# Proposed Design:

The first agriculture drone of its type, it is quad tiltrotor fixed-wing UAV configuration with all 4 rotors at ends of 4 wings. The UAV’s mass is 4kg with a capacity of 3kg pesticide carriage. Its wingspan is 1.44m, fuselage length is 1.55m. Maximum spraying capacity of drone is 3.5L/min.

With full payload, the drone can cruise at 15ms-1 consuming only 84 Watts for propulsion. Drone can fly at 30ms-1 (max. airspeed for required mission) with rotors burning only 452 Watts. Moreover, the drone can achieve 62ms-1 airspeed (not used in mission) with its 14kg maximum thrust.

It uses an advanced spraying mechanism with two different types of nozzles for spraying and misting. This approach maximizes the quality of spray hence reducing pesticide consumption per acre. The pump used for this purpose has a BLDC motor for controllable flow and maximum pressure of 1MPa at 40 Watts power consumption.

It isn’t just an abstract idea of an unrealistic drone configuration but a thorough analysis and calculation of its performance in required mission, manufacturability, procurement and mitigation of all possible safety hazards. This UAV is capable of:

* Stable flight in vertical mode due to rotors placed at more distance from fuselage
* Powerful horizontal flight due to thrust from all 4 rotors horizontally
* Quick and stable transition in flight modes due to variable tilting angles of rotors

When compared to other designs for this mission, this configuration is at top of the charts for the following reasons:

* 5.5 to 6 times more power efficient in horizontal cruise than multi-copters. i.e., suitable for spray zones far away from Ground Control Station
* Higher precision in spraying than fixed wing configuration due to capability of hovering, gliding and staying at transition state while spraying
* More stable hovering and spraying than its parent configuration quad plane

# Changes since PDR:

Only the BLDC motors and battery are changed since the PDR. It was mentioned in the report that these aren’t final and are subject to changes in future. Due to temporary import issues, Tmotors MN5008 cannot be procured. By change in motor, ultimately battery is also changed since the new motor used EMAX2826 KV860 requires 4S and can’t run on 6S voltage.

# Payload & Mission summary:

Drone will carry load at its maximum capacity, i.e., 3kg. It will follow the longest route of 4km towards the spraying zone on cruise speed of 15ms-1. This will ideally consume 266 seconds and 7.75Wh energy. Drone will cover the complete spray zone in 118-125 seconds following its optimal path for least time consumption. This shall ideally consume 32Wh energy. UAV will then cruise back to landing at 10.7ms-1. This shall ideally consume 47 seconds and 0.65Wh energy. Hence, including 3 seconds take-off & 5 seconds landing and transition time of 1.7 seconds, mission will be completed in 441-455 seconds. This is the approach for optimum energy consumption, and it is adopted in this mission since time isn’t an issue and completing mission before 10 minutes doesn’t end up in bonus points. But in real-world scenarios in emergency, this UAV can complete the same mission in <290 seconds with only 28% more power consumption. Details provided in Engineering Analysis part.