There are various designs of tools and equipment used for harvesting the crops and threshing it separately. Sickles, hand tools and reapers for grain crops and diggers for tuber crops and rhizomes, operated with different power sources are used. Combine harvesters, both tractor mounted and self-propelled, are being very widely used for different grain crops. Functional requirements and principles of working of tools and equipment for harvesting and threshing are given below:

**Harvesting Tools and Equipment**

Crops are harvested after normal maturity with the objective to take out grain, straw, tubers etc. without much loss. It involves cutting / digging / picking, laying, gathering, curing, transport and stacking of the crop. In case of cereals like wheat and paddy the plants are straight and smooth and ears containing grains are at the top whereas most of oilseed and pulse crops have branches, which create problems in harvesting by manual or mechanical means. As per Bureau of Indian Standards the cutting and conveying losses should not be more than 2 per cent.

**Traditional method of harvesting**

The harvesting of crops is traditionally done by manual methods. Harvesting of major cereals, pulse and oilseed crops are done by using sickle whereas tuber crops are harvested by country plough or spade. All these traditional methods involve drudgery and consume long time.

**Mechanical harvesting equipment**

Timeliness of harvest is of prime importance. During harvesting season, often rains and storms occur causing considerable damage to standing crops. Rapid harvest facilitates extra days for land preparation and earlier planting of the next crop. The use of machines can help to harvest at proper stage of crop maturity and reduce drudgery and operation time. Considering these, improved harvesting tools, equipment, combines are being accepted by the farmers.

**Different type of mechanical harvesting tools / equipment, suitability for crops and their limitations**

(a) Serrated blade sickle

It has a serrated curved blade and a wooden handle. The handle of improved sickle has a bend at the rear for better grip and to avoid hand injury during operation. Serrated blade sickles cut the crop by principle of friction cutting like in saw blade. The crop is held in one hand and the sickle is pulled along an arc for cutting. Cutting of crop close to the ground is possible with modified handle. Energy requirement is 80-110 man-h/ha. It can be used effectively for harvesting of wheat, rice and grasses.

(b) Reapers

Reapers are used for harvesting of crops mostly at ground level. It consists of crop-row-divider, cutter bar assembly, feeding and conveying devices. Reapers are classified on the basis of conveying of crops as given below:

i. **Vertical conveying reaper windrower**

It consists of crop row divider, star wheel, cutter bar, and a pair of luggered canvas conveyor belts. This type of machines cut the crops and conveys 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 reaper-windrowers are available. These types of reapers are suitable for crops like wheat and rice. The field capacities of these machines vary from 0.20-0.40 ha/h.

ii. Horizontal conveying reapers
This type of reapers are provided with crop dividers at the end, crop gathering reel, cutter bar and horizontal conveyor belt. They cut the crop, convey the crop horizontally to one end and drop it to the ground in head-tail fashion. Collection of crop for making bundles is difficult. This type of reapers is tractor mounted and suitable for wheat, rice, soybean, and gram. Performance of reapers with narrow-pitch cutter bar is better for soybean and gram crops.

iii. Bunch conveying reapers
This type of reapers are similar to horizontal conveying reapers except that the cut crop is collected on a platform and is being released occasionally to the ground in the form of a bunch by actuating a hand lever. Here, collection of crops for making bundles is difficult. Bullock drawn and tractor-operated models are available and they are suitable for harvesting wheat, rice and soybean crops.

iv. Reaper binders
The cutting unit of this type of reapers may be disc type or cutter bar type. After cutting, the crop is conveyed vertically to the binding mechanism and released to the ground in the form of bundles. Self-propelled walking type models are available but these are not popular due to high cost of twine. Reaper binders are suitable for rice and wheat.

(c) Strippers
The design of a tractor front mounted stripper is available for collection of matured grass seeds from the seed crops. It consists of a reel having helical rubber bats which beat the grass over a sweeping surface where the ripened seeds get detached and the seeds are collected in the seed box.

(d) Diggers
The design of groundnut and potato diggers of animal drawn and tractor operated types are available. The digging units consists of V-shaped or straight blade and lifter rods are attached behind the share. These lifter rods are spaced to allow the clods and residual material to drop while operating the implement. The plant along with pods/tubers is collected manually.

(e) Combines
Various designs of combine harvester having 2 to 6 m long cutter bar are commercially available. Therefore, no research effort has been initiated under the Project up till now. However, the need of a small whole crop combine harvester is felt. The function of a combine harvester is to cut, thresh, winnow and clean grain/seed. It consists of header unit, threshing unit, separation unit, cleaning unit and grain collection unit. The function of the header is to cut and gather the crop and deliver it to the threshing cylinder. The reel pushes the straw back on to the platform while the cutter bar cuts it. The crops are threshed between cylinder and concave due to impact and rubbing action. The threshed material is shaken and tossed back by the straw rack so that the grain moves and falls through the openings in the rack onto the cleaning shoe while the straw is discharged at the rear. The cleaning mechanism consists of two sieves and a fan. The grain is conveyed with a conveyor and collected in a grain tank.

Requirements of field and crops for harvest by mechanical reapers or windrowers.

The following criteria must for successful use of mechanical harvesting equipment.

i. Field must be fairly level without undulations to facilitate smooth operation and uniform stubble length.
ii. For small reapers and binders, plants must be grown in rows.
iii. Field efficiency of harvesting machines is high in large fields.
iv. Water control in rice field is essential to ensure that the fields are drained and are relatively dry at harvest time.

Methods and equipments for harvesting major crops

Harvesting of crops like paddy and soybean has to be done carefully as the matured grains easily detach from the earheads/pods and, therefore, cannot be harvested by fast working tools or machines. Bengalgram, green gram, lentil are to be harvested at ground level. Oilseed crops pose different type of problems to engineers for mechanization of their harvesting. Safflower is a spiny crop and difficult to harvest even manually. In case of sunflower, harvesting is simpler as only flower heads are to be collected. In sesame crops, pods containing seeds are attached to the main stem and they are mostly raised by broadcasting. This also needs gentle handling. Farmers follow different methods for harvesting of rapeseed/mustard and pigeon pea. Mostly, farmers harvest these crops at branch level, but small farmers harvest these crops at ground level. Harvesting of root crops involves digging, shaking to remove adhering soil, windrowing or stacking and picking. A good root crop harvester should give maximum recovery and cause minimum damage to pods or tubers.

The harvesting methods followed by farmers for major crops are as follows:

Cereal crops

Wheat and Rice: Harvesting of these crop is traditionally done by using local sickle. Improved serrated blade sickles are also in use. The following machines are available for efficient harvesting of these crops.

i. Self propelled walking type reaper
ii. Reaper binders
iii. Tractor front and rear mounted reapers
iv. Combine harvesters

Sorghum: Harvesting by local sickle is the traditional practice followed by farmers. Suitable machines are not available for harvesting this crop. However, combine harvesters are in use in advanced countries.

Maize: The traditional practice is to collect the matured cobs manually. Grain combines equipped with corn-head snipping unit are being used in developed countries.

Pulse crops

Bengal gram: Harvesting by local sickle is the traditional practice. Improved serrated blade sickles are also in use. The performance of narrow pitch cutter bar with horizontal conveyor is better than other types of available reapers. Combines with floating cutter-bar are in use in advanced countries.

Pigeon pea: This crop is traditionally harvested at ground level by using a chopper or local sickle. No suitable machine for harvesting this crop is available in the country. Crop stems are being used by farmers for domestic use.

Urad, Moong and Cowpea: These crops are traditionally harvested by using local sickle. Improved serrated blade sickles are also in use.

Oilseed crops

Groundnut: Digging of crop with country plough and blade hoe at proper soil moisture level and manual pulling and gathering of pods using hand hoe is common practice. Animal drawn and tractor operated diggers and digger windrowers are improved implements developed for groundnut harvesting. The blade harrow is widely used for digging of groundnut crop in Gujarat. TNAU, CIAE and CTAE, designs are some of the improved animal drawn groundnut diggers.
Tractor operated groundnut diggers have wide blade, which cover 1.25 to 2 metre width and operate at 10 to 15 cm depth. PAU, APAU and GAU diggers are some of the designs developed.

Rapeseed and Mustard: The traditional practice is to harvest manually using sickles. In tall varieties, farmers cut the plants above ground level and leave long stubbles in field, which are subsequently ploughed in. In some areas, where plants are used as fuel or thatch material, harvesting with serrated blade sickles close to ground level, is practised by farmers. Mechanical harvesting of crop is carried out by following type of machines:

i. Self propelled walk behind type vertical conveyor reaper,
ii. Tractor front or rear mounted pto operated reaper, and
iii. Combine harvester

Combine harvesters need slight modification to make them suitable for harvesting rapeseed crop because of tall and branchy nature of the crop. The changes required are (a) attachment of vertical cutter bar at outer ends to get a clean cut windrow and (b) increase of header table length to accommodate the bulky crop. Combine harvesters can handle the crop easily after above changes are made.

