AEN-172

Cooperative Extension Service

Decision Aid to Determine the Cost of Using a Drone Sprayer in Production Agriculture

Josh Jackson, Karla Ladino, Tim Stombaugh, and Gabriel Abdulai, Biosystems and Agricultural Engineering

Similar to other agricultural equipment purchases, cost and potential for return on investment for drone sprayers must be carefully evaluated. General Considerations and Requirements for Drone Spraying (AEN-171) summarized what aspects should be evaluated prior to the purchase of a drone sprayer, or unmanned aircraft systems (UAS) sprayer. These aspects include cost considerations, potential uses, certificates and licenses, equipment, utilities, software, insurance, maintenance and repairs, and time allocation.

This publication describes how to determine different cost metrics (cost per acre, cost per flight, and cost per hour) for drone sprayers and serves as a guide to using the Drone Sprayer Cost Summary Decision Aid. This tool is meant to help farmers and sprayer service providers make more informed economic decisions about the purchase and utilization of drone sprayers. For both farmers and sprayer service providers, the cost determination will allow comparisons between different sizes and models of drone sprayers. Furthermore, the determination of the cost per acre allows comparison against other sprayer platforms such aerial (planes and helicopters) and ground-based sprayers. While the cost per acre is important, the flexibility with regard to timing of application provided by a drone sprayer must be individually evaluated by farmers or service providers for their respective operations. For service providers, the decision aid will also help ascertain what potential rates to charge for their applications and how that will affect profitability.

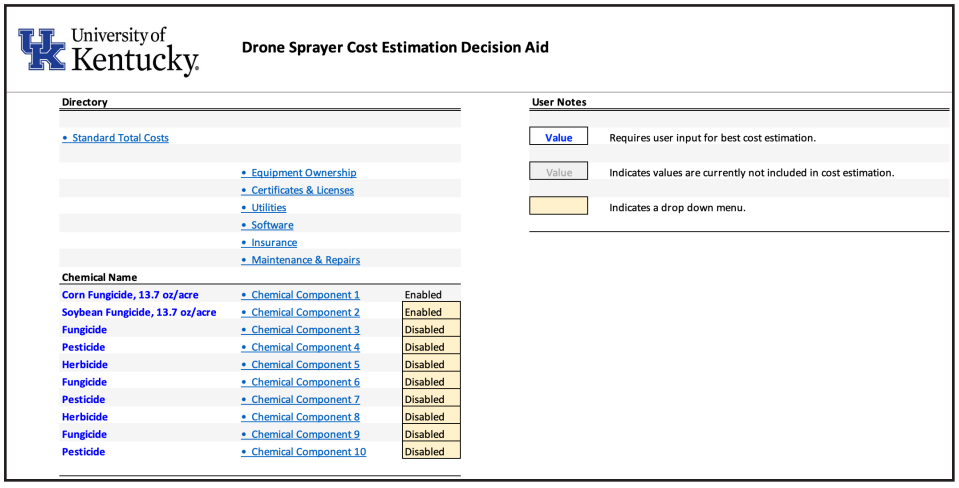
A Drone Sprayer Cost Summary Decision Aid has been developed specifically for drone sprayer applications and is available online at https://www.engr.uky.edu/directory/jackson-joshua. A separate decision aid (AEN-160) has been developed to estimate the cost per flight and cost per acre of UAS flights that entail crop scouting, fence line inspecting, livestock monitoring, and other remote sensing activities.

Using the Tool

This decision aid provides an overview of the costs that will be encountered when purchasing and operating a drone sprayer. The decision aid is an Excel workbook that is organized into individual sheets containing pertinent cost inputs and calculations. The directory sheet contains basic instructions for using these sheets and navigational hyperlinks to the sheets on total costs, equipment ownership, certificates and licenses, utilities, software, insurance, repair and maintenance, and chemical applications (1–10). The sheets can also be accessed using the tabs along the bottom of the workbook. Note that, depending on screen width, you might need to use the left and right scroll arrows to see all of the tabs. Start a session by opening the workbook and clicking on the directory sheet, if the directory sheet is not already open. A blue button at the top of each sheet will allow the user to return to the directory at any time.

