Project Report on

Design Improvisation of manually operated conoweeder for paddy field cultivation in Konkan and Goa Region

By

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Certificate

This is to certify that the project report titled **Design Improvisation of manually operated conoweeder for paddy field cultivation in Konkan and Goa Region** prepared by **Arjunkumar Bavalia** is approved for submission at Centre for Technology Alternatives for Rural Areas (CTARA), IIT Bombay, Powai, Mumbai-400076.

11th July 2015

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Co-Principal Investigator,

RuTAG, IIT Bombay

Declaration

I hereby declare that the report entitled **Design Improvisation of manually operated conoweeder for paddy field cultivation in Konkan and Goa Region** submitted by me, for my summer internship program under RuTAG (CTARA), IITB is a record of the project work carried out by me. I further declare that this written submission represents my ideas in my own words and where other' s ideas or words have been included, I have adequately cited and referenced the original sources. I affirm that I have adhered to all principles of academic honesty and integrity and have not misrepresented or falsified any idea/data/fact/source to the best of my knowledge. I understand that any violation of the above will cause for disciplinary action by the Institute and can also evoke penal action from the sources which have not been cited properly.

Place: Mumbai

Date: 7th July 2015

(Arjunkumar Bavalia)

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I am very much thankful to the farmers whom I met and interacted in my field visit for their helpful responses.

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Abstract

This is an internship report on the Design improvisation of manually operated conoweeder for paddy field cultivation in Konkan and Goa region. The project was carried under RuTAG office, IIT Bombay. Our country is 2nd largest rice producing country after China and it contributes 21% of world production. Generally in most rice producing region of our country are given highly stressed to follow the System of Rice Intensification (SRI) system. This system is one of the factors which contribute to increase productivity within same area of land. The paddy cultivation require huge water source and labour cost especially for removing weeds in the field. Under the SRI it is emphasize to use less amount of water and take weed as opportunity for productivity and hence reduce labour cost. In our country in many region like North east and Western Ghats the farmers have small part of land in which they grows rice. In that small part of land it is not worth to invest for labour especially for weeding which take most part of cost of production. Under SRI more emphasize is given by various agricultural research institutes to use conoweeder. There are lot of study is ongoing to make it user friendly especially for women labours in the terms of design, ergonomics, efficiency. Conoweeder is used to uproot weeds and again bury them under the soil. The buried plants increase the biomass of the land and hence productivity increase. It has been observed that in Konkan and Goa region the conoweeder is not giving it output effectively. The project was carried out to understand the problem and to study the related factor with the weeder. The journey starts with market survey in India over telephone along with studying various reports from various Agricultural research institutes and university in India. Field visit to NGO situated at Narangi village in Raigarh District of Maharashtra, DBSKKV University, and NGO in Goa have been made. The visit comprises interaction with faculties, research team, NGO staff, and farmers. After considering all the studied and observed factors to come up with ideas and thereafter choose one direction to improvise it. The idea is not to solve the concerned problems in the product but to come up with a form in the product. Give a user friendly appearance touch and feel along with ergonomic factor consideration. The project ends up with a

full scale CAD model after finalisation from ideation sketching and a half scale mock up model.

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1. About RuTAG

Rural Technology Action Group (RuTAG) at Indian Institute of Technology Bombay (IITB) was established in year 2010. The goal of RuTAG at IIT Bombay is to provide Science and Technology inputs to organizations working for the development of rural areas. This involves development and field deployment of technologies appropriate for the specific applications.

The idea is to identify technology needs of the region, available technology solutions, problems encountered in adopting the existing technology at the grassroots, identify R&D institutions which can improve the technology, assessment of the existing technology, find out solutions to overcome the technological problems, and adapt a rural technology through R&D institutions to suit specific conditions using local resources.

1.1 Project brief

The main objective to execute this project and undertake this project is to study about conoweeder used under SRI system. The main scenario was for basic issues related to failure of conoweeder in Konkan and Goa region. Every part of India where rice is grown this conoweeder is used without any failure rather than Konkan and Goa region. As a design student, idea is to undertake the problem and come with some solution covering not only problem but also have some form in the design. So that farmer appreciates to use the equipment. Taking one direction come up with a 3D CAD model showing its aspects.

1.2 Design process:

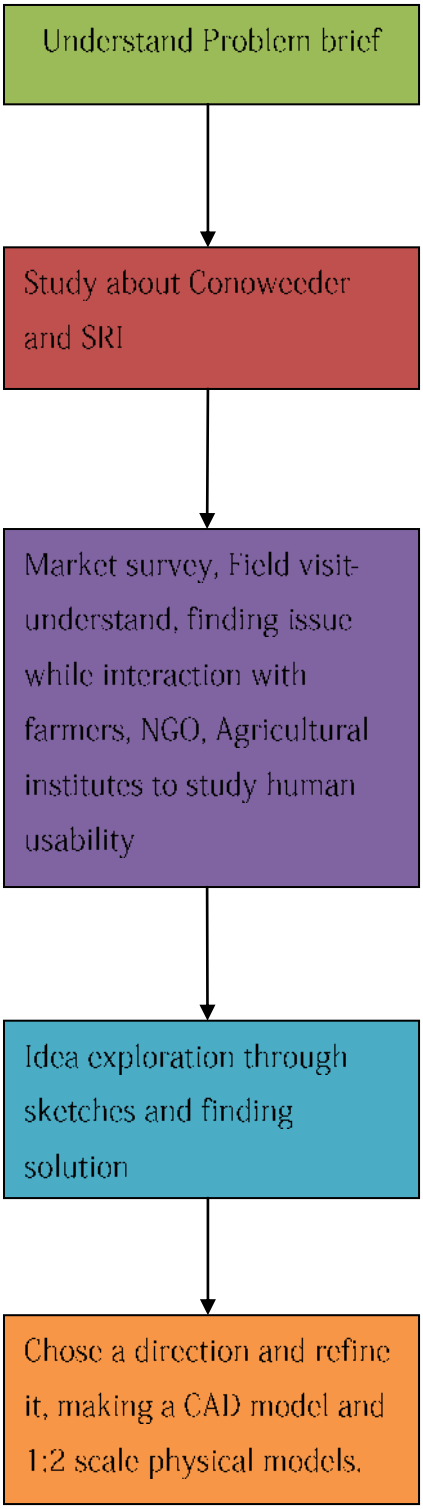


Figure-1.1: Design process

2. Introduction

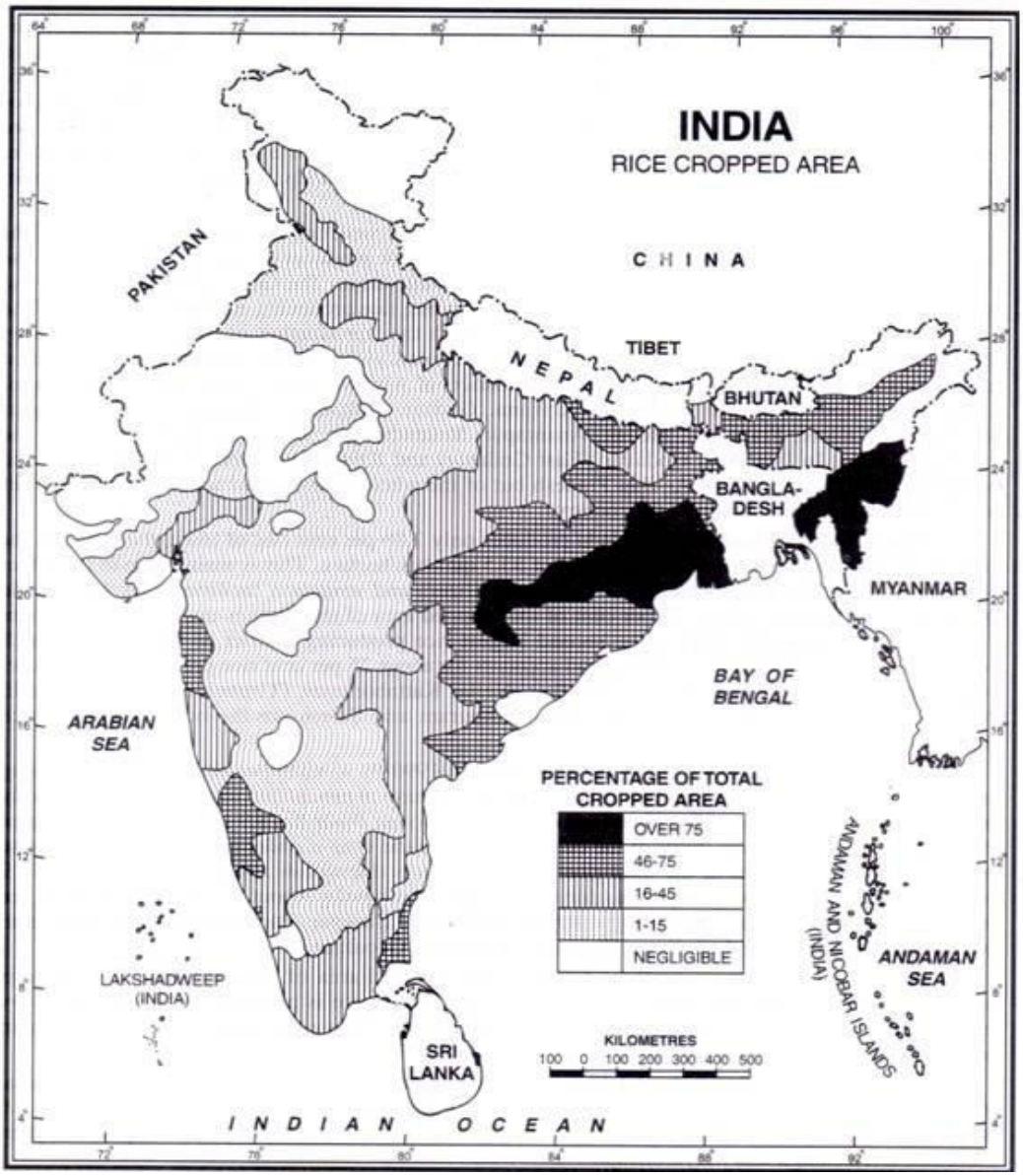


Figure-2.1: Rice cropped area

2.1 Brief study on Paddy cultivation in India

India is the second largest producer and consumer of rice in the world after China and accounts for 21 per cent of the world' s total rice production. Rice is India's pre-eminent crop, and is the staple food of the people of the eastern and southern parts of the country. Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population.

