RESEARCH PROGRAM ON Livestock

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

Birthe K. Paul, John Y. Mutua, Paul Zaake, An Notenbaert (Alliance of Bioversity and CIAT)

Deogracious Wonekha (MAAIF), Derrick Senyonga (MWE)

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ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

Alliance Bioversity CIAT

MAAIF Ministry of Agriculture Animal Industry and Fisheries

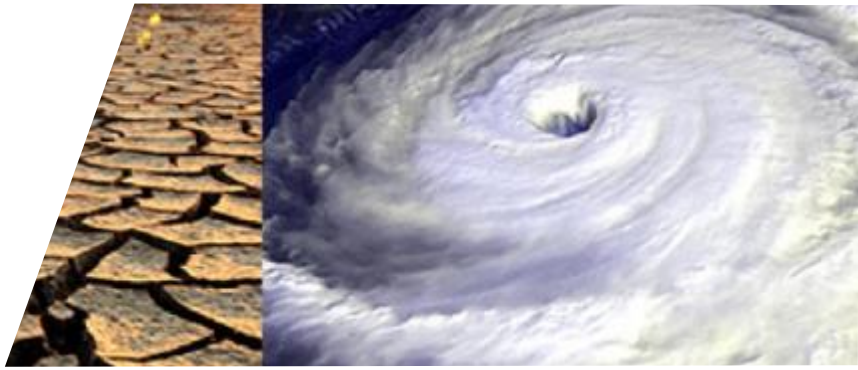
MINISTRY OF WATER AND ENVIRONMENT REPUBLIC OF UGANDA

CGIAR RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security

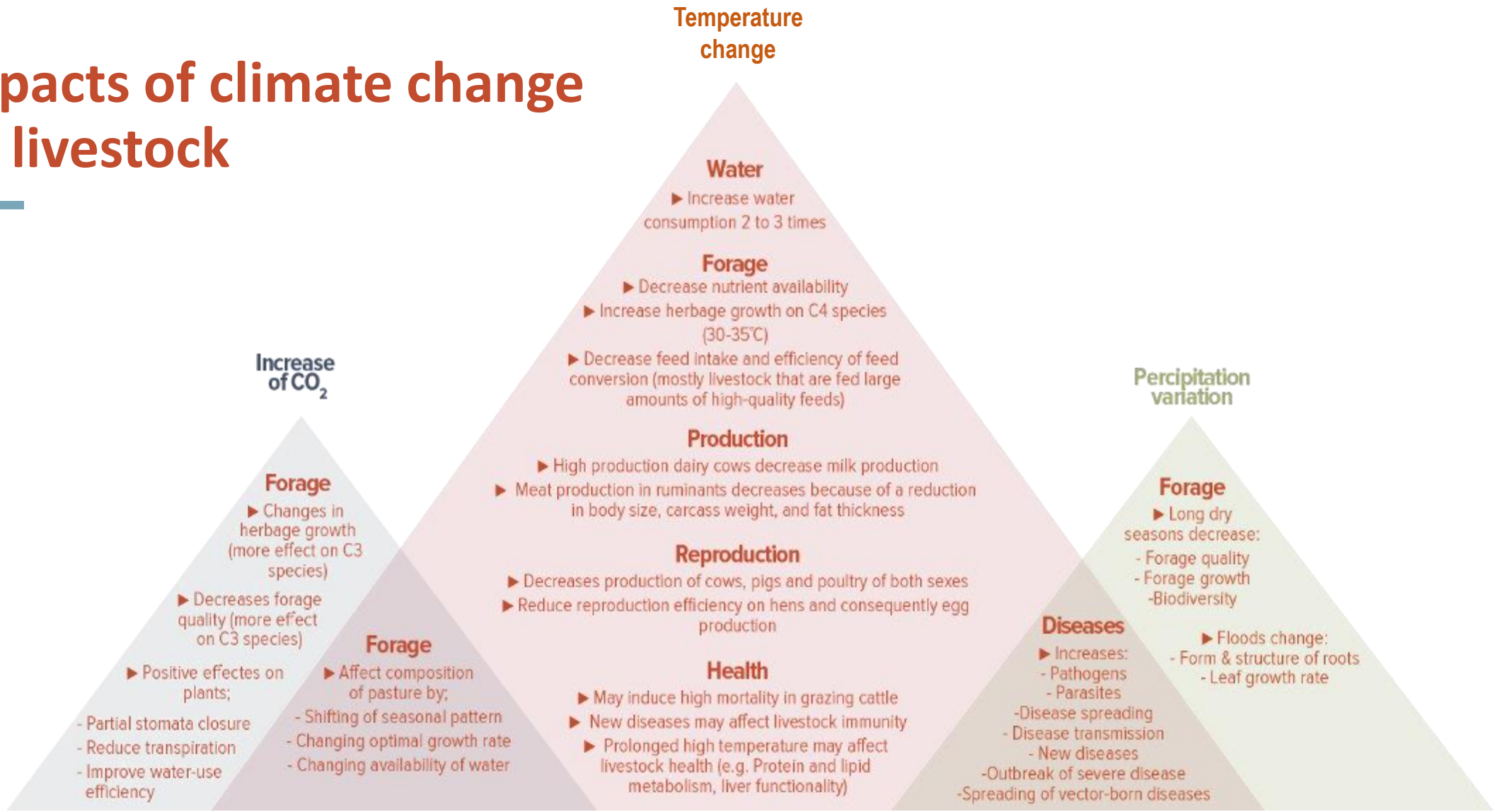
CCAFS

Climate change

- Rising temperatures
- Increase in heavy precipitation and humidity
- Increase in hunger and water crises
- Health risks due to rising temperatures and heatwaves
- Increasing spread of pests and pathogens



Impacts of climate change on livestock



Adapted from: Rojas-Downing MM, Nejadhashem AP, Harrigan T and Woznicki SA 2017. Climate change and livestock: impacts, adaptation, and mitigation. Climate Risk Management 16, 145–163.

Pigs are especially affected by heat stress

