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Original Article

Economics of Production and Processing of Seabuckthorn Value-added Products Commercialization of Sea buckthorn in Cold Desert Himalayas

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Abstract

In India, seabuckthorn (Hippophae L.) grows naturally in high altitude areas of cold desert Himalayas, spread over 75,000 Sq. km area in Himachal Pradesh and Jammu and Kashmir. Fruit is very reach in phyto- nutrients and has potential in health food, cosmetic and drug industries. Plant is also a useful fuel wood, fodder and soil binder and a life line of the tribal people of Himachal Pradesh even then this plant was neglected due to unawareness of its economics. Keeping this backdrop in view the present study has been investigated through 40 farmers for base– line survey for the year 209-10, 56 orchardists who planted plants in 2010-11, 48 orchardists who planted plants in 2011-12, seven farmers started growing fodder in seabuckthorn orchards, two processing units in Lahual –Spiti district of Himacchal Pradeh, five processing units in Leh district of (J&K), one semi- processing units in Kullu district of HP and two semi-processing units out side HP i. e. Haryana & Delhi. Based upon the results of the study, the pertinent findings indicate that existing area under seabuckthorn was less than 1 per cent of the total geographical area, whereas as 5.2 per cent of the total cultivated area on an average farms and its share in farm income was only 1.05 per cent of the gross farm income (Rs. 3,14, 028) indicates potential for improvement. Benefit- cost ratio (BCR) in nursery raising ranged between 1.51 to 2.10. However, it was 3.26 in full life span period of the seabuckthorn orchards plus fodder crop (tall fescue, red clover and Lucerne grass) and 6.04 at full bearing stage of the orchard and fodder i. e. after 6th year of the plantation of plants. On an average per quintal loss borne by Lahaul (HP) processing units was Rs. 2,957. Whereas, on an average per quintal net returns of processing seabuckthorn fruits were Rs. 1973 in Leh area of Jammu & Kashmir. Break-even analysis indicates that in Lahaul area the processing units were running just above the shut down point, whereas on the other hand in Leh area these were earning profits. Benefit cost ratio of semi -processing units in the country vary between 1.44 to 1.90 . Based on the findings of the present paper, it is suggested that area under seabuckthorn plantation should be increased and enhance the wild seabuckthorn fruits collection through improving the harvesting technology and it is also suggested that there exists a need for development of its package of practices and efforts should be made to provide remunerative prices of seabuckthorn produce to the orchardists buy back system, besides this, nursery raising techniques and management should be imparted to the Forest Officials of the state Govt. Besides these, the entire stakeholder involved in its farming and business should be aware about the economics and benefits of this new venture.

Keywords: seabuckthorn; Orchards; Benefit- cost ratio (BCR).

Introduction

Sea buckthorn has been reported growing in about 40 countries. In India, Seabuckthorn (*Hippophae* L.) grows naturally in high altitude areas of cold desert Himalayas, spread over 75,000 sq. km area in Himachal Pradesh and Jammu & Kashmir. Fruit is very rich in phyto-nutrients and has potential in health food, cosmetic and drug industries. Plant is also a useful fuel wood, fodder and soil binder. In Himachal Pradesh seabuckthorn grows widely in the tribal cold desert areas, constituted about 42 per cent area of the state. It grows mainly in the districts of Lahaul-Spiti, parts of Kinnaur and Chamba, which are surrounded by Tibet, occupied by China and Ladakh region of Jammu & Kashmir state in the north on the southern side. Rainfall fluctuates from 50 to 700 mm per year depending on place to place. The mean temperature in Keylong, district head quarter and centre place of Lahaul-Spiti district, shows considerable variation in temperature throughout the year (a maximum of 27^0C in July and minimum of -16^0C in February). During the winter this region is affected by a series of western disturbances, which cause heavy snowfall (200-400cm/yr). Seabuckthorn grows at 2,500-3,300 m amsl in Lahaul Sub-Division of Lahaul-Spiti district.

In Spiti tehsil of Lahaul-Spiti district it grows from 3,120 m at Samdoh to 4,500 m amsl near Kunjam pass. Rainfall rarely crosses 100 mm per year. Seabuckthorn grows in Pooh tehsil of Kinnaur district and Pangi tehsil of Chamba district. It has also been found in upper areas of Shimla and Kullu districts. There is about 1200 ha area under this plant in tribal areas of Himachal Pradesh (Singh et al., 1995).

The people of the tribal area of the state have to face severe climate, cold desert winds, and lack of oxygen in the absence of vegetation in most parts of these areas can result in heart and breathing troubles and other body ailments. Even the inhabited area remain heavily covered under snow and cut off from the rest of the world for six to eight months (November to June) depending upon the late or early snowfall on the passes (Thakur and Moorti). Seabuckthorn is the only plant which survives in this harsh climate. The people use its shrubs for fuel and roofing the house and its leaves as a fodder for the animals. The traditional mediciners (Amchies) use its fruits far medicinal purposes.

Due to the severe climate, only one crop season is available for growing of agricultural crops in this area. The farmers of these areas were growing potato and pea only for their home consumption till early seventies. After the construction of roads in tribal areas these crops were introduced as commercial crops. However, seabuckthorn was a life line of the tribal people of Himachal Pradesh even then this plant was neglected due to unawareness of its importance and assured market for its products.

Farmers/ collectors were collecting fruits of widely growing seabuckthorn in cold desert areas of Himachal Pradesh and sell them to local traders and private organizations, which gave unsure market and exploited the situation for collectors/ farmers. In view of this, the farmers/ collectors do not get remunerative prices for their produce. Hence, most of the farmers are reluctant to grow seabuckthorn on there farm. To see the economics of this new venture, needs to be investigated through comprehensive study to assess economics of production and processing of end products. Keeping this background in view, the present study has been undertaken with the following specific objective.

Objectives

To study the existing position of seabuckthorn in the cropping pattern and farm income in the study area .

To assess economics of production and processing of end product of sea buckthorn.

Methodology

In Himachal Pradesh, seabuckthorn grows mainly in the districts of Lahaul-Spiti, parts of Kinnaur and Chamba districts. The maximum area under seabuckthorn is in Lahaul block of Lahaul-Spiti district. Therefore, this block has been selected purposely for the main activities of the study. Also, the farming community of this block is innovative and very receptive as for as the adoption of enterprise or technology is concerned.

For socio-economic baseline survey on a value chain on seabuckthorn out of 106 total villages falling under the selected block, 76 villages have been identified where the farmers are fully aware and willing to start the commercial cultivation of sea buckthorn. A sample of 10 villages was selected randomly to carry out the base line survey. Further, stratified random sampling technique was followed to select the sample respondents from the selected villages. A sample of 20-25 per cent of respondents was drawn from various categories of farmers randomly from 10 selected villages, thus making a total sample size of 40 farmers.

For economic analysis of nursery raising, the data relating to various costs, returns and marketing were collected (for the year 2010-11) from well maintained and successful seabuckthorn nursery units established in the study area by the State Department of Forest, Govt. of Himachal Pradesh and nursery raised at KVK Farm, Kukumseri (CSK HPKV) in Lahaul (for the year 2010-11). Besides this, complete farmers who have planted the seabuckthorn plants in the district Lahaul & Spiti in 210-11 (56) & 2011-12 (48) have been surveyed in 2012-13 for economic and management aspect of the orchards.

For end product, the information was gathered from two well running processing units at Lahaul in Lahaul & Spiti district of Himachal Pradesh and 5 units out of 7 from Leh district of Jammu & Kashmir. The economics of semi-processing unit and juice and squash, has been analysed on the basis of information gathered from seabuckthorn processing unit of Lahaul Potato Growers Co-operative Society at Raison in Kullu district of Himachal Pradesh. The economics of various cosmetics like body lotion, face wash, shampoo, etc. and their processing was analysed by gathering information from semi-processing units, New Delhi and Faridabad in Haryana.

Analytical Tools and Methods

To meet out the objectives of the present study, various related statistical and economic tools such as averages, ratios, percentages, cropping pattern, standard cost methodology, gross income, benefit-cost ratio and break-even output, etc., have been applied for the analysis and interpretation of the data.

In order to achieve the requirements of first objective, the cropping pattern was examined on the sampled farms. The cropping pattern was computed as proportion of area under various crops to the operational holding the course of investigation. The formula used was as under:

$$P_{ij} = \frac{A_{ij}}{A_j} \times 100$$

Where,

P_{ij} = Proportion of area under i^{th} crop in j^{th} season

A_{ij} = Actual area under i^{th} crop in j^{th} season

A_j = Total sown area during jth season

To meet out the requirement of second objective of the study, the costs of nursery raising and orchard plantation of seabuckthorn were worked out through computing fixed and variable cost and also standard farm management cost concepts.