2.2 Annual Average Rainfall in India suitable for Rice

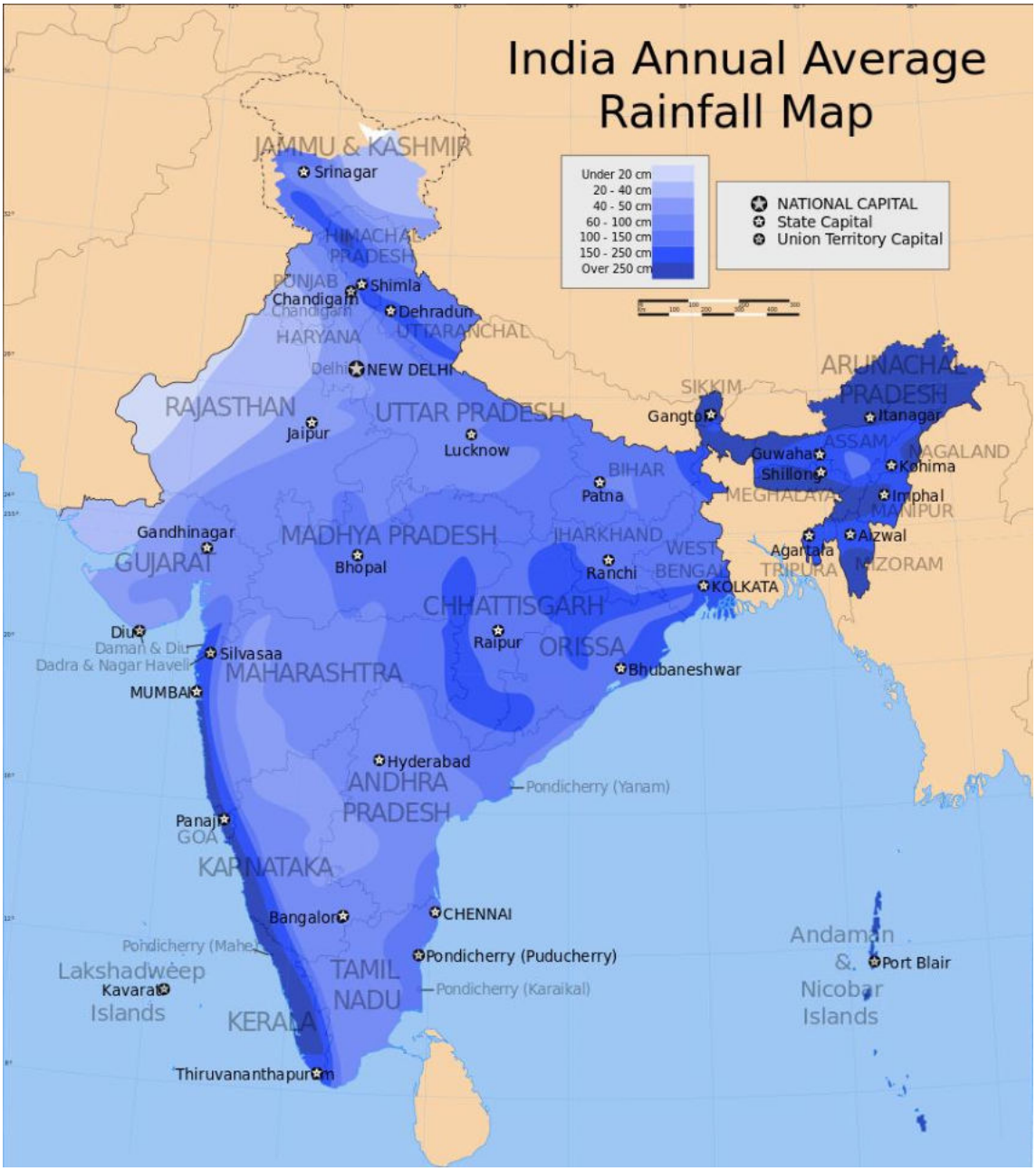


Figure-2.2: India Annual avg. Rainfall

Rice is the basic food crop and being a tropical plant, it flourishes comfortably in hot and humid climate. Rice is mainly grown in rain fed areas that receive heavy annual rainfall. That is why it is fundamentally a kharif crop in India. It demands temperature of around 25 degree Celsius and above and rainfall of more than 100 cm. **Konkan and Goa** region lies in the Western Ghats having rainfall ranges between

2.3 Brief study on types of Soil in India

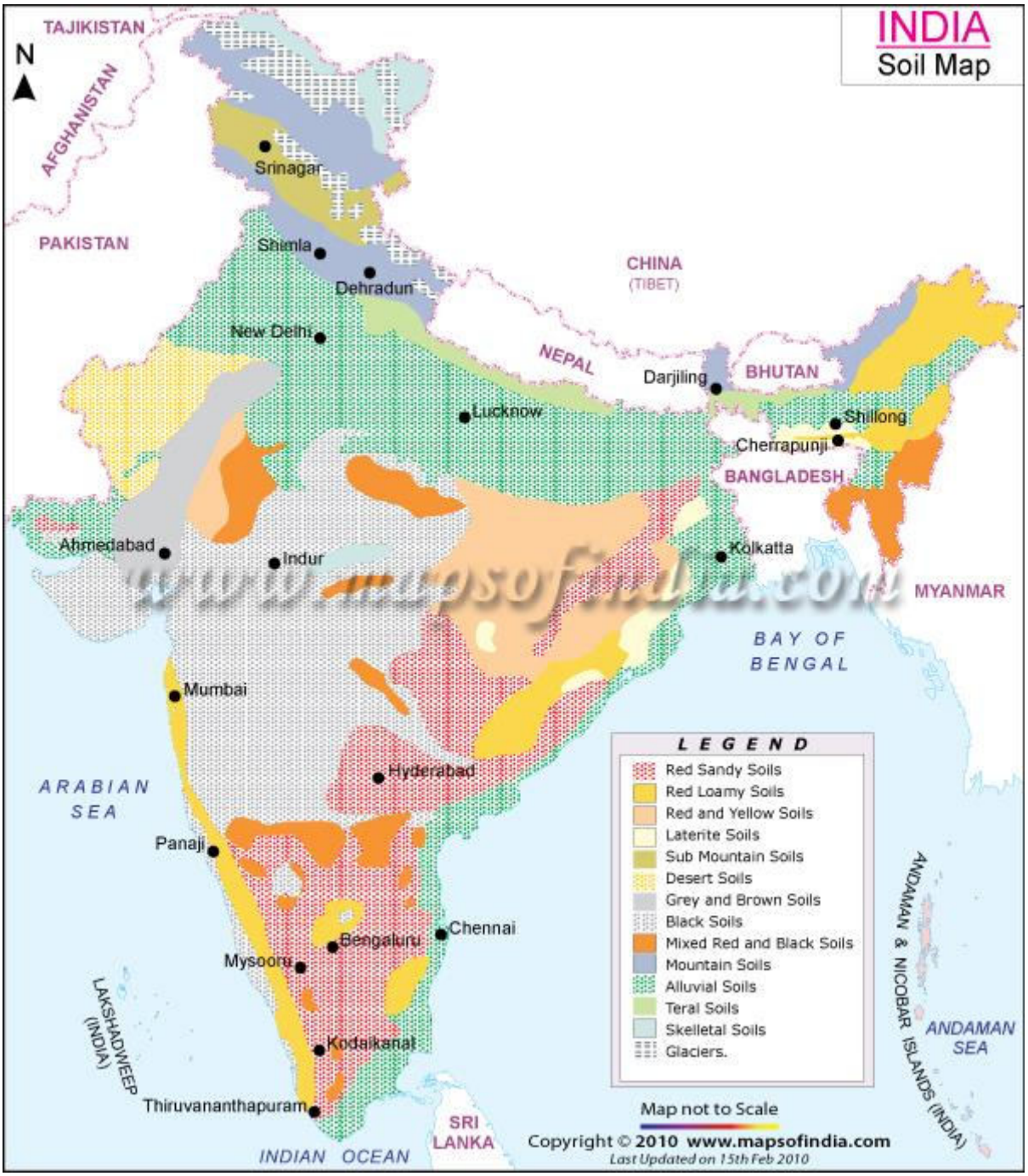


Figure-2.3: India Soil Map

India has eight major types of soil which involves following are:

1. Alluvial soil:


Figure-2.4: Alluvial Soil

Alluvial soil is fertile grained soil is deposited by flowing water over flood plains or river beds. Alluvium is derived from a Latin word Alluvius, from Alluere: to wash against. It generally contains silt, clay, sand and gravel. It is found in Punjab, Haryana, U.P, Bihar, W.B, Assam, Odisha, Delta region of South India.

2. Black soil:


Figure-2.5: Black Soil

The black soil is also known as regard soil or black cotton soil. The soil is developed by weathering of Lava. It is found in Gujarat, Deccan traps: Maharashtra, West M.P, and Andhra Pradesh.

3. Red soil:

Figure-2.6: Red Soil

Red soil is earth that has a reddish tinge because of iron compounds in it. Red soil is a group of soils that develop in a warm, temperate, moist climate under deciduous or mixed forests and that have thin organic and organic-mineral layers overlying a yellowish-brown leached layer resting on an illuvial. It is found in Tamil Nadu, Karnataka, M.P, Maharashtra, W.B, Rajasthan, North East State, in some part of Goa also.

