IDC IIT Bombay

Drumstick plucker

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Guided by-
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Prof. B. K. Chakravarthy
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http://media-cache-ec0.pinimg.com/736x/d4/b7/98/d4b7984f4b77cbad8a5b218108563888.jpg as on 10th sept, 2014

Drumsticks

India : Largest producer of Drumsticks (Moringa)
380 sq. Km area under cultivation
1.1 to 1.3 million tonnes per year
Top three producing states – 1] Andhra-Pradesh
2] Karnataka
3] Tamil Nadu

Also produced in Thailand, Philippines, Taiwan

Fig.1: Drumstick farm

Medicinal uses of drumsticks

Leaves

relieve headaches
stop bleeding from a shallow cut
treats gastric ulcers and diarrhea
anti-bacterial and anti-inflammatory effect
High Iron content- used against Anemia

Seeds

antibiotic and anti-inflammatory properties
treat arthritis, relaxant for epilepsy
Oil of is used for hysteria, scurvy, prostate problems

Flowers

Juice good for pregnant women
useful against urinary problems

Pod

It can cure pain of the joints
high protein and fiber content- treating malnutrition

Bunch of drumstick pods

Fig.2: Drumsticks bunch

Average ht of drumstick tree – 20 ft
Distance of pod from ground – 5 ft to 18 ft

Position – End of the branch

a = 50 mm to 90 mm
b = 80 mm to 120 mm
C = 40 mm to 90 mm

Stem thickness = 6 mm to 9 mm

Order of getting mature-

Pods nearer to main trunk are older and hence mature

Pod no 1,2 - ready to pluck
Pod no 3,4 - Not yet ready
Pod no 5 - immature

Harvesting statistics

Harvesting period- November to june

Cyclic process
All drumsticks wont get mature at a time ; Repeated after every 6 to 7 days.
10 to 15 pods / tree
Plucking : 5 to 6 min / tree
Time required to pluck pods from 65 trees- 6 hrs

[Generally son or brother helps him]

3 hrs continuous work [In morning Or afternoon]

Tool 1

Heavy tool= 4.8 kg
No selective plucking
Upper holding hand gets more strain
Neck pain, waist pain, back pain, severe pain in hands
Repetitive action of bending for collecting plucked pods
Difficult to balance
Time consuming process
Difficult to carry and store

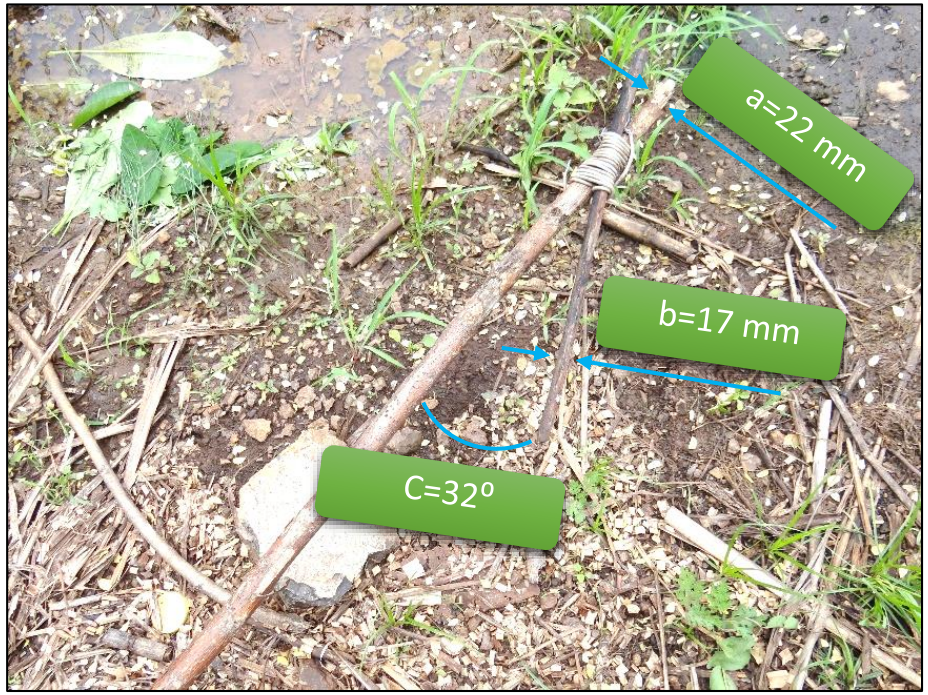


Fig.3: Tool made-up of a bamboo and small wooden stick

Fig.4: Tool being used in field

Tool 2

Heavy= 3.4 kg
New *Khurpe* attached at one end
Khurpe/ koyta works perfect under shearing action;
But they are using it as chopper knife.
No selective action: breaks branch
Sometimes used as hook (*Aakada*)
Repetitive bending action- waist pain
Muscle pain
Difficult to carry

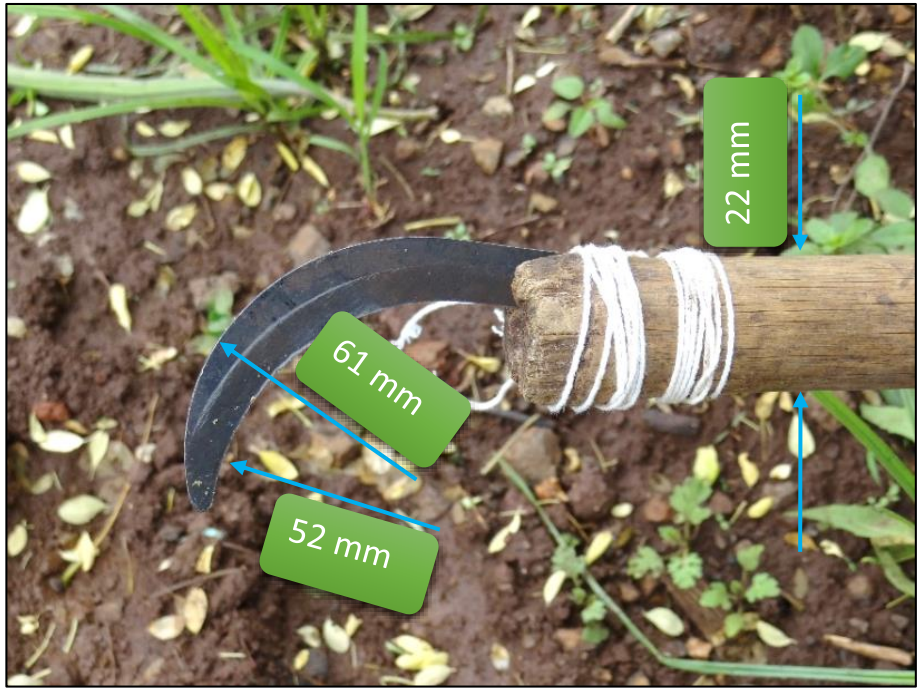


Fig.5: Tool made-up of a bamboo and small *Khurpe*

Fig.6: Tool being used in field

Tool 3

Light in weight

No selective plucking
Smaller length: No height adjustment
smaller hook opening

Fig.7: Tool made-up of a bamboo and long steel rod

Fig.8: Tool being used in field

Tool 4

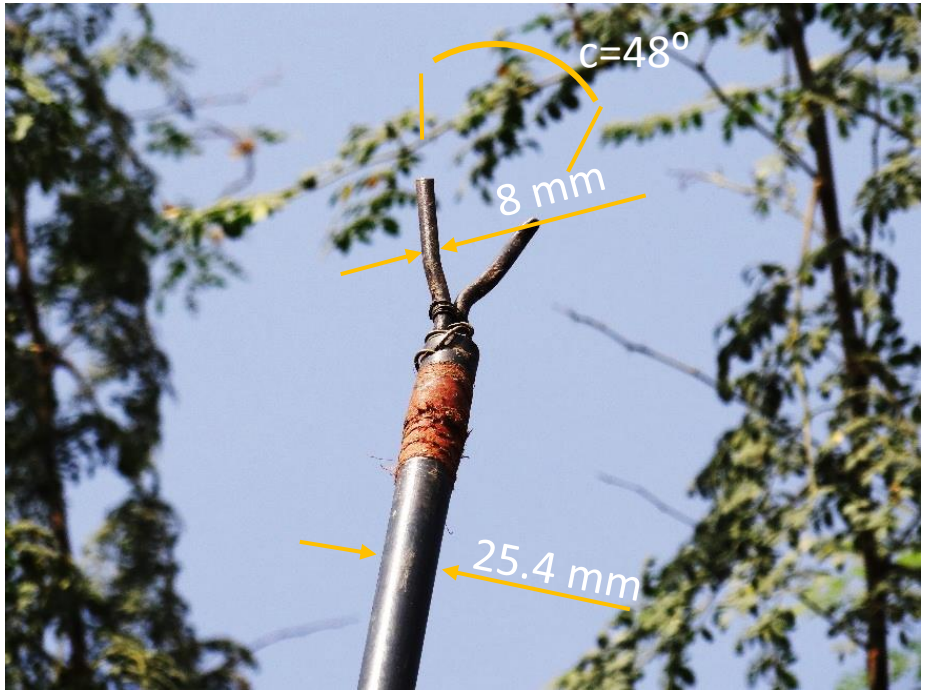


Fig.9: Tool made-up of a PVC pipe and steel rod

Light in weight

Allows selective plucking: less loss

PVC pipe bends : Aiming towards pod is difficult

PVC pipe cracks due to UV rays and repetitive twisting action

Pods slip from out of the hook

Pods fall directly on ground: skin damage

No height adjustment

Difficult to carry and store

Fig.10: Tool being used in field

Problems identified

1. Heavy tool- Average weight 3.9 Kgs
2. No selective plucking- Major loss
3. Skin damage- less market value
4. Time consuming (3-4 hrs), repetitive and tedious job
5. Tool- Difficult to carry & store
6. Back pain, Neck Pain, Shoulder pain, Eye strain

