

Chapter 2- Agricultural Engineering

Technology no. 1

- 1. Name of technology:** Cook-stove run on powdery Biomass
- 2. Source of technology:** Department of Agricultural Engineering, AAU, Jorhat
- 3. Year of release:** 2010
- 4. Agro-climatic zone:** All zones of Assam
- 5. Detail description of technology:** This cook-stove run on powdery biomass (1.4 kg/hr) like paddy husk and rice chaff is recommended for use to supplement the household cooking energy needs and use crop residue as fuel (Thermal efficiency 11.5%). It consists of an outer container with a conical shaped hopper top made up of sheet metal, which is attached to the cylindrical shaped bottom portion of perforated sheet. In the centre, an inner cylinder of perforated sheet (holes of 3mm dia) is attached at a slightly less height. This acts as the combustion chamber. The hopper and combustion chamber placed on the top of grate made of perforated sheet, is pivoted at the center of the inner cylinder. It is almost maintenance free. Only maintenance required is the removal of ash by inverting the stove. The nut and the bolt of the grate need periodic tightening.

Management practices: Fill the rice chaff or husk in the outer cylinder up to the top maintain a space of 30mm-50mm below the edge of the container.

Use of only dry and fresh chaff or husk is recommended in the stove for burning. Take the wooden stick, wrap cotton waste at one end of it, and soak it in kerosene. Light it and insert inside the stove from the bottom port. In case of difficulty in burning the stove after lighting, check the chaff/husk if it is dry. Keep the stove away from direct blast of air due to wind or fan as it affects the burning and gasification. The flame will rise in the cylinder of the stove. The golden colour of the flame increases as the temperature of the rice chaff or husk rises and as gasification starts. The flow of combustible gases will be visible in the form of flames coming out of the perforations. As the gases burn completely, the colour of the flame changes to blue-red. This flame indicates the proper burning of the fuel and its optimum functioning. At this stage cooking of food or boiling of water can be done by simply placing the food/water in a cooking vessel/container and putting it on the stove and covering it on top.

The temperature or the heat can be lowered by simply removing the sticks from the bottom and hence can be adjusted as per requirement. The black colour of the chaff/husk indicates that the volatile matter has been exhausted. Therefore adding of more chaff or husk is recommended to continue burning.

Farming situations: Rice based cropping system

- 6. Critical inputs required:** Cook-stove run on powdery biomass (1.4 kg/hr) like paddy husk and rice chaff
- 7. Observations to be recorded:** Type of biomass fuel in use among the villagers before intervention, Amount of powdery biomass used per month after intervention, net benefit by using the improved cookstoves, Acceptability - cheap fuel in use or portability of the cookstove, B: C ratio. Farmers' reaction.
- 8. Additional information if any:** Cost benefit analysis

Assumption 1 - Assuming a household of 5 persons and per head consumption of firewood @1.12 kg per day. Hence for 5 member family fire wood consumed is 5.6 kg/day.

Assumption 2 – Paddy husk required for a 5 member family is 4kg/day.



Annual fuel consumption per Household	Using the traditional Cookstove	Using the improved cookstove run on powdery biomass.	Cost of fuel (Rs) Firewood @ 2/ kg Paddy husk@1/kg
Firewood	2,044 kg	Small quantity	Rs 3475 (assuming 15% from bari & 80% bought)
Paddy husk	-	1460 kg	Rs 1460 (firewood from bari)

Cost calculation on year basis –

For the portable metallic stove

The life of the improved cookstove (costing Rs 1800/-) can be assumed as 2yrs hence depreciation @ 50% on year to year basis.

Cost of a metallic improved cookstove run on paddy husk	= Rs 900
Maintenance cost @400/year*	= Rs 400
Fuel cost	= Rs 1460
Total	= Rs 2760

For the traditional cook-stove

Cost of running a traditional cook-stove with 80% of firewood bought from the market

@ Rs 2 /Kg = Rs 3475

Benefit of running a metallic improved cook-stove = Rs 3475 - Rs2760 = Rs 715/Yr

* The maintenance cost will include the replacement of worn out perforated inner cylinder.

The life of a perforated inner cylinder is 6 months.

Partial Budget Analysis Of Portable Metallic Stove

Particulars Qty Amount (Rs)

A) ADDED COST:

1. Depreciation of stove @ 50% 900
of cost of the Stove per year (Rs 1800)*
2. Maintenance cost 400
3. Paddy husk 1460

Total = 2760

B) ADDED RETURN: Nil

C) REDUCED COST:

1. Purchase of Fuel wood (85% bought firewood
For traditional stove is 2044 kg) 3475

Total =3475

D) REDUCED RETURN: Nil

= (Added return + Reduced cost) – (Reduced return + Added cost)

=3475 – 2760

=715

Therefore, % decrease in cost = $(715/3475) \times 100\%$

= 20.57% = 21% (approx)

Technology no. 2

- 1. Name of technology:** Solid State Bio-Gas Plant
- 2. Source of technology:** Department of Agricultural Engineering, AAU, Jorhat
- 3. Year of release:** 2009
- 4. Agro-climatic zone:** Suitable for all agro climatic zones
- 5. Detail description of technology:** The solid state biogas plant is recommended for use by to achieve reduction in water use while feeding (by 78%), enhanced gas production (30%) and ease in spent slurry handling (man-hr reduction by 50%). It consists of a 30cm internal diameter RCC/PVC pipe placed at an inclination of 75degree. A feed hopper is provided at the upper end of the feed pipe to facilitate feeding of plant with dung. Enlarged outlet slurry chamber is provided to accommodate total volume of the slurry displaced from the digester with an inclined smooth surface for streamlining the flow of the digested slurry. An outlet channel widening from 15- 30cm is present to facilitate self discharge of the digested slurry on to ground. The interior side of the gas dome is provided with an additional layer of 1: 1 cement sand mortar plaster of about 8mm thickness to withstand higher gas pressure.
- 1. Management practices:** No or very little water is required for mixing with the dung and therefore feeding is far easier. No stirring required. Spent slurry (TS) is about 10-12%. The paste like digested slurry discharged from the plant gets dried within a week. It requires much lower space for drying and labour for handling. Relatively higher TS content makes handling of slurry easier compared to the conventional biogas plant. Biogas plant spent slurry (BSS). It is rich in N, P, K and several micronutrients. The slurry can be successfully utilized as component of integrated nutrient management (INM) practices of crop production to partially replace the inorganic fertilizer nutrients. 60 to 65 kg fresh dung/day and 11litre of water in the feedstock gives 1550-1700lit/day of combustible gas. Maintenance the solid-state plants are initially charged as usual with 1: 1 mixture of cattle dung and water (TSC of the slurry 8-10%) along with the inoculum. Fresh digested slurry (upto 10% of the total volume of the mixture) is collected from a nearby working biogas plant and fed into the new plant. After the plant operation gets stabilized, the substrate is changed from the liquid slurry to undiluted cattle dung. Fresh cattle dung (TSC 16-18%) @ more than 25 kg/ m³ capacities is straight away poured into the inlet pipe every day. The cattle dung slowly slides into the digester under gravity and the digested slurry flows out through the outlet channel. As far as possible feeding should be done regularly. Use fresh and neat cattle dung as substrate. If TSC of the dung is more than 18%, mix water thoroughly to bring it down to around 16%. Original shape off the dung should also be deformed before feeding for better digestion in the plant. The inlet pipe and outlet pit should be kept covered. This checks moisture loss/drying and ensures smooth flow of the cattle dung from inlet pipe to digester and digested slurry from outlet pit into the outlet channel.
Farming situations: Any cropping system coupled with
- 6. Critical inputs required:** Solid state biogas plant
- 7. Observations to be recorded:** Use of biogas as cooking fuel in the household. Use of spent slurry for nutrient enrichment in their crop fields. Maintenance of biogas plant particularly feeding the plant regularly without fail. B: C ratio Farmers' reaction.

8. Additional information if any:

Table : Cost and return of a Solid-state Deenbandhu Bio gas plant

Particulars	Unit	Quantity	Rate/Unit	Amount (Rs)
Size of the plant	2m ³			
Initial cost	Rs			34000**
Variable cost	Rs			
Dung as manure	Kg	2000*		-
Dung as fuel	kg/day	55*		-
Labour	man-days	47	114	5358
Total variable cost				5358
Bio gas production/day	m ³	1.4		
Annual production	m ³	511		
1m ³ bio gas =0.43 kg of LPG		219.73		
No of cylinder (1 cylinder contains 14.5 kg LPG)	No	15	924	13860
Net return				8502
B: C ratio				2.59

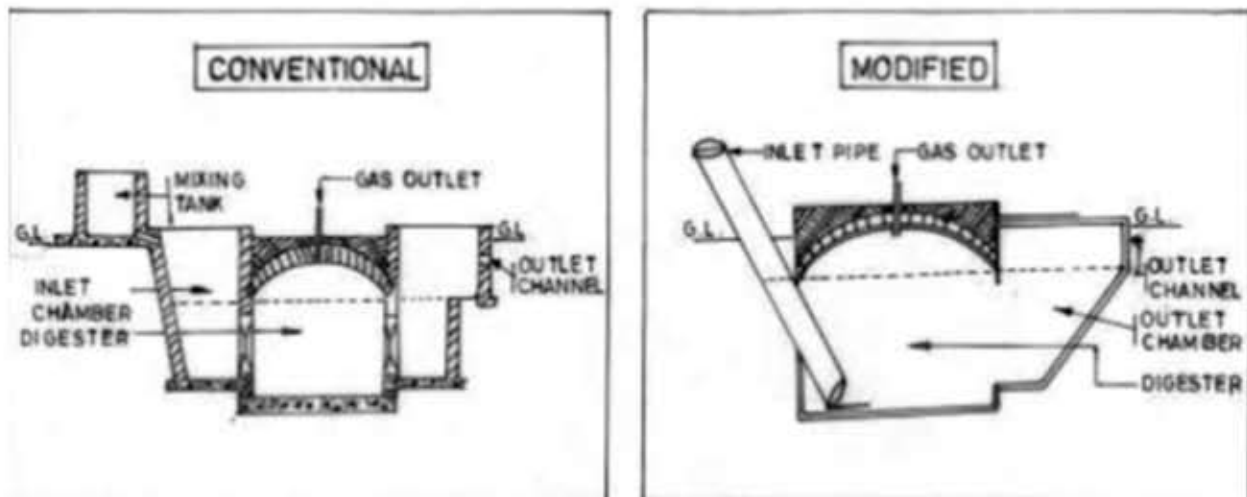


Fig. 1. Schematic diagram of conventional and solid state Janta biogas plant

Technology no. 3

1. **Name of technology:** Drip irrigation in Assam Lemon
2. **Source of technology:** Assam Agricultural University
3. **Year of release:** 2015
4. **Agro-climatic zone:** All zones of Assam
5. **Detail description of technology:** Plants are to be irrigated with 2 dripper of 2 LPH capacity fitted at a distance 30 cm from the trunk on either side of the plant. Irrigation frequency should be everyday during 1st week of November to 2nd week of April or initiation of pre-monsoon shower whichever is earlier.
6. **Critical inputs required:** Drip irrigation system as per specification
7. **Observations to be recorded:** Rainfall (mm), moisture status in soil, time of flowering and fruiting, yield, B: C Ratio, Farmers' reaction.

