Livestock Breeding Related to Climate Change in Malaysia:
A Perspective of the Malaysian Swine and Poultry Sector

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ABSTRACT

Conventional poultry and swine production systems in Malaysia are affected by climate change which manifest as suppression of appetite, lower average weight gain and the overall reduction of productivity. Close house systems with proper ventilation systems and better genetic selection are currently being practiced in Malaysia as a strategy to offset the impact of climate change. Close house systems enable the optimization of microclimate inside the barns and studies shown will improve feed intake (17%), weight gain (38%), feed conversion ratio (43%). Breeders are genetically selected for heat resilient breeding traits such as lactation feed intake, better feed and environmental efficiency traits. Moving forward, more advancement in feed technologies to allow for greater feed efficiencies and the adoption of renewable green technology to reduce the emission of greenhouse gaseous from livestock waste have to be put in place to mitigate the effects of climate change.

KEYWORDS

Climate Change, close house system, genetic selection, swine, pig, poultry, food security

INTRODUCTION

Climate change or global warming is the result of the drastic increase of greenhouse-gaseous (carbon dioxide, methane, and nitrous dioxide) in the atmosphere.[2] Intergovermental Panel on Climate Change (IPCC,2007) reported that global temperature increased from 1˚C-1.5 ˚C within the last 30- 50 years and it is estimated to rise another 4˚C by the year 2100.[3] With an increase of 1.5˚C to 2.5 ˚C, approximately 20 to 30 percent of plants and species are expected to be at risk of extinction with severe consequences of food security in developing nations.[4] Burning of fossil fuels is the major source of greenhouse gas emissions and it is reported that about a fifth of the total greenhouse-gas emissions are produced by agricultural activity especially livestock production.[1,5] As a result, livestock production systems ae experiencing the effects of changes in temperature and increase frequency of extreme weather events. [16]

At present in Malaysia, poultry meat and eggs account for 53.8% of national protein consumption, whilst pork meat is 13.78%, beef 5.2%. The local production of poultry meat and eggs is 2,388,000 MT per year and local pork meat production is 215,760,000 MT per year and self-sufficiency level of poultry and pig are 113.55% and 95% respectively, compared to beef which is 23.5%, whereas majority of the local beef consumption is being imported. Hence, this paper will focus on the main livestock commodities in Malaysia namely poultry and pig industry as both operate on large scale or commercialized systems.

The direct effect of climate change will be the reduction of productivity. In conventional production housing systems such as open houses, poultry and pigs are vulnerable to warmer temperatures, which manifest as suppression of appetite which leads to lower average weight gain. The indirect effect of climate change will be the quantity and quality of nutrition made available to these livestock, causing lower production yields.[6] Poultry and pig industry in Malaysia are heavily reliant on importation of corn and soy beans from other countries as the main protein source for animal feed, so animal feed are formulated with least cost ration formulation.[6] Global climate change promotes the food: feed: fuel conflict overseas, where more feeds are channel into biofuel, instead of being use as animal feed, thus reducing the available feed supplies and feed quality, and overall causing lesser production yields for poultry and pig industry.[6] As an adaptation to climate change, and to reduce the vulnerability of the livestock industry on a long term, Malaysian poultry and pig farms are now using close house systems with proper ventilations, and better genetics selections, to offset the impact of climate change.

1.0 Close house and ventilation system

Poultry and swine farms in Malaysia are generally shifting from the conventional open house systems towards close house system in order to comply with the stringent regulatory policies put in place by the government in the recent years. In Malaysian weather scenario where temperatures average around 25 ± 5 °C to 35.3 ± 5 °C, the ability to control the microclimate inside the barns are critical to enhance poultry and swine production.[7] The most common type of close house system used in Malaysia's poultry and swine farms is negative pressured tunnel ventilated system where the air inlet clad with cooling pads are place at the side or the end of the barn and gable fans are installed at the other end of the barn, creating a constant airflow in the barn. [8] Temperature and humidity are optimized with appropriate wind speed. The internal close house temperature can be reduce 5-6 °C from external ambient temperature, and the wind-chill effect of the wind speed on the pigs will further reduce the perceived temperature by the pigs and poultry down another 3-4°C. [11] Besides that, to aid further reduction of internal house temperatures, these close house are commonly orientated in an east west direction to avoid direct sunlight falling on to the sidewalls, a drop ceiling is installed which reduces the volume of air to be cooled down using the ventilation system, making it more efficient to cool the air inside the barn with a shorter period of time, roofing insulation which acts as a thermal barrier to prevent heat build-up inside the barn, and double-ridge roofing to re-direct heat quickly away from the house by facilitating air circulation and reduce the amount of hot air trapped at bird/ pig level especially if no roof or ceiling insulation has been used for the roof design, house width and distance between houses are given careful consideration to allow for better aeration/ air exchange, increasingly more farms have already repeal and replace the conventional concrete flooring and partitioning to slatted flooring and galvanized steel partitioning where the air flow from below the slats helps to cool the birds and pigs and reduce ammonia levels. [12] Close house are also equipped with a house computer which controls multiple parameters and manages the ventilation system based on a series of inputs and settings which allows the microclimate to be adjusted to the animal's comfort zone.[8] A study was done to compare the effects of growing pigs in a tropical ambient temperature and a closed housed conditions and reported an improvement of feed intake (17%), average daily weight gain, ADG (38%), shorten the days to achieve market weight, improved feed conversion ratio, FCR (43%) and etc as tabulated in Table 1.[25]