The gross returns of different crops were estimated by using the following relationship as used for seabuckthorn:

$$GR = Y_S \times P_S + Y_B \times P_B$$

Where,

GR = Gross returns from seabuckthorn in Rs / farm

Y_S = Yield of seabuckthorn fruits in q/farm

P_S = Price of seabuckthorn fruits in Rs/q

Y_B = Yield of seabuckthorn by- product in q/farm

P_B = Price of seabuckthorn by- product in Rs/farm

The net returns over total cost have been computed as follows:

Net Returns = Gross Returns – Total cost

$$\text{Output- Input ratio} = \frac{\text{Gross returns}}{\text{Total cost}}$$

Similarly, benefit -cost ratios were calculated as

1. $PVB = \delta_t(\sum B_t)$

$PVC = \delta_t(\sum C_t)$

$NPW = \delta_t(\sum B_t - (\sum C_t))$

2. $BCR = \delta_t(\sum B_t) / \delta_t(\sum C_t)$

3. IRR is the discount rate i.e. 8 percent per annum which makes PVB = PVC

Where,

PVB = Present value of benefits,

PVC = Present value of cost,

δ_t =Discount factor

B_t =Benefits from the seabuckthorn and fodder plantation,

C_t = Cost involved in the seabuckthorn and fodder plantation,

t =Time period

Break- even analysis has been calculated. The point at which two curves, total cost curve and total revenue curve intersect each other is called the break –even point (BEP) which indicates the level of production at which the producer neither loses money nor makes a profit. In other words, the quantity at which all costs allocated to a product are equal to all revenues from its sale is known as break-even point. At quantities smaller than the break-even point, there is loss and at larger quantities there is a profit. The break-even output has been calculated with the following algebraic method:

BEP= F/ (P-V)

Where,

F = Fixed cost of the processing unit

P = Price per quintal of seabuckthorn in rupees

V = Variable costs per quintal of seabuckthorn in rupees

Shutdown point has been calculated, when total fixed cost of the processing unit is equal to total revenue of the processed products.

Results and Discussion

Cropping pattern

There is only one cropping season starting from April to September. Generally farmers allocate land among different crops according to local climatic conditions, market availability, soil type, resource availability and technology. Some other considerations include increased income and risk minimization. Thus cropping pattern of an area may be outcome of trial and adjustments. It can be seen from Table 1 that in the overall cropping pattern of potato and peas dominated the scene by occupying more than 71 per cent of the total cultivated area. Next in importance was apple covering an area of 9.36 per cent of the total. The sea buckthorn occupied 5.2 per cent of the total cultivated area per farm.

Farm Incomes

The gross farm income from main product of crops has been depicted in Table-2. It can be seen from the table that on an average gross income per farm was estimated to Rs.3,05,492 where as income from by-product was Rs.8,536 only. A critical analysis of Table-2 shows that 86 per cent of the gross income was provided by two crops i.e.potato and pea. The rest of the income was mainly contributed by kuth, manoo and other crops.Table-2 shows the gross income and marketed surplus. The crops like potato, pea, cauliflower, cabbage, carrot, *kuth, patish* and sea buckthorn were found to be very important crops contributing 77 per cent to 100 per cent of the marketed surplus.

Comparative Economics of Seabuckthorn Nursery Raising

Economics of seabuckthorn orchards is also effected by the initial cost of the plants purchased for the plantation in the farmers' field. Considering this aspect of the costs, the economics of seabuckthorn nursery raising at KVK Farm, Kukumseri (CSK HPKV) in Lahaul and economics of seabuckthorn nursery raised at Himachal Pradesh Government Forest Nursery in Lahaul have been analysed for the agricultural year 2010-11(Table 3).

Economics of Seabuckthorn Nursery Raised at University Farm

Data relating to various costs, returns and marketing aspects were collected from University farm. The data were tabulated, processed and analysed for arriving at the final economics of seabuckthorn nursery raising (Table 3). It can be seen from the table that major inputs cost was the variable cost, among variable costs the main cost was human labour that accounts for about 52 per cent in the seabuckthorn nursery raising in university farm. The next important is the material cost that contributes around 43 per cent of the total cost. The fixed investment in university farm is negligible. The average sale price and cost per plant were Rs. 10/- and Rs.4.76/- respectively and as such, the net profit earned by the nursery units was approximately Rs. 71,309/- per bigha (0.08 ha) and benefit cost ratio was 2.10.

Table 1: Cropping pattern on the sample farms in study area Per/farm

Sr. No.	Crops	Area (ha)	Per cent
A.	**Agricultural and Horticultural Crops**		
1.	Barley	0.015	1.20
2.	Kathu/ Buckwheat	0.017	1.36
3.	Rajmash	0.019	1.52
4.	Sarson	0.001	0.08
5.	Potato	0.491	39.28
6.	Pea	0.407	32.56
7.	Cauliflower	0.007	0.56
8.	Cabbage	0.007	0.56
9.	Carrot	0.004	0.32
10.	Manoo	0.053	4.24
11.	Kuth	0.033	2.64
12.	Patish	0.003	0.24
13.	Oat	0.011	0.88
14.	Apple	0.117	9.36
15.	Sea buckthorn	0.065	5.20
	Total:	1.250	100.00

Table 2: Gross farm income from main product and by-product on the sample farmers Per/Farm

Sr. No.	Crops	Production (qtl./farm)		Price (Rs./qtl.)		Value (Rs.)		Gross Income (Rs.)	Marketed surplus of the main product (%)
		Main product	By product	Main product	By product	Main product	By product		
1.	Barley	0.18	0.27	1600	300	288	19	307	-
2.	Kathu/ Buckwheat	0.25	0.12	1000	250	250	30	280	-
3.	Rajmash	0.28	0.060	4500	320	1260	19	1279	15.98
4.	Sarson	0.02	0.02	3000	250	60	5	65	-
5.	Potato	109.03	10.90	1121	250	122259	2725	124984	88.22
6.	Pea	52.57	10.52	2698	320	141815	3366	145181	94.90
7.	Cauliflower	0.63	-	1500	-	945	-	945	86.84
8.	Cabbage	0.80	-	1167	-	933	-	933	89.58
9.	Carrot	0.18	-	1500	-	270	-	270	77.27
10.	Manoo	2.68	-	7000	-	18760	-	18760	96.91
11.	Kuth	2.03	-	7000	-	14210	-	14210	96.86
12.	Patish	0.03	-	7000	-	210	-	210	94.44
13.	Oat	2.86	2.86	200	200	572	572	1144	-
14.	Apple	0.60	-	3600	-	2160	-	2160	55.56
15.	Sea buckthorn	0.30	SBT fodder=1.0 Fuel= 4.0)	5000	SBT fodder=200 Fuel= 400	1500	1800	3300	100.00
	Total:	-		-		3,05,492	8,536	3,14,028	

Table 3: Economics of seabuckthorn nursery raised in the study area (2010-11) Rs./ Bigha**

Sr. No.	Particulars	KVK, Kukumseri (CSK HPKV, Palampur)	Forest Deptt., Govt. of H.P.
I.	Fixed Investment		
	Total Fixed Cost (Depreciation + interest on fixed capital)	18	3219
II.	Variable Costs		
A.	Material Cost	28025	42322
B.	Labour Cost(Human and Bullock)	33568	29716
i)	Interest on total variable cost @10% for half of the period (A+B)/ @10 per cent for six months	3080	3602
ii)	Total variable cost	64673	75640
C.	Total cost (fixed cost+variable cost)	64691	78859
III.	Nursery plant raised/ mortality		
a)	Cuttings/ sapling planted (No.)	22400	16875
b)	Cuttings/ sapling mortality(No.)	8800	5375
c)	Plant mortality (%)	39.29	31.85
d)	Sapling raised successfully(No.)	13,600	11,500
e)	Sale price (Rs./ plant)	10.00*	10.36
IV.	Returns	71309	40281
V.	Per plant economics		
a)	Per plant cost of raising nursery(Rs.)	4.76	6.86
b)	Per plant profit (Rs.)	5.24	3.50
c)	Output- input ratio	2.10	1.51

Note: * = Rs. 10 per plant has been fixed for agencies other than farmers. The sale price for farmers in Lahaul has been fixed Rs. 0.50 per plant.

** =1 Bigha = 2 Kanal = 0.08 ha

Economics of Seabuckthorn Nursery Raised at Forest Nurseries in Lahaul

Economics of nursery raised on university farm was compared with the nursery raised by the Forest Department, Govt. of Himachal Pradesh as presented in Table 3. The data relating to various costs and returns were collected from well maintained and successful seabuckthorn nursery units established in the study area by the Department of Forest, Govt. of Himachal Pradesh. The variable cost contributed 96 per cent of the total cost incurred in seabuckthorn nursery raising in Government farm. The material cost (plant) was the main cost incurred in the variable costs as accounted for 57 per cent of the total cost in nursery raising. The Next important variable cost was human labour which accounts for about 38 per cent of the total cost. The fixed investment accounted for only 4 per cent of the total cost in nursery raising by the Forest Department of Govt. of Himachal Pradesh. The Output- input ratio was lower in forest nursery (1.51) as compared to university farm nursery (2.10), even at a higher sale price at forest nursery.