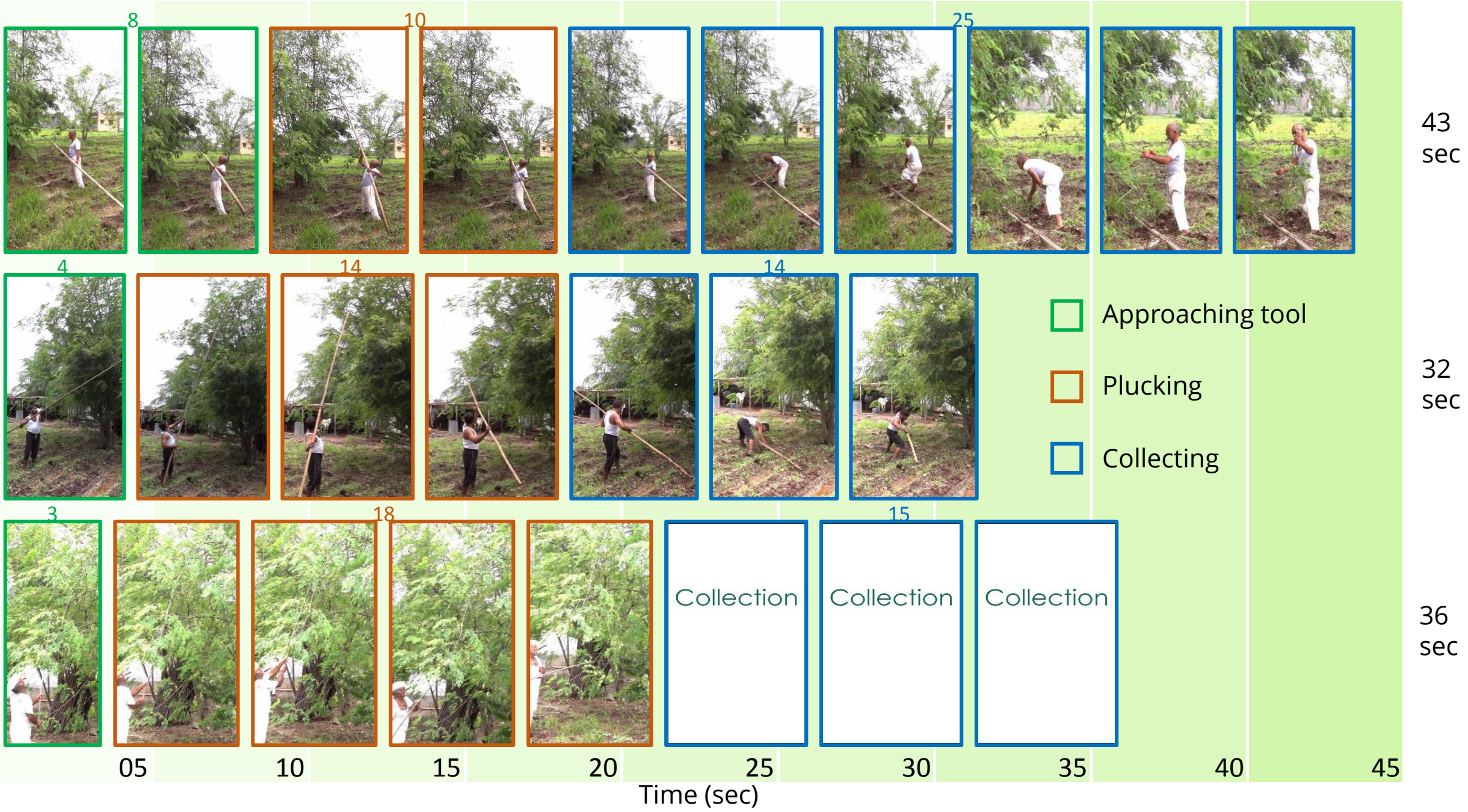


Fig.11: Activity analysis on time basis

Design statement

Redesigning of drumstick plucker for safe and secure gathering of mature drumsticks

Design brief

- It should allow selective plucking
- It should gather drumsticks safely
- It should eliminate drumstick-skin damage
- It should be easy to cut / hook / plucked
- It should be affordable [Rs. 1200 max.]
- It should be light weight [Not more than 2 Kgs]
- It should be maintenance free / repairable at home
- It should be easy to operate
- It should be easy to carry and store
- It should be steady and strong

Parallel products

Fig.12: orange plucker
http://ecx.images-amazon.com/images/I/61hUuMo1%2BbL.jpg as on 5th sept, 2014

Fig.13: Mango plucker
http://de.rolandschmid.ch/images/articles/4394_23cb21b86abb8fee14fb14a6cce71c1a_5.jpg as on 5th sept, 2014

Fig.14: Mango plucker
http://thebchmag.com/wp-content/uploads/2014/06/008-the-tool-of-the-pluckers-trade.jpg as on 5th sept, 2014

Fig.15: Fruit collector
http://www.cutedecision.com/wp-content/uploads/2011/10/harvester-03.jpg?e9936a as on 5th sept, 2014

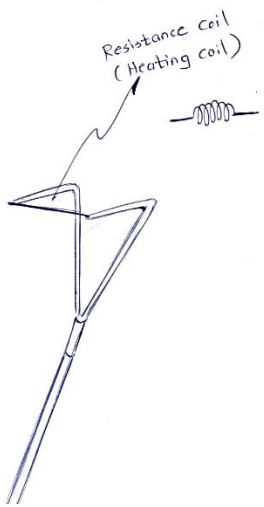
Fig.16: orange / apple plucker
http://ecx.images-amazon.com/images/I/51rnqkp8UML._SL1500_.jpg as on 5th sept, 2014

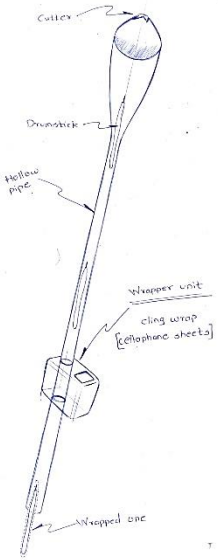
Fig.17: Fruit plucker
http://clevedoncounty.com/wp/wp-content/uploads/Ppicker.jpg as on 5th sept, 2014

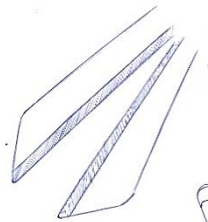
Fig.18: Flower cutter
http://images.knifecenter.com/knifecenter/clauss/images/AU33503.jpg as on 5th sept, 2014

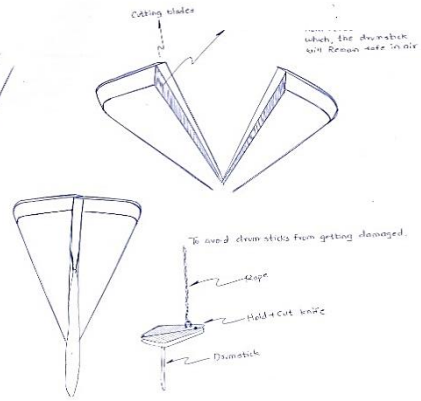
Fig.19: Flower stem cutter (slant cut)
http://bilder.myfavoritethings.se/flower_cutter_-_skarare_for_snittblommor.jpg as on 5th sept, 2014

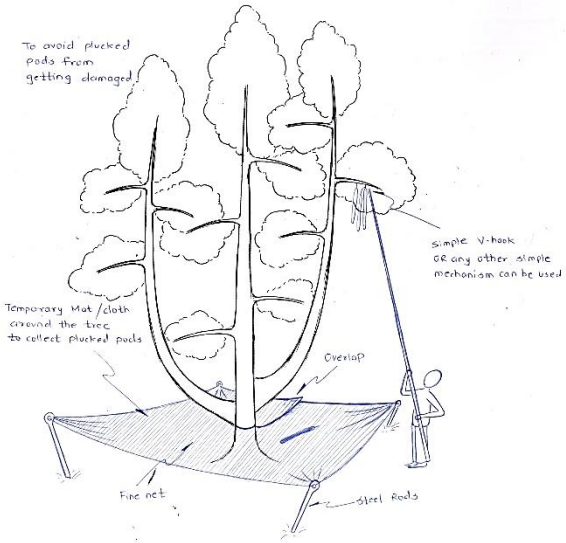
Ideations

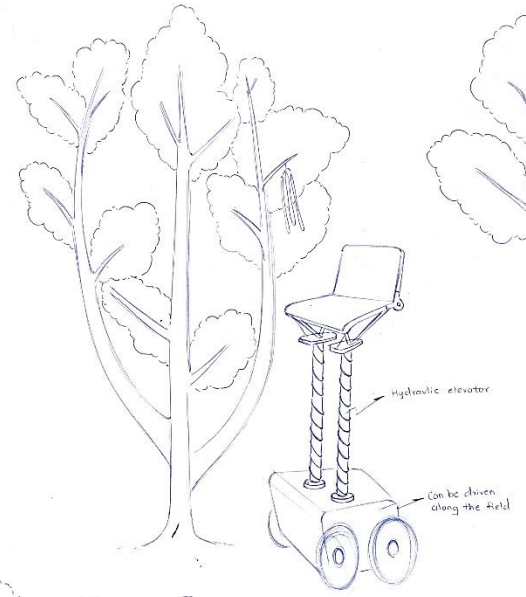

Resistance coil
(Heating coil)

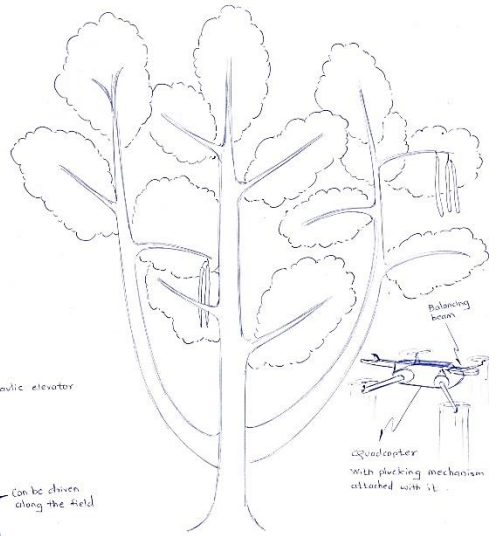

Cutter
Drumstick
Hollow pipe
Wrapper unit
cling wrap
[cellophane sheets]
Wrapped pipe

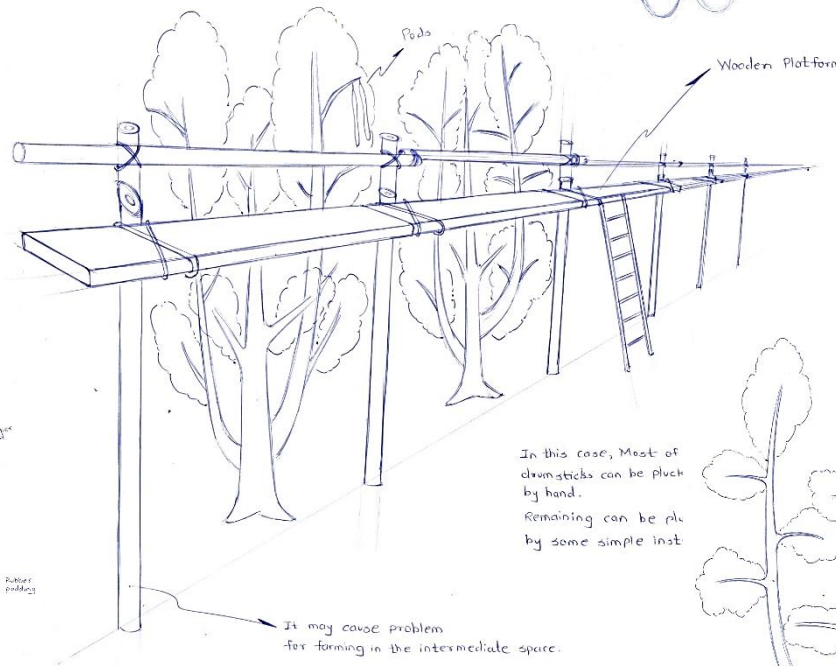


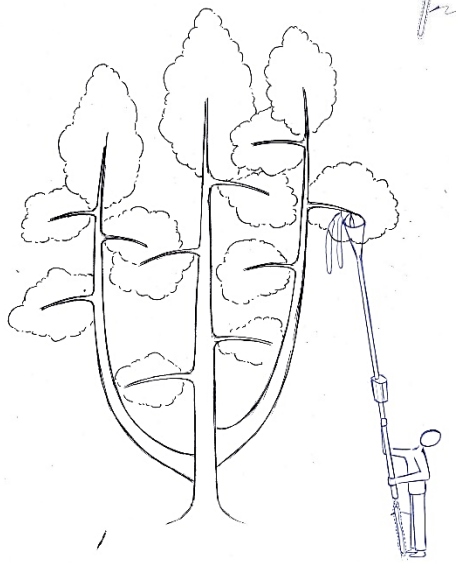

Cutting blades
which, the drumstick will Remain safe in air
To avoid drum sticks from getting damaged.
Rope
Hold+Cut knife
Drumstick

