Table S1. Nutrient content (%) in different organic manures and application rate

Year	Crop	Organic manures	Nitrogen	Phosphorus	Potassium	Application rate (kg/ha)
2014-15	Maize	Vermicompost	1.56	0.51	1.07	3205
		Farm yard manure	0.65	0.26	0.41	7692
		Brassicaceous seed meal	4.82	1.76	1.22	1037
		Neem cake	5.23	1.09	1.44	956
2015	Rice	Vermicompost	1.57	0.52	1.02	955
		Farm yard manure	0.62	0.24	0.48	2419
		Brassicaceous seed meal	4.89	1.70	1.25	307
		Neem cake	5.30	1.11	1.33	283
2015-16	Maize	Vermicompost	1.54	0.52	0.99	3247
		Farm yard manure	0.59	0.25	0.43	8475
		Brassicaceous seed meal	4.80	1.77	1.21	1042
		Neem cake	5.18	1.07	1.43	965
2016	Rice	Vermicompost	1.59	0.54	1.02	943
		Farm yard manure	0.66	0.22	0.40	2273
		Brassicaceous seed meal	4.90	1.81	1.15	306
		Neem cake	5.13	1.19	1.36	292

Table S2. Energy calculation for maize production system/hectare (Based on mean data of two years)

Farm operation	Energy source	Amount/Unit	Calculation	Energy input (MJ)
Land preparation	Ploughing by tractor along with cultivator	2 times × 1.25 hrs. = 2.5 hrs.	[Wt. of the tractor (kg) / Life span (hrs.)] × MJ × hours of operation = [2500 / 12000] × 64.80 × 2.5 = 33.75 MJ [Wt. of the cultivator (kg) / Life span (hrs.)] × MJ × hours of operation = [400 / 6000] × 64.80 × 2.5 = 10.80 MJ	44.55 MJ
	Ploughing by tractor along with rotavator	1 times × 2.5 hrs. = 2.5 hrs.	[Wt. of the tractor (kg) / Life span (hrs.)] × MJ × hours of operation = [2500 / 12000] × 64.80 × 2.5 = 33.75 MJ [Wt. of the rotavator (kg) / Life span (hrs.)] × MJ × hours of operation = [400 / 4000] × 64.80 × 2.5 = 10.80 MJ	44.55 MJ
	Levelling by tractor along with harrow	1 times × 1.25 hrs. = 1.25 hrs.	[Wt. of the tractor (kg) / Life span (hrs.)] × MJ × hours of operation = [2500 / 12000] × 64.80 × 1.25 = 16.87 MJ [Wt. of the harrow (kg) / Life span (hrs.)] × MJ × hours of operation = [300 / 6000] × 64.80 × 1.25 = 4.05 MJ	20.92 MJ
	Diesel consumption for tractor (4 L/hr.)	6.25 hrs.	6.25 × 4 × 56.31MJ = 1407.75 MJ	1407.75 MJ
	Driver for tractor (Human)	1 man 6.25 hrs.	1 × 6.25 × 1.96 MJ = 12.25 MJ	12.25 MJ
	Preparation of layout, bund, irrigation channel and dressing (according to the layout of experiment) and remove stubbles	15 men for 6 hrs.	15 × 6 × 1.96 MJ = 176.4 MJ	176.4 MJ
Sowing	Seed	15 kg	15 × 14.70 MJ = 220.5 MJ	220.5 MJ
	Labour	15 men for 8 hrs.	15 × 8 × 1.96 MJ = 235.2 MJ	235.2 MJ
Irrigation	Water lifting pump (5 HP)	5 times × 5 hrs. = 25 hrs.	[Wt. of the engine (kg) / Life span (hrs.)] × MJ × hours of operation = [75 / 26280] × 64.80 × 25 = 4.62 MJ	4.62 MJ
	Diesel consumption for pump (4 L/hr.)	25 hrs.	25 × 4 × 56.31MJ = 5631 MJ	5631 MJ
	Pump operator (human)	5 man for 5 hrs.	5 × 5 × 1.96 MJ = 49 MJ	49 MJ
Plant protection and surveillance	Insecticide	1 times × 0.675 L = 0.675 L	0.675 × 184.63 MJ = 124.63 MJ	124.63 MJ
	Sprayer	Weight of the sprayer = 5.0 kg	[Wt. of the sprayer (kg) / Life span (hrs.)] × MJ × hours of operation = [5.0 / 17520] × 62.70 × 16 MJ = 0.29 MJ	0.29 MJ
	Labour	2 men for 8 hrs	2 × 8 × 1.96 MJ = 31.36 MJ	31.36 MJ
Harvesting (cob plucking and stalk cutting)		30 men for 8 hrs	30 × 8 × 1.96 MJ = 470.4 MJ	470.4 MJ
Post-harvest operation (dehusking, shelling, storing)		38 men for 8 hrs	38 × 8 × 1.96 MJ = 595.84 MJ	595.84 MJ
Total				9069.26 MJ