4. Laterite soil:

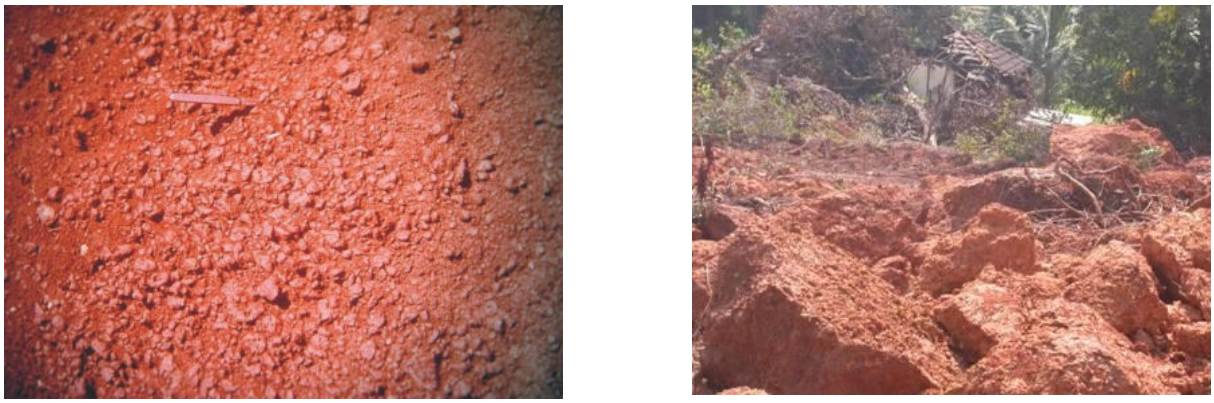


Figure-2.7: Laterite Soil

Laterite is soil types rich in iron and aluminium, formed in hot and wet tropical areas. Nearly all laterite are rusty-red because of iron oxides. They develop by intensive and long-lasting weathering of the underlying parent rock. It is found in NE state, M.P, Western Ghats, and Goa.

5. Desert soil:

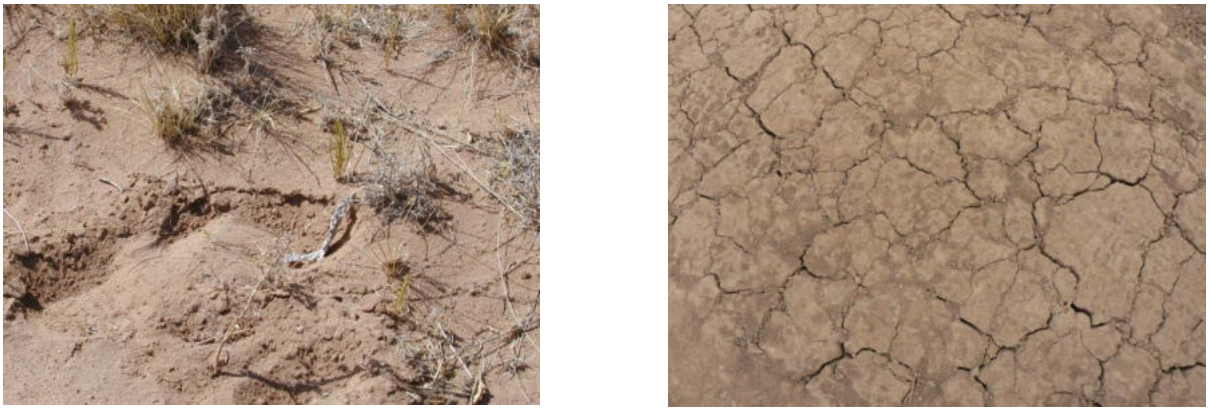


Figure-2.8: Alluvial Soil

Desert soils are basically of sandy texture. This type of soil has poor clay content and also lacks in moisture content. Desert soils are generally of brown, light brown or reddish colour. Due to the arid conditions, leaching of soil is almost absent in the desert soils and thus evaporation is quite rapid. Therefore, these soils are in general saline. Further, in some low level areas, the salt content in the desert soils is really high. In fact, it is so high that common salt is obtained by evaporating the saline water collect from such areas. It is found in Rajasthan, S. Haryana, N. Gujarat, and Punjab)

6. Mountain soil:

Figure-2.9: Mountain Soil

Mountain soils are mainly found in hill slopes and are formed by deposition of organic matter from woodlands and forests. Mountain soils are generally located in the dry and cold districts like Ladakh, Lahaul and Spiti District, Kinnaur District etc.

Mountains soils are mostly found in the Himalayan regions, Sikkim, Assam, Arunachal Pradesh and Kashmir and also in the Peninsula, Eastern Ghats and the summits of Sahyadris. There is a huge variety of soils in the Himalaya Mountain ranges and mountain soils are one among such diverse varieties.

7. Saline & Alkaline soil:

Figure-2.10: Saline & Alkaline Soil

Saline and alkaline soils occur in the drier parts of Rajasthan Uttar Pradesh, Bihar, Haryana, Punjab and Maharashtra covering about 68,000 sq. km of area. These soils are characterised by saline and alkaline efflorescence's consisting of salts of sodium, calcium and magnesium which appear on the surface as a layer of white salt through capillary action. Such soils have also been formed in areas of canal irrigation and high sub-soil water-table. These soils are known by various local names like reh, kallar, usar, rakar, thur, karl and chopan etc. In Uttar Pradesh about 1.25 million hectares and in Punjab about 1.21 million hectares of area is affected by such infertile usar soils. Texturally, these soils are sandy to loamy sand. They are deficient in calcium and nitrogen and hence very low water bearing capacity. Saline soils generally contain free sodium and other salts whereas alkali soils contain large quantities of sodium chloride. These soils can be reclaimed by providing good drainage, applying lime or gypsum and cultivating salt resistant crops (like be seem, rice and sugarcane). These soils are utilised in the cultivation of a wide variety of crops like rice, wheat, cotton, sugarcane and tobacco etc.

8. Peaty & Marshy soil:

Figure-2.11: Peaty & Marshy soil

Peaty soils originate in the humid regions due to the accumulation of large amount of organic matter in the soils. These are generally submerged under water during the rainy season and are utilised for paddy cultivation afterwards. The soils are black and heavy and highly acidic. They are highly saline, rich in organic matter but deficient in phosphate and potash. Sometimes these soils are highly toxic to plant life as they contain ferrous and aluminium sulphates in considerable amounts. These soils mainly occur in the western parts of Kottayam district and some parts of Alappuzha district (Kerala).Marshy soils are found in the coastal regions of Orissa, West Bengal and Tamil Nadu; central portion of north Bihar and in Almora district of Uttaranchal. They are the result of water-logging anaerobic conditions of the soils, and the presence of iron and varying amount of organic matter.

Soils suitable for rice production are those with a pH of around 6.0 which includes a wide variety of soils ranging from sandy loam to silt clay loam. Rice is grown in India in different types of soils. The classification of soils has been done depending upon the soil texture, colour of the soil etc. The rice soils of India have been classified into 17 types as mentioned below:

a) Sub montane soils.
b) Hill soil
c) Tarai soil
d) Calcareous soils
e) Riverine Alluvium

f) Laterite soil
g) Red sand or gravelly soils
h) Mixed red and black soil
i) Red yellow loams
j) Shallow black soil
k) Saline and Alkaline soil
l) Deltatic alluvium
m) Medium black soil
n) Seleletal soil
o) Deep black soil
p) Red loamy soil
q) Coastal Alluvium

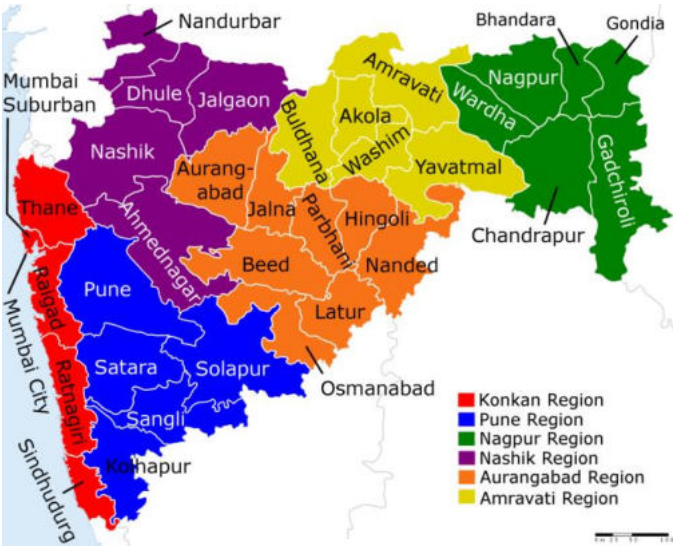


Figure-2.12: Soil map of Maharashtra

This region comprising of Maharashtra, Western and central Madhya Pradesh and Goa, Daman and Diu Union Territories, having alluvium coastal alluvium, mixed red and black soils. The Ratnagiri district, parts of Kolhapur and South of Kolaba are having Laterite soils. This is high rainfall zone and rice is cultivated in laterite soils. Non-laterite soils are found in high rainfall zone of Thana district, part of Kolaba and some areas of Nasik district in Maharashtra.

The soils of Goa possess unique characteristics and have variable soil fertility status. These pose severe constraints for crop production and one of the major reasons for this is multinutrient deficiency. In Goa the soils are red lateritic in hilly part and alluvial along the coast. Rice is the principal crop of the state.

2.4 Rice growing season

The main rice growing season in the country is the 'Kharif'. It is known as winter rice as per the harvesting time. The sowing time of winter (kharif) rice is June-July and it is harvested in November-December.

Sr. No.	Region/State	Autumn		Winter		Summer	
		Sowing	Harvesting	Sowing	Harvesting	Sowing	Harvesting
1	Gujarat	x	x	Jun-Aug	Oct-Dec	x	x
2	Maharashtra	x	x	Jun-July	Oct-Dec	x	x
3	Rajasthan	x	x	Jun-Aug	Oct-Dec	x	x

Table-2.1: Rice growing season

This region comprises of Gujarat, Maharashtra and Rajasthan. Rice is largely grown under rain fed condition during June-August to October - December.

