment system. The water treatment system consists of solid separator, manure pit and series of tanks; anaerobic pond, facultative pond, aerated facultative pond, and aerobic pond. The treated water can be released to the public drainage while the sludge can be processed as manure. Besides that, the ruminant waste can be treated with biogas system that will generate biogas for electricity and digestate. The digestate can undergo dewatering process to produce organic fertilizer and the effluent from this process must be treated before being discharged.

Based on the Chicken Farming Waste Management Guideline (DVS, 2019), there are several ways of waste management that can be implemented by poultry farmers [23]. Solid waste in the poultry farm can be managed by means of composting while the liquid waste can be treated by screening or solid separator, composting, sedimentation tank, and

digester tank. The poultry waste can be treated with effective microorganism (EM) to speed up the organic matter decomposition in waste water, facilitate composting process, and reduce the smell problem. Chicken droppings are processed by composting method to produce organic fertilizer. Besides that, sludge produced from the treated wastewater can also be dried to produce the manure. Poultry waste can also be treated using digester tank to produce biogas.

The waste management in swine farms are also generally the same as the ruminant waste management. Besides that, 3R (Reduce, Reuse and Recovery) concept is also promoted to be adopted in the farm as it can save cost and reduce the waste management problems [24]. Reduce refers to the reduction of unnecessary waste as this will reduce the burden for waste management. Reuse or recycling means to process the waste material into something that can be utilized again in the farm, such as using the treated effluent from the water treatment system for cleaning. Reusing the treated effluent is also an essential step towards achieving zero waste discharge in the farm. Recovery is referring to the recovery of sources from the waste material such as generating energy from biogas or producing organic fertilizer from the solid waste.

Livestock farmers in Malaysia can get certified for MyGAP in accordance to the Malaysian Standard MS 2027:2006 Good Animal Husbandry Practice. It is a voluntary certification scheme that emphasizes the aspect of productivity, environmental friendly livestock activities, farm biosecurity and good disease control, and production of quality and safe product for consumption. From this scheme, the certified farms must have proper waste management including effluent treatment system, as well as proper control of pollution from livestock activities such as fly, smell, dust, and sound pollution [40]. Therefore, with this scheme, proper waste management in livestock farms can be promoted which will benefit the farmers, the nation and the environment.

4.2 Waste to Wealth Approach

Waste to wealth concept can be defined as the conversion of waste material into useful product. Livestock industry can generate valuable products from its waste as well as utilizing waste product from other industry. The most common waste to wealth products from livestock industry are manure for soil application and biogas for generating energy. Malaysia has a biogas potential of 4,589.49 million m^3/year that can be converted from animal waste which can generate 8.27×109 kWh/year of electricity [37]. Biogas system also produce stabilized manure from livestock waste with high nutrient contents that is environmentally and economically attractive compared to mineral fertilizer [39].

Livestock industry can benefit from agriculture waste to be used as the animal feed and bedding material. Agriculture biomass such as rice straw can be used as animal bedding for ruminants [9, 41]. Organic waste such as fruits, vegetables and agriculture waste can be processed into animal feed and this promotes sustainability as it reduces the amount of waste going to the landfill. Among the organic wastes that are used as animal feed are fruit and vegetable waste, rice husk, palm kernel cell, soymeal, rapeseed meal, sunflower meal, coconut meal, cotton seed, and crop residue [42]. Utilizing fruit waste as animal feed gives a cheaper alternative for the farmers while also provide health benefit to the animal as the fruit waste contains nutrients and minerals [43].

