Designing a Mobility Solution for Small and Marginal farmers of India

Submitted in partial fulfilment of the requirements
of the degree of

Masters of Design

By

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DECLARATION

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrityand have not misrepresented or fabricated any idea/data/ fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited of from whom proper permission has not been taken when needed.

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Date:
Mobility and Vehicle Design
IDC School of Design, IIT Bombay

APPROVAL SHEET

This Mobility and Vehicle Design project entitled " Mobility solution for small and marginal farmers" by Sudhanshu Ranjan is approved in partial fulfilment of the requirement for Master of Design degree in Mobility and Vehicle Design.

Project Guide

Internal Examiner

External Examiner

Chairperson

Date

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Special thanks to the small and marginal farmers who generously shared their experiences, which were vital to this research. Lastly, I am thankful to my family and friends for their unwavering support and encouragement during this journey.

CONTENT

1. INTRODUCTION

Agriculture is the backbone of the Indian economy, with small and marginal farmers constituting a significant portion of the farming community. Despite their vital role in food production, these farmers face numerous challenges that hinder their productivity and economic stability. Limited access to resources, high transportation costs, and inadequate infrastructure are among the key issues that restrict their ability to efficiently manage and market their produce.

This project, "Mobility Solution for Small and Marginal Farmers," aims to address these challenges by developing an innovative, cost-effective, and user-friendly mobility solution tailored to the needs of smallholder farmers. By leveraging technology and local resources, the proposed solution seeks to improve the accessibility and efficiency of transportation, reduce costs, and ultimately enhance the livelihoods of small and marginal farmers.

The primary objective of this research is to design a mobility framework that not only facilitates better access to markets but also ensures that farmers can transport their produce in a timely and efficient manner. Through this, the project aspires to contribute to the sustainable development of rural communities and the overall growth of the agricultural sector in India.

1. SMALL AND MARGINAL FARMERS OF INDIA

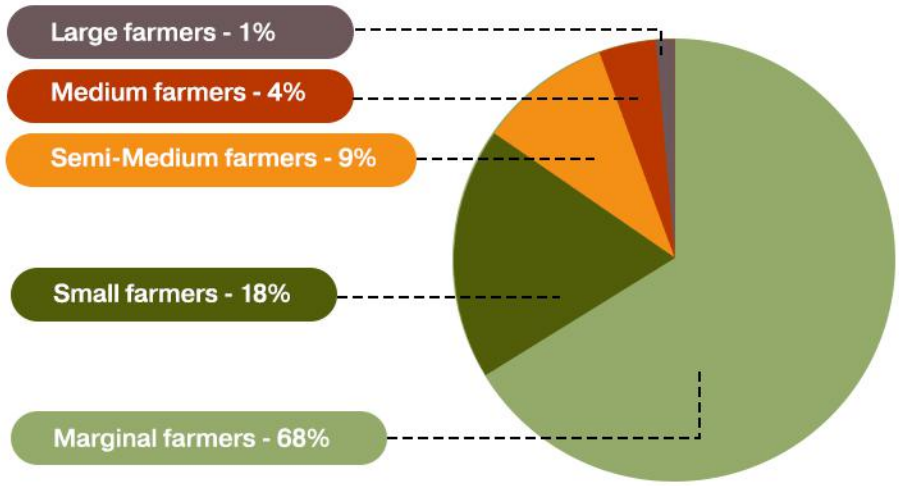
Small and marginal farmers in India typically fall under the following categories based on land ownership:

Small Farmers: These individuals own land between 1 to 2 hectares (2.47 to 4.94 acres) in size.

Marginal Farmers: Marginal farmers own land that is less than 1 hectare (2.47 acres) in size.

These categories are crucial in the Indian agricultural landscape as they often represent a significant portion of the farming population and face various challenges related to land size, access to resources, and technological advancements.

Percentage Farmers distribution in India



Percentage Distribution of Operational Holdings and Crop Area

Farmer Category	Land holding size
Marginal farmers	Farmland size below 1 hectare
Small farmers	Farmland size between 1-2 hectare
Semi-medium Farmers	Farmland size between 2-4 hectare
Medium Farmers	Farmland size between 4-10 hectare
Large Farmers	Farmland size above 10 hectare

Data according to gov. of India

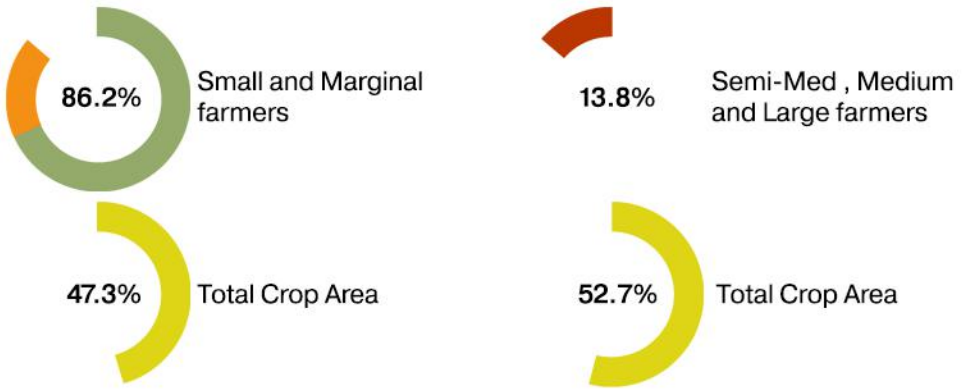
1.1 LANDHOLDINGS OF SMALL AND MARGINAL FARMERS

Small and marginal farmers in India constitute a significant portion of the agricultural sector. Small farmers own 1 to 2 hectares, while marginal farmers own less than 1 hectare.

These groups face challenges in accessing resources and technology. Their landholdings often influence their ability to adopt modern farming practices and determine their eligibility for government support in the agricultural domain.

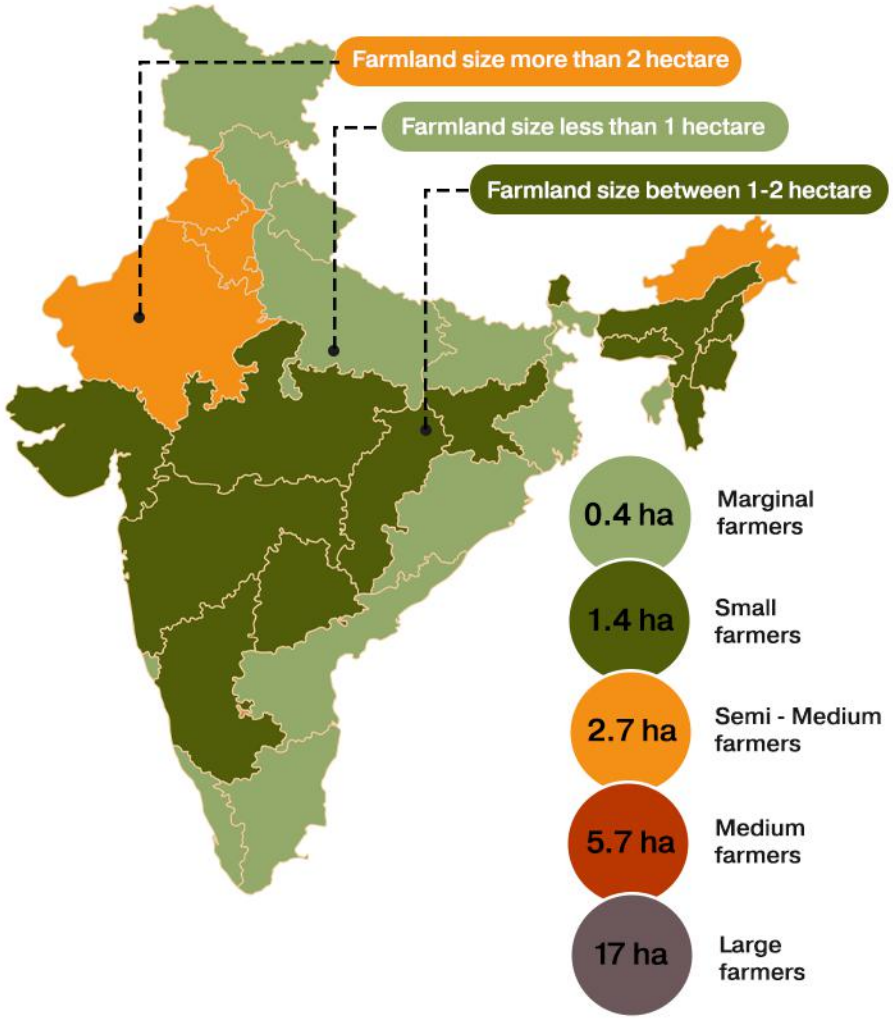
There exists a deep disparity between the crop area % to the landholding by smaal and marginal farmers.

Percentage distribution of operational landsolding and crop area in India



Data according to gov. of India

Percentage distribution of statewise average farmland size



Data according to gov. of India

1.2 WHY THE DISPARITY

Large and medium farmers often have better access to resources such as finance, technology, and irrigation facilities, allowing them to invest more in farming inputs, mechanization, and modern techniques. This leads to higher crop yields per unit of land.

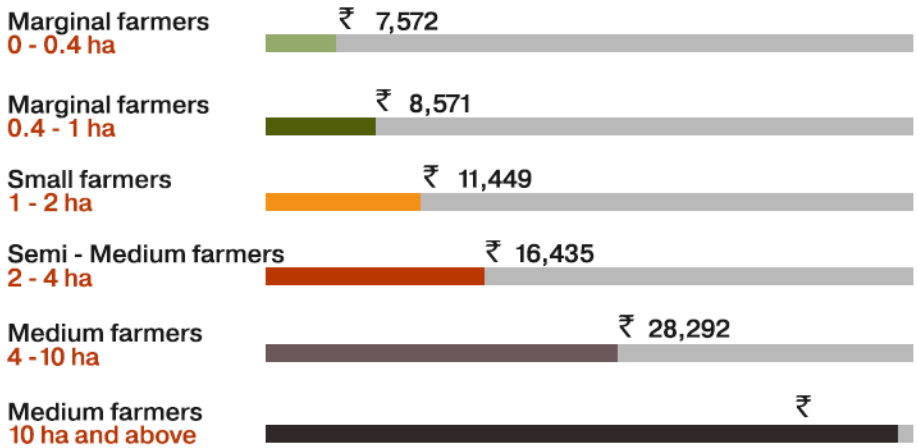
Larger landholdings enable economies of scale, making it more feasible for medium and large farmers to invest in advanced farming machinery, bulk purchasing of inputs, and implementing efficient farming practices, which often results in increased crop production.

