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COMPARATIVE EVALUATION OF PRODUCTION VARIANTS OF ANIMAL FEED PLANT

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Abstract: A pelletized feed production unit to cater the need of nutritionally balanced, optimally processed, cost and time effective availability of feed for livestock /aqua farming may be adapted as a potential business enterprise. The feed pellet manufacturing technology may be commercialized through modular design and development of feed production unit accordingly established at *CIAE*, Bhopal. The reason for wanting to achieve such an objective is to warrant investment made in establishment of feed manufacturing unit. The feed production economy is analyzed the justification of manufacturing of feed production volume by acceptance of profitable idea through determination of economic variables on production variant such as working capital (₹), breakeven point (month), payback period (*a*), benefit cost ratio and internal rate of return (*IRR* in per cent). Four different pelletized feed production variants were evaluated, variant No. 01 and 02 are specifically designed for multicultural feed requirement under mixed / integrated farming (livestock-crop-fish) combination and variant 03 and 04 for solely dairy feed requirements have been taken into consideration. All these 04 production variants have been presented as economically viable enterprise for appropriate selection on capacity utilization and marketability of the finished feed.

Key words*: livestock-aqua feed**, feed production variants, capacity utilization, economic variability parameters, comparative evaluation and INR.*

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INTRODUCTION

Farmers now realized maintaining of quality animals with appropriate feeding is vital to meet increased domestic and export demand of livestock / aqua products. The proportion of crossbred / improved breeds of animals has necessitated higher demand for nutritionally balanced and optimally processed feed. The kind of quality feed availability at cost and time effective scale would be the pre-requisite for sustainability of livestock and aquaculture enterprises in the region.

Further, to ensure quality and time effective feed production, the primary goal is to be very particular into the production and marketability aspects. Hence, the primary objective of feed formulation, processing and production is to provide livestock breeds and fish in particular with quality feed having sufficient nutritional balance, efficacy, digestibility, palatability, acceptability, storability, handling and ease of transport [6].

In this regard, an aqua (multipurpose) feed production pilot plant has been established at Central Institute of Agricultural Engineering, Bhopal, India producing aqua, poultry and cattle processed feed. The scope of the *CIAE* livestock-aqua feed pilot plant had been further augmented in view of harnessing potential demand of multicultural activities (livestock-crop-fish) combination for production of feed for aquatic, avian / ovine and bovine farming [7].

Therefore, the plant is considered to be the best fit design for promotion and development of integrated farming (agriculture-animal husbandry-aquaculture-rural industries) activities. In this paper, under the comparative evaluation of feed plant variants, the variant No.01 is considered as *CIAE* livestock-aqua feed production unit [1].

However, other feed production variant, such as variant No. 02 or other may be opted on the basis of scale-up and downsizing of *CIAE*, Bhopal feed plant respectively for facilitating and encouraging multicultural (integrated agricultural-animal husbandry-aquaculture) activities. However, in many regions within the country and outside, wherein only dairy enterprise is feasible due to socio-economic impact [5], the exclusive establishment of dairy feed production unit is found to be better judgmental from sustainability and profitability view point for all stakeholders.

Consequent upon, exclusive installation of dairy feed production unit, elimination of some of the unit operation machinery and its accessories (viz. water container for steam, water supply arrangement for steam generation, steam generator, water softener, steam conditioner, steam valve and steam supply line, hot water jacket in paddle mixer conveyor unit, pellet crumbler unit and small configuration pellet dies for pellet diameter varies from 3-4 mm) would result in substantial cost reduction on dairy feed production. The basis for selection of particular feed production plant design is required to be finalized both on techno-economic feasibility scale as well as on socio and ecological parameters [4] if scale of benefit is to be visualized.

MATERIAL AND METHODS

It is based on demand forecasting analysis dairy and poultry, dairy and aquaculture as well as dairy, poultry and aquaculture (integrated farming) the feed production variant No.1 and No.2 may be installed and commissioned. Further, dairy alone is also one of

the activities, in which India has the distinction of evolving new technologies on one hand and successfully adapting the promising technologies on the other. Hence, dairy has enough potential to initiate feed production unit establishment at the cottage or small level of enterprise [2]. Therefore, solely for catering pelletized feed requirement for dairy enterprise variant No. 03 or 04 may be opted (Table 1).