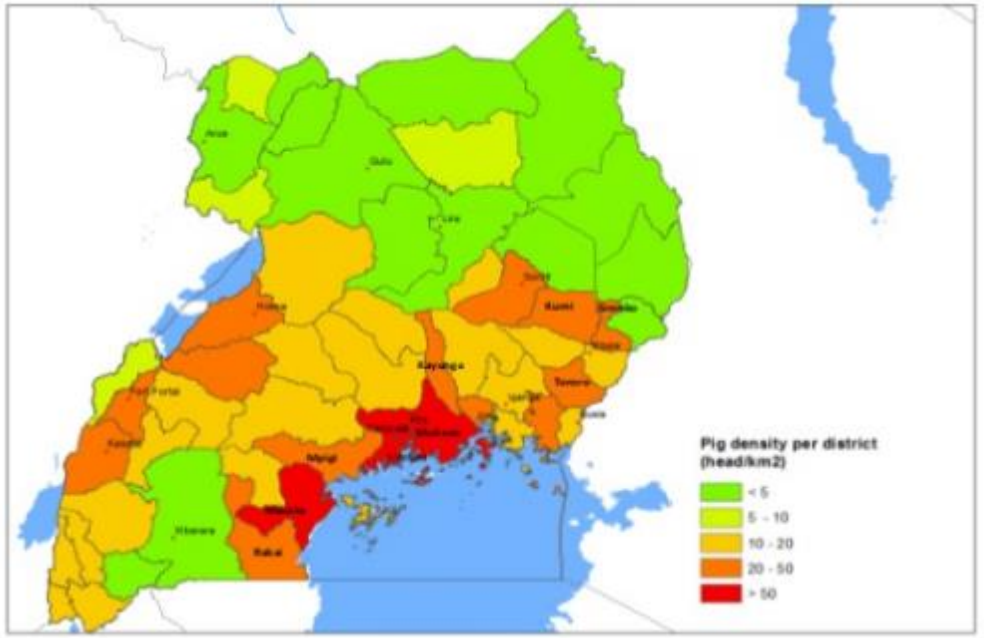
- Heat stress occurs when an animal ‘overheats’, thus the temperature of the pig exceeds the threshold for the normal functioning of the pig
- Pigs are vulnerable to heat stress as they have small lungs and lack of sweat glands so physiologically less ability to cool themselves effectively
- Various factors have been shown to increase likelihood of heat stress, including breed, management system and physiological state

With climate change and adoption of cross-breeds, heat stress exposure likely to increase

Smallholder pig production is key in Uganda

- Pig sector contributes 15% of the agricultural GDP; source of livelihood to about 4.5 million people in the country (MAAIF, 2011)
- Uganda has about 3.5 million pigs (ILRI, 2013) reared by about 1.1 million small scale farmers (MAAIF, 2011)
- Pig is second to beef in terms of meat production (FAO, 2011).
- Uganda has highest per capita consumption of pork in East Africa estimated at 3.4 kilograms/person/year as of 2013 (FAO, 2018)
- Farmers fast embracing exotic such as Landrace and Large White and cross breeds such as Camborough

