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RESEARCH PROGRAM ON Livestock

More meat milk and eggs by and for the poor

POLICY BRIEF

Reducing Climate-Induced Heat Stress in Pigs in Uganda: Policy Actions

MORE PORK UGANDA

Key Messages

- Climate-induced heat stress reduces pig growth, reproduction and health and may cause animals to die.
- Risk factors that increase heat stress include age, pregnancy, lactation, free-range management, and periods of high temperature and humidity.
- Heat stress levels are high and likely to further increase in the future. Based on IPCC climate model projections, over 90% of districts will experience severe heat stress conditions by 2100.
- The livelihoods of pig producers and sustainability of the pig sector as a whole is at risk.
- Sound adaptation strategies to heat stress will build a resilient and productive pig production sector.
- Stakeholders in the value chain must act to tackle the impending impacts of heat stress on pigs.
- Research on heat stress impacts can inform economic and livelihood policy options.

Policy Options

- Coordinate cross-sectoral policy cooperation at local and national level.
- Integrate action plans with development policies of key value chain nodes.
- Enhance risk assessment and surveillance through close research-policy cooperation and information sharing.
- Mainstream climate-induced heat stress adaptation into pig sector development initiatives and promote coping and adaptation measures at farm level.
- Accelerate investment and attention by public and private sectors and non-governmental organizations.

EXECUTIVE SUMMARY

Pig farming is important for income generation and nutrition for a large population in Uganda, with 4.2 million pigs being kept in 2017. However, future projections indicate that domestic pork production will not be sufficient to meet the increasing demand. This situation is likely to be aggravated by climate-induced heat stress. Analysis of historical climate data and simulation of future periods predicts a gradual shift towards more severe heat stress conditions experienced in most parts of the country. Animals experience heat stress when subjected to a series of conditions where the animal's body is overheating. Pigs are more vulnerable to heat stress because they do not have functioning sweat glands. Heat stress distorts the pigs' feed intake, growth and reproduction and makes pigs vulnerable to diseases. This, in turn, brings economic losses. In Uganda, smallholder pig production systems -which are the majority- are transitioning towards market-oriented models. However, to remain sustainable, adaptation of these systems to heat stress should be a priority. This policy brief synthesizes research findings on heat stress in pigs in Uganda, reviews proven interventions elsewhere, and concludes with evidence-based policy recommendations. Recommended policy options include prioritization of coordinated national & local level policy making and implementation, promoting heat stress coping and adaptation measures at farm level, action plans at various value chain stages, close research-policy cooperation and information sharing, and action and investment by donors and development organizations. If agricultural extension, policymakers and planners, and development donors and organizations leverage these options, pig farmers will be able to cope, adapt and mitigate heat stress in pigs and the pig production sector in Uganda will become more resilient.

Cambra pigs in their pens in Kazinga Village, Mukono, Uganda. Pig pens of this setup are more conducive to a more intensive system of pig management. ©Photo K. Dhanji/ILRI

BACKGROUND

Pig production is an important economic activity in Uganda. According to recent FAO statistics, pork is second to beef in terms of meat production (FAO, 2018). As of 2017, Uganda had approximately 4.2 million pigs (UBOS, 2019). In the year 2013, the country had the highest per capita consumption of pork in East Africa estimated at 3.4 kilograms per person per year (FAO, 2018). There are expectations of an intensifying pig sector in Uganda with farmers fast embracing exotic breeds such as Landrace and Large White, and cross breeds such Camborough (Tatwangire, 2013).

When heat from the sun adds to heat from the animals' body , the animal may 'overheat' - a situation called 'heat stress'. Heat stress occurs when the temperature of the pig at a given relative humidity exceeds the threshold for the normal functioning of the pig. Therefore, we have to ensure that pigs stay under comfortable conditions in terms of temperature and relative humidity. This combination of temperature and relative humidity is called temperature-humidity index (THI). Uganda's climate is changing and seasonal mean temperatures are increasing over the last 50 years. Average temperatures are projected to increase by 1 to 3°C by the 2060s, and 1.4 to 4.9 °C by the 2090s (McSweeney et al. 2007). Moreover, climate change will significantly increase humidity, magnifying the effects of environmental temperature. These climatic changes are projected to change the temperature-humidity index and thus the likelihood of heat stress being experienced by pigs.