Table 4: Expected costs and returns from seabuckthorn plus fodder per bigha on sample farms(orchards)

Sr. No.	Years	Project Costs: Fixed Investment on seabuckthorn	Seabuckthorn O & M cost	Investment + O & M cost of grass	Total costs	DF@8%	Present worth @8%	Benefits: Total Value of Production: SBT (fruit+ fuel)	Fodder	Total	DF@8%	Present worth @8%
1	2011-12	5614	2400	2000	10014	0.93	9313.02	-	-		0.93	0
2	2012-13	2807	3400	2000	8207	0.86	7058.02	-	2400	2400	0.86	2064
3	2013-14	1404	3400	2000	6804	0.79	5375.16	3060	2400	5460	0.79	4313.4
4	2014-15		3400	2000	5400	0.74	3996	6120	3600	9720	0.74	7192.8
5	2015-16		3400	2000	5400	0.68	3672	12240	3600	15840	0.68	10771.2
6	**2016-17**		**3400**	**2000**	**5400**	**0.63**	**3402**	**24480**	**3600**	**28080**	**0.63**	**17690.4**
7	2017-18		3400	2000	5400	0.58	3132	24480	3600	28080	0.58	16286.4
8	2019-20		3400	2000	5400	0.54	2916	24480	3600	28080	0.54	15163.2
9	2020-21		3400	2000	5400	0.54	2916	24480	3600	28080	0.54	15163.2
10	2021-22		3400	2000	5400	0.54	2916	24480	3600	28080	0.54	15163.2
11	2022-23		3400	2000	5400	0.43	2322	24480	3600	28080	0.43	12074.4
12	2023-24		3400	2000	5400	0.4	2160	24480	3600	28080	0.4	11232
13	2024-25		3400	2000	5400	0.37	1998	24480	3600	28080	0.37	10389.6
14	2025-26		3400	2000	5400	0.34	1836	24480	3600	28080	0.34	9547.2
15	2026-27		3400	2000	5400	0.32	1728	24480	3600	28080	0.32	8985.6
16	2027-28		3400	2000	5400	0.29	1566	24480	3600	28080	0.29	8143.2
17	2028-29		3400	2000	5400	0.27	1458	24480	3600	28080	0.27	7581.6
18	2029-30		3400	2000	5400	0.25	1350	24480	3600	28080	0.25	7020
19	2030-31		3400	2000	5400	0.23	1242	24480	3600	28080	0.23	6458.4
20	2031-32		3400	2000	5400	0.22	1188	24480	3600	28080	0.22	6177.6
21	2032-33		3400	2000	5400	0.2	1080	24480	3600	28080	0.2	5616
22	2033-34		3400	2000	5400	0.18	972	24480	3600	28080	0.18	5054.4
23	2034-35		3400	2000	5400	0.17	918	24480	3600	28080	0.17	4773.6
24	2035-36		3400	2000	5400	0.16	864	24480	3600	28080	0.16	4492.8
25	2036-37		3400	2000	5400	0.15	810	22032	3600	25632	0.15	3844.8
26	2037-38		3400	2000	5400	0.14	756	19829	3600	23429	0.14	3280.06
27	2038-39		3400	2000	5400	0.13	702	17846	3600	21446	0.13	2787.98
28	2039-40		3400	2000	5400	0.12	648	16061	3600	19661	0.12	2359.32
29	2040-41		3400	2000	5400	0.11	594	14455	3600	18055	0.11	1986.05
30	2041-42		3400	2000	5400	0.1	540	13010	3600	16610	0.1	1661
31	2042-43		3400	2000	5400	0.09	486	11709	3600	15309	0.09	1377.81
32	2042-43		3400	2000	5400	0.09	486	10538	3600	14138	0.09	1272.42
33	2043-44		3400	2000	5400	0.08	432	9484	3600	13084	0.08	1046.72
34	2044-45		3400	2000	5400	0.07	378	8536	3600	12136	0.07	849.52
	Total	**9825**	**114600**	**68000**	**192425**	**11.74**	**71210.2**	**630040**	**116400**	**746440**	**11.74**	**231819.88**

Note: *O&M= Operational and maintenance cost include preparation of land , training and pruning, labour charges, irrigation, harvesting of fruit and grass, watch and ward services, FYM and fertilizers, etc.*

Cost of seabuckthorn plant at approved rate @ Rs.0 .50/- per plant by CSK HPKV, Palampur. DF= Discount factor, it was assumed 8% as prevailing interest rate of the banks on fixed deposit in the study area. Analysis of project has been carried out on the basis of per bigha (1 bigha = 2 kanal =0.08 ha) plantation of seabuckthorn plants and grasses by the farmers.

Break -even point = 6 Years

$$\text{Benefit -Cost Ratio} = \frac{231820}{71210} = \mathbf{3.26}$$

Note:

1. Break even point=6th year after the establishment of the seabuckthorn orchards and grass by the farmers
2. This Benefit-cost ratio (3.26) has been calculated on the bases of farmers' costs and returns. However, BCR would be many folds higher if we include other sectors of the economy related to seabuckthorn.
3. Current prices have been considered for the analysis.
4. The cost and returns will be almost same after 6th to 24th years of the plantation of seabuckthorn plants and grasses by the farmers, however, seabuckthorn returns will be start reducing after 25th years @10% every year.

Economics of Seabuckthorn orChards

The various aspects of management which affect the economics of seabuckthorn orchards is as follows:

Plantations and Management Aspects

Economics of seabuckthorn orchard depends upon plantations method, time of plantations, appropriate ratio and management of male and female plants, spacing and distance of plants which will ensure well establishment of the plants and better growth. To assess all these things, the survey was conducted during 2010-11 and 2011-12. The expected economics of orchard on the bases of survey report on plantation and management aspects of seabuckthorn on marginal lands in the study area has been presented in Table-4.

Expected economics of seabuckthorn orchard on the basis of sample farms (orchards)

Expected economics of seabuckthorn orchards has been analysed on the basis of costs incurred on investment and maintenance by the orchardists for establishing the orchards and actual returns on the basis of sample bearing trees in the newly established orchards and expected returns of the orchards. It can be seen from the Table 4 that the total life span of seabuckthorn orchards was expected 34 years and the fixed investment on seabuckthorn orchards was Rs.9,825 and seabuckthorn operation and maintenance costs was expected Rs.1,14,600 and investment plus operational and maintenance costs of grass was Rs.68,000. The total cost of seabuckthorn orchard was expected to be Rs. 1, 92,425/- and the present worth of total cost @ 8% discount factor was Rs. 71,210. Total value of production of orchards was expected Rs. 7,46,440 out of which Rs. 6,30,040 was expected from seabuckthorn fruit and fuel whereas, Rs. 1,16,400 was expected from grass. The total present worth/value of the production @ 8% discount factor was expected Rs. 2, 31,820. The table revealed that break-even point will be there after 6th years of establishing the seabuckthorn orchards and the benefit-cost ratio will be 3.26 in the full life span of the seabuckthorn orchards. However, benefit- cost ratio would be many fold higher if we include tangible and intangible benefits of other sector of the economy related to seabuckthorn. It is amply clear from the table that commercializing seabuckthorn orchards along with fodder crops have potential to become economically viable in the long run as displayed in the Table 4.

Expected Economics of Seabuckthorn orChard at Full Bearing Stage

Expected economics of seabuckthorn orchard has been analysed on the basis of expected cost and returns. Data collected from the sample farmers who have purchased the nursery plants and grass roots from University and Forest Department are presented in Table-5 & 6. Table 5 reveals that although fixed investment on seabuckthorn orchard was the highest cost (Rs.5,614/bigha). By apportioning this cost to the full life period of the orchard and was estimated only Rs.160/- per bigha per year which was lower than the estimated interest (Rs.449 per year) of the total cost per year (Rs 4,449). The major cost to establish and maintain the seabuckthorn orchard was operational and maintenance cost of seabuckthorn plant and grass per year (86 per cent).

Expected income from seabuckthorn orchard and fodder at full bearing stage per year was accounted for Rs. 26,880 per bigha and benefit cost ratio was 6.04. The high benefit- cost ratio of seabuckthorn orchard indicates that establishing the seabuckthorn orchard is a profitable venture.