Directory Sheet

The sheet hyperlinks on the left side of the directory sheet (Figure 1) can be used to quickly navigate to the desired sheets within the notebook. The notes section to the right reminds the user that cells with blue text will indicate values that the user must define, and cells with yellow backgrounds indicate drop-down lists that the user must select. All other cells will be prepopulated


University of Kentucky

Drone Sprayer Cost Estimation Decision Aid

Directory

- Standard Total Costs
- Equipment Ownership
- Certificates & Licenses
- Utilities
- Software
- Insurance
- Maintenance & Repairs

Chemical Name		
Corn Fungicide, 13.7 oz/acre	• Chemical Component 1	Enabled
Soybean Fungicide, 13.7 oz/acre	• Chemical Component 2	Enabled
Fungicide	• Chemical Component 3	Disabled
Pesticide	• Chemical Component 4	Disabled
Herbicide	• Chemical Component 5	Disabled
Fungicide	• Chemical Component 6	Disabled
Pesticide	• Chemical Component 7	Disabled
Herbicide	• Chemical Component 8	Disabled
Fungicide	• Chemical Component 9	Disabled
Pesticide	• Chemical Component 10	Disabled

User Notes

Value — Requires user input for best cost estimation.

Value — Indicates values are currently not included in cost estimation.

Indicates a drop down menu.

Figure 1. Directory sheet. Chemical sheets can be enabled or disabled on this sheet by using the drop-down menu.

Equipment Information	Number of Units	Purchase Price Per Unit	Years of Economic Life	Salvage Value	Total Initial Cost	Annual Depreciation	Cost Per Flight	Annual Interest	Interest Cost Per Flight
Required									
Sprayer UAS & Controller Station Package	3	$ 18,000	5	$ 2,000	$ 54,000	$ 9,600	$ 1.69	$ 600.00	$ 0.11
Battery Charger	2	$ 1,200	5	$ -	$ 2,400	$ 480	$ 0.08	$ 36.00	$ 0.01
Tablet or Mobile Device	1	$ 500	5	$ 50	$ 500	$ 90	$ 0.02	$ 16.50	$ 0.00
64 GB Micro SD Card (x4)	0	$ 20	5	$ -	$ -	$ -	$ -	$ -	$ -
Micro SD Card Reader	0	$ 15	5	$ -	$ -	$ -	$ -	$ -	$ -
Spare Batteries	10	$ 1,000	5	$ -	$ 10,000	$ 2,000	$ 0.35	$ 30.00	$ 0.01
Landing Pad	0	$ 20	5	$ -	$ -	$ -	$ -	$ -	$ -
Spare Propellers	8	$ 35	5	$ -	$ 280	$ 56	$ 0.01	$ 1.05	$ 0.00

Figure 2. Equipment ownership sheet.

estimations or calculated values that are dependent on the user-defined inputs and are locked to avoid unintended entries or keystrokes.

From this sheet, the user can define up to 10 different chemicals planned for application during the upcoming year. By default, the chemical identified as "Chemical Component 1" is enabled. Additional chemicals can be enabled by selecting the associated drop-down menu option. If more than 10 different chemicals are expected, make some grouping assumptions for cost estimates and spray volumes in the chemical sheets so that only 10 sheets are used. Define the chemical name for each applied product, and the chemical name entered on this sheet will be prepopulated on the accompanying chemical sheets. Click on each chemical component to navigate to its associated sheet.

Equipment Ownership Sheet

On this sheet, the user will define the equipment that will be purchased and the associated cost (Figure 2). The sheet has been populated with the typical items that might be needed for a drone spraying operation, but the sheet can be customized to a particular operation by activating or deactivating rows as needed. Changing the number of units for any item to zero will deactivate the row (indicated by gray shading), thereby excluding it from the calculations; changing the number of units to one or greater will activate the row. The equipment information can be edited to be more descriptive of the actual equipment being considered. The purchase price can be obtained from the website of the distributor or manufacturer.

