

Full Length Research Paper

Earthquake relief measures through promotion of improved farm implements, renewable energy gadgets and agro-processing technologies in Sikkim, India

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The North East hill region has a total geographical area of 275000 km² of which 212000 km² is under hills. The 0.43 million rural people are living in four districts of Sikkim. The Sikkim is badly affected due to earthquakes. There is a huge loss in the state which was estimated as \$45.8 million by State government. The union government has sanctioned \$208.33 million for the earthquake victims. The main crops in Sikkim are rice, maize, black gram, mustard, cardamom, finger, passion fruit, mandarin etc. The rural population of Sikkim needs immediate relief measures (short term and long term strategy for employment opportunities) through engineering interventions in the disciplines of renewable energy, agro and food processing and entrepreneurship development for commercialization of improved farm technologies. The establishment of modern rice mill (capacity 0.5 t/h) costing \$20833.33 need to be established in each block of state. The organic agro-processing centre costing \$8333.33 within 5 km periphery is the ideal approach for each 10 clusters in terrace condition. The Sikkim state has production of mandarin (9256 tons) and passion fruit (293 tons) annually which need processing for value addition ensuring employment opportunities (Anonymous, 2009). The small gadgets of renewable energy like solar cooker, solar lantern, solar dryer, solar street light, solar water heating system, improved cook-stove should be made available to all consumers of earth affected regions.

Key words: Earthquake, mandarin, terrace, gadgets, passion fruit.

INTRODUCTION

In the country 433 million laborers (94%) are engaged in unorganized sector out of 459 million total available laborers. The laborers in agricultural sector constitute 269 million (Anonymous, 2010). Sikkim is the smallest state of India in terms of population and area, the state is bounded by three sovereign nation's viz. Nepal in the West, Bhutan in the East and China's Tibet region in the North. The state shares its Southern borders with the state of West Bengal as shown in Figure 1. The rural population constitute approximate 0.43 million out of total population (0.7 million) in the Sikkim state. The state has 11% cultivated area which is covered using animate power sources (Anonymous, 2010). The thrust on renewable energy gadgets can bring down the hardships

of rural people through installation of solar water heating system, solar lantern, solar dryer, solar photo voltaic street lights and solar cookers (Pandey et al., 2008).

The agro-processing gadgets viz. seed cleaner cum grader, maize sheller, chaff cutter, flour mill working on rotary mode of operation of draught animals need to be established as earthquake relief measures. The agro-clinic for processing and food based commodities (spices, cereals, pulses and oilseeds) can boost employment opportunities in the affected areas from the central grant of \$10.41 million during 2011 to 2012. The participatory training on efficient management of draught animals and nutritive feed formulation for different type of work animals, improved animal housing and health care measures have been initiated in earthquake affected areas of Sikkim.

The subsidy for purchase of equipment/gadgets be enhanced and skill development is need of hour in such

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Figure 1. Geographical Map of Sikkim State in India.

regions of Sikkim. The mechanized farming (power tiller/mechanical sources) in terrace condition with suitable matching equipment for the prevailing cropping pattern can usher the economy (Pandey et al., 2006). The entrepreneurship development through involvement of rural artisan can boost the employment opportunity in North Sikkim district which is most affected. The processing of paddy with mini rice mill/huller needs to be initiated in all the blocks of four districts of Sikkim. In each district one modern rice mill (capacity 0.5 t/h) costing \$20833.33 can create more employment opportunities for earthquake victims.

The objective of paper is to evolve strategy and conduct frontline demonstrations for promotion of improved engineering interventions in the disadvantaged region of country which is situated in hills where farmers are not aware about farm mechanization and gadgets related with renewable and post harvest technologies.

The packages suggested will be the bench mark for self-help groups/NGO for which fund had already been ensured by union Government of India. At present the hill region has no use of any improved implements and machinery suitable for terrace cultivation. The region is needed renewable energy and post harvest gadgets for boosting the employment opportunities which will prove boon for earthquake affected people of Sikkim surrounded by foreign countries (Nepal, Bhutan and China).

