COMPARATIVE ANALYSIS OF THE ECONOMIC IMPACTS OF LONGER LAY CYCLE BETWEEN DIFFERENT HOUSING SYSTEMS IN CANADA:

The case of Aviary and Enriched Systems

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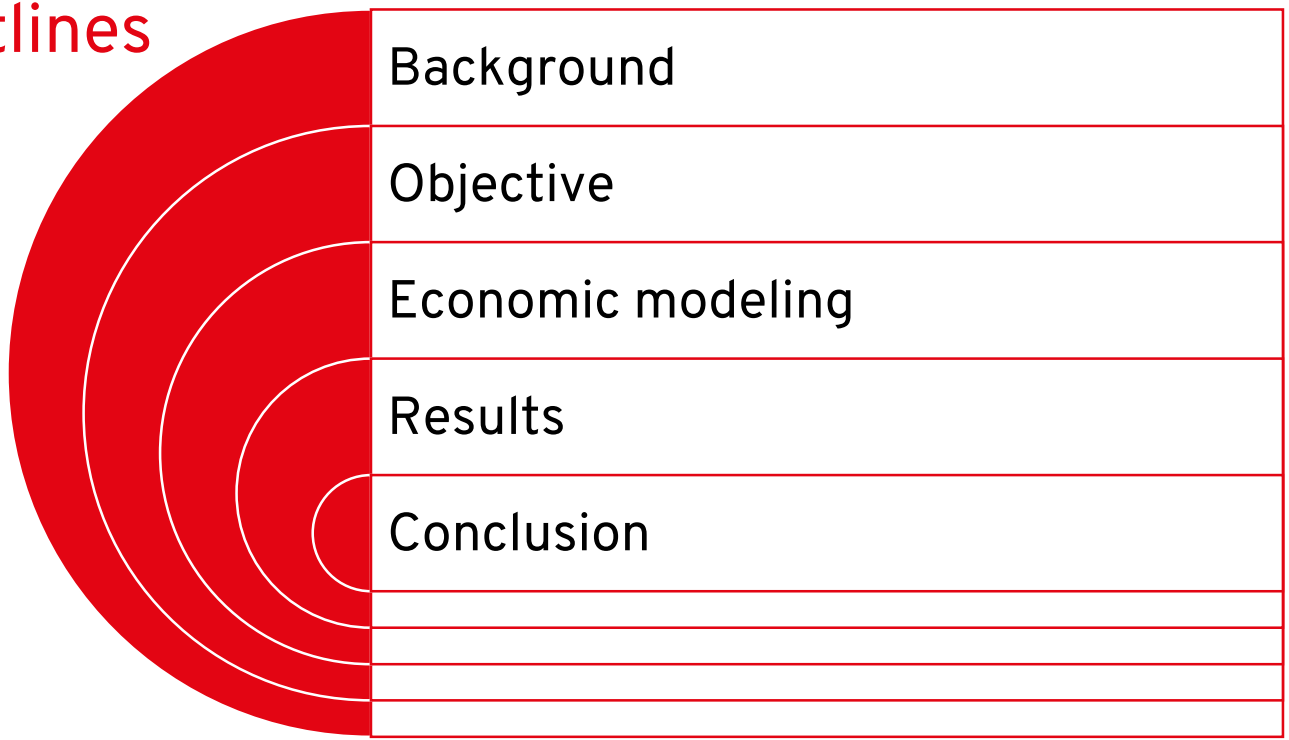
Outlines



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Canadian egg producers are constantly exploring new ways to make egg production more sustainable

- Egg farmers are increasingly interested in enriched housing as opposed to conventional cage
  - Enriched housing provides higher animal welfare than cage free housing systems ;
  - Between 2018 and 2022, the percentage of hens in conventional cages decreased significantly, from 71.38% to 51.17% of hens in Canada, while it more than doubled in enriched housing, from 14.21% to 31.58% (EFC, 2022).
  - Unlike in Europe or certain states such as California, in Canada the transition from battery cage was initiated by egg producers and is taking place more in enriched housing ;

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Canadian egg producers are constantly exploring new ways to make egg production more sustainable

- Longer lay cycles are attracting a lot of interest in Canada, but very few Canadian egg producers have integrated them. **Why ?**
    - Absence of economic impact studies in the context of enriched cage farming (Traore et Doyon, 2023);
    - Longer lay cycles are associated with higher mortality rate (Aerni et al., 2005);
    - Hen productivity and eggshell quality decreases as hen age increases (Samiullah et al., 2017);
    - Longer lay cycles require tighter management practices (Weeks et al., 2016): light control, feed composition and comfort measures.