The estimated years of economic life relate to the duration for which an asset would be functionally viable to the average drone sprayer operator. The drone manufacturer may offer some information about typical longevity of the product. If that is not available, a reasonable estimate for the years of economic life of a drone sprayer, or a similar electronic device, is usually about three to five years.

The salvage value is the estimated worth (resale value) of an asset at the end of its economic life. With the rapid advancement of electronic and drone technology, drone sprayers over five years old may have a limited resale capability due to obsolescence. Some items, such as batteries and propellers, would possess no resale value at the end of their economic life.

Certificates and Licenses Sheet

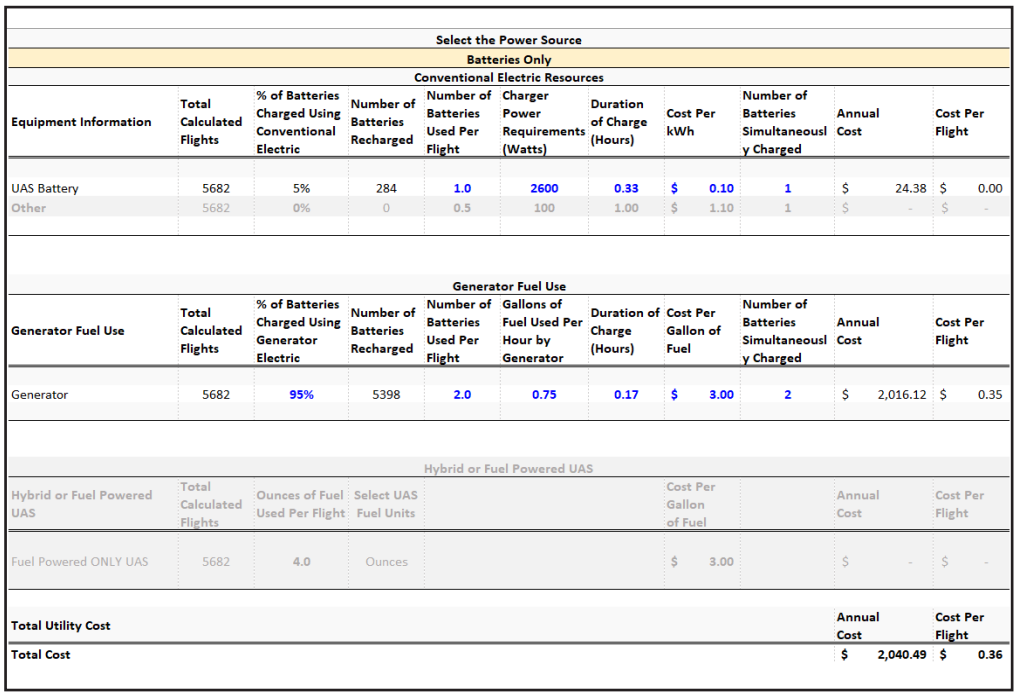
The operation of drone sprayers must follow the rules and regulations laid out by the Federal Aviation Administration (FAA) as well as state and local regulations (Figure 3). Publication AEN-171 enumerates these requirements as they pertain to drone spraying. The certificates and licenses sheet allows users to input the monetary costs of these required certifications.

Utilities Sheet

In this sheet, information associated with energy use is characterized. Select the power source from the drop-down list. Most

Certificates & Licenses for Sprayer Drones	Years Valid	Purchase Price	Annual Cost	Cost Per Flight
Required Federal				
FAA Remote Pilot Certificate Knowledge Exam	2	$ 175	$ 88	$ 0.02
FAA UAS Registration	3	$ 5	$ 5.00	$ 0.00
FAA Part 137 and 107.36 Exemptions (<55 lb.)			$ -	$ -
Agricultural Aircraft Operator Certificate Application			$ -	$ -
49 U.S.C. §44807 Exemption (> 55 lbs)			$ -	$ -
FAA Part 61, 91, and 137 Exemptions (> 55 lb.)			$ -	$ -
Other	0	$ -	$ -	$ -
Optional Federal				
FAA Study Material for Remote Pilot Test	1	$ 20	$ 20	$ 0.00
CFR § 107.35 (Operate Multiple Drones (< 55 lb.)			$ -	$ -
Other	0	$ -	$ -	$ -
Required State (Kentucky)				
Commercial Pesticide Applicator	1	$ 10	$ 10	$ 0.00
Commercial Pesticide Operator	1	$ 25	$ 25	$ 0.00
Other	0	$ -	$ -	$ -
Required Other States				
Other	0	$ -	$ -	$ -
Other	0	$ -	$ -	$ -
Other	0	$ -	$ -	$ -
Total Cost		**$ 235.00**	**$ 147.50**	**$ 0.03**