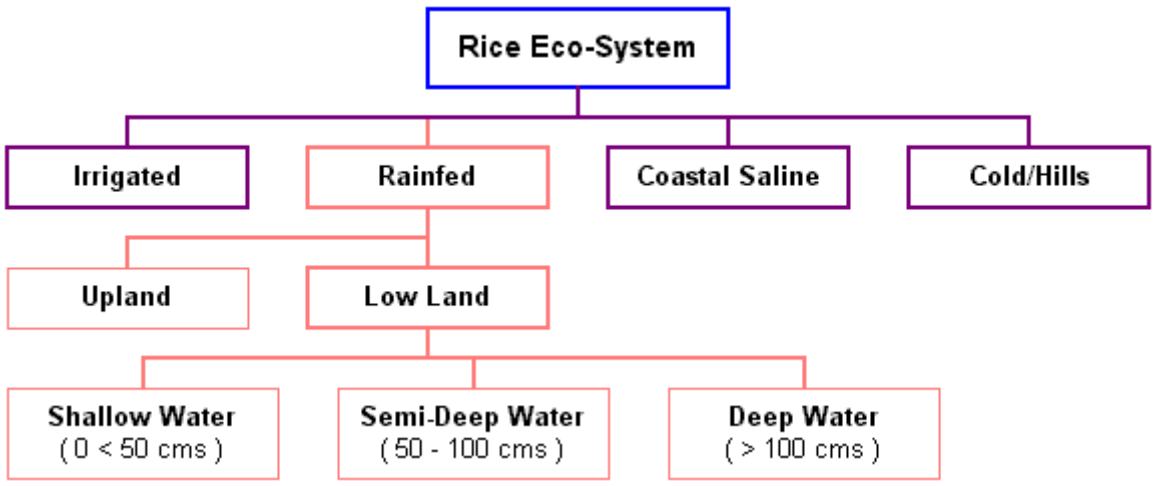


Figure-2.13: Rice Ecosystem

2.5 Method of Cultivation of Rice

In India Rice is mainly grown in two types of land region i.e., (i) uplands and (ii) low lands.

Figure-2.14: Upland or Dry land rice cultivation method

In hilly areas, the hill slopes are cut into terraces for the cultivation of rice. Such a cultivation in which the hill slopes are cut into terraces is called terraced cultivation. The supply of water to the hill terraces is not as much as in the plain areas and the rice grown in hilly areas is called dry or upland rice.

Figure-2.15: Lowland or Wetland rice cultivation method

The fields must be flooded under 10-12 cm deep water at the time of sowing and during early stages of growth. Therefore, the fields must be level and have low mud

walls to retain water. This peculiar requirement of rice makes it primarily a crop of plain areas. Rice grown in well watered lowland plain areas is called **wet or lowland rice.**

There are four type of cultivation methods practiced are:

- Broadcasting the seed
- Sowing the seed behind plough or drilling
- Transplantation method
- Broadcasting sprouted seed

In Konkan and Goa region we have found that generally they follow the Transplantation method, in which initially the seeds are grown in the puddle soil and when the seedling comes out after a week or 10 days. After this week period the seedlings are transplanted into a proper row. Nowadays the transplantation method is going to be obsolete with another method in which the seeds are sown directly in row according to DBSKKV.

2.6 Weeds found in Kokan and Goa region

C. helicacabum

Cyperus iria

Eriocaulon

Echinochloa colona

Isachne globossa

Commelina benghalensis

Alternanthera sessilis

Ageratum conyzoides

Sida rhombifolia

Blumea Lacera

Ischaemum rugosum

Hyptis suaveolens

Hygrophila auriculata

Figure-2.16: Types of weeds found in Konkan & Goa Region

Generally all the weeds shown above having their roots inside the soil up to 3 to 4 cm initially during first weeding i.e. 20 days after transplantation.

2.7 Weeding losses:

The global figure for crop yield loss is accepted as 10% of actual yield. The yield losses ranges from 10 50% in transplanted rice and 50 90% in upland rice depending on the extend of weed infestation. It is estimated that one-third to one-half of the labour used in rice production is for weed control with an average figures of 30 40 labour-days per hectare and 8-10 man-hour per day.

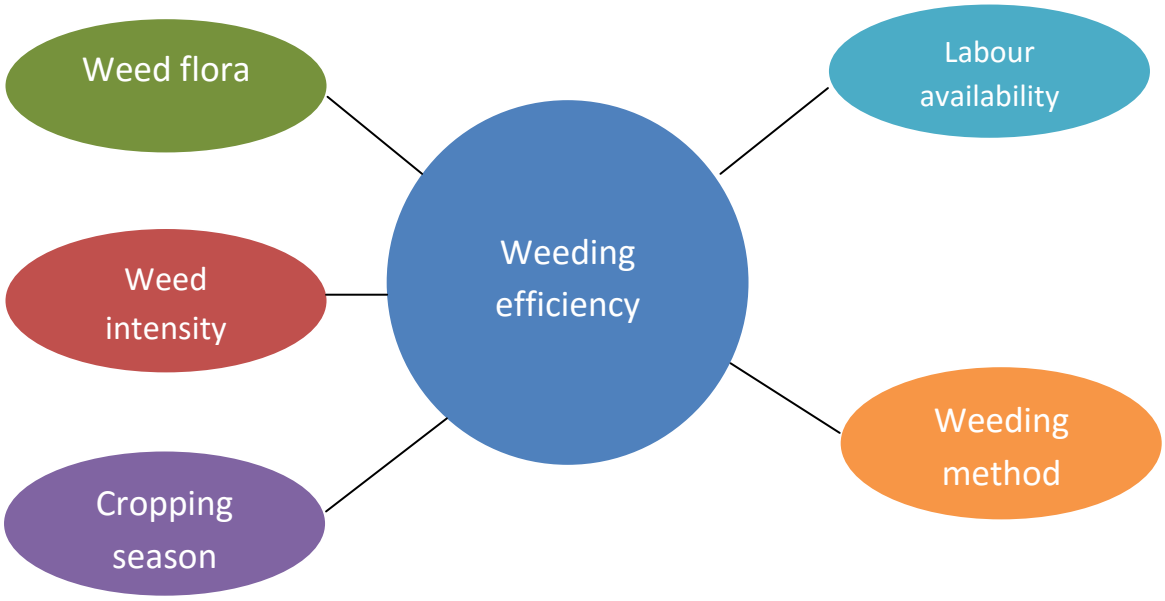


Figure-2.17: Weeding losses

2.8 Methods to control weeds:

The method of controlling weeding is divided into four types:

1. Cultural method:

a) Thorough land preparation
b) Frequent tillage,
c) Crop rotation

Figure-2.18: Cultural method

2. Use of Herbicides

Figure-2.19: Herbicides method

3. Hand weeding:

Figure-2.20: Hand weeding method

4. Mechanical weeding method:

a) Manually operated weeder like conoweeder, rotary weeder

b) Power weeder

Figure-2.21: Manually operated weeder

Figure-2.22: Power weeder

2.9 Disadvantages of Hand weeding methods

Although the Hand weeding methods has less energy consumption compared to mechanical method, but it has maximum drudgery. Responsible factors are:

a) Monotonous in performance.
b) Continuous squatting posture.
c) Performing it for longer period of time.
d) Always in bending posture.
e) Experience more discomfort on neck, upper back, mid back, lower back right clavicle and left clavicle.

Weed control is important to prevent losses in yield and production costs, and to preserve good grain quality. Specifically, weeds

a) Decrease yields by direct competition for sunlight, nutrients, and water.
b) Increase production costs e.g., higher labour or input costs.
c) Reduce grain quality and price.

2.10 SRI System of Rice Intensification

In such situations, **System of Rice Intensification (SRI)** emerged as an alternative in paddy cultivation with core principles like using less seed, less water, and less fertiliser requirement. In SRI, weeds are not seen as a problem, but as an opportunity. As the weeds are incorporated into the soil by way of mechanical weeder, it helps build up of soil organic matter and subsequently large and diverse microbial population in the soil. Thus mechanical weeding operation facilitates the process of aeration in the soil.

3.Cono weeder

A cono weeder has two conical rotor mounted in tandem position with serrated and smooth blades mounted alternately on the rotor. While operation, it uproots and bury the weed in the top 3 cm of the soil. The cono weeder is generally for shallow water rice where water is less available.

Figure-3.1: Conoweeder

The first weed management started by conoweeder 20 days after transplantation, and then after each gap of 10 days. Before starting weeding the land is irrigated before a day.

Figure-3.2: Sri Lanka conoweeder

Figure-3.3: conoweeder operation

3.1 Weeding advantages by Conoweeder

a) Enhances the utilization of biomass
b) Facilitates proper aeration in the soil
c) Promotes healthy growth of the root system and consequently the plant
d) Provides earthing up effect facilitating plants to produce new roots which help additional nutrients uptake
e) Increased yields as a result of more productive tillers, large panicle size, more number of grains per panicle and increased grain weight

3.2 Rough Drawing of a Conoweeder

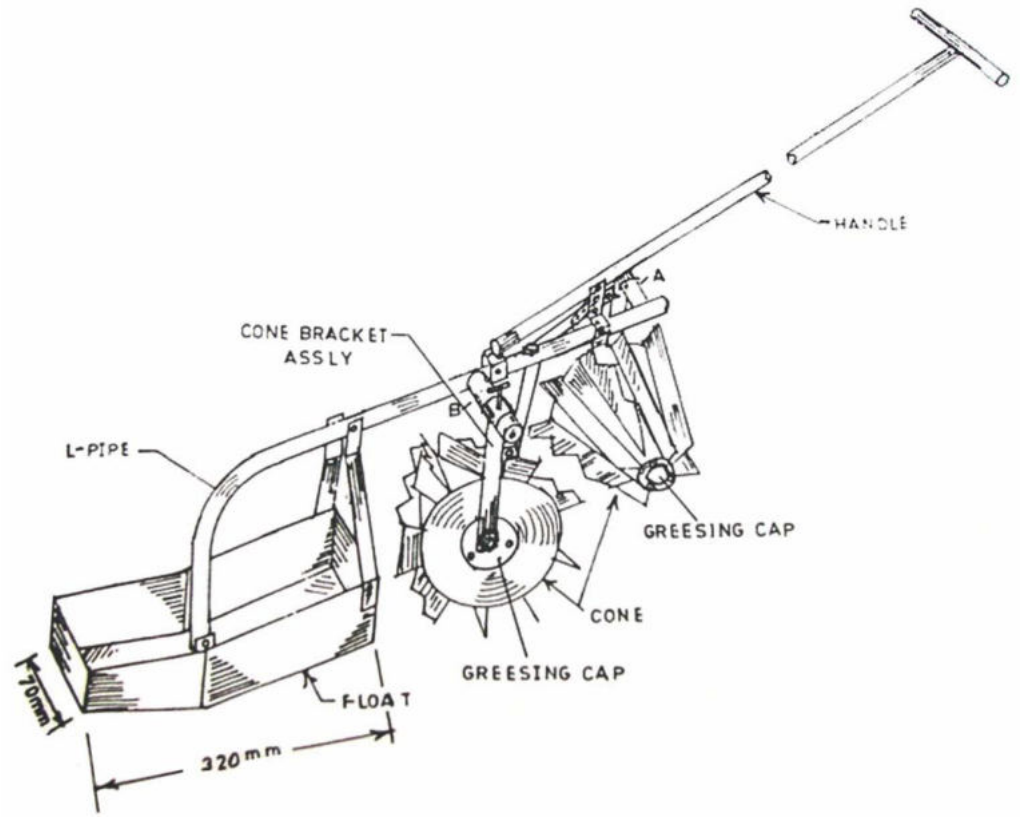


Figure-3.4: Rough drawing of conoweeder

Cone with serrated blade and flat blades, serrated blades uproot the weeds and the flat blades bend and buries the weed into the soil as the weeder travels. The rotors are in the cone shape to provide the differential velocity so that it can provide better uprooting of soil with less effort. Float prevents the sinking of weeder into the puddle soil.

