Significance of Electric Vehicle in Agro Logistics and Supply Chain

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Introduction

After the introduction of many e-commerce giants in agriculture and food's logistics and supply chain system like Big Basket, Food Panda, etc. which are supplying raw vegetable and groceries as well as meals, a new this sector has started in logistics and supply chain. There is a vast scope of use of electric vehicles for delivery at metropolitan scale.. The electric vehicles has a great opportunity in this sector of logistics and supply chain system to reduce cost factor, increase efficiency by reducing fuel and maintenance cost of the various vehicles and carriers that are used for delivery and supply. Moreover, these vehicles will not harm the environment that is always a plus point to use electric vehicle anywhere or in any sector. A brief study of use of electric vehicles in this supply system has been discussed in this paper in a metropolitan area

Methodology

Most of the delivery and supply vehicles which are used in any metropolitan area are mostly used either in day or in night time. For example, supply vehicles, which are used for the supply of various agricultural and food material to the supermarket and grocery stores, supplies stock mainly in between early morning and before noon hours whereas delivery vehicles start their job from noon to mid-night.

Hence supply vehicles can easily be re-charged from evening till morning hours and delivery vehicles can be recharged during night hours. One of the major drawbacks of electric vehicles can be easily used as strength in this logistic and supply chain sector.

Another major drawback of the electric vehicle is the distance covered per charge will also be not able to affect this sector because the range of any electric vehicle per charge is about 250Kms - 400Kms which is more than enough for the usage in metropolitan area for supply and

delivery purposes. Moreover, the load of the agro products and diary product is also considered as light loads and medium loads and hence it should be difficult to carry such a load across a city. There are a lot of examples to represent how the drawbacks of an electric vehicle can be converted in to big advantages of this sector.

Electric vehicles are going to be the future of the transportation in coming 5-10 years and hence it will be an adequate option to electric vehicle in the logistics and supply chain in the sector of agro to handle all kind of raw as well as groceries including packed and loose items and delivering food orders in the metropolitan area.

Electric Vehicles

Many people have the first subconscious image of an electric vehicle as a car running on batteries. But unfortunately that's not true, the correct definition of an electric vehicle is, any vehicle (e.g. Car, truck, bus, locomotive, three wheeler etc.) running on electricity regardless of source of generation of electricity. That means any vehicle which uses battery, fuel cell or even Internal Combustion Engine (ICE) to generate electricity to propel a vehicle is an electric vehicle.

Economic Viability

In today's market when internet is also playing a vital role in agro sector by bringing new market for all kind of agro and food industry. Introduction of online e-commerce sites line Big Basket, Food Panda, Zomato, etc. and online delivery of the food by various food chains captures a large market and its revenue. A huge part of this revenue goes into fuel and maintenance cost of the delivery and supply vehicles. This operation could be easily eliminated by using electric vehicles.

Table 1

Vehicle	Fuel Cost/Km	Maintenance Cost/Km
ICE Vehicle	Rs. 3.20-4/km	Rs. 0.67-1.13/km
E Vehicle	Rs. 0.45-0.52/km	Rs. 0.125-0.2/km

(Here it is assumed that distance travelled by both vehicles is 12,000km/year and fuel cost is constant for both the vehicles throughout the year.)

Table 1 represents the average cost of fuel per kilometer and maintenance cost per kilometer of a petrol or diesel Internal Combustion Engine (ICE) and of an electric vehicle.

From the above table we can see the mathematically how the operation and maintenance is going to differ in both situations. For a bigger of the cost difference we can also refer to per year cost analysis of both Internal Combustion Engine (ICE) and electric vehicle. The cost analysis of both vehicles in a year is discussed in table 2

Table 2

Vehicle	Fuel Cost/Year	Maintenance Cost/Year
ICE Vehicle	Rs. 38,500	Rs. 8000
E Vehicle	Rs. 5,500	Rs. 1500

(Here it is assumed that both vehicles travel 12,000km/yr. and fuel cost is constant throughout the year.) From the above table the significant difference in the fuel and maintenance cost of both the vehicles is clearly visible in a run of complete one year. In a sector which is basically operated by common people, the difference in operation cost will result as the raise in revenue which will eventually reduce the cost of the product.

Cost of operation of Logistics and supply chain system in agricultural and food industry completely depends on the cost of fuel which is very volatile and keeps on increasing. By removing the dependency of this sector from such of fuel and operation cost may increase the reliability and stability, resulting in cost reduction of product and operation in long run.

Various Uses in Agro Logistics and Supply Chain

- **Use as Refrigerated Vehicles**: One of the major portions of the logistic and supply chain agro industry includes refrigerated or cold storage system of transportation in order to keep raw vegetables, diary, egg and meat kind of food item, in order to keep them fresh. This

refrigerated or cold storage mobile vehicles consumes extra fuel apart from the travelling to run compressors of refrigerators which increases operation and maintenance cost of this kind of vehicles a lot.

This problem of maintenance and operation cost of refrigerated or cold storage vehicles could be solved easily with the help of electric vehicles (EVs). Electric vehicles being running on battery or fuel cells provides constant or stable form of power input to the compressors which increases efficiency of refrigeration system as well as reduces the operation and maintenance cost of these vehicles.