Objectives

- Help Canadian egg farmers make informed decisions on extending lay cycles in different housing systems
    - Address the lack of comparative analysis of the economic impacts of longer laying cycles between two housing systems of importance in Canada.

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Economic modeling following Traore et Doyon (2023)

Partial budgeting

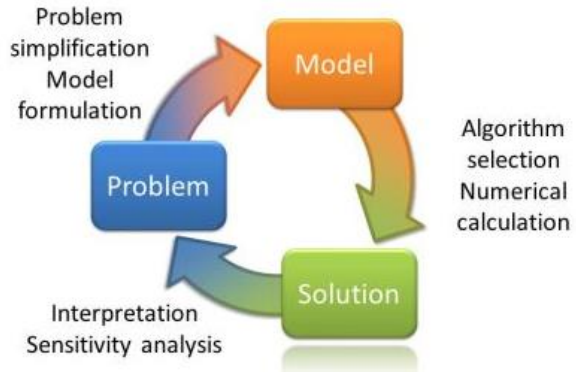
- Consists of comparing costs and benefits of some alternative scenario to the status quo (i.e., 52 week lay cycle).
- Assume that lay cycle extension will impact producer profits by either increasing, reducing, or eliminating income and cost variables.
- Compare the net change in farm unit profit associated with a longer flock cycle compared to a relatively shorter production period.
- To fairly compare the costs and benefits associated with two different production periods, we normalize results such that comparisons are being made on a common basis.

Source: Martin-Gatton College of Agriculture, Food and Environment, Univerty of Kentucky,

Economic modeling following Traore et Doyon (2023)

Mathematical programming model

- The optimization problem is set up as a single-objective, constrained maximization problem with producers' profit as the objective function, and constraints defined in terms of productivity, mortality, and expected egg price.
- The profit corresponds to earnings prior to interest, taxes, depreciation, and amortization (EBITDA).
- The objective is to determine the optimal lay cycle length from an economic perspective
- The optimal cycle length in weeks is defined by any argument that equalizes to zero the marginal profit.