Figure 3. Certificates and licenses sheet.



Select the Power Source

Batteries Only

Conventional Electric Resources

Equipment Information	Total Calculated Flights	% of Batteries Charged Using Conventional Electric	Number of Batteries Recharged	Number of Batteries Used Per Flight	Charger Power Requirements (Watts)	Duration of Charge (Hours)	Cost Per kWh	Number of Batteries Simultaneously Charged	Annual Cost	Cost Per Flight
UAS Battery	5682	5%	284	1.0	2600	0.33	$ 0.10	1	$ 24.38	$ 0.00
Other	5682	0%	0	0.5	100	1.00	$ 1.10	1	$ -	$ -

Generator Fuel Use

Generator Fuel Use	Total Calculated Flights	% of Batteries Charged Using Generator Electric	Number of Batteries Recharged	Number of Batteries Used Per Flight	Gallons of Fuel Used Per Hour by Generator	Duration of Charge (Hours)	Cost Per Gallon of Fuel	Number of Batteries Simultaneously Charged	Annual Cost	Cost Per Flight
Generator	5682	95%	5398	2.0	0.75	0.17	$ 3.00	2	$ 2,016.12	$ 0.35

Hybrid or Fuel Powered UAS

Hybrid or Fuel Powered UAS	Total Calculated Flights	Ounces of Fuel Used Per Flight	Select UAS Fuel Units	Cost Per Gallon of Fuel	Annual Cost	Cost Per Flight
Fuel Powered ONLY UAS	5682	4.0	Ounces	$ 3.00	$ -	$ -

Total Utility Cost	Annual Cost	Cost Per Flight
Total Cost	$ 2,040.49	$ 0.36

Figure 4. Utilities sheet.

drone sprayers will use either batteries only, fuel only, or a hybrid of batteries and liquid fuel (Figure 4).

Selecting "Batteries Only" as the power source will cause the sections on conventional electric resources and generator fuel use to be activated. Since most of the spraying is likely to be conducted in remote locations, the majority of charging for battery-powered drone sprayers will be done using a generator. In the section related to generator fuel use, the user must input the percentage of batteries charged using an electric generator (0-100%). The remaining percentage will be automatically allocated to the percentage of batteries charged using conventional electrical power, listed in the section on conventional electric resources, as the two values must equal 100 percent. For instance, if the percentage of batteries charged using electric from a generator is set to 95 percent, the percentage of batteries charged using conventional electric power will automatically be changed to 5 percent. To activate the row designated as "Other" in the equipment information column and include it in the cost estimate, change the "% of Batteries Charged Using Conventional Electric" entry within that row to a value greater than zero. Alternatively, to deactivate the row, change the "% of Batteries Charged Using Conventional Electric" entry to zero.

For batteries charged using conventional electric resources, enter additional information to indicate the number of batteries used per flight, charger power requirements (measured in watts), duration of charge (measured in hours), cost per kilowatt-hour (kWh), and number of batteries simultaneously charged. For generator fuel use, input the number of batteries used per flight, gallons of fuel used per hour by the generator, duration of charge (measured in hours), cost per gallon of fuel, and number of batteries simultaneously charged.

If "Fuel Only" is selected as the power source, the hybrid or fuel powered UAS section will be activated. The column titled "Select UAS Fuel Units" allows the drone sprayer to list the fuel used per flight in ounces, pints, quarts, or gallons. The number of units of fuel used per flight and the cost per gallon of fuel would then need to be defined.