Technology no. 4

1. **Name of technology:** Fertigation through drip irrigation in Assam Lemon
2. **Source of technology:** Assam Agricultural University
3. **Year of release:** 2015
4. **Agro-climatic zone:** All zones of Assam
5. **Detail description of technology:** Fertigation through drip irrigation with 80% of recommended dose of N-P-K using Urea, DAP or MAP and MOP with a benefit to cost ratio of 4.04. Fertigation is to be done through 60 equal splits during 1st week of November to 2nd week of April or onset of pre monsoon rains whichever is earlier.
6. **Critical inputs required:** Drip irrigation system as per specification, Urea, DAP or MAP and MOP
7. **Observations to be recorded:** Rainfall (mm), moisture status in soil, time of flowering and fruiting, yield, B: C Ratio, Farmers' reaction, soil nutrient status.

Technology no.5

1. **Name of the Technology:** Tractor Drawn Rotavator
2. **Source of the Technology:** CAUCIAE, Bhopal
3. **Year of release:** 2003
4. **Agro Climatic Zone:** Eastern Himalayan Region/NEH Region
5. **Details description about the technology:** It consists of a steel frame, 3-point hitch system, a rotary shaft on which blades are mounted, power transmission system and a gearbox. The blades are of L-shape, made from medium carbon steel or alloy steel, hardened and tempered to suitable hardness. It uses the power from tractor PTO. Rotavator is used as both

primary and secondary tillage operations. A good seedbed and pulverization of the soil is achieved in a single pass of the Rotavator. It is used in both dry land and wet land conditions. It is also suitable for incorporating straw and manure in the field. The power requirement will vary depending upon the width of the Rotavator. It saves 60 percent operating time, 40 percent labour and 40 percent on cost of operation compared to conventional method of land preparation.



Fig: 1. Rotavator operation under dry land condition.



Fig: 2. Rotavator operation under wet land condition.

6. Critical inputs: Rotavator

7. Observations to be recorded:

- i. Puddling Index.
- ii. Field capacity.
- iii. Field efficiency
- iv. Fuel consumption.
- v. Depth of puddling.
- vi. Cost of operation per hectare.

8. Contact Address for relevant information:

- i. Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.
- ii. North Eastern Region Farm Machinery Training and Testing Institute (NERFMTTI), Biswanath Chariali, Sonitpur, Assam- 784176.

Technology no. 6

- 1. Name of the Technology:** Animal drawn Paddy puddler (small size for NEH region).
- 2. Source of the Technology:** CIAE, Bhopal.
- 3. Year of release:** 2002
- 4. Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
- 5. Details description about the technology:** It is a helical blade type of puddler suitable for puddling in wetland condition and also for cutting and mixing of green manure crop. The implement consists of tow angle iron brackets carrying a bush. These blade are imparted a twist along their length to form a helix. The handle for the operation is made of wood and help in comfortable operation. It saves 30 percent labour, 40 percent operating time and 30 percent cost of operation compared to conventional method of using country plough.
- 6. Critical inputs:** Peddler



Fig: 1. Animal drawn paddy puddler.

7. Observations to be recorded:

- Puddling Index.
- Field capacity.
- Field efficiency
- Depth of puddling.
- Cost of operation.

8. Contact Address for relevant information:

- Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.
- North Eastern Region Farm Machinery Training and Testing Institute (NERFMTTI), Biswanath Chariali, Sonitpur, Assam- 784176.

Technology no. 7

1. **Name of the Technology:** Self propelled vertical conveyor reaper.
2. **Source of the Technology:** CIAE, Bhopal.
3. **Year of release:** 2000
4. **Agro Climatic Zone:** Eastern Himalayan Region/NEH Region
5. **Details description about the technology:** It consists of crop row divider, star wheel, cutter bar, and a pair of lugged canvas conveyor belts and a handle fitted with clutch and brakes. This type of machines cut the crops and conveys it vertically to one end and windrows the crops on the ground uniformly. Collection of crop for making bundles is easy and it is done manually. Self-propelled walking type, self-propelled riding type and tractor mounted type vertical conveyor reaper are also available. These types of reapers are suitable for crops like wheat and rice. It can also harvest mustard, niger and other standing crops with some adjustment. In this reaper there is no shattering of the crop. It saves 90 percent labour, 60 percent operating time and operation cost compared to conventional method using sickle.
6. **Critical inputs:** Self propelled vertical conveyor reaper.
7. **Observations to be recorded:**
 - i. Field capacity (ha/hr).
 - ii. Field efficiency (%).
 - iii. Fuel consumption (lit/hr).
 - iv. Cutting width.
 - v. Cutting height.
 - vi. Labour requirement (man-hr/ha).
 - vii. Cost of harvesting per hectare.
8. **Contact Address for relevant information:**
 - i. Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.
 - ii. North Eastern Region Farm Machinery Training and Testing Institute (NERFMTTI), Biswanath Chariali, Sonitpur, Assam- 784176.



Fig.1: Paddy harvesting.



Fig.2: Mustard harvesting.



Fig.3: Niger harvesting.

Technology no. 8

- 1. Name of the Technology:** Multicrop Thresher.
- 2. Source of the Technology:** CIAE, Bhopal.
- 3. Year of release:** 1998
- 4. Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
- 5. Details description about the technology:** The high capacity multicrop thresher consists of a spike tooth cylinder, three-aspirators, cleaning sieves and feeding system. Three concaves made of square bars of different opening sizes are provided for threshing different crops. The cylinder, aspirators and shaker assembly receive power from PTO shaft of the tractor. The concave clearance, sieve clearance, screen slope and speeds of cylinder and blower can be adjusted according to the crop requirements. The beaters or spikes on the threshing cylinder hit the crop and the impact causes detachment of grains from the ear heads of the crop. The straw and some unthreshed grains move around the cylinder. The rubbing action between the straw, threshing drum and concave threshes the rest of grains and the straw is broken in the form of chaff. Threshed grains, chaff and other foreign matters pass through the concave openings and fall on the oscillating sieve assembly. The aspirators suck and blowout the chaff and lighter impurities through outlet. Cleaning sieves further separate the heavy straw, bigger impurities, clean grain, broken grain through oscillating motion of sieve assembly. The secondary inlet of blower does final cleaning and clean grain is obtained at the main grain outlet. It is suitable for threshing of wheat, maize, soybean, sorghum, sunflower, pigeon pea, gram, mustard and other similar crops. The output capacity of the machine is 500kg/hr to above 1000kg/hr depending on types of crops to be thresh. It saves 50 percent labour and operating time and 45 percent on cost of operation compared to manual threshing.



Fig.1. Paddy threshing.



Fig.2. Mustard threshing.



Fig.3. Niger threshing.

- 6. Critical inputs:** Multicrop Thresher.
- 7. Observations to be recorded:**
 - Output capacity (kg/hr)
 - Labour requirement (man-h/q)
 - Threshing efficiency (%)
 - Cleaning efficiency (%).
 - Total grain losses (%).

- vi. Broken grains (%).
- vii. Cost of threshing per hectare.

8. Contact Address for relevant information:

- i. Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.
- ii. North Eastern Region Farm Machinery Training and Testing Institute (NERFMTTI), Biswanath Chariali, Sonitpur, Assam- 784176.

Technology no. 9

- 1. Name of the Technology:** Axial flow paddy thresher.
- 2. Source of the Technology:** CIAE, Bhopal.
- 3. Year of release:** 1990
- 4. Agro Climatic Zone:** Eastern Himalayan Region /NEH Region.
- 5. Details description about the technology:** It consists of a threshing cylinder, concave, cylinder casing, cleaning system and feeding chute. In axial flow concept, the crop is fed from one end, moves axially and the straw is thrown out from the other end after complete threshing of the crop. During threshing, the crop rotates three and half times around the cylinder and all the grains get detached. The threshing cylinder is of peg type. The casing of the thresher has 7 louvers for moving the crop axially. Two aspirator blowers and two sieves are provided for cleaning. It saves 70 percent labour and operating time and 20 percent on cost of operation.



Fig.1. Axial flow paddy thresher.

- 6. Critical inputs:** Paddy thresher
- 7. Observations to be recorded:**
 - i. Output capacity (kg/hr).
 - ii. Labour requirement (man-h/q).

- iii. Threshing efficiency (%).
- iv. Cleaning efficiency (%).
- v. Total grain losses (%).
- vi. Broken grains (%).
- vii. Cost of threshing per hectare.

8. Contact Address for relevant information:

- i. Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.
- ii. North Eastern Region Farm Machinery Training and Testing Institute (NERFMTTI), Biswanath Chariali, Sonitpur, Assam- 784176.

Technology no. 10

- 1. Name of the Technology:** Tractor Drawn Post Hole Digger.
- 2. Source of the Technology:** CIAE, Bhopal.
- 3. Year of release:** 2004
- 4. Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
- 5. Details description about the technology:** Posthole digger is an attachment to the three-point linkage of tractor. It consists of an auger, which is driven through bevel gears. The auger gets drive from the tractor pto through a propeller shaft and bevel gear box. The perpendicularity of digging auger is maintained with four-bar linkage formed by hitching system the tie rod provided at the top, The tip of the auger is either diamond shaped or pointed with wings to suit to different soil conditions. The diameter and depth of hole can be changed by changing the auger assembly. It is suitable for planting orchards and forests. It saves 90 percent labour, time and 50 percent operating cost over manual digging.



Fig.1. Operation of Tractor operated post hole digger for planting banana sampling.

- 6. Critical inputs:** Post hole digger
- 7. Observations to be recorded:**

- i. Field capacity (holes/hr)
- ii. Operating cost (Rs./ha)

8. Contact Address for relevant information: Central Institute of Agricultural Engineering Nabi Bagh, Berasia Road, Bhopal - 462 038.

Technology no. 11

- 1. Name of the Technology:** Twin Wheel Hoe.
- 2. Source of the Technology:** CIAE, Bhopal.
- 3. Year of release:** 1996
- 4. Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
- 5. Details description about the technology:** Twin wheel hoe consists of two wheels, frame, V-blade fixed on a Tyne, U-clamp and a handle. The cutting and uprooting of weeds in field is done through push and pull type action of the equipment. The equipment is operated at optimum soil moisture condition and preferably after 20-25 days of sowing i.e. when the weeds are small i.e. 1 to 3 cm height for better weeding performance. It is used for weeding and intercultural operation in upland row crops.



Fig.1. Twin Wheel Hoe under operation

- 6. Critical inputs:** Twin Wheel Hoe.
- 7. Observations to be recorded:**
 - i. Field Capacity (%)
 - ii. Weeding Efficiency (%)
 - iii. Labour requirement (man-h/ha).
 - iv. Operating cost (Rs./ha).
- 8. Contact Address for relevant information:** Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.

Technology no. 12

1. **Name of the Technology:** Wheel Hoe.
2. **Source of the Technology:** ICAR, Barapani.
3. **Year of release:** 1996
4. **Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
5. **Details description about the technology:** The wheel hand hoe is a widely accepted weeding tool for doing weeding and interculture in row crops. It is a long handled tools operated by pushing and pulling action. The number of wheel varies from one to two and the diameter depends upon the design. The frame has provision to accommodated different types of soil working tools such as, straight blade, reversible blades, sweeps, V -blade, tine cultivator, pronged hoe, miniature furrower, spike harrow (rake) etc. It can be operated by a single person. It is used for weeding and intercultural operations in vegetables and other crops sown in rows.
6. **Critical inputs:** Wheel Hoe.



