

# Modelling and Analysis of Multifunctional Agricultural Vehicle

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**Abstract**-India has always been known for its agricultural products and quality, plus it is one of the key drivers of Indian economy (almost 25 % in GDP in 2003-2004). In India almost 66% families do farm practices for the living. In recent years if we compare production rate or efficiencies of Indian farms to other nations then we realize India certainly lagging behind. If we go deeper down in search of reasons excluding whether we come up with this. 1. Less mechanization in the farms 2. Decreasing (small) size of farms. 3. Money problems. From engineering perspective we can't change the size or provide money but we can ensure more mechanization in the farm. In India farm sizes are small and unorganized so we can't use machines which are used in other nation. There is space for engineers to create machine which can deliver in this circumstances, with low price and more operations. In this article we study one such machine is Multifunctional Agricultural Vehicle. We have covered most of drawbacks of existing machines and providing solution in better and efficient way. Our USP for this project is attachment-detachment model for accessories and accessories like seed bower, grass cutter, fertilizer spreader.

**Index Terms**-Seed bower, grass erupter, fertilizer spreader, attach-detachment model.

## 1. INTRODUCTION

### 1.1 Need of the project

In the most part of India small farms remains at the center of agricultural and rural development. Most of the time, they are out of machinery which are specially designed for those farms. This leads to use more human resource at the farm resulting in lesser productivity and costlier scenario.

In India and neighbor countries the most urgent need is to feed the growing population. This requires food production in sustainable way, which can be targeted by land and labor efficiency in farm sector with help of farm mechanization.

Years	Average size of farms
1970-71	2.28 hectares
1980-81	1.5 hectares
1995-96	0.5 hectares

(Data taken from Pooja Mondal's article from [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com))

So from this research 10 years are passed and there is more probability of farms divided in severe way. We are creating a **MULTIFUNCTIONAL AGRICULTURAL VEHICLE** which can perform many operations such as seed bowing, fertilizer spraying and grass eruption from roots.

To get in depth need of current problem we have gone through a case study where we selected some region comprising of three districts. In this case study we have prepared questionnaire. We then formed graphs to know exact response from farmers. Following questions were covered during the survey.

1. What is problem in current Indian agricultural practices?
2. What steps you will take in order increase productivity?
3. What will be your next agricultural device? Why?
4. What problems are in today's power tiller?

From this questions we got a response in a unique way where need of multifunctional agricultural vehicle emerged as clear winner.

### 1.2 Literature survey

In order to carry out this work we have undergone extensive literature survey and contribution of by various authors is as follows,

(1) D.A. Mada, Sunday Mahai, [2013], In this research paper author has mentioned importance of mechanization in agricultural by giving examples. The conclusion from the paper was need of multifunctional single axel vehicle for pre and post harvesting . We

have taken this as base for our research and further production of our multifunctional agricultural vehicle.

(2) *V.K. Tewari, A. Ashok Kumar, Satya Prakash Kumar, Brajesh Nare*[2012] In this research papers author have done case study on farm mechanization in west Bengal as being part of India it give clear status about availability and progress in India. This ensured us to take right steps compared to current steps.

(3) *F.A. Adamu, B. G. Jahun and B. Babangida* [2014] In this paper authors draws our attention towards the performance factor of a power tiller. Among those demand for light weight power tiller was sought out most. Fuel efficiency and field capacity such parameters are also discussed. We taken those points in consideration while designing a sustainable multifunctional agricultural vehicle.

(4) *David D. Wilson and John H. Lumkes*[2015] In this papers authors have used certain multipurpose machine with help of this paper we were able to derive our attention to broader way also how attachments can be used for making a model more useful in efficient and sustainable way.

(5) *Mohammad Muneer Uz Zaman* Author have emphasized on designing parameters of the grass cutter and he done research on reduction of cost of the material to be used. We taken this information for our design our one of the attachment which is related to grass cutter.

(6) *M. A. Quayami & Amin Muhamaad Ali* [2012] Author have done extensive study by taking case study of Bangladesh. They have come with growth scope and other terms. We used their conclusion as one of the basic points to start our design for the multifunctional agricultural vehicle.