If "Hybrid (Battery and Liquid Fuel)" is selected as the power source, all the sections within the utilities sheet will be activated, since both battery and liquid fuel are used to power the drone.

Software Sheet

This sheet addresses the cost of software used (Figure 5). Most drone sprayers come equipped with the software needed for operation; however, some manufacturers or distributors may require specialized software upgrades or licenses for support. Input the initial cost and the number of valid years for the software upgrades or licenses. Please note: If there is a one-time fee and perpetual license, enter "40" as the number of valid years, along with the associated initial cost.

Software	Number of Years Valid	Initial Cost	Annual Cost	Cost Per Flight
Flight Software	0	$ -	$ -	$ -
Post-Processing Software	0	$ -	$ -	$ -
Upgrades & Support License	0	$ -	$ -	$ -
Other	0	$ -	$ -	$ -
Total Cost		**$ -**	**$ -**	**$ -**

Figure 5. Software sheet.

Insurance Sheet

Insurance is necessary to ensure that operators of agricultural drone sprayers protect themselves from financial difficulties that may arise due to equipment damage or claims against the drone sprayer operation. Traditional resources for insurance may not offer the desired coverage or plans needed for drone sprayers; insurance plans from dedicated aviation insurance companies should be investigated. Drone sprayer insurance would typically involve hull insurance and liability insurance (Figure 6). Hull insurance would cover damage to drone sprayer equipment. Liability insurance would cover bodily injury, property damage, and personal injury claims. Depending on the insurance coverage, additional coverage related to the risk associated with chemical transport, application, drift, and potential damages to the client's or neighbor's crops should be considered. As such, it is important to obtain several quotes on different types of coverage plans, keeping in mind that contacting dedicated aviation insurance companies may be required.

Insurance Information	Years Valid	Intial Cost	Annual Cost	Cost Per Flight
Hull Insurance	1	$ 2,500	$ 2,500	$ 0.48
Water Damage			$ -	$ -
Sensors			$ -	$ -
Liability Insurance	1	$ 2,500	$ 2,500	$ 0.48
Public Liability			$ -	$ -
Chemical Liability			$ -	$ -
Comprehensive Chemical Liability			$ -	$ -
Crop Treated Liability			$ -	$ -
Farmer Liability			$ -	$ -
Adjacent Fields Liability			$ -	$ -
Chemical Drift Liability			$ -	$ -
Additional Insurance			$ -	$ -
Payload Coverage			$ -	$ -
Ground Station Coverage			$ -	$ -
Non Owned Coverage			$ -	$ -
Personal Injury Coverage			$ -	$ -
Total Cost		$ 5,000	$ 5,000	$ 0.97

Figure 6. Insurance sheet.

Maintenance and Repairs Sheet

As with other farm equipment, maintenance and repairs are essential for the continuous function and timely deployment of the drone sprayer. Unless the cost for maintenance and repairs for drone sprayers can be more specifically defined, assume it to be at least 5 to 10 percent of the initial cost of the drone (Figure 7).

Equipment Information	Number of Units	Initial Value	Maintenance & Repair	Annual Cost	Cost Per Flight
Maintenance					
UAS Platform	3	$ 18,000	2.5%	$ 1,350	$ 0.26
Mainframe	0	$ 400	2.5%	$ -	$ -
Power Plant	0	$ 400	2.5%	$ -	$ -
Navigation System	0	$ 500	2.5%	$ -	$ -
Electronic System	0	$ 200	2.5%	$ -	$ -
Repairs					
UAS Platform	3	$ 18,000	2.5%	$ 1,350	$ 0.26
Mainframe	0	$ 400	2.5%	$ -	$ -
Power Plant	0	$ 400	2.5%	$ -	$ -
Navigation System	0	$ 500	2.5%	$ -	$ -
Electronic System	0	$ 200	2.5%	$ -	$ -
Total Cost				$ 2,700.00	$ 0.52

Figure 7. Maintenance and repairs sheet.