Small and marginal farmers often face higher risks due to limited resources and land. They may focus on subsistence farming or traditional methods, which might not optimize productivity, resulting in lower crop yields per unit of land.

1.3 SOURCES OF INCOME

Indian farmers depend on many sources of income that account to their average income these income source have the primary roots in farming but surprisingly that is not even half their source of income other farm activities like labourours in cities , other farms and animal husbandary account for a major chunk of their income source.

Average income of Indian farmers as of 2018 - 19 (monthly)



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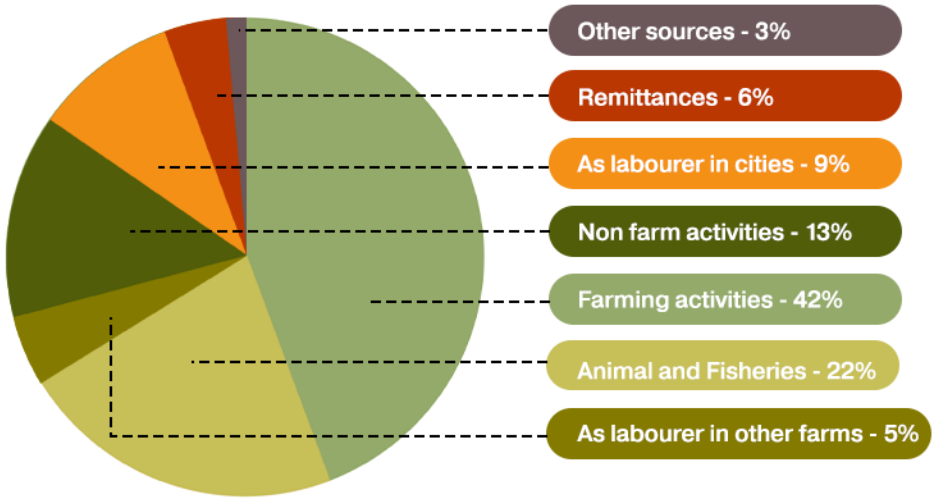
Sources of Income for small and marginal farmers



Data according to gov. of India

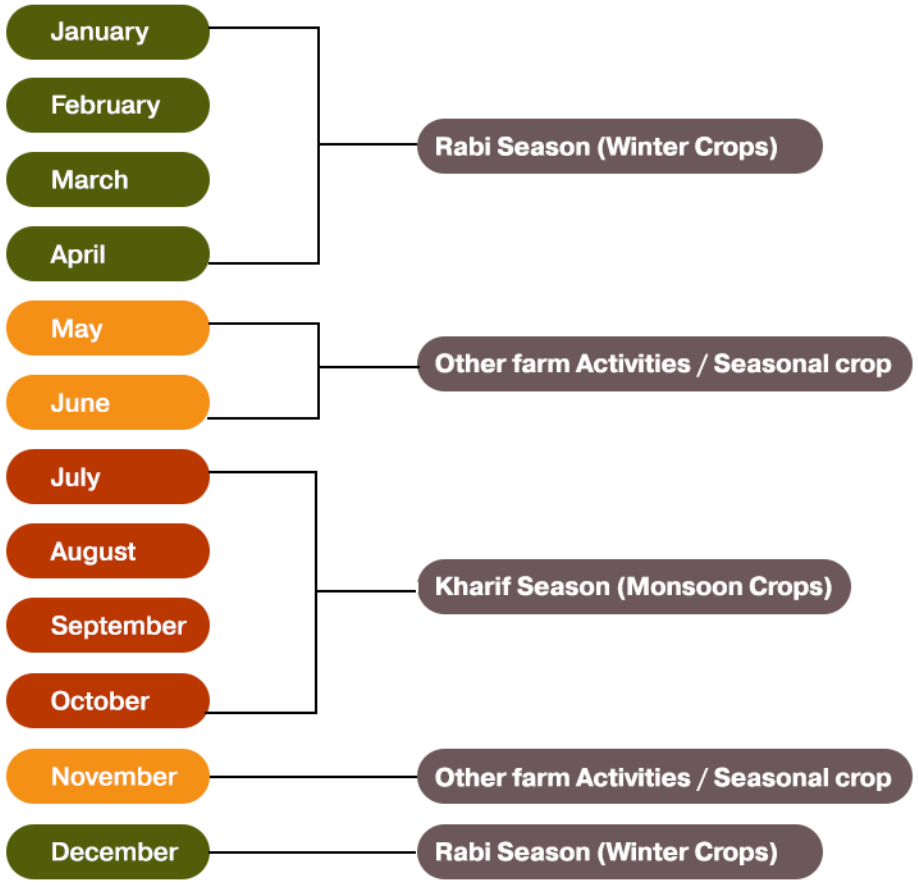
2 AGRICULTURE PRODUCES IN INDIA

Kharif Crops (Monsoon Crops)
Time Frame: June - July to September - October
Requirement: Requires lots of water for germination of seeds and maturation and humid climate to grow
Major Crops: Rice, Millets, Cotton, Groundnut, Jute, Pulses, Sugarcane,Watermelon.

Rabi Crops (Winter Crops)
Time Frame: October - November to April - May
Requirements: Requires warm condition for germination of seeds and maturation and cold weather for the growth.
Major Crops: Wheat, Gram, Pea, Barley, Potato, Tomato, Onion, Oil seeds,

Zaid Crops
Time Frame: Grown between Rabi and Kharif crop seasons (March - June)
Requirements: Requires less water and less time to mature.
Major Crops: Watermelon, Bitter Gourd, Few Pulses like Moong Dal, etc.

Employment seasons for farmers



2 .1 FARMING METHODS USED BY SMALL AND MARGINAL FARMERS

Subsistance Farming

Subsistence farming is one of the popular types of cultivation in agriculture that's the main purpose for personal consumption.

- It helps to reduce rural vulnerability
- Decreases the food inflation
- Basic Equipment used
- Low Yeild

Livestock Farming

In livestock farming, there are types of farming of livestock such as different types of dairy farming, types of poultry farming, types of fish farming, crab farming, cattle farming and many more.

- A livestock farmer can get many food items, wool, leather, and more by raising livestock.

Conventional Farming

Farming done with synthetic chemicals / fertilizers are used to maintain the crops is known as Conventional Farming.

- Maintenance is made easy for farmers
- Mono Cropping
- Uniform crop is ideal because it reduces labor costs.

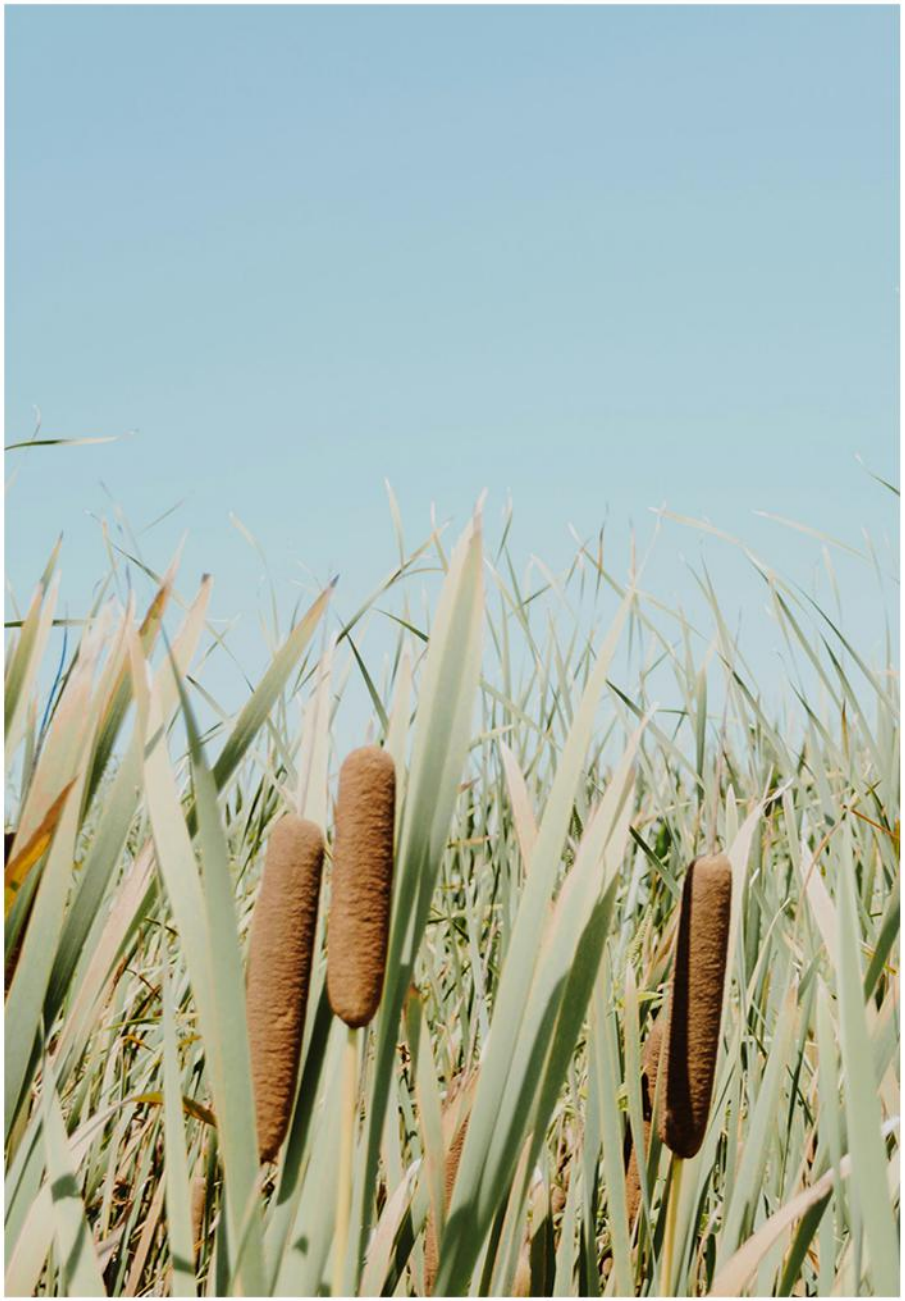
2 .1 FARMING METHODS USED BY SMALL AND MARGINAL FARMERS

Commercial Farming

Commercial farming is farming where crops and raises livestock to sell crops or food items for making money.

