Supplementary Material

Suppl. Table:1 Details of input used in different production systems per year

		Production systems			
Input	Unit	PS-I	PS-II	PS-III	PS-IV
Labour	No.	106	235	245	270
Seed	kg	13	36.48	36.48	36.48
Manure compost	kg	5234	14908	15098	15358
Animal waste	kg	3854	11762	11838	12113
Crop residue (straw/stover)	kg	1380	3146	3260	3245
Bio pesticide for plant protection	l/kg	4	12.6	12.6	12.8
Water	l	30200	69000	73000	80300
Irrigation water	M^3	5.6	12.8	12.8	12.8
Fuel	l	6.2	13.2	13.2	13.2

PS-I: Mono-cropping cereals + livestock; PS-II: Diversified cropping + livestock; PS-III: Diversified cropping + livestock+ poultry; PS-IV: Diversified cropping + livestock+ poultry+piggery.

Suppl. Table:2 Details of economic output from different production systems per year

Particulars	Unit	Production systems			
		PS-I	PS-II	PS-III	PS-IV
Maize	kg	1133.5	710.4	708.8	723.6
Rice	kg	286.35	450.75	429.3	441.3
Black gram	kg	……	152.8	162	152.68
Vegetable pea	kg	……	1312.78	1392.72	1444.52
Spinach	kg	……	161.675	155.5	163.15
Coriander	kg	…….	222.2	214.8	197.6
Broccoli	kg	…….	189.875	203.2	205.45
Fenugreek	kg	……	233.95	231.3	233.4
Cauliflower	kg	……	212.09	223.9	200.3
Cabbage	kg	……	157.25	152.6	151.025
Fodder	kg	…….	3443	3452	3056
Fodder (winter)	kg	……	1874	1904	1890
Milk	l	1234.52	2646.72	2515.24	2409.68
Calf	No.	1	2	2	1
Poultry bird	No.	……	…..	23	21
Poultry eggs	No.	…..	…..	1955	1725
Pig live weight	kg	…….	…..	…..	77.4
Piglets	No.	…..	….	…..	12.0

PS-I: Mono-cropping cereals + livestock; PS-II: Diversified cropping + livestock; PS-III: Diversified cropping + livestock+ poultry; PS-IV: Diversified cropping + livestock+ poultry+piggery.

Suppl. Table: 3 Energy coefficient used in the study

Input	**Unit**	**Energy value (MJ per unit)**	**References**
Labour	hr	1.96	[1]
Diesel	l	47.87	[1]
Farm machinery	kg	62.7	[1]
Electricity kWh	kWh	3.6	[2]
FYM	kg	0.3	[3]
Vermicompost	kg	1.5	[4]
Irrigation water	M^3	1.02	[5]
Chick	kg	4.56	[6]
Concentrate	kg	6.3	[7]
Minerals	kg	2	[8]
Seed	kg	14.7	[1]
Output			
Egg	kg	7.28	[9]
Milk	l	7.14	[10]
Meat	kg	9.22	[11]
Urine	l	0.64	[12]
Poultry meat	kg	10.33	[13]
Rice	kg	14.7	[14]
Maize stover	kg	183	[15]
Fodder dry	kg	18	[1]
Straw	kg	12.5	[1]
Vegetables	kg	0.8	[12]

Suppl Table: 4 Waste recycling potential and nutrients balance in different systems

Production systems	Total waste recycled (Mg y^{-1})	Nutrient generated/recycled from waste (kg y^{-1})			Nutrients economy (kg y^{-1})		
		N	P	K	N	P	K
PS -I	4.68	29.60	14.78	28.55	-12.40	-13.22	-13.45
PS-II	14.91	85.67	45.8	88.31	-1.82	-1.19	-1.69
PS-III	15.10	89.37	46.21	90.37	1.87	-0.80	0.37
PS-IV	15.36	89.55	47.18	91.31	2.05	0.18	1.31

PS-I: Mono-cropping cereals + livestock; PS-II: Diversified cropping + livestock; PS-III: Diversified cropping + livestock+ poultry; PS-IV: Diversified cropping + livestock+ poultry+piggery.