Table 1. Various types of multipurpose/ sole feed production variants

S.No.	*Type of feed production variant*	*Gross price (million, ₹)*
01	*CIAE multipurpose feed production plant*	*1.087*
02	*Scale-up multipurpose feed plant*	*2.5*
03	*Minimum economic size production unit solely for dairy*	*0.8*
04	*Scale-up economic size production unit solely for dairy*	*1.5*

The following have been the assumptions (Tab. 2) considered for the economic viability analysis [3] of the four commercial feed production plant variants, may be proposed as adaptable business ventures Feed plant produces relatively homogeneous feed, hence its capacity can be measured in number of units of output per unit of time as feed produced in $q \cdot h^{-1}$ can be set as a standard example for design and development of variants of feed production plant.

Table 2. Assumptions of production variants under economic viability analysis

Sr No	*Particulars of Assumptions*	*Variant 01*	*Variant 02*	*Variant 03*	*Variant 04*
1	*Initial Cost of feed plant (₹)*	*1.087.000*	*2.500.000*	*800.000*	*1.500.000*
2	*Estimated life of feed plant*	*12*	*14*	*12*	*14*
3	*Production capacity ($q \cdot h^{-1}$)*	*1*	*10*	*1*	*2*
4	*Operation of feed plant ($h \cdot d^{-1}$)*	*16*	*8*	*16*	*10*
5	*Annual plant operation days (d)*	*300*	*150*	*300*	*300*
6	*Direct labour cost (₹)*	*10.000*	*18.000*	*10.000*	*15.000*
7	*Cost on shed construction (₹)*	*150.000*	*250.000*	*150.000*	*200.000*
8	*Raw material cost (₹)*	*11.440*	*60.000*	*11.440*	*14.300*
9	*Miscellaneous LS charges (₹)*	*60.000*	*75.000*	*50.000*	*72.000*
10	*Price of feed (₹ $\cdot d^{-1}$)*	*1.000*	*1.000*	*1.000*	*1.000*
11	*Fixed cost on per q feed (₹)*	*94,3*	*59,2*	*101,9*	*90,9*
12	*Variable cost per q feed (₹)*	*744*	*755,8*	*744*	*738,2*
13	*Total cost on production /q (₹)*	*838,3*	*815*	*845,9*	*829,1*
14	*Contribution (₹)*	*256*	*244,2*	*256*	*261,8*

RESULTS AND DISCUSSION

References in the Tab. 3, Tab. 4 and Fig. 1 have been produced on account of completion of economic analysis of capacity utilization and capital expenditure for different feed production variants by taking into consideration the parameters assumed under Tab. 2.

Table 3 Parameters of Financial Viability of Feed Plant

Variant Sr. No.	Initial Cost (₹ million)	Working Capital (₹ million /a)	Profitability Index (Benefit Cost Ratio)	Break Even Point (month)	Pay Back Period (a)	IRR (%)
1	1,087	1,0296	1,193	4,42	3,04	27,75
2	2,5	2,65	1,227	2,90	2,53	30,98
3	0,8	0,85	1,182	4,77	3,79	29,11
4	1,5	1,875	1,206	4,17	3,61	23,37