It has high demand in the farming sector because Commercial plantations have to export to other countries and also use to make raw materials in the industries.

2 .2 FARMING OPERATIONS



The whole cultivation process of the crop was studied. Any crop cycle can be divided into mainly three steps where machines and implements are involved the most and frequent. All the operations can be performed by animals, tractors and power tiller based its availability and convince.

Land Preparation

Land preparation is done after the last harvest to make the soil suitable and productive for the next crops land preparation includes,

Ploughing: It is done to break the soil into clods, rotate the layer of the soil and remove roots/crops residue. To plough minimum 7 to 10 hp is required. (for Single furrow plough).

Tilling/Harrowing: It is the second stage after ploughing, it is done to break the clods into smaller size and bury the crops residue.

Furrowing and Ridging: Furrowing is the process to create a water channel in the plowed field, so each plant gets an equal amount of nutrition, sunlight, and water. Image below shows the standard size of the furrow and ridge, although the spacing between two plants varies based on crops.

Puddling: It is a wet-tillage operation that mixes soil and water to produce an impervious layer. It is achieved by plowing the flooded land and harrowing it at progressively lower water contents — puddling benefits rice by controlling weeds and conserving water.

Leveling: In case of rice cultivation, leveling is done after puddling operation so that planting and seeding happen at the same level since rice cultivation
does not involve creating furrow and ridge.

2 .2 FARMING OPERATIONS

Plantation and Cultivation

Seeding: It is the process of sowing seeds at certain depth directly into fields and covering it with soil for better germination and growth. Various methods, such as broadcasting, drilling, and dibbling. Most of the granular crops are planted using this method.

Transplanting: In this method, the plant is grown in necessary first for controlled growth and protect young plants from weed. These saplings are then planted in the fields using manual labor or transplanter. Most of the vegetables and fruits are planted using this method.

Interestingly, rice can be planted using both methods, seeding, and transplanting. Each method has its pros and cons*.

Weeding: It is the process of removal of unwanted weed from the crop field, which may slow down the crops growth process by sharing nutrition with it. Manual weeding is the most common practice in India using a sickle. It can also be done using power tiller and weeder.

Spraying: It is the process of spraying pesticides and liquid fertilizers

2 .2 FARMING OPERATIONS

Harvesting

Reaping: It is the process of cutting the crops from the field either manually or using reaper. In the case of vegetables, the product is plucked from the plant manually.

Threshing: It is the process of separating grains from the straw. Even today, threshing is done on communal based by running a tractor or ox over the crops or by smashing crops against the hard surface. Threshers are also used to carry out the operation.

Combine Harvesting: Here, combine harvester is used which carry out repeaing and threshing process in one go reducing time and labor spent in the process.

2 .2 FARMING OPERATIONS

Different stages of farm operations

3 FARM CHARACTERISTICS AND RURAL INFRASTRUCTURE

- Small and fragmented plot of land
- Diverse cropping patterns
- Farmland often surrounded by a mud wall.
- Traditional farming methods.
- Labor-intensive practices.
- Little to no gap between sown crops.
- Farmland connected by a semi major road to reach the farm.
- Poor Farm mechanization.

Rural Infrastructure

Rural Electrification is at 95%

Source - NFHS (National Family and Health Survey) 2022

Rural paved road is at 65%

Source - Road Ministry Data 2019 -2020

Rural Irrigation acess is 52%

Source - Niti Aayog Data 2022 - 2023

4 FARM MECHANIZATION IN INDIA

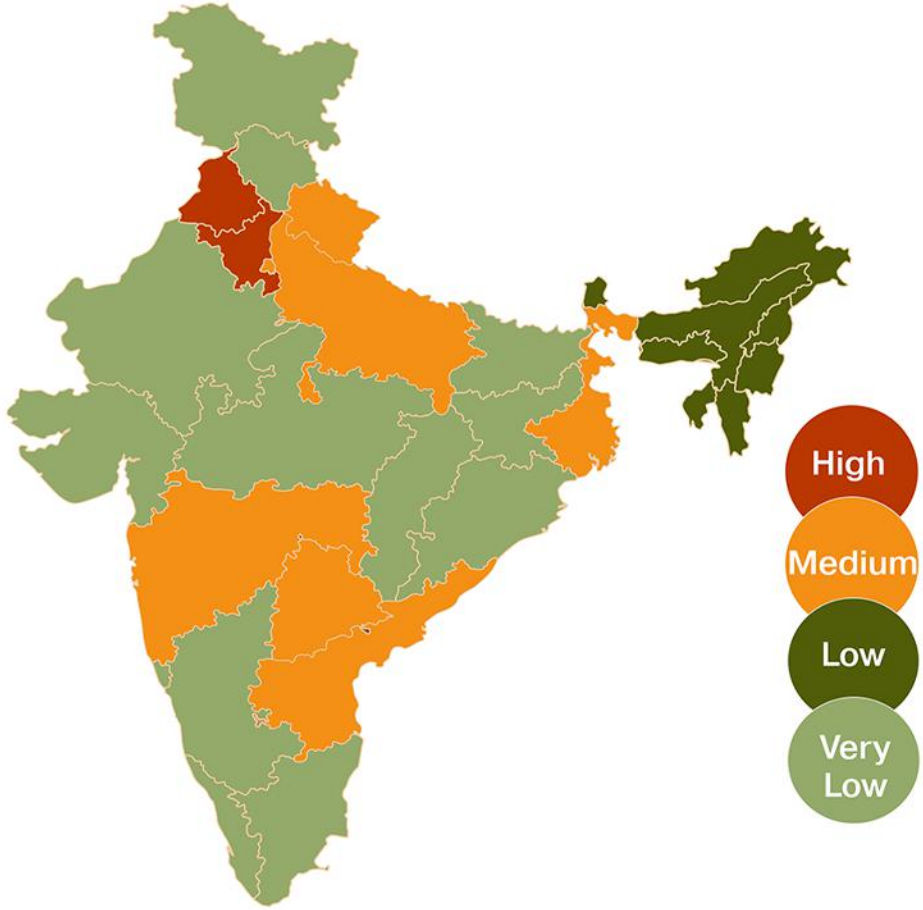
Farm mechanisation in India stands at about 40 45 percent This is low when compared to countries such as the US 95 percent), Brazil 75 percent) and China 57 percent) .

North(Haryana and Uttar Pradesh) have high level of mechanisation due to the highly productive land in the region as well as a declining labour force The state governments in these states have also provided timely support in promoting mechanisation of farms.

Western and southern states in the country have a lower level of mechanisation due to the smaller land holdings prevalent in these regions as well as the land holding being more scattered As a result, in many cases, mechanisation has been uneconomical leading to the lower development.

North eastern states the level of mechanisation is extremely low. The reasons are hilly topography, high transportation cost, lack of state financing and other financial constraints due to socio economic conditions.

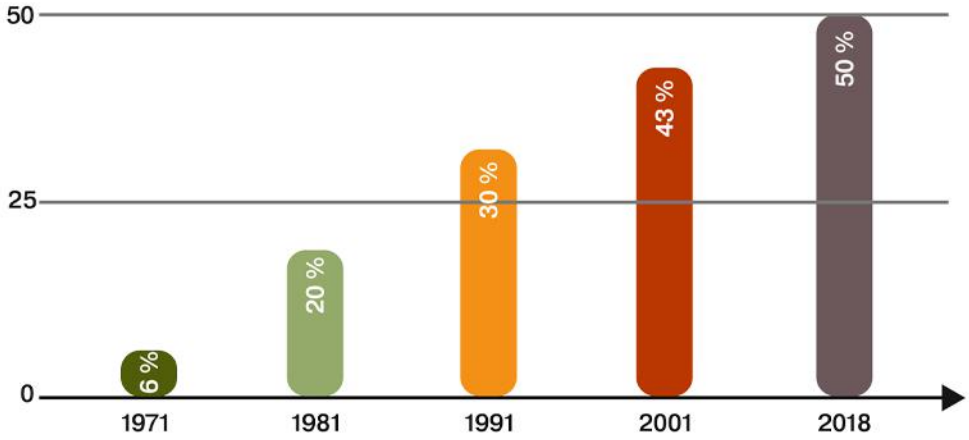
State wize level of mechanization



Data according to gov. of India

4.1 FARM MECHANIZATION IN DIFFERENT FARMING OPERATIONS

Level of mechanization withing farms have increased drastically within the past 5 decades. Most the work for which we relied on animals and agricultural labours to get the job done but with the markets opening for the India , with the advent of new innovative and affordable technology agro-mobility solutions were more and more adopted by india.



%ge involvement of **Agro Machinery** in farming in the past 4 decades

Farm Mechanization in different farming operations

Level of mechanization till 2008

Soil bed preparation	42%	Tillage, seed bed preparation Tractors, Levelers, Ploughs, Dozers, Scrapers etc.
Seeding and planting	20%	Sowing and planting Drill, Seeder, Planter, Dibbler, Transplanter etc.
Plant protection	30%	Weeding, inter cultivation, plant protection Shovel /Plough, Harrow, Tiller, Sprayer, Duster, etc.
Irrigation	28%	Using waterpumps to irrigate feilds
Harvesting	25%	Harvesting and threshing Harvester, Thresher, Digger, Reaper, Sheller, Sickle/Dao, etc.

Level of mechanization till 2018

Soil bed preparation	68%	Tillage, seed bed preparation Tractors, Levelers, Ploughs, Dozers, Scrapers etc.
Seeding and planting	30%	Sowing and planting Drill, Seeder, Planter, Dibbler, Transplanter etc. but 60% & 65% for wheat and rice
Plant protection	32%	Weeding, inter cultivation, plant protection Shovel /Plough, Harrow, Tiller, Sprayer, Duster, etc.
Irrigation	34%	Using waterpumps to irrigate feilds
Harvesting	32%	Harvesting and threshing Harvester, Thresher, Digger, Reaper, Sheller, Sickle/Dao, etc.

