



## Assessment of Factors Influencing the Performance of Agricultural Tractors: In the Case of Srikakulam City, A.P., India

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**Abstract:** *Having attained the firm footing into the technological revolutions in the agriculture sector, it is evident that the usage of tractors for several purposes by majority group is highly appreciated for the productivity matters the difference. It was found imperative that the performance of tractors in line with efficiency, longevity, reparability, maintenance, comfort etc is considered to be the most influencing element which are depended on three major variables proposed are farmers' Control factors, manufacturers' control and drivers' demographics. With the stated objective, a survey research backed up with quantitative and descriptive research design as well as cross sectional technique for data collection was adopted. The determined sample of 182 managerial, technical and administrative staff of all tractor showrooms in Srikakulam form the population frame of 334 was targeted. The ANOVA through SPSS 20 to test the formulated hypotheses was used and thereby the interpretation along with findings on the influence of the factors on the performance of tractors have been drawn, the recommendations in line with statistical inferences have also been disseminated to the related communities.*

**Keywords:** *agricultural tractors, farmers' Control factors, manufacturers' control and drivers' demographics, performance of tractors*

### 1. INTRODUCTION

Tractors are used in agriculture from field preparation to transportation of final Agri product to market and the services such as Plowing, Harrowing, Sowing, Inter-cultivation, Spraying/ Pesticide application Harvesting (to collect harvested products like grains with combine harvester) and Transportation. Tractor is a self-propelled power unit having wheels or tracks for operating agricultural implements and machines including trailers. Tractor engine is used as a prime mover for active tools and stationary farm machinery through power take-off shaft (PTO) or belt pulley.

On the basis of purpose, wheeled tractor is classified firstly into General purpose tractor which

is used for major farm operations; such as ploughing, harrowing, sowing, harvesting and transporting work. Such tractors have low ground clearance, increased engine power, good adhesion and wide tyres. Secondly the Row crop tractor used for crop cultivation is provided with replaceable driving wheels of different tread widths. It has high ground clearance to save damage of crops. Wide wheel track can be adjusted to suit inter row distance. Finally, the special purpose tractor is used for definite jobs like cotton fields, marshy land, hillsides, garden etc. Special designs are there for special purpose tractor.

Eshtad Iran company has the first ranking indicates that some criteria such as liquidity, activity and financial leverage affect performance of the Agricultural Machinery companies in Iran

(Mohammad Reza Sheikhi & Vahide Hajihassan, 2015). It is understood that the total Machinery that are used for agriculture influences and tractors is also a part of that.

There is no precise method for the calculation of the repair costs. The variation of factors influencing the costs, such as exploitation conditions, machines quality or prices relations; causes that the coefficients used in the calculations are not universal and differ between different countries. (Edmund Lorencowicz & Jacek Uziak, 2015)

The gradual transition towards higher working speeds in agriculture and greater use of specialized transport-oriented vehicles poses technical problems. These are related to the general deterioration in dynamic behaviour associated with increased speed and can be categorized into the following areas: (a) ride vibration; (b) steering and handling and (c) control of implements. Results are shown to highlight some interesting features of the suspension, steering and linkage design of off-road vehicles. Further use and refinement of these models will depend on the commercial pressures to replace conventional agricultural equipment with higher speed alternatives. (D.A.Crolla & D.N.L.Horton, 1984)

The role of Agricultural Sector in Srikakulam District Economy is very significant. However, out of 47.36% of Main Workers in the District Population comes under this category, 32.14 % Cultivators and Agricultural Labors are still dependent on Agriculture. Agriculture in Srikakulam district is mostly Rainfall dependent; Monsoon and Seasonal conditions play a major role in the Agriculture Production. During the year 2009-10, the South-West Monsoon Period, the district received deficit rainfall with negative deviation of -15.3% against Normal. However,

North-East Monsoon Rainfall was Scanty Deviation by -37.2%. As compared to Normal, the overall Rainfall for the year was 978.1 mm as against the District Normal of 1162.5 mm there by showing deficit of -15.8%. The Net area sown in the District during 2009-10 is 2,84,644 hectares as against 3,21,892 hectares in 2008-09 a decrease of 11.57%.