Heat stress is a growing problem that impacts pig health, pork quality and quantity, and livelihoods. While periods of high temperatures can occur under current weather conditions, with climate change they become more severe, last longer and happen more frequently. When pigs are exposed to continuous heat stress, their bodies lose the ability to cool themselves effectively, resulting in low productivity, weakened immune systems and, at times, death. During heat stress, the average daily feed intake is low (about 1kg less feed than normal), leading to reduced weight gain and general growth. The pork from a heat-stressed pig is of poor quality. It is more fatty, less protein-rich, and has a lower shelf life. Pigs reared for breeding purposes are affected by heat stress because it leads to low libido, fertility, embryo survival, fetal growth and pregnancy rate.

> *When pigs are exposed to continuous heat stress, their bodies lose the ability to cool themselves effectively, resulting in low productivity, weakened immune systems and, at times, death.*

All these lead to higher losses and/or lower profits. Quantitative information on the impact of heat stress in terms of productivity and economic losses is missing in Uganda. For comparison, the estimated annual loss due to heat stress in the pig industry in the United States of America (USA) is $1 billion.

Uganda has laid out a plan towards adapting to climate change. The second National Communication to the United Nations Framework Convention for Climate Change (UNFCCC) in 2014 stressed the need to support agricultural research in coming up with technologies that address climate change issues, and to revise by-laws & ordinances to help communities efficiently adopt and implement the climate change adaptation measures. The National Adaptation Programme of Action (NAPA, 2007) aims at identifying priority activities to respond to the urgent needs of the country to adapt to climate change. Heat stress adaptation is in line with the nine prioritized intervention areas identified in the NAPA. As part of Uganda's efforts to address climate change and meet its obligations to the Paris Agreement, the country signed the Nationally Determined Contributions (NDCs) Partnership Plan. Some of the priorities in the NDCs Partnership Plan include strengthening; operational and gender-responsive policy and institutional frameworks for the effective governance of climate change, and the capacity of government officials, civil society, the private sector and academia to effectively integrate NDCs and Sustainable Development Goals (SDGs) commitments.

Priority should be given to updating development policies to include heat stress risk in pigs. Resources should be allocated for action plans to catalyse innovations towards resilient pig value chain.

The National Adaptation Plan for the agricultural sector (2018) aimed at supporting Uganda's process on integrating agricultural sector priorities and concerns into the overall Uganda NAPA with focus on crops, livestock, fisheries and the related sub-sectors. Priority should be given to updating development policies to include heat stress risk in pigs. Resources should be allocated for action plans to catalyse innovations towards resilient pig value chain. International, national, sector and local level stakeholders in the area of livestock and climate change adaptation should be involved in implementing the policies and strategies outlined above. The following shortcomings become evident: 1) piggery is not among the priority strategic commodities but usually included just for food and nutrition security of the population; 2) there are no existing specific pigs' heat stress policies, strategies and action plans at both national and local levels. 3) adaptation to climate-induced heat stress in pigs is not explicitly integrated into climate change adaptation measures. 4) where key stakeholders have made progress in joint development of related policies, strategies and plans, a gap still exists in joint implementation.

RESEARCH INSIGHTS

Mapping heat stress risk

Recent spatial analysis (Mutua *et al.* 2020) highlights hotspot areas in Uganda where heat stress could significantly affect pig production. Heat stress risk is already high and likely to increase further in the future. In the study, it is observed that most of north-western Uganda already experiences heat stress conditions. On average, the frequency of severe heat stress conditions ranges from 10 per cent (~37 days/year) in the southern to more than 50 per cent (~183 days/year) in the northwestern parts of the country. Currently, the likelihood of exposure to heat stress is high in December, January, February and March. The impact of climate change is evident with more areas exposed to heat stress in the future. Based on model projections, severe heat stress conditions will be dominant all throughout the country with over 90 % of the districts experiencing severe heat stress conditions by 2100. Results show that more than 800,000 pigs in Uganda are likely to be affected by heat stress by 2100 if no action is taken.