Table S3. Energy utilized through different nutrient and weed management practices in maize production system/hectare (Based on mean data of two years)

Treatment	Urea	SSP	MOP	Organic manure	Application	Total energy
Nutrient management						
NM_1	200 × 60.6 MJ = 12120 MJ	60 × 11.1 MJ = 666 MJ	60 × 6.7 MJ = 402 MJ	–	Basal: 2 men for 6 hrs. 2 × 6 × 1.96 MJ = 23.52 MJ; Top dressing (2 times): 4 men for 8 hrs. 4 × 8 × 1.96 MJ = 62.72 MJ; Total = 86.24 MJ	13274.24 MJ
NM_2	150 × 60.6 MJ = 9090 MJ	60 × 11.1 MJ = 666 MJ	60 × 6.7 MJ = 402 MJ	3326 × 0.60 × 0.3 MJ = 598.68 MJ	Basal (fertilizer): 2 men for 6 hrs. 2 × 6 × 1.96 MJ = 23.52 MJ; Basal (Organic manure): 2 men for 6 hrs. 2 × 6 × 1.96 MJ = 23.52 MJ; Top dressing (2 times): 4 men for 8 hrs. 4 × 8 × 1.96 MJ = 62.72 MJ; Total = 109.76 MJ	10866.44 MJ
NM_3	–do–	–do–	–do–	8065 × 0.24 × 0.3 MJ = 580.68 MJ	–do–	10848.44 MJ
NM_4	–do–	–do–	–do–	1040 × 0.89 × 0.3 MJ = 277.68 MJ	–do–	10545.44 MJ
NM_5	–do–	–do–	–do–	961 × 0.90 × 0.3 MJ = 259.47 MJ	–do–	10527.23 MJ

Treatment	Herbicide	Application		Mechanical weeding		Total energy
		Sprayer	Labour	Mechanical weeder	Operation	
Weed management						
WM_1	–	–	–	–	–	–
WM_2	Atrazine: 2.0 × 254.45 MJ = 508.9 MJ	[Wt. of the sprayer (kg) / Life span (hrs.)] × MJ × hours of operation = [5.0 / 17520] × 62.70 × 16 MJ = 0.29 MJ	Two men for 8 hrs. 2 × 8 × 1.96 MJ = 31.36 MJ	–	–	550.55 MJ
WM_3	–do–	–do–	–do–	[Wt. of the weeded (kg) / Life span (hrs.)] × MJ × hours of operation = [4 / 11680] × 64.80 × 184 = 4.08 MJ	Twenty three men for 8 hrs. 23 × 8 × 1.96 MJ = 360.64 MJ	905.27 MJ

ATR 50 (Atrazine): 2.0 kg/ha; Moisture content (%): Vermicompost- 40; Farm Yard Manure- 76; *Brassicaceous* Seed Meal- 11; Neem cake- 10

Table S4. Energy calculation for greengram production system/hectare (Based on mean data of two years)