3.3 Weeder impact on yield

Some research studies have amply demonstrated that there is positive correlation between weeder use and crop yields. In the experiments conducted during 2001-2002, Senthilkumar (2003) compared the use of rotary weeder (five times with ten days interval from 20 days after transplanting till booting stage) with the conventional hand weeding (three times) for wet season and chemical weeding and two times hand weeding for dry season. In both the seasons, mechanical weed control significantly increased grain yields. Weeder use alone increased the plant height and enhanced the grain yield by 10.9%, as compared to manual weeding. The dry matter accumulation during the growing season showed that the differences between the weed control treatments occurred primarily after flowering. The higher grain yield recorded in the use of mechanical weeder and continued stirring of soil for 5 times could be attributed to prolonged active leaves (LAI) and higher number of productive tillers.

Vijayakumar et al (2004) also found significant yield increase of **9.7%** (20 x 20 cm plant density) and **11.1%** (25 x 25 cm plant density) due to the weeder use when compared to conventional weeding (herbicide + hand weeding) with 14 day old seedlings and limited irrigation.

Figure-3.5: SRI and Non-SRI cultivated rice roots

3.4 Weeder impacts productivity

Experiments on physiological work load of women while using Manual Conoweeder (ANGRAU) in SRI Cultivation in comparison to conventional method has revealed that the cono weeders could increase the productivity of woman labour by two times and save 76% of the women' s time through improvement brought into their pace of performance.

Improvement could be brought in their postures, thereby facilitating them to walk comfortably along the rows while weeding with manual conoweeder. Significant relief in muscular skeletal pains at neck and low back regions was also experienced by women, the results through the above ergonomic study is useful to establish that optimized technology could potentially enhance the pace of work and productivity of women in paddy weeding and reduce the muscular fatigue at few sensitive zones.

Figure-3.6: Hand weeding

Figure-3.7: conoweeder

3.5 Issues in Weeder

Based on a model developed by International Rice Research Institute, the **Acharya N G Ranga Agricultural University of Andhra Pradesh**, developed 'cono weeder'. Few innovative farmers did several experiments for different soil situations and easy operation. Even multi-row weeders were developed by some farmers. At this point of time WWF Dialogue Project and WASSAN have organised an Innovators Workshop on SRI Implements in July, 2005. After analysing various issues the Workshop made the following recommendations regarding weeders:

Needs to have built-in adjustability to change the width of working

a) Should have some arrangement to avoid mud getting stuck between the teeth/blades.
b) Needs to be fitted with a guard.
c) Should be simple in design so that it can be manufactured locally and sold at an affordable price.
d) Should be made all weather-proof and durable.
e) SRI farmers should have option to choose from several designs.
f) A motorized version is to be developed to lessen fatigue/workload on the operator.

Institutional Recommendation:

a) Lack of proper understanding on the intricacies of weed management
b) Non availability of equipment
c) Absence of decentralized manufacturing
d) A sense of increased work load among men

3.6 Different types of conoweeder by various manufacturers and agricultural university in India

Cono weeder by Agri-Max Bihar, Darbhanga

Material of construction:

G.I blades

G.I pipe,

M.S. angle,

Cones are plastic alloy,

PVC for float

Figure-3.8: Conoweeder by Agri-Max

A manufacturer of Farm equipments has developed under the guidance of CIAE (ICAR) - Regional centre

They claim that they have reduced the wtt. From 6.5 to 5.5 kg.

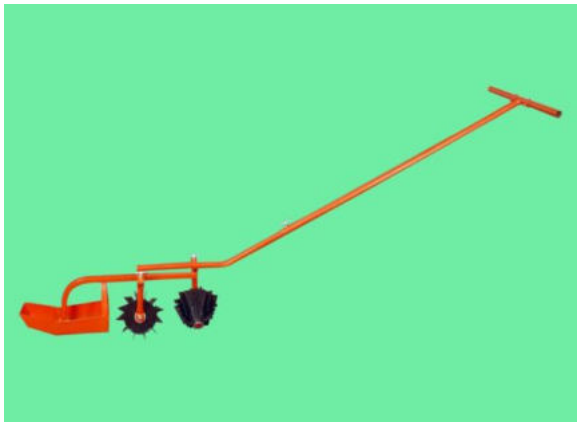


Figure-3.9: CIAE weeder

3.8 Observations in current design

The following observations have been noticed:

a) Design is too mechanical.

b) A jugad type.

c) Absence of form.

d) Only shows functionality

e) Absence of Ergonomics

f) More drudgeries

g) Rigid package.

h) Limited adjustment like height, width

3.7 Areas identified in the design which can be improved are:

a) PVC float is not durable to work in soil.

b) Non adjustable length

c) Blades requires change in arrangement pattern

d) No provision to adjust width for row

e) Handle grip which effects on palm if it is rigid

Figure-3.10: Existing conoweeder

3.9 A worker assembling at KSNM factory in Coimbatore:

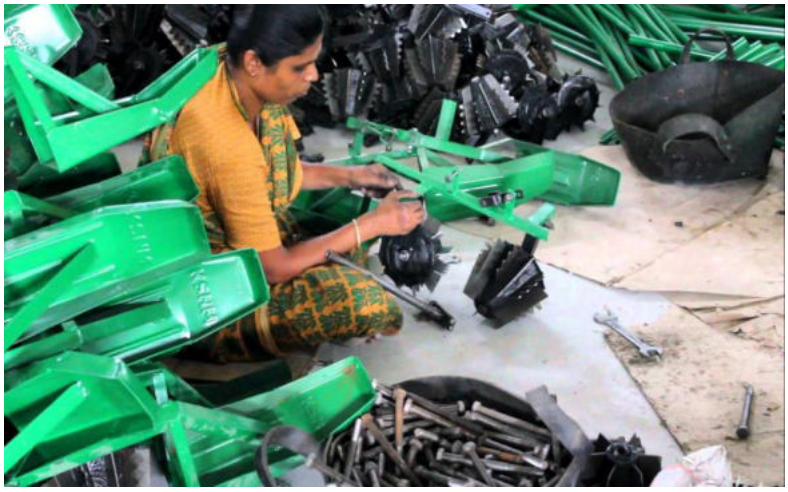


Figure-3.11: Assembly of conoweeder at KSNM factory

From the image we can see the whole assembling of parts is done manually and it shows the floats are hollow and open at rear

Different types of available manually operated mechanical weeder:

Women friendly Cono weeder developed by TNAU-Coimbatore

Weight-5-6kg

Cost-Rs.900

Overall dimension- 37cmx1.4m

TNAU has sold about 10 pc in 2013-14 (Progress report-2012-14)

Figure-3.12: TNAU weeder

After that under their guidance various nearby located company are manufacturing the same product.

Figure-3.13: Japanese weeder

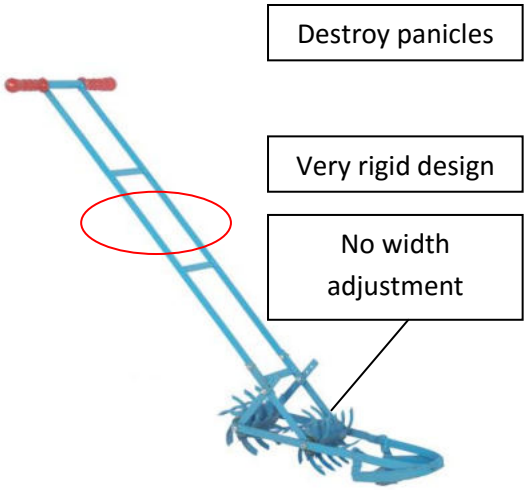


Figure-3.14: Indian design based on Japanese weeder

Figure-3.15: Jharkhand weeder

A weeder developed by a factory in Jharkhand

Cost: Rs. 900

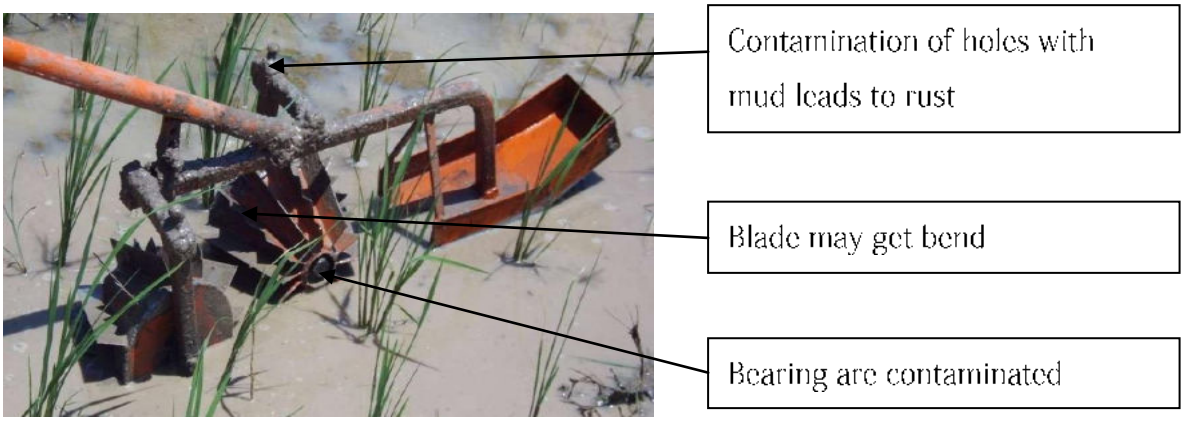


Figure-3.16: Weeder in puddle soil

Cambodian weeder

Figure-3.17: Cambodian Weeder

The operator can face more fatigue due to more penetration of rod into the soil.