As mentioned statistics has elaborated the importance of agriculture in Srikakulam district farmers from every corner have been found to be practiced with modern agricultural methods. It can clearly be said that the mostly used cattle are diminishing for the use of farming because of the socialization of agricultural vehicles with respect to each and every activity which is made easier. On the other hand giant companies such as Mahindra, John Deere, Sonalika, Kubota, Tafe etc., are trending with compatible features and parts, feasible installments and productivity featuring which have been motivated by the traditional community of farmers thereby turned to the usage of tractors for agricultural development. Government also supports as a part of contributing the required infrastructure to rural India from which most of the farmers commonly opt tractor as a mandatory and multi task vehicle.

## 2. OBJECTIVES

1. To comprehend the elements machine efficiency, reparability, longevity, and usage effectiveness in line with agricultural tractors' performance.
2. To assess influence of the Farmers' Control factors such as Skill, working conditions and Maintenance Standards on the performance of Agricultural Vehicles Tractors.

3. To appraise influence of the Manufacturers' Control factors such as Features, Parts and Repair Cost on the performance of Agricultural Vehicles Tractors.
4. To evaluate influence of the Drivers' Demographic factors such as Age, Income, Speed, Hazards Clearance and Usage on the performance of Agricultural Vehicles Tractors

### 3. HYPOTHESIS

1. Farmers' Control factors such as Skill, working conditions and Maintenance Standards have significant influence on the performance of Agricultural Tractors.
2. Manufacturers' Control factors such as Features, Parts and Repair Cost have significant influence on the performance of Agricultural Tractors.
3. Drivers' Demographic factors such as Age, Income, Speed, Hazards Clearance and Usage have significant influence on the performance of Agricultural Tractors

### 4. LITERATURE REVIEW

Just like other automotive, the engine serves as the core of the tractor parts. The engines are usually able to provide between 18 to 575 power which allows them to complete otherwise impossible tasks. Earlier in their invention, tractors often used steam engines which often failed and were very unreliable and dangerous. The engines used in tractors since the 20th century has been internal combustion engines, similar to those used in cars. However these can run on kerosene, ethanol and

gasoline. Modern tractor today uses biodiesel or diesel engine to function

In the last century, tractors have seen great improvements in terms of transmissions, allowing for more efficient operations of the tractor. Old versions of tractors had simple yet hardy designs that were rugged and durable. However, they featured manual transmission. Today, several of such tractors are still used worldwide but increasingly being replaced by tractors that offer auto transmissions. The manual transmissions are unsynchronized with the tractor having to slow down or stop before gears can be changed which is very inconvenient and burns more fuel. On the other hand, modern tractors tend to use synchronized or continuously variable transmissions (CVT) which is much more fuel efficient as it allows the CVT to shift through an unlimited number of effective gear ratios.

Tractors usually feature designs that have two small front wheels and large back wheels. The large back wheels provide the tractor the immense amount of power required to carry out the various tasks, and the smaller front wheel simply guide the tractor through. However, there may be some designs where all four wheels of the tractor supply it with power. Overtime, more and more developments have been made to the design of the tractor, with some tractors today featuring tracks similar to those used on military tanks. These tracks are used to suit the environment that the tractor would be used in as they provide superior traction in areas with wet or heavy soils. There are also the large wheels tractors which are used in some places.

Tractor engines are able to produce great amounts of power and for this power to be used by the tractor; it first has to be harnessed. Hitches are tractor parts used to harness the great amounts of

power produced by the engines so that it can be used by the tractor to do various tasks. Taking the form of draw bars, fixed mounts or three-point hitches and quick hitches, the hitches allow the energy produced by the engine to be transferred to implements that may be pulled behind the tractor or beside it. Attachments such as plows, tillers, mowers and seeders are often used as attachments with tractors while hitches allow these implements to be used together with the tractor. (<http://www.hillagric.ac.in/edu/coa/agengg/lecture/243/Lecture%209%20Farm%20tractor.pdf> and (<https://www.google.co.in/search>)

Dave Boyt (2016) explained in his article “15 Reasons You Need a Tractor” about how many utilities are furnished by an agricultural tractor in line with the working conditions of particular geographical area. Amongst the 15 reasons, the applicable reasons in an agricultural area pertaining to Indian ethnicity are land clearing, cultivating, emergency transport and landscaping.

