UNIVERSITY OF SOUTHERN QUEENSLAND

FACULTY OF ENGINEERING AND SURVEYING

THE MICROCLIMATE OF AUSTRALIAN CATTLE FEEDLOTS

A Dissertation submitted by

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CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

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ABSTRACT

The incidence of cattle heat stress is a significant production and welfare issue for the feedlot industry. It is hypothesised that the presence and physical nature of feedlots causes significant microclimatic variations compared to the external environment.

In order to test this hypothesis, data was collected using a series of automatic weather stations located in the external environment surrounding two Australian feedlots. Comparison of this data with regional Bureau of Meteorology sites was undertaken to verify the quality of these 'control' sites. To determine the climate within the feedlot separate automatic weather stations were placed within the cattle pens at each site, with one station located in an unshaded pen and one directly under an artificial shade structure within an adjacent pen.

This dissertation reports the collection and analyses of detailed climatic data from the surrounds and within the cattle pens of these two Australian feedlots. The project also sought to determine microclimatic differences within the feedlot pen area that may be caused by the presence of the shade structures.

It was found that the presence of a feedlot does create significant microclimatic variations. Specifically, it was determined that the albedo values of the feedlot pen surface are significantly lower (ranging from 0.13 to 0.19) than those of the external feedlot environment (typically 0.15 to 0.25). This is a result of the surface changes arising from the establishment of clay based manure covered pens. Under wet conditions the differences in albedo values were further increased. It was found that the short wave radiation reflection from the external feedlot environment was 4% greater than that from the unshaded feedlot pen surfaces under dry conditions and 10% greater under wet conditions. The increased adsorption of solar radiation by the feedlot pen surface created ground temperatures that were on average 2 to 4°C warmer than those of the feedlot surrounds. The re-radiation of heat from the pen surface was found to create warmer air temperatures within the feedlot pens compared to the external environment, particularly overnight. Between the hours of 4am to 6am it was found that on average the air temperatures of the shaded and unshaded feedlot pens were 0.7°C and 0.5°C warmer than the external feedlot environment.

It was found that feedlot pen infrastructure and cattle significantly reduce wind speeds under a height of 10 metres. The average 2 metre wind speeds of the external feedlot environments were found to be 29% and 9% higher than those recorded in the unshaded pens at the northern and southern feedlots respectively.

Shade structures within feedlot pens were found to be effective in reducing incoming solar radiation with the galvanised sheeting reducing incoming solar radiation by 76% and the shade cloth providing a 72% reduction. These reductions provided both lower ground temperatures and a significant reduction in radiant heat loads under the shade. It was determined that the environment under shade structures was more humid compared to that of the unshaded pens with humidity levels recorded being 8 to 12% higher. Shade structures also restrict horizontal wind movement with the 2 metre wind speeds in the shaded pens being on average 11% and 0.5% lower than those recorded in the unshaded pens for the Queensland and NSW feedlots respectively.

Research has shown that microclimatic variations such as increased air temperatures, increased humidity and restricted air movement can have an adverse effect on cattle health. It is concluded from this project that in order to mitigate these effects a number of feedlot design concepts be implemented, and management practices should be adopted. Maintaining minimal quantities of manure on the pen surface will provide lower ground temperatures, dryer pen conditions and inhibit the re-radiation of heat and evapotranspiration from the pen surface. Adequate air flow should be maintained by siting feedlots in areas of suitable topography, and designing feedlot infrastructure and shade structures to maximise air movement. Shade structures need to aim at providing dryer pen surfaces to minimise humidity levels. Incorporation of these recommendations into feedlot design and management will assist in optimising the feedlot microclimate.

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