Soybean: Harvesting by local sickle is the traditional practice followed by farmers. However, modified serrated blade sickles are recommended, as plant stem is 8 to 12 mm thick. The following machines have been evaluated and found suitable for soybean harvesting:

i. Self propelled vertical conveyor reaper windrower
ii. Tractor rear mounted reaper
iii. Combine harvester

When the available harvesters are to be used for soybean, these are required to be modified and adjusted to reduce field losses and suit crop and soil conditions. Cutting of crop close to ground with low stubble height and crowding and stripping effect are the main requirements. Combine harvesters with floating cutter bars are recommended for low harvesting losses. Narrow pitch cutter bar has been reported to give lower harvesting losses as compared to conventional cutter bar.

Sunflower and Castor: The traditional practice is to manually harvest the flower heads of sunflower and castor plants. These are stacked and sun dried for threshing. Suitable machines are not available for harvesting of sunflower and castor crops. Harvesting of whole plant would require separation of flower heads for threshing and thus the time saved by harvesting the whole plants would not reduce the labour requirement. The combine harvesters are used for harvesting of above crops using specially designed header. These are in use in advanced countries.

Safflower: The traditional practice is to manually harvest the crop using sickles. Because of thorny and spiny nature of crop, harvesting and handling of safflower plants is a problem. Use of hand gloves and covers on legs and arms is recommended during harvesting. Hayforks are used for gathering and stacking the plants in field or on trailers.

For mechanical harvesting of safflower following machines are recommended:

i. Self propelled (1 metre wide) vertical conveyor reaper,
ii. Combine harvester

Threshing Equipment

Thresher is a machine to separate grains from the harvested crop and provide clean grain without much loss and damage. During threshing, grain loss in terms of broken grain, unthreshed grain, blown grain, spilled grain etc. should be minimum. Bureau of Indian Standards has specified that the total grain loss should not be more than 5 per cent, in which broken grain should be less than 2 per cent. Clean unbruised grain fetch good price in the market as well as it has long storage life.
Traditional threshing methods

Trampling of paddy under feet, beating shelves of rice or wheat crop on hard slant surface, beating crop with a flail, treading a layer of 15 to 20 cm thick harvested crop by a team of animals are traditional methods followed by farmers depending upon capacity, lot size and situation. Threshing by bullock treading is practised on large scale in the country but it is also time consuming and involves drudgery. Tractor in many places is now used in place of animals for treading. Introduction of animal drawn olpad thresher reduced the drudgery of the operator and gave comparatively higher output per unit time. In all above methods the threshed materials are subjected to winnowing either in natural wind flow or blast from winnowing fan for separation of grain from straw.

Threshing wheat by traditional method involves drudgery and takes more time to obtain required quality of bhusa. Due to these, mechanical threshers are widely accepted by the farmers.

Different parts of a thresher and their functions

A mechanical thresher consists of the following parts:

i. Feeding device (chute/tray/trough/hopper/conveyor)
ii. Threshing cylinder (hammers/spikes/rasp-bars/wire-loops/syndicator)
iii. Concave (woven-wire mesh/punched sheet/welded square bars)
iv. Blower/aspirator
v. Sieve-shaker/straw-walker.

The crop is fed from the feeding tray into the threshing cylinder. The threshing cylinder is fitted with spikes/bars/hammers or wire-loops around its periphery according to the type of thresher. Below the cylinder there is a concave and it covers lower portion of the cylinder. The cylinder rotates at high speed and thus the crop is threshed and the entire or a portion of threshed material falls from the concave on to top sieve of cleaning system. Due to reciprocating motion of top sieve lighter material accumulate at the top and grain falls on to the bottom sieve. In case of spike-tooth thresher, an aspirator blower sucks out the lighter material from the top sieve and throws it out from blower outlet. The sieves help in further cleaning of the grain by allowing heavier straw to overflow.

Adjustments

Various adjustments are required before starting threshing operation. The machine is to be installed on clean level ground and is to be set according to crop and crop conditions. The adjustments necessary to get best performance from the machine are (i) concave clearance, (ii) sieve clearance, (iii) sieve slope, (iv) stroke length and (v) blower suction opening. Besides these, cylinder concave grate, top sieve hole size and cylinder speeds for threshing different crops are important for a multicrop thresher.

Setting of a spike tooth multicrop thresher having 500 mm cylinder diameter and 720 mm blower diameter are given below:

Working principle of a thresher

During operation, the crop material is slightly pushed into the threshing cylinder through the feeding chute, which gets into the working slit created between the circumference of the revolving drum having attached spikes and the upper casing. The speed of the spikes is greater than the plant mass due to which they strike the latter which results in part of the grain being separated from straw. Simultaneously, the drum pulls the mass through the gap between the spikes and the upper casing with a varying speed. The angle iron ribs on the other hand, restrain the speed of the travelling of stalks clamped by the spikes. Due to this the spikes move in the working slit with a varying speed in relation to the shifting mass of material, which is simultaneously shifted, with a varying speed with respect to the upper casing. As a result, the material layer is struck several times by the spikes against the ribs,
causing threshing of the major amount of grains and breaking stalks into pieces, and also accelerating them into the inlet of the lower concave.

As the material layer shifts towards the progressively converging slit of lower concave, its size reduces. The vibration amplitudes, therefore, decrease, whereas the speed of the layer increases. This causes mutual rubbing of the ear stalks, as well as rubbing of the ears against the edges of the concave bars and causes breaking of stalks depending on the concave clearance. Since the system is closed, the thicker stalk, which cannot be sieved through the concave, again joins the fresh stalk and the same process is repeated until the stalk size is reduced to the extent that it can pass through the concave apertures. Thus fine bruised straw is produced.

The effective threshing process means that the loss of unthreshed kernels ejected with the straw through the concave and the loss of grain damage should be low and the amount of the material passed through the concave should be high.

**Different type of thresher and their suitability for crops**

The type of thresher is generally designated according to the type of threshing cylinder fitted with the machine (Fig.9.1). The major type of threshers commercially available is as follows:

1. **Drummy type**
   It consists of beaters mounted on a shaft which rotates inside a closed casing and concave.

2. **Hammer mill type**
   It is similar to dummy type but it is provided with aspirator type blower and sieve shaker assembly for cleaning grains.

3. **Spike-tooth type**
   Spikes are mounted on the periphery of a cylinder that rotates inside a closed casing and concave. It is provided with cleaning sieves and aspirator type blower.

4. **Raspbar type**
   Corrugated bars are mounted axially on the periphery of the cylinder. It is fitted with an upper casing and an open type concave at the bottom of the cylinder. The cleaning system is provided with blower fan and straw walker.

5. **Wire-loop type**
   Wire-loops are fitted on the periphery of a closed type cylinder and woven wire mesh type concave is provided at the bottom.

6. **Axial flow type**
   It consists of spike tooth cylinder, woven-wire mesh concave and upper casing provided with helical louvers.

7. **Syndicator type**
   The cylinder consists of a flywheel with corrugation on its periphery and sides, which rotates inside a closed casing and concave. The rims of the flywheel are fitted with chopping blades. Rice, wheat, gram, maize, and sorghum are the major crops grown in the country. Besides these soybean cultivation is also catching up rapidly. In case of wheat threshing farmers want not only clean grain but also need fine quality of bruised straw (bhusa) for cattle feed. This requirement of quality 'bhusa' makes combining unattractive to small farmers.

Drummy type, hammer mill type and syndicator type threshers are suitable for threshing wheat crops only and they can produce fine quality of 'bhusa', rasp-bar type, wire-loop type and axial flow type threshers are suitable for paddy and they do not make fine straw. Rasp-
bar type threshers can be used for threshing other crops but farmers do not prefer, this machine because it does not make fine 'bhusa'; and cost is very high due to its bulky size. Though the hammer mill type threshers can produce fine quality 'bhusa' its use is decreasing day by day due to high power requirement. Portable wire loop type paddle operated threshers are widely used by farmers in paddy growing areas. Spike tooth type thresher can thresh wheat crop and can produce fine quality of 'bhusa'. This thresher can be used for threshing other crops if the blower is mounted on a separate shaft so that the cylinder speed can be varied independently. Majority of farmers prefer spike tooth type threshers because of their simplicity in design, low cost and their ability to make fine 'bhusa'.

**Factors affecting thresher performance**

The factors which affect the quality and efficiency of threshing are broadly classified in following three groups:

i. **Crop factors:**
   - Variety of crop,
   - Moisture in crop material.

ii. **Machine factors:**
   - Feeding chute angle,
   - Cylinder type,
   - Cylinder diameter,
   - Spike shape, size, number
   - Concave size, shape and clearance

iii. **Operational factors:**
   - Cylinder speed,
   - Feed rate, method of feeding,
   - Machine adjustments.