Farm operation	Energy source	Amount/Unit	Calculation	Energy input (MJ)
Land preparation	Ploughing by power tiller	3 times × 8 hrs. = 24 hrs.	[Wt. of the power tiller (kg) / Life span (hrs.)] × MJ × hours of operation = [150 / 6000] × 64.80 × 24 = 38.88 MJ	38.88 MJ
	Diesel consumption for power tiller (0.75 mL/hr.)	24 hrs.	24 × 0.75 × 56.31MJ = 1013.58 MJ	1013.58 MJ
	Driver for power tiller (Human)	1 man 24 hrs.	1 × 24 × 1.96 MJ = 47.04 MJ	47.04 MJ
	Preparation of layout, bund, irrigation channel and dressing (according to the layout of experiment) and remove stubbles	3 men for 8 hrs.	3 × 8 × 1.96 MJ = 47.04 MJ	47.04 MJ
Sowing	Seed	25 kg	25 × 14.70 MJ = 367.5 MJ	367.5 MJ
	Labour	15 men for 8 hrs.	15 × 8 × 1.96 MJ = 235.2 MJ	235.2 MJ
Irrigation	Water lifting pump (5 HP)	2 times × 5 hrs. = 10 hrs.	[Wt. of the engine (kg) / Life span (hrs.)] × MJ × hours of operation = [75 / 26280] × 64.80 × 10 = 1.85 MJ	1.85 MJ
	Diesel consumption for pump (4 L/hr.)	10 hrs.	10 × 4 × 56.31MJ = 2252.4 MJ	2252.4 MJ
	Pump operator (human)	2 man for 5 hrs.	2 × 5 × 1.96 MJ = 19.6 MJ	19.6 MJ
Interculture operation	Thinning and gap filling	7 men for 10 hrs	7 × 10 × 1.96 MJ = 137.2 MJ	137.2 MJ
Plant protection and surveillance	Insecticide	1 times × 0.15 L = 0.15 L	0.15 × 184.63 MJ = 27.69 MJ	27.69 MJ
	Sprayer	Weight of the sprayer = 5.0 kg	[Wt. of the sprayer (kg) / Life span (hrs.)] × MJ × hours of operation = [5.0 / 17520] × 62.70 × 16 MJ = 0.29 MJ	0.29 MJ
	Labour	2 men for 8 hrs	2 × 8 × 1.96 MJ = 31.36 MJ	31.36 MJ
Harvesting (pod plucking and stalk cutting)		30 men for 8 hrs	30 × 8 × 1.96 MJ = 470.4 MJ	470.4 MJ
Post harvest operation (threshing, storing)		23 men for 8 hrs	23 × 8 × 1.96 MJ = 360.64 MJ	360.64 MJ
Total				5050.67 MJ

Table S5. Energy utilized through different nutrient (residual) and weed management practices in greengram production system/hectare (Based on mean data of two years)

Treatment	Herbicide	Application		Mechanical weeding		Total energy
		Sprayer	Labour	Mechanical weeder	Operation	
Weed management						
WM_1	–	–	–	–	–	–
WM_2	Imazethapyr: 1.00 × 254.45 MJ = 254.45 MJ	[Wt. of the sprayer (kg) / Life span (hrs.)] × MJ × hours of operation = [5.0 / 17520] × 62.70 × 16 MJ = 0.29 MJ	Two men for 8 hrs. 2 × 8 × 1.96 MJ = 31.36 MJ	–	–	286.1 MJ
WM_3	Pendimethalin: 3.33 × 254.45 MJ = 847.32 MJ	–do–	–do–	[Wt. of the weeded (kg) / Life span (hrs.)] × MJ × hours of operation = [4 / 11680] × 64.80 × 240 = 5.33 MJ	Thirty men for 8 hrs. 30 × 8 × 1.96 MJ = 470.4 MJ	1354.7 MJ

Depend (Pendimethalin): 3.33 kg/ha; Weed Block (Imazethapyr): 1.00 kg/ha

Table S6. Energy calculation for rice production system/hectare (Based on mean data of two years)