Table 1 Comparison of tropical temperature and close house system on growth rate of pigs [25]

Parameters	Growing pigs at 54-79kg	
	Open house (29˚C, RH69-91%)	Closed house (17˚C, RH 73-79%)
Feed intake, kg/d	2.12	2.56
Average daily Weight gain (ADG), kg/d	0.57	0.93
Feed conversion ratio, kg/kg	3.57	2.50

The comfort zone as mentioned earlier for poultry and swine are different for each breeds and producers will refer to the breed specifications to adjust the microclimate effectively to optimize production performance. Example of parameters recommended by for poultry by Aviagen (Broiler) and pigs by PIC are as Table 2.

Table 2 Comfort level for optimal poultry and swine productivity

Parameters	Poultry (Broiler) [12, 13, 14]	Swine[9,10] (varies from different age groups)
Temperature (° C)/	24-36 °C Litter temperature= 28-30 °C	16-37 °C
Humidity (%)	60-70%	<65%
Wind Speed (ms^{-1})	4.0 (800 ft/min) at air inlet	0.5 – 1.7
Drinker	8 Bell drinkers (40cm diameter) per 1,000 birds at post brooding stage. Flush drinker lines in hot weathers to ensure that the water is as cool as possible. Insulate/ shade or place underground the pipes and water tanks.	1 to every 10 heads
Stocking density	0.9- 4.6 ft^2	0.26-0.8 m^2

2.0 Genetic selection

2.1 Pig industry

Genetic selection plays an important role in coping with climate changes. According to the Food and Agriculture Organization of the United Nations, FAO 2015 which reported that globally, pig production is gradually shifting from temperate to warmer climatic zones and this created a requirements for animals to be bred for resilience to hot conditions, leading to the selection of heat resilient breeding traits such as lactation feed intake, and also better feed efficiency trait to address the growing concerns about environmental efficiency (e.g. Greenhouse gas emission, phosphorus retention and nitrogen excretion).[17] An average local pig farm generally have their breeder stock for 7-8 parity for sows, and 3-4 years for boar breeder, and aims to have 30-40% replacements of gilts each year.[18] Grandparent stock (GGP), grandparent stock (GP) are commonly imported from countries like USA, Canada, Denmark, Finland, France, and more, to prevent inbreeding of the herd and these farms benefit from the current genetic improvements and advancements.[18] The current practice of these GGP breeders is to provide a ballpark value of each sow or boar that reflects its genetic potential selected to improve economically important traits. [18] This value is termed Estimated Breeding Value (EBV) done through the Combined Cross-bred and Pure-bred Selection (CCPS) scheme, which involves recording the cross-bred progeny of artificially inseminated (AI) nucleus board under commercial conditions and using the data to estimate the breeding values (EBV) of the pure-bred relatives that are selection candidates in the nucleus.[15,17] Amongst the traits that can be selected are as Table 2. While the main focus of genetic improvement programmes has been on increasing production, improve resilience, increasing emphasis is now being given to functional traits influencing the cost of production and economical sustainability.

Table 2 Selection criteria in pigs [17]

Traits		Comments
Reproduction traits	Stress susceptibility: Halothane sensitivity	Allele eradication at a single gene; still relevant in a few extreme sire lines only
	Piglet survival	Mothering ability of the sow, viability of the piglets, litter uniformity
	Farrowing interval	
	Congenital defects	Atresia ani, cryptorchidism, splayleg, hernias, hermaphrodites, etc.
	Leg soundness	Osteochondrosis and many other aspects
Production traits	Growth rate	At various age
	Carcass quality	Carcass yield, carcass leanness, uniformity
	Feed efficiency	
	Meat quality	Water-holding capacity, colour, intramuscular fat content
Robustness traits	Disease resistance	Specific *Escherichia coli* strains
	Survival	Piglet viability (effect of the sire); post weaning survival rates
	Sow longevity	

