Use of a Simulation Model to Develop Feeding Strategies for Cattle at Pasture in Small Scale Dairy Farming Systems in the Highlands of Central Mexico: Methodological Frame Work

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Introduction Simulation models are useful tools in field research ,technology transfer and decision making process (Ahuja and Howell 2002) .The use of simulation models facilitate the development of feeding systems for dairy cattle ,based on strategies that fulfils the metabolizable protein and energy requirements of cattle ,therefore the *Buttercup* simulation model was used .The aim of this work was to develop a methodological frame for the formulation of feeding strategies for dairy cattle in small scale dairy farming systems through calibration and the *on farm* validation of the model .

Materials and methods Figure 1 show the methodological approach used in this study .The methodology has two stages .

Stage 1 Simulation ,includes the calibration of the model with a input data set from previous researches ,specific input data about the feeding strategies ingredients and the cattle from small scale dairy farming systems of the highlands of central Mexico .Local feeding strategies for cattle at pasture were simulated using a 3x3x4x4x5 factorial design that includes different productive and reproductive cow characteristics ,different ingredients (four forages and four concentrates with five levels of supplementation 0 , 2 ,4 ,6 y 8 kg cow d^{-1}) .

Stage 2 includes on farm experiments .The best feeding strategies developed in stage 1 were used : three concentrates evaluated with two on farm experiments with a double *latin* square design with three periods of 21 days and condition score ,milk yield and milk characteristics as variables .Data from the cattle and from the ingredients characteristicssuch as : feed value and degradation characteristics (*in vitro* gas production technique) were obtained .With a Pearson correlation and a lineal regression the main predicted *vs* observed values were compared .

Results The simulation process confirm nutrient deficiencies in the local feeding strategies ,alternative strategies that fulfill it were developed ,table 1 presents the ingredients used in the concentrates developed in stage 1 . The results of the experiments on milk yield , condition score and milk characteristics were compared with the predictions of the model the R values were acceptable ($R^2 = 0.55$ and $R^2 = 0.69$ for experiment 1 and $R^2 = 0.41$,and $R^2 = 0.53$ for experiment two)

Table 1 *Composition of the concentrates used in the on farm experiments (g kg^{-1}).*

Ingredient	C1	C2	C3
Maize grain	610	630	900
Soy bean meal	310	320	0
Urea	30	0	50
Molases	50	50	50

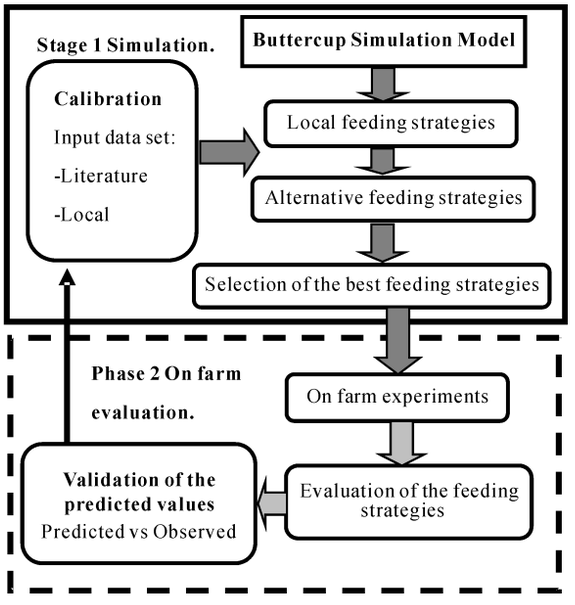

Figure 1 *Methodological approach used to develop feeding strategies for dairy cattle in small scale dairy farming systems .*

Conclusions Simulation model buttercup is a useful tool to be used in this kind of systems ,develop of alternative management strategies and the design of *on farm* experiments . The methodology presented contributes to simplify the use of simulation models in small scale dairy farming systems .

Reference

Ahuja LR , Howell TA . Agricultural System Models in Field Research and Technology Transfer . *United States : Lewis Publishers* , 2002 .