COST OPTIMIZATION OF INTERVENTION STRATEGIES TO ERADICATE RABIES IN DAVAO CITY USING LINEAR PROGRAMMING

DARE TO
RESEARCH GRANT

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INTRODUCTION

- Davao City was one of the top ten cities in the country with high rabies incidence in 2017.
- The Rabies Surveillance Report in March 2018 showed that Davao del Sur placed 11th out of 32 provinces with high reported human rabies
- To alleviate this, Davao City's Veterinarian's Office (CVO) has come up with four main intervention strategies – vaccination, castration, impounding of dogs and conducting information education campaigns (IEC).
- Despite the limited budget, the CVO continues to intensify their rabies eradication program. To help them, this research provided a linear programming model that determines the optimal combination of the number of heads (dogs and individuals) to undergo each intervention strategy per district that minimizes the cost of implementation.

OBJECTIVES

☑ Determine the optimal number of dogs to undergo vaccination, castration, and impounding and the number of individuals attending IEC sessions for every district in Davao City using linear programming (LP).

☑ Propose a policy that will help the CVO minimize their implementation cost and at the same time control the rabies spread.

METHODOLOGY

- Data were obtained through interview and existing records from year 2015 to 2016 from the CVO.
- Intervention strategies are: vaccination, castration, impounding, and IEC sessions.
- The districts considered are the following: Poblacion/Agdao, Talomo, Buhangin, Bunawan, Paquibato, Baguio, Calinan, Marilog, Toril, and Tugbok.

Data Gathering → Model Formulation → Solve LP Problem → Analysis and Interpretation

Fig. 1 Flowchart of the Study

The LP model is described below where the objective is to minimize the cost of implementation.

Objective function:

$$Min\ F(x_i^j) = \sum_{j=1}^{10}\left(\sum_{i=1}^{4} c_i^j x_i^j\right)$$

subject to:

$$\sum_{i=1}^{4}\sum_{j=1}^{10} c_i^j x_i^j \le M \qquad \text{(Budget constraint)}$$

$$c_i^j x_i^j \ge L_i^j \qquad \text{(Cost constraint)}$$

$$\sum_{j=1}^{10} x_1^j \ge \alpha \sum_{j=1}^{10} x_2^j \qquad \text{(Castration scaling constraint)}$$

$$\sum_{j=1}^{10} x_1^j \ge \beta \sum_{j=1}^{10} x_3^j \qquad \text{(Impounding scaling constraint}$$

$$x_k^j \ge T_k^j \qquad \text{(Target constraint)}$$

$$\sum_{j=1}^{j} x_1^j \ge 110{,}000 \qquad \text{(Minimum vaccination constraint)}$$

$$x_i^j \ge 0;\ x_i^j \text{ is an integer} \qquad \text{(Nonnegativity integer constraint)}$$

where x_i^j is the unit for measuring intervention strategy i in district j and c_i^j is the associated cost.

RESULTS AND DISCUSSION

- Initially, the model provided an infeasible solution thus it was modified which provided four LP models that generated an optimal solution.
- The cost minimization problem, where the castration scaling constraint, α, was set to 239, has an optimal solution presented in Figures 2 to 5. This model has an objective value of Php 6, 076, 891.