Multi row cono weeder developed by Oxfam & Rajarata university, Sri Lanka:

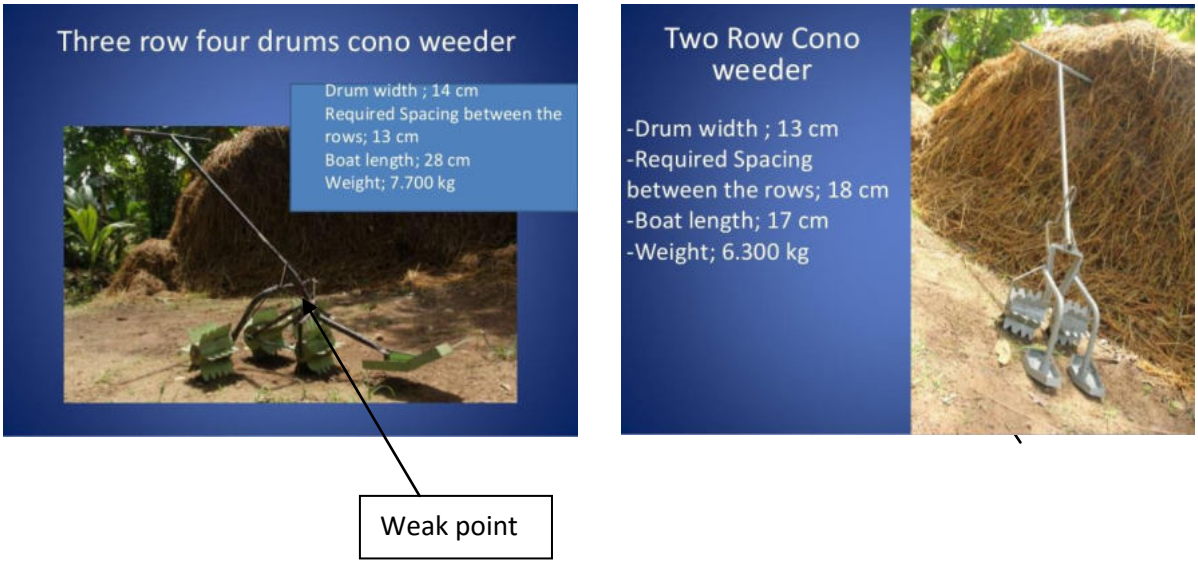


Figure-3.18: 3 -row weeder from Sri Lanka

The design is heavy due to which the operator may face fatigue while changing the row. In three rows it also require float in side rotors.

3.10 Market survey

Figure-3.19: Market survey

To know the exact scenario it is required to carry out market survey which involved telephonic interaction with dealers and manufacturers in India. And following observation have been noticed:

The red dot shows all the manufacturers are located in the country where rice production is higher. The basic problem in the Kokan & Goa region due to unavailability of manufacturer.

As the weeders are imported from the other state manufacturers which are manufactured considering the various factors of their own location like:

a) Soil condition

b) Ergonomics

c) Aerobic capacity of worker

Following observation have been noticed through market survey:

a) Users are Tribal labor, Family labor with small piece of land.
b) Their annual sale lies between in the range: 500-5000 pcs.
c) Cost lies between: Rs. 400 to 1500 (depends on the design, availability of subsidy, logistic etc.)
d) Weight lies between: 5-7 kg.
e) Durability: 5 months to 5 yrs, depends on various factors like material, user awareness, and soil cone index.
f) Various University are researching on it under the head of women friendly tool considering various study on ergonomics, soil condition etc.
g) University like TNAU Coimbatore has sold around 10 pc and under their guidance some of the nearby manufacturers have developed and selling weeder.
h) DBSKKV has sold around more than 55000 pcs.
i) Kokan Krishi Vidyapeeth, Dapoli has also conducted ergonomic study and evaluation on Women friendly conoweeder model developed by TNAU Coimbatore.
j) Cornell University, USA in collaboration with Sri Lankan university has developed variants in conoweeder for single row, multi row.

4. Field visit

4.1 Rural Communes

Rural Communes is non-profit organization established in 1974. It is located in Narangi village of Raigad District in Maharashtra. The organization is working towards comprehensive rural development. Here they conduct and provides various training related to Agriculture, Poultry, Nurturing of Domestic animals, etc. The benefits are availed by various development workers, youth, farmers, midwives, women, landless and artisans from the communities

Figure-4.1: Rural Communes, Narangi village, Raigarh (Maharashtra)

4.2 Weeder Developed by Rural Communes

Figure-4.2: Rotary weeder developed by Rural Communes under SRI

Rural communes has undertaken project for three years under SRI scheme for paddy cultivation. The organization has conducted various workshops and seminar under this scheme and trained farmers from various parts of Raigad and nearby district. Under this SRI they conducted weed management program separately under which they developed three various designed of weeder for paddy field cultivation. Following observations noticed:

a) Developed a Japanese form of rotary weeder with two rotors for better mixing.
b) The second rotor blades are bent more for better mixing.
c) The height of the weeder is not appropriate.
d) The weeder is weighing around 7.5 kg which much higher.
e) The weeder is for only single row.
f) It can work for row size 20 25 cm
g) The float level is not adjustable.
h) It cost around Rs.1000.

Due to more drudgery found in the previous model, they come up with few modifications and developed another rotary weeder.

Figure-4.3: Rotary weeder developed with modification by rural communes

a) The weeder height is comfortable for weeding.
b) The blade size also increased.
c) But the weight of the weeder has increased and it was around 12kg. And which led to more drudgery.
d) Here the float leveling is adjustable.
e) For height adjustment 5 holes in the flat bar are provided.
f) But with this modification not that much result has gained.

Another weeder developed is the conoweeder because of lack of proper penetration of blades in the soil. It is the in-house developed model of conoweeder by rural communes still the weeder found heavy weighing around 8kg.

Figure-4.4: Conoweeder developed based on Japanese weeder

a) The flat blade and serrated blades are mounted over the cones.
b) Lower height of weeder led to back pain.
c) Few points of adjustments found are not appropriate.
d) The weeder cost around Rs. 1000.
e) Although the design requires much more modification to make it more purposeful.

f) In all the weeder the worker has to move back and forth to mix weed into the soil.

While interaction with NGO we found that the failure of equipment is due to the soil. The weeder slips over the soil with cutting weeds.

4.3 Field Visit to Dr. BabaSaheb Sawant Konkan Krishi Vidyapeeth, Dapoli

Figure-4.5-DBSKKV University

DBSKKV provide education in agriculture and allied sciences. The institute provide research base to improve the productivity of agriculture, horticulture, livestock, fisheries and Agri-allied activities in Konkan region through basic, applied, adoptive and need based research for attaining economic growth and self-sufficiency of the State. Develop appropriate plans for conservation of natural resources and their sustainable use.

DBSKKV has carried out performance evaluation and ergonomics study on the conoweeder and compared with the same developed by TNAU.

4.4 Objectives of visit:

a) To understand about conoweeder.

b) Basic facts are considered in the design.

c) Factor affecting equipment like soil, water, weeds.

4.5 Conoweeder developed by DBSKKV & TNAU

Figure-4.6: Weeder developed by DBSKKV, TNAU weeder

Cono weeder developed by DBSKKV is based on Japanese weeder. Left one weeder in Image-1 is a rotary weeder based on Japanese weeder. Again due to more fatigue in the rotary weeder they developed a cono weeder without much change in the frame structure. Right image shows a cono weeder developed by Tamil Nadu Agricultural University.

Figure-4.7: Cone detail of DBSKKV weeder and TNAU weeder

Figure shows the conoweeder developed by DBSKKV. The cone shaft axes are parallel. The float is a thin sheet of MS plate with shallow height and in the rear it is open. The serrated and flat blades are mounted alternately over the cone. The cones are MS. The width is fixed.

Figure shows the conoweeder developed by TNAU. The cone axes are non parallel and non- intersecting. The width is adjustable with finite number of holes in the horizontal wheel arm. The float is enclosed from all side. The float height is non adjustable. The cones are made of plastic. The blades are inserted in the lateral surface of the cone.

The below mentioned table shows the specification of the DBSKKV and TNAU conoweeder.

S.No.	Particulars	DBSKKV cono weeder	TNAU cono weeder
1.	**DRUM**		
	No. of drums	2	2
2.	**BLADE**		
	Serrated	6	6
	Flat	6	6
3.	Diameter of cone, mm		
	Large dia. of the cone, mm		
	With blades	185	200

	Without blades	135	130
	Small diameter of cone, mm		
	With blades	135	140
	Without blades	85	60
4.	Length of cone drum, mm	105	135
5.	Distance between the drums, mm	245	190
6.	Width of weeder	100	120
7.	HANDLE		
	Length, mm	1140	1180
	Thickness, mm	160	25
8.	FLOAT		
	Length, mm	180	322
	Width, mm Front Rear	45 110	65 110
4.	Weight of the unit, kg	6.5	6.3

Table-4.1: Specification of DBSKKV & TNAU conoweeder

4.6 Comparative study of DBSKKV model and TNAU model

a) DBSKKKV weeder is heavier than TNAU model.

b) DBSKKV weeder is non adjustable in width compared to TNAU.

c) DBSKKV model having two parallel rods for main length instead of TNAU model.

d) DBSKKV model has float having smaller edge and is broader in dimension than TNAU.

e) The float of DBSKKV model is adjustable in height compared to TNAU model.

f) The axis of the cone in DBSKKV are parallel whereas in TNAU model are non parallel and non intersecting which helps the blades of cone to interact with differential velocity.

g) The cones of TNAU model are of plastic mould and plates are inserted in the surface of cone and DBSKKV model are of MS over which plates are welded.

h) Both models are priced around Rs.1200.DBSKKV model is gives more drudgery to operator compared to TNAU model while changing the row.

