

Heat stress and productivity in lactating Vietnamese household dairy cows

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Vietnamese dairy production

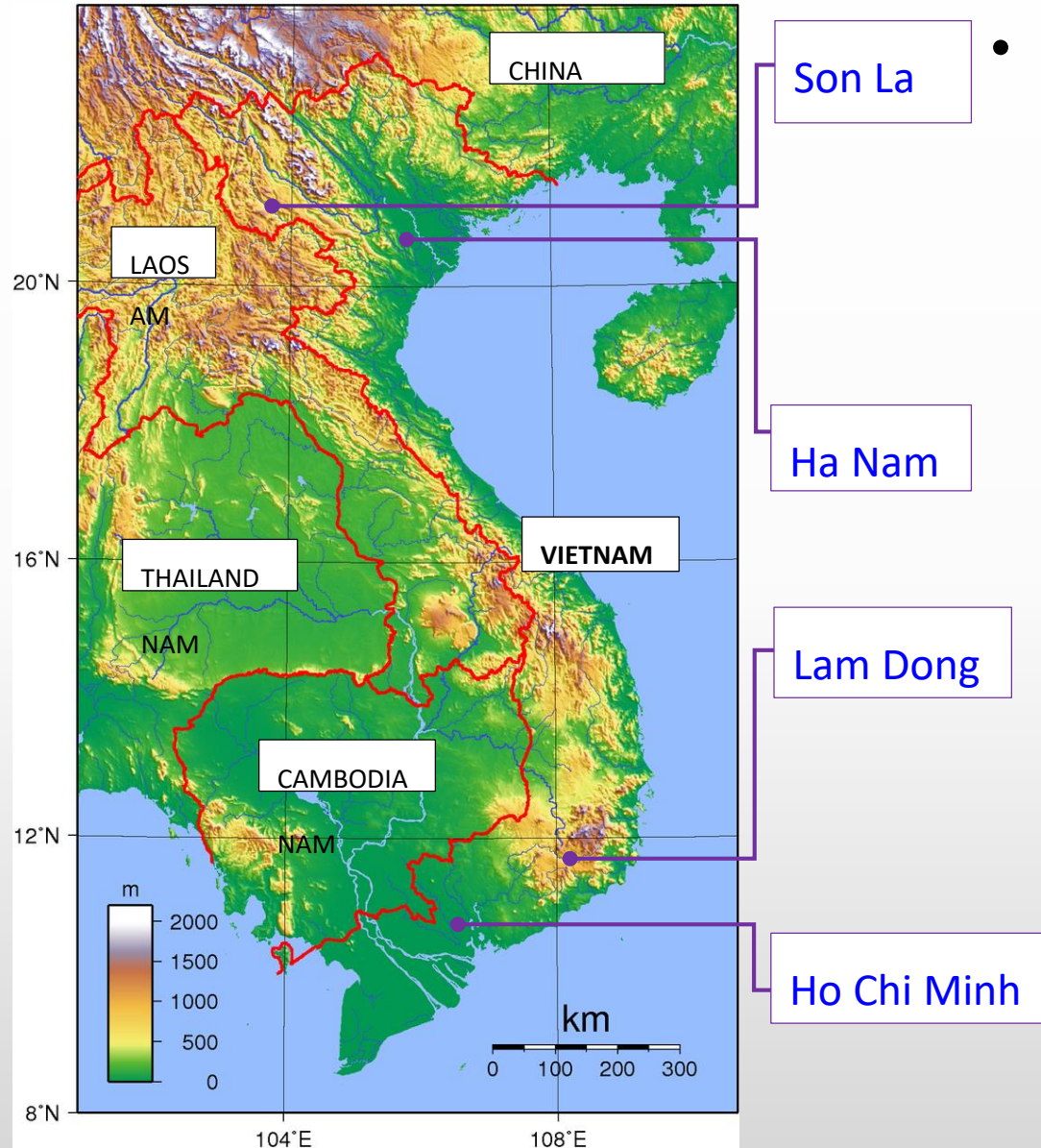


- Tropical climate -> Too hot for dairy cows
- Majority of farms are small, “household dairy farms” (HDF) and produce > 80% of Vietnam’s fresh milk
- Cows are always kept indoors, mainly Holstein Friesian genetics
- <20 cows per farm and low yield, 16 L/cow/day

What limits milk production the most, diet or heat stress?

Methodology

- August to October 2017 (Autumn)



Topographic map of Vietnam mainland and study sites.

Characteristics	Region			
	Son La (SL)	Ha Nam (HN)	Lam Dong (LD)	Ho Chi Minh City (HCM)
Location	North	North	South	South
Altitude (m)	600-700	2-70	800-1000	0.5-25
THI	70.0	73.5	65.6	78.3
Experience (years)	14	4	11	11

Region	THI during a year											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SL	60,7	64,4	68,3	72,6	74,7	75,6	75,2	74,9	73,8	70,9	66,7	61,9
HN	62,9	65,7	68,6	74,0	78,6	81,2	80,9	79,8	78,3	75,6	71,2	65,6
LD	62,4	63,5	65,3	66,8	67,6	67,3	66,7	66,6	66,4	65,8	65,2	63,5
HCM	75,6	76,2	78,1	80,1	80,3	79,6	78,8	79,0	78,6	78,5	78,3	76,9

THI	<68	68-71	72-79	80-89
Meaning for the cows	Normal	Stress threshold	Mild-moderate stress	Moderate-severe stress
Colour				

Methodology

- August to October 2017 (Autumn)
- Visit 32 farms (each region 8 farms): afternoon + next morning
- Weigh all feed types and subsample for chemical analysis (29 samples)
- Weigh morning and afternoon milk yield of each cows and sample milk: 690 milk samples from 346 lactating cows
- Estimate cow body weight by tape