(7) *Adamade, C.A. and Jackson B.A.* [2014] fellow researcher worked on Mechanization is recognized as the necessary major means needed to accelerate agricultural production and create a period of surplus in Nigeria. Indeed food sufficiency can only be attained in Nigeria by encouraging and promoting local designs and manufacture of implements and equipment at low cost. We have taken the useful data from this research paper.

(8) *Parminder Kamboj, Rohinish Khurana, Anoop Dixit* [2012] Disc harrow, tractor, laser leveller, rotavator, BT cotton seed drill are available in more than 85% of societies. Tractors which are available in societies are ranging from 50-60 hp. Most of the hiring charges vary from 25-40 Rs. h-1 except that of laser leveller whose hiring charge is 500 Rs. h-1 and tractor hiring charge is 150-250 Rs. h-1 and rotavator hiring charge is 70-80 Rs. h-1. In more than 70% of the societies, annual use of the rotavator was 550 h. and annual usage of tractor.

(9) *G. Moitzi, T. Szalay, M. Schüller, H. Wagentristsl, K. Refenner, H. Weingartmann, P. Liebhard, J. Boxberger, A. Gronauer* [2013]

The tractor-implement combination influenced via working speed and working width, the work time and fuel consumption. A tractor-implement combination operated in a high engine load had a great potential in reducing fuel consumption A well loaded "small tractor" with small implements are more fuel efficient than a worse loaded "big tractor". This data have been used accordingly.

(10) *P. Šařec, O. Šařec* [2015] The lowest values of soil penetration resistance below the cultivated profile were determined with the cultivators equipped with chisel shaped shares, i.e. in the case of Farmet and Köckerling. Cultivators Väderstad TopDown 400 and Farmet Turbulent 450 showed good capacity in embedding plant residues. This results have taken for our research basis.

### **1.3 Problem definition**

Small-size farms are a huge issue in mechanisation because of it's against of the "economics of scale". These problems are classified into technological constraints, financial and economic problems, and environmental issues. There are machines available in the market nowadays which are generally used for large-scale farming and thus are not suitable for small-scale farming conditions of the user. Big machineries involve higher cost and also high maintenance cost, which are not affordable for the users. Poor rural infrastructures such as roads, bridges, canals, and power network are one of the main obstacles in this sector. Also, in developing countries, farm labor is also a big issue. The income of farmers remains also very low and the wages for farm labors are increasing day by day.

As Indian farmers are not much educated and are from rural area, they don't possess much machine operating skills; hence usage of complicated machines is not useful.

### 1.4 Scope of the project:

Multifunctional agricultural vehicle mainly focuses on the basic problems faced by fellow farmers. i.e. Seed bowing, fertilizers spraying and grass eruption. We are looking this project as revolution in small farms in India, which is most uncovered area in this sector is cost and more efficient way.

### 1.5 Expected outcome:

- It will cater the needs the problem of small scale farmers to a higher level.
- It will provide these mentioned features in less cost and more efficient way.
- The whole process of farming will be revolutionized and will be hassle free. Farmers don't need to rely on other human resources for doing this stuff.
- As an outcome the proposed machine will be able to bowing seeds, supply fertilizer near the root of plant, erupting grass.
- This machine is specially design for farmers of India who have small farms.
- The benefit of this machine is to perform different operations in single machine.
- Hence it is attach-detachable model we can have more operating functions in future.

## 2. PLAN OF RESEARCH WORK

As the name of this research multifunctional agricultural vehicle we are going to design and manufacture certain components and respectively a holding device which then can be used as complete assembly.

We are going to focus on both design and fabrication of this project. Firstly we will design our proposed sketch. Once design over we will analyze our design by using certain methods. After getting a good sense of correction we will then move towards fabrication of parts. Some of the parts are gears, seed bower moulding and other welding etc. this will be followed by testing the fabricated assembly.

## 3. DESIGN AND CALCULATION

The design were made based on trial and error approach. The calculations for the same were made according to our needs. The important calculations are mentioned below.