4.7 Interaction with Mineral foundation NGO & Farmers at Paddy fields of Goa region

Figure-4.8: Interaction with Farmers and NGO at Goa

Mineral foundation has distributed conoweeder and rotary weeder developed by CIAE Bhopal.

4.8 CIAE conoweeder

Figure-4.9: CIAE conoweeder float detail

The float is fixed but it is open in rear. The float is fixed.

Figure-4.10: CIAE weeder cone and blades detail

Cone weeder blades are made by joining layers of sheet. The axes are non parallel and non-intersecting.

Figure-4.11: CIAE weeder Main rod detail

The handle main rod length is adjustable.

Figure-4.12: CIAE weeder wheel arm detail

The weeder arm is adjustable for width.

4.9 Rotary weeder by CIAE:

Figure shows the rotary weeder devloped by CIAE Bhopal. The rotary weeder has only one rotor with serated blades and float with shallow construction in the front of weeder. The rotary weeder has fixed proportions.

Figure-4.13: CIAE weeder wheel arm detail

4.10 Observations:

a) The cono weeder is distributed by a Mineral Foundation of Goa under SRI scheme for paddy field cultivation for Rs.2000 under subsidy scheme.

b) The model distributed by organization in the entire region is model developed by Central Institute of Agricultural Engineering (CAIE), Bhopal.

c) Generally the conoweeder is possessed by Farmers who having the average land area of 20 sq.m. and more than this area is done by power weeder.

d) Average standing water level in the field is 3-5 cm.

e) Generally the period of Rice cultivation ranges from 105-145 days.

f) The first weeding is done after 10-15 days after seedling transplantation.

g) Generally weeding is done for 3 to 5 times with gap of 10 days depending on the weeds.

h) While working with conoweeder Farmer has to take rest after every 30 minutes.

i) While changing rows in the field he/she faces more drudgery.

j) Rotary weeder compared to cono weeder is lighter with only one rotor and also while changing row he/she doesn't feel that much drudgeries than cono weeder.

k) Also while working with cono weeder there are chance of uprooting of rice roots along with weeds.

l) While pulling back the weeder sinks into the soil.

m)While operating cono weeder the farmer feels more pain at his/her shoulders, hand palms, thighs due to walking in puddle field as well as pushing weeder.

n) Actual requirement to reduce the drudgery by doing modification in the weeder.

o) Very limited adjustments in the machine according to the user and which leads to more fatigue.

p) According to the user the he has to carry tool from his home to the farms and which is also one kind of fatigue activity.

q) This tool is used for 4 to 5 times per season of rice.

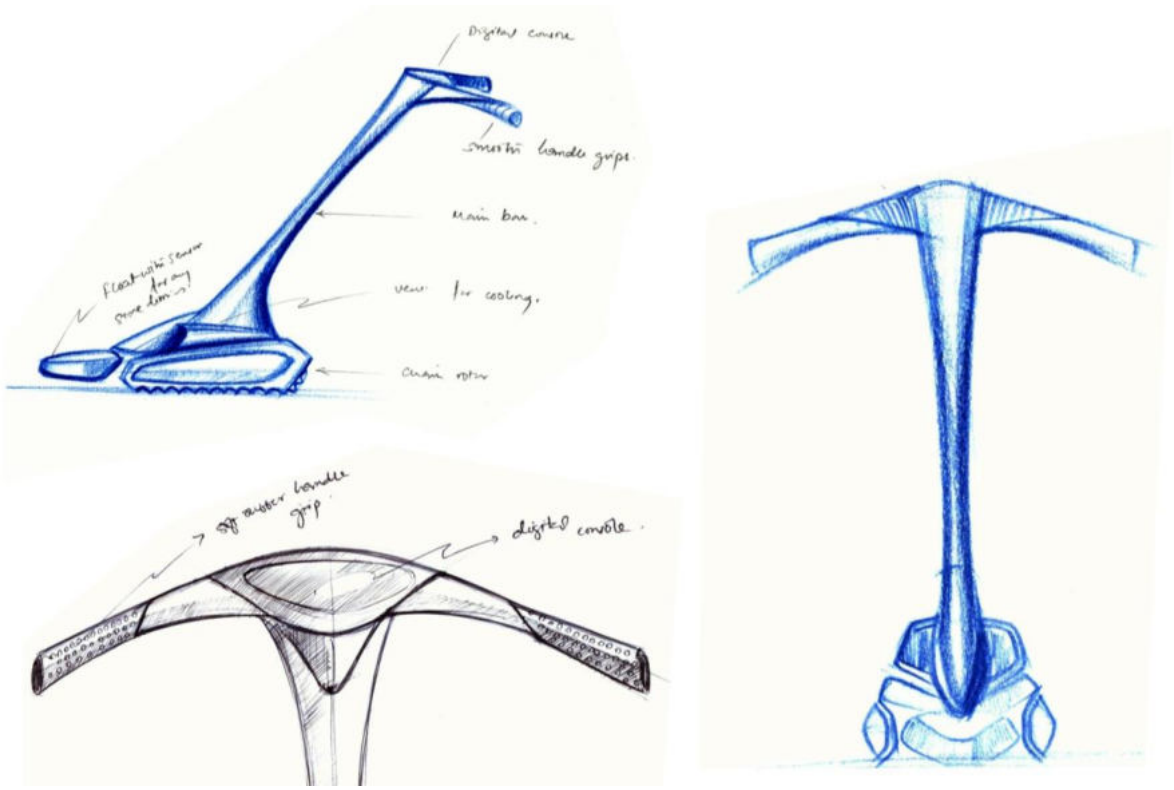
r) While working, the cone blades slip over the soil without cutting it.

s) The farmer has to work in muddy soil and due to which his feet sinks by 1 foot generally.

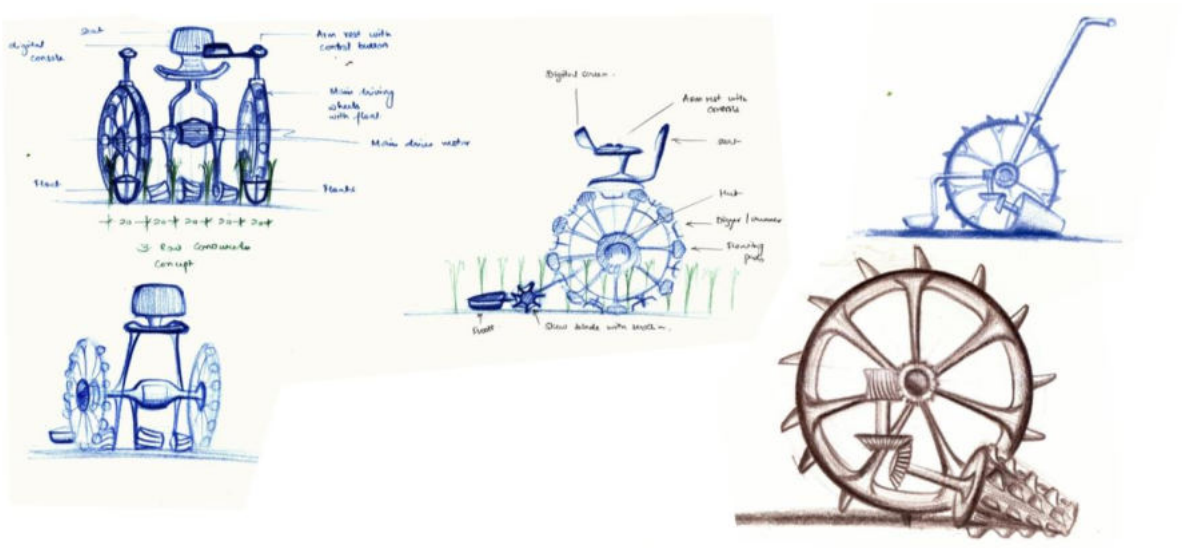
t) The width is fixed and it damages panicles of rice plants due to wider.

u) Rotary weeder is better than conoweeder.

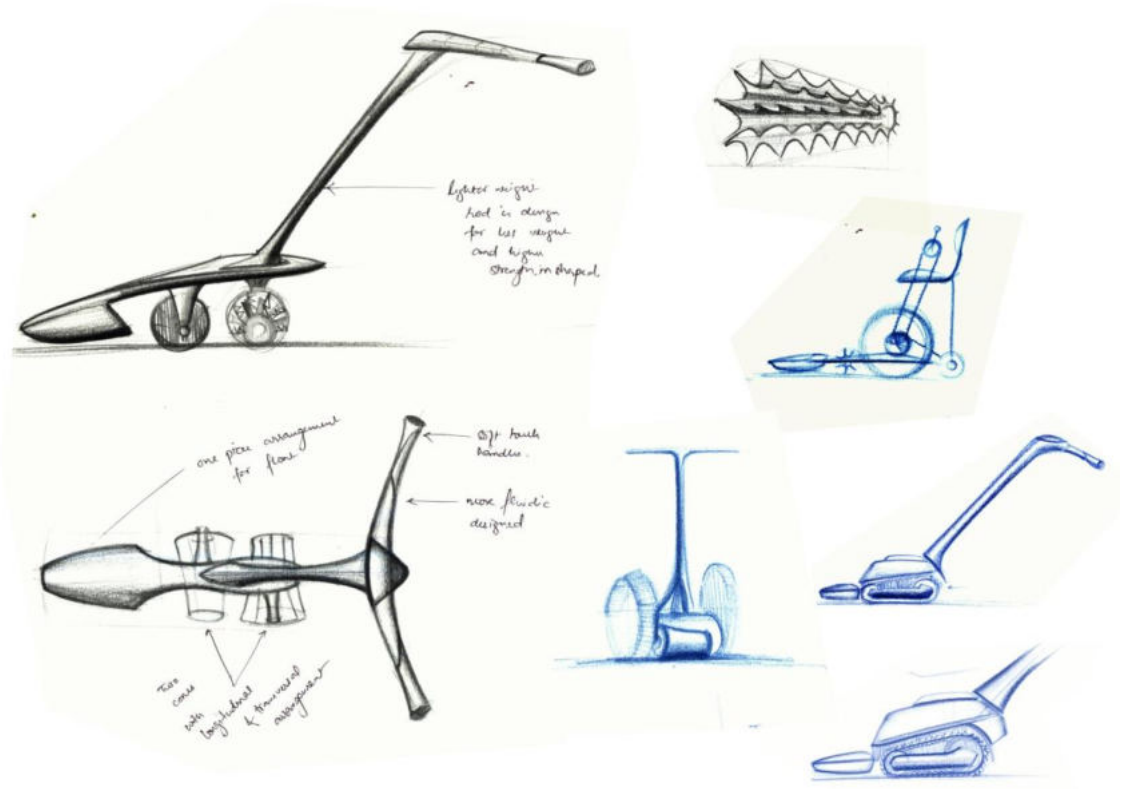
5. Idea exploration through sketches



The idea was to develop a future advanced machine which should be an automated chain rotor. And it is ergonomically designed with digital sensor and controller which records the information and pass it to the labor or farmer through digital console provided over handle. Over mechanism vents are provided for cooling of the motor drive.