Economics of Seabuckthorn Processing

The shelf life of seabuckthorn fruit is very less so it needs processing. By processing, it is converted into form utility and can be used for longer period. Seabuckthorn fruits are utilized in preparation of beer, syrup, jam, squash and juice. Its fruit oil is extracted from seeds and used for pharmaceutical industry to prepare medicinal and cosmetic preparations. *Mehandi* and tea are prepared from seabuckthorn leaves. To see technical feasibility and economic viability of the seabuckthorn industry, the economics of seabuckthorn processing units and its products is necessary. Therefore, economics of processing units and products are presented in this section.

Table 5: Expected plantation cost of seabuckthorn orchard and grass per year after 6th Year

Sr. No.	Particulars	Cost (Rs./ Bigha)
1.	Fixed Investment 267 plants(Female=240+ Male=27) and grass	5,614.00
2.	Apportioning of fixed investment for 35 years (planting the plant and grass per year)	160
3.	Interest @ 8% per year of the total investment	449.00
4.	Operational and Maintenance cost of Seabuckthorn per year	2,400.00
5.	Operational and Maintenance cost of Grass per year	1,440.00
	Total Cost per year	**4,449.00**

Note:
1. Operational and maintenance costs include preparation of land, training and pruning, labour charges, irrigation, harvesting of fruit and grass, watch and ward services, etc.
2. Cost of seabuckthorn plant at approved rate of Rs. 0.50/ plant by HPAU, Palampur.
3. 1 bigha = 2 Kanal = 0.08 ha

Table 6: Expected income from seabuckthorn orchard and fodder at full bearing stage per year

Sr. No.	Particulars	Income (Rs. / Bigha)
I.	Income from sea buckthorn after 6th year (9.6 qtl./ bigha @Rs. 25/- per kg)	24,000.00
2.	Income from Fodder (Rs.200/ qtl.)	2,400.00
3.	Income from fuel (Rs. 300/ qtl.)	480.00
	Total Return	26,880.00
	Total Cost	4,449.00
	Net Income	22,431.00
	Benefit -cost ratio	6.04

Note:
1. Harvesting of fruit and cutting of grass charges have been included in operational and maintenance costs.
2. This cost and returns will be almost same after 6thh to 25th years of the plantation seabuckthorn plants by the farmers

Table 7: Economics of processing units of Lahaul, Himachal Pradesh (2011-12)

Sr. No.	Particulars	Qty.	Value (Rs.)
A.	**Fixed Cost**		
i)	Rental value of building per year	No.1	60,000
ii)	Investment on machinery	Rs, 1,50, 000	-
a)	Depreciation of machinery per year @ 5 per cent on the invested cost of machinery	Life of machinery is about 20 years	7,500
b)	Interest on fixed investment of the machinery @ 10 per cent per annum	-	15,000
iii)	Repairs and maintenance cost of the machinery	-	2,500
iv)	Wages of permanent labour/ watch and ward per year	-	30,000
	Total fixed cost	-	1,15,000
B.	Operational/ variable cost		
i)	Cost of seabuckthorn fruit @Rs. 3,000/ q	14.5 q purchased	43,500
ii)	Transportation charges @ Rs. 50/ q	14.5 q	725
iii)	Wages of the operators @ Rs. 120 per day	145 days	17,400
iv)	Electricity charges @ Rs.100/q on pulp	12.5 q	1,250
	Total operational/ variable cost	-	62,875
C.	Total cost (A+B)	-	1,77,875
D.	Income:		
i)	Pulp @ Rs. 10,000/q sale price	12.5 q	1,25,000
ii)	Seed @ Rs. 5000/ q sale	1 q	5,000
iii)	Residue @ Rs. 5,000/ q sale price	1 q	5,000
	Total income	-	1,35,000
	Net return over variable cost/ operational cost	-	72,125
	Net return over fixed investment	-	20,000
	Net return over total cost	-	-42875
	Average fixed cost per q	-	7,931
	Average variable cost per q	-	4,336
	Average total cost per q	-	12,267
	Average return per q	-	9,310
	Net return over variable cost per q	-	4,974
	Net loss per q	-	2,957

The economics of processing unit depends upon availability of land, labour, raw materials (fruits, etc.) and capital investment in the processing unit. It can be seen from Table 7 that fixed investment/ cost was the major cost in the total cost of the processing unit. On an average fixed cost was Rs. 1,15,000 per processing unit which accounted for about 65 per cent of the total investment of the processing unit in Lahaul area. The variable cost of the processing unit was Rs. 62,875 (35 per cent) out of the total cost (Rs. 1,77,875) per annum.

The total income of the processing unit was estimated to be Rs. 1,35,000 per annum through sale of seabuckthorn pulp, seed and residue. The net returns over variable cost were Rs. 72,125, net return over fixed cost was Rs. 20,000 and net loss instead of making profit per processing unit per annum was Rs. 42,875 due to low volume of seabuckthorn fruits which was purchased/ handled from the collectors, who collected from the forest area.

Besides this, bulk bearing of seabuckthorn plants has started now in the farmers' field in the project area. The entrepreneur of processing unit also expected uncertain demand and low price in the market. On an average per quintal loss borne by the processing unit was Rs. 2,957.

The economics of processing unit of Leh area of Jammu & Kashmir has been presented in Table 8. It can be seen from the table that in Leh area major cost of the processing unit was variable cost (Rs.10,20,070) and accounted for 76 per cent of the total cost of the processing unit. The fixed cost on an average was 24 per cent (Rs.3,17,425) of the total cost (Rs. 13,37,495) incurred per processing unit in Leh area.

The total return per processing unit was estimated to be Rs.17,01, 800 per annum through sale of seabuckthorn pulp, jam, juice, squash, lolleypope, seed and residue. The net return over fixed cost was Rs. 15,70,455, net return over variable cost was 8,67,810 and net return over total cost was Rs. 5,50,385 per processing unit in Leh area. On an average per quintal net returns of processing seabuckthorn fruits were Rs. 1973 in Leh area of Jammu & Kashmir.

Some of the problems highlighted by the entrepreneurs of seabuckthorn processing units of the Lahaul and Leh at the time of survey were lack of electricity supply, remunerative prices of the processed produce of seabuckthorn, market for seed and residue; fund for proper running of the processing units, adequate labour at reasonable wages and availability of Follow on Public Offer (FPO) certificate.

Break-Even Analysis

Break-even analysis is important concept to examine the business performance of processing units. The break-even output is that level of output below which the processing units would not be in a position to cover the fixed costs besides variable costs (both manufacturing and selling) and eventually might incur losses. On the other hand, the processing capacity achieved above break-even output would start yielding net profit to the processing units of seabuckthorn fruits. Based upon cost and return structure the seabuckthorn levels of outputs for two areas Lahaul in Himachal Pradesh and Leh in J & K processing units have been presented in Table- 9 & 10. It was estimated in Table 9 that seabuckthorn processing unit should process minimum quantity of 23 quintals of seabuckthorn fruits per year in Lahaul area, and then utilize the plant capacity to stay in business since at this level of plant capacity the unit would be able to cover both variable and fixed costs of processing of fruits. At this level total return and total cost is equal (Rs. 2.14 lakhs).

It can be visualized from the Table-9 that in Lahaul area the processing unit was running just above the shut down point (12.5 quintals) of fruits of seabuckthorn processed per annum. The unit was covering only fixed cost and part of the variable cost. Thereby it indicates that this industry is in initial stage in Lahaul area and it needs to create awareness amongst the growers (seabuckthorn orchardists), collectors of seabuckthorn from forest area and traders for sustainable linkages with the traders in the market for assured and remunerative prices from its products.

Table 10 indicates that the break-even point of Leh processing unit is reached at 102 quintals of fruits processed per unit. Whereas at present these units were processing 279 quintals of seabuckthorn fruits per unit. These units were covering fixed and variable costs and earning Rs. 5,50,385 profit per unit. It indicates that the processing units at Leh in J&K are in viable position. Although at present these units totally depend upon the forest produce.

Economics of Semi-Processing Unit in Himachal Pradesh

The economics of seabuckthorn semi-processing unit gives the sustainability of the functionaries involved in the value addition of this industry. Seabuckthorn juice and squash processing unit at Raison, Distt. Kullu, Himachal Pradesh is the main semi-processing unit in Himachal Pradesh which converts whole seabuckthorn pulp of Lahaul & Spiti processing units into final finished products' consumable to the consumers. It can be seen from the

Table 11 that 12 quintal of seabuckthorn pulp was purchased by this unit from the Lahaul processing units. The total fixed cost of this processing unit incurred on handling seabuckthorn pulps and products was Rs. 67,000. This processing unit produces juice and squash from seabuckthorn pulp as presented in Table 11. During, 2011-12 this unit has made 12,000 bottles of juice from 2.5 quintal of pulp and 560 bottles of squash from 1 quintal seabuckthorn pulp out of the total pulp (12q) purchased by this semi-processing unit from the Lahaul's processing units. The total operational/ variable cost incurred on preparation of these produce was Rs.1,26,611 out of which Rs.96,575 incurred on juice and Rs.30,036 incurred on preparation of squash as presented in table. The material and handling charges accounted for 98 per cent of the variable cost and only 2 per cent was the marketing cost. Total income earned by the processing unit from preparation of 12,000 bottles of juice and 560 bottles of squash was Rs. 2,31,200. Net return over total cost was Rs. 1,04,589 in which Rs. 95,425 from juice and Rs.9,164 from squash. Net return per quintal of seabuckthorn pulp was estimated to be Rs.3,970 from juice and Rs.2,337 from squash.