Methodology

- Shed dimensions: length, width, height
- Number of fans
- Estimate percentage of side open of the shed
- Weather data inside the shed, 7 times per day
- Panting score (scale: 1 - 4.5)
- Vulva temperature using an infrared thermometer



Methodology

- How to score panting

Panting score	Breathing condition
0	No panting
1	Slight panting, mouth closed, no drool, easy to see chest movement
2	Fast panting, drool present, no open mouth
2.5	As for 2, but occasional open-mouth panting, tongue not extended
3	Open mouth and excessive drooling, neck extended, head held up
3.5	As for 3 but with tongue out slightly and occasionally fully extended for short periods
4	Open mouth with tongue fully extended for prolonged periods plus excessive drooling, neck extended, and head up
4.5	As for 4 but head held down, cattle “breathe” from flank, drooling may cease



- Data analysis

ANOVA and Kruskal Wallis for comparisons between regions. Choosing variables for regression analysis based on variance inflation factor ($VIF < 3$). Bayesian Average Model for choosing final Multivariate Regression Models.

Typical cow performance per region

Parameters	HCM mean (SD)	LD mean (SD)	HN mean (SD)	SL mean (SD)
Energy corrected milk yield (kg/cow/day)	13.06 ^b (1.89)	15.05 ^b (1.57)	15.63 ^b (3.14)	19.18 ^a (1.4)
Milk fat content (%)	3.92 ^a (0.38)	3.46 ^{ab} (0.39)	3.89 ^a (0.38)	3.38 ^b (0.22)
Milk protein content (%)	3.18 ^b (0.14)	3.10 ^b (0.24)	3.54 ^a (0.31)	3.24 ^{ab} (0.2)
Body weight (kg)	449 ^b (28)	495 ^{ab} (38)	512 ^a (49)	534 ^a (37)
Body condition score (1-5)	2.74 ^b (0.14)	2.72 ^b (0.22)	3.04 ^a (0.24)	2.77 ^b (0.13)

Heat stress status of the cows and shed conditions per region

Parameters	HCM mean (SD)	LD mean (SD)	HN mean (SD)	SL mean (SD)
Panting score (PS, scale: 0-4.5)	1.82 ^a (0.31)	0.78 ^c (0.3)	1.37 ^b (0.32)	1.29 ^b (0.34)
Infrared vulval temperature (VIRT, °C)	37.77 ^a (0.47)	37.01 ^b (0.35)	36.91 ^b (0.58)	37.4 ^{ab} (0.73)
Temperature humidity index (THI)	72.17 ^a (1.76)	66.36 ^b (1.51)	72.53 ^a (1.75)	67.6 ^b (0.96)
Heat load index (HLI)	79.72 ^a (4.15)	70.29 ^b (2.55)	80.38 ^a (3.42)	70.57 ^b (3.11)
Floor area per cows (m ² /cow)	5.22 ^b (1.05)	7.79 ^b (2.47)	7.68 ^b (2.81)	14.01 ^a (4.36)
Roof height, lowest point (m)	2.58 ^b (0.48)	2.42 ^b (0.37)	3.42 ^a (0.49)	2.94 ^{ab} (0.65)
Roof height, highest point (m)	3.39 (0.39)	3.43 (0.67)	4.25 (0.96)	3.79 (0.65)
Number of fans	1.12 ^b (1.25)	0.00 ^b (0.00)	8.38 ^a (2.50)	0.00 ^b (0.00)
Percentage of shed side open (%)	60.6 ^a (21.7)	85.6 ^a (10.4)	75.3 ^a (14.8)	78.1 ^a (25.9)

Multivariate regression analysis identifying the factors affecting cow heat stress

Predictors	Panting score		Vulval infrared temperature	
	Coeff	P	Coeff	P
Intercept	-7.610	0.000	35.014	0.000
Body weight (BW, kg)	.		.	
Days in milk (days)	.		.	
Roof height (m)	-0.278	0.006	-0.337	0.039
Percentage of side open (%)	-0.006	0.053	-0.008	0.085
Dry matter intake (%BW)	0.242	0.240	.	
Dietary dry matter (DM, %)	0.057	0.001	0.093	0.002
NDF (% DM)	.		0.076	0.025
Lignin (% DM)	0.182	0.009	.	
Crude protein (% DM)	.		.	
Heat load index (HLI)	0.031	0.017	.	
Milk protein (%)	.		-0.915	0.023
Milk dry matter (%)	0.315	0.002	.	
R ²	0.743		0.52	

Multivariate regression analysis identifying the factors affecting milk production

Predictors	Fat + protein (kg/100kg BW)	
	Coef	P
Intercept	0.353	0.210
Percentage of pure HF (%)	0.000	0.068
Days in milk (days)	0.000	0.013
Infrared vulval temperature (°C)	-0.014	0.046
Panting score	.	
Lactations	.	
Roof height (m)	.	
Number of fans	.	
Percentage of side open (%)	.	
Dry matter intake (%BW)	0.034	0.049
Dietary dry matter (DM, %)	0.004	<0.001
NDF (% DM)	.	
FAT (% DM)	0.025	0.005
Lignin (% DM)	0.014	0.011
Na (% DM)	.	
R ²	0.709	

Conclusion

- Cows in HCM (South low altitude region) were the most heat stressed
- Heat stress was evident even in the coolest regions
- Increasing shed ventilation and improving the balance of fat in the diet should be a focus for future research to reduce the impact of heat stress on milk yield
- Vulval infrared temperature should be further evaluated as a simple measure of heat stress in dairy cows



Acknowledgements: Australian Government, Vietnamese Governments, UQ, household farmers, local extension staff, VNUA, NLU, and NIAS.