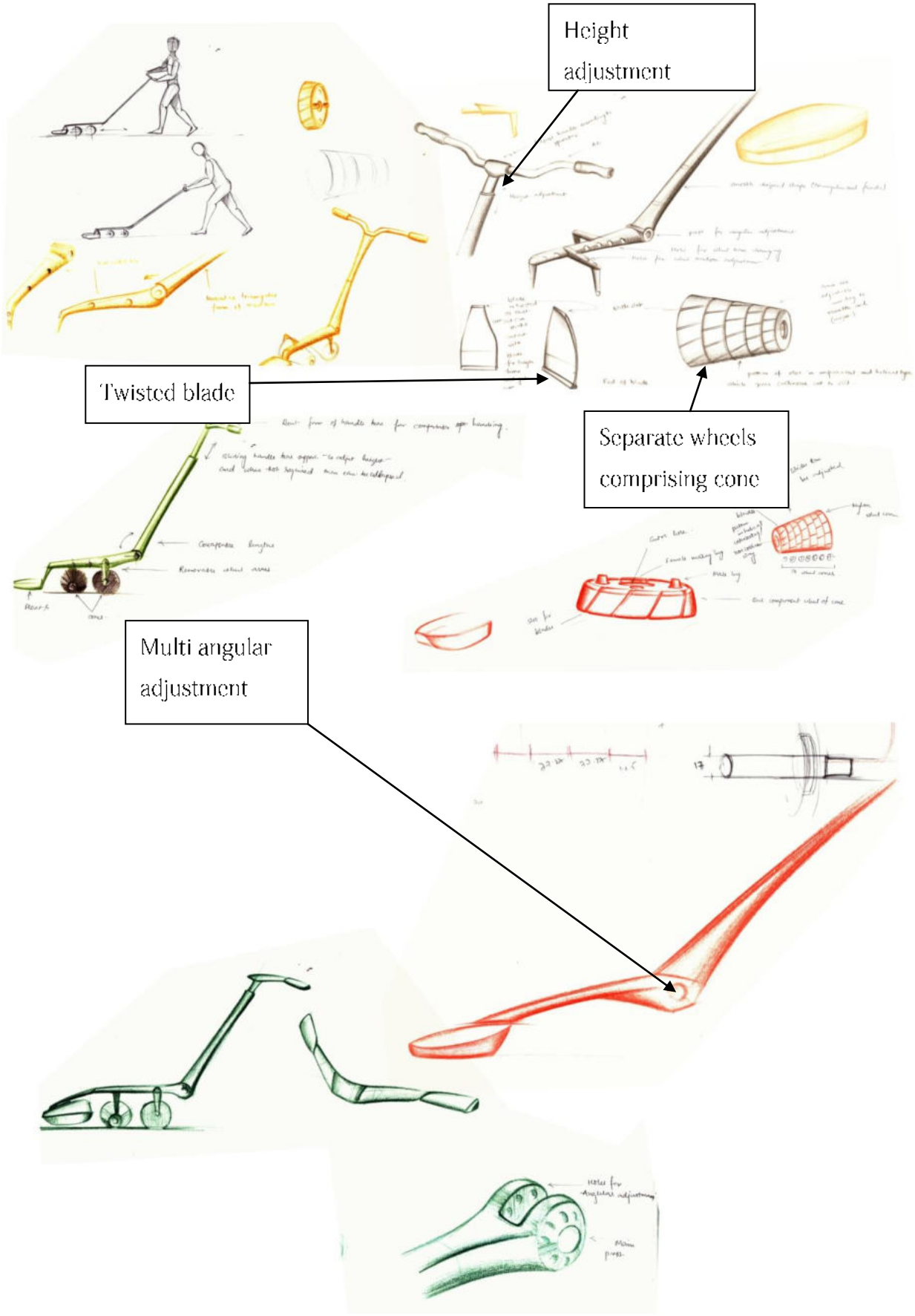


Here the basic idea was to weeder should do the operation for simultaneously for five rows. Where the operator will sit on the seat and can operate the equipment by controls provided over the arm rest. And all the recorded information is provided on the digital console. But it has complicated mechanism too.



5.1 Directional sketches

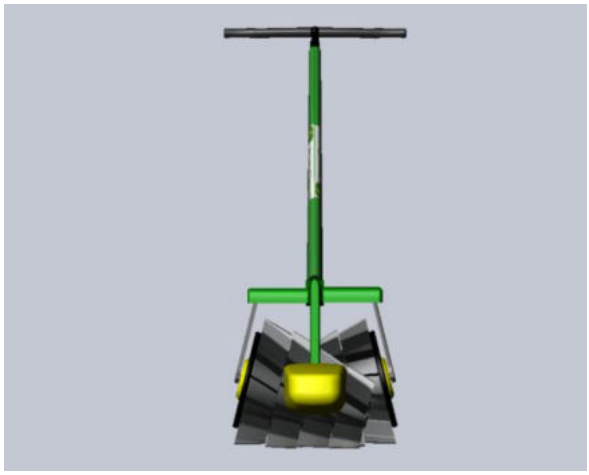
In the above sketches shows the few modification in the pattern of the blades and also taken some concept of rotary weeder and included in the development of rotary weeder.



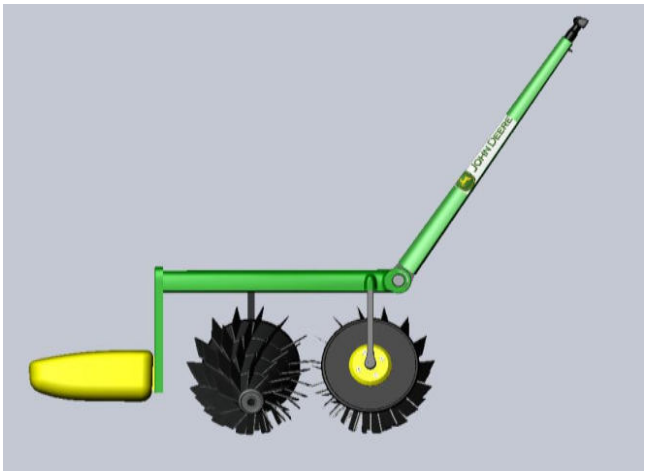
Here the idea to consider the adjustments in the width of the rotor. The entire cone (rotor) is divided into four parts. According to the width requirement each part can

be separated and weeding can be done. The blades are mounted in non uniform pattern so that if soil lump is escaped by one row of blade then it will be cut by another one likewise. Also the blades are twisted slightly longitudinally and arranged helically over the lateral surface to enhance the cutting and damaging of weeds easily. The main rod is provided with multi angular adjustment to lessen fatigue. The idea is to develop with more adjustability with lessen fatigue to the operator and with increase productivity. And the weeder should not appear as mechanical equipment but it has nice form which attracts the farmer to work and have some identity in it.

6. CAD modeling

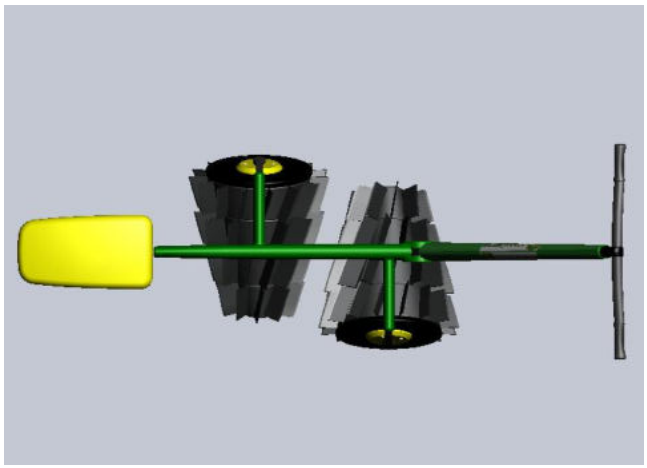


Front view



Side view

Rear view



Top view

Isometric view

7. Possible material can be used to manufacture the equipment

a) **Main frame:** It can be made of MS rod claded with plastic have high impact strength, tensile strength and resistant to water, suggested plastic is Phenyl Formaldehyde.

b) **Cones:** Nylon can be used for separate wheels of cone because of low friction properties with good abrasion and wear resistance in addition to toughness, fatigue resistance, impact resistance, and resistance to chemicals.

c) **Wheel cover:** Nylon can be used.

d) **Handle:** Integral skin semi flexible foam

e) **Float:** Amino plastic with some additives. These are available in an unlimited color range both translucent and opaque. Processing is mainly by compression molding but some grades are suitable of injection molding also. They have good electrical properties, high surface hardness, excellent gloss and appearance and resistance to solvents.

f) **Blades:** Blades can be made of MS.

8.Features in new design

a) A form inspired design and which also attracts user.

b) It has more adjustability in the form of height, width, angular adjustment.

c) More comfortable handling.

d) No corrosion problem.

e) Problem of soil slipping may be cured with non-uniform pattern of blade arrangement

f) Light weight.

g) Parts are interchangeable.

h) Can be easily carried from field to home vice versa.

i) The joints are smoothly filleted which gives an enhanced appearance.

j) The float is adjustable in depth.

k) Handle grips are designed for better handling.

l) The entire packaging cost can be ranged lesser or equal to current i.e. around 1000-1500.

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