Source: Athens University of Economics and Business

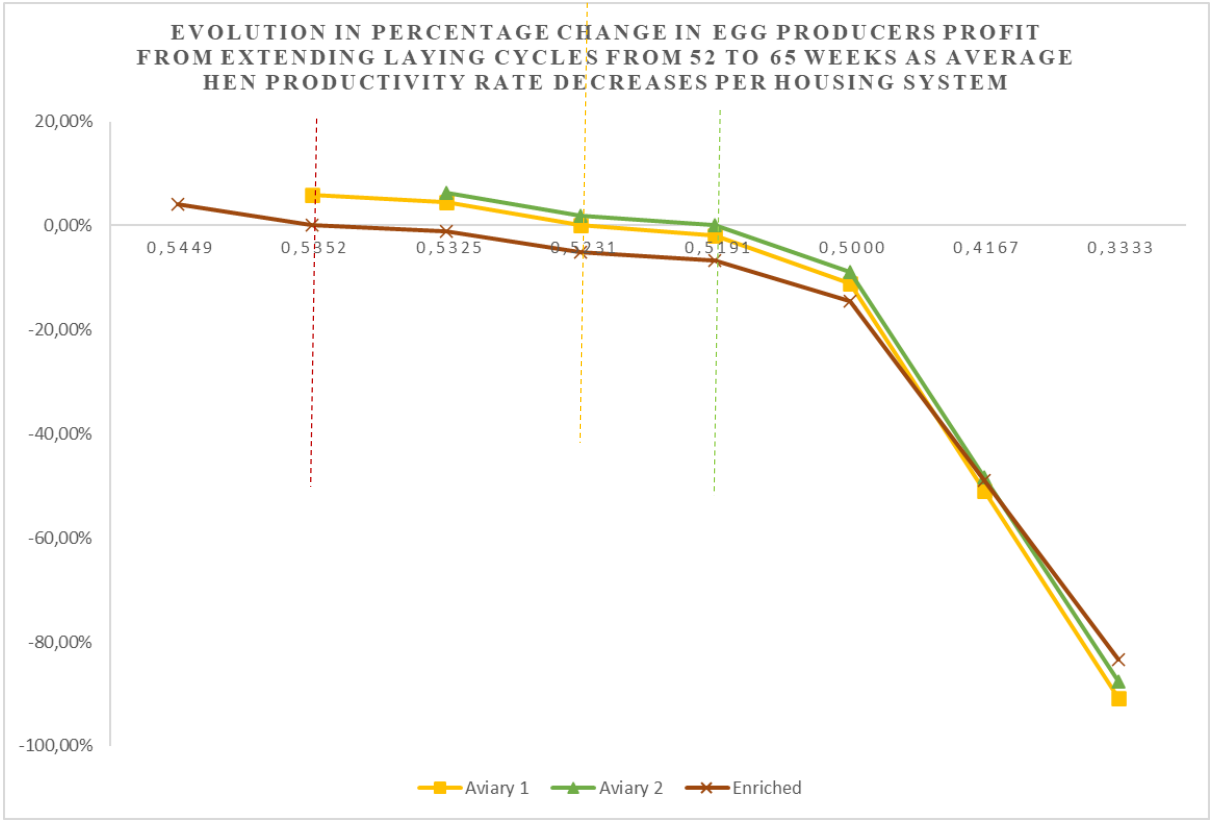
Preliminary Results

Partial budgeting

Item	Hen housing system		
	Aviary 1	Aviary 2	Enriched
Increases in Income			
A. Added income due to change			
(1) Jumbo/Extra/Large eggs (eggs > 56g)	$54 426,81	$62 959,47	$114 096,74
Total A = (1)	$54 426,81	$62 959,47	$114 096,74
B. Reduced costs due to change			
(2) Pullet cost	$72 429,57	$63 887,18	$192 289,85
(3) Feed cost	$5 000,47	$5 157,04	$11 489,19
(4) Capture cost	$3 866,10	$3 828,22	$10 205,81
(5) Cleaning cost	$4 004,00	$4 004,00	$4 004,00
Total B = (2) +(3) +(4) +(5)	$85 300,15	$76 876,43	$217 988,85
Increase in Income = A + B	$139 726,96	$139 835,90	$332 085,59
Decreases in Income			
C. Added costs due to change			
(6) Electricity cost	$108,54	$108,54	$252,32
(7) Labor cost	$675,00	$675,00	$1 134,00
(8) Maintenance and repair cost	$108,54	$108,54	$252,32
(9) Cost associated with more Cracked Eggs	$2 908,67	$2 891,37	$40 825,73
(10) Cost associated with more Dirty Eggs	$478,28	$479,81	$449,44
Total C = (6) +(7) +(8) +(9) +(10)	$4 279,04	$4 263,27	$42 913,81
D. Reduced income due to change			
(11) Medium eggs (eggs > 49g)	$60 122,71	$56 664,20	$144 357,69
(12) Small eggs (eggs > 42g)	$17 198,29	$15 974,58	$23 369,18
(13) Peewee eggs (eggs < 42g)	$1 557,05	$1 425,25	$4 001,26
Total C = (11) +(12) +(13)	$78 878,06	$74 064,03	$171 728,13
Decrease in Income = C + D	$83 157,10	$78 327,30	$214 641,94
Net Income = **Increase in Income - Decrease in Income**	$56 569,86	$61 508,60	$117 443,65
Percentage change in Net Income	5,82%	6,37%	4,00%