As one of the major producer of palm oil, Malaysia produces a large volume of palm oil biomass. The by-products from palm oil industry is also a convenience source of alternative feed for ruminant livestock. Oil Palm Frond (OPF) and Palm Kernel Expeller (PKE) were introduced as feed resources where OPF can be used in the diet either in fresh, pelleted or cube form [20]. Besides that, Palm Acid Oil (PAO) from Palm Oil Mill Effluent (POME) sludge can be incorporated as goat's feed which help to obtain better body weight gain [44]. Waste to wealth concept brings creative ideas to provide alternate choices of animal feed that is cost-effective and nutritious for the livestock. It also helps in reducing the need for converting land to plant crops for animal feed. Overall, the waste to wealth approach helps to repurpose waste into valuable products and also conserve natural resources. This effort is consequential in achieving sustainability not only in livestock industry, but also other industries.

4.3 National Policies

In recent years, Malaysian government has introduced national policies that supports sustainable agriculture practices. Shared Prosperity Vision 2030 (Wawasan Kemakmuran Bersama 2030; WKB) is a commitment to make Malaysia a nation that achieves sustainable growth and equitable wealth distribution across income groups, ethnicities, regions, and supply chains [45]. One of the Key Economic Growth Activities (KEGA) proposed in WKB is smart and high-value farming. It aims to integrate environmental friendly and high technology in farming activities such as drones and Internet of Things. This policy also promotes the concept of circular economy to minimize waste production.

National Agrofood Policy 2.0 (Dasar Agromakanan Negara 2.0; DAN2.0) was launched on October 2021 [32]. It is a policy crafted based on three principles which are economy, social and environment. One of the objective is to encourage sustainable food consumption and production practices. This policy will enable the agrofood sector in Malaysia to remain competitive, thus contributing to national economic growth while ensuring environmental sustainability. Both of these policies can serve as the catalyst to drive the national livestock industry towards sustainability. Therefore, this industry can expand to meet the demand and SSR without causing adverse effect to the environment.

5. Conclusion

Livestock industry in Malaysia is essential to provide commodities such as meat for consumption, and also as a source of income and employment. Chicken makes up a major population of livestock in Malaysia as poultry meat is the most consumed type of meat, together with the high demand for poultry eggs in the diet. The number of farms for ruminant livestock such as beef cattle and goat are significantly larger than the number of farms for non-ruminant. This is because ruminant farmers are usually smallholders while the non-ruminant are dominated by large scale enterprise. Currently, Malaysia achieved comfortable SSR for poultry meat (over 100%) and pork (over 90%) while for ruminant meat is below 30%. Besides providing commodities, livestock industry also generates by-products from the waste such as manure that is useful as organic fertilizer. It is estimated that the manure production in Malaysia is 17.745 million tons for 2020. Livestock waste can also be utilized to produce biogas for electricity generation. The current practices and policies regarding livestock farming in Malaysia are supporting the move towards sustainable agriculture. Thus, we may see positive effects in terms of the growth of livestock industry to meet the demand while at the same time conserving natural resources and preserving the environment.

References

[1] Nabarro, D., & Wannous, C. (2014). The potential contribution of livestock to food and nutrition security: the application of the One Health approach in livestock policy and practice. Rev Sci Tech, 33, 475-485.

[2] MESTECC. (20180. Malaysia Third National Communication and Second Biennial Update Report. Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), 2018.

[3] Mohamad Hifzan, R., & Nor Amana, M. (2015). The Development and Future Direction of Malaysia's Livestock Industry. Food and Fertilizer Technology Center for the Asian and Pacific Region, 2015.

[4] Mohammad Hariz, A., & Mohd Fairuz, S. (2011). Current scenario and prospects of livestock waste management in Malaysia in Proceedings of the International Seminar on Sustainable Resource Management of Livestock and Poultry Wastes for Asian Small-scale Farmers. Ho Chi Minh City.

[5] Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., Rosales, M., & de Haan, C. (2006). Livestock's long shadow: environmental issues and options., Food & Agriculture Org. (FAO).

[6] FAO. (2018). World Livestock: Transforming the livestock sector through the Sustainable Development Goals. Food and Agriculture Organization of the United Nations (FAO). Rome.

[7] Steinfeld, H., Mooney, H., Schneider, F., Neville, L. (2013). Livestock in a changing landscape, Volume 1: Drivers, consequences, and responses. Island Press.

