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## Alternative Feeding Options to Enhance Dairy Farm Sustainability in Bangladesh

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### Abstract

Mixed-crop dairy farming systems are important contributors to income and nutrition security in Bangladesh. Dairy cattle production is however characterised by poor integration with primary farming systems, low productivity, mainly due to genotypic and feeding constraints. The latter is due largely to limited on-farm fodder production and dependency on external feed items. External feed costs are high, undermining farmers' potential profitability. When cattle and crop production are not tightly coupled, negative environmental externalities can result. Reconfiguration of non-integrated farming practices are needed to support increased appropriate feed production, soil organic matter (OM) balances, farm income, and to reduce the feed costs and off-farm externalities. Here, we investigated alternative feeding options for large ( $\geq 10$  cows), medium (4–10 cows) and small ( $\leq 3$  cows) integrated crop-livestock farm types to enhance economic and environmental performance in Jhenaidha and Meherpur districts in Bangladesh. Following focus group discussions from February to May 2018 with three farms in each size category, we considered baseline data from one representative average from each group for modelling in the software package FarmDESIGN. We optimised the operating profit, feed costs, OM balance, Soil N losses and self-reliance. In the results, we found the highest operating profit in Meherpur for medium-sized farms, as well as lowest feed costs per kg dry matter. Examining risks of soil N losses, OM balance and feed self-reliance (increasing the on-farm feed production), maximum improvements over baseline farm scenarios came from small farms in Meherpur, and large and medium-sized farms in Jhenaidha, respectively. Trade-offs and synergies between objectives were found. Increasing feed self-reliance reduces potential N losses, though this was also associated with lower operating profit and soil OM balances. Despite existing trade-offs, we found opportunities to improve economic and environmental performance simultaneously. It appears that feed self-reliance can be increased by intensifying cropping and substituting fallow periods with appropriate fodder crops. Integrated analysis of alternative feeding systems for sub-tropical dairy farms in Bangladesh can contribute and enhanced understanding of the combined economic and environmental benefits in mixed crop-dairy production systems, thereby overcoming apparent trade-offs and offering farmers a suite of management options to explore.

**Keywords:** Dairy farming, economic, environment, feeding strategies, optimisation, sustainability

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