Source - Indian Council for Agriculture Research (ICAR) 2018

5. MOBILITY SOLUTIONS IN FARMING

Small and marginal farmers in India engage in diverse activities: crop cultivation (rice, wheat, pulses), livestock rearing (cattle, poultry), and agroforestry. They manage land, sow seeds, nurture crops, tend livestock, harvest produce, and sell at local markets.

Activities done along with farming

Mobility solutions

Bullock carts

Bicycles

Modified Bikes

Power Tillers

Motorcycles

Compact Tractors

The conditions for small and marginal farmers in India varied across regions. Challenges like limited access to resources, insufficient infrastructure, and dependency on traditional methods persisted. Efforts were being made to improve access to credit, technology, and markets. Initiatives focusing on digital platforms for market linkage and government schemes aimed at enhancing agricultural infrastructure were underway.

However, the situation was dynamic, with ongoing efforts to address these challenges and uplift the farming community. For the most current and specific updates, recent sources or reports would provide accurate insights into the present conditions.

5.1 MOBILITY SOLUTIONS IN FARMING

Small Indian farmers benefit from tailored mobility solutions integrating technology and shared resources. Mobile apps aid in scheduling transport and accessing market data, while collaborative ownership of vehicles enables cost-effective transportation of produce. Improving last-mile connectivity with innovative modes like e-rickshaws ensures better access. Financial aid and government support further empower farmers, fostering sustainable practices and enhancing market reach for improved livelihoods.

5.2 COMPARITIVE ANALYSIS OF DIFFERENT MOBILITY SOLUTIONS

Design Parameters	Compact Tractor	Tiller	Commuter Bike	Bicycle	Modified Bike	Bullock Cart
Suitability and Versatility	Versatile and suitable for various tasks	Limited to tilling and basic farm work	Limited, best for short distances in and around the farm but good for commute activities	Limited, best for short distances in and around the farm	Modified for some farm tasks	Suitable for transporting goods and performing basic farm work
Ease of Use	Requires training and experience	Relatively simple and easy to operate	Simple and easy to use	Simple and easy to use	Variable, depends on modifications	Requires training and handling
Affordability	Expensive upfront cost and maintenance	Affordable upfront cost and maintenance	Low upfront cost and maintenance	Low upfront cost and maintenance	Variable, depends on modifications	Low upfront cost and maintenance
Comfort and Ergonomics	Comfortable seating and controls	Poor Comfort and Ergonomics	Basic and simple design	Basic and simple design	Variable, depends on modifications	Poor Comfort and Ergonomics
Maneuverability	Good maneuverability in fields but hard to navigate between narrow spaces	Excellent maneuverability in small fields	Excellent maneuverability around the fields	Excellent maneuverability around the fields	Variable, depends on modifications	Good maneuverability in narrow spaces
Adaptability to Local Context	Require customization to suit specific needs	Easily adaptable to local needs	Very adaptive for local needs	Very adaptive for local needs	Variable, depends on modifications	Well-integrated with local culture and practices
Load Carrying Capacity	High capacity for carrying heavy loads	Moderate capacity for light loads	Limited capacity for small items	Limited capacity for small items	Variable, depends on modifications	Can pull on good amount of load
Durability and Maintenance	Durable and requires regular maintenance	Durable and requires basic maintenance	Low maintenance	Low maintenance	Variable, depends on modifications	Durable and requires regular maintenance
Social Acceptance and Values	Perceived as a sign of progress and modernity	Perceived as traditional and culturally accepted	Perceived as modern and convenient	Perceived as a simple commute vehicle but having ability of perform multiple tasks	Variable, may be seen as innovative or unconventional	Embedded in traditional farming practices

5.3 OWNERSHIP OF DIFFERENT MOBILITY SOLUTIONS

For small and marginal farmers, mobility ownership holds significant importance in facilitating access to markets, resources, and essential services. Owning or having access to transportation means enables these farmers to transport their produce to markets efficiently, reducing dependency on middlemen and ensuring better returns. Additionally, it aids in accessing agricultural inputs like seeds, fertilizers, and equipment, thereby enhancing productivity.

Mobility ownership

Compact Tractor

Rented
Owned

Modified Motorcycle

Rented
Owned

Motorcycles

Rented
Owned

Power Tiller

Rented
Owned

Bicycles

Rented
Owned

Bullock carts

Rented
Owned

5.3 SHG's AND CUSTOM HIRING CENTERS

Custom Hiring Centers

- Government backed centers having set of agriculture equipments that can be leased by farmers.
- Has inventory of own.
- No private interest rules out any incentive for the staff.
- Issues of maintenance and up gradation of equipment.

Franchise model

- Similar to above but assets are owned by franchise. Back-end is supported.
- Own inventory makes order execution easy
- Risk is born by individual entrepreneur which will limit scale

Community groups

- These are groups formed by group of people from the village itself to rent of buy a machinery so that it can be used by them.
- Reduces the cost per head of acquiring this machinery.

6 AGRICULTURAL ACTIVITIES AND SUPPORT SYSTEM OF A FARMER

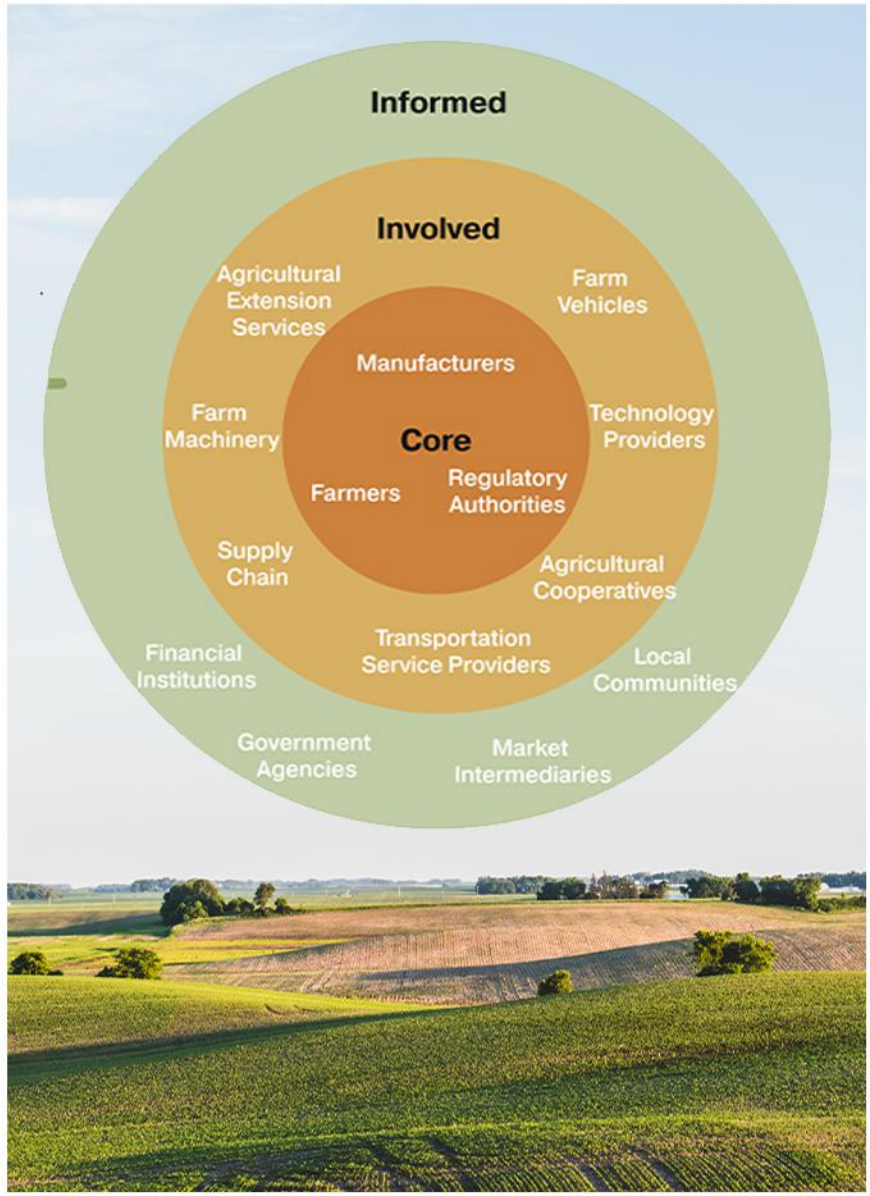
A farmer's agricultural activities encompass cultivation, livestock rearing, and crop management. Their support system includes access to resources like seeds, fertilizers, and machinery, along with technical assistance and market linkage.

Agricultural activities involve planting, irrigation, pest control, and harvesting. The support system aids in optimizing yields, improving quality, and sustaining the farm's productivity.

Collaboration with agricultural extension services, government initiatives, and cooperatives further strengthens this support network, ensuring farmers have the necessary tools, knowledge, and assistance for successful farming

Support system of a Farmer

Stakeholder Map



7 AGRICULTURAL MARKET IN INDIA

The compact machinery segment had been witnessing increased demand due to several factors, such as the need for smaller, more maneuverable equipment suited for small landholdings, the rising adoption of mechanization among smallholder farmers, and government initiatives promoting farm mechanization.

Companies manufacturing compact agricultural machinery have been witnessing growing interest and demand in India due to the advantages these machines offer in terms of affordability, maneuverability, and suitability for small landholdings.

Market share of different sized tractors

Compact Tractors (21-30 HP), Sub compact tractors(<20HP)	Mid range Tractors (31-50 HP),	High power Tractors (>50 HP),
Average cost - 2.5 -4.5 L Marketshare - 14%	Average cost - 4.5 - 9.5 L Marketshare - 79%	Average cost - 9.5 L and above Marketshare - 7%

Tractor Marketshare	79%
Power Tiller Marketshare	16%
Other Machinery Marketshare	5%

7.1 USABILITY ISSUES WITH THE CURRENT PLATFORM

Power Tiller

Dimensions
Length - 2360 Height - 1070
Width - 900

- No roll over protection Structure (ROPS)
- Poor seating positions
- Poor weight distribution
- Limited Customization
- Noise and Vibration
- Inefficient fuel consumption and emissions
- Self - maintenance accessibility

Compact Tractor

Dimensions

Wheel base - 1600 mm
Length - 2766
Width - 1295
Height - 1238 (without ROPS)

- Roll over protection Structure (ROPS) is absent in low cost compact tractors
- Difficult to operate
- Inadequate ergonomic design
- No overhead roof to protect from heat
- Front lifting due to inadequate weight distribution
- Mud throw from rear tyre on foot zone
- Hot air in foot zone
- No seat for multiple people to travel

7.3 TECHNOLOGY COMPARISION INDIA VS WORLD

World

India

Technology in 1990's

The 1990s saw significant advancements in precision agriculture technologies, including the use of GPS for accurate field mapping and guidance of machinery. Tractor automation and variable rate application systems were also introduced.