[8] Von Braun, J. (2010). The role of livestock production for a growing world population. Lohmann Information, 45(2), 3-9.

[9] Grossi, G., Goglio, P., Vitali, A., & Williams, A. (2019). Livestock and climate change: impact of livestock on climate and mitigation strategies. Animal Frontiers, 9(1), 69-76.

[10] FAO. (2021). Climate-smart livestock production. A practical guide for Asia and the Pacific region. Food and Agriculture Organization of the United Nations (FAO). Bangkok.

[11] Eisler, M.C, Lee, M.R., Tarlton, J.F., Martin, G.B., Beddington, J., Dungait, J.A., Greathead, H., Liu, J., Matthew, S., Miller, H., & Misselbrook, T. (2014). Agriculture: steps to sustainable livestock. Nature News, 507, 32-34.

[12] Doreau, M., Corson, M., & Wiedemann, S. (2012). Water use by livestock: A global perspective for a regional issue? Animal Frontiers, 2(2), 9-16.

[13] FAO. (2019). Water Use in Livestock Production Systems and Supply Chains—Guidelines for Assessment (Version 1). Livestock Environmental Assessment and Performance (LEAP) Partnership. Rome.

[14] Mekonnen, M., & Hoekstra, A. (2012). A global assessment of the water footprint of farm animal products. Ecosystems, 15(3), 401-415.

[15] DVS. (2021). 2019/2020 Livestock Statistics. Department of Veterinary Services (DVS), December 2020. [Online]. Available: http://www.dvs.gov.my/index.php/pages/view/3338?mid=42. [Accessed 27 October 2021].

[16] Garmyn, A.J. (2021). More than meat: contributions of livestock systems beyond meat production. Animal Frontiers, 11(2), 3-5.

[17] DVS. (2013). Malaysian Livestock Breeding Policy. Department of Veterinary Services (DVS).

[18] DVS. (2018). Total Registration of Livestock Premises by Commodity in Peninsula Malaysia. Malaysia Open Data Portal, 19 September 2018. [Online]. Available: https://www.data.gov.my/data/en_US/dataset/sem-malaysia-jumlah-pendaftaran-ladang-premis-ternakan-mengikut-komoditi-dari-tahun-2015-2017. [Accessed 28 October 2021].

[19] Ariff, O., Sharifah, N., & Hafidz, A. (2015). Status of beef industry of Malaysia. Malaysian Journal of Animal Science, 18(2), 1-21.

[20] Sharif, H. (2014). Advances in R&D to Address the Livestock Industries Issues Beyond 2020. Malaysian Journal of Veterinary Research, 5, 2-6.

[21] DVS. (2019). Ruminant Farming Waste Management Guideline. Department of Veterinary Services (DVS).

[22] Mohd Rashid, R., Nik Rozana, N., & Mohd Dainori, M. (2016). Malaysian Agricultural Quality Standards. Food and Fertilizer Technology Center for the Asian and Pacific Region.

[23] DVS. (2019). Chicken Farming Waste Management Guideline. Department of Veterinary Services (DVS).

[24] DVS. (2019). Swine Farming Waste Management Guideline. Department of Veterinary Services (DVS).

[25] Henchion, M., Moloney, A., Hyland, J., Zimmermann, J., & McCarthy, S. (2021). Review: Trends for meat, milk and egg consumption for the next decades and the role played by livestock systems in the global production of proteins. Animal, 100287.

[26] Abdurofi, I., Ismail, M., Kamal, H.A.W., & Gabdo, B.H. (2017). Economic analysis of broiler production in Peninsular Malaysia. International Food Research Journal, 24(2), 761-766.

[27] Gardir Singh, M., & Fong, R. (2016). Swine Breeding and Production in Malaysia. Food and Fertilizer Technology Center for the Asian and Pacific Region.