Table 8: Economics of processing units of Leh in Jammu & Kashmir (2011-12) (Unit/annum)

Sr. No.	Particulars	Qty.	Value (Rs.)
A.	Fixed Cost		
i)	Building cost	Rs. 5,65,000	-
a)	Depreciation cost of the building @ 2.5 per cent per annum	Life of the building is 40 years	14,125
b)	Interest on fixed investment of building @ 10 per cent per annum	-	56,500
ii)	Investment on machinery:	Rs. 6,40,000	-
a)	Own fund	Rs. 3,60,000	-
b)	Loan	Rs. 2,80,000	-
c)	Interest on fund @ 10 per cent per annum	Rs. 3,60,000 (own fund)	36,000
d)	Interest on loan paid @ 13 per cent per annum	Rs. 2,80,000 (borrowed money)	36,400
e)	Repairs and maintenance cost of machinery	-	16,000
f)	Wages of permanent labour/ watch and ward per year	-	1,58,400
	Total fixed cost	-	3,17,425
B.	Operational/ variable cost		
i)	Cost of seabuckthorn fruit @Rs.2380/ q	279 q purchased	6,64,020
ii)	Transportation charges @ Rs. 50/ q	279 q	13, 950
iii)	Wages of the operators @ Rs. 352 per day	790 days	2,78,080
iv)	Electricity charges @ Rs.100/q on pulp	254 q	25,400
v)	Jam:		
	Material cost of the Jam excluding pulp @ Rs. 36/ kg	350 (kg)	12,600
vi)	Juice:		
	Material cost of the juice excluding pulp cost @Rs. 21/ ltr.	620 (ltr.)	13,020
vii)	Squash:		
	Material cost of the squash excluding pulp cost @ Rs. 36/ ltr.	350 (ltr.)	12,600
viii)	Lolleypope:		
	Material cost of the Lolleypope excluding pulp cost @ Rs. 2/ No.	200(No.)	400
	Total operational/ variable cost	-	10,20,070
C.	Total cost (A+B)	-	13,37,495
D.	Income:	-	
i)	Pulp @ Rs. 6700/ q sale price)	254 (q)	17,01,800
ii)	Jam @ Rs. 160/ kg sale price	350 (kg)	56,000
iii)	Juice @ Rs. 100/ ltr. sale price	620 (ltr.)	62,000
iv)	Squash @ Rs. 120/ ltr. sale price	350 (ltr.)	42,000
v)	Lolleypope @ Rs. 5/ No. sale price	200 (No.)	1,000
vi)	Seed @ Rs. 40/ kg sale price	195 (kg)	7,800
vii)	Residue @ Rs. 54/ kg sale price	320(kg)	17,280
	Total income:		18,87,880
	Net return over variable cost/ operational cost		8,67, 810
	Net return over fixed cost		15,70, 455
	Net return over total cost		5,50,385
	Average fixed cost per q		1,138
	Average variable cost per q		3,656
	Average total cost per q		4,794
	Average return per q		6, 767
	Net return over fixed cost per q		5, 629
	Net return over variable cost per q		3,110
	Net return over total cost per q		1973

Table 9: Break-even analysis of seabuckthorn processing unit at Lahaul in Himachal Pradesh (2011-12) (Unit/ annum)

Seabuckthorn fruits processed per unit (q)	Total revenue (Rs.)	Total cost (Rs.) (Total fixed cost+Total variable cost)
0	0	1,15,000
10	93,100	1,58,360
12.35	1,15,000	1,68,550*
14.5	1,35,000	1,77,875**
23	2,14,130	2,14,728***
30	2,79,300	2,45,080
100	9,31,000	5,48,600

*Shut down point, **Present status ***Break-even point

Table 10: Break-even analysis of seabuckthorn processing unit at Leh, Jammu & Kashmir (2011-12) (Unit/ annum)

Seabuckthorn fruits processed per unit (q)	Total revenue (Rs.)	Total cost (Rs.) (Total fixed cost+total variable cost)
0	0	3,17,425
100	6,76,700	6,83,041
102	6,90,234	6,90,337*
200	13,53,400	10,48,625
279	18,87,880	13,37,495**
300	20,30,100	14,14,225

*Indicate the break-even point, ** Present position per processing unit

The expected economics of seabuckthorn processing unit has been portrayed in Table 11. The table revealed that net return of the processing unit would be Rs.42,039 if all the seabuckthorn pulp is converted into same ratio of juice and squash. The minimum and maximum expected income ranged between Rs.32,147 to Rs.46,007 depending upon the ratio of juice and squash prepared by the processing unit.

Table 11: Economics of seabuckthorn juice & squash processing unit at raison distt. kullu, himachal pradesh (2011-12) (Unit/ annum)

Sr. No.	Particulars	Qty.				Value (Rs.
A.	**Expected fixed cost to processing of 12 quintals of seabuckthorn produce**			**12 q**		**-**
i)	Approximate building cost			Rs.10,00,000		-
ii)	Imputed rental value of rooms used for seabuckthorn products per annum			2 rooms		12,000
iii)	Investment on machinery used for seabuckthorn products			Rs. 50,000		-
a)	Depreciation on machinery per year @5% on the investment cost of machinery			Life of machinery is about 20 years		2,500
b)	Interest on fixed investment of the machinery @10% per annum					5,000
c)	Repairs and maintenance cost of the machinery					2,500
iv)	Wages of permanent labour and management			One month payment of the whole staff		45,000
	Total fixed cost:					67,000
B.	**Operational/ variable cost of processed produce(2011-12)**	**Juice**		**Squash**		**Total valu**
		Qty.	**Value (Rs.)**	**Qty.**	**Value (Rs.)**	**(Rs.)**
1)	**Material cost and handling charges**					
i)	Seabuckthorn pulp	2.5q	25,000	1q	10,000	35,000
ii)	Sugar	3q	9,000	2.25q	6.750	15,750
iii)	Colour		200		100	300
iv)	Citric acid		200		100	300
v)	Essence		60		50	110
vi)	Bottle @Rs 2/- per juice bottle of 200ml. and Rs.6/- per squash bottle of 700ml. packing	Packing of 12,000 bottles/ 2,400 litre juice	24,000	Packing of 560 bottles/ 392 litre squash	3,360	27,360
vi)	Cork @Rs.0.50/- per cork	12,000	6,000			6,000
vii)	Packing and labeling		10,000		1,200	11,200
viii)	Electricity charges		857		243	1,100
ix)	Fuel/ diesel		3,000		500	3,500
x)	Contractual labour		3,000		1,500	4,500
	Sub-total:		**81,317**		**23,803**	**1,05,120**
2)	**Marketing cost**					
i)	Loading & unloading charges		200		100	300
ii)	Transportation charges		500		250	750
iii)	Permanent labour for marketing		600		300	900
	Sub-total:		**1,300**		**650**	**1,950**
	Total operational/ variable cost (1+2)		**82,617**		**24,453**	**1,07,070**

	Total fixed cost of the processed products out of the total pulp (12q) procured by processing unit	2.5q	13,958	1q	5,583	19,541
	Total operational/ variable cost	2.5q	82,617	1q	24,453	1,07,070
	Total cost:	2.5q	96,575	1Q	30,036	1,26,611
	Total Income: 2,400 litre juice and 392 litre squash	12,000 bottles of 200 ml. @Rs. 16/- per bottle	1,92,000	560 bottles of 700 ml. @Rs.70/- bottle	39,200	2,31,200
	Net return over fixed cost	2.5q (pulp)	1,78,042	1q (pulp)	33,617	2,11,659
	Net return over variable cost	2.5q (pulp)	1,09,383	1q (pulp)	14,747	1,24,130
	Net return over total cost	2.5q (pulp)	95,425	1q (pulp)	9,164	1,04,589
	Net return per bottle	200ml.	7.94	700ml.	16.36	24.30
	Net return per litre	1 litre	39.70	1 litre	23.37	63.07
	Net return per q of seabuckthorn pulp	1q	3970	1q	2337	6307
	Economics of seabuckthorn processing unit:					
i)	Net return of the processing unit, if all the pulp converted into same ratio of juice & squash	8.75q	34,023	3.43q	8,016	42,039
ii)	Net return, if rest of the pulp (12q-3.50=8.50q) converted into juice	11q	43,670	1q	2,337	46,007
iii)	Net return, if rest of the pulp converted into squash (12q-3.50q=8.50q)	2.5q	9,945	9.5q	22,202	32,147

Economics of Semi-Processing units outside Himachal Pradesh

The information regarding semi-processing units has been gathered from two main semi-processing units i.e. from Faridabad (Haryana) and New-Delhi for the year 2011-12. These two semi-processing units in India consumed maximum seabuckthorn pulp, seed, residue and leaves and converted into seabuckthorn cosmetics, juice and jam, etc.