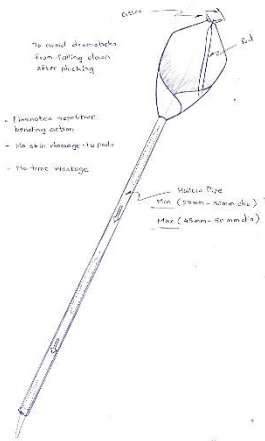

To avoid plucked pods from getting damaged
simple V-hook OR any other simple mechanism can be used
Temporary Mat/cloth around the tree to collect plucked pods
Overlap
Fine net
Steel Rods

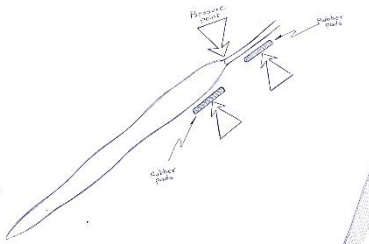

Hydraulic elevator
Can be driven along the field

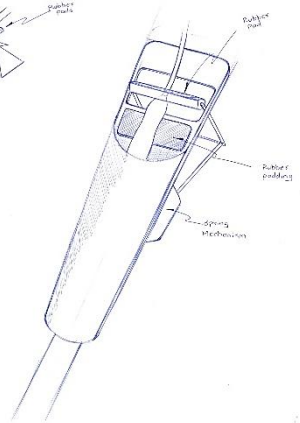

Balancing beam
Quadcopter
With plucking mechanism attached with it

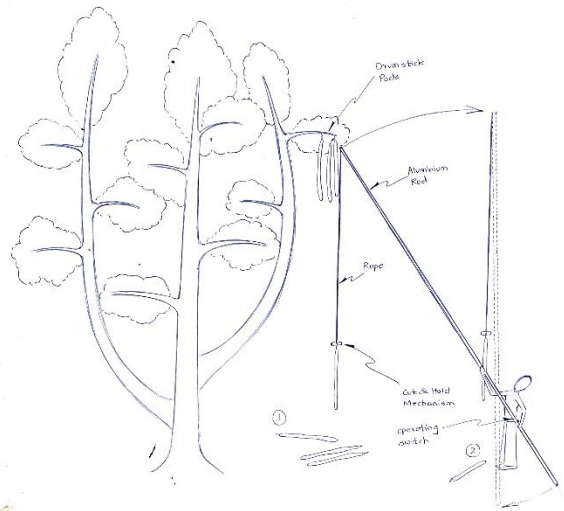

Pods
Wooden Platform
In this case, Most of drumsticks can be pluck by hand.
Remaining can be plu by some simple inst
It may cause problem for forming in the intermediate spare.



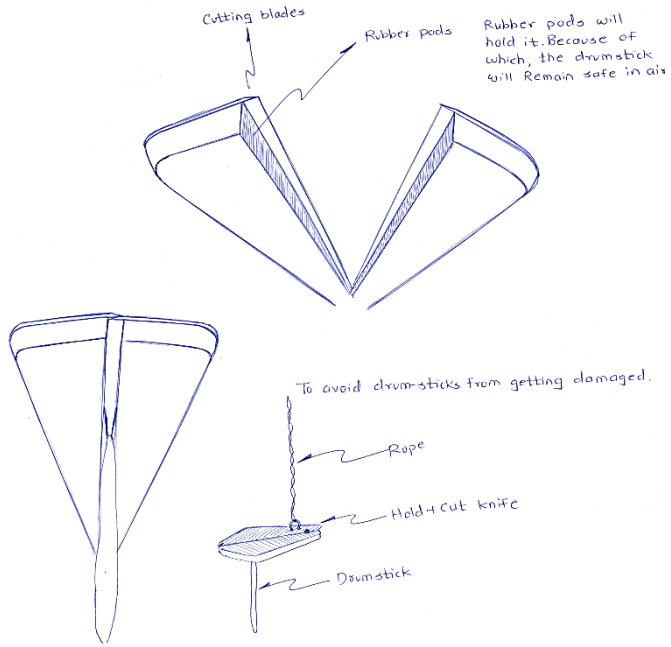

To avoid drumsticks from falling down after plucking
- Eliminates repetitive bending action
- No skin damage to pods
- No time wastage
Cutter
Rod
Water Pipe
Min (25mm - 30mm dia)
Max (45mm - 50mm dia)