Chemical Sheets

These sheets allow the cost per acre and the cost per flight of chemical application to be estimated. Complete the estimates for the other sheets prior to entering values into the chemical sheets.

Please note: A chemical sheet must first be enabled from the directory sheet (Figure 1) before it can be accessed.

Important: If more than one chemical sheet will be used, enter information for all the desired chemical sheets before going back to review the numbers.

Input data related to the chemical information, spray volume (including both chemical and carrier), drone sprayer specifications, flight information, personnel responsibilities, and economic considerations. For the chemical information, specify the chemical cost, carrier cost, and chemical application rate. Chemical cost is the cost per unit volume (measured in ounces, pints, quarts, or gallons) for the chemical being applied. In this example (Figure 8), the chemical cost of the corn fungicide is $289.98 per 2.5-gallon container. The chemical cost per gallon will be automatically calculated. Carrier cost per gallon will be the cost per gallon of water or other carrier solution. This may be a real cost from a utility company. If local well water is used, consider including the electricity cost for pumping the water. The chemical application rate is the stated amount (measured in ounces, pints, or quarts) of chemical applied per acre, as specified by the label. The spray volume per acre is the chemical volume plus the carrier volume, as applied per acre. The cost per spray volume is primarily determined by the chemical cost and is automatically calculated.

The drone sprayer specifications (spray tank volume, maximum operating speed for spraying, effective spray width, maximum flow rate, maximum flight time, and maximum sprayer application time) are

used to ascertain both the calculated flow rate required at maximum operating speed and the calculated speed required at the maximum flow rate (Figure 9). Most of the drone sprayer specifications can be found on the manufacturer's website or within the product information. The exception would be the maximum sprayer application time, as this is just an estimate of the minutes of battery power available for spraying minus any ferrying time to and from the spray location. With the limits established by the drone specifications, either the maximum flow rate or the maximum speed will be automatically applied to set the actual operating speed. From the set speed, the operational flight time required to empty the tank completely is calculated and used to determine if a full load or partial load will be applied.

Flight information, such as total acres sprayed and the number of drones used, will determine the total number of flights conducted and the actual UAS spraying time (Figure 10).

Personnel responsibilities must be input as well. The overall labor cost (measured in dollars per hour) can be input and used as the overarching way to set all the individual task labor costs (Figure 11). If multiple drone sprayers are used, the overall labor cost must be adjusted accordingly. Typically, service providers might charge $150 per hour for each drone sprayer flown. Thus, three drone sprayers operated simultaneously would cost $450 per hour. This overall labor cost charged by a service provider would be used to generate income and cover their operating and ownership cost, as well as allowing for a profit.

For farmers or their workers, the overall labor cost estimate would be a flat rate between $8 and $20 per hour and would result in a significant cost savings for the farmer. The overall labor cost for farmers or their workers is dramatically lower than that charged by service providers, but it is based on the opportunity cost of other work that could be performed by the farmers or their workers. Farmers would want to minimize this expense, whereas service providers would charge their customers to optimize their revenue streams.

The duration of time allocated per flight (measured in minutes), as associated with flight planning and setup, ferrying, time spent between flights, post-processing time, visual observer (VO) responsibilities, and

Sheet Status	**Enabled**			
Chemical 1 Name	**Corn Fungicide, 13.7 oz/acre**			
Chemical & Drone Information				
Chemical Information				
Chemical Cost	$ 489.98	per	2.5	gal
Chemical Cost per Gallon	$ 195.99	/gal		
Carrier Cost per Gallon	$ 0.007	/gal		
Chemical Application Rate	13.7	oz Chem. Per Acre		
Spray Volume = (Chemical + Carrier)	**Imperial Units**		**Metric Units**	
Spray Volume Per Acre	3.00	gal/acre	11.36	L/acre
Cost Per Spray Volume	$ 7.00	/gal	$ 1.85	/L

Figure 8. Chemical sheet, showing chemical information.

