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Decision Support System (DSS) for Techno-Economic Viability Analysis of Livestock cum Aqua Pellet Feed Plant

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ABSTRACT: *A decision support system (DSS) has been developed using (C++) computer language for appraisal of managerial economy on technically assessed production input data of pellet feed plant. Primarily, the pellet production unit to produce feed either for cattle and fish, poultry and fish or cattle, poultry and fish. Since, the cost of feed is the major share about (60-70%) of the cost of production of livestock-aqua products. Hence, by using the developed decision support system (DSS), the dependent managerial economic variables viz. total production cost, net income after taxes, return on investment (RoI), breakeven point (BEP), payback period (PBP), internal rate of return (IRR), net present worth (NPW) and benefit cost ratio (BCR) is possible for instant determination of operational feasibility of production unit. For validation of DSS two smaller capacity size commercially available feed production were analysed for their techno-economic viability. Therefore, the feed production unit should be selected from their minimum commercial sizes scale availability, so that the entire integrated farming potential of the production catchment can be harnessed. Further, the availability of variety of feed raw material provides opportunities for increased use of DSS as an algorithm.*

Key words: *Algorithm, Decision Support System (DSS), Pellet feed Production unit, Integrated livestock-aquaculture-agriculture, Techno-economic viability.*

INTRODUCTION

In designing an industrial project for rural development, the planners not only establish the base of social, institutional, environmental and technical standards but also focus more on economic and financial viability base. It becomes more important to increase weightage to techno-economic viability analysis, where project sponsors tend to try to ensure that limited funds are used to enhance economic development by generating additional resources for the managerial economy. Hence, in addition to technical aspects the instant determination of economic variables helps in maintaining operational feasibility of feed production unit under the integrated farming set-up approach. The sustainability and consistent profitability of feed processing unit provide the basis for existence and encouragement of livestock cum aquaculture as integrated activities in the production catchment.

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The instant determination of managerial economic dependent variables viz. fixed cost, variable cost, net income after taxes, annual profit, return on investment (RoI), breakeven point (BEP), payback period (PBP), internal rate of return (IRR), net present worth (NPW) and benefit cost ratio (BCR) as discussed by Anonymous [1] using DSS as an algorithm (C++) Lafore [5] would help in ensuring sustainability and profitability of any agro processing unit. The

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multiplicity of variety of raw produce and their availability from different sources can also enhance the prospects of income, entrepreneurship opportunities and employment generation. Since, the cost on feed is the major share about 60-70% to the cost of production of livestock-aqua products. The feed production unit should be so designed that the designed production capacity (0.7 t/h to 2 t/h) should be optimally utilized Singh J. and Singh G.[11] under integrated farming concept also ensure expected water availability.

METHODOLOGY

The decision support system (Fig. 1), an algorithm (C++) provides quick appraisal of techno economic feasibility analysis variables. It derives suitable production capacity available, justifying the sustainable livestock cum aqua feed utilization potential and its scope for facilitating more viable integrated farming practices in the production catchment. The limitation of the DSS software is that it can be applied, where the cash inflows (net income after taxes) are constant in nature for every year. However, upon increase in annual feed production the input data would vary and instantly determine the changed output values. The potential for integrated aquaculture (Fig. 2) exists in many developing countries but more research is needed if the development of integrated livestock-fish farming systems is to be enhanced. Reliable quantitative production and management guidelines are yet to be generated, recorded and disseminated to serve as a baseline for development programmes Pullin and Shehadeh [8]. Since, there are adverse conditions develop due to increase in raw material prices, per unit energy cost, increase in manpower wages and increase in maintenance charge (conditions I to IV) given below in flow chart. The production costs are compared to assumed producer price and compared with market price of feed. Therefore, the production unit performance is to be continuously assessed, without affecting its market share, enabling more consistency in competence as more market share gainer by using the algorithm (DSS) as follows:

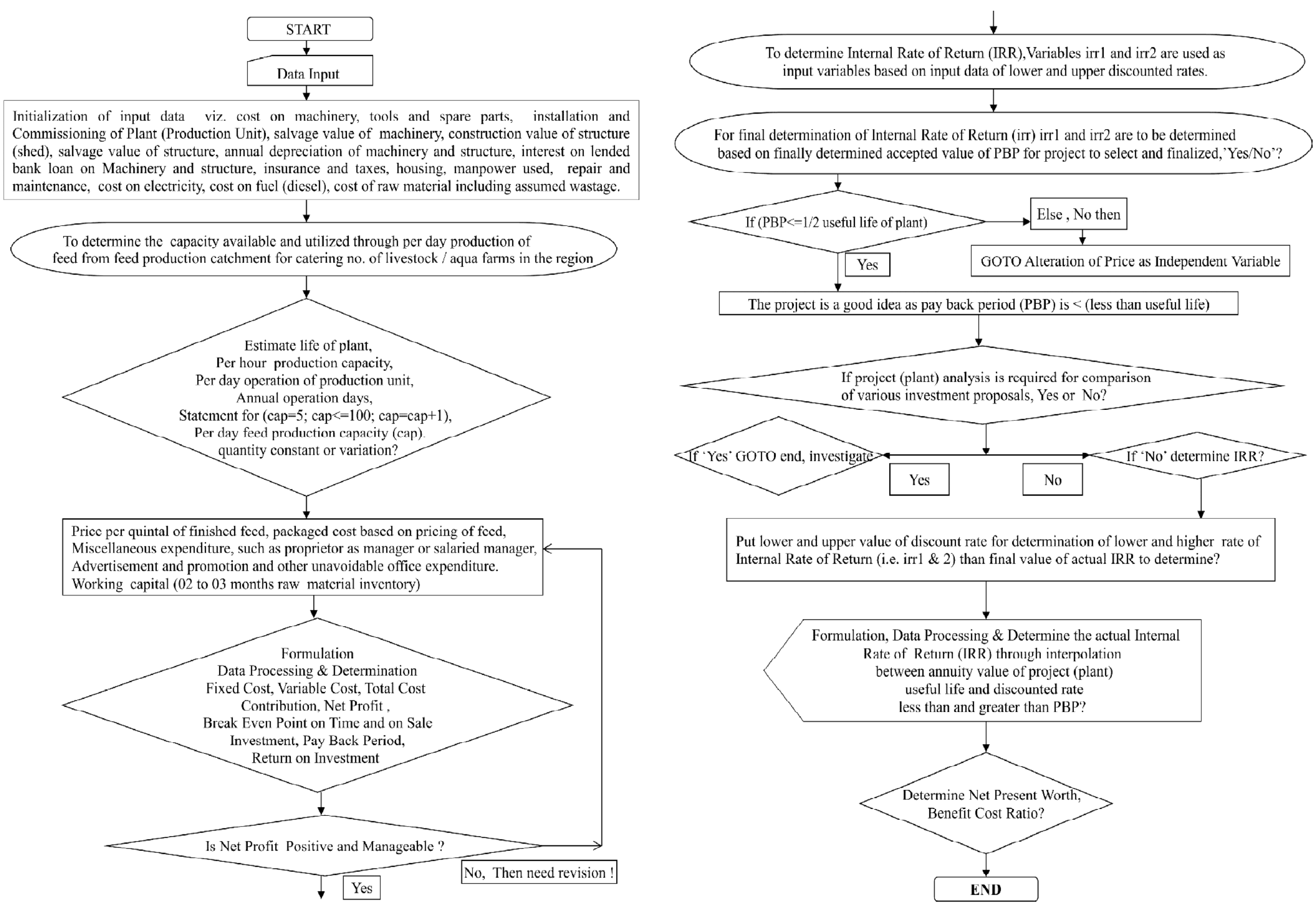

Figure 1: Flow Chart of DSS for determination of techno-economic viability

I. Calculations as per input data given in table 1.

II. The raw materials increased price by 5% greater than over condition I, table 3 & 4.

III. The increase in prices of raw material 5%, manpower wages 10%, energy 10%, miscellaneous 3% and maintenance 1% greater than over condition I, table 3 & 4.