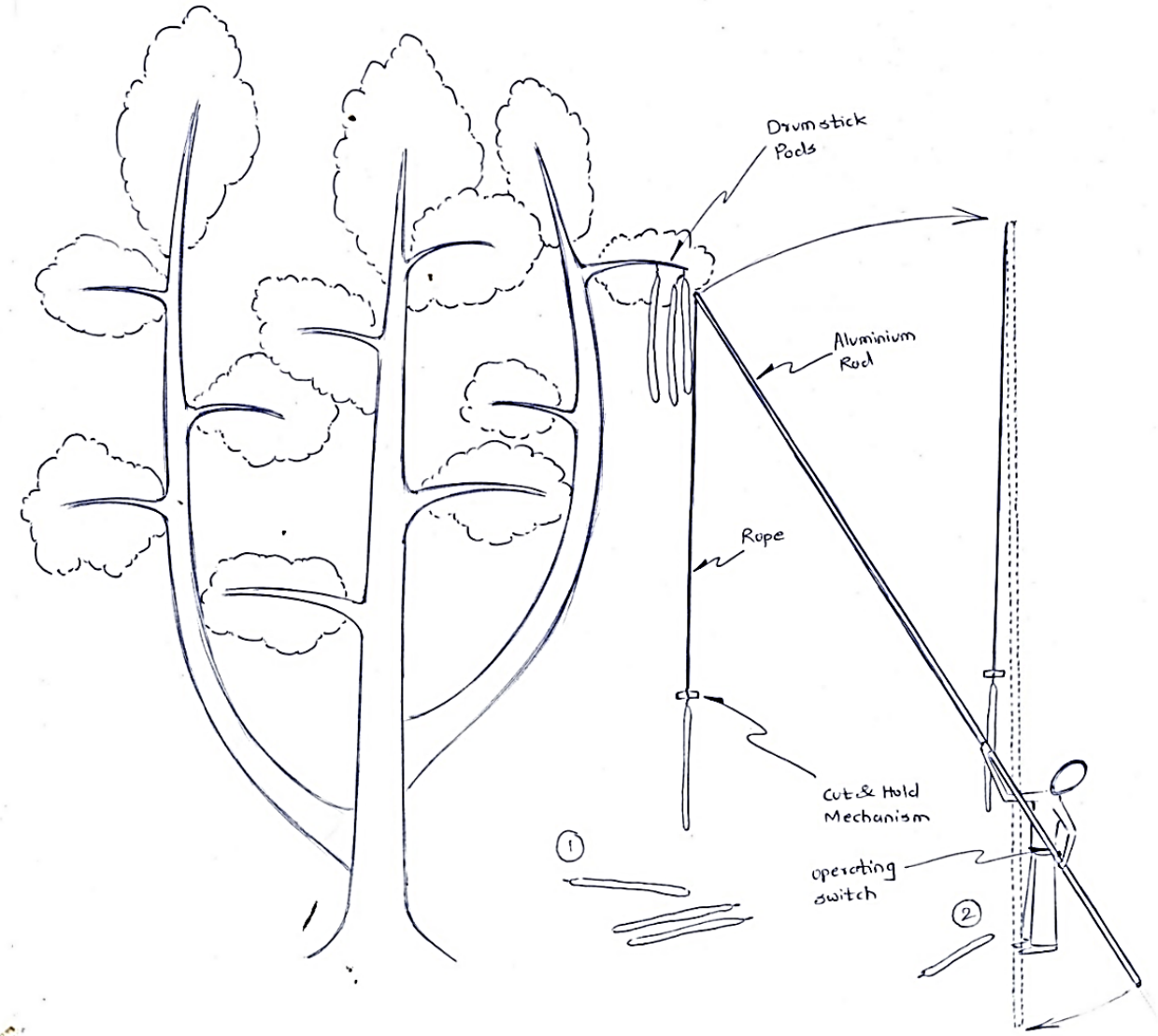

Pressure sensor
Rubber pads
Rubber pads


Rubber pad
Rubber padding
Spring Mechanism

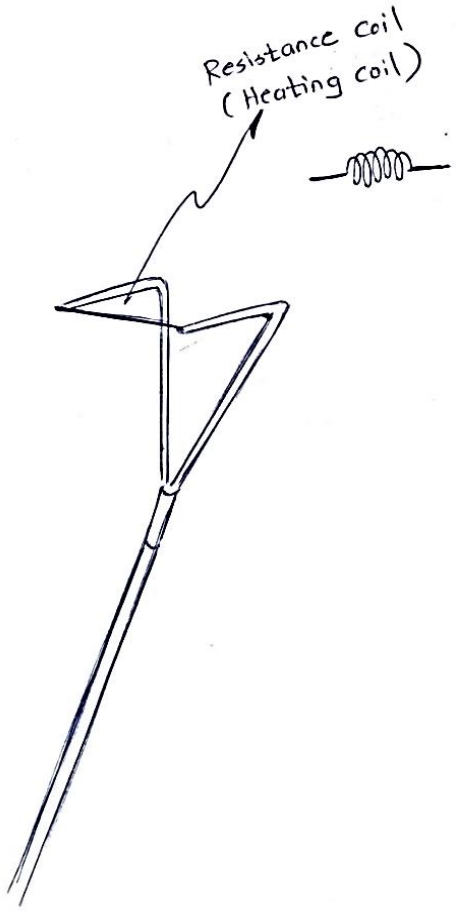

Drumstick Rods
Aluminium Rod
Rope
Cutter& Hold Mechanism
operating switch
1
2

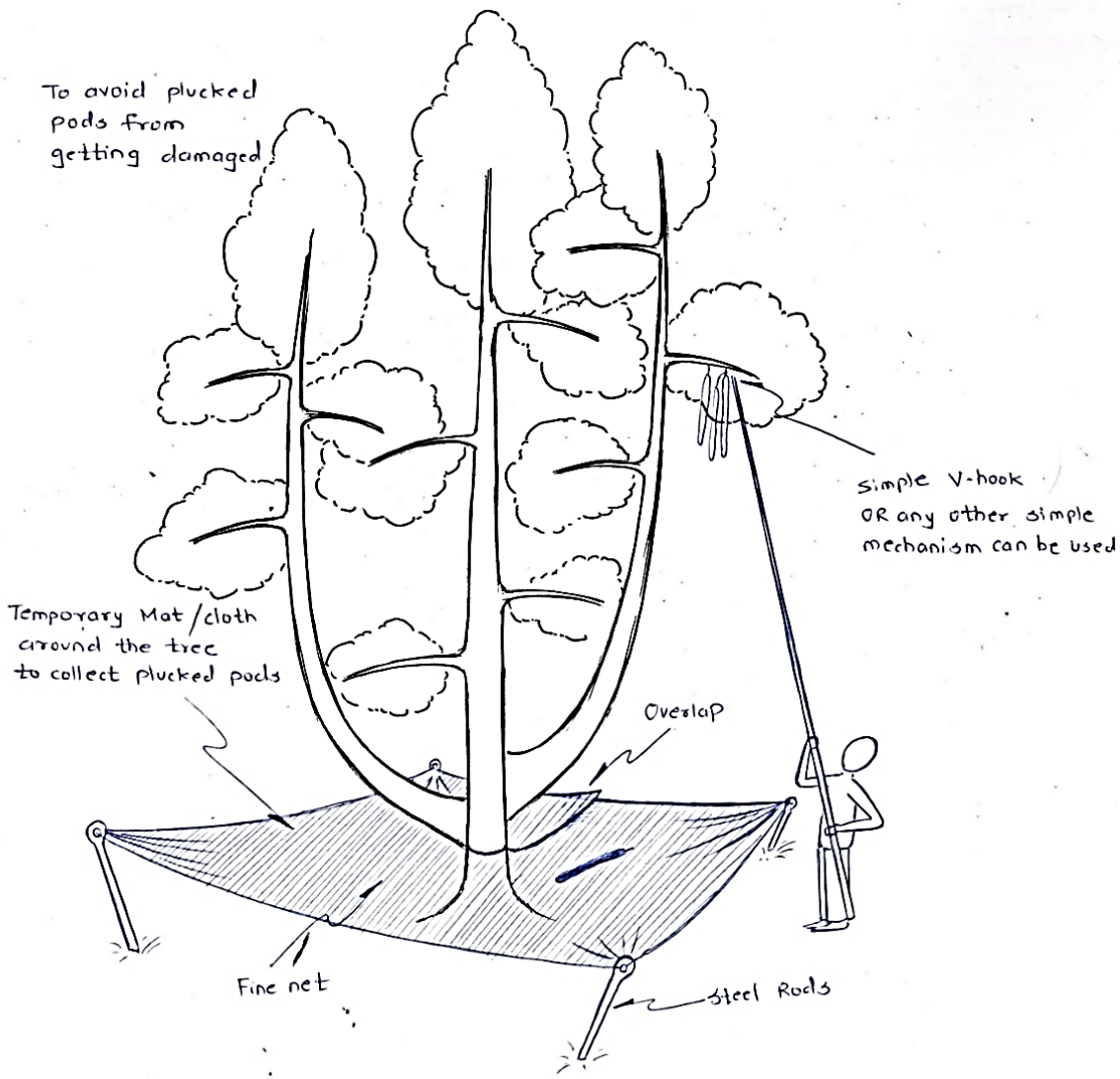
Concept 1


Cutting blades
Rubber pads
Rubber pads will hold it. Because of which, the drumstick will Remain safe in air
To avoid drumsticks from getting damaged.
Rope
Hold+cut knife
Drumstick

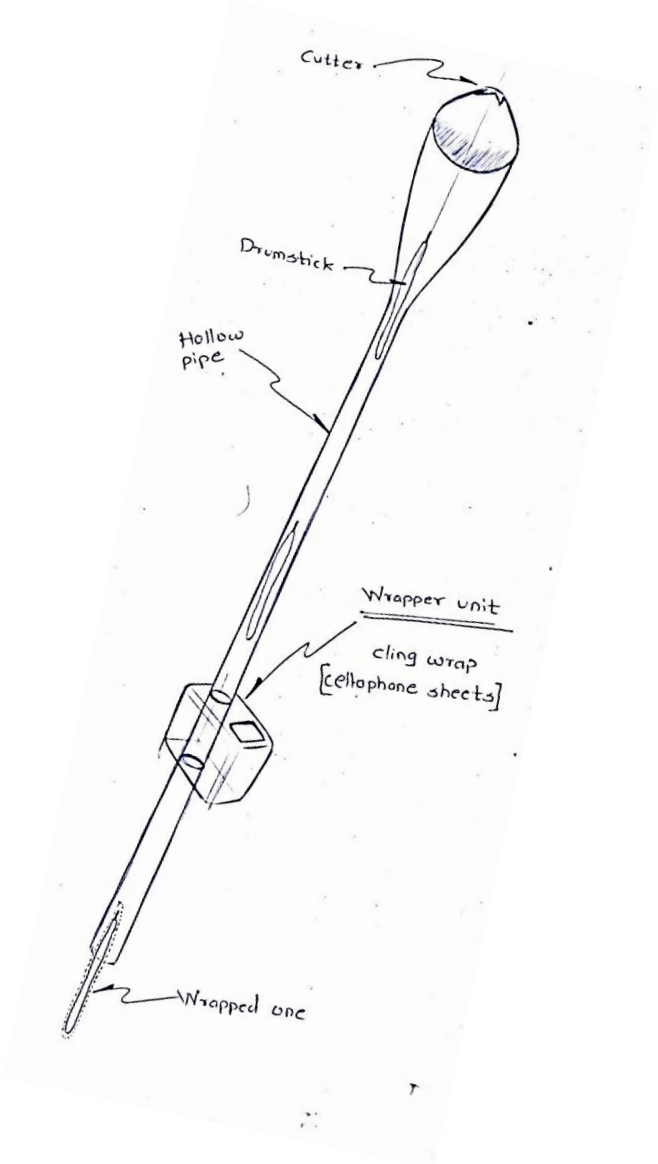

Drumstick Pads
Aluminium Rod
Rope
Cut & Hold Mechanism
operating switch
1
2

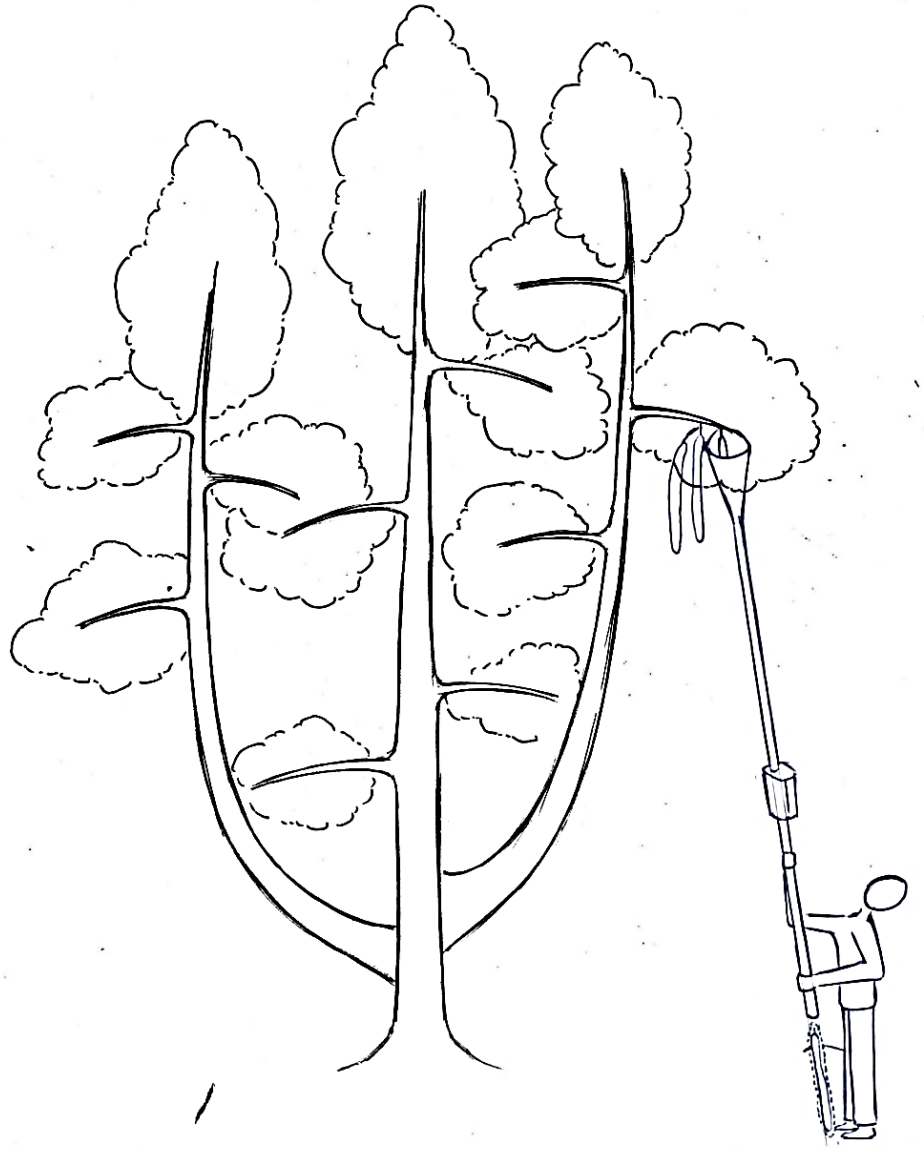
Concept 2


Resistance coil
(Heating coil)


To avoid plucked pods from getting damaged
simple V-hook OR any other simple mechanism can be used
Temporary Mat/cloth around the tree to collect plucked pods
Overlap
Fine net
Steel Rods

Concept 3


Cutter
Drumstick
Hollow pipe
Wrapper unit
cling wrap
[cellophane sheets]
Wrapped one



