

# Lighting and noise levels in compost dairy barns with natural and forced ventilation

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The housing system, called compost dairy barn, is attracting the interest of several farmers. It allows dairy cows to remain in free movement inside a shed without any containment partitions like those used in freestall barns. In Brazil the compost barns with open sides are very common, but recently some closed barns with climatic control systems have been implemented. The objective of this work was to evaluate and compare lighting and noise levels in an open compost barn with natural ventilation and in a closed compost barn with a climate control system.

## MATERIALS AND METHODS

The survey was conducted in two compost dairy barns with different ventilation systems: climate controlled (CBC) and natural ventilation (CBN). The facilities are located on the same farm, in the city of Cajuri (Minas Gerais, Brazil). The dimensions of the CBC barn are 55.0 m x 26.4 m. It is oriented northwest-southeast. On the southeast side of the building, porous cellulose panels with dimensions 18.0 x 3.5 m are used for evaporative cooling. The panels are moistened by dripping to cool the air before entering the CBC. A temperature sensor located inside the CBC monitors environmental conditions and allows the system to remain on if the air temperature is above 21 °C and the relative humidity below 75%. On the northwest side the facility has five exhaust fans (BigFan®, 3.5 m diameter, six propellers, air volume 150.000 m<sup>3</sup> h<sup>-1</sup> volume and power of 2.0 HP). The five exhaust fans remain on continuously, 24 hours a day. Five LED lamps (100W) are distributed along the bedding area and feeding alley.

In the experimental period the CBC housed 88 lactating Holstein cows (600 kg) with a stock density of 10 m<sup>2</sup> cow<sup>-1</sup>. The milk production per cow was 25 kg day<sup>-1</sup>. The natural ventilation compost barn (CBN) was built in July 2019. It is oriented northwest-southeast. The dimensions of the CBN barn are 60.0 m x 24.0 m. The barn has completely open sides to allow natural ventilation. In the experimental period the CBN housed 63 lactating Holstein cows (600 Kg) with a stock density of 13.3 m<sup>2</sup> cow<sup>-1</sup>. The milk production per cow was 30 kg day<sup>-1</sup>.

The study was carried out during the month of August 2019, that is winter season in the southern hemisphere. The variables illuminance (lx) and noise (dB) were recorded inside the two compost barns in the morning shift. The evaluated data were collected into a rectangular grid containing 54 equidistant points, placed over the bedding area and feeding alley. Therefore, the data were collected in the area of 60 m x 18 m (CBN) and 55 m x 20 m (CBC). The collection of illuminance and noise data in each barn occurred on the same day and time. The procedures for data collection for both facilities were similar. The variables were collected at a height of 1.5 m. The conditions of noise level and lighting verified inside each of the compost dairy barn studied were compared statistically by means of the Mann–Whitney test at the level of 5% of significance. Subsequently, from the data collected, descriptive maps of lighting and noise were generated (data is interpolated into a grid for contour plots). The SigmaPlot® 12.0 software was used as a tool statistics for all analyses performed.

## RESULTS

### Illuminance (lx)

Figure 1 shows the distribution of the light intensity based on data collected in the two facilities. A statistically significant difference was found between the data observed in the CBN and CBC barns.

