Egyptian Journal of Rabbit Science, 35(1): 73- 83(2025

Economics Of Production Of Two Rabbit Breeds And Their Cross Under Two Feeding Regimes

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ABSTRACT

A study was carried out to assess the economics of production (all costs of production fixed with feed costs as the only variable) of New Zealand White (NZW), California White (CAL) and their Cross (Z×C) under two feeding regimes; concentrate based diet (feeding regime 1) and forage based diet (feeding regime 2).

Regardless of the feeding regime, the (Z×C) recorded least feed intake thus lowest feed cost compared to the pure breeds. Total Feed intake was significantly higher (P<0.01) in feeding regime 2 than feeding regime 1. Despite the high feed intake under this feeding regime, lowest total feed cost was recorded due to low cost of the Rhodes grass hay (Ksh.10kg^{-1} compared to the concentrate diet (Ksh. 31kg^{-1}). When production cost was extrapolated for 100 doe unit for a year production cycle, feeding regime 1 (4.3) was still profitable because of the higher fryer crops per doe per year than feeding regime 2 (3.1).

***Conclusively,** it was also concluded that more revenue was generated when animals were sold as breeding stock rather than meat, regardless of the feeding regime, in Kenya.*

***Key words:** Cost of production; feeding regime; rabbit breeds, profit margin*

INTRODUCTION

Feed cost is estimated to represent over 70% of the total cost of producing livestock intensively (Oluyemi, 1984). The cost of feed is particularly high when concentrates are used (Cheeke, 1986). This high cost of feed is driving the shift to other farm animals that are able to utilize non-conventional feeds such as the rabbit (Mmereole *et al*., 2011) hence making the production system more profitable and sustainable (Anugwa *et al*., 1982).

Several researchers have demonstrated the economic importance of non-conventional feeds in livestock feeding (Ekpo *et al*, 2009). Farinu (1994) and Ekpo *et al*. (2009) concluded that it was economical to rear rabbits on mixed diet consisting of cassava based concentrate and forage.

Concentrates as feed are relatively expensive compared to forage (Lebas *et al*., 1986) hence cheaper feeding regimens that will not compromise on growth and slaughter weight at the target age will be of economic importance. It is also noteworthy that rabbits fed on forages as sole diet generally grow at a lower rate and attain the target slaughter weight at a later age, necessitating supplementation with concentrates. Though rabbits have been reported to perform best when fed on high concentrate diets, (Farinu, 1994), the ever increasing costs of grains has created a need to augment both the energy and protein requirements with forages (Mmereole *et al*., 2011). Given this challenge, this study was undertaken to assess the economics of production of New Zealand White (NZW), California White (CAL) and their Cross (Z×C) under concentrate and forage based feeding regimes. In this study, all costs of production were held constant, except feed costs.

Therefore, this study aimed to evaluate economics of production of New Zealand White, California White rabbit breeds and their cross under two feeding regimes, in Kenya

MATERIALS AND METHODS

The experiment was carried out at the rabbit Unit, Department of Animal Production, Faculty of Veterinary medicine, University of Nairobi. The experimental animals, experimental design, experimental diets and rabbit feeding management was discussed in a previous study (Wanjala *et al.*, 2016). Briefly, ten females of each breed (NZW and CAL) were mated to obtain the purebred litters. Another 10 NZW females were mated with CAL males to obtain the crossbreed (Z×C). Each of these does was bred twice to produce two litters for the two feeding trials. A complete random design (CRD) with a 3 × 2 factorial arrangement of treatments (three rabbit genotypes) and two feeds (concentrate or forage based diets) was applied. At weaning, the litters were randomly allocated to either of the feeding regimes and fed until they attained a 2kg live weight. The experiment had three replicates per litter per doe per feeding regime.

Grower rabbits on either of the two experimental diets were monitored from weaning to attainment of 2kg target weight. The chemical analysis of the

Table 1: Ingredient and chemical composition of the concentrate ration on dry matter (DM) basis

Ingredient	Percentage	Chemical composition	Percentage
Maize grain	15.3	Moisture	11.4
Wheat Bran	15.0	Crude protein	16.05
Pollard	28.8	Ether extract	4.12
Rice Bran	12.6	Crude fiber	11.29
Rhodes Hay	10.0	Total ash	8.56
Cotton seed cake	6.3	Nitrogen free extract	48.58
Soybean Meal	6.3	Calcium	1.14
Limestone	2.3	Phosphorus	0.56
Dicalcium phosphate	0.3	DE (kcal/kg)	2910.18
Premix*	0.09	ME (kcal/kg)	2820.82
Lysine (100% CP)	0.27		
Methionine	0.27		
Molasses	1.8		
Urea	0.40		
Salt	0.27		
Total	100.0		