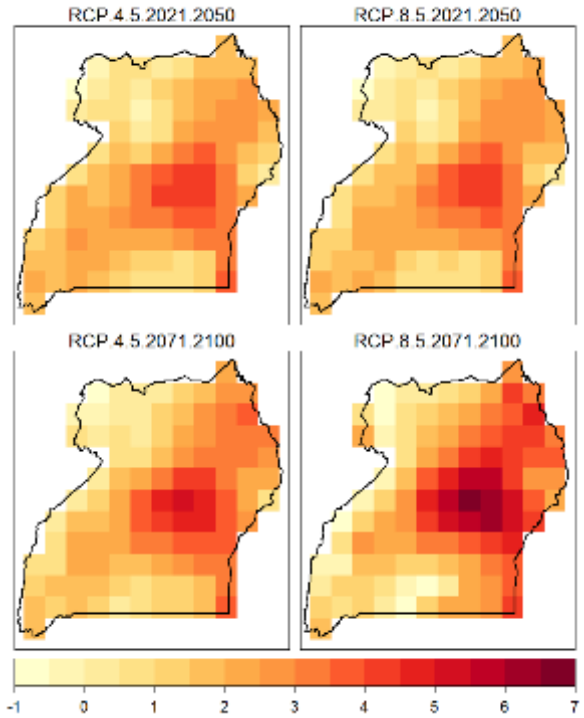
Pig density per district in 2008



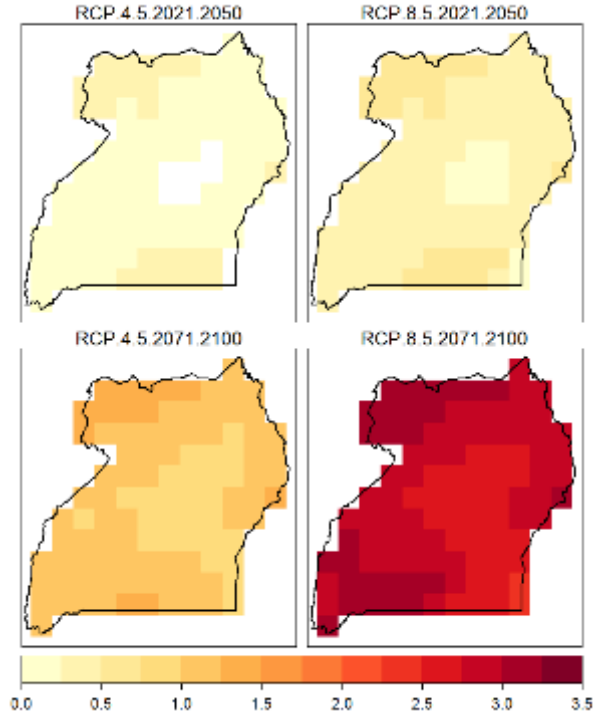
Source: UBOS, 2008

Climate change in Uganda

Change in humidity

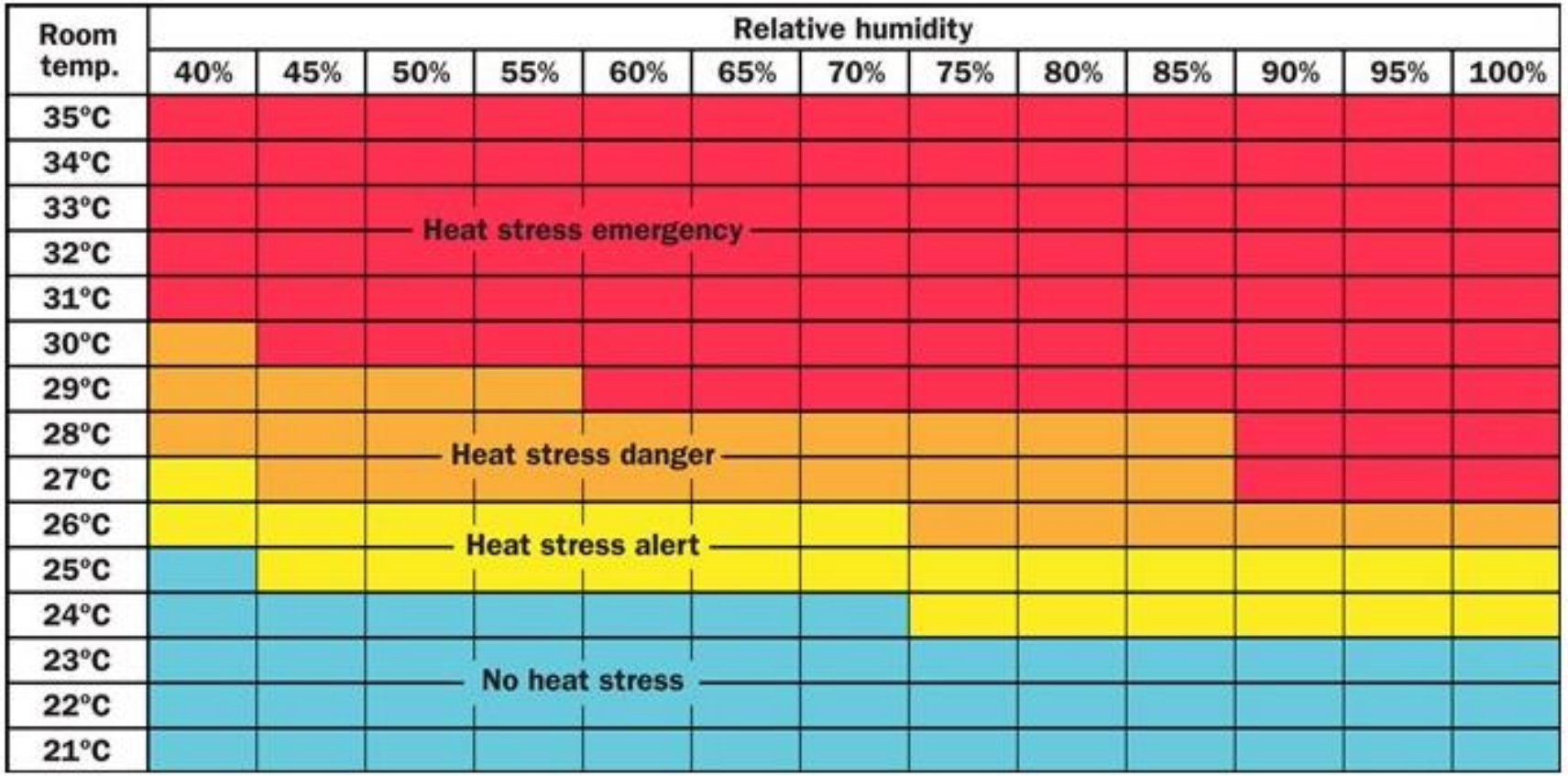


Change in temperature



- State of the art climate modelling techniques have enabled us to look at the historical as well as the future periods
- Seasonal mean temperatures have increased over the last 50 years
- Future climate simulations are based on two representative concentration pathways (RCPs): 4.5 (intermediate) and 8.5 (pessimistic) scenarios
- By 2100 maximum temperature is expected to increase by 1.5 and 3.5°C
- By 2100 relative humidity is expected to increase by 4 and 7% based on RCP 4.5 and RCP 8.5 scenarios respectively

Temperature Humidity Index (THI)



- Heat stress chart developed for growing-finishing pig by University of Iowa
- Combination of temperature and humidity that determines heat stress
- It is the best available and the use of it in Uganda gives a good indications of where problems are likely to occur, especially in intensifying systems
- Chart used as basis for spatial analysis

Adapted from Xin and Harmon (1998). Livestock Industry Facilities and Environment: Heat Stress Indices for Livestock. Agriculture and Environment Extension Publications. 163. http://lib.dr.iastate.edu/extension_ag_pubs/163

THI thresholds and response in pigs

Category	Swine	Response
None	THI ≤ 74	i. Both productive and reproductive performance are optimum
Mild	74 < THI ≤ 78	i. Livestock body is able to control the heat stress by chemical and physical means. ii. Livestock seek for shade. iii. Increase in their rectal temperature, respiration rate. iv. Dilation of blood vessels
Moderate	78 < THI ≤ 83	i. Body temperature would increase and productive/reproductive performances are expected to be severely affected. ii. Respiration rate would significantly increase. iii. Dry matter intake and ratio of forage to concentrate intake is expected to decrease. iv. Water intake would significantly increase.
Severe and Danger	THI > 83	i. Respiration and excessive saliva production would increase. ii. The productive/reproductive performances will significantly decrease. iii. Rumination and urination will decrease. iv. In extreme cases, the stress would be significantly extreme and livestock may die.