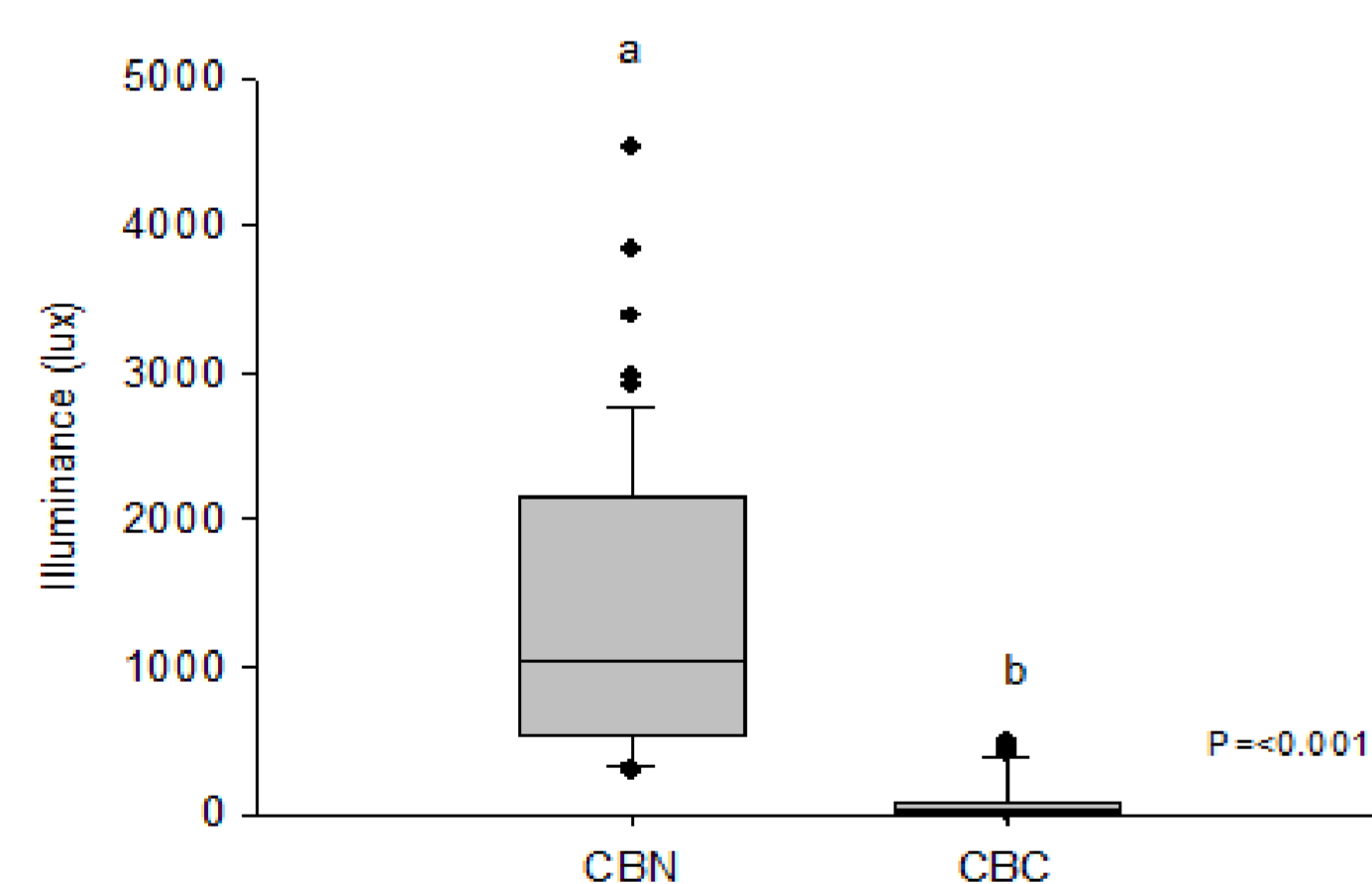


Figure 1. Distribution charts for illuminance data, in lx, during the winter period, in climate controlled compost barn (CBC) and natural ventilation compost barn (CBN). Averages followed by the same letters do not differ from each other at the 5% probability level by the Mann-Whitney test.

It is observed that the CBN (Fig. 2, a) had a huge amplitude, and a pattern of higher light intensity concentration in the northwest, southwest and southeast faces of the house. The lamps were not evenly arranged within the CBC barn (Fig. 2, b), so a variation in illuminance values was expected. In addition, in CBC the light intensity presented the highest values in the region near the hoods, which occurs due to its large diameter, allowing a greater passage of light.