**2 kg of premix contains: Vit A;12,500,000.00IU: Vit D_3;2,500,000.00IU: Vit E;25,000.00IU: Vit K;2,250.00mg: Vit B_1;2,000.00mg: Vit B_2;5,000.00mg: Biotin; 60.00mg: Folic acid;1,000.00mg: Iron; 40,000.00mg: Cobalt; 800.00mg: Copper; 6,000.00mg: Manganese;80,000.00mg: Vit B_6; 5,000.00mg: Vit B_{12}; 20.00mg: Pantothenic Acid; 10,000.00mg: Niacin;25,000.00mg: Choline-Cl;300,000.00mg: Zinc;50,000.00mg: Iodine;1,500.00mg: Selenium;300.00mg: Antioxidants;qs: Carrier:qs.*

Table 2: Chemical composition on DM basis of Rhodes grass hay offered

Parameters	(%)
Crude Protein	8.32
Moisture	86.95
Dry Matter	91.4
Ash	13.05
Crude Fiber	34.2
Neutral detergent fiber (NDF)	66.25
Acid-Detergent Fiber (ADF)	40.51
Lignin	8.58

feeds are shown in Tables 1 and 2. The concentrate ration was formulated to meet the recommended nutrient requirements of rabbits by
NRC, (1977). Concentrate ration and water was offered *ad libitum* to does. Growers on concentrate based diet were offered feed *ad libitum* but water was restricted to two hours daily for the first three weeks post weaning, then *ad libitum* to the end of the experiment.

Growers on forage based diet, were offered chopped rhodes grass (*Chloris gayana*) hay *ad libitum*. Hay offered was weighed weekly and the intake estimated as the difference between initial weight of the hay and final weight of the left over hay. The rabbits were also supplemented with the formulated concentrate diet at 50% of expected *ad libitum* intake of the balanced concentrate intake (i.e. 25g/d, 35g/d, 45g/d, 55g/d for week 6-9) then fixed at 60g/d per animal from 10th week till the end of the experiment.

Determination of reference carcass and Data Collection

Five fryers per breed per feeding regime (total 30) were randomly selected for slaughter to evaluate the carcass characteristics. The rabbits sampled for slaughter were between the weights of 2000 – 2500g. The carcasses were dissected in accordance with the norms of the World Rabbit Science Association (WRSA) (Blasco and Ouhayoun, 1996).

To determine the effect of breed and feeding regime on performance of grower rabbits, the following data was collected: Initial body weight of weaners at 6 weeks of age, live weight (average of the animals per cage as each cage was considered a unit) on weekly basis until the end of the trial (2kg weight). Feed intake was calculated as the difference between feed offered and the left-over also on a weekly basis. Feed conversion efficiency was calculated as the amount of feed intake per unit of live weight gain. Mortalities were recorded as they occurred.

Assessment of feed costs and returns

Cost of feed was calculated based on prevailing cost of ingredients per kilogram as at the time the experiment was conducted (Ksh.31 kg^{-1} for concentrate and Ksh.10 kg^{-1} for Rhodes grass hay). The quantity of feed consumed for the experimental period per unit weight gain of rabbits was used to assess the cost of feed kg^{-1} weight gain. The Kenya shilling (Ksh) to United States Dollar (USD) exchange rate was at 100.

The price of meat per kg was calculated at the prevailing market price of Ksh. 400 kg^{-1}. Price of fur was also calculated at the prevailing market price set by the Kenya Leather Developmental Council (KLDC) of Ksh. 50 per piece.

Statistical analyses

Data collected for weight gain, feed intake and reference carcass were subjected to Analysis of Variance (ANOVA) procedure using the package Genstat software (Genstat, 13th edition, 2011) for windows. When analysis of variance indicated significance for treatment effects, specific differences between means were ranked using the Bonferroni Test.

RESULTS AND DISCUSSION

Feed intake and Weight gain

Table 3 shows the results for total feed intake, average weekly gain, total weight gain, total feed costs, mortality rates and the cost per unit weight gain of rabbits for the two feeding regimes

Feed intake was significantly different between the feeding regimes ($P<0.01$) and also within a feeding regime ($P<0.05$) with the Z×C recording the lowest feed intake followed by the CAL and NZW in that order.