Fig.1. Wheel Hoe (Single tyne)

7. **Observations to be recorded:**
 - i. Field Capacity (%).
 - ii. Weeding Efficiency (%).
 - iii. Labour requirement (man-h/ha).
 - iv. Operating cost (Rs./ha).
8. **Contact Address for relevant information:**
 - i. Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umian (Barapani)-793103, Meghalaya.
 - ii. Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.

Technology no. 13

- 1. Name of the Technology:** Hand Ridger.
- 2. Source of the Technology:** CIAE, Bhopal.
- 3. Year of release:** 1996.
- 4. Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
- 5. Details description about the technology:** A manually operated hand ridger has been developed for making ridges. It consists of ridger and pulling beam with T- type handle. Field needs to be well prepared for getting better performance of equipment for making ridges/furrows. The equipment is operated by two women workers, one for pulling and another for pushing and guiding. It is used for making ridges in field to sow vegetables on ridges. It can also be use for earthing of vegetables crops. The equipment can also be used for making furrows in field for irrigation.
- 6. Critical inputs:** Hand Ridger



Fig.1. Hand Ridger

- 7. Observations to be recorded:**
 - Field Capacity
 - Labour requirement (man-h/ha)
 - Operating cost (Rs./ha).
- 8. Contact Address for relevant information:** Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.

Technology no. 14

1. **Name of the Technology:** Foot Sprayer.
2. **Source of the Technology:** CIAE, Bhopal.
3. **Year of release:** 1985
4. **Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
5. **Details description about the technology:** The foot sprayer is one of the ideal and versatile sprayers used for multipurpose spraying jobs. The sprayer consists of a pump operated by the foot lever, suction hose with strainer, delivery hose, spray lance fitted with shut off pistol valve, gooseneck bend and adjustable nozzles. The pump barrel is mounted on a steel frame, which provides it stability when placed on the ground. It has a provision of two strong springs, which retract the foot lever to its original position after each pumping stroke. The sprayer does not have inbuilt tank, therefore an additional storage device or container is required to store the spray liquid in which the strainer suction hose remains submerged. It has provision for the two discharge lines, which increases its versatility and field capacity. The plunger pump being a positive displacement pump, builds up a high pressure to throw spray liquid to larger distances with a suitable boom. For operation the inlet pipe is placed in the storage container and one person continuously operates the pump by foot lever. There is a provision for the operator to hold the sprayer at the top by V-type fixture. The other person directs the lance to the target. For spraying tall trees up to a height of 10 m, a high jet or bamboo lance. The foot sprayer is all purpose sprayers, suitable for both small and large scale spraying on field crops, in orchards, vegetable gardens, tea and coffee plantations, rubber estates, flower crops, nurseries etc.
6. **Critical inputs:** Foot Sprayer.
7. **Observations to be recorded:**
 - i. Field capacity (ha/day).
 - ii. Labour requirement (man-h/ha).
 - iii. Operating cost (Rs./ha).
8. **Contact Address for relevant information:**
 - i. Central Institute of Agricultural Engineering (CIAE), Nabi Bagh, Berasia Road, Bhopal - 462038.
 - ii. Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umian (Barapani)-793103, Meghalaya.



Fig.1. Foot Sprayer.

Technology no. 15

1. **Name of the Technology:** Multicrop Planter.
2. **Source of the Technology:** CIAE, Bhopal.
3. **Year of release:** 2000
4. **Agro Climatic Zone:** Eastern Himalayan region/NEH Region.
5. **Details description about the technology:** In the multicrop planter, the planting attachment consists of hopper, inclined plate metering mechanism fitted in the hopper, furrow openers, ground wheel, power transmission mechanism and seed tubes. For operation, the seed is filled in the hopper, seeds are picked up by the cells of inclined plate and delivered in the opening connected to furrow opener through seed tubes. It can plant crops like maize, cotton, soybean, and sunflower etc. Seed-metering mechanism in planting attachment is of inclined plate type with notched cells for each row. Row to row spacing and plant-to-plant spacing is adjustable. Plant to plant spacing can be varied by changing the transmission ratio. The drive to the metering mechanism is given through the ground wheel by means of chains, sprockets and bevel gears.
6. **Critical inputs:** Multicrop Planter



Fig.1. Multicrop Planter.

7. **Observations to be recorded:** i. Field Capacity (ha/hr). ii. Field Efficiency (%). iii. Number of plants (per m²). iv. Seed rate (Kg/ha). v. Labour requirement (man-h/ha). vi. Operating cost (Rs./ha).
8. **Contact Address for relevant information:**
Central Institute of Agricultural Engineering(CIAE), Nabi Bagh, Berasia Road, Bhopal - 462 038.

Technology no. 16

1. **Name of the Technology:** Engine operated walk behind type rice transplanter (4-row).
2. **Source of the Technology:** CIAE, Bhopal.
3. **Year of release:** 2001
4. **Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
5. **Details description about the technology:** This rice transplanter consists of prime mover transmission, engine, float, lugged wheels, seedling tray, seedling tray shifter, pickup fork and pickup fork cleaner. It is a walk behind type rice transplanter using mat type nursery and it transplants the seedling uniformly without damaging them. The planting depth and hill-to-hill spacing can be adjusted. Automatic depth control helps in maintaining uniform planting depth. The overall dimension of the machine is 2450×1480×950mm with a field capacity of 0.15-0.21ha/hr
6. **Critical inputs:** Rice transplanter, mat type nursery.

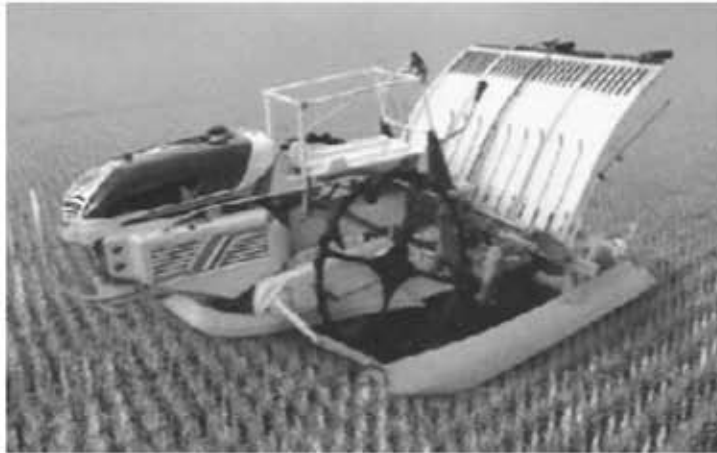


Fig. 1. Engine operated walk behind type rice transplanter (4-row).

7. **Observations to be recorded:**
 - i. Field Capacity (ha/hr).
 - ii. Field Efficiency (%).
 - iii. Hill density, hill/ m².
 - iv. Fuel consumption lit/hr.
 - v. Labour requirement (man-h/ha).
 - vi. Planting efficiency, %.
 - vii. Operating cost (Rs./ha).
8. **Contact Address for relevant information:** Central Institute of Agricultural Engineering(CIAE), Nabi Bagh, Berasia Road, Bhopal – 462038.

Technology no. 17

1. **Name of the Technology:** Pedal operated paddy thresher (OUAT Model).
2. **Source of the Technology:** OUAT.
3. **Year of release:** 2004
4. **Agro Climatic Zone:** Eastern Himalayan Region/NEH Region.
5. **Details description about the technology:** It consists of wire-loop type threshing cylinder, power transmitting system, mild steel body and foot pedal. The threshing cylinder consists of wire-loop U shape embedded in wooden or metallic strips joined to two discs. A shaft carries the threshing cylinder and is connected to the transmission system. The transmission system consists of meshed gears or sprocket-chain mechanism. The larger gear or sprocket is connected to foot pedal with link. The foot pedal is always in raised position. On pressing the pedal the threshing cylinder starts rotating. For continuous rotation of the cylinder the pedal is lowered and raised repeatedly. It is used for threshing of paddy crop and well suited under hilly areas.



Fig.1. Pedal operated paddy thresher.

6. **Critical inputs:** Pedal operated paddy thresher.
7. **Observations to be recorded:**
 - i. Output capacity (kg/hr).
 - ii. Labour requirement (man-h/q).
 - iii. Threshing efficiency (%).
 - iv. Cost of threshing per hectare.
8. **Contact Address for relevant information:**
 - i. Orissa University of Agriculture & Technology (OUAT), Bhubaneswar- 751003, Orissa, India
 - i. Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umian (Barapani)-793103, Meghalaya.

Technology no.18

- 1. Name of the Technology:** Light weight and low cost Plastic Maize Sheller for drudgery reduction
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2015
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** Feedback of farmers on use of iron maize sheller developed by CIAE, Bhopal encouraged to develop light weight and low cost plastic maize sheller for enhancing shelling efficiency and increase life of the equipment. It is hand held type plastic maize sheller of tubular shape used for shelling of maize cob. Diameter of maize sheller is 60 mm, length 70 mm, fitted with 4 number of fins and weight is approx 90 g. Tubular body is made of PVC pipe and tapered fins of MS sheet are riveted inside the tubular body. Shelling is done by holding the sheller in one hand and gradually inserting the cob in the tube by other hand with backward and forward twist. It is rust proof and safe for hands. Shelling capacity is 25-30 kg/h as compared with traditional shelling of 10-12 kg/h. Saves 66% labour and operating time. Cost of fabrication is Rs.67/- against GI maize sheller of Rs.85/ per piece.



- 6. Critical inputs required:** Matured maize cob
- 7. Observations to be recorded:** Duration of operation, quantity of maize grain shelled, quantity of broken grains.
- 8. Contact Address for relevant information:** The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.19

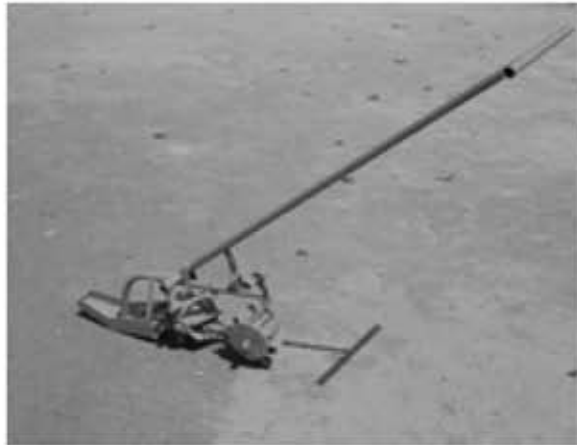
- 1. Name of the Technology:** Beehive Briquette Mould developed for small scale entrepreneurship by land less farmers.
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2016
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** This equipment is used for making briquettes from charcoal powder. Overall Dimension of the equipment is 250 mm × 100 mm. It consists of three parts a) cylinder, b) base plate with 21 rods and c) cover plate. Base plate has total 21 rods of 12 mm diameter and 95 mm height which are welded on it. Cover plate has same number of holes of diameter 13 mm so that it can move through the rods on base plate easily. After putting cover plate and cylinder on base plate, the mixture prepared with charcoal powder, clay and water is put into the cylinder and the whole unit is beaten on a wooden plank to increase the compaction of the mixture. Then the cylinder and cover plate are pulled out of the base plate along with the briquette. It is placed upside down on ground and pressed to release the briquette. Thus the dimension of each briquette is 146 mm in diameter and 85 mm in height which perfectly fits in a charcoal/ wood stove available in the market. It was found that targeting to produce 6000 briquettes per month a profit of Rs.24, 000 can be earned. The input cost per briquette was found as Rs.6.5. if the charcoal produced in-house then the cost could be much lower.