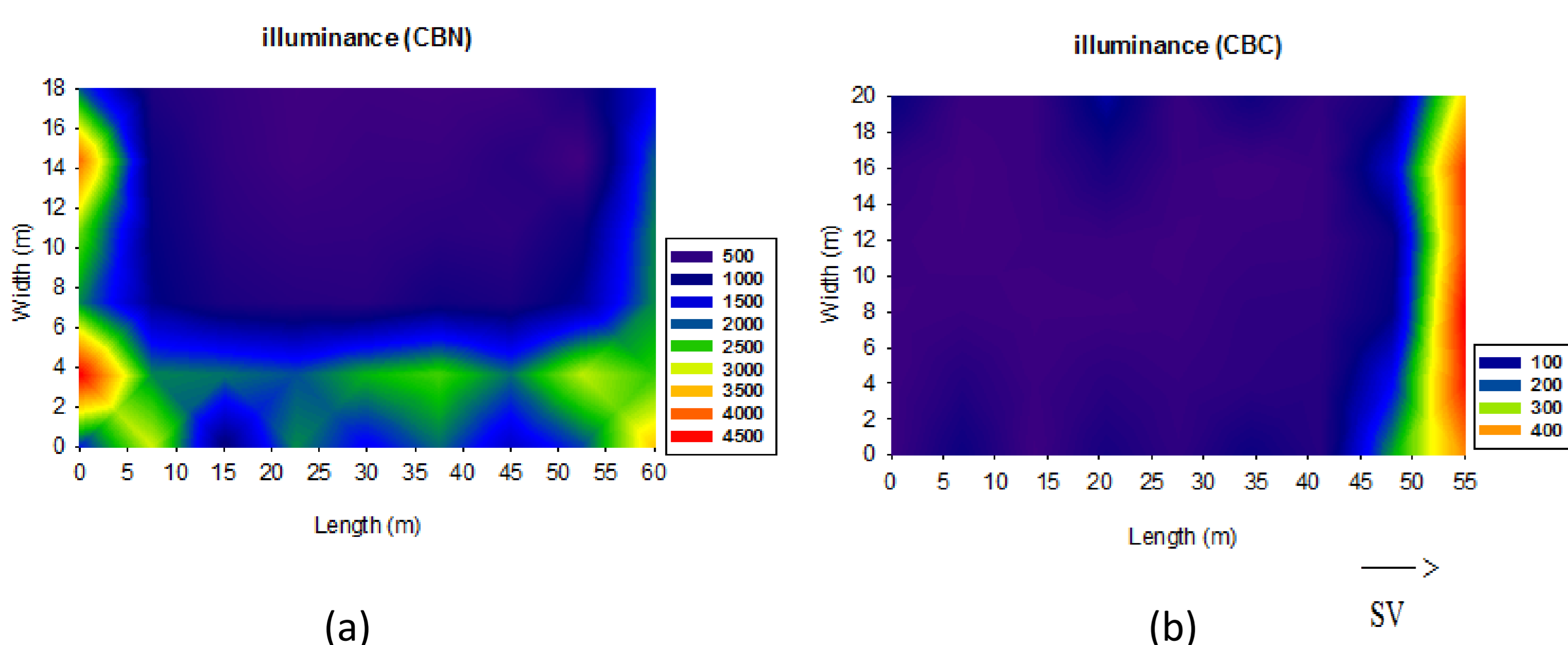


Figure 2. Maps of illuminance, in lx, during the winter period, in (a) natural ventilation compost barn (CBN) and (b) climate controlled compost barn (CBC). SV – sense of ventilation.

### Noise Levels (dbA)

The distribution of the noise level data verified in the two facilities is presented in Fig. 3. A statistically significant difference was found between the data observed in the CBN and CBC.