IV. The raw materials increased by 10% greater than over condition I, table 3 & 4.

Usually, for integrated farms the feed production unit selection should be of smaller designed capacity. Since, there used to be a problem on coordination of different activities to run in parallel with mindset of progressive and non progressive farming community. Hence, two smallest commercially available capacity pellet feed production plants (Fig. 3) and durable pellet feed (Fig. 4), usually available sizes 0.7 t/h and 2 t/h in market (table 1), have been considered and taken into derivation and determination of techno–economic variables (table 2). The various assumptions are based on anticipated annual production demand of pellet feed have been considered below. The criteria of assumptions in the algorithm are based on guidelines and codes standardized by the Bureau of Indian Standards (BIS) for agricultural machinery and processing plant in operation.

Table 1
Available minimum production capacity sizes of Feed Plant Models in the market

Sr. No.	*Production Capacity*	*Power requirement*	*DSS application on plant size selection and capacity utilization*
1	0.7 to 0.8 t/h	30 hp Main Motor 1.0 hp AC Variable frequency drive for Conditioner	1. The market pressure is built based on awareness of processed feed utilization. 2. Distance of transportation (to be covered for raw materials and finished feed procurement), usually should be as less as possible but better not exceed 35 km radius.
2	2.0 to 2.5 t/h	60 hp Main Motor 2.0 hp AC Variable frequency drive for Conditioner	

Table 2
Economic viability analysis factors (Anonymous [2])

SrNo	*Particulars of Assumptions (IS on cost of farm machinery operations)*	*Production Capacity*	
		0.7 t/h	2.0 t/h
Initial Plant and Production Parameters			
1	Initial cost of feed plant (Cost on plant equipment), (Rs.)	40,00,000	55,00,000
2	Installation and commissioning of plant machinery, (%)	8.5	7
3	Cost on plant installation and commissioning, (Rs.)	3,40,000	3,85,000
4	Cost on pellet feed production plant shed, (Rs.)	15,00,000	25,00,000
5	Estimated life of feed plant, year (a)	12	12
6	Estimated life of plant shed, year (a)	20	20
7	Salvage value of feed plant (10% of initial cost), (Rs.)	4,00,000	5,50,000
8	Production capacity, (Quintal/Hour- q/h))	7	20
9	Operation of feed plant,(hours/day,(h/d)	16	16
10	Annual operation days of plant, days (d)	300	250
11	Annual feed production of feed plant, Quintal (q)	33,600	80,000
Total Feed Cost Determinants for per Quintal Feed Production Cost			
12	Depreciation charge of feed plant (Rs./Quintal)(Annual Depreciation @ 10% by Straight Line Method)	5.16	8.93
13	Depreciation charge of feed plant shed	1.48	2.12
14	Interest on plant machinery as Banker's interest rate (14 %)	9.88	5.63
15	Interest charge on feed plant shed investment (11%)	2.58	1.80
16	Insurance and taxes charge on Plant & Machinery (2 %)	1.31	0.76
17	Insurance and taxes charge on Plant Shed (2 %)	0.47	0.33
18	Housing or rented plant machinery charges (Rs/q) unit (2%)	0.98	0.57

contd. table

SrNo	*Particulars of Assumptions (IS on cost of farm machinery operations)*	*Production Capacity*	
		0.7 t/h	2.0 t/h
19	Housing (or rented plant shed) charges per (Rs/q) unit	0.47	0.33
20	Repair and maintenance charge of plant machinery (AMC) (Annual R & M on plant machinery @ 15%), (Rs.)	17.86	10.31
21	R & M Plant shed (Annual R & M on shed @ 5%), (Rs.)	2.23	1.56
22	Indirect manpower (labour force) (Rs./day)	500	800
23	Cost on raw material including 10% wastage (Rs.)	126000	360000
24	Water charges, (Rs./day)	50	60
25	Miscellaneous for promotion, advertisement etc., (Rs./month)	25,000	40,000
26	Cost of fuel (diesel) for Boiler Operation (Rs./day)	1,500	3,000
27	Cost of electricity required per day (Rs./day)	8,400	15,120
28	Overhead establishment and working capital interest(Rs/q)	246.33	240.64
29	Total cost (Fixed + Variable Cost+ Overhead Cost), (Rs./q)	1477.95	1443.82
30	Price of feed, (Rs./Quintal)	1,700	1,700
31	Net Income (exclude depreciation because it is adding cash flow at the moment) after Taxes (Rs./Quintal)	247.01	271.15
32	Annual Net Profit (Rs./Annual quantity production)	8359008/-	21692000/-
33	Investment (Plant & Machinery +Shed+ Working Capitol)	16840000/-	38000000/-
34	Contribution (Gross return-Total variable cost), Rs.	248.78	272.24

