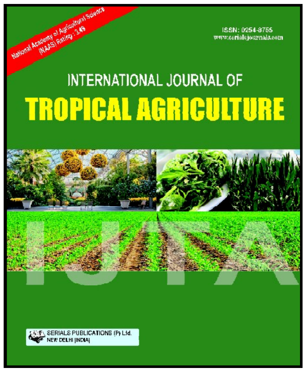

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Goal Programming Model to find least Cost Ration for Non-pregnant Dairy Buffaloes: An Alternative Approach

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Abstract: A GP model is developed for non-pregnant dairy buffalo weighing 450 kg, yielding 10 L milk with 6% of fat content and considering standard nutrient requirement on dry matter basis considering all the 7 out of 8 goals as maximization function. Only the first goal is of minimization in nature as it represents cost function. In the earlier work [12] the GP model considered all the 8 goals, as minimization function which was not depicting the reality results. Hence a thorough review of the model in consultation with the Research Scientist and Nutrionists from NIANP is done, and it was concluded that all the 8 goals were of maximizing nature within the permissible range. This new GP model is solved by real coded GA with hybrid function and the results obtained are in sync with reality.

Keywords: Dairy feed, least cost, real coded genetic algorithm, Goal Programming

INTRODUCTION

Appropriate feeding is the most important feature in dairy buffalo's management as the feed costs accounts for more than half of the total milk production (Jimmy *et al.,* 1080). The quantity of feed that is utilized for milk production should be optimum as well as satisfy the nutrient requirement for the animal, to increase the profitability of dairy farmer. The LP model developed deals with single objective of minimizing the feed cost and rigid constraints. Whereas converting an LP model to GP Model gives lot of flexibility in decision making. The rigid constraints can be considered as a goal with a specific target with permissible deviations and the solution can be seen in terms of underachievement, over achievement or fully achieved. Fixing the priorities of each goal also leads to multiple solutions and a judicial decision can be made depending upon the preference of the dairy farmers.

Goal programming model 1

$$\text{Min } Z = \sqrt{p_1(d_{cost}^{+})^2 + p_2(d_{CP}^{-})^2 + p_3(d_{TDN}^{-})^2 + p_4(d_{Ca}^{-})^2 + p_5(d_{Ph}^{-})^2 + p_6(d_{Rough}^{-})^2 + p_7(d_{Conc}^{-})^2}$$

Subjected to

1. Goal 1 (Minimize Least Cost): $\Sigma_{i=1}^{21} C_i\, x_i + d_{cost}^{-} - d_{cost}^{+} = 101.6073$
2. Goal 2 (Maximize Crude Protein): $\Sigma_{i=1}^{21} CP_i + d_{CP}^{-} - d_{CP}^{+} = 1.7158\, Kg$
3. Goal 3 (Maximize Total Digestible Nutrient): $\Sigma_{i=1}^{21} TDN_i + d_{TDN}^{-} - d_{TDN}^{+} = 9.1835\, Kg$
4. Goal 4 (Maximize Calcium): $\Sigma_{i=1}^{21} Ca_i + d_{Ca}^{-} - d_{Ca}^{+} = 0.0748\ Kg$
5. Goal 5 (Maximize Phosphorus): $\Sigma_{i=1}^{21} Ph_i + d_{Ph}^{-} - d_{Ph}^{+} = 0.0405\, Kg$
6. Goal 6 (Maximize Roughages): $\Sigma_{i=1}^{8} Rough_i + d_{Rough}^{-} - d_{Rough}^{+} = 13.136\, Kg$
7. Goal 7 (Maximize Concentrates): $\Sigma_{i=9}^{21} Conc_i + d_{Conc}^{-} - d_{Conc}^{+} = 3.2840\, Kg$
8. $\Sigma_{i=1}^{21} x_i = 16.42\, Kg$

where p_i $(i = 1, 2..7)$ are positive number between (0, 1) Such that $p_1 > p_2 > \ldots p_7$.