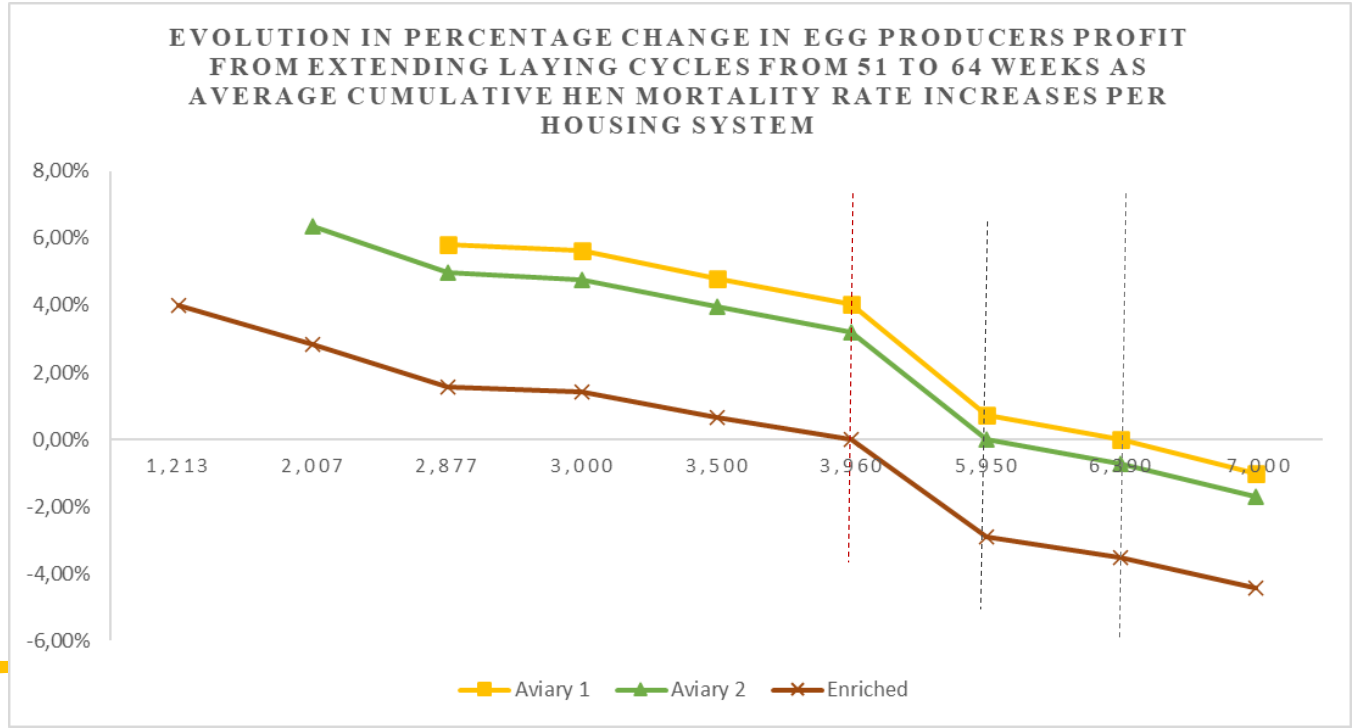
Preliminary Results

Sensitivity analysis



Preliminary Results

Sensitivity analysis



Preliminary Results

Optimization

		Aviary 1	Aviary 2	Enriched
OPTIMAL VALUE				
Length of production cycle (# of weeks)		70	68	71
Productivity (dz/hen/week)		0,563	0,528	0,527
Cumulative mortality (%)		5,53	4,45	2,70
FONCTIONS AND ESTIMATED PARAMETERS				
Hen productivity				
$y_{Week} = (\frac{7}{12})aWeek^b + e^{(-cWeek+dWeek)}$	a	2,993	5,787	2,020
	b	4,303	1,741	0,091
	c	-0,095	-0,008	0,077
	d	-2,564	-0,622	1,053
Cumulative mortality				
$CM_{Week} = \alpha_0 + \alpha_1 Week$	α_0	0,0066	-0,0033	-0,0015
	α_1	0,0007	0,0007	0,0004
Average price				
$\overline{Price}_{Week} = \beta_0 + \beta_1 Week$	β_0	1,850	1,850	2,018
	β_1	0,006	0,006	0,003

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Conclusion

- Adopting a longer laying cycle is more a trade-off between potential economic gain and other concerns such as the flock management efforts needed to prevent hen mortality and maintain hen productivity rate and eggs quality.
- The choice of an appropriate housing system is quite important.
- This paper, through a comparative analysis based on real farm-level data, generates economic information to help Canadian egg farmers make informed decisions on extending lay cycles in two housing systems of importance in Canada.
- Preliminary results suggest that both types of housing systems exhibit positive economic impact of longer lay cycles.

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