GPS Technology

Air Drill / Seeders

Honda 300 quad tractor

India started adopting some of these precision technologies, but the overall adoption was slower compared to developed countries. Tractors remained a primary workhorse for many farms.

Low power Tractors

Power Tillers

4WD Tractors

Technology in 2000's

Remote sensing and satellite imagery were integrated into farm management practices and the HP of tractors increased drastically.

Jhon Deere series 9 8 wheel tractor

FENDT 1100 Mt Belt wheel tractors

Yanmar side by side tractor

Modified Arctic cat Atv tractors

GPS & IOT based tractors

Kubota RTV Tractor

Power of tractors still remained low, induction of more and more compact and subcompact tractors with low horsepower.

Compact Tractors

15 HP Power Tillers

Cabin Tractors

7.3 TECHNOLOGY COMPARISION INDIA VS WORLD

Technology in 2010's

Internet of Things (IoT) in agriculture. Smart sensors, drones, and autonomous machinery gained prominence, improving efficiency and reducing labor.

Drone technology and IOT

John deere Giant Harvester

John deere Autonomus Tractor

Compact Autonomus Tractor

Bighorn Homested 200 UTV tractor

New compact platforms like atv and side by sides have come up.
New electric and autonomus tractors have been coming up.

Polaris ATV Tractor

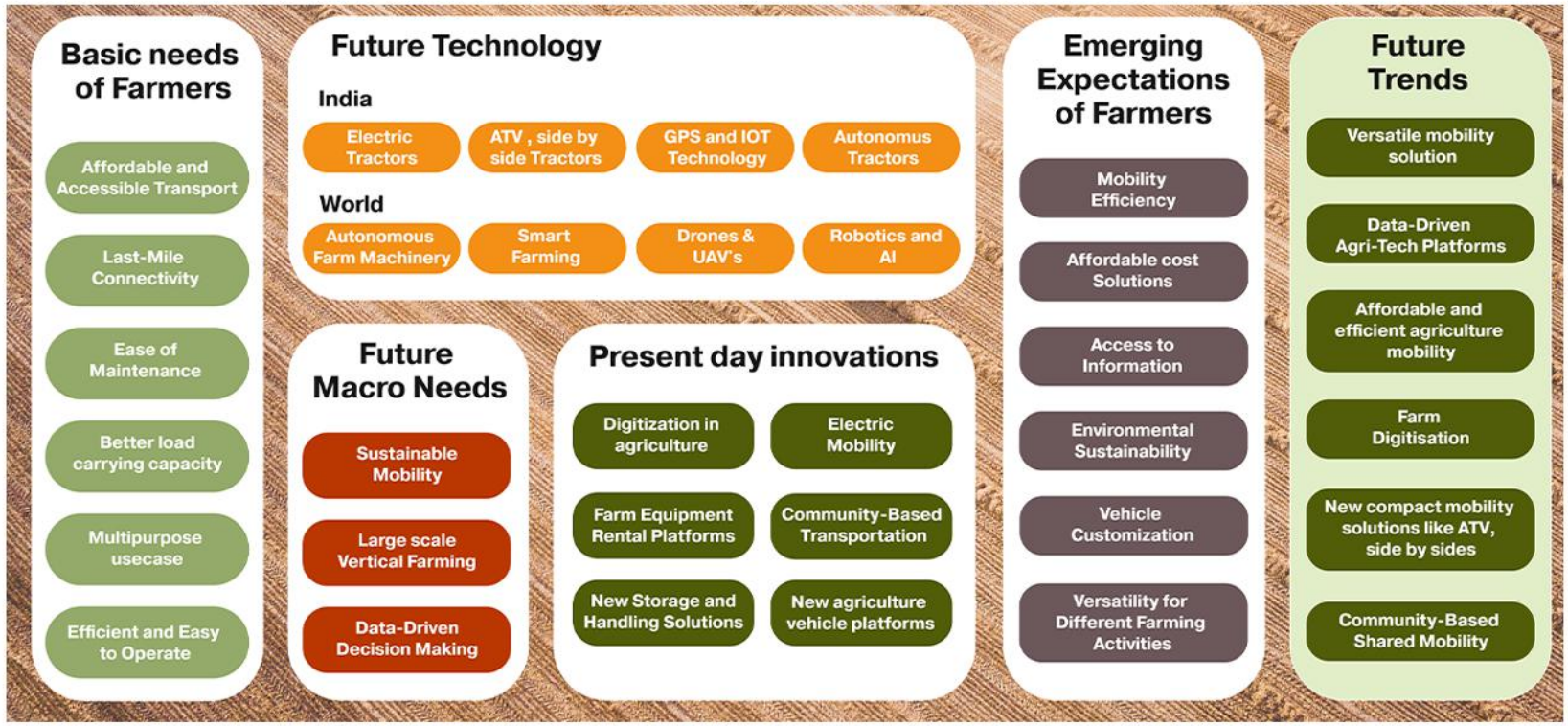
Swaraj Code ATV tractor

Escorts autonomus tractor

Powerland agro Side by side Tractor

Electric Tractor

7.4 FUTURE TRENDS IN MOBILITY SECTOR



8 TARGET GROUP

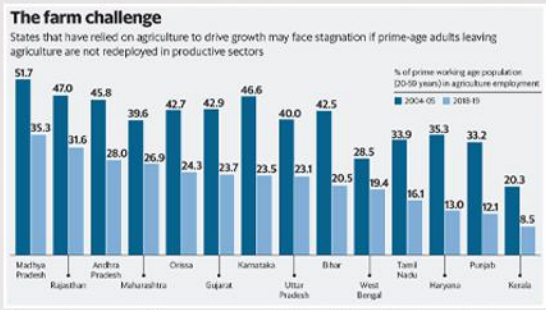
Empower small and young farmers by providing accessible technology, financial support, and skill-building programs. Foster community collaboration through cooperatives, enabling shared resources and market advantage.

Engage the youth with mentorship initiatives, encouraging innovation in sustainable agriculture. Advocate for policies that ensure fair prices, subsidies, and infrastructure development, addressing the unique needs of these farming groups and fostering their growth in the agricultural landscape.

Why young Indian farmers ?

In 2011, the average age of an Indian farmer was **47.3** years

In 2016, the average age of an Indian farmer was **50.1** years



Indian farming sector is a ageing sector and most of the young indian farmers are migrating to cities for job opportunities.

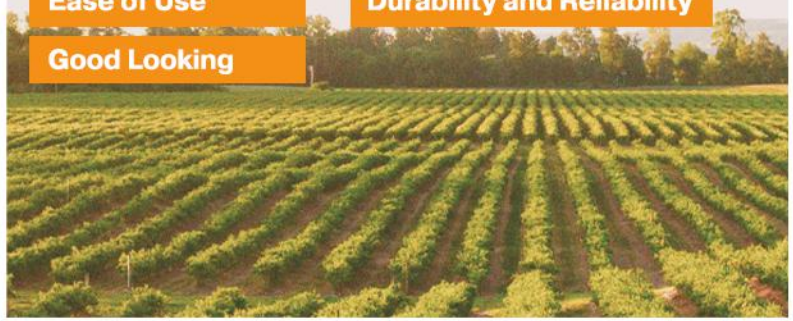
%ge prime working age population (20 - 59) in agriculture employment

Main Characteristics of the potential user

- **Tech-Savvy**
- **Environmental Awareness**
- **Adaptability**
- **Small Land Holdings**

Aspirations of young farmers the mobility solution

- **Affordability**
- **Versatility**
- **Ease of Use**
- **Durability and Reliability**
- **Good Looking**