Heat stress science and projections

- Recently published spatial analysis 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. Most of north-western Uganda already experiences heat stress conditions, and the likelihood of exposure to heat stress is high throughout the country from Dec - Mar
- 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
- 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

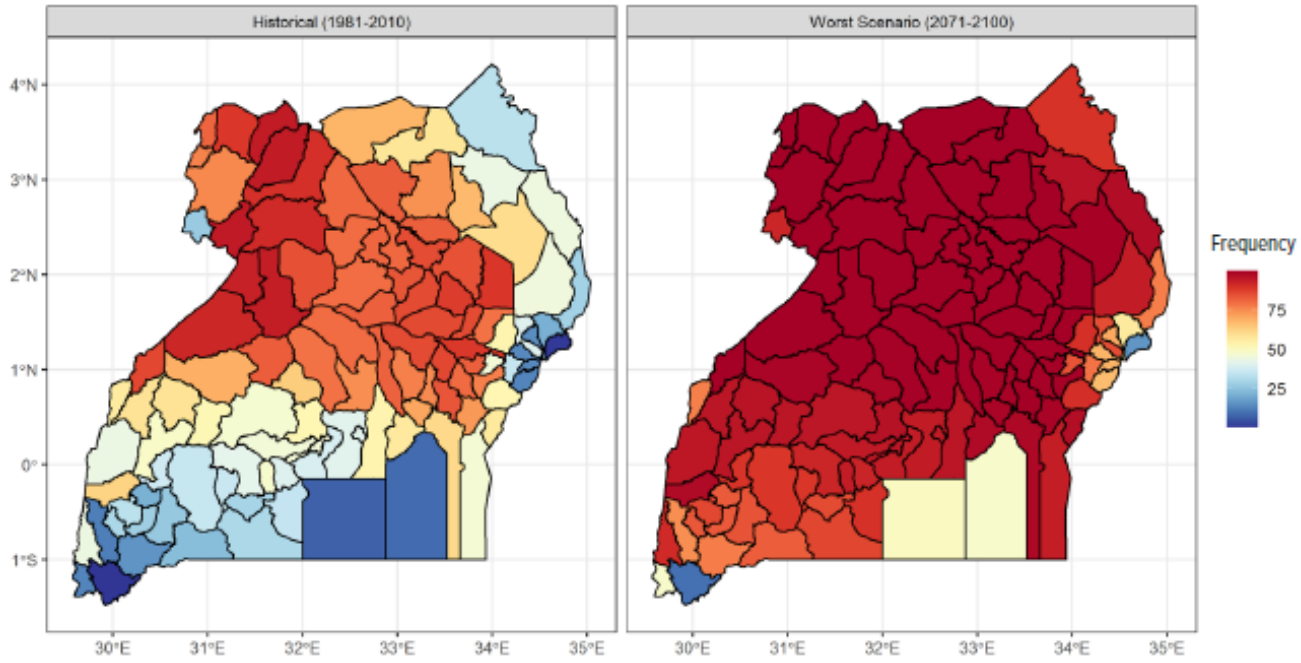
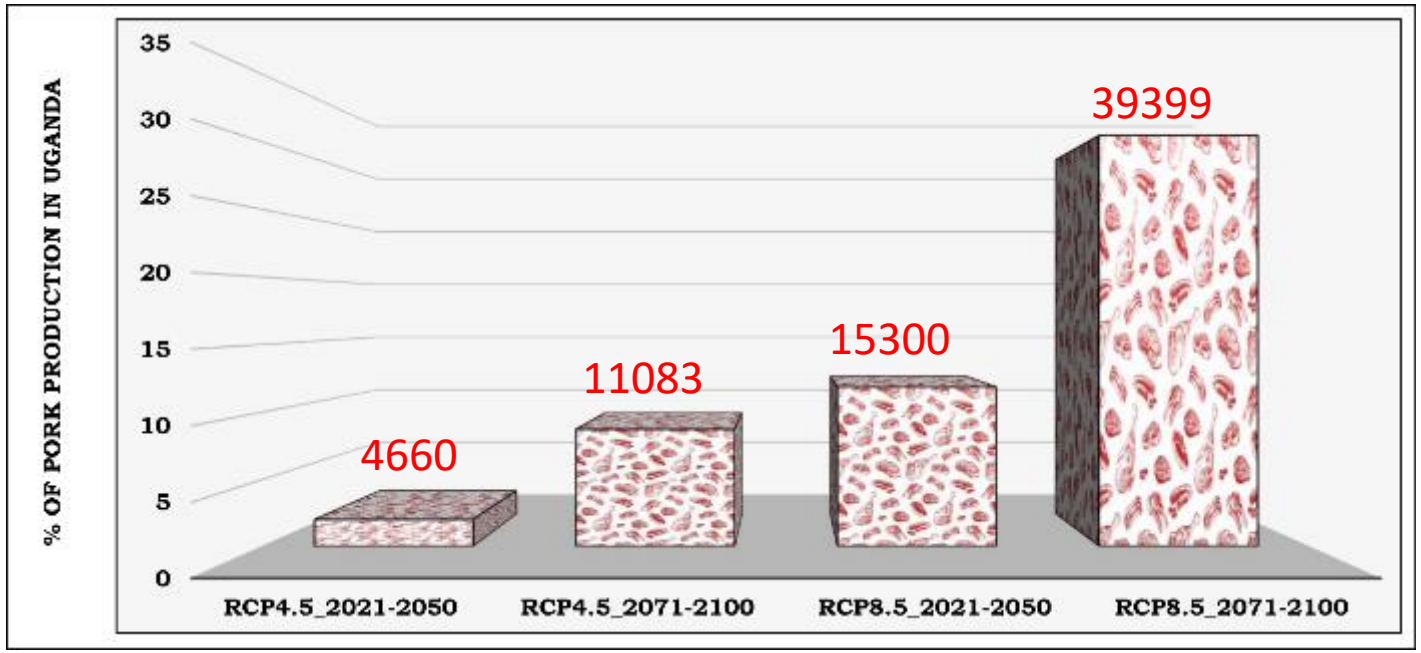