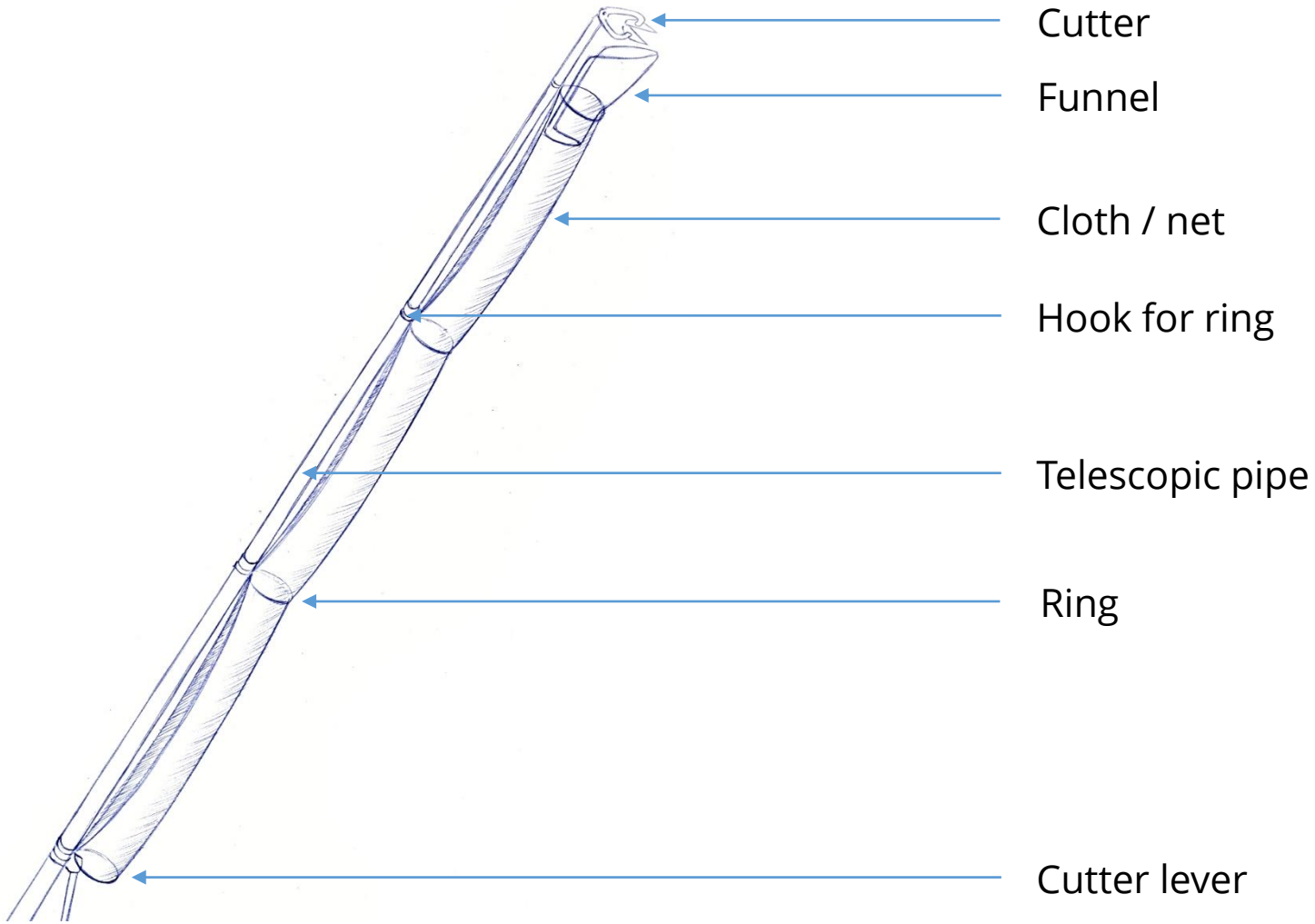
Concept Evaluation

Criteria	Concept 1	Concept 2	Concept 3
Selective plucking	✓	✓	✓
Quick operation	~	~	✓
Easy to use	~	✓	✓
Light weight	~	✓	✓
Maintenance free	✓	~	~
Affordability*	✓	✓	✓
Easy to carry & store	✓	~	✓
Steady & strong	~	~	✓

* Considering all concepts are affordable

Fig.20:Prototype comparison table

Refined concept



Cutter blade

Material used- Stainless steel
Thickness- 3mm

Fig.21: Cutter blade-1

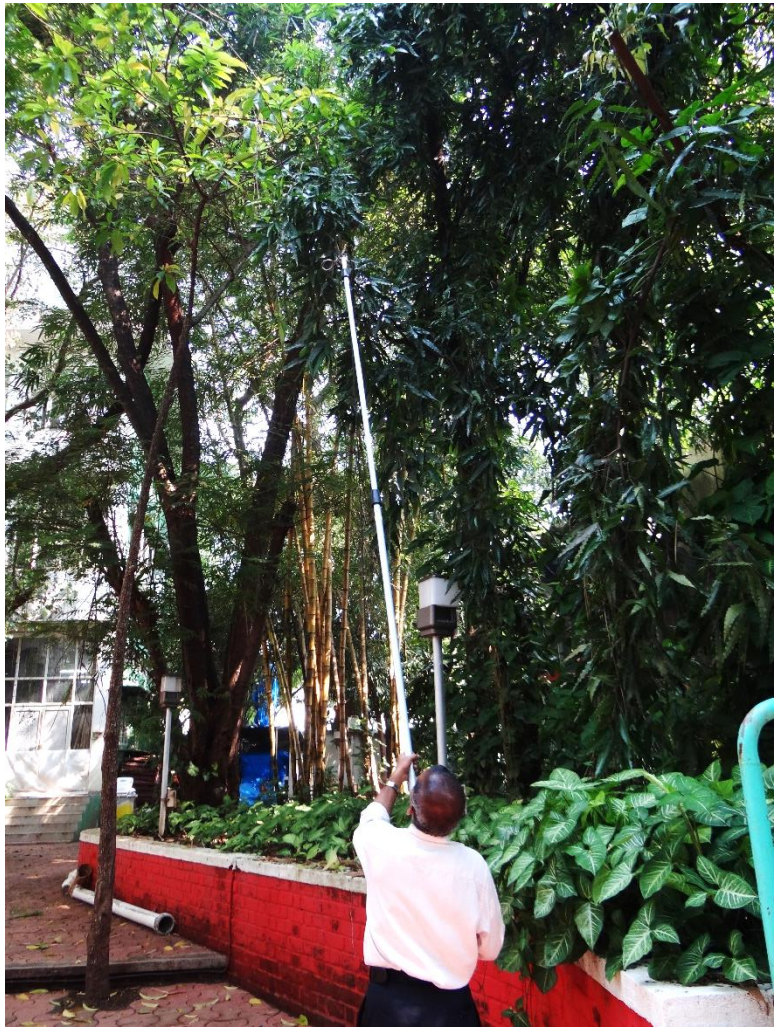
Fig.22: Cutter blade-2

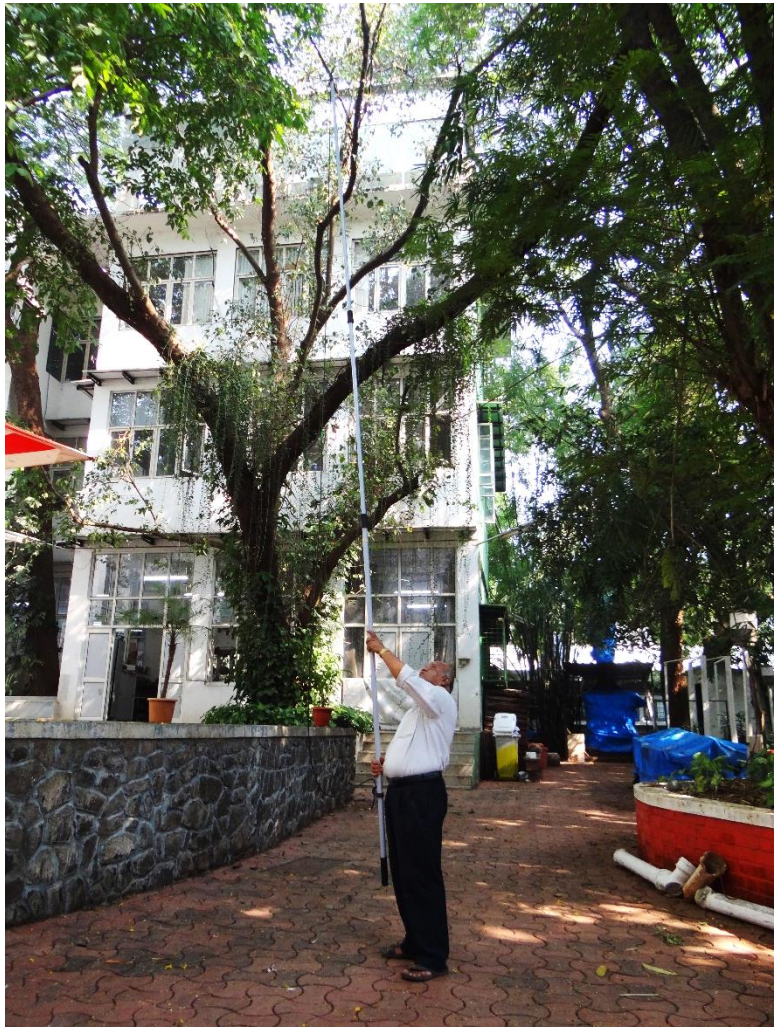
Prototype [stage 1]