Farm operation	Energy source	Amount/Unit	Calculation	Energy input (MJ)
		Raising of seedling in the nursery bed		
Land preparation	Ploughing by power tiller	1 times × 2 hrs. = 2 hrs.	[Wt. of the power tiller (kg) / Life span (hrs.)] × MJ × hours of operation = [150 / 6000] × 64.80 × 2 = 3.24 MJ	3.24 MJ
	Diesel consumption for power tiller (0.75 mL/hr.)	2 hrs.	2 × 0.75 × 56.31MJ = 84.47 MJ	84.47 MJ
	Driver for power tiller (Human)	1 man 2 hrs.	1 × 2 × 1.96 MJ = 3.92 MJ	3.92 MJ
	Cleaning the stubbles and raise the seed bed	2 man 8 hrs.	Men = 2 x 8 x 1.96 MJ = 31.36 MJ	31.36 MJ
Fertilizer in seed bed	N	10 kg	= 10 x 60.60 MJ = 606.00 MJ	606.00 MJ
	P_2O_5	2 kg	= 2 x 11.1 MJ = 22.20 MJ	22.20 MJ
	K_2O	2 kg	= 2 x 6.7 MJ = 13.40 MJ	13.40 MJ
	Application	1 man 3 hrs.	Men = 1 x 3 x 1.96 MJ = 6.88 MJ	6.88 MJ
Sowing	Seed	50 kg	50 × 14.70 MJ = 735 MJ	735 MJ
	Sowing	1 man 6 hrs.	Men = 1 x 6 x 1.96 MJ = 11.76 MJ	11.76 MJ
Irrigation	Water lifting pump (5 HP)	2 times × 2 hrs. = 4 hrs.	[Wt. of the engine (kg) / Life span (hrs.)] × MJ × hours of operation = [75 / 26280] × 64.80 × 4 = 0.74 MJ	0.74 MJ
	Diesel consumption for pump (4 L/hr.)	4 hrs.	4 × 4 × 56.31MJ = 901 MJ	901 MJ
	Pump operator (human)	2 man for 2 hrs.	2 × 2 × 1.96 MJ = 7.84 MJ	7.84 MJ
		Main field operation		
Land preparation	Ploughing by power tiller	4 times × 8 hrs. = 32 hrs.	[Wt. of the power tiller (kg) / Life span (hrs.)] × MJ × hours of operation = [150 / 6000] × 64.80 × 32 = 51.84 MJ	51.84 MJ
	Levelling by bullocks	1 pair for 16 hrs.	16 × 1 × 10.1MJ = 161.6 MJ	161.6 MJ
	Diesel consumption for power tiller (0.75 mL/hr.)	32 hrs.	32 × 0.75 × 56.31MJ = 1351.44 MJ	1351.44 MJ
Farm operation	Energy source	Amount/Unit	Calculation	Energy input (MJ)
	Driver for power tiller (Human)	1 man 32 hrs.	1 × 32 × 1.96 MJ = 62.72 MJ	62.72 MJ
	Human	1 man 16 hrs.	Men = 1 x 16 x 1.96 MJ = 31.36 MJ	31.36 MJ
	Preparation of layout, bund, irrigation channel and dressing (according to the layout of experiment) and remove stubbles	15 men for 6 hrs.	15 × 6 × 1.96 MJ = 176.4 MJ	176.4 MJ
Transplanting	Labour	30 women for 6 hrs.	30 × 6 × 1.57 MJ = 282.6 MJ	282.6 MJ
Irrigation	Water lifting pump (5 HP)	2 times × 5 hrs. = 10 hrs.	[Wt. of the engine (kg) / Life span (hrs.)] × MJ × hours of operation = [75 / 26280] × 64.80 × 10 = 1.85 MJ	1.85 MJ
	Diesel consumption for pump (4 L/hr.)	10 hrs.	10 × 4 × 56.31MJ = 2252.4 MJ	2252.4 MJ
	Pump operator (human)	2 man for 5 hrs.	2 × 5 × 1.96 MJ = 19.6 MJ	19.6 MJ
Plant protection and surveillance	Insecticide	1 times × 0.675 L = 0.675 L	0.675 × 184.63 MJ = 124.63 MJ	124.63 MJ
	Sprayer	Weight of the sprayer = 5.0 kg	[Wt. of the sprayer (kg) / Life span (hrs.)] × MJ × hours of operation = [5.0 / 17520] × 62.70 × 16 MJ = 0.29 MJ	0.29 MJ
	Labour	2 men for 8 hrs	2 × 8 × 1.96 MJ = 31.36 MJ	31.36 MJ
Harvesting		23 men for 8 hrs	23 × 8 × 1.96 MJ = 360.64 MJ	360.64 MJ
Post harvest operation (threshing, storing)		23 men for 8 hrs	23 × 8 × 1.96 MJ = 360.64 MJ	360.64 MJ
Total				7697.18 MJ