Beans are more susceptible to damage due to impact and the variety of grain has much influence on grain loss during threshing. Damage of large beans is more than smaller beans at same impact velocity and orientation. The amount of damage increases rapidly below ambient temperature of 10°C. So, handling of dry beans at low temperature should be avoided. Moisture content of grains is a major factor in controlling grain damage. Decrease in moisture content greatly increases the brittleness of grains. Unthreshed grains are more at high pod moisture content whereas grain damage decreases with increase in grain moisture content. More threshing effort is required for threshing high moisture crop, which causes more internal grain damage and thus affects viability. Soybean moisture content between 8 and 12 per cent (wb) is optimum for low mechanical damage.

The base angle of feeding chute affects the feed rate. It should be tangential to cylinder drum for maximum feed rate and minimum physical effort. The threshing cylinder requires power as high as 60-75 per cent of total power input. Hammer mill type threshers bruise the straw very fine but the specific energy requirement is the highest among all types of threshers. Rasp-bar cylinder design can thresh most of the crop except groundnut but these machines do not provide bruised straw. The concept of a straw bruising attachment to rasp-bar thresher is not economically viable. Spike tooth type threshers having independent drive to cylinder and blower can thresh major crops effectively but the cylinder speed is to be adjusted according to the crop conditions. Larger cylinder diameter has lower power requirements than smaller ones at higher feed rates. Higher rib spacing in upper concave increases unthreshed grain but reduces power consumption. The performance with flat spikes is better than round and square spikes. Larger spike spacing in a row reduces power consumption and broken grains whereas power increases and broken grains reduce with the increase in number of rows of spikes. However, uniformity of spike distribution over cylinder periphery is more important for better
performance. Power consumption and grain damage increases with the increase in spike length and thickness. The grain damage decreases and unthreshed grains increase with the increase in concave gap. Higher concave clearance reduces power consumption whereas straw bruising is more at low concave clearance.

The effect of cylinder speed on threshing performance is highly significant at all machine settings. Power consumption and broken grains increase and unthreshed grains decrease with the increase in cylinder speed. Though the unthreshed grain losses decrease but the total grain losses increase with the increase in cylinder speed. Quality of bhusa is better at higher cylinder speeds, low concave clearance and concave gap. Higher feed rate increases power consumption, reduces broken grains and unthreshed losses and to some extent helps in straw bruising. In general, feed input capacity is considerably affected by machine settings. Lower rib spacing in upper concave, concave bar spacing, concave clearance and non-uniform spike distribution over cylinder periphery reduces the capacity. Low feed rate, high labour rate, high energy consumption, high percentage of broken grain and poor quality of straw all contribute to high qualitative cost of operation.

For harvesting tall varieties, there are problems as plants in rows are entangled with each other. Therefore, in combine harvesters, a vertical cutter bar is used at outer end to cut and separate the plants of harvested row. Similar cutting device is also used on reapers on the outer crop row divider and the belt conveyor has to be raised up, to take care of tall crop.

*Sesamum and Linseed:* Traditional practice is to harvest and gather the crop manually using sickles. Tractor rear and side mounted reaper can be used for harvesting the broadcast crop. Vertical conveyor reapers have been used for harvesting crop, raised in rows and at optimum moisture level, i.e. 15-20 per cent, to avoid shattering of pods.

**Factors affecting performance of harvesting machines**

**i. Crop Factors**
- Crop variety
- Ambient temperature
- Maturity of crop
- Crop moisture
- Crop condition
- Crop density

**ii. Machine factors**
- Shape and size of crop divider
- Reel position and speed
- Cutting blade shape and speed
- Conveyor speed
- Machine vibrations
- Machine settings

**iii. Operational Factors**
- Height of cut
- Operation speed
SICKLES

Features
Sickle is one of the most common hand tools used for harvesting of the crops, grass and cutting of other vegetative matters. It consists of curved steel edged blade fixed to the wooden handle. The cutting edge may be plain or serrated depending upon the design. The curvature of the blade differs widely in plain edged and serrated sickles. The blade is fabricated from medium carbon or high carbon steel and hardened to resist wear. Manganese steel, tool steel and alloy steel can also be used to produce better quality sickles which have more life than the sickles fabricated from the plain carbon steel. The blade has a knife section and the thickness reduces towards the cutting edge. The tang of the blade is inserted in to the wooden handle for joining the blade to the handle. The wooden handle is either straight or bent at the end. For cutting, the part of the plant to be cut is held in one hand and sickle operated with other hand. Cutting is achieved by imparting translatory and rotary movement to the blade around the point of cut. This action leads to applying frictional and shearing force components required to achieve cutting.

Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length (mm)</td>
<td>260-420</td>
</tr>
<tr>
<td>Overall width (mm)</td>
<td>145-200</td>
</tr>
<tr>
<td>Overall height (mm)</td>
<td>25-75</td>
</tr>
<tr>
<td>Blade thickness (mm)</td>
<td>1.5-4, tapered to the cutting edge</td>
</tr>
<tr>
<td>Length of cutting edge (mm)</td>
<td>130-210</td>
</tr>
<tr>
<td>Hardness of the cutting edge</td>
<td>37-46 HRC</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>150-400</td>
</tr>
</tbody>
</table>

Uses
The sickle is general purpose harvesting hand tool. It is used for the harvesting of vegetables, cereal crops and cutting of the grass and other vegetative matters.

Sources (Appendix)
7, 13, 116, 155, 206, 209, 209, 335, 336, 385, 387, 410, 420, 463, 500, 557, 569, 633, 658, 691, 700, 701, 783, 783, 841, 857, 857, 858, 859, 884, 916, 938, 955, 1009, 1010, 1272, 1282, 1291, 1385, 1413, 1472, 1521, 1528, 1536, 1684, 1692, 1743,

SICKLE
Local Name: Kachi

Features
It is a traditional type sickle with curved cutting edge, which is serrated. It is made from mild steel flat or angle section. A wooden or bamboo handle is fitted on tang of the blade. For cutting, the part of the plant to be cut is held in one hand and sickle operated with other hand. Cutting is achieved by imparting translatory and rotary movement to the blade around the point of cut. The cutting takes
place due to frictional and shearing forces.

### Specifications

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Mild steel flat/ angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td>Bamboo/wood</td>
</tr>
<tr>
<td>Handle</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension of blade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length×Width×Thickness (mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Angle between the blade and handle (°)</th>
<th>180</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dimension of handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
</tr>
<tr>
<td>Length (mm)</td>
</tr>
</tbody>
</table>

| Weight (kg)                           | 0.15-0.20 |

### Uses

The sickle is used for weeding, harvesting of paddy, wheat, vegetables, and standing crops.

### Sources (Appendix)

100, 114, 121, 136, 232, 950, 964, 986, 1083, 1095, 1248, 1250, 1251, 1258, 1292, 1425, 1487

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**SICKLE**

*Local Name: Thangol*

### Features

The sickle is made from mild steel flat or leaf spring steel and forged to shape. The blade of the sickle is curved on the tip. Concave side of the blade beveled and sharpened. Quality and price of the sickles vary according to raw material used and method of fabrication. The sickles made of spring steel are hardened and tempered to suitable hardness.

### Specifications

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Mild steel flat, leaf spring steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td>Wood</td>
</tr>
<tr>
<td>Handle</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Dimension of blade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length×Width×Thickness (mm)</td>
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</table>

<table>
<thead>
<tr>
<th>Angle between the blade and handle (°)</th>
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<table>
<thead>
<tr>
<th>Dimension of handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
</tr>
<tr>
<td>Length (mm)</td>
</tr>
</tbody>
</table>

| Weight (kg)                           | 0.15-0.20 |

### Uses

Used for harvesting of paddy and weeding.

### Sources (Appendix)

794, 801, 802, 805, 1069, 1622, 1623, 1625, 1626, 1647
IMPROVED SICKLE
Local Name: Thangol akonbi

Features
It consists of blade and handle. Tang of the blade is bent in ‘Z’ shape and inserted in wooden handle. The tang is secured firmly in the handle by a metal ring. The blade is made from mild steel flat section or leaf spring steel and forged to shape. The cutting edge is bevel and sharp. The blades made from spring steel are hardened and tempered to suitable hardness. The operation of the sickle is similar to other sickles. It is also used for cutting thick soft stems by striking the cutting edge on them.

Specifications
Raw material used
- Blade: Mild steel flat, leaf spring steel
- Handle: Wood

<table>
<thead>
<tr>
<th>Dimension of blade</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length x Width x Thickness (mm)</td>
<td>250-275 x 30-35 x 3-4</td>
<td></td>
</tr>
<tr>
<td>Angle between the blade and handle (°)</td>
<td>180</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension of handle</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>25-30</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>150-200</td>
</tr>
</tbody>
</table>

| Weight (kg) | 0.20-0.30 |

Uses
Used for cutting grass, weeds, harvesting of crops and cutting thick soft stem crops.

Sources (Appendix)
794, 801, 802, 805, 1069, 1622, 1623, 1625, 1626, 1647

SICKLE
Local Name: Kachi

Features
It is a plain edged common sickle made from mild steel flat or angle section. The blade is forged to shape and is curved. The sickle requires frequent sharpening during use, since the blade is made of mild steel. Shape of tip permits to use the sickle for weeding in addition to harvesting of crops. The sickle is operated giving translatory and rotary motion to the blade for harvesting and for weeding it can be used like soil working tool.