Fig.23:Prototype 1

Fig.24:Prototype 2

Prototype testing





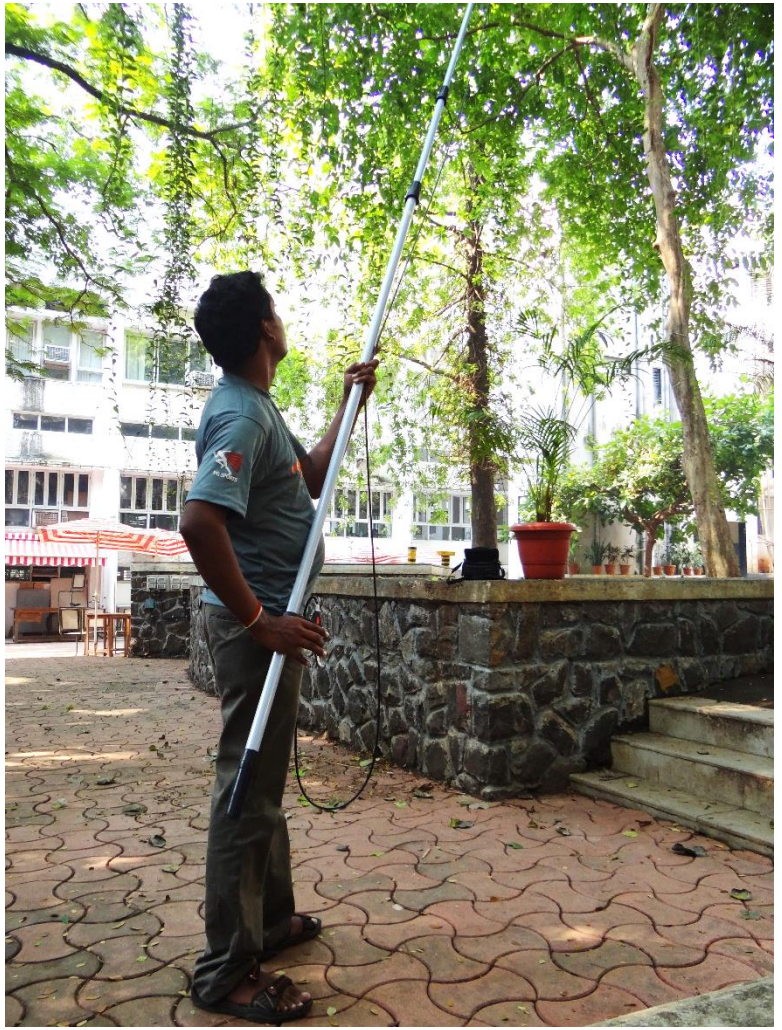


Fig.25: Prototype testing

Prototype comparison

Fig.26:Prototype 1

Fig.27:Prototype 2

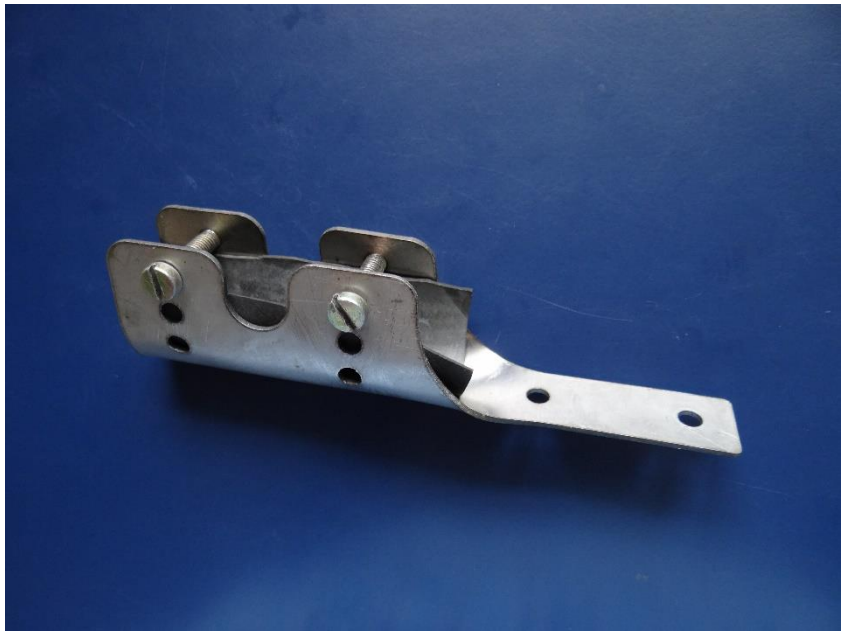
Criteria	Prototype 1	Prototype 2
Selective plucking	✓	✓
Quick operation	✓	✓
Easy to use	~	✓
Light weight	~	✓
Maintenance free	~	✓
Affordability	~	✓
Easy to carry & store	✓	✓
Steady & strong	~	✓

Fig.28:Prototype comparison table

Prototype [stage 1]

Fig.29: Prototype [stage 1]

Prototype [stage 2]



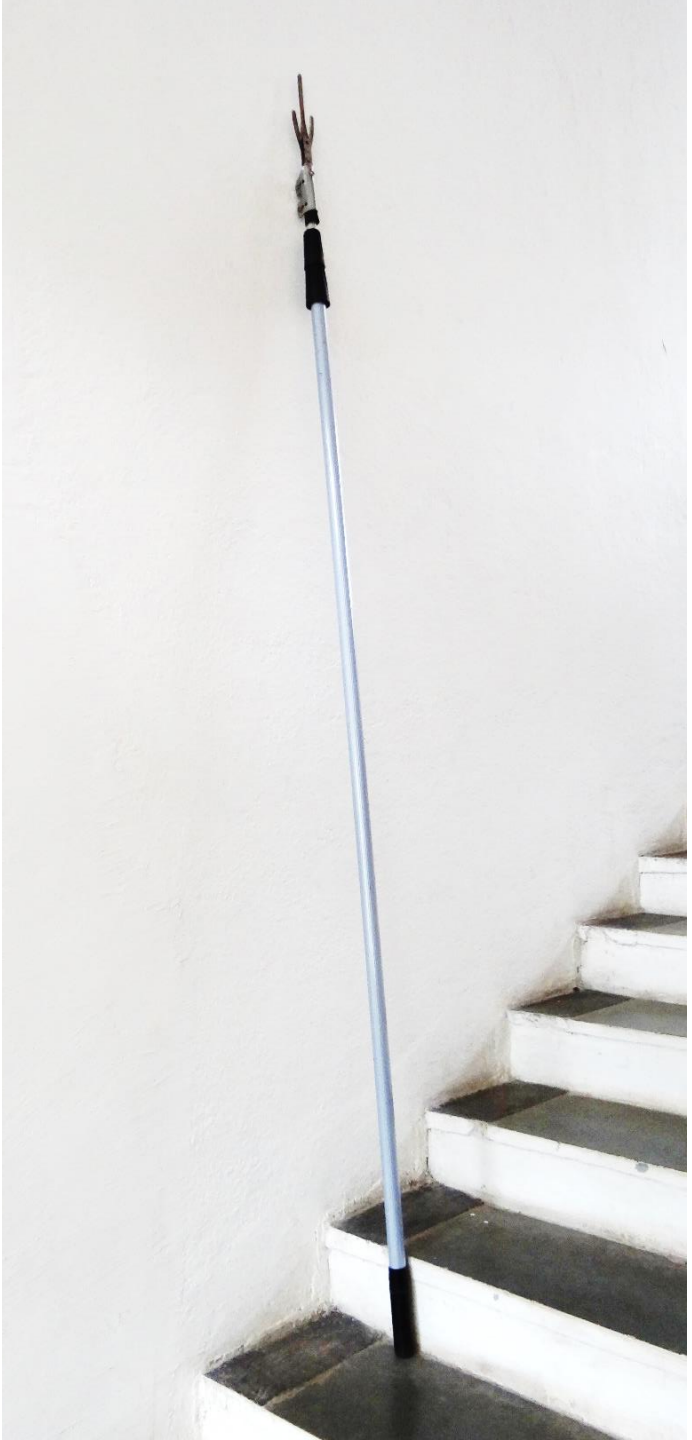
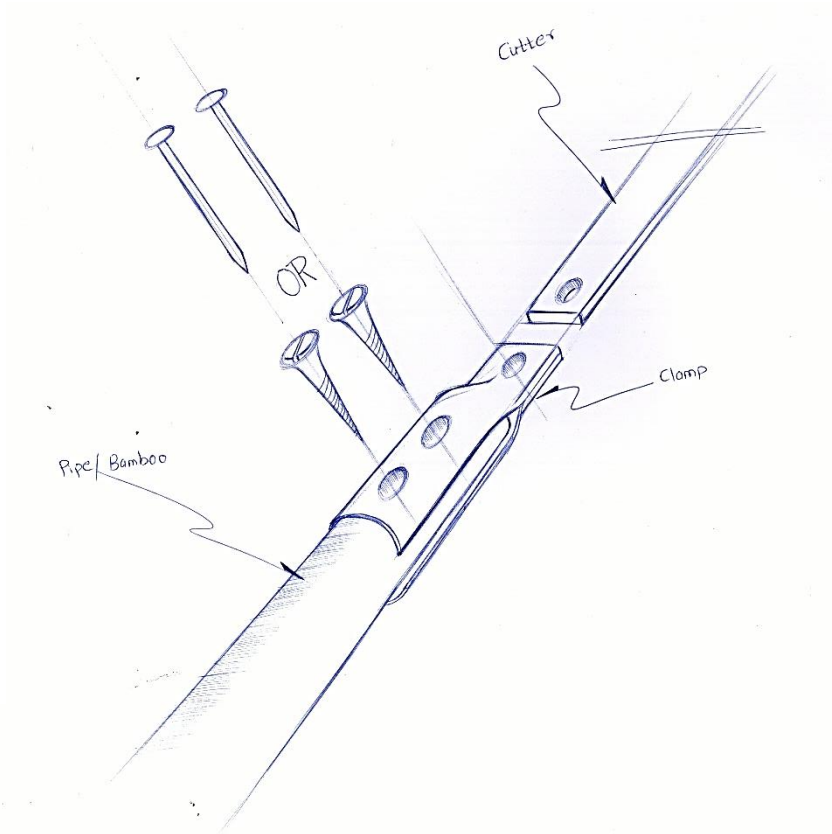
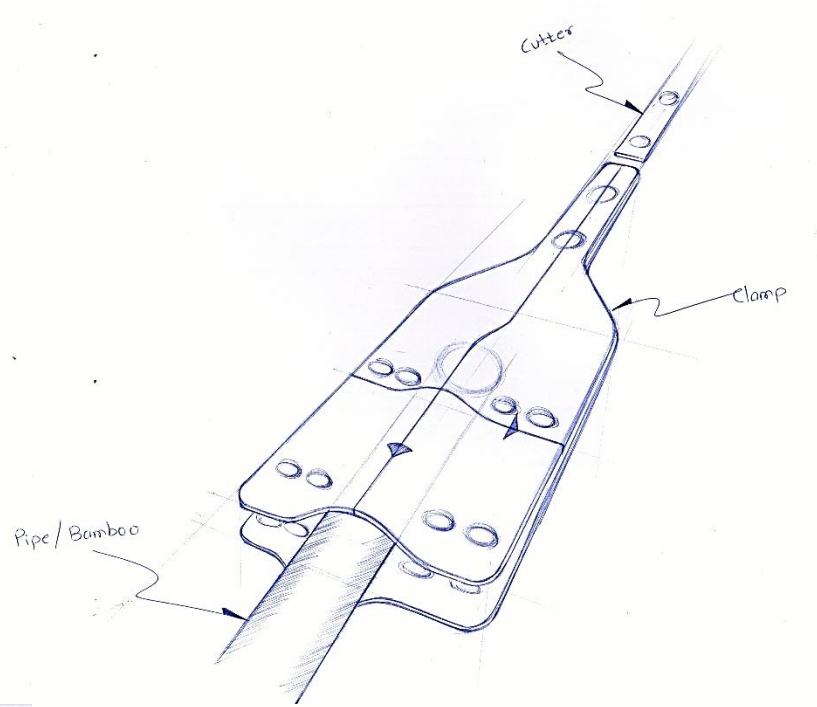
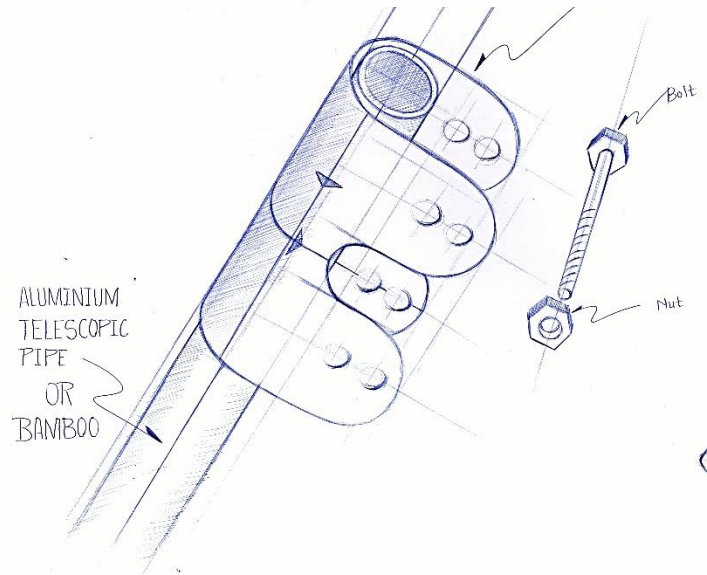