RESULTS

Table 1
Least cost and Deviation value solved by Hybrid RGA for Goal Programming models

Feed Stuff's	*Values*
Dry Matter Basis	
Paddy straw	0.0272
CO-4 grass	0
Maize fodder	0
Co Fs 29 sorghum fodder	0
Ragi Straw	0.0171
Berseem	13.074
Wheat straw	0.0156
Maize Stover	0.0022
Maize	0.0505
Soya DOC	0
Copra DOC	0.0053
Cotton DOC	0.0006
Wheat Bran	0.0227
Gram Chunies	0.0231
cotton seed	0.4741
chickpea husk	0.0151
Concentrate Mix Type I	0.0057
Calcite	1.4125
MM	1.1399
DCP	0.0001
Salt	0.1344
Deviations	
d_{cost}^{-}	0.0021
d_{cost}^{+}	0
d_{CP}^{-}	0
d_{CP}^{+}	0.4508
d_{TDN}^{-}	0
d_{TDN}^{+}	0.0901
d_{Ca}^{-}	0
d_{Ca}^{+}	0.9891
d_{Ph}^{-}	0
d_{Ph}^{+}	0.0499
d_{Rough}^{-}	0
d_{Rough}^{+}	0
d_{Conc}^{-}	0
d_{Conc}^{+}	0

Constraints

Dry Matter Intake (DMI)	16.42
Crude Protein (CP)	2.1666
Total Digestible Nutrient (TDN)	9.2736
Calcium (Ca)	1.0639
Phosphorus (P)	0.0904
Roughage	13.136
Concentrates	3.2840
Least cost on DM Basis	**101.6052**

RESULTS AND DISCUSSION

On assigning the weights P_1 (goal 1: cost), P_2 (goal 2: CP), P_3 (goal 3: TDN), P_4 (goal 4: Ca), P_5 (goal 5: Ph), P_6 (goal 6: Roughage), P_7 (goal 7: Concentate) as 0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.3 and solving the GP Model, using RGA with hybrid function, we obtain $d_{\cos t}^{-} = 0.0021$, $d_{CP}^{+} = 0.4508$, $d_{TDN}^{+} = 0.0901$, $d_{Ca}^{+} = 0.9891$, $d_{Ph}^{+} = 0.0499$ and rest of the deviational variables $d_{\cos t}^{+}$, d_{CP}^{-}, d_{TDN}^{-}, d_{Ca}^{-}, d_{Ph}^{-}, d_{Rough}^{-}, d_{Rough}^{+}, d_{Conc}^{-}, d_{Conc}^{+} are zero. We observe that goal 1 is overacheived, goal 2, 3, 4, 5 are underachieved whereas goal 6 and 7 is fully achieved without any deviation with minimum of $Z = 0$. The result obtained in this work is better than the results obtained for GP model 1 in [12]. On comparing the result obtained by [12], $d_{\cos t}^{-}$, d_{DM}^{-}, d_{CP}^{-}, d_{TDN}^{-}, d_{Ph}^{-}, d_{Rough}^{-} are overacheived whereas d_{Ca}^{-}, d_{Ca}^{+}, d_{Conc}^{-}, d_{Conc}^{+} are fully achieved due to which constraints accept calcium and concentrates are not satisfied with least cost of Rs 100.7965/- on DM basis, and the reason for not satisfying the constraints by goal programming model is adding the deviation variables to dry matter basis i.e. Dry matter intake is one of the fixed constraints hence it has to be treated as constraints rather than treating that as a goal. Whereas in the present work after considering all the loopholes a new goal-programming model is developed which gives the improved solution in which almost all the constraints are satisfied including our high priority goals (least cost and Dry matter intake). The obtained result does not completely accept by nutritionist, as the reason for underachieved and overacheived target need to be analyzed, where the choice of final solution depends on the nutritionist and there is a need of further discussion with nutritionist for better output.

CONCLUSION

The present work focused on improving the solution of dairy buffalo of body weight 450 kg in third lactation period, where buffalo need ration for body maintenance with 10-liter milk production (6% fat content). Nutrient Requirements of buffalo is calculated by Excel based computer programme developed by NIANP, Bangalore, as per the Indian Council of Agricultural Research-ICAR 2013 and NRC 2001 standard. An alternate goal-programming model is formulated based on linear model developed by [12] and solved by real coded genetic algorithm with hybrid function. Results obtained shows that the present goal-programming model can be used to formulate the least cost diet plan for dairy buffaloes, however fixing the constraints and use of code for making software is considered while choosing the technique for making least cost diet plan. Further detailed research with various additional constraints needs to fine-tune the technique.