- 6. Critical inputs required:** Charcoal powder, clay soil, water
- 7. Observations to be recorded:** Number of briquettes made per day, time required to make each briquette, life of briquette mould, marketing price of briquette.
- 8. Contact Address for relevant information:** The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.20

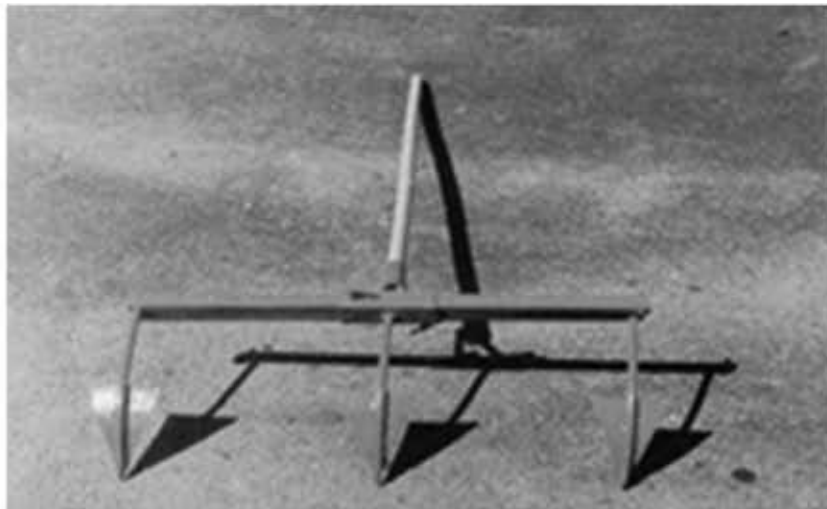
- 1. Name of the Technology:** Modified Cono weeder
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2008
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** It is manually operated equipment for weeding in low land paddy in the presence of water. Overall dimension is 1740x200x940 mm and weight approx 7.0 kg. It mainly consists of two rotors, float, frame and handle. Rotors are cone frustum with serrated strips, mounted in tandem with opposite orientation. It is operated by pushing action and pulling action and suitable for weeding in low land paddy, when water is present in the field. - One person is required to operate the equipment without bending the posture thus reducing drudgery of work, 60% saving in cost as compared to manual weeding.



- 6. Critical inputs required:** Labour to operate the equipment
- 7. Observations to be recorded:** Width of operation, depth of water present in the field, weeding efficiency, field capacity, labour requirement per unit area
- 8. Contact Address for relevant information:** The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.21

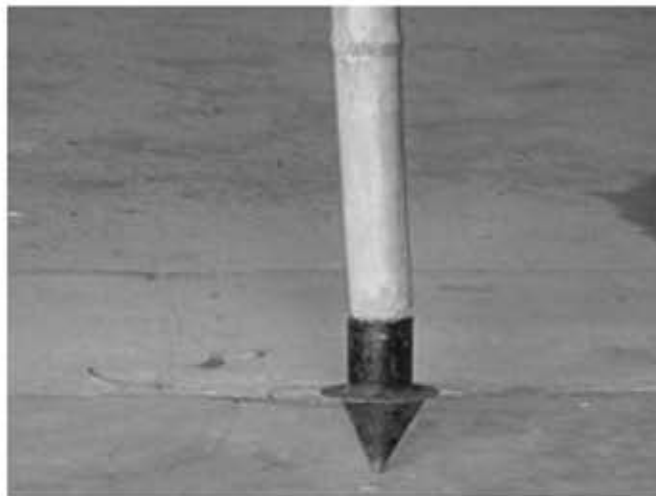
- 1. Name of the Technology:** Adjustable Row Marker
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 1998
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology:** It is manually operated equipment suitable for marking rows on seed bed for maintaining row to row spacing while using single row seeding device. Overall dimension of the equipment is 240x120x60 cm and weight is 2 kg. Three number of rows can be marked at a time and row to Row spacing can be adjusted from 20 to 60 cm. Field capacity of 0.2 ha/h at 60 cm spacing and 0.06 ha/h at 20 cm spacing can be achieved using this equipment. Marking of rows in the field is faster as compared with traditional method of using rope and peg.
- 6. Critical inputs required:** Man –power,



- 7. Observations to be recorded:** Row spacing, depth of furrow made, field capacity, labour requirement per unit area
- 8. Contact Address for relevant information:** The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.22

- 1. Name of the Technology:** Metallic tip dibbler
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 1994
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs) :** Metallic tip dibbler is having a cone shape point for making hole and fitted with wooden handle. It is used for dibbling maize and other bold seeds on steep slopes manually. It helps in getting better output per unit time as compared with local dibbling stick. Seeds can be sown up to 7 cm depth as compared to 3-4 cm with wooden stick. Its field capacity is about 0.10 ha/day at 40 cm row-to-row spacing.



- 6. Critical inputs required:** Seed to be sown, labour for operating the equipment
- 7. Observations to be recorded:** Depth of sowing, plant to plant spacing, area covered, field capacity, labour requirement per unit area
- 8. Contact Address for relevant information:** The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.23

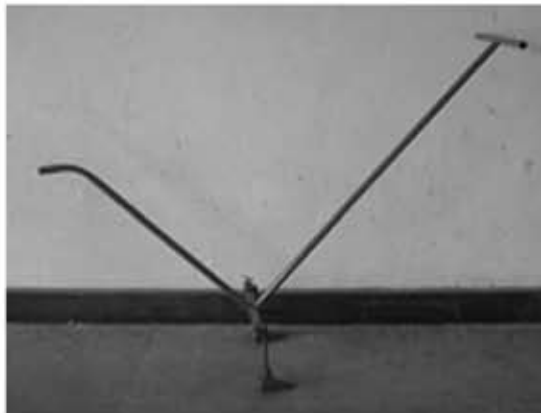
- 1. Name of the Technology:** Long handle weeders
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 1994
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** Five designs of long handle weeders namely Multipurpose “U” blade weeder, Garden rake, V-blade weeder, Hand grass slasher and Hand fork are suitable for performing weeding operation manually without bending thus reducing drudgery of the operator with increased output. These weeders are suitable for weeding in vegetable fields. The uprooted weeds can be collected using garden rake. With these hand tools labour saving to the extent of 60-65% can be achieved over traditional method.
- 6. Critical inputs required:** Labour for operating the hand tools



- 7. Observations to be recorded:** Type of crop, width and depth of cut, field capacity, weeding efficiency, labour requirement.
- 8. Contact Address for relevant information:**
The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570276, Fax: 0364-2570213

Technology no.24

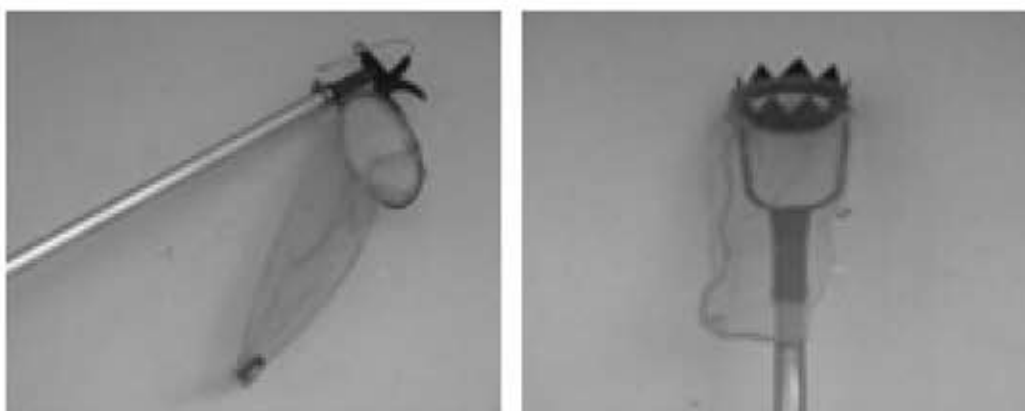
- 1. Name of the Technology:** Adjustable Zero Till Furrow Opener
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2013
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** It is manually operated equipment for making furrow under zero till condition. Two persons are required to operate the equipment. There are two numbers of furrow openers fitted on it which can open furrow of 2-3 cm width and 3-4 cm depth. The furrow opener is of narrow tine type with rake angle of 30° fitted with two small boards to overturn the soil. Row spacing can be adjustable between 20-60 cm. It has a long pulling handle and a guiding handle. It is suitable for making furrow for sowing mustard, pea and lentil after harvesting paddy. Field capacity vary from 0.06 to 0.2 ha/h depending on row width.
- 6. Critical inputs required:** Seed to be sown, two labourers



- 7. Observations to be recorded:** Row spacing, depth of furrow made, field capacity, labour requirement
- 8. Contact Address for relevant information:** The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.25

- 1. Name of the Technology:** Fruit harvesters
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2001
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** Two different types of fruit harvesters designed are a) Hold and cut type and b) Hold and twist type. Fruits such as orange and guava can be harvested while standing on the ground. After picking 5-7 fruits at a time the holder bag are emptied. With the use of this harvester damage to the fruits can be minimized which will increase shelf life of fruits. These light weight fruit harvesters are simple and easy to operate.