Specifications
Raw material used
- Blade: Mild steel flat, angle
- Handle: Wood

<table>
<thead>
<tr>
<th>Dimension of blade</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length x Width x Thickness (mm)</td>
<td>130-150 x 25-30 x 1-2</td>
<td></td>
</tr>
<tr>
<td>Angle between the blade and handle (°)</td>
<td>180 (approx.)</td>
<td></td>
</tr>
</tbody>
</table>
Dimension of handle

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>20-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>120-150</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.05-0.75</td>
</tr>
</tbody>
</table>

Uses

It is used for harvesting paddy and cutting of weeds, grasses and fodder etc. It is also used for weeding and interculture operations.

Sources (Appendix)

Various blacksmiths of Arunachal Pradesh.

SICKLE

Features

The sickle consists of curved blade with tang and handle. The tang is inserted in the wooden handle. The blade is made from old leaf spring steel or mild steel flat/angle section by forging to shape. The shape of the blade differs slightly with in north-eastern region and accordingly the sickles are given different names. The sickle fabricated from spring steel are hardened and tempered to suitable hardness.

Specification

Raw material used

<table>
<thead>
<tr>
<th>Blade</th>
<th>Leaf spring steel, mild steel sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handle</td>
<td>Bamboo/wood</td>
</tr>
</tbody>
</table>

Dimension of blade

<table>
<thead>
<tr>
<th>Length x Width x Thickness (mm)</th>
<th>180-200 x 25-30 x 4-5</th>
</tr>
</thead>
</table>

Angle between the blade and handle (°) 175 (approx.)

Dimension of handle

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>25-30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>130-150</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.120-0.150</td>
</tr>
</tbody>
</table>

Uses

The sickle is used for harvesting paddy and cutting of weed, grasses etc.

Sources (Appendix)

Various blacksmiths of Nagaland.

SICKLE

Local Name: Rashi

Features

It is a plain edged sickle and consists of blade with tang and long wooden handle. The sickle is either forged from a mild steel round bar to shape or a thick mild steel sheet is used for the blade and a round bar is joined to the blade for making tang. The tang is secured in the wooden handle by a metal ring usually made from mild steel pipe. The sickle is also used for cutting thick soft stems similar to the
action of dao.

**Specifications**

**Raw material used**
- Blade: Mild steel rod, sheet
- Handle: Wood

**Dimension of blade**
- Length×Width×Thickness (mm): 200-250×18-25×1.5-2
- Angle between the blade and handle (°): 180

**Dimension of handle**
- Diameter (mm): 25-30
- Length (mm): 150-175
- Weight (kg): 0.10-0.15

**Uses**

It is used for harvesting paddy, other field crops and cutting of weeds. It is also used for clearing jungle growth and cutting of soft stem bushes etc.

**Sources (Appendix)**

2, 134, 286, 731, 835, 925, 1097, 1313, 1488, 1593, 1595

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**PLAIN SICKLE**

*Local Name: Hosia*

**Features**

The sickle is wider, longer and heavier than the serrated and other types of sickles. It consists of blade with tang and wooden handle. The blade is made from old leaf spring steel, mild steel flat or angle sections by forging process. Sickles made from spring steels are hardened and tempered to suitable hardness for longer service life of the blade. For clearance of jungle growth, the sickle is used by striking the blade against the object and for harvesting the operation is like other sickles.

**Specifications**

**Raw material used**
- Blade: Spring steel, mild steel
- Handle: Wood

**Dimension of blade**
- Length×Width×Thickness (mm): 250-300 × 30-35 × 4-5
- Angle between the blade and handle (°): 180

**Dimension of handle**
- Diameter (mm): 30-35
- Length (mm): 190-220
- Weight (kg): 0.30-0.40

**Uses**

It is used for harvesting paddy and other field crops. It is also used for intercultural operations and clearance of jungle growth.
**SERRATED SICKLE**

*Local Name: Kochia*

**Features**

It is a serrated edged cutting tool slightly heavier and thicker than other serrated sickles used in other region of north-eastern states. Similar to other sickles it consists of blade with tang and wooden handle. The blade is made from old leaf spring steel of mild steel flat/angle section by forging to shape. Filing or squeezing the blade in punch-die creates the serrations of the cutting edge. The back of serrated edge is ground to bevel profile for exposing cutting teeth. Cutting takes place due to shear and friction action of the blade teeth with crop stems.

**Specifications**

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Leaf spring steel, mild steel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blade</strong></td>
<td>Wood</td>
</tr>
<tr>
<td><strong>Handle</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Dimension of blade</strong></td>
<td>200-250×25-30×3-4</td>
</tr>
<tr>
<td><strong>Angle between the blade and handle (°)</strong></td>
<td>180</td>
</tr>
<tr>
<td><strong>Dimension of handle</strong></td>
<td>25-30</td>
</tr>
<tr>
<td><strong>Diameter (mm)</strong></td>
<td>25-30</td>
</tr>
<tr>
<td><strong>Length (mm)</strong></td>
<td>190-220</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>0.15-0.25</td>
</tr>
</tbody>
</table>

**Uses**

It is used for harvesting paddy and other field crops. It is also used for intercultural operations.

**Sources (Appendix)**


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**SERRATED SICKLE**

*Local Name: Dani kachi*

**Features**

The serrated sickle is made from mild steel flat, angle or sheet by forging operation by local blacksmiths. It consists of curved blade with tang inserted in wooden handle. The blade is not much curved as compared to other sickles. The serrations on the blade are usually created by...
filing. The operation of sickle is similar to other sickles and due to serrations, cutting take place due to shearing and friction action between teeth of the blade and crop stems.

**Specifications**

**Raw material used**
- Blade: Mild steel flat, angle, sheet
- Handle: Bamboo/wood

**Dimensions of blade**
- Length x Width x Thickness (mm): 200-230 x 25-30 x 1-2
- Angle between the blade and handle (°): 170-180

**Dimension of handle**
- Diameter (mm): 25-30
- Length (mm): 100-130
- Weight (kg): 0.10-0.20

**Uses**

It is used for harvesting paddy and other field crops. It is also used for cutting weeds and grasses.

**Sources (Appendix)**

52, 71, 95, 146, 154, 166, 182, 190, 225, 226, 259, 352, 452, 503, 505, 510, 643, 901, 958, 981, 989, 1018, 1019, 1020, 1050, 1056, 1061, 1153, 1158, 1159, 1169, 1273, 1276, 1338, 1339, 1352, 1525, 1526, 1542, 1546, 1552, 1580, 1624

**NAVEEN SICKLE**

**Features**

It is a serrated blade sickle suitable for harvesting wheat, rice and grasses. The blade is made from medium carbon steel or alloy steel, hardened and tempered to suitable hardness. The back of serrated edge is ground to bevel profile to expose the cutting teeth. Upon wearing of teeth, the bevel profile is ground and teeth are exposed again. The wooden handle has a bend at the rear for better grip and to avoid hand injury during operation. It saves 26 per cent labour and operating time and 27 per cent on cost of operation compared to harvesting by local sickles. The sickle is outcome of the research and has been adopted by manufacturers for commercial production.

**Specifications**

- Dimensions of blade (mm): 260 x 33 x 1.7
- Weight (kg): 0.257
- Length of cutting edge (mm): 225
- Radius of curvature (mm): 260
- Number of teeth per cm: 5
- Diameter of handle (mm): 40
- Power source: One person

**Performance results**

- Crop: Wheat
- Field capacity (ha/h): 0.018
Labour requirement (man-h/ha)  80

Uses
It is suitable for harvesting wheat, rice and cutting of grasses.

Sources (Appendix)
254, 335

PUNJAB SICKLE

Features
It is a serrated blade sickle and consists of blade and wooden handle. The blade is stiffened by providing a ‘U, strip at the back edge, which holds the blade in place and is joined to the handle. The wooden handle has a bend at the rear for better grip and to avoid hand injury during operation. The sickle with self-sharpening blade saves 25 per cent labour, operating time and 35 per cent cost of operation compared to conventional method of harvesting with local sickle. The sickle is outcome of the research, presently commercially available in the market and is being used by the farmers of this region.

Specifications

<table>
<thead>
<tr>
<th>Dimension/Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions of blade (mm)</td>
<td>280 × 31 × 1.5</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.25</td>
</tr>
<tr>
<td>Length of cutting edge (mm)</td>
<td>220</td>
</tr>
<tr>
<td>Diameter of handle (mm)</td>
<td>40</td>
</tr>
</tbody>
</table>

Performance results

<table>
<thead>
<tr>
<th>Crop</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field capacity (ha/h)</td>
<td>0.009-0.011</td>
</tr>
<tr>
<td>Labour requirement (man-h/ha)</td>
<td>150-160</td>
</tr>
</tbody>
</table>

Uses
It is suitable for harvesting of wheat, rice and grasses.