Drone Sprayer Specifications		
Spray Tank Volume	2.64 gal	9.99 L
Max. Operating Speed for Spraying	15.00 mph	6.71 m/s
Effective Spray Width	16.40 ft	5.00 m
Max. Flow Rate	1.32 gal/min	5.00 L/min
Max. Flight Time	15 min	15 min
Max. Sprayer Application Time	13 min	13 min
~~Calculated Flow Rate Required at Max. ***Operating Speed***~~	~~1.49 gal/min~~	~~5.64 L/min~~
Calculated Speed Required at Max. Operating ***Flow Rate***	13.28 mph	5.94 m/s

Figure 9. Chemical sheet, showing drone sprayer specifications.

Flight Information	
Total Acres Sprayed	2050 acres
Number of Drones Available	3 drones
Number of Drones Used	3 drones
Total Number of Flights	2330 flights

Figure 10. Chemical sheet, showing flight information.

Personnel Information

Overall Labor Cost $ 450.00 /hour

Assumes Simulataneous UAS Spraying

Personnel Responsibilities	Time Allocated Per Flight (Minutes)	Labor Cost ($/hr)	Total Time (Hours)	Annual Cost	Annual Cost Per UAS	Cost Per Flight
Flight Planning & Setup	0.1	$ 450	1.6	$ 2,131	$ 710	$ 0.75
Ferrying	0.5	$ 450	7.9	$ 10,654	$ 3,551	$ 3.75
Actual UAS Spraying Time	2.00	$ 450	31.6	$ 42,615	$ 14,205	$ 15.00
Time Spent Between Flights	0.50	$ 450	7.9	$ 10,654	$ 3,551	$ 3.75
Post-Processing	0	$ 450	0.0	$ -	$ -	$ -
Visual Observer	3.10	$ 20	48.9	$ 2,936	$ 979	$ 1.03
Other	0	$ 450	0.0	$ -	$ -	$ -
Personnel Total Cost				**$ 68,989**	**$ 22,996**	**$ 24.28**
Total Man Hours			**97.86**			
Pilot in Command (PIC) Hours			**48.93**			
Pilot in Command (PIC) Weeks (40 hrs)			**1.2**			
Capacity (Acres Per Hour) PIC			**51.10**			

Figure 11. Chemical sheet, showing personnel responsibilities.

other related responsibilities, will need to be determined. The labor cost will automatically be pulled from the previously input overall labor cost but could be modified for each task, if desired. For instance, the time required for the VO is initially set to be the summation of all the other tasks conducted by the pilot in command (PIC). Depending upon the VO's skillset, the VO may have an hourly rate equal to or less than that of the PIC. The summation of all personnel responsibilities (excluding the VO) will be used to determine the capacity (measured in acres per hour) of spraying that can be conducted by the PIC. The calculated acres per hour should be similar to the rate quoted by the manufacturer.

In the economic considerations section (Figure 12) the cost per flight and cost per acre will be calculated for the UAS, chemical, and combined assets (UAS and chemical). Entering the price per bushel of the crop (listed on the Excel sheet as "$/bu for Crop") allows for the calculation of the breakeven increase in yield when compared to an untreated crop. Depending on whether "Farmer" or "Service Provider" was selected on the total cost sheet, the PIC income or cost will be calculated on a total and per flight basis. The total cost (UAS and chemical) will also be determined.

Within the chemical sheet, the desired total UAS cost of application per acre can instead be input and used to determine the overall labor cost (Figure 13). For instance, the user might input a UAS cost of application per acre of $12 to be competitive with ground-based equipment. Clicking the button to solve for desired cost per acre will cause the sheet to calculate the overall labor cost required to achieve that desired cost per acre of application. In the example, the overall labor cost would be modified from $450 per hour to $72.08 per hour to achieve a $12-per-acre cost of application.

