SUMMARY BRIEF

Heifer study on climate-smart agriculture adoption rates amongst goat farming households in three districts of Nepal and the impact on key environmental and economic indicators.

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Intro

This info brief provides an executive overview of the research methods and key finding of a series of information briefs. The briefs were developed to assess the role of Heifer Nepal programming in supporting the adoption of Climate-Smart Agriculture (CSA) practices amongst Heifer supported goat cooperatives, and their impact on a range of environmental and economic indicators. The recommendations of the analysis are intended to further strengthen the integration of climate change considerations into Heifer Nepal's programming, with the goal of raising overall household incomes amongst supported households through means that have minimal negative impact on the environment. The research was conducted in three districts encompassing the main agro-ecological contexts in which Heifer Nepal works. The resulting analysis was divided into four separate, but complementary information briefs:

- **BRIEF 1** – "Assessing the impact of Heifer Nepal programming on the use of climate-smart agriculture practices in smallholder goat farming systems", this brief aims to provide greater insight into the farming systems of the three study regions and their application of CSA practices, comparing uptake between Heifer supported cooperatives and non-Heifer supported cooperatives, using data gathered though the Rural Household Multi-Indicator Survey (RHoMIS).
- **BRIEF 2** – "Comparative analysis of goat farming systems in Nepal and their mitigation potential: Comparing results from Heifer and non-Heifer supported cooperatives" presents the results of a modelling analysis of farming systems from the three study sites, shedding light on the potential greenhouse gas mitigation potential of improved goat production systems as promoted by Heifer Nepal.
- **BRIEF 3** – "Assessing the soil health of three goat farming districts in Nepal: Insights for improved farm management" identifies promising soil management practices based on the soil characteristics and current management practices in each district.
- **BRIEF 4** – "Economic analysis of climate-smart agriculture interventions for goat farming households in Nepal and their marginal costs of abatement", to support agenda setting on priority CSA interventions for the attainment of National mitigation targets under Nepal's updated NDC.

Methodology

Three sites selected by the study team where the districts of Sarlahi (Eastern terai), Chitwan (Inner terai), and Surkhet (Mid-west hills). In each district around 35 households from three cooperatives were selected at random and surveyed, with 316 households interviewed in total. Two of the three cooperatives from each district were supported by Heifer Nepal under their multi-annual programming[1]. The non-Heifer cooperative had no engagement with Heifer or other development partners and was used as a control group to which Heifer cooperatives could be compared[2]. The household survey was constructed from the Rural Households Multi-Indicator Survey (RHoMIS) tool, a standardized farm household survey used in rural development contexts. Additional modules were included in the survey to capture

1 Due to the random sampling of households, not all households surveyed were actively engaged in Heifer programming which should be considered when interpreting the results.

2 In Brief 2 (Box 1) of the series the research team highlight a number of limiting factors in the selection of the control cooperatives. Advising readers to be cautious in directly attributing all the observed differences to Heifer programming, as there are a number of uncontrolled external factors that could be driving the observed heterogeneity.

information on engagement with Heifer programming and the use of specific CSA practices.

To evaluate the impact of different livestock systems on environmental indicators the Comprehensive Livestock Environmental Assessment for improved Nutrition and secured Environment and Sustainable Development along livestock value chains (CLEANED) tool was utilised. CLEANED is a rapid environmental impact assessment tool that allows users to explore multiple impacts—land requirements, water use, and greenhouse gas emissions (GHGe)—of developing livestock value chains by running different intervention scenarios. For the purpose of this study three scenarios were run for each region, a low adopt scenario based on non-heifer supported household data, a medium adopt scenario based on Heifer supported household data, and an aspirational high adopt scenario based on the best performing households with high CSA adoption rates.

Furthermore, agricultural fields from 40 households from each district were sampled and taken to a local laboratory for analysis of their soil physical and chemical properties (120 samples in total). The soil samples were analysed for: pH, nitrogen (N), phosphorous (P_2O_5), potassium (K_2O), soil organic matter (SOM), electric conductivity (EC), bulk density (BD), moisture content, and soil texture (textural class and classification). The results of the soil analysis were used to recommend priority soil management measures for each region.

Finally, the priority interventions were assessed using benefit-cost analysis (BCA) to determine the profitability of their adoption. The BCA was conducted using experimental data gathered from relevant literature which was cross-referenced with the results of the RHoMIS. At a programmatic level a Marginal Abatement Cost Curve (MACC) was developed demonstrating the relationship between the marginal costs of carbon mitigation and the overall potential of different management scenarios.