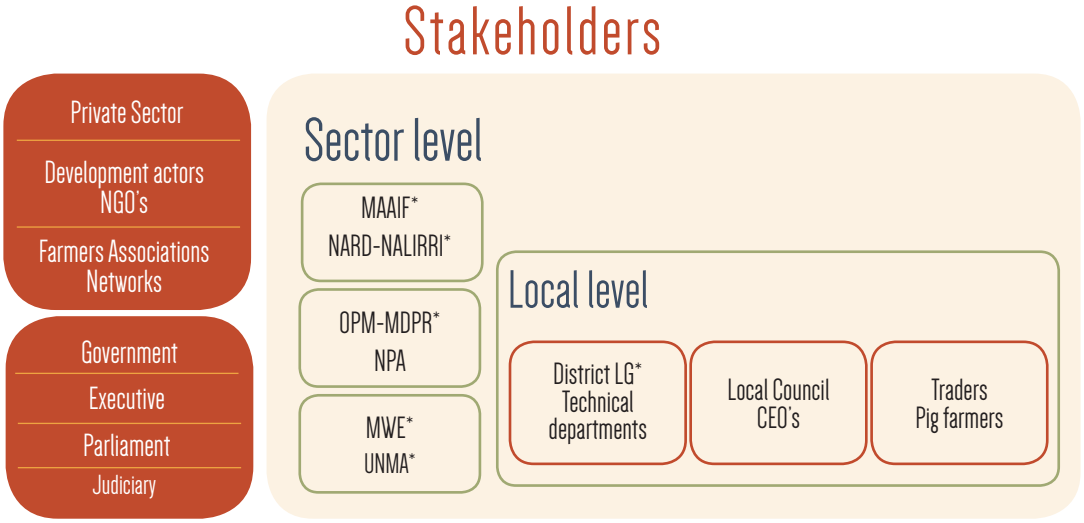

Figure 1: NGOs - Non-Government Organizations; MAAIF - Ministry of Agriculture, Animal Industry and Fisheries; NARO - National Agricultural Research Organization; NALIRRI - National Livestock Resources Research Institute; OPM - Office of Prime Minister; Ministry of Disaster Preparedness and Refugees; NPA - National Planning Authority; MWE - Ministry of Water and Environment; LG - Local Government; CBOs - Community Based organizations

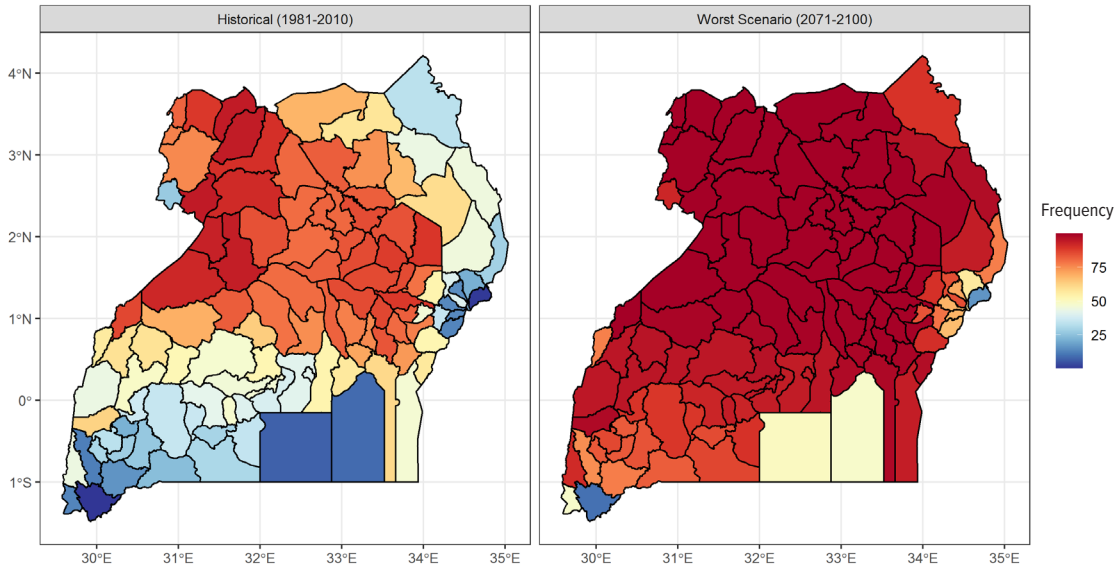

Figure 2: Frequency of severe heat stress conditions during the historical (1981-2010) and future (2071-2100) periods for pigs in Uganda.