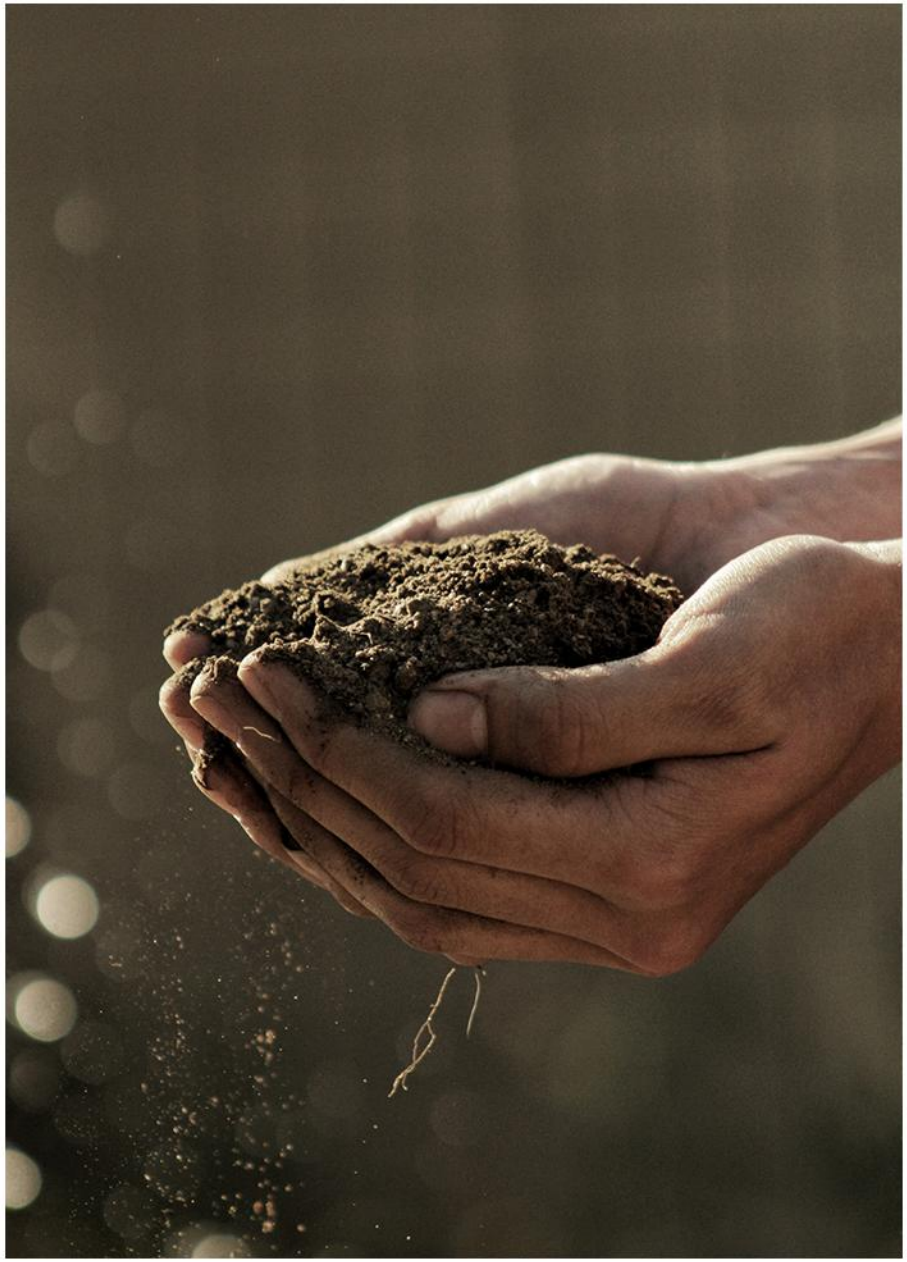


9.2 USER STUDY

Name: Sanjay Jena , 32

Location: Cuttack, Odisha
Farm Area: 1 acres
Crops: Rice and mustard
Farming: Part-time farming and fishery
Current Agriculture Mobility: Power Tiller (Greaves Cotton)
Personal Vehicle: Bajaj Pulsar 150
Annual Income: 2 to 3 Lakhs
Education: Till class 8
Mobile Applications Used: Krishi Odisha, WhatsApp, Facebook, YouTube
Purpose of Agriculture Mobility: 100% agriculture
Preferred HP Range: 12 to 15 HP for power tiller
Budget Limit for Buying New Agriculture Mobility: Up to 1 lakh
Problems Faced with Agricultural Mobility : Vehicle over heating , need to early maintainance , lack of implement integration , Ergonomic discomfort, and suboptimal weight distribution
Feel of Using Power Tiller: Not satisfied and looking for a new agricultural mobility
Most Celebrated Festival: Rath Yatra
Luggage Space: Limited, often uses a small cart for transportation
Accessories Preferred: new attachment with power tiller
Design: its like machine is vehicle , totally non usable apart from agriculture , looks bad but does perform the task of agriculture,
Your Favourite non agricultural vehicle - Mahindra Bolero

9.3 DAILY ROUTINE OF A FARMER



Morning:

5:00 AM - 6:00 AM: Wake up early and tend to personal hygiene.
6:00 AM - 7:00 AM: Have a simple breakfast.
7:00 AM - 9:00 AM: Start fieldwork using a manual plow attached to a bullock or a small tractor. Tasks could include plowing, harrowing, and initial soil preparation.

Late Morning:

9:00 AM - 11:00 AM: Continue field activities such as using a hand-operated seed planter or a seed drill pulled by an ox or small tractor.

Midday:

11:00 AM - 1:00 PM: Take a break for lunch and rest.

Afternoon:

1:00 PM - 3:00 PM: Resume field tasks, utilizing a small tractor with implements for cultivating, ridge-making, or furrow creation.

Late Afternoon:

3:00 PM - 5:00 PM: Attend to various priorities such as using a trailer attached to a tractor for transporting harvested crops, repairing equipment, or taking care of livestock using a livestock cart.

9.3 DAILY ROUTINE OF A FARMER

Evening:

5:00 PM - 7:00 PM: Return home from the fields. Engage in household chores, tend to livestock, and spend time with family.
7:00 PM - 9:00 PM: Dinner time with family.

Night:

9:00 PM - 10:00 PM: Reflect on the day's work and plan for the next day.
10:00 PM: Rest and prepare for bed.

Additional Activities with Vehicles:

Market Day: Use a cart, small truck, or tractor with a trailer to transport harvested crops to nearby towns or markets for sale.

Purchasing Seeds and Supplies: Travel to nearby towns using a tractor or other motorized vehicle to purchase seeds, fertilizers, pesticides, and other essential items.

Financial Transactions: Use a tractor or bicycle to visit local banks or cooperative societies to handle financial matters.

Community Meetings: Travel to community meetings or workshops using a bicycle, motorcycle, or local transport.

9.3 USER STUDY INSIGNTS

Most of the young farmers are educated and interested in full time farming as the farming profession makes them Independent, Proud, Dignified, Empowered and United with their farming community.

Preferred HP range is between 20 to 25HP suitable for all agricultural application and non agricultural applications.

All farmers want their tractor with modern, powerful and rugged.

Young farmers want modern features and aggressive forms in the tractor.

All young farmers need a cabin for their comfort which should be detachable during puddling operation.

Most common problems farmers face with tractors are 1. Less safety without ROPS, 2. Front lifting, 3. Hot air in foot zone, 4.uncomfortable seats, 5.Mud throw from rear tyre on foot zone.

Average budget to buy a agricultural mobility is 3-4 Lakhs.

They generally keep a motorcycle as their primary go to vehicle.

10 VEHICLE PLATFORM & DESIGN DECISIONS

My design decisions emphasize crucial aspects of stability, soil conservation, and space optimization so i have used Yanmar electric UTV tractor platform. Using same-sized wheels for front and rear ensures stability on slopes, reduces soil compaction, and enhances traction, crucial for farming operations.

Crucial aspects

Wheel Uniformity for Stability: Employing same-sized wheels in the Yanmar electric UTV tractor ensures stability on slopes, crucial for safe operations in uneven terrains.

Soil Compaction and Traction: Equal-sized wheels reduce soil compaction and improve traction, preserving soil health and ensuring efficient movement across diverse landscapes.

Low Center of Gravity: This design choice enhances stability while optimizing space utilization, especially in the rear section, allowing for more flexibility in accommodating attachments or cargo.

Space Optimization: The uniform wheel size creates a space-efficient design, contributing to maximizing the rear area, essential for varying agricultural tasks, thus enhancing the platform's versatility for small and marginal farmers.

9.2 USER STUDY

Manoj Yadav , 30

Place - Mujjafarpur, Gaya , Bihar
Farm area - 2.8 acres (3 bighas)
Crops - Paddy and water melon
Farming - Fulltime Farming with livestock
Current Agriculture mobility - Mahindra MM 275 di
Personal vehicles - Hero Splendor Plus
Annual income - 4 to 6 Lakhs
Education - Matriculation
Mobile Applications used - Krishi Jagran , Kisan Suvidha , Facebook , WhatsApp , Ludo King , YouTube
Purpose of Agriculture mobility - 70% agriculture, 30% haulage
Preferred HP range - 35 to 40HP suitable for all application
Budget limit for buying new Agriculture mobility - up to 3 lakhs
Problems faced with his tractor - Front lifting , need front bumper with weight, Fender front guard is less , stones thrown on the legs from rear tyres , Difficult to maneuver with the attached trailer.
Feel of using tractor - Proud, (want to drive modern and aggressive tractor)
Most celebrated festival - Diwali , Chaath puja
Luggage space - fenders and on the implements
Accessories preferred- Hard canopy with ROPS, Front weight.
Design - Doesn't look good when using it in cities around new modern vehicles but is functional to use for my purpose.
Your Favourite non agricultural vehicle - Hyundai Creta new model
Your Favourite agricultural vehicle - Compact tractor (Sonalika WT 60)