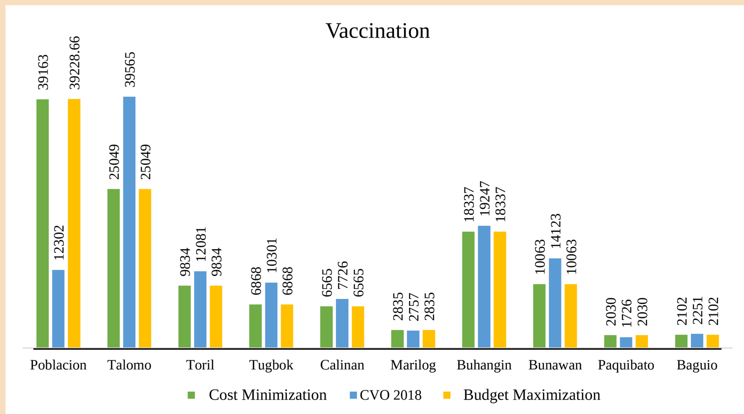

Fig. 2. Model Solutions vs CVO 2018 Performance for Vaccination

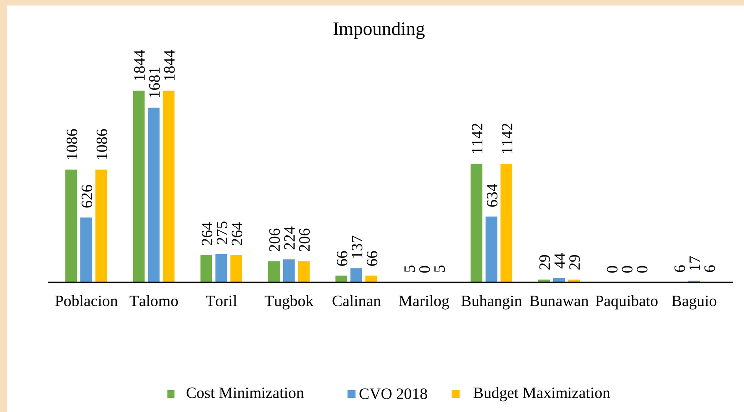

Fig. 3. Model Solutions vs CVO 2018 Performance for Impounding

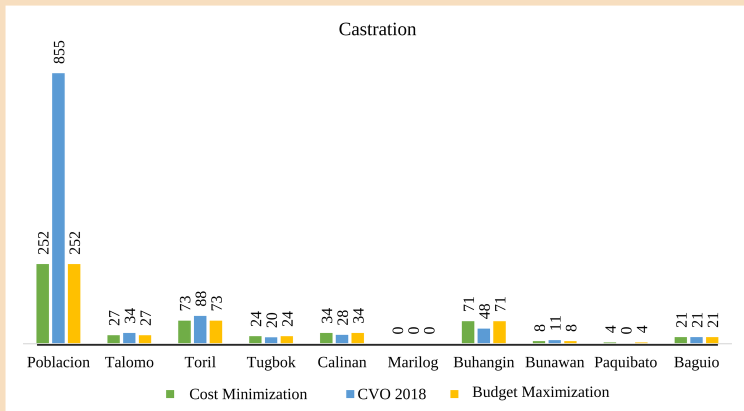

Fig. 4. Model Solutions vs CVO 2018 Performance for Castration

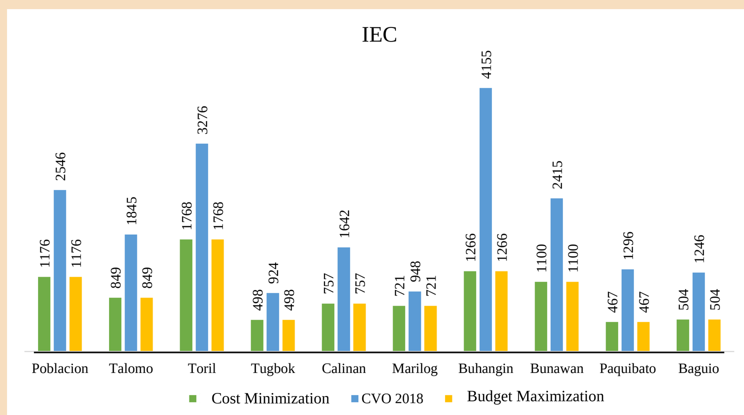

Fig. 5. Model Solutions vs CVO 2018 Performance for IEC

- Given the limited budget of CVO of Php 6, 079,911, the researcher maximized the budget by minimizing the difference of the budget allocated and the cost of implementation.
- However, it was observed that the result of the cost minimization and budget maximization were almost identical.
- The cost minimization problem provided the optimal number of heads to undergo each intervention strategy per district that will minimize the cost, meanwhile the budget maximization problem gave the optimal number of heads that can undergo each intervention strategy.
- Table 1 summarizes the suggested performance that the CVO can implement

SUGGESTED POLICY

Table 1. Suggested performance policy to be implemented

District	Vaccination	Impounding	Castration	IEC
Poblacion	Intensify	Intensify	Minimize	Minimize
Talomo	Minimize	Intensify	Maintain	Minimize
Toril	Maintain	Maintain	Maintain	Minimize
Tugbok	Maintain	Maintain	Maintain	Minimize
Calinan	Maintain	Maintain	Maintain	Minimize
Marilog	Maintain	Maintain	Maintain	Minimize
Buhangin	Maintain	Intensify	Maintain	Minimize
Bunawan	Maintain	Maintain	Maintain	Minimize
Paquibato	Maintain	Maintain	Maintain	Minimize
Baguio	Maintain	Maintain	Maintain	Minimize

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