Heat stress risk factors

Heat stress management in pigs needs an understanding of factors that contribute to heat stress. The three factors that contribute to heat stress are climate, management and pig characteristics. Climate factors that affect heat stress in pigs include air temperature and humidity, which are used to calculate the THI. The main management factor that contribute to heat stress is free-range pig management which expose pigs to solar radiation and makes it difficult to implement preventive heat stress measures. Pigs that are at greater risk of heat stress include those that are older, lactating, dark in color, over weight, on free range, exotic breed and pregnant, which usually have a high metabolism rate (see Figure 3). Therefore farmers should pay particular attention during periods of high THI, and to pigs that are at higher risk, e.g. pigs that are older, pregnant, lactating, under free-range management.

Effects of heat stress

The effects of heat stress on the pig value chain are graded from moderate through major to severe. They span across all stages of the pig value chain, impact all value chain actors, and affect both men & women (see Table 1).

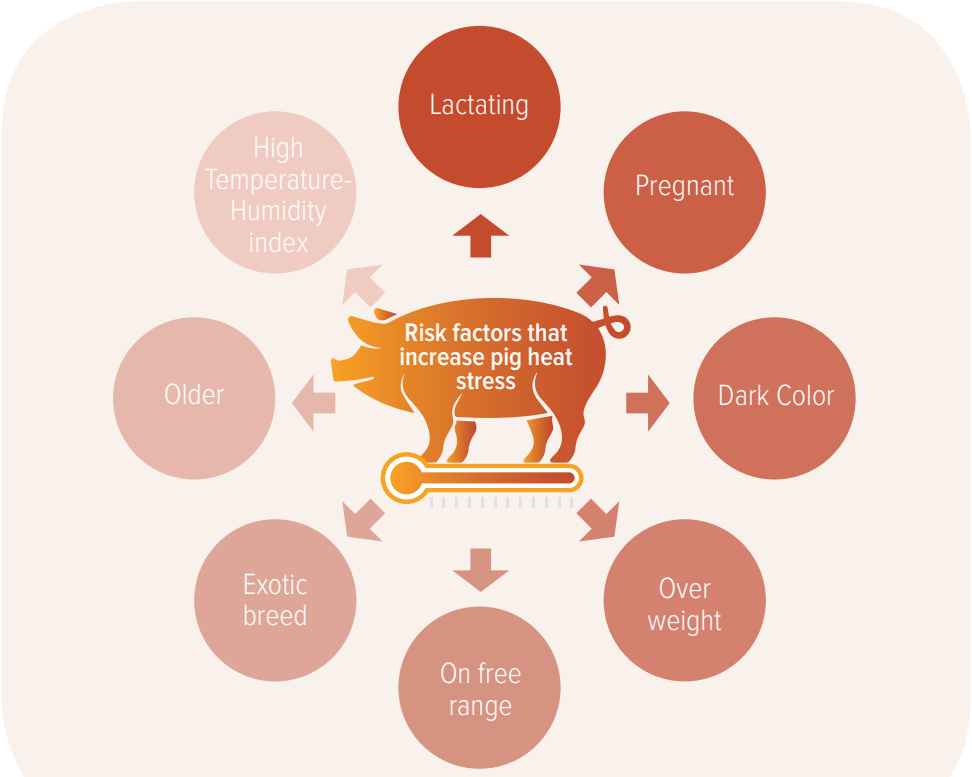

Figure 3: Risk factors that increase pig heat stress

Table 1: Effects of heat stress in the pig value chain activities in Uganda

STAGE	CONSEQUENCE	SEVERITY	WHO IS IMPACTED
INPUT SUPPLY	Heat stress affects the design of the structure	Major	
	Causes water and feed scarcity and increases their cost and/or price	Major	
	Increased cost of research while innovating	Moderate	
	Affects fertility of semen (affects the boer, sow and quality of semen)	Major	
ON - FARM PRODUCTION	More diseases and thus increased costs of treatment (as well as high mortality rates)	Severe	
	Low feed intake leading to slower growth	Severe	
	Bacteria multiplication in hot environment, high costs on cleaning, high greenhouse gas emissions specifically methane (CH_4)	Major	
TRANSPORT	Change in transportation patterns from day/hot times to night/cool times, increased cost of transportation, increased mortality during transportation	Severe	
	Low pig numbers, increased cost to provide for shade, added water costs	Major	
OUTPUT MARKET	Reduced volume of trade, high transaction costs	Severe	
	Affects quality of pork product, low shelf life	Moderate	
	Increased cost of enforcement of existing laws	Major	

How to cope and adapt

Like most coping and adaptation strategies in animals, adaptation to heat stress in pigs starts with modifying the environment (J. Mutua, Zaake, & Paul, 2020; P. Zaake, 2019; Paul. Zaake et al., 2018). These strategies are flexible, easier to promote and modify in line with the local context, and can be done instantly. Adaptation strategies enable mitigation of heat stress in the long term but it requires a collective effort by stakeholders.

