# Environmental Efficiency in Mixed Crop Livestock Farming in India

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**Introduction** The global concern on environmental externalities such as animal waste , excess nutrients , heavy metals in soil , pollution of surface and ground water (Gerber *et al*., 2005) has become limitations for commercialization , intensification and industrialization in livestock systems . The present research was carried out with an objective of analysing the environmental externalities in scale of operation in mixed crop dairy farming systems .

**Materials and methods** The study was conducted in rural areas of Bareilly district of Uttar Pradesh in India . Sampling method was the multistage stratified random sampling . Data ($n=120$) on land extend , herd structure and waste disposal methods were collected using pre-structured during the period of February to April in 2006 visiting the dairy farming households . Collected data were further categorized according to the land size viz . landless (no own land) marginal ($<1$ ha) , small (1-2 ha) , medium (2-4) , large($>4$ ha) and analysis was taken place accordingly .

To achieve the objective of the study about the environmental externalities in sample households , it was estimated the nutrient production from the cattle units in the farm , nutrient uptake by the crops cultivated in the farmyard , manure disposed , mass balance of nutrients (N and $P_2O_5$) .

### Estimation of cattle units and N and $P_2O_5$ production
Dairy animal was taken as 0.7 animal unit and amount of nitrogen and phosphate as 16.9 lbs and 29.3 lbs in each dairy unit (0.7 unit) respectively . Total N and $P_2O_5$ production from each category was calculated using following formula (Sharma *et al*., 2002) .

$$T_h^n = \sum a_l^n AU_{lh} + CF_h^n \quad \text{.....................................}(1)$$

Where , l is livestock category , n is nutrient type (N ,$P_2O_5$) , H is household , $T_h^n$ is total nutrient n deposited by household , $AU_{lh}$ is animal units of livestock type l in household h , $CF_h^n$ is form of nutrient n applied as commercial fertilizer by household h and $a_l^n$ is amount of nutrient n produced per animal unit of livestock type l .

### Estimation of crop uptake
The capacity of these nutrients use at the household level is estimated assuming that all the available land was planted with rice which was the main crops in summer in the area , would uptake the nutrients .It was assumed that N uptake for rice production is 100 kg/ha and $P_2O_5$ uptake is 32 kg/ha (Sharma et al ., 2002) .

**Results and discussion** The mass balance of N and $P_2O_5$ was negative in landless farmers (-9.76 kg of N per ha and-17.6 kg of $P_2O_5$ per ha) . Marginal farmers had negative mass balance of $P_2O_5$ (-10.9 kg/ha) and positive mass balance of N . All the other groups had positive mass balance in both the nutrients . Overall mass balance was positive for both the nutrients in the area . Further , the people use 46% of dung as fuel in the area .

**Table 1** *Dung Usage and Mass Balance (MB) of Nutrients .*

| Item | LL | Ma | Sm | Me | La | Overall |
|---|---|---|---|---|---|---|
| % usage as fuel | 61.5 | 40.5 | 39 | 46.6 | 38.8 | 46.12 |
| % sales | 10 | - | - | - | - | - |
| N MB | -9.76 | 41.7 | 127 | 246 | 468 | 137.7 |
| $P_2O_5$ MB | -17.6 | -10.6 | 10 | 51.6 | 120 | 19.2 |

MB Unit (kg/ha) ; LL-landless , Ma-marginal , Sm-small , Me-medium , La-large

**Conclusions** Since the positive mass balance implies the sufficient land to absorb the nutrients that they produce , it can be concluded that on an average the farming systems are efficient enough to internalize the probable environmental externalities due to livestock production . Therefore , animal food demand can be met by efficiently managed small-scale mixed crop livestock systems in future .

**References**
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