Redesigning of Farming Systems Using Multi-Criteria   
Assessment Tool for Sustainable Intensification and   
Nutritional Security in Northwestern India

A. K. Prusty 1,\*, N. Ravisankar 1,\*, A. S. Panwar 1, M. L. Jat 2, J. P. Tetarwal 3, Santiago López-Ridaura 4, Roos Adelhart Toorop 5, Jelle van den Akker 5, Jashanjot Kaur 6, P. C. Ghasal 1, Luis Barba-Escoto 4, Jeroen C. J. Groot 5, Poonam Kashyap 1, M. A. Ansari 1,\* and M. Shamim 1

**Supplementary Material**

**Table S1**. Decision variables and constraints for optimization of each of representative marginal farm households from typology

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|  | **Minimum** | **Maximum** |
| **Decision variables** |  |  |
| Land use current crop rotations | 0 | Total arable land (ha) |
| Land use alternative crops | 0 | Total arable land (ha) |
| Crop residues to soil (%) | 0 | 100 |
| Chickpea grain (feed) | 0 | 1500 |
| Cotton seeds | 0 | 2500 |
| Groundnut meal | 0 | 1000 |
| Mustard cake (MPF farmer) | 0 | 2500 |
| Mustard cake (MDF farmer) | 0 | 3000 |
| Sugarcane tops fresh | 0 | 3000 |
| Sugarcane tops silage | 0 | 2500 |
| Wheat straw | 0 | 4000 |
| Wheat screenings (delhia) | 0 | 3000 |
| Lentils ('multigrain mix') | 0 | 3000 |
| **Constraints** |  |  |
| Farm area (ha) | Current area -0.01 ha | Current area + 0.01 ha |
| Saturation deviation ruminants (%) | -∞ | 3 |
| Energy deviation ruminants (%) | -5 | 15 |
| Protein deviation ruminants (%) | -5 | 30 |
| Organic matter balance (kg/ha/year) | -320 | ∞ |
| Self-reliance household consumed crops | 1 | ∞ |
| Regular Labour balance | 0 | 999 |
| Casual labour balance | 0 | 999 |
| Leisure time | 0 | 999 |
| N Balance | 0 | 999 |

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| Chart, bar chart, histogram  Description automatically generated  **Figure S1.** Scree plot of principal components with percentage explained variation |
| Chart  Description automatically generatedChart, bubble chart  Description automatically generated  **Figure S2 and S3:** Variables projected on PCs. Colour code gives cos^2 as means of representation (closer to 1 is more represented) |

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| Diagram  Description automatically generated |
| **Figure S4.** Hierarchical cluster analysis dendrogram with three clusters |