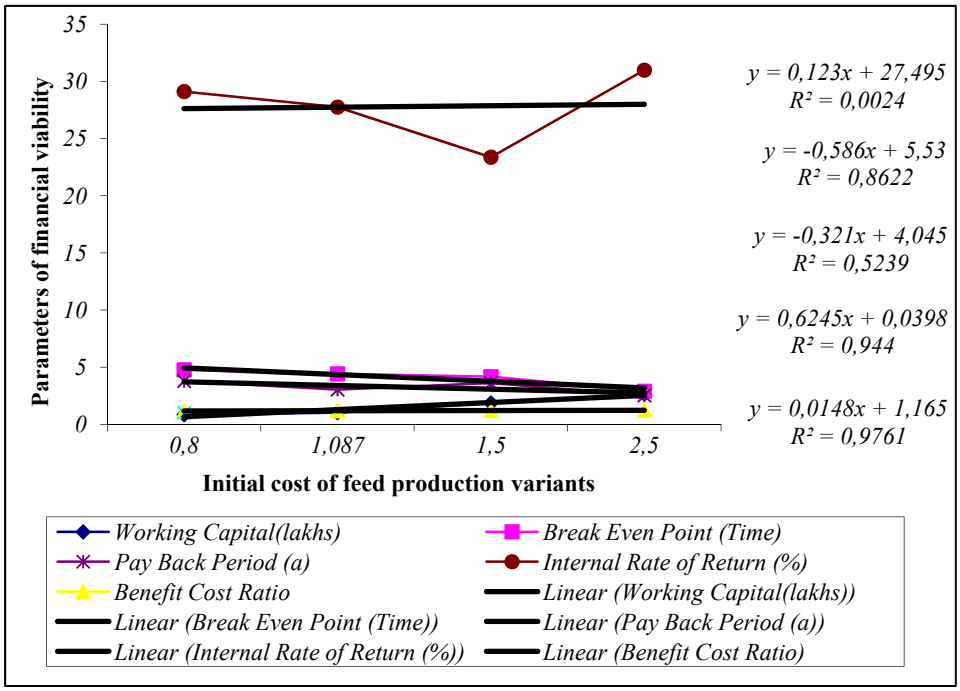

Fig. 1 Initial costs versus other economic parameters

Table 4 Relationship of Independent Vs Response (dependent) Variables

Sr. No.	Initial Investment Vs. economic parameters	Deviation	Coefficient of Correlation (r)	Regression Equations
1	Working Capital (Rs lakhs)	R^2=0.9400	0,970	Y = 6.2454X + 0.398
2	Profit amount (Rs , lakhs)	R^2=0.9760	0,814	Y = 0.0140X + 1.165
3	Break Even Point (Months)	R^2=0.8600	0,930	Y = -0.5860X + 5.530
4	Pay Back Period (Annum)	R^2=0.5230	0,724	Y = -0.3210X + 4.045
5	Internal Rate of Return (%)	R^2=0.0024	0,049	Y = 0.1230X +27.495

Working Capital

The working capital requirement is the minimum amount of resources that a production unit cover effectively as cost necessary to operate the business. The working capital (Table -3, column II) includes the cost of raw material inventory for 03 months.

This has been the fixed amount that remains more or less permanently invested for ones as working capital in production unit. There has been excellent correlation of 0.94 exists with the initial cost of feed plant vs. working capital. It is higher the initial capital investment the greater would be the capacity to produce feed and ultimately more of the raw material and finished feed inventory would require to use into the plant operational system. However, for higher capacity plant the high working capital investment require assured market of quality processed feed. Many a times due to socio economic problems the total operational days of production unit may get drastically reduced.

Profitability Index (*PI*)

The profitability index (PI) or benefit cost ratio (*BCR*) (Eqt. 1) is an alternative way of stating the net present value (*NPV*) help in choice of profitable feed plant variant pertaining to marketability. A shortcoming of *BCRs* is that, by definition, they ignore non-monetized impacts.

$$PI = Present\ Value\ of\ Cash\ Inflows\ /\ of\ Cash\ Outflows \quad (1)$$

A profitability index of 1.0 means one has achieved exactly one's set target of sustainability of enterprise i.e. rate of return greater than 1.0 means one has exceeded one's pre-set rate of return. It is most commonly used method for comparing economic alternatives. The objective is to determine whether the benefit (gained) in return to any cost (spent) is favorable.

The profitability index (Table 3 and column IV) varies from 1,193 (variant No.1), 1,227 (variant No. 2), 1,182 (variant No. 3) and 1,206 (variant No. 4). The profitability index reveals that variant 2 and variant 4 shows *PI* values more than 1,2 reflect that variants having maximum capacity utilization due to assured product utilization back-up farming practices would generate more income and benefit.