Figure 2: Frequency of severe heat stress conditions during the historical (1981-2010) and future (2071-2100) periods for pigs in Uganda.

Mutua, J.Y., Marshall, K., Paul, B.K., Notenbaert, A. (2020). A methodology for mapping current and future heat stress in pigs. Animal, 14 (9).

Potential repercussions for pig sector in Uganda



Units: tons; Source FAO 2018

- Heat stress will lead to higher losses and/or lower profits
- However, 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

Current pork production in Uganda which will be significantly challenged by increasing frequency of heat stress

Mutua, J., Zaake, P., Paul, B. (2020). Heat stress assessment stakeholder consultation workshop. CIAT report, 16p.

Who is at risk?

- Output from stakeholder workshop in February 2020 in Kampala
- The effects of heat stress on the pig value chain are graded from moderate through major to severe
- Risks span across all stages of the pig value chain from input supply to on-farm production, transport and output market
- All value chain actors and men, women and youth are impacted

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	

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Adaptation solutions: What can be done?

- Coping strategies are flexible, easy to promote and modify in line with the local context, and can be done instantly – much already ongoing along the value chain
- Adaptation strategies enable mitigation of heat stress in the long term but it requires a collective effort by stakeholders – potential to step up action

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

STAGE	ONGOING	POTENTIAL
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

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Stakeholder and policy landscape

Uganda has put a set of policies and plans in place to support climate change adaptation