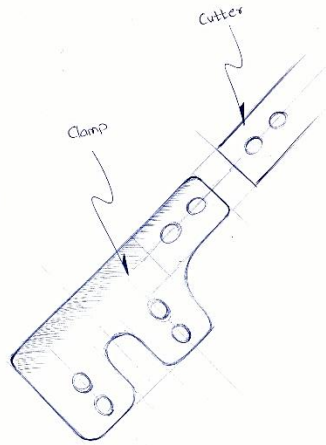
Fig.30: Prototype [stage 2]

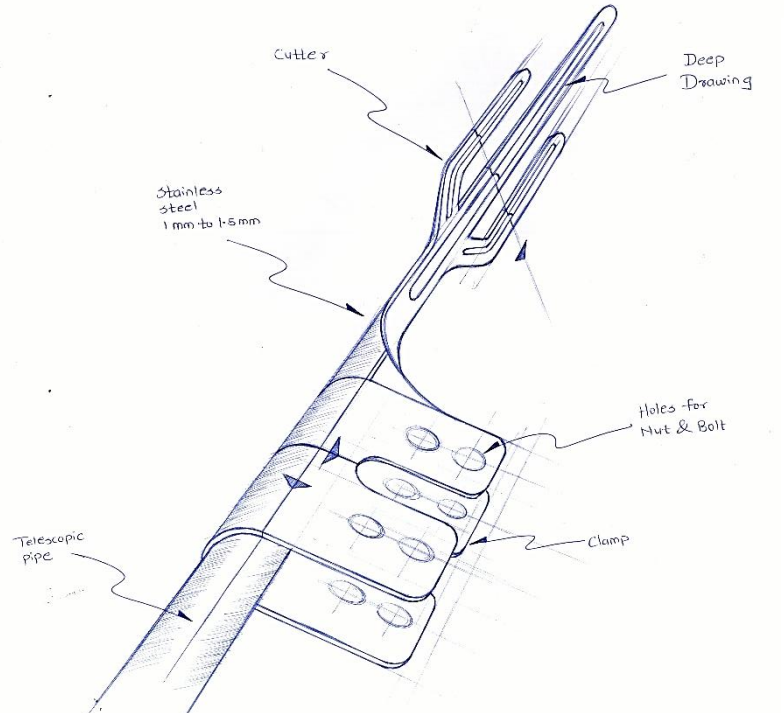
Clamp


Cutter
OR
Clamp
Pipe / Bamboo


Cutter
Clamp
Pipe / Bamboo


Bolt
Nut
ALUMINIUM
TELESCOPIC
PIPE
OR
BAMBOO


Cutter
Clamp


Cutter
Deep
Drawing
Stainless
steel
1 mm to 1.5 mm
Holes for
Nut & Bolt
Clamp
Telescopic
pipe

Prototype [stage 3]

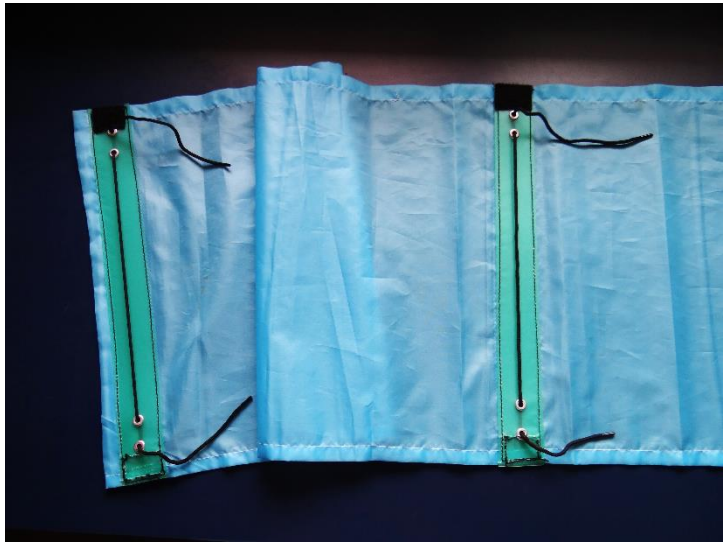


Fig.31: Collection bag details

Fig.32: Collection bag details

Fig.33: Prototype

Prototype testing

Insights-

Collection Bag- Not efficient

- Wind makes it unstable
- Difficult to balance
- Difficult to aim at specific pod
- Visibility problem
- Assembly- Time consuming activity

Fig.34: Prototype (collection bag)

Prototype testing

Insights-

Cutter works very well

- Average time (Approaching tool + plucking) = 12 sec
- Easy to aim
- Easy to pluck
- Selective plucking

Fig.35: Prototype (cutter)

New concept

Ideation

Fig.36: New concept

Working principle

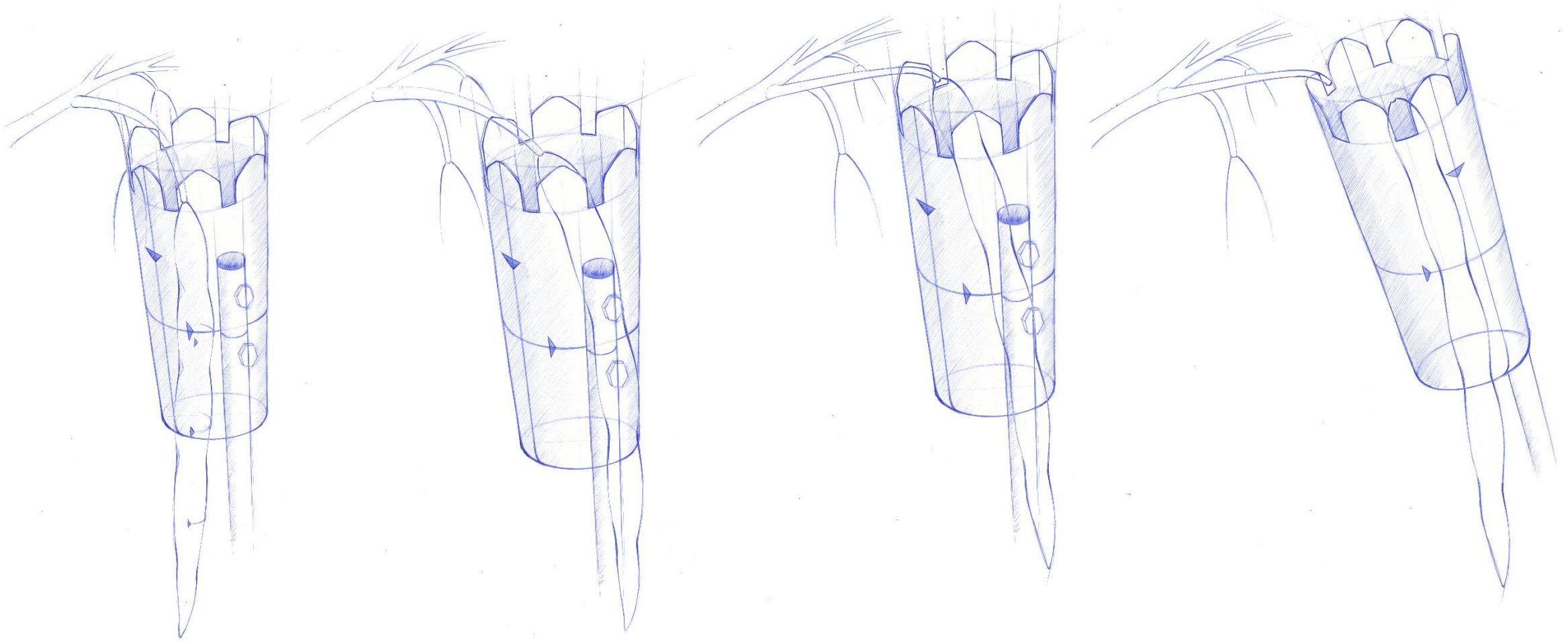


Fig.37: Working principle

Mock-up

Material- PVC pipe

Fig.38: New concept- mock up

Fig.39: New concept- mock up

Field testing

Field testing

Insights-

Cutter

- Allows selective plucking
- Easy to aim
- Easy to pluck

Collection bag

- Extremely efficient
- Light weight
- Eliminates pod-skin damage
- Easy to assemble

Telescopic pipe

- Light weight
- Easy to carry
- Easy to store

Field testing

Insights-

Cutter
- Allows selective plucking
- Easy to aim
- Easy to pluck

Collection bag
- Extremely efficient
- Light weight
- Eliminates pod-skin damage
- Easy to assemble

Telescopic pipe
- Light weight
- Easy to carry
- Easy to store

Modifications required-

Cutter
- Deeper cutting slots
- Smaller length
- Better material
- Better clamp design