- 6. Critical inputs required:** Fruits ready for harvesting
- 7. Observations to be recorded:** Type of fruit harvested, number of fruits harvested per unit time, fruit damage percentage, ease of operation
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103

Phone: 0364-2570257, Fax: 0364-570213

Technology no.26

- 1. Name of the Technology:** Modified Hand operated Winnower
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2008
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** It is a manually operated hand winnower used for cleaning threshed paddy grains and separation of straw, husk, dust and other light weight foreign material from paddy crop. One person is required for the operation of this equipment while another person release grains from height so as to separate the husk or other unwanted light material from the grain by air flow of the winnower. Overall dimension of the equipment is 1.16x1.16x1.77 m and weight is 29 kg.
- 6. Critical inputs required:** Grain to be cleaned, basket for dropping the grains in front of winnower, two labours



- 7. Observations to be recorded:** Quantity of grain cleaned per unit time, cleaning efficiency, labour requirement
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103

Phone: 0364-2570257, Fax: 0364-570213

Technology no.27

- 1. Name of the Technology:** Pedal Paddy Thresher
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:**
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** It is manually operated equipment for threshing harvested paddy. Pedal thresher consists of threshing cylinder, pedal and grain shield. Threshing cylinder fitted with wire loops perform threshing operation by combing action. The overall dimension of the equipment is 1.25x0.65x0.63 m. The output capacity is 40-50 kg grain/hr with threshing efficiency of 98%.
- 6. Critical inputs required:** Harvested paddy crop, two labours



- 7. Observations to be recorded:** Quantity of grain cleaned per unit time, cleaning efficiency, labour requirement
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103

Phone: 0364-2570257, Fax: 0364-570213

Technology no.28

- 1. Name of the Technology:** Power paddy Thresher
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2009
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** It is an improvement over pedal type paddy thresher. It consists of threshing cylinder, blower, prime mover (1 HP motor) and grain shield. Its capacity is four times higher than that of pedal type. Blower fitted with the machine helps to throw the broken chaff at some distance away from grain. The machine can be operated either with 1.0 hp electric motor or 2 hp engine. Threshing cylinder and prime mover can easily be detached (if required) from the frame to enable easy transportation of thresher in hilly area. There is saving of about 80% labour requirement and 74% on cost of operation against pedal type paddy thresher. Dimension is 0.85x0.75x0.75 m and weight approx 50 kg. The output capacity of the equipment is 150-200 kg/h with 98% threshing efficiency.
- 6. Critical inputs required:** Harvested paddy crop, single phase AC supply, two laboures



- 7. Observations to be recorded:** Quantity of grain threshed, threshing efficiency, cleaning efficiency, labour requirement
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.29

- 1. Name of the Technology:** Power Tiller operated Inclined Plate Planter
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2013
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** It is a Power tiller operated 3 row inclined plate planter for sowing maize, soybean and pea in terraces and valley lands. Chain and sprocket mechanism is used for getting drive from ground wheel to seed metering shaft. Bevel gears are used for operating the seed plates. There is provision for sowing different crops by selecting appropriate seed plates for different crops and by changing the transmission ratios. The overall dimension of the planter is 900 x 990 x 610 mm (lxwxh) having row spacing range of 130-280 mm. The equipment is fitted with shoe type furrow opener and inclined plate with edge cells type seed metering mechanism.
- 6. Critical inputs required:** Seed to be sown, conventional power tiller (12 HP)



- 7. Observations to be recorded:** Row spacing, average depth of sowing, area covered, field capacity
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.30

- 1. Name of the Technology:** Bio-terracing techniques for slow conversion of hill slopes into terraced land
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2014
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** Bio-terracing technology provides an option for conversion of hilly slope into bench terrace on hill slopes. The hedgerows are established by planting of fast-growing and deep rooted leguminous trees or shrubs such, as *Leucaena leucocephala*, *Gliricidia sepium*, *Erythrina* sp. etc. along the contours on a hill slope. The spacing (vertical interval) of the hedgerows may be designed as per the land slope. However, in NEH region vertical interval between the hedgerows has been recommended as 1.0–1.5 m. Crops are planted between hedgerows. Accumulation of organic matters through leaf litter of hedgerow species improves the water holding capacity and improves other physical properties of the soils. *Cajanus cajan*, *Crotalaria tetragona*, *Desmodium rensonii*, *Flemingia macrophylla* and *Indigofera tinctoria* are some of the hedgerow species of the region. Regular pruning of nitrogen fixing hedgerow species added 20–80, 3–14 and 8–38 kg ha⁻¹ yr⁻¹ of nitrogen, phosphorous and potassium, respectively. The hedgerow helps in progressive development of terraces through accumulation of up slope hedgerow and stabilization of risers against rain storms by stems and roots. Among perennial grasses legumes–*Stylosanthus guyamensis*, *Shameta*, *thin nappier* and *Seteria spiculata* with yield potential of 19.7, 19.0, 65.05 and 80.86 t ha⁻¹ of green fodder may be planted on bunds and terrace risers.
- 6. Critical inputs required: Leguminous grasses or hardy hedge row grasses**



- 7. Observations to be recorded:** Spacing of staggered rows, plant to plant and row to row distance
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no.31

- 1. Name of the Technology:** Agrifilm Lining of Water Harvesting Pond on Hillslopes using Plastic
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2016
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** The pond is dug as per the design. Pond bed and sides are made weed and stone free. Steps at 50 cm vertical interval are made on sides of the pond to hold the agrifilm at its place. On top of the sides, continuous trench of 50x50 cm is dug for the purpose of anchoring the agrifilm to prevent it from sliding down. Pre-emergence weedicide is also sprayed on sides and bed to arrest the weed growth. After the sides and bed are dressed properly, 10cm thick layer of sieved sand is spread uniformly on bed and sides to provide cushion to the agrifilm. Perforated plastic pipes are laid in trenches. Pipes are wrapped with coir rope to prevent choking of the perforations in the pipe. Then pipes are covered with sand. After that, agrifilm is laid properly in the pond. LDPE agrifilm of 250 μ is used for lining. Utmost care is taken in joining the agrifilm to suit the shape and size of the pond. For joining, bitumen of 85/25 and 80/100 grade in the ratio of 2: 1 is used. Over agrifilm, soil cover of 30 cm is provided. Then stone pitching is done on sides only to safeguard the sides of the pond against erosion and any other external forces. Safety mechanism included a well-designed drainage system with perforated plastic pipe laid on the bottom of pond to drain out seepage water.

Cost of construction: Rs 1, 75,000/- for a 260 m³ of pond having life of 15 years

Benefit: Seepage loss reduced from 55 (unlined) to 2.9 L/m²/day i.e. by 94.7%.

Small agrifilm lined water harvesting ponds of capacity 15–20 m³ are successfully constructed in the farmer's field at upper reaches of the hill slope to utilize the harvested rainwater for irrigating homestead gardens by gravity flow and to meet the water requirement for poultry, pig or cattle in the dry season.

More advanced and durable plastic materials like silpaulin, HDPE or nylon also can be used



for the lining of water harvesting tanks using the same technology.

- 6. Critical inputs required:** Availability of terrace width, LDPE/HDPE
- 7. Observations to be recorded:** Wetting front, labour requirement, evaporation
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103

Technology no.32

- 1. Name of the Technology:** Low cost bamboo frame polyhouse technology for terraced beds on hill slopes
- 2. Source of the Technology:** Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umiam, Meghalaya
- 3. Year of release/ development:** 2013
- 4. Agro Climatic Zone:** Eastern Himalayan Region
- 5. Detail description about the technology (with suitable photographs):** Hill cultivation is affected by low temperature, insect and pests. Cultivation of cash crops and high value off season vegetables protected cultivation under poly house condition has been recommended. Initial cost of construction using iron frame is high. A technology was developed and evaluated replacing iron frame by locally available bamboo frame. The cost of construction has reduced drastically to 1/3rd of the iron framed poly house in which resource poor farming community can afford. A rectangular terraced portion of 20m x 5m land is selected and bamboo posts painted with bitumen at 5m intervals (lengthwise & 2.5m (widthwise) making longitudinally arc shape. Splitted bamboo post are used to provide supports. 200 μ thick UV stabilized transparent LDPE film is cladded over the frame fixed with nails to make the house. Most profitable cropping sequence of the capsicum-tomato-lettuce with assured income of Rs. 197.90 m⁻² of land per year has been recommended from cost of construction of Rs. 240 per m² of floor area (at 2014 cost index).



- 6. Critical inputs required:** Bamboo, UV stabilized LDPE film, bitumen, rope, nails
- 7. Observations to be recorded:** Crop growth parameters, yield, insects and pest infestation
- 8. Contact Address for relevant information:**

The Head, Division of Agricultural Engineering, ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya – 793 103
Phone: 0364-2570257, Fax: 0364-570213

Technology no. 33

- 1. Name of the Technology:** Processing and value addition of pineapple for production of osmo dehydrated slices, juices, titbits etc.
- 2. Source of the Technology:** College of Agricultural Engineering and PHT, CAU, Ranipool - 737135, Sikkim
- 3. Year of release:** 2010
- 4. Agro Climatic Zone:** All agro-climatic zones of NEH, India
- 5. Detail description about Technology**

Juices

- Sorting, washing, peeling and cutting of pineapple slices
- Extraction of juice using juice extractor
- Processing of juice with additives
- Bottling/packaging of juices

Osmo-air dried slices

- Sorting, washing, peeling and cutting of pineapple slices
- Osmotic dehydration using sugar syrup
- Tray drying of osmo-dried slices
- Packaging of osmo-air dried slices



- 6. Critical input required:** Pineapple, Sugar syrup, Additives, Washer, Cutter, Corer, Slicer, Juice extractor, Tray drier, Hand sealers, Bottling machine, and Crown corking machine.
- 7. Observations to be recorded:** Total soluble solids content, Acidity, Processing temperature and time, Slice thickness, Drying air temperature and time, Packaging weight.
- 8. Contact Address for relevant information:**
 - Director of research, CAU, Imphal
 - Dean, CAEPHT, Ranipool, Gangtok

Technology no.34

- 1. Name of the Technology:** Blended RTS beverages using passion fruit, orange and ginger
- 2. Source of the Technology:** College of Agricultural Engineering and PHT, CAU, Ranipool - 737135, Sikkim
- 3. Year of release:** 2010
- 4. Agro Climatic Zone:** All agro-climatic zones of NEH, India
- 5. Detail description about Technology**
 - Sorting, washing and peeling of fruits and spices
 - Extraction of passion fruit, orange and ginger juice using juice extractor
 - Blending of juices in different proportions
 - Addition of sugar and KMS as per RTS formulae
 - Pasteurization of blended beverages
 - Bottling of blended beverages



- 6. Critical input required:** Passion fruit, Orange, Ginger, Sugar, KMS, Sugar syrup, Washer, Juice extractor, Bottling machine
- 7. Observations to be recorded:** Total soluble solids content, Acidity, Pasteurization temperature and time, Packaging volume
- 8. Contact Address for relevant information**
 - Director of research, CAU, Imphal
 - Dean, CAEPHT, Ranipool, Gangtok

Technology no.35

- 1. Name of the Technology:** Value addition of high value cut flowers
- 2. Source of the Technology:** College of Agricultural Engineering and PHT, CAU, Ranipool - 737135, Sikkim
- 3. Year of release:** 2009
- 4. Agro Climatic Zone:** All agro-climatic zones of NEH, India
- 5. Detail description about Technology**
 - Sorting of cut flowers
 - Cutting to suitable length
 - Packaging in suitable packaging films using hand sealer
 - Shrink packaging of cut flowers
- 6. Critical input required:** Orchids, Cartons, Packaging film, Hand sealer, Shrink packaging machine.