Key finding

- Overall, there tended to be a large proportion of households using CSA practices such as cultivated forages, feed additives, improved sheds, livestock vaccines, and compost. CSA practices such as improved breeds, agroforestry, legume intercropping, and System of Rice Intensification (SRI) had lower levels of use.
- Heifer supported households were more likely to employ CSA practices such as cultivated forages, improved sheds, and improved breeds. Nevertheless, the overall use of improved breeds remained low even for households in Heifer supported cooperatives.
- Heifer supported households had a higher probability of participating in savings and loan groups, women's groups, and had better access to AgroVet services, and information on crop related CSA practices. Engagement in the above services was found to positively influence the likelihood of households to use 3 or more crop or livestock CSA practices.
- In almost all regions the intensity of GHG emissions, and land and water use per kg of goat meat fell when comparing the Heifer household to the non-Heifer household type. However, for a number of regions and metrics there was an increase in absolute terms as households transitioned to larger herd sizes. The largest differences were observed when comparing both the Heifer and non-Heifer household type with the model scenario, which was characterised by improved feeding practices and breeds.
- Improved sheds and legume intercropping were found to be the most effective interventions to reduce emissions intensity, followed by improving the feed basket through the addition of improved forages and feed additives. There is also considerable potential to reduce emissions intensity through the adoption of improved breeds, which currently only experiences low levels of adoption (See Figure 1).
- Soil physical properties were similar across the three districts. Soils were generally categorised as either loam or sandy loam, both of which are considered to be good for plant growth due to the relative balance between clay, silt, and sand.
- Soil organic matter (SOM), electric conductivity (EC), and total nitrogen (N) were often found to be lower than nationally set optimal ranges. The district averages for soil pH were neutral, with available phosphorous (P) and available potassium (K) both in the optimal range.
- The BCA revealed that all the practices covered in the assessment improved the profitability of production. The introduction of improved fodder offered the highest benefit-cost ratio (BCR) at 23.3, mostly driven by the low costs of implementation. Other highly profitable practices included intercropping or crop rotation with legumes (BCR 2.3-3.2), the introduction of feed additives (BCR 2.5), and the construction of improved sheds (BCR 2).
- The MACC revealed that the program level costs of GHG mitigation differ considerably by region, ranging from \$5 – \$50/tCO_2e, with an average cost of \$13tCO_2e mitigated. These values fall well below the \$100 threshold for cost effective mitigation measures, and in many instances fall below the recommended \$25 price floor for carbon.

- The overall mitigation impact of Heifer programming in Nepal was calculated at 331,182 tCO_2e per year, with the potential to rise to 2.6 million tCO_2e per year if 70% of participating households were to perform as well as the best performing Heifer supported households.

Recommendations

1. **The role of AgroVet centres within the cooperatives was shown to be a significant factor related to the use of both crop-related and livestock-related CSA practices.** These centres may facilitate both greater access to farm inputs as well as technical knowledge about the use of CSA techniques. In this regard, it is recommended that, where appropriate, the establishment of AgroVet centres should be supported in cooperatives.

2. **Access to information on CSA practices for crop and livestock production was found to be a significant driver for their adoption.** While the analysis only found a significant relationship between Heifer engagement and access to information on crop related CSA practices, there is clear potential to accelerate CSA adoption through improved knowledge transfer and capacity development on the economic and environmental benefits of CSA interventions. This can be achieved by expanding the training programmes delivered by Heifer or through providing technical support to local extension agents and AgroVet centres.

3. **Improved sheds and legume intercropping were found to be the most effective mitigation measures across the three districts, currently only receiving moderate to low adoption amongst Heifer supported households.** With most households already adopting these practices finding them either beneficial or very beneficial, there is potential to further scale these interventions, unlocking considerable GHGe reductions in the process.

4. **Improvements to the feed basket through the introduction of feed additives and improved forage crops were also found to be effective mitigation measures,** each of which performing better in Sarlahi and Chitwan where their current share of the feed basket is low. The best performing forage crops were kimbu, jai, bakaino, and ipil-ipil. While the best performing feed additives were rice bran and maize bran in terms of reductions in emissions intensity of goat production. Heifer programming that focusses on training linked to forage production and the provision of suitable seeds/saplings could further increase their share in the feed basket. This could either be delivered directly by Heifer or through capacity development of cooperative staff and local AgroVet providers.

5. **Few households currently use CSA techniques as part of their soil management practices.** It is possible that the observed deficiencies in soil macronutrients across the three districts are related to this finding. It is therefore recommended that Heifer further engages with the cooperatives and the farmers on issues around Integrated Soil Fertility Management (ISFM).

