Comprehensive Documentation for Cost-Feature-Benefit Analysis: Proposed Indigenous Drone vs. Commercial Drones in India

1. Introduction

The agricultural sector in India has seen a transformative shift with the integration of drone technology, which is being used for various purposes such as crop monitoring, precision spraying, and environmental data collection. However, the high cost of commercially available drones has limited their adoption, particularly by small and medium-scale farmers.

This document presents a detailed **cost-feature-benefit analysis** comparing a proposed **indigenous drone** priced between ₹1.5 to ₹2 lakhs with **commercial drones** currently available in the Indian market, such as the **DJI Agras T20, Garuda Aerospace Kisan Drone,** and **RattanIndia X-Fly Agribot Drone**, which range from ₹5 to ₹9 lakhs. This analysis highlights how our indigenous drone offers comparable or even superior features at a fraction of the cost, making it an ideal solution for the Indian agricultural landscape.

2. Overview of Commercial Drones in India

Several high-end drones are currently available for agricultural use in India. However, their prohibitive costs have made them inaccessible for a majority of farmers. Below are some popular models, along with their prices and features:

- **DJI Agras T20**
  - **Price:** ₹8-9 lakhs
  - **Features:** 20L tank, advanced radar, RTK GPS for precision spraying and mapping.

- **Garuda Aerospace Kisan Drone**
  - **Price:** ₹6-7 lakhs
  - **Features:** 10L tank capacity, multispectral camera, GPS navigation, precision agriculture tools.

- **RattanIndia X-Fly Agribot Drone**
  - **Price:** ₹5-6 lakhs
  - **Features:** 10L tank, multispectral camera, GPS, automated spraying.

Despite their advanced features, the high price tags make these drones unaffordable for smaller-scale farmers. This is where the proposed indigenous drone comes in, offering similar functionalities at a significantly lower price point.

3. Proposed Indigenous Drone: Features, Components, and Costs

The proposed indigenous drone has been designed with cost-efficiency in mind, incorporating locally sourced and easily available components without compromising on essential agricultural features. Key components and features are outlined below:

3.1. Key Features of the Proposed Drone

Flight Control:

- **Flight Controller:** Pixhawk PX4 with Ardupilot software for stable flight control and mission execution.

- **GPS:** Ublox NEO-M8N GPS for accurate navigation and pre-programmed flight paths.

- **Motors and Propellers:** 3508 700KV BLDC motors paired with 15x6 Gemfan propellers for efficient and powerful flight performance.

- **Power Supply:** Tattu 6S 22000mAh 22.2V LiPo battery providing extended flight times.

Sensors for Environmental Monitoring:

- **Temperature & Humidity Sensor:** DHT22 for real-time environmental data.

- **CO2 Sensor:** MH-Z19 for air quality monitoring.

- **Ultrasonic Sensor:** HC-SR04 for obstacle detection and landing assistance.

- **Multispectral Camera:** DIY-modified camera with filters for specific wavelengths, useful for vegetation indices such as NDVI and GNDVI.

- **Thermal Camera:** Waveshare MLX90640 for detecting plant stress via temperature anomalies.

Spraying Mechanism:

- **Tank Capacity:** 10L HDPE tank for precision spraying.

- **Nozzles:** TeeJet AIXR 11004-VP for controlled, precision spraying.

- **Control System:** Real-time spraying control via Ground Station Interface software.

Communication and Data Transmission:

- **LoRa Communication Module (RFM95):** Long-range data transmission (up to 15 km), providing uninterrupted communication in remote areas.

- **Post-Flight Data Analysis:** AI-driven models for analyzing crop health, irrigation needs, and yield estimation using data from multispectral and thermal cameras.

3.2. Cost Breakdown

Component	Estimated Cost (₹)
Flight Controller (Pixhawk PX4)	₹15,000-20,000
GPS Module (Ublox NEO-M8N)	₹5,000-7,000
Multispectral Camera (DIY)	₹15,000-20,000
Thermal Camera (Waveshare MLX90640)	₹25,000-30,000
Motors (3508 700KV)	₹25,000-30,000
Propellers (15x6 Gemfan)	₹5,000-7,000
Battery (Tattu 6S 22000mAh)	₹20,000-25,000
Sprayer System (TeeJet)	₹15,000-20,000
Frame (Carbon Fiber/Aluminum)	₹10,000-15,000
Sensors & Other Components	₹25,000-35,000
Total Estimated Cost	**₹1.5-2 lakhs**