- 7. Observations to be recorded:** Length of cut flowers, Shrink packaging temperature.
- 8. Contact Address for relevant information**
 - Director of research, CAU, Imphal
 - Dean, CAEPHT, Ranipool, Gangtok

Technology no.36

- 1. Name of the Technology:** Essential oil extraction from Lemongrass and Java Citronella
- 2. Source of the Technology:** College of Agricultural Engineering and PHT, CAU, Ranipool - 737135, Sikkim
- 3. Year of release:** 2013
- 4. Agro Climatic Zone:** All agro-climatic zones of NEH, India
- 5. Detail description about Technology**
 - Field drying of Lemongrass and Java Citronella for 12-16 h after harvesting
 - Steam distillation using steam distillation plant
 - Collection of oil
 - Packaging of oil in consumer pack or in bulk for marketing to dealers of aromatic oils
- 6. Critical input required:** Lemongrass, Java citronella, Steam distillation plant, Packaging containers



- 7. Observations to be recorded:** Temperature of condenser, Water flow rate in steam distillation plant, volume of oil for packaging
- 8. Contact Address for relevant information**
 - Director of research, CAU, Imphal
 - Dean, CAEPHT, Ranipool, Gangtok

Soil and Water Engineering

Technology no.37

- 1. Name of Technology:** Development of portable manual mulch laying machine for hill terraces
- 2. Source of Technology:** All India Coordinated Research Project on Plasticulture Engineering and Technologies (PET)
- 3. Year of Release:** 2014-16
- 4. Agro Climatic Zone:** Humid
- 5. Detail description about the technology:**

The portable manual mulch laying machine was fabricated at the AICRP-PET's CAEPHT, Ranipool Centre in 2014. The two furrow openers made up of MS flat were attached to the machine for soil inversion on plastic mulch sheet from two ends along its length. A plastic sheet roll carrier and a handle for manual pulling of the machine are other important machine attachments.



Manual mulch laying machine fabricated at AICRP-PET's CAEPHT, Ranipool



Manual mulch laying machine after satisfactory operation

6. Critical input required:

Specifications of the Machine :

Size/ Dimensions of the machine : Length: 1.75 m, Width: 1.4 m

Width of mulch sheet : 1.2 m

Material of Make : Iron (MS) frame

No. of furrow openers : Two

Operation : Manual pulling

Machine cost : 2,500/-

- 7. Observations to be recorded:** In its testing inside the poly-house, it was observed that the soil inversion was satisfactory. Sufficient soil was turned on to the plastic mulch sheet,

besides a very good unrolling and laying of the plastic mulch sheet.

8. Contact address for relevant information

The Project In-charge, All India Coordinated Research Project on PET, Department of Soil and Water Engineering, CAEPHT, Ranipool

Technology no.38

1. Name of Technology: Gravity fed micro irrigation system

2. Source of Technology: College of Agril Engineering & PHT, CAU

3. Year of Release: 2011

4. Agro Climatic Zone: Humid

5. Detail description about the technology:

The rain water falling on a roof is collected through suitable channel. The water is collected in a tank. The tank is placed at a height of more than 18 m height to provide suitable pressure. The water under when routed to micro sprinkler it provides a rainfall patter with uniformity of distribution.

6. Critical input required: Roof size, rainfall pattern and probable use

7. Observations to be recorded:

- i. Head (pressure difference between sprinklers and collecting tank): Most of the sprinklers operate at optimal efficiency at a pressure of 1.8 Kg/cm² or 18 m.
- ii. Leakage of piping system
- iii. Time of operation

8. Contact address for relevant information: Department of Soil and Water Engineering, College of Agricultural Engineering and PHT, Ranipool; (E) Sikkim- 737135

Renewable Energy Engineering

Technology no.39

1. Name of the technology: Drying of freshly harvested large cardamom using fuel wood/ briquettes.

2. Source of the Technology: Department of Farm Power and Machinery, College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok, Sikkim

3. Year of release: 2012

4. Agro Climatic Zone: Any Where

5. Detail description about the technology

Smokeless stove operated hot air drier is suitable for drying of freshly harvested large



cardamom using wood/briquettes fuel, comparatively in smaller quantity than the conventional biomass combustion based drying. Freshly harvested large cardamom can be dried in 6–8 h of its continuous operation.

6. Critical inputs required: Nil

7. Observations to be recorded

Initial moisture content, %

Final moisture content, %

Weight of product, kg

Ambient air temperature, °C

Dryer air temperature, °C

Solar insolation, W/m²

8. Contact address for relevant information: Department of Soil and Water Engineering, College of Agricultural Engineering and PHT, Ranipool; (E) Sikkim- 737135

Technology no.40

1. Name of the technology: Portable Side Feed Smokeless Cook Stove

2. Source of the Technology: Department of Farm Power and Machinery, College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok, Sikkim

3. Year of release: 2012

4. Agro Climatic Zone: Any Where

5. Detail description about the technology

This is a portable and light weight insulated metallic biomass cook stove, which uses long size fuel wood sticks for continuous operation. The equipment is well suitable for indoor & outdoor cooking of food without production of smoke during combustion.

6. Critical inputs required: Nil

7. Observations to be recorded

Moisture content of biomass, %

Weight of biomass, kg

Initial water temperature, °C

Flame Temperature, °C

Time taken for cooking measured quantity, h

Quantity of biomass consumed in cooking, kg

8. **Contact address for relevant information:** Department of Soil and Water Engineering, College of Agricultural Engineering and PHT, Ranipool; (E) Sikkim- 737135



Technology no.41

1. **Name of the technology:** Mixed Mode Photovoltaic Powered Forced Convection Solar Dryer
2. **Source of the Technology:** Department of Farm Power and Machinery, College of Agricultural Engineering and Post Harvest Technology, CAU, Ranipool, Gangtok, Sikkim
3. **Year of release:** 2015
4. **Agro Climatic Zone:** Any Where
5. **Detail description about the technology**

It is combination of direct and indirect solar dryers. Product may dry with both direct exposure to solar radiation and hot air supplier on it. The dryer had capacity to dry 10 kg of drying product. The solar dryer has total collector area of 0.9902 m² including 0.5002 m² of solar air collector area, 0.49 m² of drying area. The air can be circulated within dryer with the help of 12 V DC fan operated on 37 Wp solar PV module. It is recommended that the developed mixed mode photovoltaic powered forced convection solar dryer can be used for drying of agricultural and horticultural products, which reduces quality degradation over an extended storage period. The developed solar dryer can be provided a promising option for drying various agricultural and horticultural products in NEH region. The developed solar dryer can be used to heat air up to the range 55-75°C temperature needed for drying of most of the agricultural and horticultural products, efficiently and economically without compromising in quality of final product.

6. **Critical inputs required:** Nil
7. **Observations to be recorded**
 - i. Initial moisture content, %
 - ii. Final moisture content, %
 - iii. Weight of product, kg
 - iv. Ambient air temperature, °C
 - v. Dryer air temperature, °C
 - vi. Solar insolation, W/m²



8. **Contact address for relevant information:** Department of Soil and Water Engineering, College of Agricultural Engineering and PHT, Ranipool; (E) Sikkim- 737135

Technology no.42

1. **Name of Technology:** Portable Pv Powered Forced Convection Solar Dryer
2. **Source of Technology:** College of Agricultural Engineering and Post Harvest Technology, Central Agricultural University, Ranipool, Gangtok, Sikkim
3. **Year of release:** 2014
4. **Agro climatic Zone:** All states.
5. **Brief description**

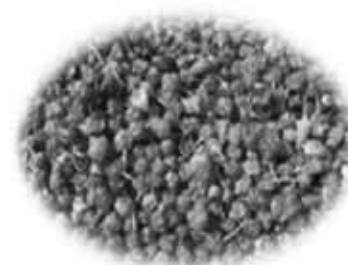
This dryer has four main components viz. flat plate collector, drying trays, exhaust fan and solar PV module. The drying chamber is made up of M.S. angle, G.I. sheet and glazing material with the frame of size of (700×700) mm², opposite wall size of (700×700) mm² and front side size of (890×700) mm² with the inclination of 45°. The two drying trays are contained inside the drying chamber which is made up of aluminum angle, aluminum strip and steel wire mesh. The lower and upper tray are fitted at the height of 150 mm and 350 mm from the base of the dryer. The size of lower and upper tray are (680×490) mm² and (680×270) mm² respectively. Air inlet is provided in the one fourth area of the base with the diameter of 600 mm.

Specification

Type and model	Forced convection
Area of the flat plate, m ²	0.49
Loading capacity, kg/batch	5
Glazing materials	Glass
Air circulation mode	PV powered forced convection
Power of PV Module, Wp	5
No. of trays	02
Unit Price, Rs.	5,000/-

Performance

Average air temperature attained in the solar dryer is about 40 °C higher than the ambient temperature. The chilly is dried within 32 hour of solar radiation from initial moisture content 80



% to the final moisture content about 10% (w.b). The thermal efficiency of the dryer is 30%.

Benefits

The dryer has high efficiency, uniform drying of products, suitability for NEH region, drying temperature in desirable range, light weight and easy to handle.

6. **Contact address for relevant information:** Department of Soil and Water Engineering, College of Agricultural Engineering and PHT, Ranipool; (E) Sikkim- 737135

Technology no.43

- 1. Name of Technology:** Modified Double Pot Improved Biomass Cook Stove
- 2. Source of Technology:** College of Agricultural Engineering and Post Harvest Technology, Central Agricultural University, Ranipool – 737135, Gangtok, Sikkim.
- 3. Agro climatic zone:** All state of NEH region
- 4. Year of release:** 2013
- 5. Brief description of Technology:**

The modified double pot improved biomass cook stove having two pot holding places is designed to meet the cooking requirement of the hilly region. This stove is sufficient to cook the meal of one family of 10–12 persons and is of permanent nature. The special feature of the improved biomass cook stove is bigger size of fire box, which is suitable for big size firewood and light agro waste type of fuel. The cook stove is suitable for firewood, agro waste and dung cakes. Bigger sized wood may also be used at the fuel burning rate of 1.00 kg/h. The thermal efficiency is 26 %. The passage between the firebox chamber and the inlet of the chimney pipe is horizontal, which flows smoky gases outside the kitchen. A mixture of cement and sand is used to fix up the bricks and to enhance the life of the structure.

Specification

Type and model	Modified double pot improved biomass cook stove
Body (L×B×H), mm	790 × 360 × 250
First pot diameter, mm	200
Second pot diameter, mm	180
Fire box opening (D × L), mm	200 × 160
Chimney (D × L), mm	76 × 3000
Average thermal Efficiency, %	27
Unit price, Rs.	1,000/-

Performance

The thermal efficiency of traditional biomass cook stove and modified double pot improved biomass cook stove are respectively 10–11% and 26–28%.

Benefits

The modified improved biomass cook stove saves 70% fuel (2.67 kg of wood saved by one improved biomass cook stove) and 64.28% saving in cooking time. Smokeless environment of kitchen is achieved by modified double pot improved biomass cook stove. Pollutant emission in the kitchen is lower than the traditional biomass cook stove.



