Abstract of the Problem

AgriDroid EV Sugarcane Harvester Project

Sugarcane harvesting in India is predominantly carried out using diesel-powered mechanized harvesters. While mechanization has significantly improved productivity and reduced dependency on manual labor, the continued reliance on diesel engines presents serious economic, environmental, and operational challenges for harvesting vendors, farmers, and sugar factories.

A typical diesel sugarcane harvester consumes approximately 20–25 liters of diesel per hour and operates for 8–10 hours per day during peak season. This results in high daily fuel consumption and substantial operating costs. With frequent fluctuations and rising diesel prices, fuel expenses form a major portion of total harvesting costs, directly affecting vendor profitability and increasing the financial burden on farmers. The business model remains highly sensitive to fuel price volatility.

In addition to economic concerns, diesel harvesters contribute significantly to environmental pollution. Continuous engine operation releases large amounts of carbon dioxide (CO_2), particulate matter, and noise emissions in rural agricultural regions. As India advances toward clean energy goals and carbon reduction commitments, agricultural machinery has not yet transitioned to sustainable alternatives. This creates a critical gap in the country's green mobility and climate action framework.

Operational reliability is another key issue. Diesel engines involve complex mechanical systems requiring frequent maintenance, including oil changes, filter replacements, fuel system servicing, and engine overhauls. Breakdowns during peak harvesting periods disrupt supply schedules to sugar factories. Delays in harvesting mature sugarcane can reduce sugar recovery rates and affect farmer income, factory efficiency, and overall supply chain stability.

Furthermore, rural areas often face unstable or limited grid power infrastructure, making conventional electric machinery challenging to deploy without supporting energy systems. The absence of a dedicated battery-swapping mechanism or renewable-integrated charging solution for agricultural harvesters limits the feasibility of electrification. There is currently no standardized electric retrofit system specifically designed for converting existing diesel-powered sugarcane harvesters into efficient electric machines suitable for field conditions.

The sector also faces increasing labor shortages due to rural-to-urban migration. Mechanization has become essential to maintain harvesting timelines; however, without technological advancement, current diesel-based systems remain costly and environmentally unsustainable in the long term.

Despite more than a decade of successful diesel harvesting operations supplying over two lakh tons of sugarcane to sugar factories, the prevailing model remains carbon-intensive, maintenance-heavy, and economically vulnerable. There is an urgent need for a scalable, cost-effective, and sustainable solution that reduces diesel dependency, lowers operating costs, minimizes emissions, and ensures uninterrupted harvesting operations.

In summary, the core problems include excessive diesel consumption, high operating expenses, carbon emissions, maintenance challenges, lack of renewable charging infrastructure, and absence of a dedicated EV retrofit solution for sugarcane harvesters. Addressing these challenges is essential to enable sustainable agricultural mechanization, improve vendor margins, enhance farmer income stability, and align the sugarcane harvesting ecosystem with India's clean energy transition goals.