For Land clearing, tractor provides the muscle for heavy lifting, pulling and hauling. A good winch lets you pull the load to you for easier removal. The selection of a 12-volt electric winch, gas-powered winch or power-takeoff (PTO) winch depends on your budget and how much pulling you need to do. Brush pullers are special tongs that attach to bushes or saplings so you can pull them out by the roots with the tractor or winch. The front-end loader, of course, is useful for pushing, lifting and carrying brush and logs. For heavy loads, a rear carrier might be just what you need, because it has more lift capacity and puts the weight on the tractor’s more robust rear axle (Dave Boyt, 2016).

Plows, disks, seed drills and cultivators are available for every size tractor, so a plot of land can be worked as intensively as possible. The manure

spreader is an often overlooked tool that can be very useful. The auger makes planting fruit and nut trees, berries and ornamentals an easy job.

Emergency Transport such as floods, tornado or other natural disaster may make roads impassable. Those big tractor wheels can plow through mud and climb over debris that would block a 4WD pickup, making it the ultimate “get there” vehicle. (Dave Boyt, 2016).

Landscaping is mostly used while building a fish pond, retaining wall or planting shrubs to beautify your home, you need a tractor. The front end loader of rear is used to lift to move rocks and fill dirt and the blade to sculpt the ground, level off hills, direct drainage and build small ponds. If you have a lot of trees and shrubs to plant, consider a post-hole auger.

#### ➤ Selection of Tractor

Selection of tractor depends upon following factors (<http://www.hillagric.ac.in>):

*Land holding:* Under a single cropping pattern, it is normally recommended to consider 1 hp for every 1 hectares of land, In other words, one tractor of 20-25 hp is suitable for 20 hectares farm.

*Cropping pattern:* Generally less than 1.0 hectare/hp have been recommended where adequate irrigation facilities are available and more than one crop is taken. So a 30-35 hp tractor is suitable for 25 hectares farm.

*Soil condition:* A tractor with less wheel base, higher ground clearance and low overall weight may work successfully in lighter soil but it will not be able to give sufficient depth in black cotton soil.

*Climatic condition:* For very hot zone and desert area, air cooled engines are preferred over water-

cooled engines. Similarly for higher altitude, air cooled engines are preferred because water is liable to be frozen at higher altitude.

*Repairing facilities:* It should be ensured that the tractor to be purchased has a dealer at nearby place with all the technical skills for repair and maintenance of machine.

*Running cost:* Tractors with less specific fuel consumption should be preferred over others so that running cost may be less.

*Initial cost and resale value:* While keeping the resale value in mind, the initial cost should not be too high; otherwise higher amount of interest will have to be paid.

*Test report:* Test report of tractors released from farm machinery testing stations should be consulted for guidance.

#### ➤ **Empirical evidences**

Tractors are used in agriculture from field preparation to transportation of final Agri product to market and the services such as Plowing, Harrowing, Sowing, Inter-cultivation, Spraying/Pesticide application Harvesting (to collect harvested products like grains with combine harvester) and Transportation. The application and utility of the tractor by the farmers in several ways is highly appreciated and being considered as the activities stated above are under the control of the farmer.

The skill of the operator, working conditions, and maintenance standards are recognized as important determinants of machinery repair cost, many aspects of which lie within the farmer's control. These variables need to be included in future studies of machinery costs (J.Morris, 1988); hence

the researcher of this study has taken the items of skill, working conditions and maintenance Standards under one of the variable called farmers control.

The performance curves of the tractor are then plotted against their official reference curves. A rule-based system (Scorpio) compares the present performance to the reference, analyses the differences and suggests which parts may be responsible for the lack of performance. (I. Alvarez, S. Huet, 2008).