- 6. Contact address for relevant information:** Department of Soil and Water Engineering, College of Agricultural Engineering and PHT, Ranipool; (E) Sikkim- 737135

Technology no.44

1. **Name of the technology:** Wing Plough
2. **Source of the Technology:** Department of Farm Power and Machinery College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim) .
3. **Year of release:** 2011
4. **Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
5. **Detail description about the technology:** The plough is suitable for both friable and wet condition in place of traditional wooden plough. The higher work rate is due to reduced drudgery to the animal and operator and time lost in turning and removing clogging. The required draft is also reduced from 45 kg in case of conventional plough to 40 kg making it suitable for local breed of bullock. The clod size formed is smaller requiring less energy requirement for secondary tillage. Working width: 200 mm, Weight: 5.5 kg, Work rate: 300 sqm/h, Cost, Rs 1000.00, operation cost: Rs 2500.00/ha, saving over traditional plough: 35% .
6. **Critical inputs required:** Nil
7. **Observations to be recorded:**



Sl. No.	Parameters to be recorded	Average Values
1.	Soil moisture content(d.b)%	
2.	Area covered per unit time, ha	
3.	Time taken to cover 01 ha, h	
4.	Working width, mm	
5.	Depth of operation, mm	
6.	Speed of operation, km/h	
7.	Draft of the implement, kg	
8.	Time lost, h	
9.	Field capacity, ha/h	
10.	Field efficiency, %	

8. **Contact address for relevant information:** Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.45

1. **Name of the technology:** Animal drawn improved wedge plough
2. **Source of the Technology:** Department of Farm Power and Machinery under AICRP on UAE Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
3. **Year of release:** 2013
4. **Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
5. **Detail description about the technology:** It is used for primary tillage for seed bed preparation in wet and and dry conditions. The CAEPHT designed animal drawn improved sedge plough consisting of handle, shoe, share and beam(overall dimension: handle height 800 mm, shoe length with share 600 mm, width 2010 mm Weight: 12 kg, unit Price Rs. 1200/-) The Average work rate of wedge plough is 0.025 hectare (250 sq. meters) per hour at average draft of plough is 45 kg corresponding to depth of operation of 110 mm. The cost of operation has been estimated as Rs. 2100/- per hectare using improved wedge plough. This equipment is an improved version of traditional plough made of mild steel which provided more working width(210 mm) as compared to traditional plough (local wooden plough) having (100 mm width, work rate 0.012 hectare per hour at average draft of 48 kg with a depth of operation of 100 mm). The improved wedge plough was operated in 250 sq.m area. The net saving in cost of operation by improved CAEPHT design plough is estimated as Rs. 400/- per hector over traditional plough (Rs. 2500/ha). It showed that the available area may be better managed by adoption of animal drawn improved wedge plough which would reduce the drudgery and cover more area in a season for cultivation.
6. **Critical inputs required:** Nil
7. **Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Soil moisture content(d.b)%	
2.	Area covered per unit time, ha	
3.	Time taken to cover 01 ha, h	
4.	Working width, mm	
5.	Depth of operation, mm	

6.	Speed of operation, km/h	
7.	Draft of the implement, kg	
8.	Time lost, h	
9.	Field capacity, ha/h	
10.	Field efficiency, %	
11.	Cost of operation, Rs./ha	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.46

- 1. Name of the technology:** Animal drawn multi purpose Tool frame with attachments
- 2. Source of the Technology:** Department of Farm Power and Machinery under AICRP on UAE Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2013
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** Performing different unit operations viz. ploughing, ridge making, sowing, potato digging and intercultural operations by using same unit by fitting appropriate attachments. It is multi-purpose equipment consisting of ground wheel, main frame, handle, hitch, beam & two hollow square sections for depth adjustment. The attachments of light weight are fitted to it. The main frame is of round section of galvanized pipe. The mould board plough(150 mm size), two ridgers (170 mm size each), single row potato digger (200 mm size), and sowing of maize in two rows can be attached on multi-purpose tool frame. The draft of all attachment varies 25-40 kg.
- 6. Critical inputs required:** Nil

Attachments:

i) Improved Mould Board Plough

Brief description

Mould plough (one of the attachments of multipurpose tool frame) weight 10 kg, width 150 mm, and unit price Rs. 1000/-. The work rate of plough is 0.021 ha/h. The average draft of plough is 38 kg corresponding depth of operation is 100 mm. The cost of operation of the mould board plough is 1760 Rs./ha. The net saving in cost of operation by improved

CAEPHT mould board plough is estimated as Rs. 1548/- per hectare over traditional plough (Rs. 3308/ha).

Observations to be recorded:

Sl. No.	Parameters to be recorded	Average Values
1.	Soil moisture content(d.b)%	
2.	Area covered per unit time, ha	
3.	Time taken to cover 01 ha, h	
4.	Working width, mm	
5.	Depth of operation, mm	
6.	Speed of operation, km/h	
7.	Draft of the implement, kg	
8.	Time lost, h	
9.	Field capacity, ha/h	
10.	Field efficiency, %	
11.	Cost of operation, Rs./ha	

ii) Ridger Plough

Brief description – Ridger plough (one of the attachments of multipurpose tool frame) weight 12 kg, width 512 mm, and unit price Rs. 1500/-. The work rate of ridger is 0.05 ha/h. The average draft of plough is 40 kg corresponding depth of operation is 80 mm. The cost of operation of the ridger plough is 470 Rs./ha.

Observations to be recorded:

Sl. No.	Parameters to be recorded	Average Values
1.	Soil moisture content(d.b)%	
2.	Area covered per unit time, ha	
3.	Time taken to cover 01 ha, h	
4.	Working width, mm	
5.	Depth of operation, mm	
6.	Speed of operation, km/h	
7.	Draft of the implement, kg	
8.	Time lost, h	
9.	Field capacity, ha/h	
10.	Field efficiency, %	
11.	Cost of operation, Rs./ha	

iii) Animal Drawn Improved Maize Planter

Brief Description – The maize planter (one of the attachments of multipurpose tool frame) overall dimensions are 730 x 700 x 960 mm and its weight with seeding attachment is 19.8 kg. The work rate of Maize planter is 700 sq. m/h. The average draft of machine is 25 kg with

45 mm the depth of sowing. The cost of operation for sowing of maize is Rs. 630/ha.

Observations to be recorded:

Sl. No.	Parameters to be recoded	Average Values
1.	Soil moisture content(d.b)%	
2.	Area covered per unit time, ha	
3.	Time taken to cover 01 ha, h	
4.	Working width, mm	
5.	Depth of operation, mm	
6.	Row spacing, mm	
7.	Plant to plant spacing, mma	
8.	Plant population, No./sqm	
9.	Yield, kg/ha	
10.	Cost of operation, Rs./ha	
11.	Economic comparison	

iv) Animal drawn single row improved potato digger

Brief description – It consists of mild steel plate, shank, L Shape clamps (02 no.), main frame, clevis, beam and handle, The light weight digger can work up to 100 mm depth. The working width of digger is 200 mm and its required draught of 35 kg.

Observations to be recorded:

Sl. No.	Parameters to be recoded	Average Values
1.	Soil moisture content(d.b)%	
2.	Area covered per unit time, ha	
3.	Time taken to cover 01 ha, h	
4.	Working width, mm	
5.	Depth of operation, mm	
6.	Speed of operation, km/h	
7.	Draft of the implement, kg	
8.	Time lost, h	
9.	Field capacity, ha/h	
10.	Field efficiency, %	
11.	Cost of operation, Rs./ha	

7. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.47

1. **Name of the technology:** Animal drawn improved rolling Peg type puddler
2. **Source of the Technology:** Department of Farm Power and Machinery under AICRP on UAE Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
3. **Year of release:** 2014
4. **Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
5. **Detail description about the technology:** It is use for the seed bed preparations of field for transplanting of paddy. The developed Light weight improved rolling peg type puddler (weight: 12 kg, Size: 700 mm, Unit price: Rs. 3500/-) consisted of 200 mm size rotor made from 25 x 25 x 5 mm size 04 no. of mild steel angle. Each row was welded with 04 pegs (10 x 10 mm size, square bar) of 50 mm length. The work rate of puddler is 0.105 ha/h and average draft is 35 kg.



6. **Critical inputs required:** Nil

7. **Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Area, ha	
2.	Time taken to cover the area, h	
3.	Work rate, ha/h	
4.	Puddling index	
5.	Depth of water on soil surface, mm	
6.	Operating cost Rs/h Rs/ha	
7.	Economic comparison with traditional method	
8.	Saving in cost, Rs/ha	

- 8. Contact address for relevant information:** Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.48

- 1. Name of the technology:** Cultivator matching to light weight (65 kg) power tiller
- 2. Source of the Technology:** Department of Farm Power and Machinery under AICRP on FIM Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2012
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** All manufacturers of power till provide only rotary tillage attached with it. It restrict the use of power tiller for single operation that results limited annual use of power tiller thus it becomes un-economical. Different attachments have been developed so that power tiller can be used not only for secondary tiller but for all the agricultural operations. One of them is cultivator. This cultivator is consisted of a frame on which hitching attachment and three tynes are fitted. At the end of tyne, a shovel type blade for soil cutting and manipulation is attached. The cultivator was tested in the field and performance was satisfactory. The function is similar to tractor drawn cultivators used in the plain areas.
- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Width of coverage, mm	
2.	Speed of operation	
3.	Area covered, ha	
4.	Time taken to cover the area, h	
5.	Work rate, ha/h	
6.	Average size of clod, mm	

7.	Fuel consumed, lit/h lit/ha	
8.	Operation cost, Rs./h Rs./ha	
9.	Economic comparison with traditional method	
10.	% saving in cost	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.49

- 1. Name of the technology:** Light weight power tiller operated cage wheel
- 2. Source of the Technology:** Department of Farm Power and Machinery under AICRP on FIM Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2013
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** Puddling is one of the most energy and time consuming process in traditional method. Keeping in view of details given earlier and aiming to reduce the drudgery, a cage wheel was developed which can be attached to the power tiller. This cage wheel in combination with rotary tiller has been found suitable for puddling purpose. A flap cover over rotary tiller has been provided to protect the operator and also helps in churning of soil.
- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Area, ha	
2.	Time taken to cover the area, h	
3.	Work rate, ha/h	
4.	Puddling index	

5.	Depth of water on soil surface, mm	
6.	Fuel consumption lit/h lit/ha	
7.	Operating cost Rs/h Rs./ha	
8.	Economic comparison with traditional method	
9.	Saving in cost, Rs/ha	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.50

- 1. Name of the technology:** Animal drawn Peg planker
- 2. Source of the Technology:** Department of Farm Power and Machinery, College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2012
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** The equipment is used for secondary tillage operation. Its working width is 800 mm and made of mild steel sheet similar to local harrow was developed to suite the topographical conditions of the North Eastern Hill Region as a substitute to the local wooden peg type harrow. The average large size clod after operation was 112.55 x 81.25 mm in case of control plot and 71.82 x 54.70 mm in case of developed equipment. The work rate of 0.035 and 0.047 ha h⁻¹ and draft requirement 52 kg and 48 kg for local and improved equipment respectively was observed. These values suggested that the soil was finer, well and uniformly graded by use of improved developed peg planker as compared to local harrow. The total energy input was 2077.8961 MJ ha⁻¹ and 1546.9671 MJ ha⁻¹ for local and improved equipment respectively. The saving in energy input by use of improved equipment was 25.55%.
- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Area, ha	
2.	Time taken to cover the area, h	
3.	Work rate, ha/h	
4.	Average clod size before, Before operation After operation	
5.	Depth of water on soil surface, mm	
6.	Operating cost Rs/h Rs./ha	
7.	Saving in cost, Rs/ha	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.51

- 1. Name of the technology:** Two row manual sprouted rice seeder
- 2. Source of the Technology:** Department of Farm Power and Machinery ,College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2010
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** The equipment is used for sowing of sprouted rice seeds in puddle soil of narrow terraces in place of transplanting rice cultivation. The advantage are: saving of cost, time involved in nursery raising, establishment is 15-20 days advanced than the transplanting rice resulting and possibility of growing second crop under rainfed condition. The tapered(diverging towards the end) container facilitate easy flow of seed towards the holes. Telescopic markers with wedge shape openers provided ahead of the metering rows helps to accommodate dropped seeds on the surface of the soil in rows for early establishment of crop. The working with is 500 mm, cost is about Rs. 1000.00, the work rate is about 600 sqm/h. The top surface of the field after puddling should be smooth, flat and free from crop/weed residues.