Since it's an integrated part with the system of electric vehicle hence no extra charging or refueling is required for this system. Though the electric vehicle's range reduces because of the addition load of refrigeration still it is superior than internal combustion engine refrigerated vehicles. Moreover, reduces range of electric vehicles would affect much because of the operations in metropolitan area and in a limited time of operation, that is most of the vehicles are used during morning hours and could be recharged easily rest of the time.

(For example fig. 1).

(Battery swapping is the process of exchanging discharged battery or power packs with fully charged ones. Battery swapping also comes under the three guidelines of business model given by CERC for recharging and refueling of electric vehicles. Hence it is completely legal.)

Figure 1

Figure 2

Figure 2 represents use of refrigerated electric vehicle to deliver the food orders in metropolitan city, which conserves fuel and maintenance cost and conserves environment by reducing emission and eliminating emission of pollutants into the environment.

- **Silent Operation:** Silent operation of electric vehicles is one the major advantages. Delivering the precious diary and vegetables silently in the morning hours, without disturbing anyone will provide social viability to this industry. Most of the timeloud delivery vehicles come in early morning to deliver something or other and they are so loud that they replaces the alarm clock beside us. The silent operation of electric vehicles will allow them to move quietly across the city without disturbing anyone.
- **Use by Mobile Vendors:** One of the major suppliers of the agro products are the vendors that move from door to door or from colony to colony. Now a day, these vendors are also using internal combustion vehicles to supply and sell their products. Use of electric vehicles by these vendors will also help a lot to reduce the price of final product. It is often seen that these vendors keeps the engine of vehicle turned on while selling the product in order to reduce the effort of turning on and off frequently and sounds logical too. But this kind of operation increases idling loss which increase fuel consumption, decreases efficiency and hence increases operation cost. Where as in case of electric vehicles it doesn't matter whether the motor is on or off because when vehicle is not running or moving there is no power consumption or no idling loss. Just a push to throttle and it moves or stops, no need to on or off. In other words, use of electric vehicles which increase efficiency and growth of vendors and decrease the operation cost. Apparently many vendors have understood the importance and advantages of electric vehicles over the internal combustion engine and hence have started the use in electric vehicles for their supply and sale (For example fig. 3).

Figure 3

• **Farm Utility Vehicle:** Apart from supply and logistics in a metropolitan area, an electric can be used in the production of the agro product as various transportation and supply operations are carried out at fields also. Even here internal combustion engine vehicles are used which are

economically not suitable for the agricultural purpose though these are in trend. Use of electric vehicle at such is possible now a day due to electrification of more than 24, 65,156 villages across India, which is about 73% and government, is focused to electrify all villages by the beginning of 2018 and all households by the 2020.

Hence, there will be no problem of power for recharging of battery packs. Since villages have very small land area and are close to each to other so it will be least problematic situation in regards of limited range of electric vehicles. Moreover, if the electric vehicle is using hydrogen fuel cell then there will be no problem of range as well as of refueling in coming future.

Use for E-Commerce Business Models

Internet has given boost to the e-commerce sites that supply all kind of agro and grocery products across the metropolitan cities. They receive orders on their online websites and give rapid delivery service systems. These systems are basically based on three business models that are:

- Inventory model.
- Just-in-time or Purchase-to-order model.
- Hyper-local model.

• **Inventory Business Model:** In this model company maintain a warehouse inventory at some places across the metropolitan area at distance apartthese warehousescould be located at 7-20Km apart from each other depending upon the population density and demand. When any order is placed then the closest inventory gets the notification and products are shipped to the address as soon as possible. This is a well-established business and have good efficiency rate but cost of inventory is extra cut on the revenue generated.

Electric vehicle can easily replace the delivery vehicles in this system because distance for transportation or delivery is very small as compared to the maximum range of vehicle. When delivery vehicle is not on service they could be easily recharged.

Moreover, the frequency of delivery can also be increased because company can also consider the individual delivery system, where each order is served separately as operating cost of electric vehicle is very less as compared to the internal combustion engine vehicles. Though company, still can deliver multiple order if shipping addresses are close as it is done in current operation

scenario. This individual delivery system will also increase the service of the company towards the customers by reducing the delivery time of the order placed.

• **Just-in-time or Purchase-to-order model:** In this model as name suggest company tries to save the money on inventory by purchasing the product when any order is received or by maintaining a small inventory enough to supply almost a single day demand. In this model company needs to forecast the demand and maintain their inventory. In order to do so many companies have to do tie-ups with supermarket, grocery stores or with retailers.

When any order is received then company gives priority to its inventory to accumulate all product of order then to stores if anything is not available. Rest of the delivery system is same as of the inventory based model and electric vehicles can play the same as it has been described for the inventory based business model.

• **Hyper-local Business Model:** In this model company has no inventory or no stock. Company has no assets in regard of the warehouse or delivery vehicle. In fact, they have direct partnership with the local supermarket and grocery stores. When any order is placed then company notify the closest supermarket or grocery store about the details of order then service is provided by that store. The delivery system is as same as the previous two models and hence electric vehicles could serve as described in Just-In-Time business model.

Conclusion

An electric vehicle could be life saver for the environment but it will be profit and revenue maker in the sector of agro logistics and supply chain in a metropolitan area. From low maintenance and low fuel cost to higher efficiency in high-tech refrigerated electric vehicle to the farm utility vehicle, it can fit well in every aspects of the business.Electric vehicles can also serve all business models that are widely used by e-commerce in this sector of logistics and supply chain system of agro that are

- Inventory model.
- Just-in-time or Purchase-to-order model.
- Hyper-local model.

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