Uunder feeding regime1 the Z×C had the lowest feed intake due to earlier attainment of 2kg target weight (12 weeks) than both NZW and CAL (13 weeks). This feed intake trend was also reported by Ozimba and Lukefahr (1991). Feed intake was highest in feeding regime 2 than in feeding regime 1 attributed to the longer feeding time (17 weeks). The Z×C rabbit also had the lowest feed intake under the feeding regime 2 for the same reason that it attained the target weight earlier (15 weeks) than the pure breeds (17 and 18 weeks for NZW and CAL respectively).

Weekly average weight gains were highly significantly different ($P<0.01$) between the feeding regimes but not within a feeding regime. Regardless of the feeding regime the crossbreed recorded highest average weekly weight again of the three genotypes followed by CAL and finally the NZW.

The higher weight gain of rabbits under concentrate based diet are in agreement with Pinheiro *et al*. (2011) who noted that rabbits kept under intensive system on high concentrate diets gained more weight than those kept under extensive system on forages.

Table 3: Feed intake, weight gains and cost of weight gain of grower rabbits fed on concentrate and roughage based diet.

	Feeding regime 1 (Concentrate based diet)			Feeding regime 2 (Forage based diet)			SEM	Sig
	NZW	CAL	Z×C	NZW	CAL	Z×C		
Total feed intake (kg)	5.912 ± 67^{by}	5.591 ± 32^{abxy}	5.148 ± 20^{ax}	8.635 ± 43^{dy}	9.66 ± 88^{az}	7.533 ± 3.0^{cx}	0.16	***
Concentrate supplementation (kg)				1.6	1.68	1.48		NS
Total hay intake (kg)				7.03	7.98	6.05		NS
Average weekly gain (g)	198.5 ± 2.2^{cx}	200.0 ± 7.1^{dx}	208.9 ± 3.2^{dex}	140.5 ± 2.9^{ax}	147.1 ± 5.8^{abx}	156.6 ± 3.7^{bx}	10	***
Total weight gain (g)	1227 ± 22^{abx}	1319 ± 1.9^{bxy}	1278 ± 2.1^{abx}	1255 ± 8.52^{abx}	1291 ± 11^{abx}	1201 ± 10.20^{ax}	34.6	**
FCR	4.818 ± 0.1^{bxy}	4.23 ± 0.03^{abxy}	3.966 ± 0.02^{ax}	6.898 ± 0.05^{cx}	7.393 ± 0.11^{cx}	6.272 ± 0.06^{cx}	0.232	***
Total feed Cost(Ksh)	183.2 ± 2.1^{dxy}	173.3 ± 0.99^{dxy}	159.59 ± 0.7^{cx}	120 ± 0.43^{abx}	131.9 ± 0.88^{bxy}	106.4 ± 0.30^{ax}	3.21	***
Cost/Kg weight gain(Ksh)	150.1	131.3	124.9	96	102.2	88.6		NS
Average post weaning mortality rate (%)		14.6 ± 0.82^{b}			6.3 ± 0.31^{a}		0.21	***

abcde Means within same row with different superscripts are significantly different between the feeding regimes.
xyz Means within same row with different superscripts are significantly different within a feeding regime.
NS- Non significant (P>0.05); P<0.05)**; (P<0.01***)
NZW: New Zealand White; CAL: California White, Z×C-Crossbreed

Cost per kilo weight gain

Lower total feed intake translated to lower feed cost thus the Z×C recorded lowest feed costs than the purebreds regardless of the feeding regime. The total feed cost were significantly ($P \leq 0.01$) different across the three genotypes within a feeding regime as well as between the feeding regimes with high average cost of Ksh.172 and Ksh.119 for feeding regime 1 and 2 respectively. Although high feed intake was recorded in feeding regime 2 than in feeding regime 1, the low average total feed cost is because of the cost of the feed (Ksh. 35 and Ksh.10 for concentrate diet and Rhodes grass hay respectively)

Therefore the cost per kilo weight gain was lower under feeding regime 2 and was lowest for the Z×C at Ksh.88.6 (USD 0.87) followed by NZW and CAL. The Z×C also had the most favorable cost per kilo weight gain at Ksh.124.9 (USD 1.25) while the NZW had the highest at Ksh.150.1 (USD 1.50) under feeding regime 1. These observations are in agreement with Ozimba and Lukefahr (1991) who noted that at 70 d the Z×C and CAL yielded better returns than NZW under intensive systems of feeding. Ekpo *et al* (2009) concluded that rabbit production systems based on unconventional feeds (cassava tuber meals) led to lower cost of production due to lower cost of the raw material. These observations further suggest that the NZW is better produced through forage based diets than the CAL.

Cost of producing a kilo of edible meat and returns analysis

Data in Table 4 shows the costs incurred and the estimated revenue from edible meat yield for the two feeding regimes.