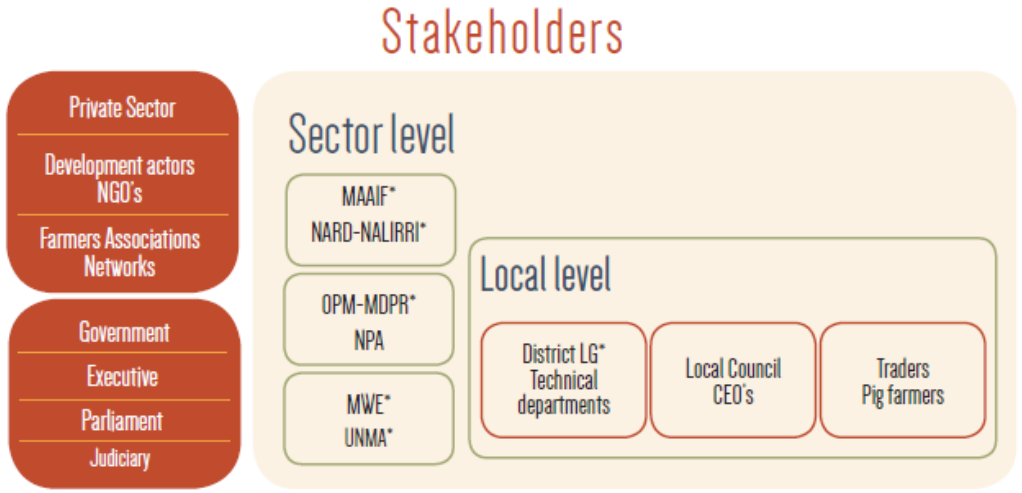

Figure 1: NGOs - Non-Government Organizations; MAAIF - Ministry of Agriculture, Animal Industry and Fisheries; NARO - National Agricultural Research Organization; NALIRRI - National Livestock Resources Research Institute; OPM - Office of Prime Minister; Ministry of Disaster Preparedness and Refugees;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

- The **National Adaptation Programme of Action (NAPA, 2007)** prioritizes nine intervention areas to respond to the urgent needs of the country to adapt to climate change
- Uganda signed the **Nationally Determined Contributions (NDCs) Partnership Plan** to meet its obligations to the Paris Agreement. Priorities 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
- 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 adapt
- **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

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Challenges remain

1. Piggery is often not among the priority strategic commodities
2. Adaptation policies, strategies, action plans and measures at both national and local levels do not specifically refer to mitigating climate-induced heat stress in pigs
3. Where key stakeholders have made progress in joint development of related policies, strategies and plans, a gap still exists in joint implementation

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Policy options for concerted action of all stakeholder

Policymakers have an opportunity to leverage available and new strategies for coping and adapting to heat stress

Broad support for the adoption of coping and adaptation strategies by all stakeholders will help to meet the development goal of sustainably empowering farmers and improving their income

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Production level options

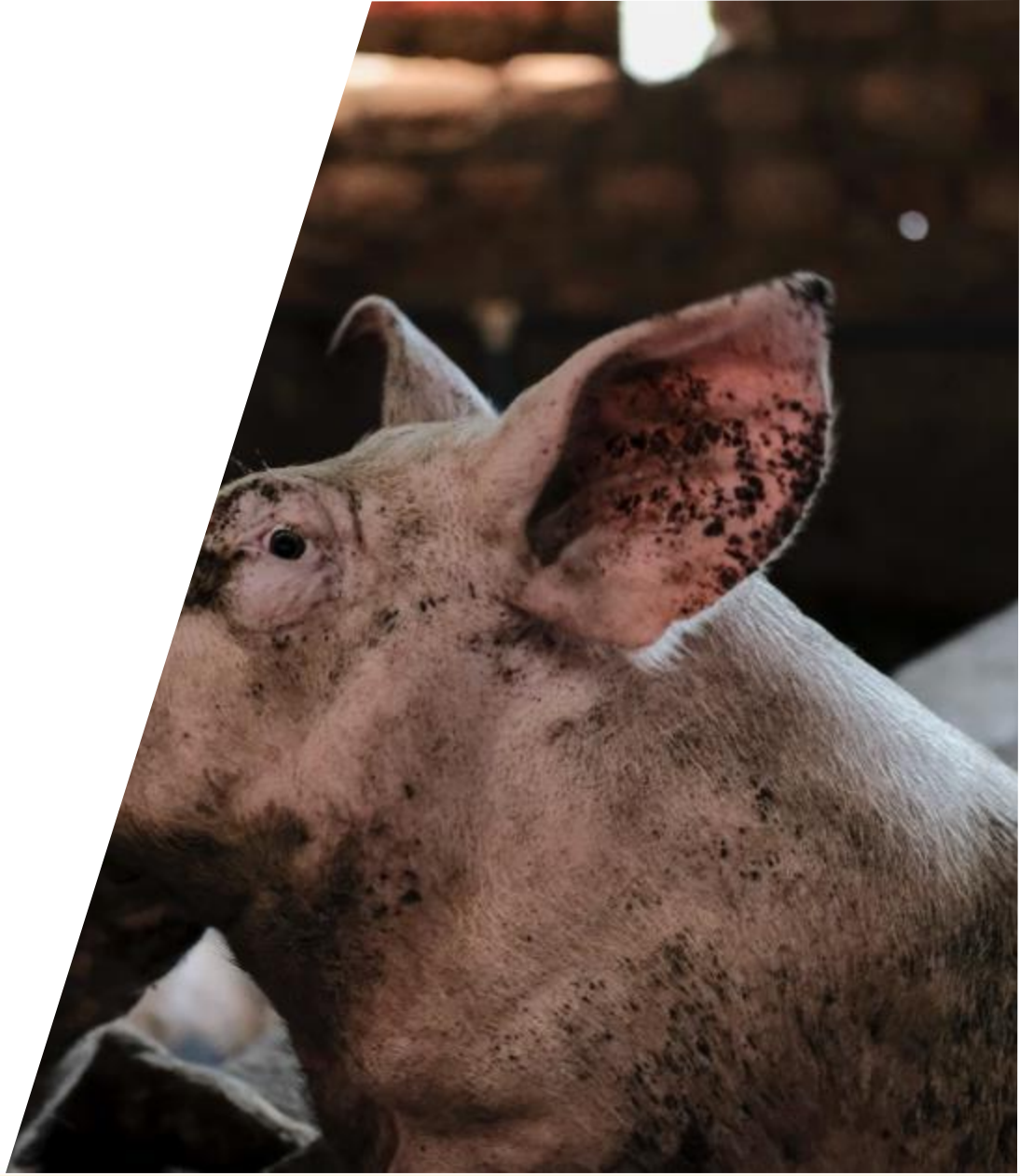
Mainstream climate-induced heat stress coping and adaptation into pig sector development initiatives at farm level