Table S7. Energy utilized through different nutrient and weed management practices in rice production system/hectare (Based on mean data of two years)

Treatment	Urea	SSP	MOP	Organic manure	Application	Total energy
Nutrient management						
NM_1	60 × 60.6 MJ = 3636 MJ	30 × 11.1 MJ = 333 MJ	30 × 6.7 MJ = 201 MJ	–	Basal: 2 men for 6 hrs. 2 × 6 × 1.96 MJ = 23.52 MJ; Top dressing (2 times): 4 men for 8 hrs. 4 × 8 × 1.96 MJ = 62.72 MJ; Total = 86.24 MJ	4256.24 MJ
NM_2	45 × 60.6 MJ = 2727 MJ	30 × 11.1 MJ = 333 MJ	30 × 6.7 MJ = 201 MJ	950 × 0.60 × 0.3 MJ = 171 MJ	Basal (fertilizer): 2 men for 6 hrs. 2 × 6 × 1.96 MJ = 23.52 MJ; Basal (Organic manure): 2 men for 6 hrs. 2 × 6 × 1.96 MJ = 23.52 MJ; Top dressing (2 times): 4 men for 8 hrs. 4 × 8 × 1.96 MJ = 62.72 MJ; Total = 109.76 MJ	3541.76 MJ
NM_3	–do–	–do–	–do–	2344 × 0.24 × 0.3 MJ = 168.77 MJ	–do–	3539.53 MJ
NM_4	–do–	–do–	–do–	307 × 0.89 × 0.3 MJ = 81.97 MJ	–do–	3452.73 MJ
NM_5	–do–	–do–	–do–	288 × 0.90 × 0.3 MJ = 77.76 MJ	–do–	3448.52 MJ

Treatment	Herbicide	Application		Mechanical weeding		Total energy
		Sprayer	Labour	Mechanical weeder	Operation	
Weed management						
WM_1	–	–	–	–	–	–
WM_2	Bispyribac-Na: 0.25 × 254.45 MJ = 63.61 MJ Metsulfuron methyl + chlorimuron ethyl: 0.02 × 254.45 MJ = 5.09 MJ Total: 68.7 MJ	[Wt. of the sprayer (kg) / Life span (hrs.)] × MJ × hours of operation = [5.0 / 17520] × 62.70 × 16 MJ = 0.29 MJ	Two men for 8 hrs. 2 × 8 × 1.96 MJ = 31.36 MJ	–	–	100.35 MJ
WM_3	Bensulfuron methyl + pretilachlor: 10 × 254.45 MJ = 2544.5 MJ	–	One man for 8 hrs. 1 × 8 × 1.96 MJ = 15.68 MJ	[Wt. of the weeded (kg) / Life span (hrs.)] × MJ × hours of operation = [6 / 11680] × 64.80 × 240 = 7.99 MJ	Thirty men for 8 hrs. 30 × 8 × 1.96 MJ = 470.4 MJ	3038.57 MJ

Moisture content (%): Vermicompost- 40; Farm Yard Manure- 76; *Brassicaceous* Seed Meal- 11; Neem cake- 10

Nominee Gold (Bispyribac-Na): 250 mL/ha; Almix (Metsulfuron methyl + chlorimuron ethyl): 20 g/ha; Erase Strong (Bensulfuron methyl + pretilachlor): 10 kg/ha