Natural Bath & Body Products Pvt. Ltd., Faridabad

This semi-processing unit has been established at Gurukul Industrial Area, Faridabad (Haryana). The different Natural Bath and Body Products produced by this unit have been displayed in Table 12. In 2011-12 this processing unit purchased 200 quintal pulp, 50 quintal seed, 10 quintal residue and 1.5 quintal leaves and total cost accounted for Rs. 20,67,000 as displayed in the Table 12. The fixed cost has been incurred to the tune of Rs. 9,62,500 for manufacturing different products of seabuckthorn as displayed in the table. Operational/ variable costs of processed products were Rs. 35,52,254 which compasses seabuckthorn material used (Rs.1,02,317) on about 5 quintal of seabuckthorn pulp, seed, residue and leaves; manufacturing & handling charges (Rs.30,29,375) and marketing cost (Rs. 4,20,563). The total cost on different products produced in the unit has been assumed to be Rs. 45,14,754. The total income from different seabuckthorn products produced in the unit has been estimated to be Rs. 65,07,500. The net return over total cost of the unit for the year 2011-12 has been estimated to be Rs.19,92,746. The benefit- cost ratio has been estimated to be 1.44.

Seabuck Care Pvt. Ltd., New Delhi

This semi-processing unit has been established at Zamroodpur, Greater Kailash Part-1, New Delhi. The raw material is purchased by this processing unit from Leh crushing of fruit units. The quantity-wise material purchased by this processing unit has been presented in Table13. The economics of this processing unit has been analysed on the basis of sampled cosmetics and other products as presented in the table. It can be seen from the table that the total manufacturing and material cost of 8 quintal sampled products was Rs. 2,24,000 and total marketing cost was estimated Rs. 2,21,551. Total operational and variable cost of the sampled products was Rs. 4,45,551 accounted for 76 per cent of the total cost(Rs.5,84,049). Total income of the sampled products has been estimated to be Rs. 11,07,750 and net return over total cost was Rs. 2,23,701. Benefit-cost ratio of sampled product produced by the processing unit was 1.90.

The minimum estimated total income of the semi-processing unit for the year 2011-12 was Rs. one crore. Total fixed cost, total variable cost and total cost were estimated to be Rs. 12,50,260, Rs 40,22,126

Table 12: Economics of Natural Bath & Body Products Pvt. Ltd., at Faridabad (Haryana)-2011-12

Sr. No.	Particulars	Qty.(q)	Value (Rs.)
A.	Seabuckthorn material purchased from Leh for preparing products		
i)	Seabuckthorn pulp @ Rs.80,000/-q	200 q (Rs.16,00,000)	
ii)	Seabuckthorn seed @Rs.8,000/-q	50 q (Rs.4,00,000)	
iii)	Seabuckthorn residue @ Rs.2,500/-q	10 q (Rs.25,000)	
iv)	Seabuckthorn leaves @Rs. 28,000/-q	1.5 q (Rs. 42,000)	
	Total Cost:	Rs.20,67,000	
B.	Fixed Cost		
1.	Building cost	Rs.25,00,000	
a)	Depreciation on building per year @2.5% per annum	Life span of building is 40 years	62,500
2.	Investment on machinery	20,00,000	-
a)	Depreciation on machinery per year @ 5% on the investment cost of machinery	Life span of machinery is 20 years	1,00,000
b)	Interest on fixed investment of the machinery @ 10% per annum	-	2,00,000
3.	Repairs and maintenance cost of machinery	-	1,00,000
4.	Wages of permanent labour/ watch and ward services per year	-	2,00,000
5.	Miscellaneous costs	-	3,00,000
	Total fixed cost:	**-**	**9,62,500**
C.	**Operational/ variable cost of processed produce**		
1.	Seabuckthorn material used (pulp, residue, seed & leaves)	4.95q	1,02,317
1.	**Manufacturing & handling charges**		
2.			
i)	Manufacturing charges		
a)	Seabuckthorn Lip Balm	0.5q	1,80,000
b)	Seabuckthorn under Eye Gel	1q	1,26,000
c)	Seabuckthorn Body Butter	4q	2,70,000
d)	Seabuckthorn Acne Control Cream	3.5q	2,67,750
e)	Seabuckthorn Body Lotion	10q	4,50,000
f)	Seabuckthorn Body Message Oil	4q	2,70,000
g)	Seabuckthorn Body Wash	9q	2,43,000
h)	Seabuckthorn Conditioner	10q	4,50,000
i)	Seabuckthorn Shampoo	10q	2,70,000
j)	Seabuckthorn Face Wash	5q	1,80,000
k)	Seabuckthorn Jam	10q	36,000
l)	Seabuckthorn Juice	10q	45,000
m)	Seabuckthorn Mehandi	5q	1,40,625
	Sub-total:		**29,28,375**
ii)	Other charges		
a)	Electricity Charges	-	21,000
b)	Contractual labour	-	80,000
	Sub-total		**1,01,000**
	Total(i+ii)		**30,29,375**
3.	Marketing Cost		
i)	Loading & unloading charges	-	1,40,188
ii)	Transportation charges	-	2,80,375
	Sub-total		**4,20,563**
	Total operational/ variable cost(1+2+3)	**-**	**35,52,254**
	Total Cost (B+C)	**-**	**45,14,754**
D.	Income from seabuckthorn products		
1.	Seabuckthorn Lip Balm sale price @Rs.8,00/ kg	0.5q	4,00,000
2.	Seabuckthorn under Eye Gel sale price @& Rs.2,800/ kg	1q	2,80,000
3.	Seabuckthorn Body Butter sale price @ Rs.1,500/ kg	4q	6,00,000
4.	Seabuckthorn Acne Control Cream sale price @ Rs.1,700/ kg	3.50q	5,95,000
5.	Seabuckthorn Body Lotion sale price @ Rs.1,000/ kg	10q	10,00,000
6.	Seabuckthorn Body Message Oil sale price @ Rs.1,500/ kg	4q	6,00,000
7.	Seabuckthorn Body Wash sale price @ Rs.600/ kg	9q	5,40,000
8.	Seabuckthorn Conditioner sale price @ Rs.1,000/ kg	10q	10,00,000
9.	Seabuckthorn Shampoo sale price @ Rs.600/ kg	10q	6,00,000
10.	Seabuckthorn Face Wash sale price @ Rs.800/ kg	5q	4,00,000

and Rs. 52,72,386 respectively. The estimated net return over total cost was Rs. 47,27,614 and benefit-cost ratio was estimated 1.90. It seems that all the semi-processing units in the value chain of seabuckthorn are technically feasible and economically viable.