Collection bag
- Collection bag-
- Cotton lace
- Large opening

Final prototype

Material- Stainless steel [SS-304]
Thickness- 1 mm

Fig.40: Final Prototype

Fig.41: Final prototype

Product details

CNC Punching

Fig.42: Cutter pipe- Profile

Rolling & Bending

Fig.43: Cutter pipe- details

Bending

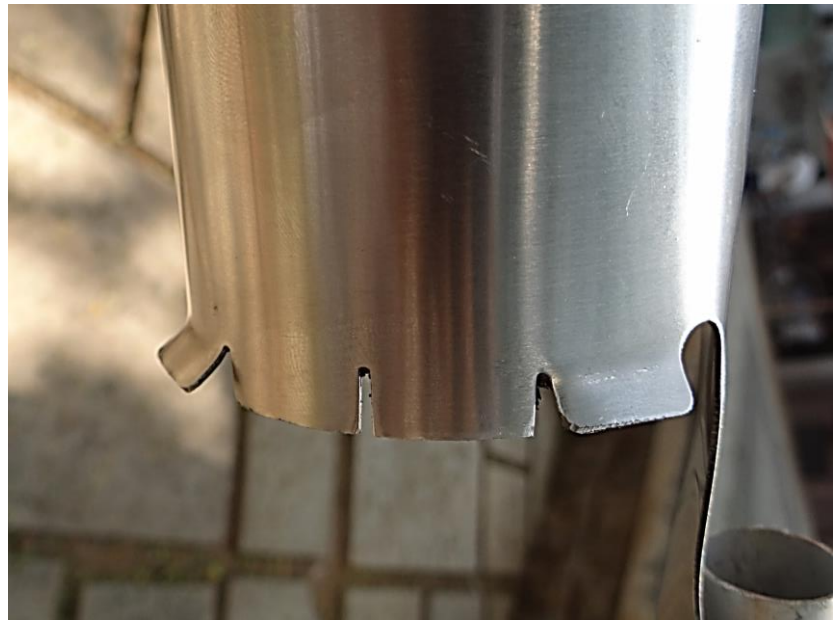


Fig.44: Cutter pipe- Collar

Product details

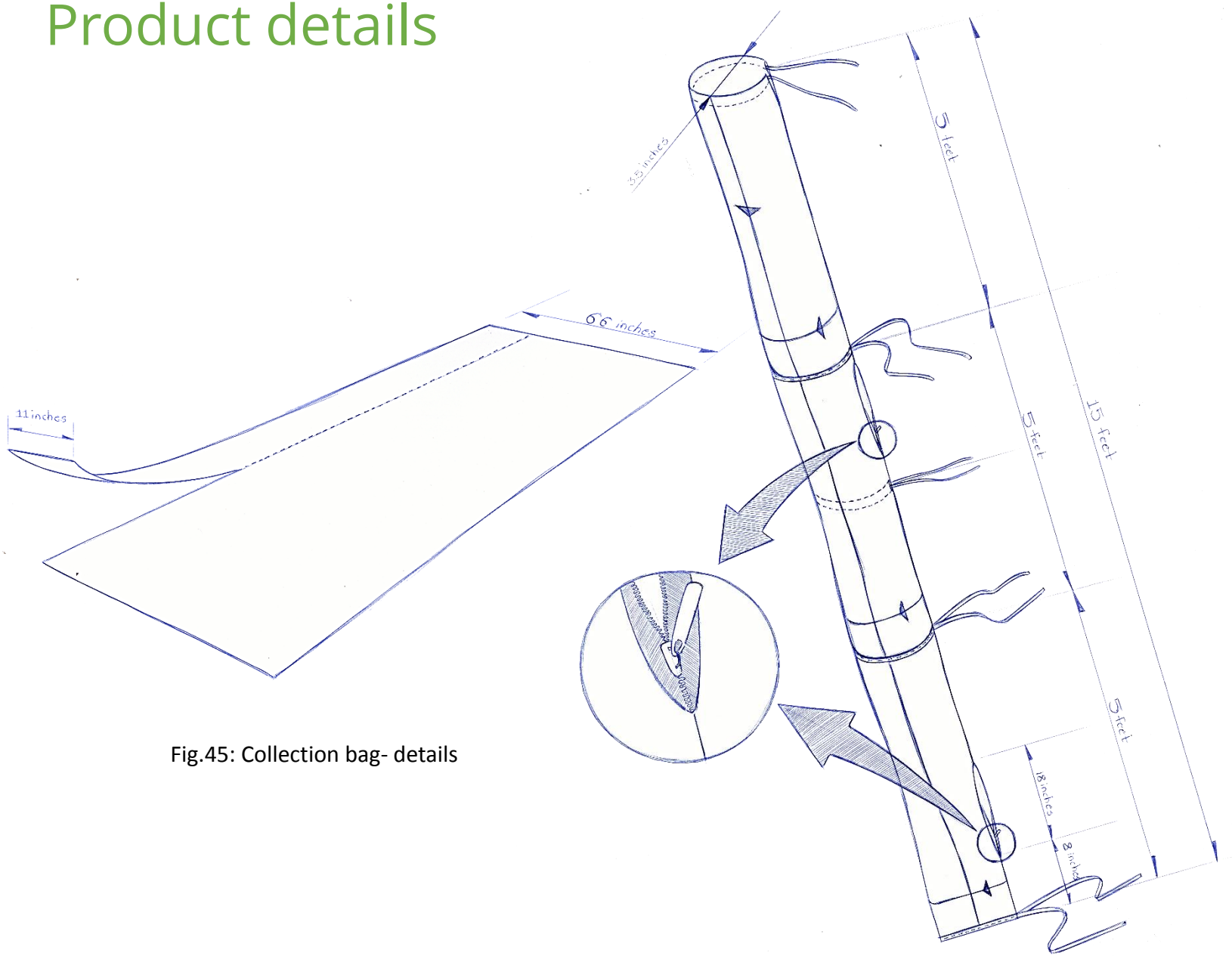


Fig.45: Collection bag- details

Fig.46: Collection bag- details

Fig.47: Collection bag- details

Form

The form evolved entirely because of the functional aspects of the cutter

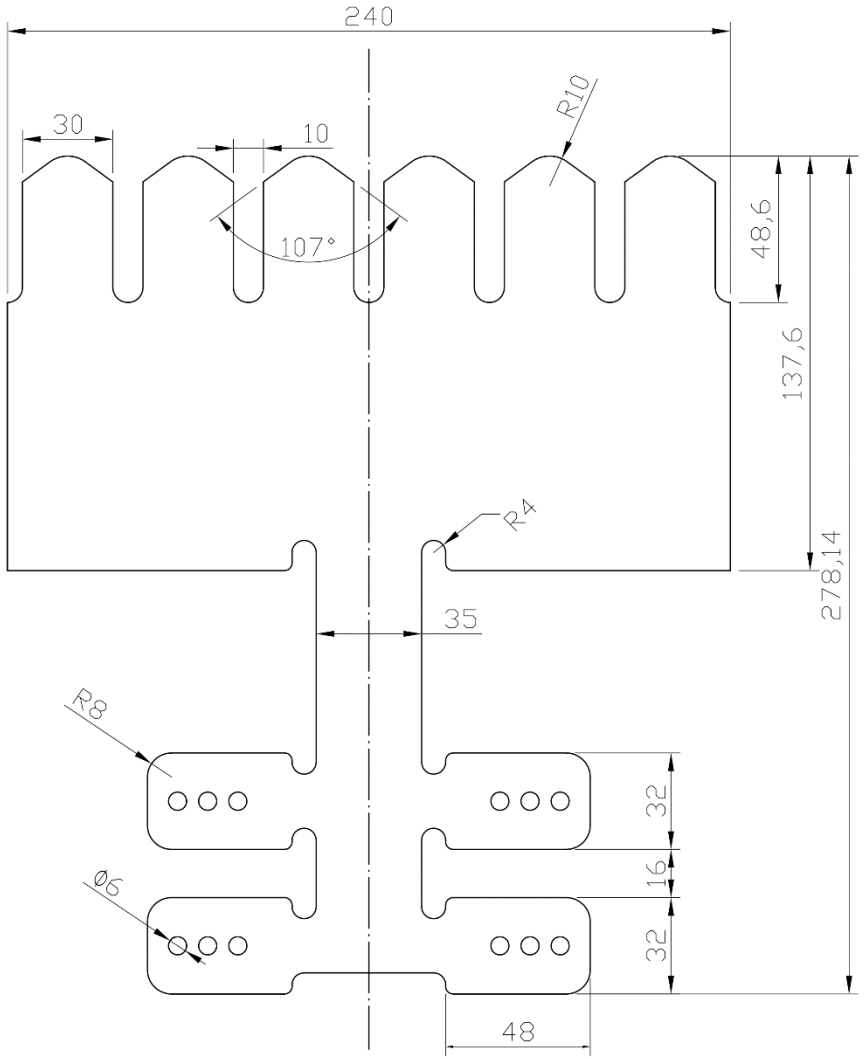
Profile
Diameter
Length
Clamp
Material

Fig.48: Form of the cutter

Fig.49: Stainless steel shows strength

Fig.50: Form of the plucker

Product dimensions



ALL DIMENSIONS ARE IN MM

Fig.51: Cutter dimensions

Costing

Aluminium pipe 0.75 inch 6 ft	Rs.90 [Rs.15/foot]
Aluminium pipe 1.00 inch 6 ft	Rs.108 [Rs.18/foot]
Aluminium pipe 1.25 inch 6 ft	Rs.132 [Rs.22/foot]
Pipe joiner [small]	Rs.50-60
Pipe joiner [big]	Rs.50-60
Cutter [Material cost + manufacturing cost].....	Rs.130-150
Collection bag cloth	Rs.15 [Rs.90/meter]
Labor cost	Rs.30
Total manufacturing cost.....	Rs.605-645
Transportation cost	Rs.10
Total	Rs.615-655
Manufacturer's profit [10 to 12%]	Rs.60-75
Total	Rs.675-730
Shopkeeper's profit [7 to 10%]	Rs.50-75
Plucker price for farmer	Rs.725-805

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Plucker price for farmer	Rs.725-805 ‹ **1200**

Product planning

Fig.54: Final Logo of the company

‘Zela’

Harvesting tools manufacturing company

“To provide farmers an efficient & affordable harvesting equipments”

Product statistics-

Using Synergy of different industries

Cutter : CNC punching- from vender
Rolling & bending within plant
Pipes and joiners : from respective company
Collection bag : from local tailors Or within plant

Fig.52: Logo-ideations

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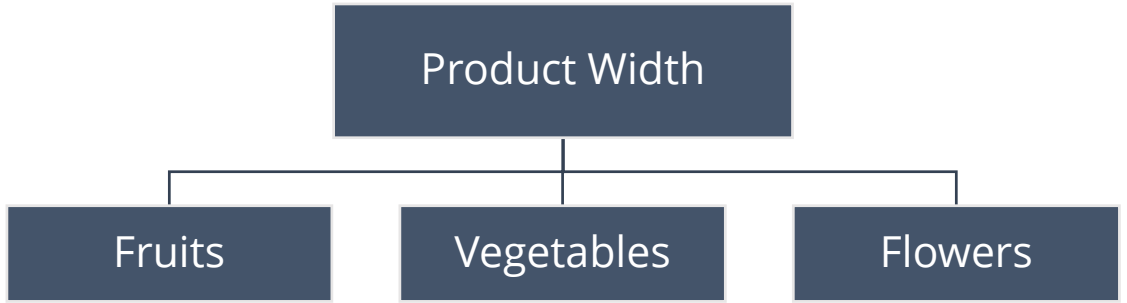
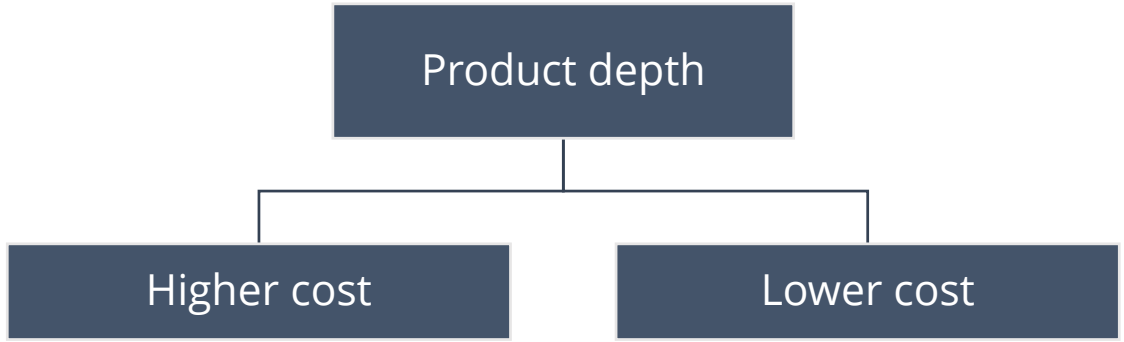
Product planning

Fig.54: Final Logo of the company





Product planning

Fig.54: Final Logo of the company

Indian farmers- Lower buying capacity

Parts of harvesting tool will be made available separately for purchase in the market

Collection bag and telescopic pipe can be used with different cutters

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Fin.