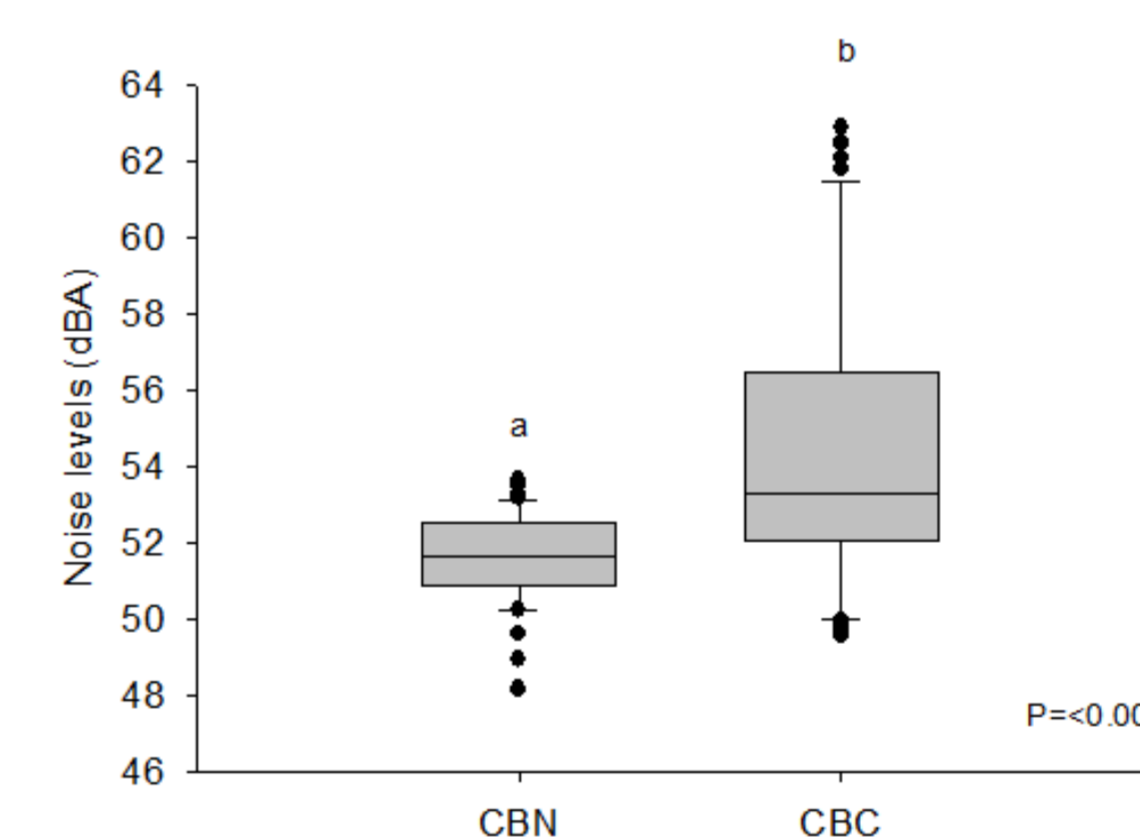


Figure 3. Distribution charts for noise level data, in dbA, during the winter period, in climate controlled compost barn (CBC) and natural ventilation compost barn (CBN). Averages followed by the same letters do not differ from each other at the 5% probability level by the Mann-Whitney test.

For the CBN and CBC facilities, the results on the noise levels showed that there was variation of this variable inside the installation, with greater amplitude for the CBC (Fig. 4, a, b).

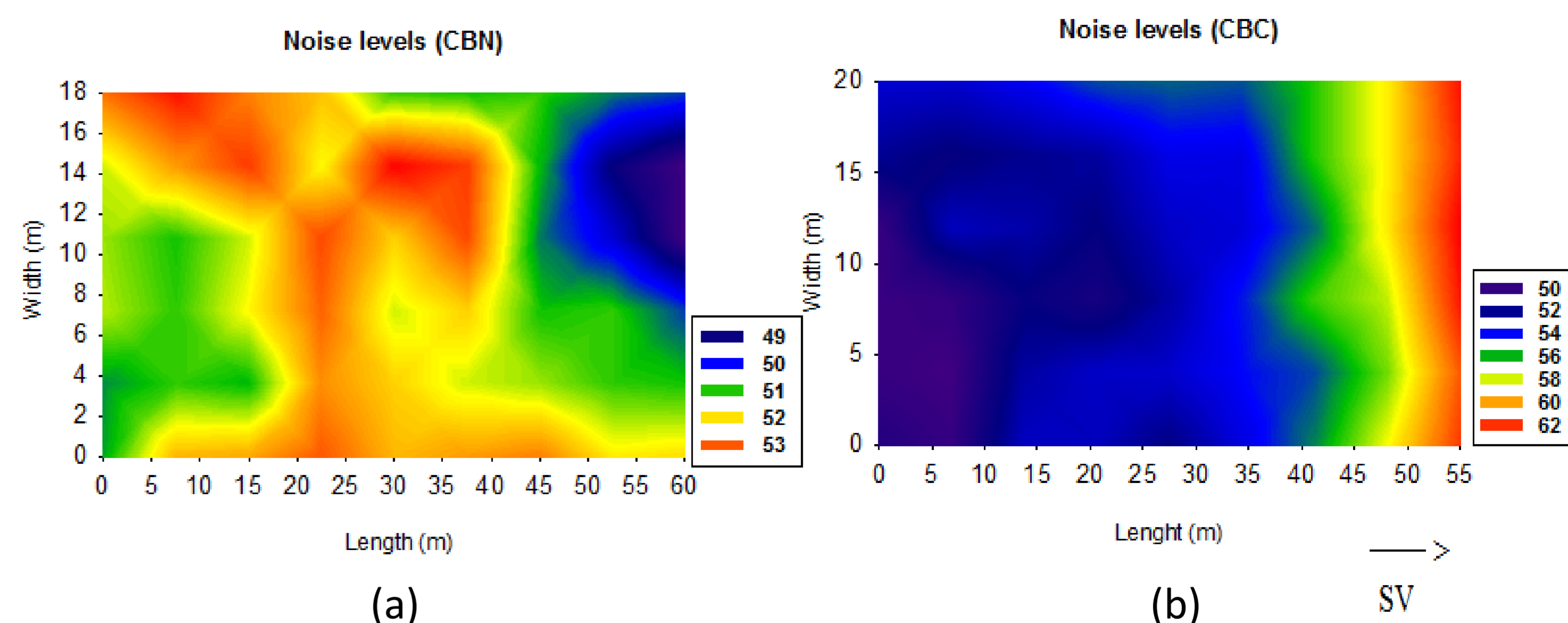


Figure 4. Maps of noise levels, in dbA, during the winter period, in (a) natural ventilation compost barn (CBN) and (b) climate controlled compost barn (CBC). SV – sense of ventilation.

## CONCLUSIONS

The natural ventilation compost barn presented, as expected, more light intensity when compared to climate controlled compost barn. In the latter, the artificial lighting system distributed throughout the facility was not sufficient to maintain the light intensity within the range recommended for lactating cows. The sound pressure recorded inside the compost barn did not exceed the ranges of noise discomfort recommended for the rearing of animals in both the two facilities analysed.