- ✓Community awareness about heat-stress in pigs should be increased, and capacity building on best practices for heat stress identification, coping, adapting or mitigating accelerated through existing extension services
- ✓Strengthen community-based initiatives, including women groups (since many pig farmers are female), to develop support programs and sharing of information about low-cost coping and adaptation techniques and technologies
- ✓Government and other development actors should prioritize support (technical, financial, and material) in improving pigsty designs using low-cost measures that improve natural ventilation, insulation and reducing exposure to solar radiation, and promote planting and maintenance of trees at farms to create a suitable microclimate for heat stress mitigation in pigs

Value chain level options

Integrate action plans with development policies of key value chain nodes

- ✓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 could be rescheduled in the cool hours of the day or night
- ✓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



Research options

Close research-policy cooperation and information sharing

- ✓Stakeholders, including government, private, researchers, academics, farmers , should collaborate and engage in multi-disciplinary participatory research activity, as well as data and information sharing
- ✓Establishment of heat-stress surveillance mechanisms to monitor heat stress events (present and future), effects, and impacts. Government agencies can be involved in heat stress monitoring

Policy options

Coordinate cross-sectoral policy cooperation at local and national level

- ✓Heat stress risk should be included in development policies and action plans to allow for resource allocation and activity implementation for respective departments
- ✓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
- ✓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

Investor options

Accelerate investment and attention by public and private sectors and non-governmental organizations.

- ✓ Heat stress management strategies and actions require informed investment to catalyze innovations aimed at embedding resilience in current pig production systems

Key take-home messages

- ✓ Pigs are especially vulnerable to heat stress due to their physiological characteristics
- ✓ Climate-induced heat stress reduces pig growth, reproduction and health and may cause animals to die – heat stress is among the most severe expected impacts of climate change on livestock
- ✓ Risk factors that increase heat stress include breed, management system and physiological stage
- ✓ Model predictions point to an increase of 1.5-3.5°C in temperature and 4-7% in relative humidity in future
- ✓ Heat stress levels are high and likely to further increase in the future - based on climate model projections, over 90% of districts will experience severe heat stress conditions by 2100
- ✓ 30% (39,000 tons) of current pork production is under threat due to heat stress in future based on pessimistic scenario (RCP 8.5)
- ✓ Risks span across all stages of the pig value chain from input supply to on-farm production, transport and output market – with men, women and youth affected differently
- ✓ Uganda has put a set of policies and plans in place to support climate change adaptation, supported by various stakeholders, but challenges remain
- ✓ Policy options for concerted action by all stakeholders are available

More to read

- A methodology for mapping current and future heat stress risk in pigs | animal | Cambridge Core
- Heat stress assessment stakeholder consultation in Uganda: Workshop report (cgiar.org)
- An assessment of heat stress status in pigs and adaptation options in lira district Uganda (cgiar.org)
- Report and outputs on pig heat stress research in Lira District - Uganda (cgiar.org)
- Reducing climate-induced heat stress in pigs in Uganda: Policy actions (cgiar.org)

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The **CGIAR Research Program on Livestock** aims to increase the productivity and profitability of livestock agri-food systems in sustainable ways, making meat, milk and eggs more available and affordable across the developing world.

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