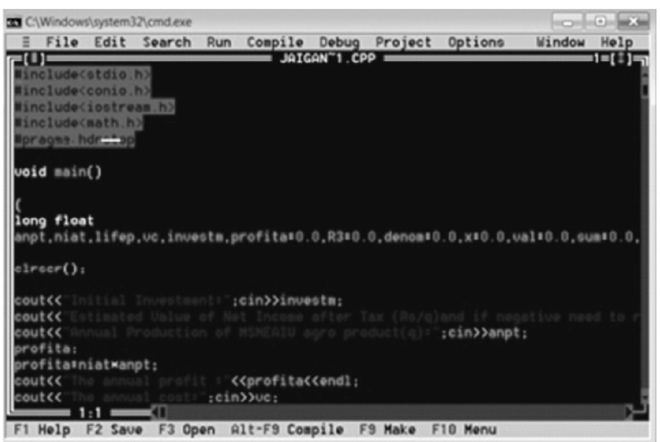

Figure 2: DSS for techno-economic variables

Figure 3: Integrated Cattle cum Fish Farm

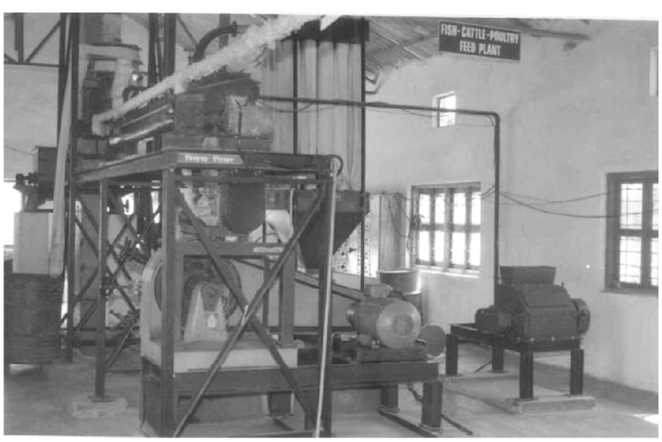

Figure 4: Pellet Feed Production Unit

Figure 5: Production of Durable Pelllets

RESULTS AND DISCUSSION

Keeping in view the basis of application of an algorithm as DSS of the two plant production variants as per table 1 and table 2 (condition I) have been determined. The condition II, III and IV, wherein variation in raw material price has seen impact on output values indicating that as the economic feasibility of the enterprise is beneficial to use the managerial decision making system as an algorithm (DSS). The result in terms of output data for study on variation of techno-economy feasibility has been tabulated and figured for 0.7 t/h (table 3) and (fig. 6) and for unit 2.0 t/h (table 4) and (fig. 7) :

Table 3
Feed Plant Unit with Production Capacity 0.7 t/h

Sr No.	*Price Change Decision*	*Net Profit/ Qtl. (%)*	*Return on Investment (ROI, %)*	*(Breakeven Point) Time (Days)*	*Quantity (Quintal)*	*Pay-back Period (Year)*	*Internal Rate of Return (IRR %)*	*Net Present Worth (Rs)*	*Benefit Cost Ratio*
1	I	16.71	48.31	40	3611	2.07	47.88	29795980	2.73
2	II	11.61	35.11	54	4955	2.85	34.07	16958440	1.99
3	III	11.30	34.25	56	5078	2.92	34.25	16124949	1.94
4	IV	6.94	21.90	86	7895	4.57	19.26	4120896	1.24

Table 4
Feed Plant Unit with Production Capacity 2 t/h

Sr No.	*Price Change Decision*	*Net Profit/ Qtl. (%)*	*Return on Investment (ROI, %)*	*(Breakeven Point) Time (Days)*	*Quantity (Quintal)*	*Pay-back Period (Year)*	*Internal Rate of Return (IRR %)*	*Net Present Worth (Rs)*	*Benefit Cost Ratio*
1	I	18.78	56.51	22	4719	1.77	56.25	84399530	3.20
2	II	13.48	42.44	29	6274	2.36	41.80	53833950	2.40
3	III	13.27	41.87	30	6360	2.39	41.20	52576180	2.37
4	IV	8.62	28.38	43	9360	3.52	26.72	23268370	1.61