Manufacturers' focus on the utility of the tractor for agriculture purpose for long run directly recounts to the performance of the same and it is absolutely the features, repairs and maintenance which have a significant influence on the performance. (D.A.Crolla & D.N.L.Horton, 1984).

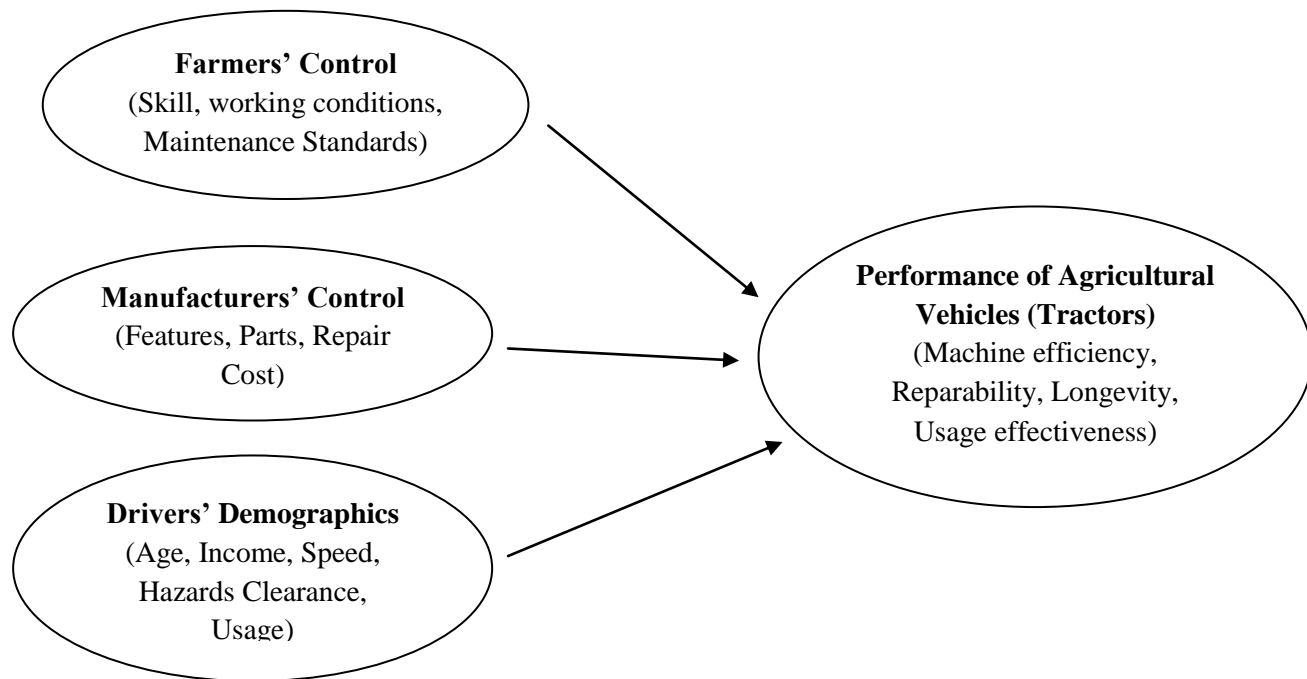
The studies discussed above catapult the desk to capture the variables such as Features, Parts and Repair Cost for the contextual recommendations in line with the study area are highly influencing.

The results revealed from the research study of Ehsan Houshyar and Moslem Houshyar (2018) such as the drivers aged 30–45 years had higher rates of injuries. Most of injuries were moderate (41%) occurring due mainly to oily surfaces on the tractor or implements, carelessness or fatigue during the work. The low-income group had also higher injuries since the drivers in this group work with no regular work-rest schedule and they usually work with old tractors equipped with unsafe facilities. Those that do comply with safety measures are likely to have fewer exposures to unsafe work practices and consequence injuries. Further education of tractors drivers in various aspects of farm safety besides enforced regulations to adjust safety issues are the possible approaches to prevent tractor-related injuries.

According to Barbara Marlena (2017) and et al, it is demonstrated by highly significant intra-class correlations for key indicators of performance (speeds and hazard clearances). While there was some evidence for construct validity, as indicated by trends in performance across the age groups, findings were mixed.