Sources (Appendix)
70, 391

VAIBHAV SICKLE

It is a serrated blade sickle and consists of blade, handle and a tang for joining blade with handle. The blade is made from medium carbon steel or low alloy steel, hardened and tempered to suitable hardness after serrations. The serrations are created in punch-die by squeezing operation. The back of serrated edge is ground to bevel profile. The cutting edge is sharpened by grinding the bevel profile and exposes new teeth. It saves 25 per cent labour and operating time and 24 per cent cost of operation compared to conventional method of harvesting by local sickle. The sickle is outcome of the research efforts and is commercially available.
Specifications
Dimensions of blade (mm) 180 × 28 × 5
Radius of curvature (mm) 128
Weight (kg) 0.175
Diameter of handle (mm) 40
Power source One person

Performance results
Crop Rice
Field capacity (ha/h) 0.011
Labour requirement (man-h/ha) 89

Uses
It is suitable for harvesting wheat, rice and cutting of grasses.

Sources (Appendix)

LAXMI SICKLE

Features
These are serrated blade sickles available in different sizes and curvatures. In some designs tang is bent and fixed to the handle. Basically all the sickles consist of blade, handle and a tang for joining blade with handle. The blade is made from medium carbon steel or low alloy steel, hardened and tempered to suitable hardness after serrations. The serrations are created in punch-die by squeezing operation. The back of serrated edge is ground to bevel profile. The cutting edge is sharpened by grinding the bevel profile and exposes new teeth.

Specifications
Length (mm) 350
Width (mm) 100, 150
Weight (kg) 0.220
Field capacity (ha/h) 0.011
Source Manual, single person

Uses
It is suitable for harvesting wheat, rice and cutting of grasses.

Sources (Appendix)
1742

GRASS CUTTING DAO
Local Name: Jungle kata da

Features
The cutting tool has a long blade and the cutting tip of the blade is provided slight curvature to hold thin stems. The curved tip facilitates cutting of tender weeds and is mainly used for
weeding purposes. The tool is fabricated from mild steel or old leaf spring steel and forged to shape. The tang of the tool is fitted with a wooden handle. The blade is struck against the stem for cutting or drawn in soil for weeding.

**Specifications**

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Leaf spring/mild steel flat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td>Wood</td>
</tr>
<tr>
<td>Handle</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension of blade</th>
<th>Length x Width x Thickness (mm)</th>
<th>320-350 x 35-40 x 4-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle between the blade and handle (°)</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Dimension of handle</td>
<td>Diameter (mm)</td>
<td>30-35</td>
</tr>
<tr>
<td></td>
<td>Length (mm)</td>
<td>250-300</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.35-0.40</td>
<td></td>
</tr>
</tbody>
</table>

**Uses**

For cleaning and cutting of vegetation and for cutting grass and weeds.

**Sources (Appendix)**

Various blacksmiths of Arunachal Pradesh

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**FELLING DAO**

*Local Name: Mashik*

**Features**

This is a multipurpose cutting tool used for cutting and felling of tree and bamboo. It is also used for cutting of meat and fish. This tool is mainly used by Adi community of the state. It is made from leaf spring by forging and is tapered to the cutting edge. The shape of cutting side is curved and the tip is rounded. The cutting edge is hardened for longer service life of the cutting tool.

**Specifications**

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Leaf spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td></td>
</tr>
<tr>
<td>Handle</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension of blade</th>
<th>Length x Width x Thickness (mm)</th>
<th>300-350 x 50-55 x 4-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle between the blade and handle (°)</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Dimension of handle</td>
<td>Diameter (mm)</td>
<td>35-40</td>
</tr>
<tr>
<td></td>
<td>Length (mm)</td>
<td>150-200</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.30-0.35</td>
<td></td>
</tr>
</tbody>
</table>

**Uses**

Used for felling wood and bamboo. It is also used for preparation of bamboo-based products and preparation of meat.
LONG FELLING DAO
Local Name: Nishi da

Features
It is a long blade cutting tool similar to garden sword and consists of blade and wooden handle for gripping of the tool. It is made from old leaf spring by forging; the cutting edge is hardened and tempered. Nishi community of the state mainly uses the tool. The cutting edge is a slightly curved and sharpened. A suitable wooden or bamboo handle is fitted to the blade. It is operated by swinging action or striking the blade against the wood or bamboo for cutting.

Specifications
Raw material used
- Blade : Leaf spring
- Handle : Bamboo/wood

Dimension of blade
- Length x Width x Thickness (mm) : 450-500 x 45-50 x 4-5
- Angle between the blade and handle (°) : 180

Dimension of handle
- Diameter (mm) : 35-45
- Length (mm) : 250-300
- Weight (kg) : 0.50-0.65 (without handle)

Uses
It is used for cutting wood and bamboo and clearance of jungle growth. It is also used for splitting fuel wood.

Sources (Appendix)
Various blacksmiths of Arunachal Pradesh

GRASS CUTTING DAO

Features
It has a long and curved blade at the tip. The blade is made from old leaf spring steel by forging and the tang end is fitted to a bamboo or wooden handle. The blade is hardened and tempered to suitable hardness for longer service life. The tool is operated by striking the blade on the stems or twigs or by dragging the blade on the grass or weeds just like sickle. The tall weeds are cut by swinging action.

Specifications
Raw material used
- Blade : Leaf spring
- Handle : Bamboo/wood
Dimension of blade

Length x Width x Thickness (mm) : 320-350 x 45-50 x 5-6
Angle between the blade and handle (°) : 180

Dimension of handle

Diameter (mm) : 35-40
Length (mm) : 300-320
Weight (kg) : 0.65-0.70

Uses

Used for cutting weeds, grass etc. It is also used for fuel wood preparation.

Sources (Appendix)

Various blacksmiths of Nagaland.

FELLING DAO

Features

The tool consists of blade and handle. One end of the blade is flattened and the other made to form a tang for insertion in the handle. The blade is made from old leaf spring steel and forged to shape. The cutting edge is hardened and tempered to suitable hardness for longer service life of the cutting edge. The tool is used by striking the cutting edge against the object for cutting.

Specifications

Raw material used

| Blade          | Leaf spring
| Handle         | Bamboo/wood

Dimension of blade

Length x Width x Thickness (mm) : 230-250 x 60-65 x 5-6
Angle between the blade and handle (°) : 180

Dimension of handle

Diameter (mm) : 30-40
Length (mm) : 300-350
Weight (kg) : 0.75-0.85

Uses

It is used for cutting of branches, twigs and vegetation in jungle for clearing land. It is also used for ripping of bamboo for making mat and bamboo based products.

Sources (Appendix)

Various blacksmiths of Nagaland.

FELLING DAO

Local Name: Chem

Features

The tool consists of blade and handle and is smaller version of dao used in the northeastern region of the country. The blade has broader end at the tip and cutting is slightly curved. The other end is formed into a tang for fixing to the handle. The blade is made from old leaf spring...
steel and forged to required shape. The cutting edge is hardened and tempered to suitable hardness for longer service life. The tool is operated by hitting the job with the cutting edge of the tool.

**Specifications**

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Leaf spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td>Wood</td>
</tr>
<tr>
<td>Handle</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension of blade</th>
<th>250-280×50-55×4-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length×Width×Thickness (mm)</td>
<td>175 (approx.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Angle between the blade and handle (°)</th>
<th>35-40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>150-180</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>0.40-0.50</th>
</tr>
</thead>
</table>

**Uses**

It is used for cutting wood, bamboo and ripping of bamboo for making bamboo based products. It is also used for splitting wood for fuel purposes.

**Sources (Appendix)**

Various blacksmiths of Mizoram state.

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**KHASI DAO**

*Local Name: Wait bnoh*

**Features**

It is one of the most widely hand tool used in Meghalaya State. It has a long blade fitted to a long wooden handle. It is made from old leaf spring steel by forging operation. The tip of the blade is curved and allows pulling and collection of twigs, branches of tree and shrubs for cutting. The cutting edge of the blade is hardened and tempered and does not require frequent sharpening.

**Specifications**

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Spring steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td>Wood</td>
</tr>
<tr>
<td>Handle</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension of blade</th>
<th>300-350 × 40-50 × 8-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length×Width×Thickness (mm)</td>
<td>180</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Angle between the blade and handle (°)</th>
<th>25-40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>250-300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>0.45-0.50</th>
</tr>
</thead>
</table>

**Uses**

It is used for cutting of shrubs, tree branches and clearance of jungle growth. It is also used for dibbling of seeds in plots and harvesting of maize crop.
WOOD CUTTING DAO
Local Name: Gonga

Features
This is a general purpose cutting tool mostly used in the Garo Hill districts of Meghalaya. It consists of a long working blade with a curve at the tip and fitted with a long bamboo handle. The blade is made from old leaf spring steel by forging it to required shape. The cutting edge is hardened and tempered for longer service life of the tool. The tang is fitted to the wooden handle. The tool is operated by striking the cutting edge against the wooden material.