2.2 Poultry industry

The poultry sector in Malaysia also heavily rely on importation GGP day-old- chick from North America and Europe. Similar to swine industry, the tools used to gauge the potential of the bird is by using estimated breeding values (EBV) selecting for a plethora of traits which are of economic significance as listed in Table 3. [17] The trend of breeding objectives has been driven by the need for efficiency, including in environmental terms, as well as by the need for robustness and adaptability to varying production environments.[17] As poultry breeding is a global business and poultry thus there’s a demand for the development of more resilient birds to cope with varying ambient temperature, humidity, altitude, disease exposure, feed quality and management capacity. An increasing attention is also being paid to the need to reduce the carbon footprint of poultry production systems. Life-cycle analyses done in USA have indicated that the feed supply chain contributes a large proportion of the poultry sector’s share of global greenhouse gas emissions, and it is found that the key to reducing the environmental impact of poultry production is to improve feed efficiency. [17,22,23] It has been estimated that an improvement in feed efficiency resulting in a saving of 15 g feed per kg body weight gained would reduce global poultry feed requirements by around 1.85 million tonnes per year, freeing up about 4,000 km^2 of arable land. [24]

Table 3 Selection criteria for poultry [17]

Traits		Comments
Egg production	Egg number	Chicken, ducks, and geese: number of saleable eggs per bird
	Hen house production	
	Hen-day production	
	Hen-day percentage	
Egg weight	Egg weight/size, shape index	
Egg quality-external	Shell breaking strength	Broiler and layer chickens: Shell breaking strength, puncture score, dynamic stiffness, resonance frequency, egg weight loss between setting and transfer as a measure of shell porosity
	Shell thickness	
	Shell porosity/ egg weight loss	
	Shell colour, egg shape	
Egg quality-internal	Haugh uni, albumen height, yolk percentage	
Meat Production	Growth rate	Chickens, turkeys and ducks: high emphasis on selection against fat in meat-type ducks: fat percentage assessed on live birds using multidimensional ultrasound measures as well as condition scoring
	Body weight at various ages	
	Breast meat percentage	
	Leg meat percentage	
	Fat percentage	
	Eviscerated yield percentage	
Feed efficiency	Feed intake	Feed conversion ratio is feed intake per kg weight gain in meat-type birds and per kg egg mass in layers
	Residual feed intake	
	Feed conversion ratio	
Health, welfare and metabolic fitness	Liveability, leg health and walking	Selection for improved robustness, disease resistance and liveability traits and for decrease of (for example) tibial dyschondroplasia assessed with a lixiscope, valgus/varus, osteoporosis, toe defects, footpad dermatitis, femoral head necrosis and hock burn; heart and lung function assessed by measuring blood oxygen saturation using an oximeter
	Gait, bone strength	
	Gut health	
	Heart and lung function	
	Feather-pecking behaviour	
	Feather cover	
	End of lay condition score	
Reproductive efficiency	Fertility and hatchability	Broiler and layer chicken and turkeys: hatchability in terms of hatch of fertile eggs or hatch of set eggs
	Early and late embryo mortality	
	Chick viability (survivability beyond day of hatch)	
Plumage	Plumage colour	
	Feather quality	

3.0 Future advancement to mitigate climate change

Moving forward, more advancement in feed technologies and green technology has to be put in place to mitigate the effects of climate change. With the decreasing availability of arable land and increasing food-feed competition, Malaysia poultry and swine production sector which are generally dependant on feed imports will face drastic feed prices increase as Malaysia is deficient in feed resources. [16] This should prompt for a reassessment of feeding practices and a search for new protein-and energy rich feed resources that is locally available and do not compete with human food. [16] Greater use of precession or balanced feeding, identification and use of smart feeding options, and efforts to decrease feed wastage by using densified complete crop residue based feed blocks or pellets and total mixed rations instead of feeding individual feed components should be evaluated and practiced. [19] Potential alternative feed options include insects, co-products of the biofuel industry, including algae, ensiled vegetable and food waste and other unconventional feed resources such as moringa dan mulberry leaves. [16] Studies shown that there are a variety of different insect larvae may be suitable for processing into animal feed, and could potentially replace 25 to 100 percent of soymeal or fishmeal in the diet, depending on the animal species will necessitate supplementation with methionine, lysine and calcium. [16, 19] Emphasis should also be given to renewable green energy alternative to reduce greenhouse gas emissions in livestock production systems. These may include Anaerobic Digestor systems (AD System- Biogas) for on farm waste management. AD System -Biogas captures the methane gas that is otherwise be released from conventional manure holding lagoons into the atmosphere as a potent greenhouse gas.[20] This technology has the potential to reduce greenhouse gas emission and produce clean energy because the captured methane can be used as energy source to generate electricity or to produce heat[20] Malaysian government is aiming to increase the generation of renewable energy as part of the energy supply mix for the future and has introduced the feed-in-tariff (FiT) mechanism where producers are given attractive premium rates to renewable energy, there is also provision of green investment tax allowance for the purchase of green technology assets and income tax exemption on the use of green technology services and systems to further encourage the development of green technology.[21]

CONCLUSION

Poultry and Swine industry in Malaysia are able to overcome the effects of climate change by upgrading farm facilities and better managements. However, such changes require huge amount of investment.

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