6. **Examples of practices that could be included in a toolbox of improved soil fertility management techniques are: compost management, crop residue retention, cover cropping, legume intercropping and rotation, contour ploughing, minimum tillage, agroforestry, and mulching.** The trade-offs involved in the use of these techniques should be explored with the farmers of each of the cooperatives in order for them to be able to select the ones that are most suited to their context.

7. **Those farming households located in hilly areas should be engaged on Sloping Agricultural Land Technology (SALT) that can support them in countering the erosion of topsoil's, nutrient leeching, and SOM depletion.** These include measures such as contour ploughing/planting, terracing, agroforestry, and intercropping. Specialist sessions should be held with farmers in these areas to identify priority interventions and work to remove the current barriers to adoption.

8. **Cooperative managers and technical staff should be supported in the establishment of demonstration plots for priority interventions.** These plots can be used to further evaluate the effectiveness of priority interventions in boosting productivity, increasing incomes, and supporting healthy soils. Farmer group visits can be organised to the demonstration plots so farmers can learn about the practices and their potential benefits. Heifer may support this process by providing training and funding to cooperatives for the establishment of the plots and to support farmers in accessing the necessary inputs to replicate successful interventions.

9. **The results of the MACC should be presented to policy makers in Nepal to highlight the potential of CSA interventions for goat farming systems as low-cost mitigation measures, that can boost productivity and household incomes.** Should Heifer programming be modified to target the most promising CSA interventions increasing their adoption amongst participating households, there is scope to unlock considerable gains in productivity and GHGe emission reductions. This would contribute to Nepal's international mitigation targets under their updated Nationally Determined Contribution (NDC) and 2045 Net-zero target.

Table 3: Overview table on priority CSA practices, adoption rates (with percentage point differences to non-Heifer households), their impact on emissions intensity of production, the perceived impact (on a scale of very negative to very positive), the percentage of households receiving information and training from Heifer, and the main barriers to adoption. Data is from the RHoMIS survey and processed results from the CLEANED tool.

Practice	Region	Heifer Adopt (pp diff Non-Heifer)	Emissions intensity (%)	● Positive or ● Very positive or ● No impact	● Information and/or ● Training	Barriers
Cultivated forages	Eastern Terai - Sarlahi	75% (+ 37pp)	-43%	Total +ve impact **94%** (6%, 33%, 61%)	n/a; 38%	Labour intensive 37%; Lack of tech knowledge 24%; Trouble accessing inputs 18%
	Inner Terai - Chitwan	83% (+ 10 pp)	-40%			
	Midwest Hills - Surkhet	71% (+ 54 pp)	-18%			
Feed additives	Eastern Terai - Sarlahi	100% (+ 0 pp)	-49%	Total +ve impact **98%** (2%, 30%, 68%)	23%; n/a	High cost 56%; Trouble accessing inputs 26%; Lack of tech knowledge 18%; Labour intensive 17%
	Inner Terai - Chitwan	56% (+ 4 pp)	-45%			
	Midwest Hills - Surkhet	94% (- 6 pp)	-55%			
Improved sheds	Eastern Terai - Sarlahi	39% (+ 31 pp)	-69%	Total +ve impact **97%** (3%, 30%, 67%)	29%; 26%	Labour intensive 45%; High cost 45%; Lack of tech knowledge 20%; Trouble accessing inputs 17%
	Inner Terai - Chitwan	66% (- 6 pp)	-84%			
	Midwest Hills - Surkhet	56% (+ 38 pp)	-56%			
Improved goat breeds	Eastern Terai - Sarlahi	28% (+ 28 pp)	-26%	Total +ve impact **75%** (25%, 11%, 64%)	64%; 57%	Labour intensive 25%; Lack of tech knowledge 25%; Trouble accessing inputs 14%; Lack benefit 11%
	Inner Terai - Chitwan	7% (+ 7 pp)	-24%			
	Midwest Hills - Surkhet	0% (+ 0 pp)	-22%			
Compost	Eastern Terai - Sarlahi	16% (+ 10 pp)	-4%	Total +ve impact **95%** (5%, 21%, 74%)	n/a; 18%	Labour intensive 81%; Lack of tech knowledge 25%; Trouble accessing inputs 13%
	Inner Terai - Chitwan	19% (+ 16 pp)	-1%			
	Midwest Hills - Surkhet	8% (+ 5 pp)	0%			
Legume intercropping or rotation	Eastern Terai - Sarlahi	37% (- 3 pp)	-54%	Total +ve impact **81%** (19%, 7%, 74%)	16%; n/a	Labour intensive 62%; Lack of tech knowledge 13%; Low selling price 11%
	Inner Terai - Chitwan	21% (+ 9 pp)	-52%			
	Midwest Hills - Surkhet	2% (+ 2 pp)	-63%			