Break Even Points

Break-even is the point at which total revenue equals total costs (Eq. 2, 3 and 4). At levels of output below the break-even point the business will be making a loss vice versa a profit. Due to its simplicity a new business will often have to present a breakeven analysis to its bank in order to get a loan. However, its disadvantage is that, it assumes that everything produced is sold; often not all output will be sold.

$$Contribution = Selling\ Price - Variable\ cost \quad (2)$$

$$Break\ Even\ Point\ (₹) = (Fixed\ Costs\ X\ Sales) / (Contribution) \quad (3)$$

$$Brake\ even\ Point\ Feed\ Sold\ (q) = Fixed\ Costs / Contribution\ per\ (q) \quad (4)$$

It is from Tab. 3, the breakeven point of variant 02 (Table 3 column (V)) have the least value i.e. 2.90 indicates that opportunity exists for encouraging investment if forward, backward and sideway linkages are well facilitated (i.e. vertical and horizontal integration of feed production unit) to sustain in the production catchment.

Pay Back Period

Payback period is simple to compute (Eq. 5), provides some information on the risk of the investment and provides a crude measure of liquidity. It does not indicate any concrete decision criteria to understand whether an investment increases the feed production firm's value. However, as a drawback, it provides no measure of profitability.

$$\textit{Pay Back Period} = \textit{No. of preceding years before final recovery} + \left(\frac{\textit{Balance recoverable amount}}{\textit{cash flow during the year of final recovery}}\right) \quad (5)$$

The payback period (Table 3, column (VI)) payback period is least and second to the least i.e. 2.53 a and 3.04 a for variant 2 and variant 1 respectively, point out that sustainability and profitability of multicultural activities are always beneficial for on farm management of agriculture-aquaculture-animal husbandry-agro-industrial activities to encourage for sustainability for growing human population requirement.

Internal Rate of Return

The internal rate of return is a rate of return used in capital budgeting to measure and compare the profitability of investments. It is considered to be very important economic parameter for investment viability factor analysis for variant selection. It is that rate which equates the present value of the future cash inflows with the cost of the investment which produces them. *IRR* calculates (Eq. 6) an alternative cost of capital including an appropriate risk premium. It takes into account the time value of money. The cost of capital if less than *IRR* then project proposal may be considered as an alternative for investment decision.

$$\textit{IRR} = \textit{Lower rate of discount} + \left(\frac{\textit{Net present value at lower rate of discount}}{\textit{Difference in present values at lower and higher discount rates}}\right) X \left(\textit{Difference in two rates of discount}\right) \quad (6)$$

The internal rate of return *IRR* (table 3, column (VII)) is greatest and second to the greatest are 30.98 % and 29.11 % for variant 2 and 3 respectively, point out that strong linkage under production-supply chain, would ultimately ensure higher *IRR* shall foresee encouraging economic returns. As per (Fig. 1) initial investment has excellent correlation with working capital, profitability index and breakeven point. However, there has been moderate correlation exist with payback period and poor correlation observed with initial investment versus internal rate of return (*IRR*) for all the variants investigated under optional studies.

CONCLUSIONS

Out of above four feed production variants, variant No. 01 and No. 02 may be opted for integrated agriculture-aquaculture-animal husbandry activities. The variant no. 01 may be opted for limited demand of feed. On the other hand, if sufficient feed demand is

available for sustainable multicultural activities (such as dairy, goat , poultry enterprise inclusive of aquaculture farms) then production variant No. 2 has maximum economic returns i.e. least time for breakeven point, payback period and high percentage of internal rate of return (*IRR*) and top most profitability index. The government subsidy and local economic impact may also be considered as crucial deciding factors for variant No. 01 and variant No. 02. While variant 3 or 4 may be opted solely for feed production for dairy enterprise. Therefore, reliable information about economic viability may emerge on appropriate capacity utilization of feed production unit.