[28] Farrell, D. (2013). The role of poultry in human nutrition in Poultry Development Review. Food and Agriculture Organization of the United Nations (FAO).

[29] Hirschmann, R. (2021). Forecasted meat consumption per capita in Malaysia in 2021. Statista, 19 March 2021. [Online]. Available: https://www.statista.com/statistics/756920/malaysia-meat-consumption-per-capita-by-type/. [Accessed 29 October 2021].

[30] OECD/FAO. (2021). OECD-FAO Agricultural Outlook 2021-2030. The Food and Agriculture Organization of the United Nations (FAO).

[31] Shahbandeh, M. (2021). Feed conversion ratio of selected meat and fish worldwide. Statista, 9 July 2021. [Online]. Available: https://www.statista.com/statistics/254421/feed-conversion-ratios-worldwide-2010/. [Accessed 29 October 2021].

[32] MAFI. (2021). Executive Summary National Agrofood Policy 2.0 2021-2030. Ministry of Agriculture and Food Industry (MAFI).

[33] Christensen, M., & Sommer, S. (2013). Manure Characterisation and Inorganic Chemistry. Animal Manure Recycling: Treatment and Management, (pp. 41-65). John Wiley & Sons.

[34] Pedizzi, C., Noya, I., Sarli, J., Gonzalez-Garcia, S., Lema, J., Moreira, M., & Carballa, M. (2018). Environmental assessment of alternative treatment schemes for energy and nutrient recovery from livestock manure. Waste Management, 77, 276-286.

[35] Guo, S., Pan, J., Zhai, L., Khoshnevisan, B., Wu, S., Wang, H., Yang, B., Liu, H., & Lei, B. (2020). The reactive nitrogen loss and GHG emissions from a maize system after a long-term livestock manure incorporation in the North China Plain. Science of The Total Environment, 137558.

[36] Lorimor, J., Powers, W., & Sutton, A. (2004). Manure Management Systems Series: Manure Characteristics. MidWest Plan Service.

[37] Abdeshahian, P., Lim, J.S., Ho, W.S., Hashim, H., & Lee, C.T. (2016). Potential of biogas production from farm animal waste in Malaysia. Renewable and Sustainable Energy Reviews, 60, 714-723.

[38] Ogbuewu, I., Odoemenam, V., Omede, A., Durunna, C., Emenalom, O., Uchegbu, M., Okoli, I., & Iloeje, M. (2012). Livestock waste and its impact on the environment. Scientific Journal of review, 1(2), 17-32.

[39] Kinyua, M., Rowse, L., & Ergas, S. (2016). Review of small-scale tubular anaerobic digesters treating livestock waste in the developing world. Renewable and Sustainable Energy Reviews, 58, 896-910.

[40] MAFI. (2013). Guideline Malaysian Good Agricultural Practices (MyGAP). Ministry of Agriculture and Food Industry (MAFI).

[41] Rosmiza, M., Davies, W., Rosniza Aznie, C., Mazdi, M., & Jabil, M. (2014). Farmers' knowledge on potential uses of rice straw: an assessment in MADA and Sekinchan, Malaysia. Geografia-Malaysian Journal of Society and Space, 10(5), 30-43.

[42] Leman, A., Muzarpar, S., Baba, I., Sunar, N., & Wahab, R. (2017). Feedstock for ruminant, non-ruminant and aquatic fish in Malaysia-A review. AIP Conference Proceedings.

[43] Pathak, P., Mandavgane, S., & Kulkarni, B. (2019). Waste to wealth: a case study of papaya peel. Waste and Biomass Valorization, 10(6), 1755-1766.

[44] Amalina, I., Haziq, J., Syukor, A., Ridwan, A., & Rashid, A. (2021). Study of Palm Acid Oil (PAO) from Sludge Palm Oil Mill Effluent (POME) as Goat's Feed. Materials Today: Proceedings, 41, 96-101.

[45] MEA. (2019). Shared Prosperity Vision 2030. Ministry of Economic Affairs (MEA).