The total households of 1.10 lakh are in hardships that can be benefited through different package as described

in this paper. It is a pioneer study in any hill stat in India which could provide benefits to a great extent for upliftment of earthquake affected people of Sikkim.

METHODOLOGY

From secondary sources district wise data have been collected on renewable energy gadgets, post harvest gadgets and existing equipment. Average power availability from a pair of bullocks is 0.19 kW/ha in Sikkim. The cultivated area per bullock pair is 4 ha. The maximum power availability (0.138 kW/ha) is in west Sikkim. The command area by use of traditional equipment is 1 ha (50 to 70 terraces) which can be increased up to 1.5 ha by used of improved farm equipment. Maximum farmers are dependent upon animal power for cultivation (Livestock Census 2005 to 2006). The annual use of bullock pair varies 60 to 100 days and they engage laborers (average 100 in number). The animal shed with overall dimensions of 5 × 3 × 2.5 m are commonly available in clusters in different districts. The traditional yoke (Pani, size 1 m) for rice crop and (Pakha 1.5 m for other crops) are being practiced varying in weight from 2.5 to 3 kg. The local bullock pair (Siri) have unit price of Rs. 10000 to 15000. The body weight of such local breed varies 200 to 300 kg per bullock.

The status of victims available was used to estimate the packages required indifferent clusters of all the four districts. The cost of improved animal drawn package varied \$699.15 to 761.65. For total bullock pair (25000/-) there will be need of \$18.26 million. The frontline demonstrations of animal drawn wing plough, helical blade puddler, clod-crusher cum leveler cum puddler, single/two row seed drill, zero till seed drill and animal drawn planter, manual wheel hoe and manual paddy thresher were demonstrated in different parts of hill state. The small size, light weight implements, and other gadgets supply is ensured through local manufacturers



Figure 2. Operation with animal drawn improved sweep cultivator.



Figure 3. Operation with animal drawn helical blade puddler.

and with the involvement of Central Institute of Agricultural Engineering, Bhopal- India. The figures of frontline demonstrations of improved equipment were organized in different districts of Sikkim which are shown in Figures 2 to 5.

RESULTS AND DISCUSSION

Package of animal drawn improved equipment

The proven designs of improved equipment have been identified for promotion in terrace condition in different

districts of Sikkim which is listed in Tables 1 to 6. If such package is made available to the small and marginal farmers for the available bullocks pair (25000) of Sikkim then it might be of great help for the victims of earthquake in Sikkim.

Package of post harvest technologies

The unit operations for value addition of cereals, pulses, oilseeds, spices, ginger, cardamom, turmeric can generate employment and the installation of such units. The



Figure 4. Seeding of mustard by use of with animal drawn single row seed drill.



Figure 5. Seedbed preparation with wing plough.

marketing of value added products with proper network within and outside states can restore the economy in rural Sikkim.

The agro-processing units are needed to be established in each village of all the districts. The details of equipment Agro Processing Complex is given in Table 7. The cost of Agro-processing complex is worked as \$16791.62. If 15000 units in such villages of Sikkim are installed it will require investment of \$251.87 million.

Package of renewable energy gadgets

The renewable energy gadgets which can be provided for the development of earthquake pit region are listed in Table 8.

The households (0.11 million) of Sikkim can be benefited by providing set of renewable energy gadgets costing \$ 12043.17 for one set of gadgets. Thus if 15000 sets of gadgets of renewable energy are made available

Table 1. Rice crop package of improved equipment.