From the above literature references it can be understood that the items of the variable factor under drivers' control such as Age, Income, Speed, Hazards Clearance, Usage of the divers influence the performance of tractors, hence researchers have adopted the same for the study.

➤ **Conceptual Framework:**



## 5. METHODOLOGY

The research area Srikakulam District is the extreme Northeastern District of Andhra Pradesh situated within the Geographic Co-Ordinates of 18°-20' and 19°- 10' of Northern latitude and 83°-50' and 84°-50' of Eastern longitude. The Nagavali, Vamsadhara, Suvarnamukhi, Vegavathi, Mahendratanaaya, Gomukhi, Champavathi, Bahuda and Kumbikota Gedda are the important rivers of the District. The Geographical area of the District is 583700 Hectares covered by 38 Mandals coming under three Revenue Divisions Viz., Srikakulam, Palakonda & Tekkali. During the Year 2009-10 the

Cultivable land (i.e., Net area Sown, Current fallows and Other fallow lands) was 3,56,654 hectares and it accounted for 61.10percent of the total Geographical area of the district. The Forest Area of the District during 2009-10 is 68,641 hectares accounting for 11.76% this shows half of the State and one - third of the Normal Ecological balance area. Land Put to Non-Agricultural Uses occupied by buildings, roads and railways or under water i.e., rivers, canals and other land put to uses other than Agriculture area is 99,269 hectares accounting for 17.01% of the Geographical area. Barren and Uncultivable Land like mountains, deserts, etc whether such land is in isolated blocks

or within cultivated holdings, an extent of 49,687 hectares are comes under and accounted for 8.51%. Under Permanent Pastures and Other Grazing Lands covers 942 hectares accounted for 0.16%, Miscellaneous Tree Crops and Groves not included in the Net Area Sown is 7,451 hectares accounted for 1.27%, Cultivable Waste in 2009-10 is 659 hectares accounted for 0.11%, Other Fallow Lands is 17,487 hectares accounted for 2.99%, Current Fallow Lands is 54,523 hectares accounted for 9.34% and Net Area Sown represents 2,84,644 hectares accounting for 48.76% of farmers thereby turned to the usage of tractors for agricultural development. Government also supports as a part of contributing the required infrastructure to rural India from which most of the farmers commonly opt tractor as a mandatory and multi task vehicle.

The research design employed in this study is quantitative research design. Also, this is a cross-sectional study which gathers data on a single point in time throughout the entire study. To achieve the research objective, a survey of tractor showrooms has been carried out in Srikakulam city. This research has tried to examine the relationship between independent and dependant variables or assessing the impact of factors in line with farmers, manufacturers and drivers control as an independent variable on tractors' performance which is the dependant variable; and thus the research is causal/explanatory in nature. The population of this study comprises all managerial, technical and administrative staff of all tractor showrooms in Srikakulam. As per the collection of the sample frame list, 334 has been targeted as the total size of population and for the quantitative study the researcher has determined total sample size of 182 by using Yamane (1967) sample size formula.

The researcher has used proportionate stratified random sampling techniques initially at the selection of showroom level and thereby went for non-probability of convenience sampling due to the limitations associated with respondents' schedules and attention. The researcher has used primary data source and specifically questionnaire. It is particularly self-administered method which was used in collecting the required data from the respondents. In addition to this, the researcher has collected secondary data from books, articles, journals, and Internet to enrich and critically analyze the subject under study.

After data is collected through a self-administered method, it has been edited and analyzed using certain statistical tools especially Pearson correlation has been used to detect whether each independent variable is related to the dependant variable or not. Additionally, regression analysis and particularly it is multiple regression analysis which was employed to show the effect of independent variable on the dependent variable and the above procedure has been done by using SPSS version 20.0 windows statistical software.

## ANALYSIS

In order to test the stated hypotheses, multiple regressions was used to identify the dominant factor among the three factors that has a stronger impact on Tractors' performance. As the result of multiple regressions in Table 1, Farmers' control by standardized beta coefficients value of .419 significant at .000 is found to be the most important factor that affects Tractors' performance as the best predictor of performance followed by Manufactures' control with a Beta-value of .125sig. at .135 and Drivers' Demographic factors with a Beta-value of .237 sig. at 0.004.