4. Comparative Cost-Feature Analysis

Below is a detailed comparison of the **proposed indigenous drone** with the commercially available drones in the Indian market:

Feature	Proposed Drone (₹1.5-2 Lakhs)	DJI Agras T20 (₹8-9 Lakhs)	Garuda Kisan Drone (₹6-7 Lakhs)	RattanIndia Agribot (₹5-6 Lakhs)
Tank Capacity	10L	20L	10L	10L
Flight Controller	Pixhawk PX4, open-source	Proprietary	Proprietary	Proprietary

Multispectral Camera	DIY Modified	Yes	Yes	Yes
Thermal Camera	Waveshare MLX90640	Yes	Yes	Yes
Spraying System	TeeJet AIXR 11004-VP	Proprietary	Yes	Yes
GPS	Ublox NEO-M8N	Yes	Yes	Yes
Communication Range	15 km (LoRa)	10-12 km	10-15 km	10-12 km

5. Key Benefits of the Proposed Drone

5.1. Cost Efficiency

The proposed indigenous drone offers a significant **cost reduction** of **70-80%** compared to high-end commercial models like the DJI Agras T20, which is priced at ₹8-9 lakhs. This makes the technology accessible to a larger pool of farmers and reduces the financial barrier to adopting drone technology in agriculture.

5.2. Enhanced Features

Despite its low cost, the indigenous drone incorporates **advanced features** such as a **multispectral DIY camera, thermal sensing,** and **LoRa communication**, typically found in far more expensive models. Additionally, it offers **precision spraying** and **real-time environmental monitoring** using advanced sensors for temperature, CO2, and obstacle detection.

5.3. Customizability and Indigenous Advantage

The open-source nature of the **Pixhawk PX4 flight controller** and other customizable components (such as the DIY multispectral camera) provide farmers with **high customizability**. This is a stark contrast to commercial drones, which are usually pre-configured with limited flexibility. The indigenous design also leverages **locally sourced components**, reducing import dependency and making spare parts easily available, further lowering maintenance costs.

5.4. AI Integration and Data Analytics

The proposed drone uses **open-source AI models** for **post-flight data analysis**, offering actionable insights into crop health, irrigation needs, and yield estimations. In contrast, commercial drones often require costly proprietary software for similar functionalities.

5.5. Long-Range Communication

The **LoRa-based communication** module provides **real-time data transmission** up to a range of **15 km**, exceeding the capabilities of many commercial drones that rely on shorter-range communication protocols.

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6. Use Case Scenarios

6.1. Crop Monitoring and Health Analysis

With its **multispectral** and **RGB cameras**, the indigenous drone allows for the real-time monitoring of crop health using vegetation indices such as **NDVI** and **GNDVI**. The DIY-modified multispectral camera provides the same functionality as high-end commercial multispectral cameras but at a much lower cost.

6.2. Precision Spraying

The **10L tank** and **TeeJet precision nozzles** ensure accurate spraying, minimizing wastage and ensuring uniform pesticide and fertilizer application. In comparison, commercial drones with similar spraying capabilities are much more expensive and offer little improvement in performance.

6.3. Environmental Data Collection

The integrated environmental sensors (temperature, CO_2, ultrasonic) provide real-time data on environmental conditions, aiding in **decision-making** for irrigation and crop management. Such comprehensive sensor arrays are generally not found in commercial drones in this price range.

6.4. Yield Estimation and Post-Flight Data

Through open-source AI and **deep learning models**, the drone processes imaging data to estimate yield and detect issues such as **pest infestations** and **nutrient deficiencies**. This data can be accessed by farmers to optimize farm operations and improve productivity.

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7. Conclusion

The indigenous drone offers a compelling value proposition for India's agricultural sector, providing **high-end features** such as multispectral imaging, thermal sensing, and precision spraying at a fraction of the cost of commercially available drones. With a **price range of ₹1.5-2 lakhs**, it presents an accessible and sustainable solution for farmers, particularly those from small and medium farming operations.

By integrating **open-source technologies, locally sourced components,** and advanced **AI-driven analytics**, this indigenous drone could significantly enhance

agricultural productivity and sustainability, ultimately transforming the landscape of precision farming in India.