Table 13: Economics of Seabuck care Pvt. Ltd., at New Delhi-2011-12

Sr.No.		Particulars	Qty.(q)	Value (Rs./q
A.		Seabuckthorn material purchased from Leh for preparing products		
	i)	Seabuckthorn pulp @ Rs.10,000/-q	5 q (Rs.5,000)	
	ii)	Seabuckthorn seed @Rs.8,000/-q	20 q (Rs.16,000)	
	ii)	Seabuckthorn leaves @Rs. 27,500/-q	1q (Rs. 27, 500)	
		Total Cost:	Rs. 93,500	
B.		Fixed Cost		
1.		Building cost	Rs. 22,00,000	
	a)	Depreciation on building per year @3.33% per annum	Life span of building is 30 years	73,260
	b)	Imputed rental value of rooms used for SBT products per annum	4 rooms	32,000
2.		Investment on machinery	20,00,000	-
	a)	Depreciation on machinery per year @ 5% on the investment cost of machinery	Life span of machinery is 20 years	1,00,000
	b)	Interest on fixed investment of the machinery @ 10% per annum	-	2,00,000
	c)	Others instrumental cost (crate, drums, containers, etc.)	7,50,000	-
	i)	Depreciation on others instrumental cost (crate, drums, containers, etc.) @20%	Expected life span of the crate, drums, containers, etc. has been assumed 5 years	1,50,000
	ii)	Interest on others instrumental cost (crate, drums, containers, etc.) @10%	-	75,000
3.		Repairs and maintenance cost of machinery	-	2,00,000
4.		Wages of permanent labour/ watch and ward services per year	-	4,20,000
		Total fixed cost:		**12,50,260**
C.		Operational/ variable cost of processed produce		
	i)	Approximate manufacturing & material cost		
	a)	Seabuckthorn Essence Message Cream	1q	30,000
	b)	Seabuckthorn Fruit Sking Glowing Pack	1q	27,000
	c)	Seabuckthorn Facial War	1q	25,000
	d)	Seabuckthorn Mehandi	1q	22,000
	e)	Seabuckthorn Anti-aging Cream	1q	20,000
	f)	Seabuckthorn Ultra-violet Pack	1q	34,000
	g)	Seabuckthorn Gold Shine	1q	35,000
	h)	Seabuckthorn Chocolate	1q	31,000
		Sub-total:	**8q**	**2,24,000**
	ii)	Marketing Cost		
	a)	Advertisement cost @5%	-	55,388
	b)	Loading & unloading cost @ 2.5%	-	27,694
	c)	Transportation cost @2.5%	-	27,694
	d)	Handling & management cost	-	1,10,775
		Sub-total	**-**	**2,21,551**
		Total(i+ii)	**-**	**4,45,551**
		Total fixed cost	**-**	**1,38,498**
		Total Cost (B+C)	**-**	**5,84,049**
D.		Income from sampled produce		
	a)	Seabuckthorn Essence Message Cream	1q	1,80,000
	b)	Seabuckthorn Fruit Skiing Glowing Pack	1q	1,50,000
	c)	Seabuckthorn Facial War	1q	70,000
	d)	Seabuckthorn Mehandi	1q	62,500
	e)	Seabuckthorn Antiaging Cream	1q	45,000
	f)	Seabuckthorn Ultra-violet Pack	1q	2,11,250
	g)	Seabuckthorn Gold Shine	1q	2,41,750
	h)	Seabuckthorn Chocolate	1q	1,47,250
		Total Income from seabuckthorn products:	**8q**	**11,07,750**
		Net return over fixed cot		9,69,252
		Net return over operational/ variable cost		6,62,199
		Net return over total cost		5,23,701
		Benefit-cost ratio of sampled produce		1.90
		Overall estimated total income of the semi-processing unit for the year 2011-12	8-10 lakh per month	1,00,000,00
		Total fixed cost		12,50, 260

Conclusions and Policy Implication

The area already existing under seabuckthorn was less than 1 per cent of the total geographical area, whereas as 5.2per cent of the total cultivated area on an average farms indicates that farmers are more receptive to commercialization of this crop. The production of this crop shows very less 30 kg per farm and share in farm income was only 1.05 per cent of the gross farm income (Rs. 3,14, 028) indicates potential for improvement. Therefore there exists a need for development of its package of practices and also efforts should be made to provide remunerative prices of seabuckthorn produce to the orchardists.

It has been noticed that seabuckthorn nursery raising is a profitable venture. However benefit-cost ratio was lower in the Forest Nursery (1.51), as compared to University Farm Nursery (2.10) even at higher sale price at Forest Nursery. Therefore it is suggested that nursery raising techniques and management should be imparted to the Forest Officials.

The expected economics of seabuckthorn orchards on the basis of sample farms revealed that break-even point will be after 6th year of establishing the seabuckthorn orchards and the benefit– cost ratio will be 3.26 in the full span of the seabuckthorn orchards. Benefit cost ratio would be many folds higher if we include tangible and intangible benefits of other sectors of the economy related to seabuckthorn. The expected income from seabuckthorn orchard plus fodder crop at full bearing stage per year was accounted for Rs. 26,880 per bigha (0.08 ha) and benefit- cost (BCR) was 6.04. It is amply clear from above analyses that commercializing seabuckthorn orchards alongwith fodder crops have potential to become economically viable in the long run.

The processing unit at Lahau (L& S) is running below full capacity utilization due to inadequate availability of raw materials (fruits) and also expected uncertain demand and low prices in the market. On an average per quintal loss borne by Lahaul (HP) processing units was Rs. 2,957. Whereas, on an average per quintal net returns of processing seabuckthorn fruits were Rs. 1973 in Leh area of Jammu & Kashmir. So, it is suggested that area under seabuckthorn plantation should be increased and enhance the wild seabuckthorn fruit collection through improving the harvesting technology and provide assured electricity supply, etc to the processing units..

Break-even analysis indicates that the break-even point of Leh processing unit is reached at 102 quintals of fruits processing per unit, whereas at present these units were processing 279 quintals of seabuckthorn fruits per unit and covering fixed and variable cost and earning Rs. 5,50,385 per unit per annum. Although at present these units totally depends upon forest produce. On the other hand in lahaul area the processing unit was running just above the shut down point (12.05 quintals) fruits of seabuckthorn processed per annum. The unit was covering only fixed cost and part of the variable cost. Thereby it indicates that this industry is in initial stage in lahaul area and it needs to create awareness amongst the growers (seabuckthhorn Orchardists) for increasing area under this crop, collectors of seabuckthorn from forest area and local traders for sustainable linkages with the traders in the market for sure and remunerative prices from its products.

The expected economics of semi- processing unit in Himachal Pradesh revealed that net return over total cost was Rs. 1,04,589 in which Rs. 95,425 from juice and Rs. 9,164 from squash. The net return over total cost of Natural Bath and Body Products Pvt., Faridabad unit (Haryana) for the year 2011-12 has been estimated to be Rs. 19,92,746 and benefit– cost ratio has been estimated to be 1.44. Whereas, the net return over total cost of Seabuck Care Pvt. Ltd., New Delhi unit Rs. 47,27, 614 and benefit– cost ratio was estimated 1.90. It seems that all the semi- processing units in the country in value chain of seabuckthorn are technically feasible and economically viable.

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Original Article

Use of Mobile Phone in Indian Agriculture

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Abstract

The mobile phone can help farmers in making right decision at right time sustainable growth agriculture activities and also help in gathering, analyzing and disseminating information in agricultural sector is enhancing farming productivity. This study has provided a first look at potential of information in affecting the agriculture sector as a whole. The study has reported farmers able to get information through mobile phone, use among the farming community. It is helpful adoption of new farming practices and action taken on received information may be able to enhance effectiveness, efficiency, reach among farmers and reduced risk through get information on weather trends information, pest and diseases management, marketing information help farmer market to corrects decisions over all farming activities.

Keywords*:* Former; Mobile Phone; Agriculture Role.

Introduction

Use of mobile phones for economic activity and enhancement of livelihood skills was substantially higher in U.P. The applications of mobile value added services (MVAS) in U.P. were also high. However, the use of mobile phones for social networking and entertainment purposes was quite similar. Use of mobile phones in agriculture and allied industries: Farmers involved in farming activities collected information at various stages of the agricultural cycle, and for vegetable and dairy farming purposes, through their mobile phones. A large number of farmers in India are marginal and small landholders. They mostly sell their produce to middlemen, who buy the produce from the villages. Very few of them directly go to the mandi.

Research Methodology

To complete the above objectives the research Methodology employed and the study was conducted in Kanpur District with two blocks during year 2014-15, 60-60 respondents were selected from each block total 120 respondents were selected from each area through random sampling method. In the research Dependent and independent variables are divided. So dependent and independent variables namely age, religion, caste, marital status, occupation, type of house, size of family, size of land holding and social participation etc. were used the collected data were subjected to statistical analysis for which statistical tools, χ^2 per cent, weighted mean, rank and correlation coefficient were used.

Results

Distribution of respondents according to educational qualification, maximum 24.2 per cent of male respondents were belonged in high school level, whereas, 10.8 per cent of female respondents were educate din up to primary level, 14.2 per cent of male

respondents were educated in Intermediate level, followed by 8.3 per cent of male respondents were educated in both illiterate and up to primary level and 10.0 per cent of female respondents were educated in both up to secondary and high school level, 7.5 per cent of male respondents were educated graduate and above level of qualification and only 2.5 per cent of female respondents were illiterate. Only 4.2 per cent of male respondents were educated up to secondary level of qualification. The distribution of respondents according to education both combined respondents, maximum cumulative value of education high school level 34.2 per cent and 19.2 per cent of respondents educated up to primary level, whereas, 14.2 per cent of respondents educated intermediate level. 14.2 per cent of respondents educated up to secondary level followed by 10.8 per cent of respondents who have no education (illiterate) level. Only 7.5 per cent of respondents were found to be graduate and above education level.