Table 1 Multiple Regression Coefficients Drivers Demographic factors on tractors' Performance)

Coefficients<sup>a</sup>

| Model                       | Unstandardized Coefficients |            | Standardized Coefficients | t     | Sig. |
|-----------------------------|-----------------------------|------------|---------------------------|-------|------|
|                             | B                           | Std. Error | Beta                      |       |      |
| 1 (Constant)                | .235                        | .259       |                           | .909  | .038 |
| Farmers' control            | .419                        | .068       | .472                      | 6.124 | .000 |
| Manufactures' control       | .125                        | .083       | .120                      | 1.502 | .135 |
| Drivers Demographic factors | .237                        | .082       | .190                      | 2.896 | .004 |

a. Dependent Variable: Performance of agricultural Tractors

**H1: Farmers' Control factors such as Skill, working conditions and Maintenance Standards have significant influence on the performance of Agricultural Tractors.**

The multiple regression coefficient result shown in the Table 4.5, revealed that Farmers' Control factors such as Skill, working conditions and Maintenance Standards has a positive and significant effect on performance of Agricultural Tractors with (beta = .419, p=0.000). **Hence the hypothesis is accepted.**

**H2: Manufacturers' Control factors such as Features, Parts and Repair Cost have significant influence on the performance of Agricultural Tractors.**

As Table 1 shows that the Manufacturers' Control factors such as Features, Parts and Repair Cost is insignificant on performance of Agricultural Tractors, since the significant level of their effect is > 0.05 where (beta = .125, p=.135). Therefore, Manufacturers' Control factors is found to be

insignificantly effect on performance and **the hypothesis is rejected**

**H3: Drivers' Demographic factors such as Age, Income, Speed, Hazards Clearance and Usage have significant influence on the performance of Agricultural Tractors**

It is well understood that Drivers' Demographic factors such as Age, Income, Speed, Hazards Clearance and Usage is significant enough to effect on the performance of Agricultural Tractors (beta = .237, p =.004). **Hence the hypothesis is accepted.**

## 6. CONCLUSIONS

1. Farmer as a consumer use the tractor either with proper knowledge or without knowledge in consideration with certain factors such as Skill, working conditions and Maintenance has been identified or in fact indulged by the respondents from showrooms of the tractor companies.



2. It is surprising enough that the manufacturers' control factors have not shown any significance on tractors' performance is well adjudged by respondents as a conclusion of the standards being maintained by the showrooms on Features, Parts and Repair Cost.
3. Pivotal role being headed by the driver has been considered as one of the responsible factors for his demographic characteristics influence on tractors' performance with respect to the outcomes such as frustration, monotony, intoxications and rough usage.

## 7. RECOMMENDATIONS

1. The training and education about the vehicle is given to the farmers by the company initially where the farmer focuses on how to operate to serve his purpose rather than forecasting longevity of the vehicle performance. Hence the company staff should focus on the continuous and contagious education on how the skills are to be developed, how to maintain with respect to the working conditions. Farmers should also concentrate more on the maintenance which may not be applicable at present but carries much in future.
2. Manufacturers control factors are said to be insignificant as per the study outcomes but the responsibility from the government body can take in perfect service delivery which is found as a route cause for the farmers' control factors and drivers' demographic factors have high influence on the performance. Technological assistance after guaranty period is highly commercial but the common minimum knowledge on how to maintain the vehicle to get the maximum performance and last long is to educated with continuous efforts.
3. Driving is one of the noble professions but professionalism is found missing many times with the unorganized behaviour of the drivers. Fatigue out of age, stress out of low income, speed out of uncontrollable factors and frustration out of tasks relate a lot to the performance which should be focused by the companies in terms of a special training on these exclusive elements continuously.
4. Product oriented marketing strategies will enable the farmers and drivers to focus more on the parts and its application rather than the purpose of the vehicle alone.

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