Reference

1. Singh S, Mittal JP. Energy in production agriculture. New Delhi, India: Mittal Publications; 1992
2. Ozkan B, Kurklu A, Akcaoz H. An inputeoutput energy analysis in greenhouse vegetable production: a case study for Antalya region of Turkey. Biomass Bioenergy 2004;26:89e95. https://doi.org/10.1016/S0961-9534(03)00080-1.
3. Taki M, Ajabshirchi Y, Mobtaker HG, Abdi R. Energy consumption, input output relationship and cost analysis for greenhouse productions in Esfahan province of Iran. Am J Exp Agric 2012;2:485e501.
4. Singh, R., Babu, S., Avasthe, R. K., Yadav, G. S. and Rajkhowa, D. J. 2016. Productivity, economic profitability and energy dynamics of rice (*Oryza sativa* L.) under diverse tillage and nutrient management practices in rice-vegetable pea cropping system of Sikkim Himalayas. *Indian Journal of Agricultural Sciences* **86**(3): 326–30.
5. Tuti MD, Prakash V, Pandey BM, Bhattacharyya R, Mahanta D, Bisht JK, et al. Energy budgeting of colocasia-based cropping systems in the Indian sub-Himalayas. Energy 2012;45:986e93. https://doi.org/10.1016/j.energy.2012.06.056
6. Gopalan C, Rama Sastri BV, Balasubramanian SC. Nutritive value of Indian foods. 1971.
7. Komleh PSH, Omid M, Keyhani A. Study on energy use pattern and efficiency of corn silage in Iran by using data envelopment analysis (DEA) technique. Int J Environ Sci 2011;1:1094.

8. Wells C. Total energy indicators of agricultural sustainability: dairy farming case study. Technical Paper, MAF Information Bureau, P O Box- 2526, Wellington. 2001.
9. Baum AW, Patzek T, Bender M, Renich S, Jackson W. The visible, sustainable farm: a comprehensive energy analysis of a Midwestern farm. CRC Crit Rev Plant Sci 2009;28:218e39.
10. Coley DA, Goodliffe E, Macdiarmid J. The embodied energy of food: the role of diet. Energy Policy 1998;26:455e9.
11. Frorip J, Kokin E, Praks J, Poikalainen V, Ruus A, Veerm€ae I, et al. Energy consumption in animal production-case farm study. Agron Res Biosyst Eng Spec 2012;1:39e48.
12. Paramesh, Venkatesh; Parajuli, Ranjan; Chakurkar, E.B.; Sreekanth, G.B.; Kumar, H.B. Chetan; Gokuldas, P.P.; Mahajan, Gopal R.; Manohara, K.K.; Viswanatha, Reddy K.; Ravisankar, N. (2019). Sustainability, energy budgeting, and life cycle assessment of crop-dairy-fish-poultry mixed farming system for coastal lowlands under humid tropic condition of India*. Energy, 188, 116101–*. doi:10.1016/j.energy.2019.116101
13. FNAS. Nutritive values of Thai foods. Food and nutrition analysis section, Nutrition Division, Department of Health, Ministry of Public Health, Thailand(in Thai). 2001.
14. Babu, S., Singh, R., Avasthe, R. K., Yadav, G. S. and Rajkhowa, D. J. 2016. Intensification of maize (*Zea mays*)–based cropping sequence in rainfed ecosystem of Sikkim Himalayas for improving system productivity, profitability, employment generation and energy-use efficiency under organic management condition. *Indian Journal of Agricultural Sciences* **86**(6): 778–84
15. Pimentel D, Burgess M. Energy inputs in corn production. Energy Inputs Corn Prod 1980:67e84.

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