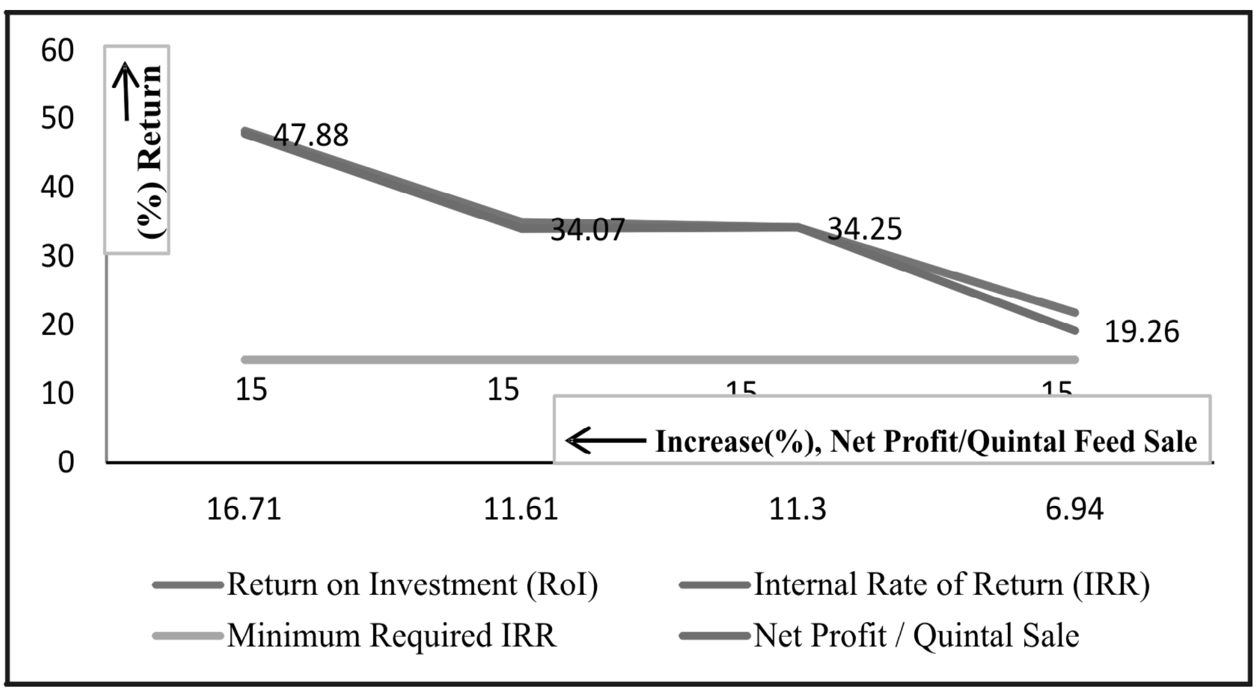

Figure 6: Effect of Net Profit / Quintal Sale vs IRR & RoI (0.7 t/h Poduction Unit)