Equipment/Practice	Unit price (\$)	Field capacity (ha/h) (sq.m/h)	Time, h/ha	Cost of operation, \$/h	Cost of operation, \$/ha
Seedbed preparation					
Animal drawn improved plough (200 mm)	20.83	0.02 (200)	50	1.25	62.5
Animal drawn improved puddler	52.08	0.05 (500)	20	1.25	25
Animal drawn clod crusher leveler- planker (Size 750 mm)	31.25	0.056 (560)	18	1.39	25
Rice transplanting					
Manual 2 row rice transplanter	93.75	0.025 (250)	40	1.02	40.62
Manual sprouted rice seeder	125	0.04 (400)	25	0.97	24.37
Manual 4 row rice transplanter	31.25	0.05 (500)	20	1.22	24.37
Weeding and interculture					
Manual cono weeder	31.25	0.05 (500)	33	2.70	10.83
Harvesting					
Improved sickle	1.25	0.005 (50)	200	0.35	70
Threshing					
Pedal operated wireloop thresher	104.16	100 kg/h	20	1.22	24.37
Motorized wireloop thresher	208.33	250 kg/h	08	1.02	8.12
Total	699.15				315.18

Table 2. Wheat crop package of improved equipment.

Equipment/Practice	Unit price (\$)	Field capacity ha/h (sq.m/h)	Time (h/ha)	Cost of operation (\$/h)	Cost of operation (\$/ha)
Seedbed preparation					
Animal drawn improved plough (size 200 mm)	20.83	0.020	50	1.25	62.50
Animal drawn clod crusher leveler- planker (Size 750 mm)	31.25	0.056	18	1.39	25.02
Seeding					
Animal drawn two row seed drill	52.08	0.05	20	1.25	25
Harvesting					
Improved Sickle	1.25	0.006	166	0.35	58.1
Threshing					
Plot thresher (1 h p)	625	100	20	0.81	16.20
Total	730.41				186.82

there will be need of \$ 180.64 million.

Conclusion

The engineering measures for helping earthquake victims

will require \$ 450.77 million which will generate employment opportunities in Sikkim. Mobile repair workshops are required for promotions of mechanization in the hilly region. Low cost poly house for low volume high value crops including growing of planting materials are needed in affected regions. The wheel hoe is very

Table 3. Maize crop package of improved equipment.

Equipment/practice	Unit price (\$)	Field capacity ha/h (sq.m/h)	Time (h/ha)	Cost of operation (\$/h)	Cost of operation (\$/ha)
Seedbed preparation					
Animal drawn improved plough (200 mm)	20.83	0.020 (200)	50	1.25	62.5
Animal drawn clod crusher leveler- planker (Size 750 mm)	31.25	0.056 (500)	18	1.39	25.02
Seeding operation					
Manual maize planter	10.41	0.040 (400)	25	0.33	8.25
Animal drawn maize planter (2 row)	156.25	0.06 (600)	17	0.47	7.99
Weeding and Interculture					
Manual hand wheel hoe	7.29	0.010 (100)	100	0.35	35
Animal drawn three tyne cultivator	12.5	0.05 (500)	20	1.25	25
Harvesting					
Improved-sickle	1.25	0.005 (50)	200	0.35	70
Threshing					
Manual maize sheller	1.25	30	50	0.39	19.5
Maize dehusker cum sheller	520.83	250	06	1.39	8.34
Total	761.65				261.60

Table 4. Soyabean crop package of improved equipment.

Equipment/Practice	Unit price (\$)	Field capacity (ha/h) (sq.m/h)	Time (h/ha)	Cost of operation (\$/h)	Cost of operation (\$/ha)
Seedbed preparation					
Animal drawn improved plough (200 mm)	20.83	0.02 (200)	50	1.25	62.5
Animal drawn planker cum leveler (750 mm)	31.25	0.05 (500)	18	1.25	22.5
Seeding operation					
Animal drawn /Two row seed drill	52.08	0.05 (500)	20	1.25	25
Weeding and Interculture					
Manual wheel hoe	7.29	0.01 (100)	100	0.35	35
Animal drawn three tyne cultivator	12.5	0.05 (500)	20	1.25	25
Harvesting					
Improved sickle	1.25	0.005 (50)	200	0.35	70
Threshing					
Plot thresher (1 hp)	625	100 kg/h	20	0.81	16.2
Total	750.20				256.20

suitable implements for this region and attachments to this are suitable multi-purpose operations. The subsidy

on purchase of improved equipment will be enhanced from 25 to 75% as the paying capacity of hill farmers is

Table 5. Mustard crop package of improved equipment.