Specifications

<table>
<thead>
<tr>
<th>Raw material used</th>
<th>Spring steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade</td>
<td>Bamboo</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension of blade</th>
<th>300-350 x 30-40 x 5-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handle</td>
<td></td>
</tr>
<tr>
<td>Angle between the blade and handle (°)</td>
<td>180</td>
</tr>
<tr>
<td>Diameter (mm)</td>
<td>30-35</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>400-450</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.30-0.40</td>
</tr>
</tbody>
</table>

Uses
It is used for cutting wooden twigs, branches of trees, shrubs, clearance of jungle growth and forest vegetation.

Sources (Appendix)
244, 247, 1242, 1281, 1457, 1611

FELLING DAO
Local Name: Wait lyngkut

Features
It is a sturdy cutting and felling tool used in Meghalya State. It is made from old leaf spring steel by forging operation by local artisan. It is usually large and heavy than the other types of dao fabricated in the region and is usually operated by male workers. The dao is operated by striking the cutting edge on the object. The curved edge helps in cutting round objects. The cutting edge is hardened and tempered to suitable hardness for longer service life of the edge and does not require frequent sharpening.
Specifications

Raw material used
- Blade: Spring steel
- Handle: Wood

Dimension of blade
- Length×Width×Thickness (mm): 375-425 × 70-80 × 8-10
- Angle between the blade and handle (°): 180

Dimension of handle
- Diameter (mm): 35-50
- Length (mm): 250-300
- Weight (kg): 1.00-1.20

Uses
It is used for felling of trees, cutting of branches and shrubs and clearance of jungle growth.

Sources (Appendix)

JUNGLE CUTTING DAO
Local Name: Wait pom dieng

Features
It is a long handle S-shaped dao having sharp convex and concave edges. Both edges are used for cutting depending on the shape of the object. The blade is made from old leaf spring steel and forged to shape. Both the edges are beveled out from the middle section and sharpened. The edges are hardened and tempered to suitable hardness for longer service life of the blade. The hook type tip is used for pulling branches of trees from far distance for cutting. The tool is operated by impact action.

Specifications

Raw material used
- Blade: Leaf spring
- Handle: Wood

Dimension of blade
- Length×Width×Thickness (mm): 300-350×40-50×8-10
- Angle between the blade and handle (°): 160-180

Dimension of handle
- Diameter (mm): 25-35
- Length (mm): 300-350
- Weight (kg): 0.45-0.50

Uses
Used for cutting of wooden logs, cleaning forest vegetation, etc.
BIG DAO
Local Name: Chenida

Features
It is a curved tip type manual cutting tool used for different agricultural operations and domestic purposes. It is made from mild steel flat or old leaf spring steel by forging operation. The dao made from leaf spring is hardened and tempered to suitable hardness and cost more than that made from mild steel flats. For cutting the cutting edges is struck against the material to be cut by impact. A ring is provided on the wooden handle at the tang end, which does not allow the tang to come out of the wooden handle.

Specifications
Raw material used
- Blade: Mild steel/leaf spring steel
- Handle: Bamboo/Wood

Dimension of blade
- Length×Width×Thickness (mm): 280-330×40-45×4-5
- Angle between the blade and handle (°): 180

Dimension of handle
- Diameter (mm): 40-50
- Length (mm): 180-220
- Weight (kg): 0.40-0.50

Uses
It is used for felling of small trees, branches and making of bamboo strips. It is also used for harvesting maize and other hard stem crops.

Sources (Appendix)
42, 101, 134, 223, 240, 243, 244, 247, 554, 666, 668, 791, 793, 828, 834, 836, 903, 967, 1049, 1065, 1067, 1068, 1070, 1096, 1097, 1150, 1217, 1219, 1242, 1281, 1293, 1310, 1312, 1314, 1316, 1317, 1457, 1471, 1595, 1611, 1748, 1752, 1754

FELLING DAO
Local Name: Hath dao

Features
It is a cutting tool made from mild steel flat or old leaf spring steel. The blade is forged to shape sharp beveled cutting edge from the back end. The tip of one end is made to hook shape and other end is formed as tang for insertion in wooden handle. The tool made from the spring steel is hardened and tempered to suitable hardness for longer service life of the cutting edge. The tool is used by striking the cutting edge against the object.
Mild steel flat or leaf spring steel
Bamboo/wood

250-280×50-70×5-7
180
35-40
150-250
0.60-1.00

Uses
It is used for cutting of shrubs, twigs, thick stems, branches and clearance of jungle growth.

Sources (Appendix)
71, 143, 166, 182, 225, 226, 236, 357, 503, 504, 505, 642, 981, 987, 989, 1019, 1020, 1050, 1056, 1061, 1153, 1158, 1169, 1276, 1337, 1339, 1344, 1526, 1542, 1546, 1552, 1555, 1560, 1069, 1624, 1759

CHOPPER

Features
Chopper is a simple harvesting hand tool, which consists of a blade, tang and a handle. The cutting edge is slightly curved (convex) along the cutting edge to facilitate the cutting. The blade is joined to the handle by inserting its tang. The blade is forged to knife section and cutting edge sharpened. The blade is important part of the tool and is made from medium carbon steel, high carbon steel, manganese steel or alloy steel including tool steel. The cutting edge is hardened and tempered to suitable hardness to resist wear and abrasion. The tool made from tool steel and alloy steel has more service life as compared to the plain carbon steel blade. The blade should have property of toughness to resist the impact stresses. The handle is made of wood and shaped to suitable handgrip. For operation, the blade is struck hard against the stem with one hand and the cutting is accomplished by the impact action and sliding of the blade along the stem. The shape and size of the chopper varies from place to place and its use.

Specifications
Overall length (mm) 285 - 475
Length of cutting edge (mm) 160 - 260
Width of cutting blade (mm) 55 - 80
Thickness of blade (mm) 4, tapered to cutting edge
Length of handle (mm) 115 - 225
Weight (g) 450 - 500
Hardness of blade 37 - 46 HRC

Uses
For harvesting of pineapple, coconut, banana etc. It is also used for splitting of the coconut and cutting the twigs and small branches.
GRASS SLASHER
Local Name: Thanghai

Features
It is a manually operated long handled tool. It consists of blade made from old leaf spring steel or mild steel round bar, flat sections and the end is flattened to form cutting part of the blade. The cutting end is sharpened on both edges. This blade is fitted with a long bamboo or mild steel pipe handle. For operation, the tool is held in one or both hands and swung in the grassy area. The cutting end of the blade strikes the grass stems and cutting take place due to impact action. The blade made from spring steel is hardened and tempered to suitable hardness.

Specifications
Raw materials used
- Blade: Mild steel rod, flat, leaf spring
- Handle: Bamboo, mild steel pipes

Dimensions of blade
- Length×Width×Thickness (mm): 750-900×30-35×4-5

Dimensions of handle
- Diameter (mm): 30-35
- Length (mm): 250-350
- Weight (kg): 0.75-0.85

Uses
The tool is used for cutting standing weeds, cleaning bunds, gardens, clearing of jungle growth etc.

Sources (Appendix)
789, 792, 794, 799, 800, 801, 802, 805, 1069, 1476, 1622, 1625, 1647

MANUALLY OPERATED LONG HANDLED SCYTHE

Features
It consists of a curved blade and a long pipe handle. The blade is made from medium carbon steel or low alloy steel and forged to shape. The cutting edge is sharpened for smooth cutting of fodder crop. Handle and blade are nearly at right angle to each other. A person operates the scythe in standing posture by gripping the handle at suitable positions and the blade is swung in a curvilinear motion. With the scythe it is possible to cut an area of about 1.2 m wide and 0.6 m long in one stroke. Cut crop is swept and windrowed in second stroke of the blade. During harvesting blade is kept close to the ground.

Sources (Appendix)
Specifications

<table>
<thead>
<tr>
<th>Power source</th>
<th>One person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>1700</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>650</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>100</td>
</tr>
<tr>
<td>Length of handle (cm)</td>
<td>170</td>
</tr>
<tr>
<td>Length of blade (cm)</td>
<td>65</td>
</tr>
<tr>
<td>Max. Width of blade (cm)</td>
<td>8</td>
</tr>
<tr>
<td>Handle material</td>
<td>Milod steel pipe (20 gauge)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Uses

Scythes are used for harvesting barseem fodder.

Sources (Appendix)

470, 927, 1474

GRASS CUTTER
Local Name: Huansam chem

Features

It consists of long blade bent near the handle and a wooden handle. The blade is made from mild steel flat section and the tang end is inserted in the handle. The blade is made to desired shape by forging and both edges are sharpened. For operation the tool is held with the handle and swung in the grassy field. The cutting edges of blade cut the grass by impact and shearing action. The tool is operated both in standing and squatting positions.