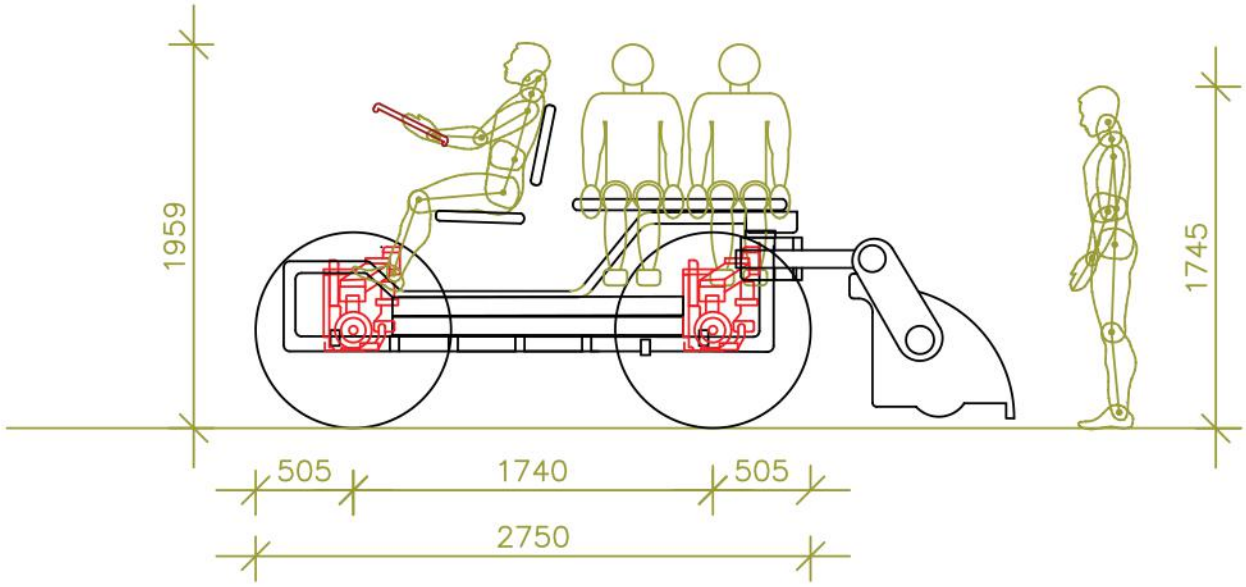
9 KEY INSIGHT

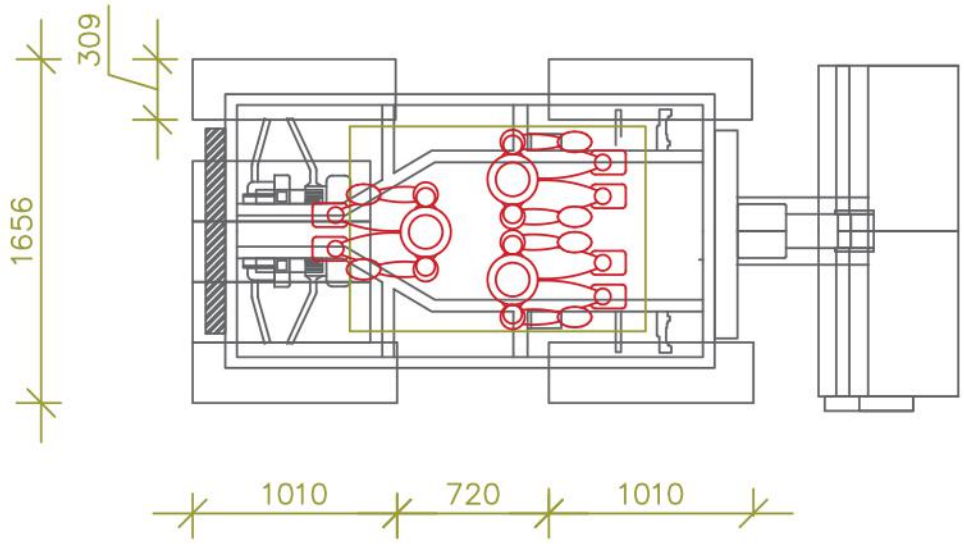
Small and marginal farmers face economic hurdles due to limited resources and market access. Modularity in vehicles offers cost-effective solutions for these farmers, providing adaptable machinery that suits their varying needs, enhancing affordability and efficiency in farming operations.

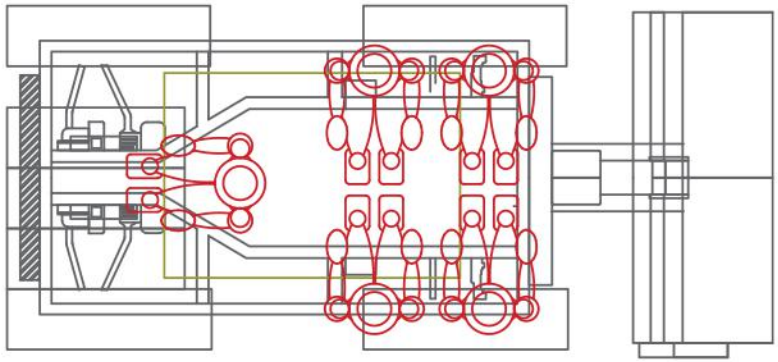
Versatile equipment caters to diverse tasks on small plots, optimizing resource utilization. Subsistence farming remains prevalent among these farmers due to constrained access to markets and modern practices, impacting income stability. Fragmented landholdings hinder scalability and mechanization, limiting productivity.

Addressing economic constraints through cooperative models, technology dissemination, and policy support tailored to their scale can uplift these farmers, fostering sustainable practices and augmenting their economic viability in the agricultural landscape.

10.1 VEHICLE PACKAGING







11 DESIGN BRIEF

Design Brief

To design a compact mobility solution that is easy to operate, and specifically optimized for small and marginal farms in India. This agro-mobility should help these farmers increase their agricultural productivity and also help the farmers to perform all their non-farm activities effortlessly, and try to make this vehicle their primary go to vehicle.

Design Objectives

Compact Size : The design of this vehicle should be such that it can efficiently operate on small and irregularly shaped plots of land with varying terrain commonly found in India.

Versatility : The vehicle must perform various agricultural and non agricultural tasks and must have a small retractable haulage trailer with it.

Ergonomics : The seating position should be comfortable for the operator and all the controls should be such that it can be assessed by seating upright.

Functionality : The vehicle can be a electric type with the power of around 20-30 HP

Modular : The design should be such that its easy and fast to change the implement attached to it.

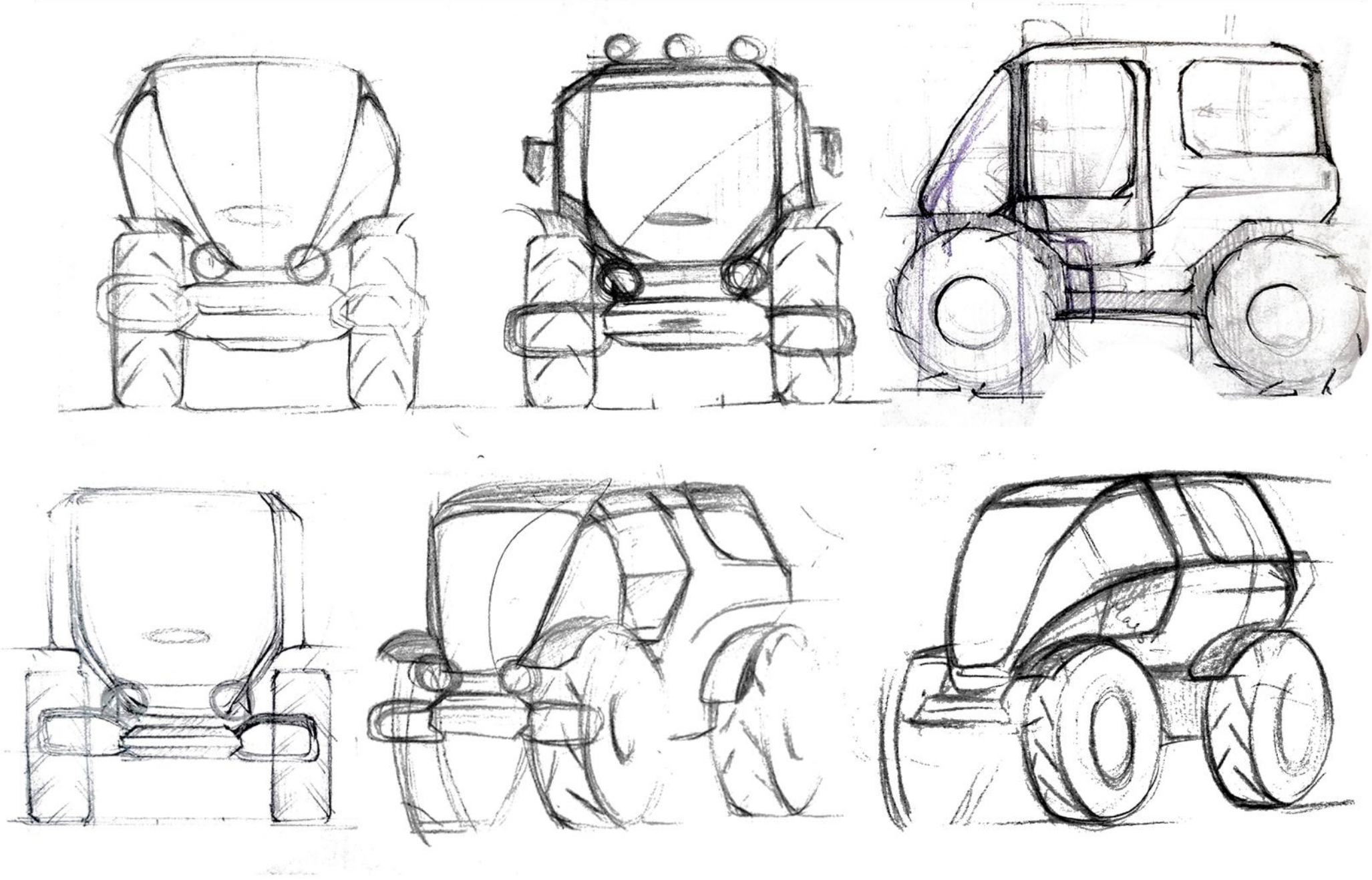
Safety : The vehicle must integrate ROPS with a overhead roof or can go with with the cabin design.

Dimensions

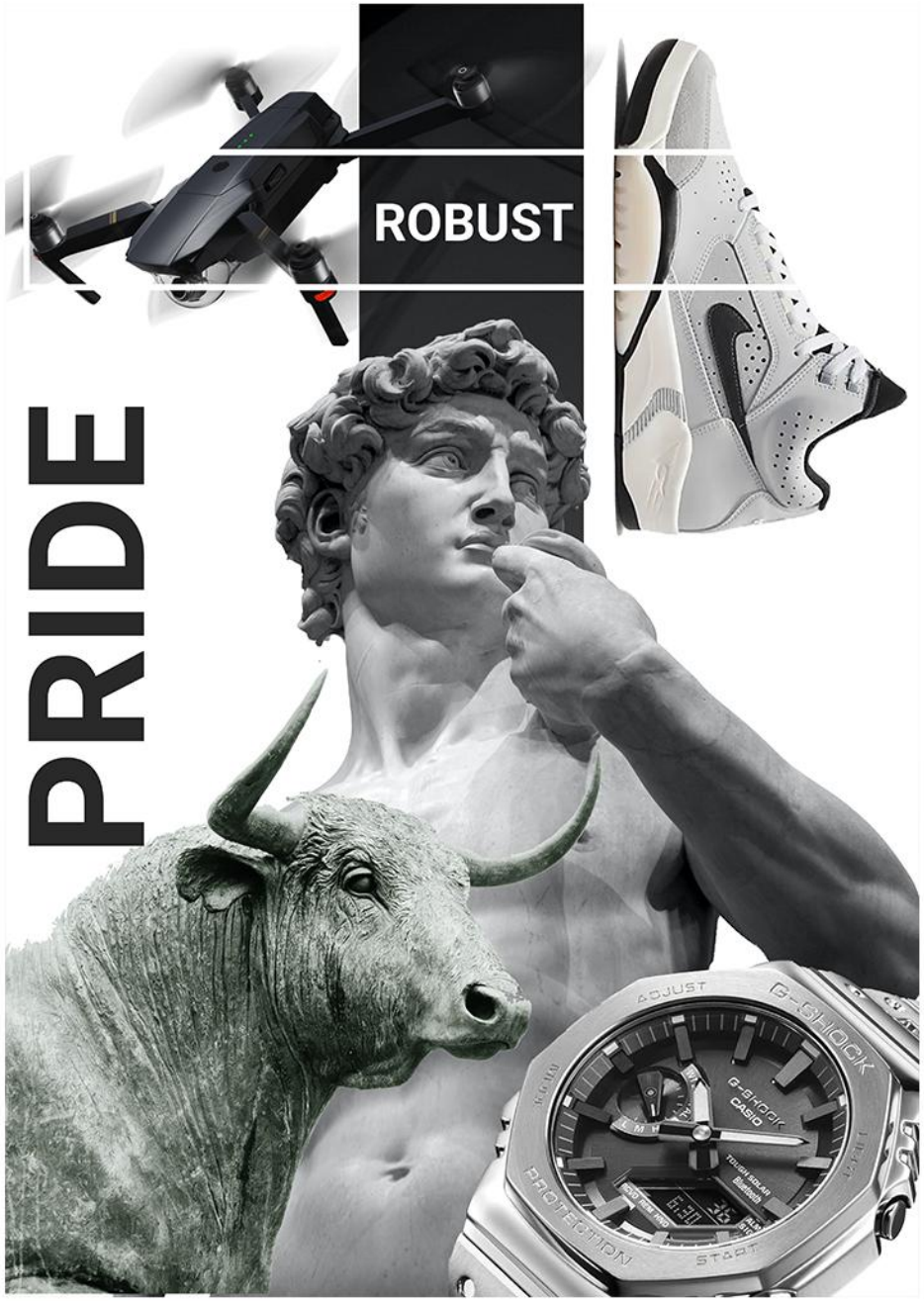
Wheel base approx. - 1740mm
Length approx. 2740mm
Width approx. 1656mm
Ground Clearance - 365 mm