As expected the cost of producing a kilo of edible meat was lowest for feeding regime 2 (Ksh.104.5) than feeding regime 1 (Ksh.152).

To enable the cost analysis for a feeding regime, calculation for a 100 breeding does unit for 1 year production cycle were done with the following assumptions:

1. A rabbit production unit with 100 breeding does and production time of 1 year, doe mortality of 22% (Farghaly *et al*, 1994) per year thus available does at 78.
2. 5.2 litter crops per doe per year (when weaning and rebreeding is done at 6 weeks post-kindling).
3. Pre weaning mortality at 8.3% with average litter size at birth of 8.6 thus average number of kits at weaning of 6.
4. Post weaning mortality at 14.6% and 6.3% for regime 1 and 2 respectively, thus fryers available for market will be 5.12 and 5.62 per litter.

Table 4: Cost of producing a kilo of edible meat for the two feeding regimes

Items	Feeding regime 1 (concentrate based diet)			Feeding regime 2 (Forage based diet)			SEM	Sig
	NZW	CW	Z×C	NZW	CW	Z×C		
Reference carcass (g)	1086	1122	1199	1078	1294	1061	51	NS
Total feed Cost (Ksh)	183.2[dy]	173.3[dy]	159.6[cx]	120[abxy]	131.9[by]	106.4[ax]	3.21	***
Cost/Ref carcass (Ksh/kg)	168.7[ax]	154.5[by]	133.1[cz]	111.3[dx]	101.9[ey]	100.3[ey]	4.71	***
Average cost/Ref carcass per feeding regime(Ksh/kg)		152.09[a]			104.5[b]		2.13	***

[a,b,c.d,e] Means within same row with different superscripts are significantly different between the feeding regimes.
[x,y,z] Means within same row with different superscripts are significantly different within a feeding regime.
NS- Non significant (P>0.05); P<0.05) **; (P<0.01***).
NZW:New Zealand White, CW: California White, Z×C-Crossbreed

5. Off take rate (fryers crops per doe per year) at 4.3 and 3.1 for feeding regime 1 and 2 respectively (based on 12 weeks for feeding regime 1 and 17 weeks for feeding regime 2 to slaughter weight attainment).
6. The total feed cost per fryer for feeding regime 1 at Ksh.172 (total average feed costs for the three groups of animals) and for feeding regime 2 at Ksh.119 (total average feed costs for the three groups of animals).
7. Average dressed weight for feeding regime 1 at 1.1357kg and for feeding regime 2 at 1.1443kg.
8. Average cost of producing 1 kg of edible meat at Ksh. 152.1 and Ksh.104.5 for feeding regime 1 and 2 respectively (Table 4).
9. Price of rabbit meat at Ksh.400 per kg and price of skin at Ksh.50 per piece.
10. Animals sold as live animals at 2 kg at Ksh. 850 (according to APD rates).

Cost and returns analysis

As shown in Table 5, higher returns would be realised by adopting the more intensive feeding system which results in more animals being available either for slaughter or sale of live animals in a year.

Table 5: Cost and returns analysis

Itms	Feeding regime 1	Feeding regime 2
Meat	4,056,579	3, 234,415
Skin	446,484	353,318
Total Income	4,503,063	3,587,733
Total feed cost	1,542,514	844,991
Profit Margin	2,960,548	2,742,742
Breeding stock profit margin	6,078,440	5,161,685

The difference in profit margin between feeding regimes 1 and 2 where the rabbits were slaughtered would be 217,806 (USD 2,179) per annum in favour of feeding regime 1. The same trend persists when the animals were sold live with even larger differences in realisable income of 916,755 (USD.9, 168) in favour of the more intensive feeding system. The returns were higher with both feeding systems when the animals were sold live than when animals are slaughtered.

Conclusion And Recommendations

The crossbreed performed better than the purebreds regardless of a feeding regime. Though the less intensive forage based feeding system translated to lower cost of production per unit weight of product, fewer animals would be available for disposal which would result in lower returns from a 100 doe breeding unit. Therefore this study recommends that use of concentrate feeds in rabbit production should be promoted by the stakeholders due to the better productivity when compared to forage use. However due to high feed costs which resource poor farmers cannot afford, the government, feed manufactures, donors and other stakeholders should come up with ways to reduce these costs for example use of cheaper raw materials, provision of subsidies and or financing.

ACKNOWLEDGEMENTS

I would like to acknowledge the following institutions; National Commission for Science, Technology and Innovations (NACOSTI) under the project 'Strategies to Promote the Rabbit Value Chain in Kenya' for funding this project; Department of Animal Production, University of Nairobi, for the technical support.

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