REFERENCES

Annual Report 2016-17. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers.

Angadi, U. B., Anandan, S., Gowda, N. K. S., Rajendran, D., Devi, L., Elangovan, A. V. and Jash, S. (2016) " Feed Assist"- An Expert System on Balanced Feeding for Dairy Animals", AGRIS on-line Papers in Economics and Informatics, Vol. 8, No. 3, Pp. 3

- 12. ISSN 1804-1930, DOI 10.7160/aol.2016.080301

A. R. Rehman, Evolutionary algorithms with average crossover and power heuristics for aquaculture diet formulation [Ph.D. thesis], University Utara Malaysia, Sintok, Malaysia, 2014.

Basic Animal Husbandry & Fisheries Statistics 2017, AHS Series-18, Government of India Ministry of Agriculture & Farmers Welfare Department Of Animal Husbandry, Dairying And Fisheries Krishi Bhavan, New Delhi.

FAO. 2012. Balanced feeding for improving livestock productivity – Increase in milk production and nutrient use efficiency and decrease in methane emission, by M.R. Garg. FAO Animal Production and Health Paper No. 173. Rome, Italy.

Jimmy H. Clark and C. L. Davis, 1980. "Some aspects of feeding high producing dairy cows", Journal of Dairy Science, 1980, 63:873.

Leng, R.A., 1991. Feeding strategies for improving milk production of dairy animals managed by small-farmers in the tropics. Feeding dairy cows in the tropics. (Eds. Speedy, A. & Sansoucy, R.) Proceedings of the FAO Expert Consultation held in Bangkok, Thailand, p.82.

M. Koda, "Chaos search in Fourier amplitude sensitivity test version," Journal of Information and Communication Technology, vol. 11, pp. 1–16, 2012.

M. A. Şahman, M. Çunkaş, Ş. İnal, F. İnal, B. Coşkun, and U. Taşkiran, "Cost optimization of feed mixes by genetic algorithms," Advances in Engineering Software, vol. 40, no. 10, pp. 965–974, 2009.

Nutrient Requirements of Animals-Cattle and buffalo (ICAR-NIANP), 2013, ISBN: 978-81- 7164-139- 9

Rehman, T. and Romero, C. 1984. Multiple-criteria decision-making techniques and their role in livestock ration formulation. Agri. Sys.15, Pp.23-49.

Ravinder Singh Kuntal, Radha Gupta, Duraisamy Rajendran and Vishal Patil , (2017), "Study of Real Coded Hybrid Genetic Algorithm (RGA) to find least cost ration for non-pregnant dairy buffaloes", (Accepted for publication in proceeding of Scopus indexed AISC series of Springer: in 7th International Conference on Soft Computing for Problem Solving - SocPros 2017 at IIT Bhubaneswar)

Ravinder Singh Kuntal, Radha Gupta, Duraisamy Rajendran and Vishal Patil, 2016. Application of real coded genetic algorithm (RGA) to find least cost feedstuffs for dairy cattle during pregnancy. Asian J. Anim. Vet. Adv., 11: 594-607.

Radha Gupta, Ravinder Singh Kuntal, Kokila Ramesh, 2013.Heuristic Approach to Goal Programming Problem for Animal Ration Formulation. International Journal of Engineering and Innovative Technology (IJEIT), Volume 3, Issue 4, Pp. 414-422.

Shilpa, Jain, Dinesh, Bisht and Prakash, C., 2013(3). Comparative Analysis of Real and Binary Coded Genetic Algorithm for Fuzzy Time Series Prediction. International Journal of Education and Information Sciences, 299-304.

Zoran Babic., Tunjo Peric.(2011) optimization of livestock feed blend by use of goal Programming", Int. J. Production Economics, 130, Pp.218–223.

19 Livestock Census-2012 All India Report Ministry of Agriculture Department Of Animal Husbandry, dairying and fisheries Krishi Bhavan, New Delhi.