Equipment/Practice	Unit price (\$)	Field capacity (ha/h) (sq.m/h)	Time (h/ha)	Cost of operation (\$/h)	Cost of operation (\$/ha)
Seedbed preparation					
Animal drawn improved plough (200 mm)	20.83	0.02 (200)	50	1.25	62.5
Animal drawn planker cum leveler (200 mm)	31.25	0.02 (200)	18	1.25	22.5
Seeding operation					
Animal drawn /Two row seed drill	52.08	0.05 (500)	20	1.25	25
Weeding and Interculture					
Manual Wheel hoe	7.29	0.01 (100)	100	0.35	35
Animal drawn three tyne cultivator	12.5	0.05 (500)	20	1.25	25
Harvesting					
Improved sickle	1.25	0.005 (50)	200	0.35	70
Threshing					
Plot thresher (1 hp)	625	100 kg/h	16	1.02	16.32
Total	750.20				256.32

Table 6. Buckwheat crop package of improved equipment.

Equipment/Practice	Unit price (\$)	Field capacity (ha/h) (sq.m/h)	Time (h/ha)	Cost of operation (\$/h)	Cost of operation (\$/ha)
Seedbed preparation					
Animal drawn improved plough (200 mm)	20.83	0.02 (200)	50	1.25	62.5
Animal drawn planker cum leveler (750 mm)	31.25	0.02 (200)	18	1.25	22.5
Seeding operation					
Animal drawn two row seed drill	52.08	0.05 (500)	20	1.25	25
Weeding and Interculture					
Manual wheel hoe	7.29	0.01 (100)	100	0.35	35
Animal drawn three tyne cultivator	2.5	0.05 (500)	20	1.25	25
Harvesting					
Improved sickle	1.25	0.005 (50)	200	0.35	70
Threshing					
Plot thresher (1 hp)	625	100 kg/h	12	1.02	12.24
Total	750.20				252.24

very poor. There is need of skill development for manufacturing of improved tools and implements for the available skilled blacksmiths and small artisans available in the region.

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Table 7. Post harvest gadgets suitable for hills region in Sikkim.

S/N	Equipment	Capacity (kg/h)	Unit price (\$)
1	Pedal operated potato peeler	180	2312.50
2	Hand operated potato slicer	30	177.08
3	Pedal operated potato slicer	180	229.16
4	Dal mill	100	583.33
5	Pedal cum power operated seed cleaner cum grader	330-800	375
6	Manual double screen grain cleaner	150-225	83.33
7	Soy blanching unit	20	375
8	Manual soybean dehuller	35	312.50
9	Motorized soybean dehuller	80	375
10	Soybean flaking machine	20	416.66
11	Manual paneer pressing device	16	83.33
12	Multipurpose tray dryer	100	1145.83
13	Soy-paneer plant	50	3645.83
14	Huller	60-80	1666.66
15	Mini rice mill	250	3645.83
16	Mini oil expeller	5-10	739.58
17	Multi-purpose grain mill	10-20	625
		Total	16791.62

Table 8. Suitable proven renewable energy gadgets for affected regions of Sikkim.

S/N	Equipment	Capacity	Unit price (\$)
1	Solar water heating system	100 l/day	2083.33
2	Double reflector box type solar cooker	2 h for cooking rice and pulse	93.75
3	Cook stove	Thermal efficiency 25%	17.5
4	Solar cabinet dryer	50 kg/batch	322.91
5	Briquetting machine with motor	80 kg/day	666.66
6	Charring kiln	80 kg/day	145.83
7	Natural draft gasifier	4-5 kg/h	625
8	Portable updraft gasifier	20,000 k Cal/h	572.91
9	Solar photo voltaic system (1 KVA) for lighting in houses	6-8 h (4 points)	2083.33
10	Rotary transmission unit for battery charging	6-8 h	2708.33
11	Solar lantern	8 h	15.62
12	Solar street light system	12 h	2083.33
13	Solar tracking device	900 watts	625
		Total	12043.17

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