12 MOOD BOARD

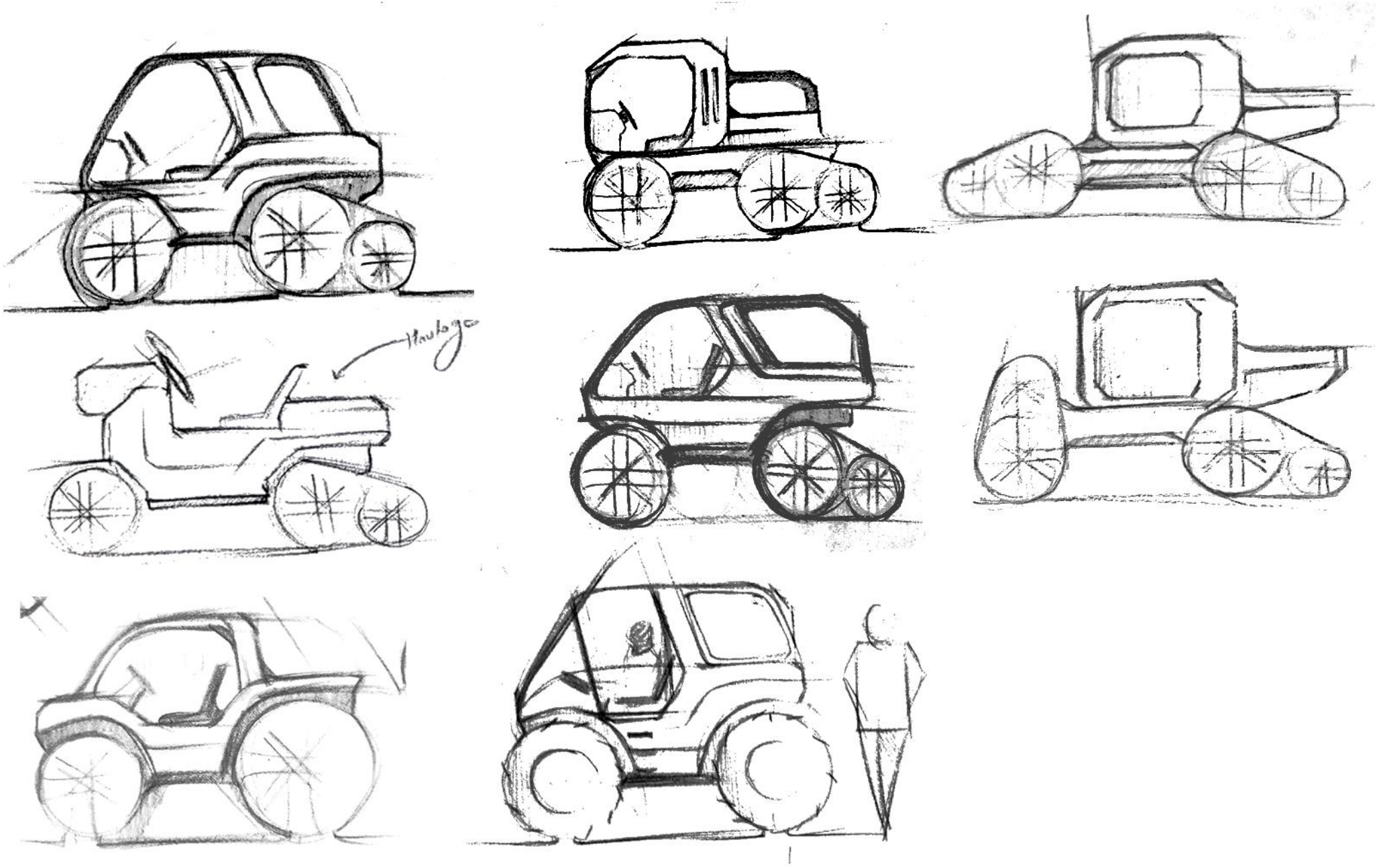
14 SKETCHES



13 THEME BOARD



14 SKETCHES



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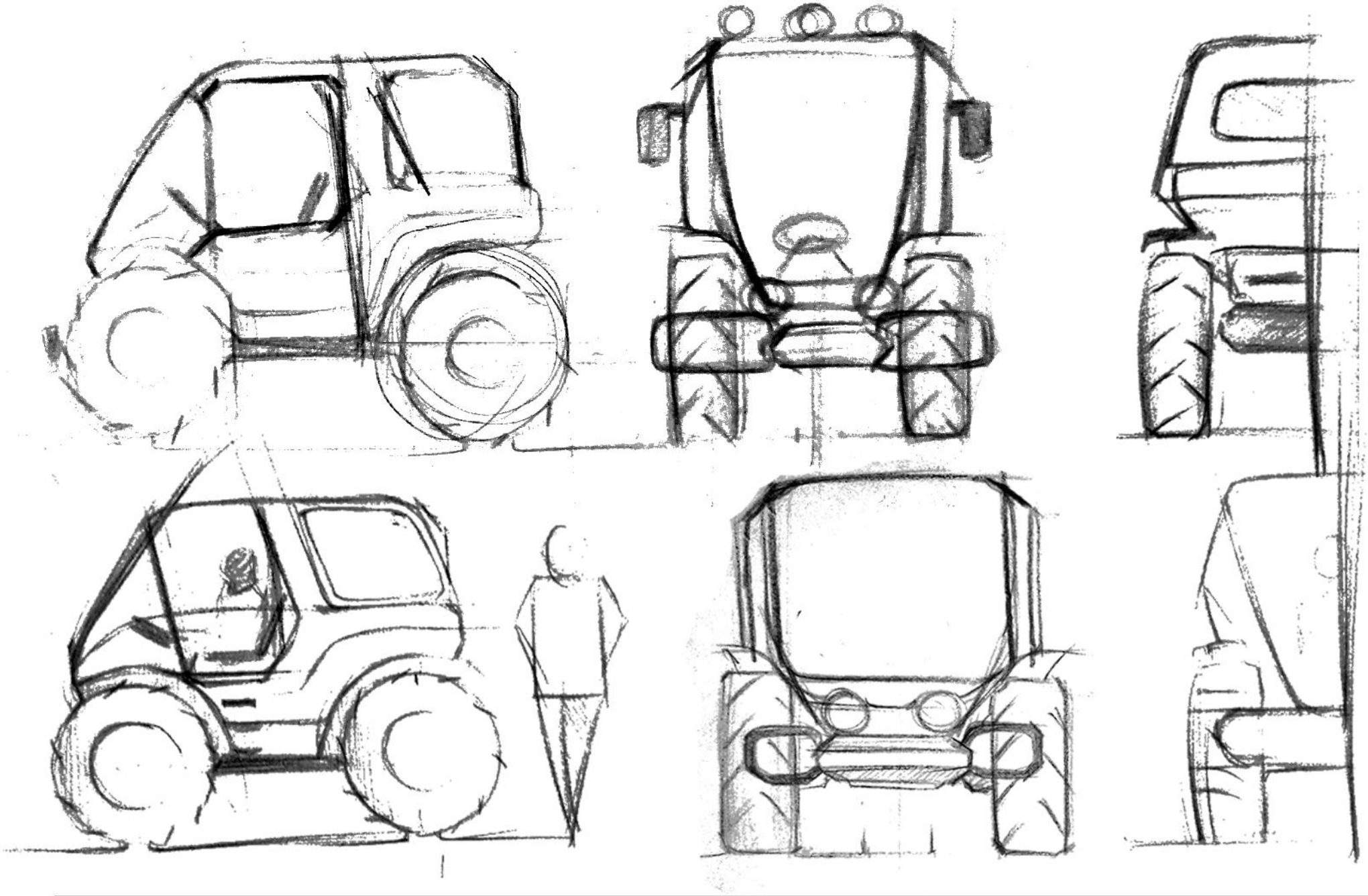

7.2 NEXT GEN. ATV AND UTV PLATFORMS

ATV Tractors

Manufacturers - Powerland Agro
Polaris
Swaraj Tractors

Cost - 9,00,000

Pros

- Tight maneuverability- easy to make quick turns while maneuvering withing farms
- Used for small cargo loads, or when you need to hop on and off a lot
- Physically demanding to balance and manage while riding
- Good for small-scale jobs

Cons

- No weather protection
- Dangerous if driven poorly
- Can tip over easily as no rollover protection provided.
- Low payload
- Minimal cargo space

Side by Side Tractors

Manufacturers - Powerland Agro
Kubota Tractors

Cost - 8,50,000

Pros

- Can be used for recreation outside of farming – even farmers like to play on their day off.
- Can seat up to six.
- Protected by rollover bars from toppling.
- Can be attached with multiple implements.

Cons

- Transmissions are not as good for heavy work that requires low-gear power.
- Lower resale value in comparison to tractors.
- Need special skills to learn to drive.

15 RENDERINGS

15 RENDERINGS

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