6. Critical inputs required: Nil

7. Observations to be recorded:

Sl. No.	Parameters to be recoded	Average Values
1.	Depth of water on soil surface, mm	
2.	Area covered, ha/h	
3.	Seed rate, kg/ha	
4.	Seed to seed spacing (in case of planting), mm	
5.	Row spacing	
6.	Cost of sowing, Rs./ha	
7.	Plant population (20 days after sowing), No./sqm	
8.	Yield, kg/ha	
9.	Economic comparison with traditional method	
10.	% saving	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.52

1. Name of the technology: Two row manual rice transplanter

2. Source of the Technology: Department of Farm Power and Machinery, College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)

3. Year of release: 2010

4. Agro Climatic Zone: Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.

5. Detail description about the technology: The equipment is used for transplanting two rows at a time in narrow terraces where other 4 or 8 row developed manual transplanter is not suitable due to narrow width of terraces. The transplanting is done in rows therefore subsequent weeding by cono-weeder is possible. The working width is 200 mm, work rate is about 100 sqm/h. Two persons are required to smooth working of the machine. The top surface of the field after puddling should be smooth, flat and free from crop/wee residues.

6. Critical inputs required: Nil

7. Observations to be recorded:

Sl. No.	Parameters to be recoded	Average Values
1.	Puddling index	
2.	Depth of water on soil surface, mm	
3.	Area covered, ha/h	
4.	Depth of planting, mm	
5.	Missing hills	
6.	Floating hills	
7.	Seed rate, kg/ha	
8.	Plant to plant spacing, mm	
9.	Row spacing, mm	
10.	Cost of planting, Rs./ha	
11.	Plant population (20 days after planting), No/sqm	
12.	Yield, kg/ha	
13	Economic comparison with traditional method	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.53

- 1. Name of the technology:** Light weight mulcher-cum-zero-till multi crop planter
- 2. Source of the Technology:** Department of Farm Power and Machinery, College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2015
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** Although, efforts have been made in developing and promoting machinery for seeding wheat in zero till/flat/FIRB systems, successful adoption of CA practices would be useful for developing, standardizing and promoting quality machinery aimed at a range of crops and cropping sequences, permanent bed and furrow planting systems, harvesting operations to manage the crop residues and others specially in terrace cultivation under rain-fed conditions. For hilly tracts of NEH region, mechanically powered knapsack type hand tools, animal drawn implements and light

weight power tiller operated equipment may have greater relevance for adoption of CA practices. Keeping in view of above, a self-propelled light weight walk behind type mulcher cum multi-crop planter was designed and developed. The planter was powered by a 1.6 kW gasoline engine, rotary blade for furrow opening, cell type seed plate for seed metering and chain and sprocket for power transmission. The actual field capacity was 0.043 ha h⁻¹ at 1.21 km h⁻¹ average operating speed with 89% field efficiency.

6. Critical inputs required: Nil

7. Observations to be recorded:

Sl. No.	Parameters to be recoded	Average Values
1.	Quantity of crop residue, t/ha	
2.	Area covered, ha/h	
3.	Depth of sowing, mm	
4.	Seed rate, kg/ha	
5.	Seed to seed spacing, mm	
6.	Row spacing, mm	
7.	Moisture content of soil, %(db)	
8.	Cost of sowing, Rs./ha	
9.	Plant population (20 days after planting), No/sqm	
10.	Yield, kg/ha	
11	Economic comparison with traditional method	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.54

- 1. Name of the technology:** Power till operated multicrop seed drill cum planter
- 2. Source of the Technology:** Department of Farm Power and Machinery under AICRP on FIM Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2015
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** The seed drill is suitable for sowing wheat and maize in narrow terraces on small area. For sowing of maize, vertical rotor cell fill type seed metering mechanism is used. For maize sowing by seed drill, the time and labour requirement were 20.8 h/ha and 42 man-h/ha respectively as compared to 50 h/ha and 100 man-h/ha respectively by traditional method.
- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Quantity of crop residue, t/ha	
2.	Area covered, ha/h	
3.	Depth of sowing, mm	
4.	Seed rate, kg/ha	
5.	Seed to seed spacing, mm	
6.	Row spacing, mm	
7.	Moisture content of soil, %(db)	
8.	Fuel consumption, lit/h and lit/ha	
9.	Cost of sowing, Rs./ha	
10.	Plant population (20 days after planting), No/sqm	
11.	Yield, kg/ha	
12.	Economic comparison with traditional method	

- 8. Contact address for relevant information:** Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmail.com, Ph: 03592-251389

Technology no.55

- 1. Name of the technology:** Manually operated seeder cum planter
- 2. Source of the Technology:** Department of Farm Power and Machinery under AICRP on ESA Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2013
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** The equipment is suitable for sowing/planting of all crops in small area. It is pulled by human power. It is fitted with seed plate that rotate in vertical plane, carry the seed and drop in seed tube. By changing the seed plate, different type of seeds can be planted. It is very much suitable for maize planting.
- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Area covered, ha/h	
2.	Depth of sowing, mm	
3.	Seed rate, kg/ha	
4.	Seed to seed spacing, mm	
5.	Row spacing, mm	
6.	Moisture content of soil, %(db)	
7.	Cost of sowing, Rs./ha	
8.	Plant population (20 days after planting), No/sqm	
9.	Yield, kg/ha	
10.	Economic comparison with traditional method	

- 8. Contact address for relevant information:** Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.56

- 1. Name of the technology:** Animal drawn single row zero till drill
- 2. Source of the Technology:** Department of Farm Power and Machinery under AICRP on UAE Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2011
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** For sowing of rabi crops, traditionally two ploughing with indigenous plough and two planking for land preparation and sowing behind plough is practiced. The animal drawn single row zero-till drill is suitable for the purpose. It consists of seed box, main frame, two ground wheels, handle and clevis for fitting beam, chain sprocket arrangements for transmitting power to seed feed shaft. The effective field capacity 0.03 ha/h, saving in time 65% and saving in cost is about 70%.



- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Area covered, ha/h	
2.	Depth of sowing, mm	
3.	Seed rate, kg/ha	
4.	Seed to seed spacing(in case of planting), mm	
5.	Row spacing, mm	
6.	Moisture content of soil, %(db)	
7.	Cost of sowing, Rs./ha	
8.	Plant population (20 days after planting), No/sqm	

9.	Yield, kg/ha	
10.	Economic comparison with traditional method	

8. Contact address for relevant information: Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.57

- 1. Name of the technology:** Animal drawn two row zero till seed drill
- 2. Source of the Technology:** Department of Farm Power and Machinery under AICRP on UAE Centre College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool. Gangtok (Sikkim)
- 3. Year of release:** 2012
- 4. Agro Climatic Zone:** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** It may be used for sowing of seeds (small and medium size) in row rows with single pass operation. The animal drawn seed drill consists of seed box fitted with fluted roller for seed metering, inverted-T furrow openers(02 no.) for making narrow opening, main frame, two ground wheels, handle, plastic rubes for seed dropping and power transmission system for transmitting power to seed feed shaft through chain and sprocket arrangement from one of the ground drive wheels. The effective field capacity of the machine is 0.07 ha/ha, cost of operation 715.00 Rs./ha, saving in time and cost are about 15 %.
- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:**

Sl. No.	Parameters to be recoded	Average Values
1.	Area covered, ha/h	
2.	Depth of sowing, mm	
3.	Seed rate, kg/ha	
4.	Seed to seed spacing(in case of planting), mm	
5.	Row spacing, mm	
6.	Moisture content of soil, %(db)	
7.	Cost of sowing, Rs./ha	
8.	Plant population (20 days after planting), No/sqm	
9.	Yield, kg/ha	
10.	Economic comparison with traditional method	

- 8. Contact address for relevant information:** Dean, College of Agricultural Engineering and Post Harvest Technology(Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.58

- 1. Name of the Technology:** Improved large cardamom harvesting knife
- 2. Source of the technology:** College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)
- 3. Year of release:** 2012
- 4. Agro-climatic zone :** Suitable for hill farming in all the six agro-climatic zones of NEH region i.e. Alpine zone, Temperate and sub-alpine zone, Sub-tropical hill zone, Sub-tropical plain zone, Mild-tropical hill zone, and Mild-tropical plain Zone.
- 5. Detail description about the technology:** The equipment is a hand held improved design of large cardamom harvesting knife. Various parameters of knife have been presented below.

Specification				
Knife parameter	1	2	3	4
Total length, mm	320	320	240	340
Length of handle, mm	150	150	110	180
Length of blade, mm	170	170	130	160
Length of blade from lower end, mm	35-40	35-40	30-35	35-40
Size of blade from upper end, mm	40-45	40-45	35-40	45-50
Curvature of cutting edge, 0	110-115	110-115	110-115	110-120
	115-120	115-120	115-120	115-120
Material of construction	Spring steel (En-3)	Spring steel (En-3)	Spring steel (En-3)	Spring steel (En-3)
Weight, g	140-200	140-200	140-170	150-200

Performance

Efficient harvesting of large cardamom capsules with reduced drudgery and more output compared to the conventional harvesting knife.

- 6. Critical inputs required:** Nil
- 7. Observations to be recorded:** Nil.
- 8. Contact address for relevant information :** Dean, College of Agricultural Engineering and Post Harvest Technology (Central Agricultural University, Imphal) Ranipool, Gangtok (Sikkim)-737135, e-mail: dean.caepht@gmailcom, Ph: 03592-251389

Technology no.59

- 1. Name of the Technology:** Pineapple Harvester
2. Source of the technology: Directorate of Research, CAU, Imphal
3. Year of release: Not yet

4. Agro-climatic zone: -

- 5. Detail description about the technology:** A manually operated pineapple harvester is fabricated with mild steel rod of 30 mm diameter and 1500 mm length. A sharp cutting blade of 125 mm diameter made of mild steel is attached at the end of the main frame which is used to cut the stalk of the pineapple. Rotation of the cutting blade (125mm) is obtained through a transmission from a 1.5 hp petrol engine through a spiral rotating shaft. When the operator pulls the lever of the cranking wheel of engine mounted at the back of the operator which is connected to the cutting blade, the blade starts rotating and cuts the stalk just beneath the pineapple. The cut pineapple is held with the finger provide just above the cutting blade. The detached/cut pineapple will be shifted to a basket kept on the ground. A single operator is required for cutting the pineapple and putting it in the basket as well. The total weight of the machine is 9 kgs. The cutting blade can be sharpened or replaced when damaged.

6. Critical inputs required :

a. Overall dimension (L×B×H mm) :	1500(L) x 130 (B)
b. Weight :	9 kgs.
c. Prime mover :	Petrol engine
d. Power (hp) :	1.5 hp
e. Man power :	Single operator
f. Land :	Hilly terrains/terrace land of NEH
g. Investment :	Rs.10,000/-

7. Observations to be recorded: NA

- 8. Contact Address for relevant information:** Directorate of Research, Central Agricultural University, Imphal-795004