Specifications

Raw materials used

| Blade                  | Mild steel flat             |
| Handle                | Wood                        |

Dimensions of blade

Length x Width x Thickness (mm) : 320-350 x 35-40 x 3-4

Dimensions of handle

Diameter (mm) : 30-35
Length (mm) : 150-180

Weight (kg) : 0.35-0.40

Uses

The tool is used for clearing and cutting of forest vegetation, cutting grass, weeds etc.

Sources (Appendix)

Various blacksmiths of Mizoram state
MANUAL FRUIT HARVESTER

Features

It consists of one fixed blade and another moving blade actuated by a spring. There is a net basket attached to it to collect plucked mango fruits. The long handle facilitates reaching fruits from ground. During harvesting, the fruit pedicel is adjusted to rest on fixed blade and pressing the lever at the grip end of the handle actuates the moving blade. The overall length of the tool is about 3000 mm and the weight of the cutting head is 1.3 kg. The blades are made from carbon steel. The device is also used for harvesting oranges, apple, and sapota.

Sources (Appendix)

28, 390, 391, 1472, 1780

MANUAL FRUIT HARVESTERS

Hold On and Twist Type

Features

It is a manual-harvesting tool with which individual fruit is first held between two jaws of the and then twisted to shear off the stock. The jaws are made of 14 gauge mild steel sheet. These are held together by a tension spring on a pivot fitted on 10 mm mild steel rod. A handle can be fitted to the tool. One of the jaws has a lever bracket and rope arrangement for operating the jaw. Three mm thick rubber sheet padding is provided on inside of the jaws to avoid any skin damage while holding the fruits. After its detachment, fruit is released by pulling the cord in to a ring. A cloth conveyor or net is provided below the jaws for collection of harvested fruits at ground level without any damage. The tool is suitable for harvesting peach, pear, and orange. Its field capacity is 250-300 fruits /man-h. A manual-harvesting device has been also developed and commercialised for harvesting mango fruit.
with panicle. It consists of an oval shaped rings. The bottom ring is meant for fastening nylon net. A cutting mechanism is provided at the top of the ring and it consists of double bladed triangular plate together with toothed wheel. This toothed wheel is riveted at the center of the two fixed cutting blades. The wheel rotates freely about its central rivet and acts as a conveyor of a mango stock. For fixing a bamboo handle of desired length, a holder is provided to the harvester opposite to the cutting mechanism. A plastic divider rod bisecting the cutting mechanism is provided in the ring to guide the stalk of fruits either to the left or to the right side of the cutting blade. For harvesting mango, the harvester is raised and fruit is taken in the ring by pulling the harvester. The pedicels of the fruit are taken in between the toothed wheel and blade. On rotation of a toothed wheel, the pedicle is guided over the sharp edge of the blade where it is sheared. Field capacity of the device is 140 fruits/h.

Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>400</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>290</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.45</td>
</tr>
<tr>
<td>Capacity (kg/h)</td>
<td>65</td>
</tr>
<tr>
<td>Power source</td>
<td>Manual single person</td>
</tr>
</tbody>
</table>

Uses

The devices are used for harvesting of fruits.

Sources (Appendix)

28, 390, 391, 1472, 1780

**MANUALLY OPERATED SAPOTA HARVESTER**

Features

It consists of main body of PVC having cylindrical shape. The upper end of the body is closed while bottom end is open to which nylon net for collecting the fruits is tied. A stretched string closes the other end of the net. A gate is made on the body for entry of the fruits to be harvested. On the lower surface of the body a metal holder is fixed to hold the bamboo of required length. Two fingers cut in V-shape and with small sharp blades are provided at the closed end of the body of the harvester. The fingers help to select and hold the fruit to be harvested from the bunch. By pulling the harvester, fruit is detached from the bunch, which falls in the body and rolls into the net. To unload the harvested fruits in the net a stretched string at the closed end of the net is loosened.

Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>240</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>150</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.225</td>
</tr>
<tr>
<td>Capacity (kg/h)</td>
<td>50</td>
</tr>
<tr>
<td>Power source</td>
<td>Manual single person</td>
</tr>
</tbody>
</table>

Uses

The harvester is used for harvesting of small fruits like lemon, sapota etc.

Sources (Appendix)

28, 390, 391, 1472, 1780
BHINDI PLUCKER

Features
The tool is ergonomically designed. The plucker consists of two arms hinged together, cutting blades joined to open ends of arms and two rings joined to the arms. The blades are made of medium carbon steel or low alloy steel, hardened and tempered to suitable hardness. Panicles are cut individually using this tool. The operator is spared of drudgery, discomfort and itching to skin of his hands, which are associated with conventional method of manual plucking without any aid. It fits in the hand properly with the help of two rings, one over thumb and another over index finger. Force to cut the pedicle is exerted by pressing these two fingers against each other. Pedicle is sheared between two straight blades, one of which is notched for better grip.

Specifications
Length (mm) : 140
Width (mm) : 95
Weight (kg) : 0.15
Capacity (kg/day) : 50

Uses
It is used for plucking of bhindi (ladies finger) from plant

Sources (Appendix)
28, 390, 391, 1472, 1780

COTTON STALK PULLER

Features
It is a simple and useful hand tool for pulling the cotton stalks from the field after harvesting. The tool consists of inverted ‘U’ frame, footrest, steel jaws and handle. All the parts are made of mild steel and assembled by using fasteners. The movement of the jaws is linked with the motion of handle, which is moved towards and away from the operator. For operation, the stalk in held between the jaws, a foot is placed on the footrest and the handle is pulled. With the pulling of the handle, the jaws grip the stalk and also move it upward and uproot the stalk. The rate of uprooting depends on the moisture content of the soil and skill of the operator.

Specifications
Overall length (mm) : 280
Overall width (mm) : 105
Overall height (mm) 1020
Weight (kg) 3.25

Uses
It is used to uproot the cotton stalk from the ground after the cotton crop has been harvested.

Sources (Appendix)
1632

COTTON STALK PULLER

Features
The tool consists of a frame, cycle wheel, axle, jaws, pivot, lever and handle. All the parts are made of mild steel and assembled by using fasteners. The movement of the jaws is linked with the motion of handle, which is moved up and down by the operator. For operation, the stalk in held between the jaws, and the handle is pulled down. With the pulling of the handle, jaws grip the stalk and also move it upward and uproot the stalk. The rate of uprooting depends on the moisture content of the soil and skill of the operator. The pivot holds the puller in position and acts as footrest.

Specifications
<table>
<thead>
<tr>
<th>Overall length (mm)</th>
<th>1080</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall width (mm)</td>
<td>350</td>
</tr>
<tr>
<td>Overall height (mm)</td>
<td>800</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>10</td>
</tr>
</tbody>
</table>

Uses
It is used to uproot the cotton stalk from the ground after the cotton crop has been harvested.

Sources (Appendix)
264

LAC SHELLER

Peg Type

Features
The hand operated lac sheller is provided with two discs mounted on axles. One disc is kept stationary and the other disc having pegs fixed on the inner face can be rotated. It is suitable for removing the resin from all types of lac sticks. It saves 29 per cent labour and 37 per cent on cost of operation and is 2.5 times faster, compared to conventional method of manual scrapping with the help of special knife (dabia). The quality of lac is not affected by the use of lac shellers.

Specifications
<table>
<thead>
<tr>
<th>Dimensions (l×w×h) (m)</th>
<th>0.43 × 0.49 × 0.48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>9.2</td>
</tr>
<tr>
<td>Disc diameter (mm)</td>
<td>200</td>
</tr>
<tr>
<td>Number of pegs &amp; size</td>
<td>36 Nos., 5 mm dia x 5 mm length</td>
</tr>
</tbody>
</table>
It is suitable for removing resin from all type of lac sticks.

Sources (Appendix)

1781

**OCTAGONAL HAND MAIZE SHELLER**

**Features**

The Octagonal Hand Maize Sheller is a manually operated simple device to remove maize grains from the dehusked cobs. The sheller is of octagonal shape. The sheller consists of 4 mild steel fins tapered along their length, one edge of the fin is taper. In each fin, two holes are provided for riveting. Each fin is bent at two places in a manner for assembling in octagonal shape. The corners of the fins are rounded in order to avoid injury to the operator during shelling operation. The fins are joined together with rivets. The assembled sheller has thus four tapered projections in side the sheller body that accomplishes removal of the grain from the maize cob. In order to avoid corrosion, the sheller is powder coated which also increases its working life. For operation, the sheller is held in left hand and the dehusked maize cob in right hand (for right hand person). The cob is inserted in the sheller and is given forward and backward twist or given clockwise and anticlockwise strokes repeatedly. The tapered edges of the fins dig into the space between the rows of the grains in the cob and with the forward or backward stroke the grains are released from the cob. After grains are separated from one end of cob, the other end is inserted in the sheller to complete the removal of grains from cob. Due to the taper edges of the fins, which are projected inside the sheller body, one end of the sheller has larger opening and the other smaller. Therefore, for shelling the larger end of the cob it is inserted in the larger opening of the sheller and the smaller opening of the sheller is used for smaller end of the cob.

