**Modelling heat stress mitigation and feed availability under climate change within the smallholder dairy sector.**

L. York1, C. Heffernan1, a , C. Rymer2, and N. Panda3

**Supplementary Table S1** *The number of Temperature-Humidity-Index (THI) units above the heat stress threshold and the quantity of milk lost during lactation by cows under normal conditions (N) and warming scenarios of +2°C (N+2) and +4°C (N+4) as expected during climate change conditions under no adaptation and the adaptations of shading, bathing, and fanning in Odisha, India.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Warming scenario | Breed | No adaptation | Shading | Bathing (x2) | Fanning and shading |
| Tree | Modern shed | Traditional shed  | Modern shed | Traditional shed |
| THI Loada | N | Jersey | 551 | 398 | 245 | 92 | 168.5 | 168.5 | 46 |
| 1/4 Jersey | 245 | 92 | 0 | 0 | 0 | 0 | 0 |
| Local | 92 | 0 | 0 | 0 | 0 | 0 | 0 |
| N+2 | Jersey | 1254 | 1009 | 795 | 612 | 703.5 | 703.5 | 535.5 |
| 1/4 Jersey | 795 | 612 | 459 | 306 | 382.5 | 382.5 | 229.5 |
| Local | 612 | 459 | 306 | 153 | 229.5 | 229.5 | 91.5 |
| N+4 | Jersey | 2020 | 1775 | 1530 | 1285 | 1407.5 | 1407.5 | 1162.5 |
| 1/4 Jersey | 1522 | 1281 | 1040 | 826 | 933 | 933 | 734.5 |
| Local | 1182 | 992 | 802 | 643 | 722.5 | 722.5 | 566.5 |
| Lost milk production(kg/cow per lactation)b | N | Jersey | 65 | 47 | 28.9 | 10.9 | 19.9 | 19.9 | 5.4 |
| 1/4 Jersey | 7.4 | 2.8 | 0 | 0 | 0 | 0 | 0 |
| Local | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| N+2 | Jersey | 148 | 119.1 | 93.8 | 72.2 | 83 | 83 | 63.2 |
| 1/4 Jersey | 24.2 | 18.6 | 14 | 9.3 | 11.6 | 11.6 | 7 |
| Local | 8.2 | 6.2 | 4.1 | 2.1 | 3.1 | 3.1 | 1.2 |
| N+4 | Jersey | 238.4 | 209.5 | 180.6 | 151.7 | 166.1 | 166.1 | 137.2 |
| 1/4 Jersey | 46.3 | 39.1 | 31.6 | 25.1 | 28.4 | 28.4 | 22.3 |
| Local | 15.9 | 13.3 | 10.8 | 8.6 | 9.7 | 9.7 | 7.6 |

Jersey = High grade Jersey crossbreed; 1/4 Jersey = Low grade Jersey crossbreed; Local = Indigenous (non-descript) breed

a Values are provided to the nearest whole number.

b Values are provided to 1 decimal place.

**Supplementary Table S2** *The cost of the various heat stress relief strategies in terms of productivity (kg of milk/day) for the various breeds (Jersey, 1/4 Jersey, Local) under normal (N) and conditions of climate change (N+2, N+4)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Warming scenario | Breed | Shading | Bathing (x2) | Fanning and shading |
| Papaya trees | Mango tree | Modern shed | Traditional shed  | Naturally occurring | Well | Motorized pump | Modern shed | Traditional shed |
| Cost (Rs/kg of milk)a | N | Jersey | 0.39 | 0.01 | 0.68 | 1.23 | 1.91 | 2.94 | 2.87 | 0.95 | 1.49 |
| 1/4 Jersey | 0.55 | 0.02 | 0.96 | 1.74 | 3.92 | 5.79 | 2.66 | 1.35 | 2.12 |
| Local | 1.19 | 0.04 | 2.08 | 3.77 | 3.15 | 6.64 | 9.67 | 2.92 | 4.61 |
| N+2 | Jersey | 0.41 | 0.02 | 0.71 | 1.27 | 3.18 | 4.30 | 4.44 | 1.13 | 1.69 |
| 1/4 Jersey | 0.56 | 0.02 | 0.97 | 1.75 | 4.74 | 6.73 | 3.06 | 1.55 | 2.33 |
| Local | 1.19 | 0.04 | 2.09 | 3.78 | 5.26 | 9.15 | 15.03 | 3.34 | 5.02 |
| N+4 | Jersey | 0.44 | 0.02 | 0.76 | 1.34 | 3.37 | 4.55 | 4.70 | 1.20 | 1.77 |
| 1/4 Jersey | 0.57 | 0.02 | 0.98 | 1.77 | 6.44 | 8.67 | 3.88 | 1.57 | 2.36 |
| Local | 1.21 | 0.04 | 2.11 | 3.81 | 8.49 | 13.01 | 23.24 | 3.37 | 5.06 |

Jersey = High grade Jersey crossbreed; 1/4 Jersey = Low grade Jersey crossbreed; Local = Indigenous (non-descript) breed

a Values are provided to 2 decimal places

**Supplementary Table S3** *The difference (as a percentage) in Temperature Humidity Index (THI) Load and total quantity of milk lost to heat stress depending on assumptions regarding the lactation length (300-day lactation v. actual lactation length).*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Warming scenario | Breed | No adaptation | Shading | Bathing (x2) | Fanning and shading |
| Tree | Modern shed | Traditional shed  | Modern shed | Traditional shed |
| THI Loada | N | Jersey | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/4 Jersey | 0 | 0 | - | - | - | - | - |
| Local | 0 | - | - | - | - | - | - |
| N+2 | Jersey | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/4 Jersey | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Local | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N+4 | Jersey | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/4 Jersey | -0.53 | -0.31 | 0 | 0 | 0 | 0 | 0 |
| Local | -8.71 | -4.84 | -2.99 | 0 | -1.66 | -1.66 | 0 |
| Lost milk production(kg/cow per lactation)a | N | Jersey | 14.98 | 15.07 | 14.94 | 15.28 | 15.03 | 15.03 | 15.28 |
| 1/4 Jersey | 19.44 | 21.34 | - | - | - | - | - |
| Local | 43.39 | - | - | - | - | - | - |
| N+2 | Jersey | 15.01 | 15.03 | 15.07 | 15.01 | 14.98 | 14.98 | 15.05 |
| 1/4 Jersey | 19.73 | 19.91 | 19.73 | 19.38 | 20.02 | 20.02 | 19.73 |
| Local | 47.72 | 46.51 | 46.51 | 46.51 | 48.13 | 48.13 | 43.08 |
| N+4 | Jersey | 15.03 | 15.05 | 15.01 | 15.02 | 15.01 | 15.01 | 15.03 |
| 1/4 Jersey | 19.38 | 19.62 | 19.66 | 19.56 | 19.61 | 19.61 | 19.83 |
| Local | 42.72 | 44.5 | 45.26 | 46.77 | 46.45 | 46.45 | 47.46 |

Jersey = High grade Jersey crossbreed; 1/4 Jersey = Low grade Jersey crossbreed; Local = Indigenous (non-descript) breed

a Values are provided to the nearest whole number.

b Values are provided to 2 decimal places.