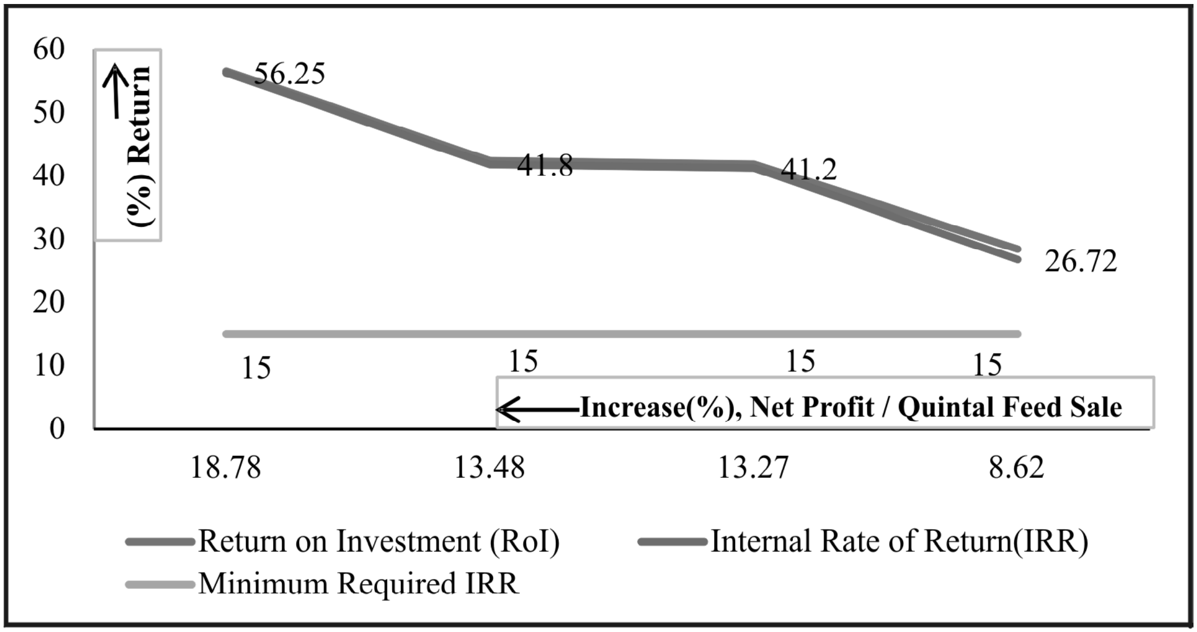

Figure 7: Effect of Net Profit / Quintal Sale vs IRR & RoI (2.0 t/h Poduction Unit)

Under technical aspects the densified feed in the pellet form have higher bulk density. The bulk density above 650 g/l is normally easy to produce with minimum operational energy requirement. The pelleted feed with reduced bulk density can ensure feeding of top dweller fishes in the production system. So that the cost and time effective feed supply can be assured for sustainability of entire biogenic potential of land and water body in effect. Further, to produce a 4-6 mm pelleted feed that will tend to float in freshwater vary from 450gm/l to 540gm/l. Above 650 gm/l, this type of product tends to sink between 550 gm/l and 650 gm /l slow sinking is achieved, Vijaygopal [13]. Some of the economic aspects of integrated fish farming have been described by several authors Delmendo [2]; Djajadiredja et al.[3], Edwards et al., 1986; Lovshin et al.,[6]. As stressed by Shang and Costa-Pierce [10], most of the economic aspects concentrate on rudimentary budget analysis which estimates costs of production and profit of operation. Such studies usually provide little sensitivity analysis in relations to variations of production, input costs and market prices.

However, as production unit size increases, the chances of continuous and regular production of feed material, diminishes because of factors related to market constraint, infrastructural and manpower shortage or disruptions occur due to natural disturbances such as adverse weather conditions prevail around approach area. Hence, it becomes wise to stick to judicious policy decision, to keep time space for higher production capacity plant upto 250 days for 2.0 t/h capacity to 300 days production per annum for 0.7 t/h production capacity plant under integrated farming management practices.

Integrated farming can also play a vital role in increasing employment opportunities, nutrition and income of rural populations and has received considerable attention in recent years. Besides many developing countries of Asia, some in Africa (Central African Republic, Cote d'Ivoire, Cameroon, Zambia) and South America (Brazil, Ecuador, Panama) have introduced this system on a pilot or larger scale, Wincke [12]. Some of the East European countries (Hungary, Czechoslovakia, Poland) have expanded and improved in recent years, the practice of integrating animal production with fish culture Pillay [7], In Asia, the integrated production systems have been developed empirically by the farmers themselves and are still largely aimed at fulfilling only their own food requirements Rajbanshi and Shrestha [9]. It has been proposed Edwards [4] for small scale farmers to integrate the water buffalo with fish farming at a ratio of about 85 buffaloes/ha of fish pond. The expected fish yield would be around 17.5 t/ha/year is a welcome step for income and employment generation.