Economic Considerations			
Cost Per Flight			
Total UAS Cost of Application Per Flight	$	29.82	/flight
Total Chemical Cost Per Flight	$	18.48	/flight
Total Cost (UAS & Chemical) Per Flight	**$**	**48.30**	/flight
Cost Per Acre			
Total UAS Cost of Application Per Acre	$	33.89	/acre
Total Chemical Cost Per Acre	$	21.00	/acre
Total Cost (UAS & Chemical) Per Acre	**$**	**54.88**	/acre
$/bu for Crop	$	8.00	/bu
Breakeven ***Increase*** in Yield Bu/Acre Required		6.86	bu
Pilot in Command (PIC) Income	$	54,172.50	
Pilot in Command (PIC) ($/Flight)	$	23.25	/flight
Total Cost (UAS & Chemical)	$ 112,513.19		

Figure 12. Chemical sheet, showing economic considerations.

Total Cost Sheet

The summary of the calculations from the other sheets will be shown in the total cost sheet (Figure 14). On this sheet, the user should define the interest rate and the cost viewpoint as either farmer or service provider. The interest rate is the cost of either having or borrowing money. Interest rate will be used to determine the opportunity cost for the equipment that is purchased, since the money could also be invested in other ventures. Depending on the current economy, a rate of 3–10 percent would be appropriate.

Establishing the cost viewpoint as farmer or service provider allows for the overall labor cost, which is assigned in the chemical sheets, to be viewed as an income stream or a cost. Selecting "Farmer" considers the overall labor cost as only a cost, whereas selecting "Service Provider" views overall labor cost as an income stream. For farmers or their workers using this decision aid, the worksheet assumes that the overall labor cost would be another expense for their operation. For sprayer service providers, the overall labor cost would be assigned to their customers. Thus, this would be the revenue stream for the sprayer service providers.

Desired Total UAS Cost of Application Per Acre	**$**	**12.00**	/acre

Click Here to Solve for Desired $/acre

Figure 13. Chemical sheet allows users to determine overall labor cost based on desired cost per acre.

Parameters			
Number of Flights Conducted Yearly		5682	
Overall Acres Covered		5000	
Interest Rate		6%	
Cost Viewpoint as Farmer or Service Provider		Service Provider	
Expenditures	**Initial Cost**	**Annual Cost**	**Cost Per Flight**
Capital Expenditure			
Equipment Ownership	$ 128,580	$ 18,741	$ 3.30
Interest (Opportunity Cost)		$ 1,560	$ 0.27
Operational Expenditure			
Certificates & Licenses	$ 235	$ 148	$ 0.03
Utilities		$ 2,040	$ 0.36
Software	$ -	$ -	$ -
Insurance	$ 5,000	$ 5,000	$ 0.88
Maintenance & Repair		$ 2,700	$ 0.48
Total Cost	**$ 133,815**	**$ 30,189**	**$ 5.31**
Income			
Total Revenue		**$ 171,359.65**	**$ 30.16**
UAS Sprayer on a Per Acre Basis			
UAS Cost Per Acre		**$ 6.04**	
UAS Revenue Per Acre		**$ 34.27**	
Net Per Acre		**$ 28.23**	

Figure 14. Total cost sheet.

The initial cost, annual cost, cost per flight, and cost per acre will be determined on this sheet. For the farmer, the total cost per acre of spraying will be ascertained. For sprayer service providers, the net per acre will be calculated and should be greater than zero to be considered as a viable business opportunity.

Conclusion

Utilizing an agricultural drone sprayer can be an effective way to apply desired chemicals to a crop. Nonetheless, it is still a purchase that must be evaluated carefully from an economic standpoint. As there are several drone sprayer manufacturers, each possessing multiple lines and sizes of drones, the intended use and specifications of the drone sprayer must be thoroughly evaluated prior to purchasing to ensure the best economic outcome. The numbers developed by this decision aid could be input into partial or annual budgets and used to justify or reject the decision to purchase a drone sprayer. Alternatively, the inputs within this decision aid could be modified and used to determine the potential payback period or the minimum number of acres required to break even from the investment. The feasibility and practicality of a drone sprayer will depend on potential cost savings, time savings, or increased revenue generated on a case-by-case basis.

Cooperative Extension Service

Agriculture and Natural Resources
Family and Consumer Sciences
4-H Youth Development
Community and Economic Development

MARTIN-GATTON COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT

Lexington, KY 40506 Revised 04-2024