Farmer in Lira pouring water on the pig to cool it ©Paul Zaake/CIAT.

Table 2: Ongoing and potential adaptation to heat stress in the pig value chain in Uganda

STAGE	ONGOING	POTENTIAL
INPUT SUPPLY	Community water management committees for sustainable use of the water resources	More farm-based water points
	Increased investment by the government in water for production, policy diversification to solar use	Private sector investment and public-private partnerships in water for production
	Farmers adopting intensive management practices specifically by constructing pigsty	Research on appropriate pigsty infrastructure designs
	Provision of general extension services	Recruitment of specialized extension staff
ON - FARM PRODUCTION	Capacity development for farmers	Strengthen farmer-extension - research linkage
	Promotion of tolerant varieties and conservation of feeds	Emphasize capacity building among smallholders on feed conservation,forage/feed diversification
	IMO technologies	More research and capacity development in imo
TRANSPORT	Transport moving pigs during the day	Capacity building for transporters and policymakers to understand the benefits of moving pigs at night and cool hours of the day
	Holding under shades	Research for appropriate transportation facilities and measures
OUTPUT MARKET	Increased establishment of pig market associations, and farmer trade relations	More awareness of climate change Information knowledge exchange with the pig market actors
	General slaughtering of pigs on unspecialised slaughter facilities.	Increased innovation by private sectors for appropriate structures/ abattoirs countrywide
	Minimal slaughtering of pigs on pig abattoirs especially in urban and peri-urban centres	Research on improved design for slaughtering facilities
	Implementation of animal movement and certification, several animal checkpoints along routes	Review of regulation to consider appropriate/cool times to move pigs during day and night Research on the appropriately designed trucks for pig transportation
	Small scale product processing	More research and technological innovation to improve products

POLICY RECOMMENDATIONS

In the face of climate change, pig farmers must adapt to heat stress. Policymakers have an opportunity to leverage available and new strategies for coping and adaptating to heat stress. Broad support for the adoption of coping and adaptation strategies by all stakeholders will help government and private actors meet the development goal of sustainably empowering farmers and improving their income.