Hence, output data in terms of making decision on managerial economy (table 3 and fig. 6) and (table 4 and fig. 7) indicates that despite continues fall in net profit per quintal sale of feed from 16.71% to 6.94% the IRR remains low upto 19.62% higher than minimum required value of 15% for feed production unit of 0. 7 t/h. For 2.0 t/h plant net profit per quintal falls from 18.78 % to 8.62%, IRR falls down to 26.72% which remain high above 15 % in both the cases. The other reason is that RoI is also high and goes up as production volume increases from 0.7 t/h to 2.0 t/h. It amply provides support to the cause of economically stable, sustainable and profitable feed business venture.

CONCLUSION

- The developed decision support system (DSS) using algorithm (C++) for smaller production capacity feed plants determines techno-economic viability. It instantly determines feasible production scale, per unit (quintal) cost of feed production, return on investment (RoI), breakeven point (BEP) in time (days) of set production scale and unit production quantity (Quintal), payback period (PBP) in time (year), internal rate of return (IRR) (%), net present worth (NPW) in (Rs.) and benefit cost ratio (BCR) in ratio proportion, while varying the input data.
- The system was also used for validation of two smaller available commercial capacities of livestock and aqua feed production units. The DSS also augments scope of agricultural diversification through maximization of economic and social returns.
- Various alternative feed raw materials can be investigated to maintain and upgrade the feed production plant operational economy, its profitability production management on the basis of their availability, affordability, and their applicability to optimal processing and nutritional balance can boost up the confidence level and management aptitude.
- Using such a DSS would help in better capital management and standard yardstick of return on net cash inflow and settlement of finance for feed plant enterprises.

REFERENCES

Anonymous, (2000), Financial and Investment Analysis Indira Gandhi National University, (IGNOU) New Delhi MS_04 course volume 4 on pp. 5-36.

Anonymous, (2002), Indian Standard guide IS 9164 (1979): Guide for estimating cost of farm machinery operation [FAD 21: Farm Implements and Machinery] online ....*https://law.resource.org/pub/in/bis/S06/is.9164.1979.pdf.*

Delmendo, M.N. (1980), A review of integrated livestock-fowl-fish farming systems. In: Integrated Agriculture Aquaculture Farming Systems, R.S.V., ICLARM Conf. Proc. 4, pp. 59–71.

Djajadiredja, R., Jangkaru, Z. and Junus, M. (1980), Freshwater aquaculture in Indonesia with special reference to small-scale agriculture-aquaculture farming systems in West Java. In: Integrated Agriculture Aquaculture Farming Systems, R.S.V.

Edwards, P. (1983), The future potential of integr. farming in Asia. Proc. V WCAP 1, pp. 273–281.

Lafore R. (1996), C++ Interactive Course, Techmedia Publication, Munish Plaza, 20, Ansari Road, Darya ganj, New Delhi-2.

Lovshin, L.L., N.B. Schwartz, V.G. de Castillo, C.R. Engle and U.L. Hatch (1986), Cooperatively managed rural panaanian fish ponds: The integrated approach. International Centre for Aquaculture Research and Development, series M033, December, 1986. Auburn University, Alabama, USA.

Pillay, T.V.R., (1980), Aquaculture. Principles and Practices. Fishing News Books, London.

Pullin S.V., Z.H. Shehadeh. (1980. Integrated Agriculture-Aquaculture Farming Systems ICLARM Conf. Proc. 4 (eds), pp. 143–165.

Rajbanshi, K.G. and M.B. Shrestha (1980), A case study on the economics of integrated farming systems: Agriculture, aquaculture and animal husbandry in Nepal. In: Integrated Agriculture Aquaculture Farming Systems, ICLARM Conf. Proc. 4, pp. 195–208.

Shang, Y.C. and B.A. Costa-Pierce (1983), Integrated aquaculture agriculture farming systems: Some economic aspects. J. World Maricul. Soc. 14: 523– 530.

Singh J. and Singh G., (2000), Aqua Feed Plant broacher, CIAE-ICAR, Nabibagh, Bhopal.

Vincke M.M. J. (1991), Integrated farming of fish and livestock: Present status and future development, the FAO/IPT Workshop proceeding on Integrated Livestock-Fish Production Systems, Kuala Lumpur (Malaysia), 16-20 Dec 1991.

Vijayagopal, P. (2004), Aquatic feed extrusion technology-an update. Fishing Chimes , 23 (10 & 11), 35-38.