In case if investor wants to play under safe game-plan by avoiding risks and also confined with limited investment potential for augmentation of feed business then the best idea would be to choose production variant no. 3 though herein breakeven point and payback period are little longer but internal rate of return is high in comparison to other variant 1 and 4. Variant No. 02 has ultimately least of working capital requirement, early payback period, greater internal rate of return, better profitability index than that of variant no.3.

The idea floated on account of economic analysis through application of parameters viz. Working Capital, Profitability Index (*PI*), Break Even Point (*BEP*), Pay Back Period (*PBP*), Internal Rate of Return (*IRR*), may either be implemented or rejected under the specific choice of alternative available for production variants may it be integrated farming/ mixed farming or eventually organized dairy development in unit way or under the cluster approach. Herein, the ultimate objective is to grow more nutritious food for growing human population. In this direction, establishment of unit like multipurpose feed production variant or exclusive dairy feed production unit based on maximum capacity utilization of available resources would prove to be a boon to generate sufficient scope for sustainable and profitable returns under agrarian economy.

BIBLIOGRAPHY

[1] Ambalkar, P.P., Singh, J., Bhandarkar, D.M. 2003. Techno-economic feasibility of feed plant in rural sector. *37th ISAE annual convention and symposium,* January 29-31, 2003, MPUAT, Udaipur, India.

[2] Banerjee, G.D., Banerjee, S. 2004. *Tea Industry – A Road Map Ahead*. Abhijeet Publications, Delhi, pp-37-54.

[3] Koutsoyiannis, A,1979. *Modern Microeconomics.* The Macmillan Publication. London.

[4] Olaloku, E.A. 1976. Milk production in West Africa: Objective and Research approaches. *Journal of the Association for the Advancement of Agricultural Sciences in Africa* 3(1). p.p. 5-13.

[5] Pullan, N.B., Grindle, R.J. 1980. Productivity of white Fulani cattle on the Jos Plateau Nigeria. IV. Economic factors. *Tropical Animal Health and Production*. 12, p.p. 161-170.

[6] Sarkar, S.K. 2002. *Freshwater Fish Culture - Volume 1- Integrated Fish Farming.* Daya Publication, p.p. 247-260.

[7] Singh, J., Singh, G. 2001. *Aqua Feed Plant Broacher*, Central Institute of Agricultural Engineering, Nabibagh, Berasia Road, Bhopal,MP, India.

UPOREDNA PROCENA PROIZVODNIH VARIJANTI UREĐAJA ZA PROIZVODNJU KONCENTROVANE STOČNE HRANE

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Sažetak: Uređaj za proizvodnju peletirane hrane koja zadovoljava potrebe za balansiranom ishranom, optimalnim preradom, troškovima i efikasnim iskorišćenjem vremena pri ishrani životinja / riba može se prilagoditi za profitabilnu proizvodnju. Tehnologija proizvodnje peletiranog hraniva može da se komercijalizuje modularnom konstrukcijom i razvojem uređaja za proizvodnju hraniva prema onom koji je razvijen u Centralnom institutu za poljoprivrednu tehniku u Bhopal-u u Indiji. Razlog za postizanje ovog cilja je sigurna investicija u razvoj uređaja za proizvodnju hraniva. Analizirana je ekonomska opravdanost proizvodnje određene količine hraniva prihvatanjem profitabilne ideje kroz određivanje ekonomskih promenljivih uticaja na proizvodnu varijantu, kao što su radni kapital (₹), tačka rentabilnosti (mesec), period otplate (*a*), odnos prihoda i troškova i interna stopa prinosa (*IRR* u procentima). Proučavane su četiri različite varijante proizvodnje peletirane hrane. Varijante br. 01 i 02 su posebno predviđene za višekomponentnu hranu kod mešovitog / integrisanog stočarstva (životinja-biljka-riba), a kombinacija varijanti 03 i 04 samo za ishranu muznih krava. Sve 4 varijante su predstavljen kao ekonomski održiva preduzeća za odgovarajući izbor kapaciteta i konkurentnosti finalnog proizvoda.

Ključne reči*: stočna hrana, varijante proizvodnje hraniva, korišćenje kapaciteta, parametri ekonomske varijabilnosti, uporedna procena i INR*.

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