### 3.1 calculation of driving force

$$P = \frac{2\pi NT}{60} \quad T = F_d \times R$$

Where, P = Power = 8HP

N = Speed in rpm = 3000rpm

R = Radius of wheel = 0.15m

$$8 \times 742 = \frac{2 \times 3.14 \times 3000 \times F_d \times 0.15}{60}$$

$$F_d = 126N$$

### 3.2 Calculation of force for crashing test

Assuming vehicle in kinetic motion with constant speed of 10 Kmph,

$$F_c = \frac{m \times v^2}{2}$$

Where,

m=mass of vehicle = 35Kg

v= velocity at which vehicle is travelling=10Km/Hr

$$F_c = \frac{35 \times (10 \times \frac{5}{18})^2}{2} = 135N$$

## 4. SELECTION OF EQUIPEMENT AND MATERIAL

### 4.1. Engine selection

Basic requirements

- Power : 8 to 10 HP
- Drive speed : Up to 3000 rpm

By considering above two points we settled on M80 petrol variant of Bajaj engine.

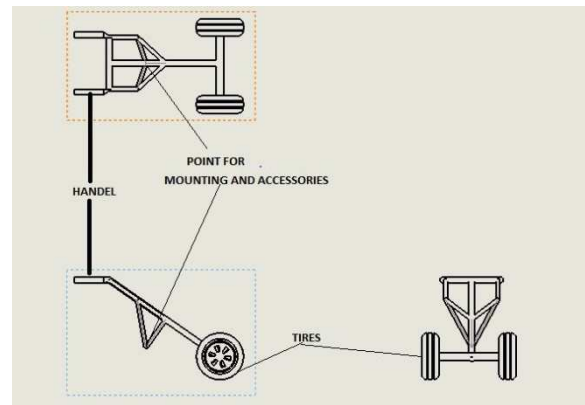


Fig. 1 Schematic representation of multifunctional agricultural vehicle

### 4.2. Material selection

Using catalogue we have chosen this material AISI 4130 for body construction.. It perfectly comply with our requirements.

## 5. ANALYSIS OF MAIN BODY

We carried out deformation test at two different points which are mentioned below.

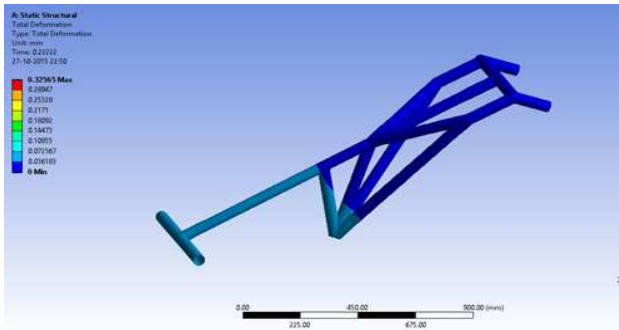


Fig2. Deformation at pivot point.

### 5.1 Deformation at pivot point

Maximum deformation= 0.32mm

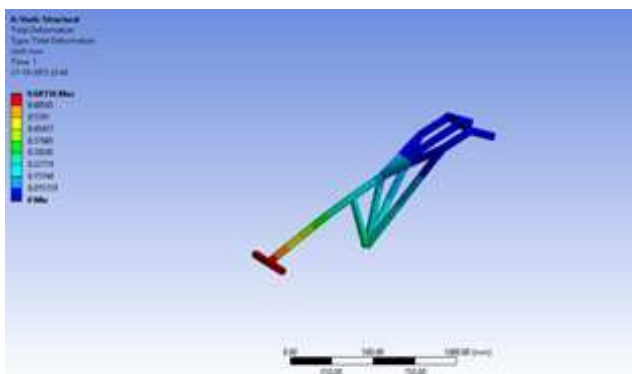


Fig3. Deformation after crash test.

### 5.2 Deformation after crash test:

Maximum Deformation = 0.68mm

## 6. CONCLUSION

As we complete this research it will fulfill the needs of small scale farm. By employing this in real world it will help in faster rate of bowing, fertilizer spreading and grass eruping.

## 7. FUTURE SCOPE

As this research sets a base of multifunctional agricultural vehicle lots of further attachments can be added on this some of the ideas are mentioned below.

- Addition of water pump.
- Tilling
- Weeding

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