**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall dimensions (mm)</td>
<td>72 × 63 × 58</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.2</td>
</tr>
<tr>
<td>Cost (Rs.)</td>
<td>25</td>
</tr>
<tr>
<td>Capacity (kg/hr)</td>
<td>15-20</td>
</tr>
</tbody>
</table>

**Uses**

The octagonal maize sheller is used for shelling of dehusked maize cobs, especially for seed purposes.
LEAFY VEGETABLE HARVESTER

Features

It is a modification of hedge shear to which a gathering mechanism provided. The mesh is made of mild steel. The blades of the shear are made from high carbon steel, alloy steel or tool steel. The edges are hardened and tempered to suitable hardness. The blades of the shear are joined to the wooden handle by tang. The handles are shaped for a comfortable grip. The harvester is operated by closing and opening of the blades with both hands. In the open position the stems of the vegetable are placed between the blades and during closing the vegetable is cut. The cutting takes place due to shearing action. The cut crop is collected in the mesh welded to the blades. The collected vegetable is placed over a twine for binding. One person operates the harvester.

Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length (mm)</td>
<td>700</td>
</tr>
<tr>
<td>Overall width (mm)</td>
<td>150</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>250</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>1.50</td>
</tr>
<tr>
<td>Hardness of the cutting edge</td>
<td>42 HRC</td>
</tr>
</tbody>
</table>

Uses

For harvesting of leafy vegetables such as spinach and fenugreek

Sources (Appendix)

28, 390, 391, 1472, 1780

RUBBER TAPPING AND DRAINING KNIFE

Features

The tool consists of a V-shaped, front edged blade, fixed to a wooden handle with the help of tang and ferrule. The blade is made from high carbon steel, tool steel or alloy steel. The cutting edge is heat treated and hardened to suitable hardness. The ferrule is made of mild steel and chrome plated to avoid oxidation. For tapping of the rubber fluid from the rubber trees, the V-shaped front edge, which is a cutting edge, is used to inflict a cut/ groove on the tree trunk through which the rubber fluid slowly flows out. The groove acts like a channel and opens the latex cells and thus allows tapping and draining of the latex. A tin is placed at the end of groove or channel for the collection of the tapped fluid/latex. Formation of the groove is due to the scratching and shearing action of the tool head. The blade is made from carbon steel and is heat-treated to obtain a hardness of 30-45 HRC.

Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length</td>
<td>300</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>250</td>
</tr>
</tbody>
</table>
Uses
This tool is used for tapping fluid from rubber trees.

Sources (Appendix)
784, 872, 1491, 1498, 1639

PEDAL OPERATED THRESHER

Features
It consists of wire-loop type threshing cylinder, power transmission system, mild steel sheet body and foot pedal. The threshing cylinder consists of wire-loops of ‘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/bar with links. The foot pedal/bar 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. For operation, paddy bundle is held in hands and earhead portion of the crop is placed on the rotating cylinder. The wire-loops hit the earheads and grain get detached from the rest of the crop.

Specifications

- Dimensions (l×w×h) (mm) : 1250 × 650 × 630
- Cylinder size (mm) : 400 diameter × 600 length
- Loop wire diameter (mm) : 4
- Number of wire loops : 144
- Number of wire loop strips : 12
- Transmission system : Pedal Crank mechanism with 1:4 gear ratio
- Power source : One persons
- Weight (kg) : 36

Performance results

<table>
<thead>
<tr>
<th>Crop</th>
<th>Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken grains (per cent)</td>
<td>Nil</td>
</tr>
<tr>
<td>Total grain losses (percent)</td>
<td>1.2</td>
</tr>
<tr>
<td>Threshing efficiency (per cent)</td>
<td>98.8</td>
</tr>
<tr>
<td>Output capacity (kg/h)</td>
<td>44</td>
</tr>
<tr>
<td>Labour requirement (man-h/q)</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Uses
It is used for threshing rice crop.

Sources (Appendix)
SUNFLOWER THRESHER

Features
It is a pedal operated hold on type sunflower thresher suitable for separating seeds from sunflower heads. It consists of a threshing wheel having spokes and a blower fan operated by foot pedal through chain and sprocket. Four persons hold sunflower heads on the threshing wheel through holes provided in the cover. It saves 50 per cent labour and operating time and 33 per cent on cost of operation compared to conventional method of manual beating.

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (l×w×h) (mm)</td>
<td>1170 × 1050 × 660</td>
</tr>
<tr>
<td>Threshing wheel dia (mm)</td>
<td>635</td>
</tr>
<tr>
<td>Number of spokes</td>
<td>50</td>
</tr>
<tr>
<td>Power source</td>
<td>One person for drive</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>42</td>
</tr>
</tbody>
</table>

Performance results

<table>
<thead>
<tr>
<th>Crop</th>
<th>Sunflower heads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder speed (rev/min)</td>
<td>166</td>
</tr>
<tr>
<td>Broken grain (per cent)</td>
<td>Nil</td>
</tr>
<tr>
<td>Total grain losses (per cent)</td>
<td>3.41</td>
</tr>
<tr>
<td>Threshing efficiency (per cent)</td>
<td>100</td>
</tr>
<tr>
<td>Cleaning efficiency (per cent)</td>
<td>95</td>
</tr>
<tr>
<td>Output capacity (kg/h)</td>
<td>40 (with 4 persons)</td>
</tr>
<tr>
<td>Labour requirement (man-h/q)</td>
<td>10</td>
</tr>
</tbody>
</table>

Uses
It is a used for separating seeds from sunflower heads.

Sources (Appendix)
270, 592

ANIMAL DRAWN POTATO DIGGER
Birsa, Ranchi

Features
It is an animal drawn digger useful for digging and exposing potato tubers. It consists of a ridger shaped bottom with welded extension rods on its wings. These rods help in separation of soil and dirt from the potato tubers. A handle is provided at the rear for guiding the implement while in operation. It is suitable for digging potato tubers after removal of vines from the field. It saves 40 per cent labour and operating time and 18 per cent on cost of operation compared to conventional method of digging with spade. It also results in reduction of 11.3 per cent losses compared to conventional method of digging with spade.
Specifications

Dimensions (l×w×h) (mm)  
630 × 330 × 730

Weight (kg)  
8

Number of ridger bottom  
One

Width of bottom (mm)  
330

No. of extension rods  
8

Type of share  
Bar point

Power source  
A pair of bullock

Performance results

Crop  
Potato

Width of cut (mm)  
350

Field capacity (ha/h)  
0.030-0.035

Damage of potato (per cent)  
3.8

Draft (N)  
460

Labour requirement (man-h/ha)  
231 (including that for picking tubers)

Uses

It is suitable for digging potato tubers after removal of vines from the field.

Sources (Appendix)

220, 1154

ANIMAL DRAWN SINGLE ROW POTATO DIGGER

Features

This is a simple implement suitable for digging and exposing potato tubers from one row. It is provided with a V-shaped blade with round bars at the rear. The blade at the front digs out the tubers and the rods at the rear help in the separation of soil from the tubers. Tubers thus exposed and free of soil are collected manually after the pass of the implement. It saves 40-45 per cent labour and operating time and 35-40 per cent on cost of operation compared to conventional method of manual digging with spade or country plough. It also results in 3-4 per cent increase in the yield. The machine is used by potato growers and is commercially manufactured.

Specifications

Dimensions (l×w×h) (m)  
1.05 × 0.54 × 0.40

Weight (kg)  
18

No. of blades  
One

Shape of blade  
V-shaped

Length of blade (mm)  
540

Power source  
A pair of bullocks

Performance results

Crop  
Potato

Width of cut (mm)  
600 (one row)

Operating speed (km/h)  
2.0
Field capacity (ha/h)  0.12  
Field efficiency (per cent)  80  
Total tubers losses (per cent)  1-2  
Labour requirement (man-h/ha)  400

Uses
It is suitable for digging and exposing tubers from one row.

Sources (Appendix)
366, 916, 1382

ANIMAL DRAWN GROUNDNUT DIGGER
TNAU, Coimbatore

Features
It is an animal drawn implement suitable for harvesting groundnut and also potato. The digger is provided with a crescent shaped blade attached to a common square shank and fitted to a frame. It is provided with two steel wheels and a hand lever for depth control. It saves 89 per cent labour and operating time and 71 per cent on cost of operation compared to conventional method of hand pulling after irrigation.

Specifications
Dimensions (l×w×h) (mm)  3300 × 1100 × 750  
Weight (kg)  120  
No. of digging blades  One  
Length of cutting blade (mm)  575  
Power source  One pair of bullocks

Performance results
Width of cut (mm)  575  
Depth of cut (mm)  110-200  
Operating speed (km/h)  2.6-2.7  
Field capacity (ha/h)  0.10  
Digging efficiency (per cent)  98.6  
Pod damage (per cent)  3  
Draft (N)  750  
Labour requirement (man-h/ha)  30

Uses
It is suitable for harvesting groundnut and also potato.

Source (Appendix)
195, 1074, 1287, 1472, 1589, 1656