Predicting nutrient excretion of dairy cows on smallholder farms in Indonesia using readily available farm data

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To improve manure management in Indonesian smallholder dairy farms, information related to nitrogen (N) and phosphorous (P) excretion of dairy cattle is needed. This information can be used to estimate nutrient losses of different manure treatment options and to quantify differences in nutrient use efficiency among farms and manure management systems. This study aims to provide models to accurately predict N and P excretion of dairy cows on smallholder farms in Indonesia based on readily available farm data. The model to predict excretion of faecal N (Q_{FN}) was based on the principles of the Lucas equation, describing the relation between dry matter intake (DMI) and faecal N excretion. Excretion of urinary N (QUN) and faecal P (QFP) were calculated based on the guidelines of the National Research Council (NRC, 2001). The research consisted of four steps. First, a farm survey was conducted among 30 smallholder dairy farms in Lembang to collect input parameters for the models. Second, the data set was used to calibrate the model to predict Q_{FN} of dairy cows for the specific case of smallholder farms in Indonesia. Third, the model was validated by comparing the predicted quantity of faecal N (Q_{FNPRED}) with the actual quantity of faecal N (Q_{FNACT}) based on measurements, and the calibrated model was compared to the Lucas equation from literature. Fourth, the models were used to predicts N and P excretion of all 144 dairy cows in the dataset. Calibration of the model to predict Q_{FN} resulted in the following equation [0.08 × TNI (g/animal/d) + 0.60 × DMI (100 g/animal/d)]. Comparing Q_{FNPRED} with Q_{FNACT} showed that the coefficient of determination (R^2) was 0.63; the mean absolute error (MAE) was 15 g/animal/d or 17% deviation of Q_{FNPRED} from the Q_{FNACT}; the root mean square error (RMSE) was 20 g/animal/d or 22% deviation of Q_{FNPRED} from the Q_{FNACT}. The calibrated model was similar to the Lucas equation as found in literature. Based on the models, we predicted that the total N excretion of dairy cows on smallholder farms in Lembang was on average 196 g/animal/d, whereas P excretion was on average 44 g/animal/d. This study demonstrated that the proposed models can be used successfully to predict N and P excretion of dairy cattle on smallholder farms in Indonesia using readily available farm data. Models can be used as a basic tool to improve manure management in Indonesian smallholder dairy farms.