1. Mainstream climate-induced heat stress adaptation into pig sector development initiatives and promote coping and adaptation measures at farm level.
    i. Community awareness about heat-stress in pigs should be increased and information about best practices for coping, adapting or mitigating shared so that they can act accordingly.
    ii. Existing extension structures should teach farmers to easily identify heat-stressed pig for heat stress management and mitigation purposes respectively.
    iii. Strengthen community-based initiatives, including women groups (since most pig farmers are female), to develop support programmes and sharing of information about low-cost coping and adaptation techniques and technologies.
    iv. Government and other development actors should prioritise support (technical, financial, and material) in improving pigsty designs using low-cost measures, particularly those aiming at improving natural ventilation, insulation and reducing exposure to solar radiation.
    v. Promote planting and maintainance of trees at farms to create a suitable microclimate for heat stress mitigation in pigs.
2. Integrate action plans with development policies of key value chain nodes.
    i. Due to the vulnerability of pigs to heat stress, a change in animal transport policy is recommended since it is best to avoid transporting pigs in hot conditions (heat-stress peak hours). Transportation of pigs should be rescheduled in the cool hours of the day or night.
    ii. Transporters should use appropriately designed vehicles. These should be well-ventilated, watered, and covered to allow air circulation, cooling, and mitigate exposure to direct solar radiation.
3. Close research-policy cooperation and information sharing
    i. Stakeholders,including government, private, researchers, academics, farmers , should collaborate and engage in multi-disciplinary participatory research activity, as well as data and information sharing.
    ii. Establishment of heat-stress surveillance mechanisms to monitor heat stress events (present and future), effects, and impacts. Government agencies should be more involved in heat stress monitoring.
4. Coordinate cross-sectoral policy cooperation at local and national level.
    i. Heat stress risk should be included in development policies and action plans should be integrated into resource allocation and activities for respective departments.
    ii. Climate policies and practices should incorporate gender mainstreaming in adaptation to heat stress. Adaptation strategies should be informed by the differences in responsibilities and contributions of men, youth and women along the value chain.
    iii. The departments responsible for water supply at the Ministry of Water and Environment should continue to invest in infrastructure for effective water distribution to address the water scarcity issue among pig farmers.
5. Accelerate investment and attention by public and private sectors and non-governmental organizations.
    i. Heat stress management strategies and actions require informed investment to catalyze innovations aimed at embedding resilience in current pig production systems.

Pigs should be kept in well designed pigsty that allows air circulation ©Photo K. Dhanji/ILRI

A grill at a pork joint (restaurant) in Mukono, Uganda. The pig sector plays an essential economic and social role in the country, with total pork consumption projected to increase by 184% between 2000 and 2030 in Uganda (FAO 2011). Meeting the food and livelihood needs of Uganda's growing population is of key importance. ©Photo K. Dhanji/ILRI

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ACKNOWLEDGEMENTS

We thank Dr. Deogracious Wonekha, Senior Veterinary Officer Dairy, Ministry of Agriculture, Animal Industry & Fisheries and Mr. Senyonga Derrick, Senior Climate Change Officer, Ministry of Water and Environment whose comments helped improve and clarify this policy brief. This research was conducted as part of the CGIAR Research Program on Livestock and is supported by contributors to the CGIAR Trust Fund.

REFERENCES

FAO. (2018). Food and agriculture organization of the United Nations statistical databases. Retrieved September 20, 2019, from http://faostat.fao.org

McSweeney, C., New, M., & Lizanco, G. (2007). *Climate Change Country Profiles: Uganda*. Oxford: United National Development Programme.

Mutua, J. Y., Marshall, K., Paul, B. K., & Notenbaert, A. M. O. (2020). A methodology for mapping current and future heat stress risk in pigs. *Animal*, 1–9. https://doi.org/10.1017/S1751731120000865

Mutua, J., Zaake, P., & Paul, B. (2020). *Workshop report: Heat Stress Assessment Stakeholder Consultation in Uganda*. Retrieved from https://hdl.handle.net/10568/107882

Tatwangire A. (2013). *Uganda smallholder pigs value chain development: Situation analysis and trends.* Nairobi, Kenya: International Livestock Research Institure.

UBOS. (2019). *Statistical Abstract 2019*. Kampala, Uganda: Uganda Bureau of Statistics.

Zaake, P. (2019). *An assessment of heat stress status in pigs and adaptation options in lira district Uganda*. Retrieved from https://hdl.handle.net/10568/99515

Zaake, Paul., Paul, B., Marshall, K., Notenbaert, A., Ouma, E., Dione, M., … Ndambi, A. (2018). *Report and outputs on pig heat stress research in Lira District, Uganda*. Retrieved from https://hdl.handle.net/10568/99217

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