Table 1: Distribution of respondents according to education N=120

Educational qualification	Male		Female		Total	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Illiterate	10	8.3	3	2.5	13	10.8
Up to Primary	10	8.3	13	10.8	23	19.2
Up to Secondary	5	4.2	12	10.0	17	14.2
High School	29	24.2	12	10.0	41	34.2
Intermediate	17	14.2	-	-	17	14.2
Graduate & above	9	7.5	-	-	9	7.5
Total	80	66.7	40	33.3	120	100.0
χ^2			19.788**		P < 0.01	

Table 2 Distribution of respondents according to caste N=120

Caste	Male		Female		Total	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
General	14	11.7	-	-	14	11.7
OBC	41	34.2	29	24.2	70	58.3
SC/ST	25	20.8	11	9.2	36	30.0
Total	80	66.7	40	33.3	120	100.0
χ^2			0.1786		P > 0.05	

Table 3 Distribution of respondents according to kind of information N=120

Kind of information	Frequency	Per cent
Crop farming	102	85.0
Livestock/animal husbandry	85	70.8
Mixed farming	64	53.3
Fishery	24	20.0
Apiculture	8	6.7
Agro-forestry/Horticulture	30	25.0

Table 4 Distribution of respondents according to type of agriculture information in mobile phone N=120

Type of information in mobile	Frequency	Per cent
Pest management	87	72.5
Use of fertilizer/soil improvement	118	98.3
Market price	110	91.7
Weather forecast	55	45.8
Financial management	10	8.3
Sowing time	119	99.2
Harvesting time	81	67.5
Post harvesting	75	62.5
Marketing	89	74.2

Distribution of respondents according to caste. It was found that most of 34.2 per cent of male and 24.2 per cent of female respondents were belonged to OBC group of caste. The respondents belonging to SC/ST group of caste category were about 20.8 per cent of male and 9.2 per cent of female respondents, while general category belonging about 11.7 per cent of only male respondents in study area. The distribution of respondents according to caste of both combined respondents, maximum cumulative value, 58.3 per cent of respondents were belonged to OBC group 30.0 per cent of respondents were belonged to

SC/ST group of caste, while 11.7 per cent of respondents belong to general caste category. The observed value of χ^2 was found to be non significant at 5.0 per cent level of significance. Caste is an important factor in rural as well as urban area to developing the men and women condition.

Distribution of respondents according to kind of information selected by mobile phone, maximum 85.0 per cent of respondents were received crop farming information by mobile phone, whereas, 70.8 per cent of respondents were received livestock/animal husbandry related information, 53.3 per cent of respondents were selected mixed farming by mobile phone, 20.0 per cent of respondents were selected fishery related information, 6.7 per cent of respondents were choose for apiculture related information. Only 25.0 per cent of respondents were received agro-forestry/horticulture related information on mobile phone.

Distribution of respondents according to type of information in mobile phone, maximum 99.2 per cent of respondents were received sowing time related information on mobile phone, whereas, 98.3 per cent of respondents were selected use of fertilizer/soil improvement related information, 91.7 per cent of respondents were received market price information, 74.2 per cent of respondents were received marketing related information, 72.5 per cent of respondents were selected pest management related information, 67.5 per cent of respondents were received harvesting-time information, 62.5 per cent of respondents were received post-harvesting information, 45.8 per cent of respondents were selected weather forecast type of information. Only 8.3 per cent of respondents were received financial management information. Thus, it can be concluded that respondents were acquire to pest management information. Similar finding was reported by Ansari and Pandey (2013) who also found the respondents prefer disease and pest management information.

Conclusion

In today's mobile phone is very common social network is one of the most efficient ways to communicate with others those are very near and dear of ours and not reaching or meets every day. "In agriculture, like in many other sectors, information is becoming a major input, knowledge and information plays an important role for farmers to gives opportunities that could improve their agricultural productivity. Information communication Technologies (ICTs) are be the best hope in India to accelerate their agricultural development process. India's telecommunication network is the second largest in the world based on the total number of telephone users. Mobile phones are one of the most important tools of ICTs, in which farmers get, exchange, and or manipulate agricultural information; they help farmers to get timely and up-to-date information from different sources ICTs initiatives. Mobile phones are important to agro-based entrepreneurs as an infrastructural device for enhancing efficiency and effectiveness of agricultural sector.

Recommendations and Suggestions

- Knowledge about bigger or smaller farm machineries such as tractors, truck, harvester, thresher, other cutting and piercing implements.
- Farmers need to be educated about how to operate different equipments for their improving with efficiently productivity to accessing the economical/financial growth.
- Farmers need to be educated time to time about changing technology, equipments etc.

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Original Article

Problems Face of Women Farmers in Agriculture

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Abstract

The present study entitled "Problems of women in Agriculture" was carried in two distances Hamirpur and Kanpur to assess the problems of women farmers. Thus selected total 120 respondents and 60 respondents were selected from each district. Out of Out of total respondents 44.2 per cent respondents belonged to 50 years and above age group. 40.8 per cent respondents were educated up to primary level. 85.0 per cent respondents were belonged to Hindu religion, 45.0 per cent belonged to OBC group, 50.8 per cent respondents were doing agriculture. 59.2 per cent respondents have lived in pukka house. 63.3 per cent has nuclear family in which 50.8 per cent respondents have belonged to medium family size. 34.27 per cent respondents belonged to those families whose annual income was between 3 lacks to 4.5 lacks and above, 57.5 per cent respondents having 2.5 to 5 acres (marginal farmers). After studying women have faced many problems higher number of women have faced seasonal problems, women faced dehydration problem in summer season with 3.82 mean value, fungal infection in rainy season with 3.9 mean score value and common cold in winter season with 3.77 mean score value. Women found health hazards by pesticide with 3.89 mean score. Some women have instant allergic reaction with 3.7 mean score. Cutting tools create problem many a time with 2.67 mean score. Women were faced back pain with 3.7 mean score. Women were faced snake and insect bites with 3.44 mean score. Many women faced problem of irritation of the eyes with 3.75 mean score. And many have bacterial infection problem with 3.58 mean score value. And most of the women have being affected by some health problems while workings in agriculture with 4.00 mean score value. Further, studying causes of problems, it was found that causes of seasonal problems that high temperature is the most affecting causes of summer with o.95 mean score, high humidity climate causes of rainy season problem with 1.87 mean score and cold winds cause to of winter season problem with 1.83 mean score. Many women have faced various physical problems due to prolonged mono-static body gesture with 1.76 mean score. And diseases by agrochemicals are very minute molecules and they can enter very easily in respiratory or 2 digestive system through water, food, respiration etc. so those problems of infected water due to agro-chemicals with 1.59 mean score. Biological agents and vector problem also having a vital effect on human health due to insect is high with 2.52 mean score. Improper use of sharp tools and farm machineries causes injuries with 1.65 mean score value. Fumes as largest causes of respiratory system problem with 1.88 mean score and straw and dust as major causes of irritation of the eyes with 1.84 mean score value. And most of the women farmers faced many health problems due to malnutrition with 2.65 mean score value. From the study it was concluded that mostly women farmers faced various problems while working in agriculture.

Keywords: Marginal farmers; Malnutrition; Agrochemicals.

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Introduction

Women play an important role in all dimensions of agricultural production-in certain regions, today's women time input equals men's while in other regions traditions restrict their work to the household where they are involved in crop processing and are in charge of household maintenance. In most cases, women's efforts are non-monetized although they make large labour contributions to a range of marketed products such as dried fruits, fuel wood, dairy products and handicrafts.

The problems of women in agriculture resemble the 'progressive set of problems' that other marginalized communities face in the general population, but in a more acute and distressing manner. These problems relate to land ownership, security of tenure, land quality issues in cases where land ownership is assured, and land management issues in terms of agriculture and the support systems it requires. Any changes in land ownership and agricultural pattern affect women for more than men (positive or negative), given the existing gender roles that women are expected to fulfill, mainly related to management of the household in their reproductive roles- fuel wood collection, fodder collection, livestock tending in general, food security needs and so on. Their dependence on agriculture on common lands, on forests and water is that much greater and more acute. The mode of female participation in agricultural production varies with the land owning status of the farm household. Women's roles range from managers to landless labourers. In all farm production, the average contribution of women is estimated at 50 per cent to 60 per cent of total labour, much higher in certain regions. Girls are preferred in cottonseed production because heir wages are lower than those of adults. Moreover, they work longer hours and more intensively, and are generally easier to administer. Gathering of fuel wood is the exclusive responsibility of women and girls. In general, male activities such as land preparation, planting sowing and fertilizer application are one-time jobs, usually accomplished within a stipulated time. Female activities, however, such as weeding, are recurrent daily activities, lasting from the time the seed is planted until it is harvested.

Research Methodology

The study was conducted in two district- Kanpur and Hamirpur during year 2013-2014, and one block selected to each district and two village selected to one block in this study. 60 respondents were selected from each district and total 120 respondents were selected according to dependent and independent variables namely age, caste, education, family income, occupation etc. The collected data were subjected to statistical analysis for which correlation coefficient were used.

Results

Table 1: Distribution of women respondents according to education

Education	Hamirpur		Kanpur		Total	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Illiterate	10	8.3	7	5.8	17	14.2
Up to Primary	24	20.0	25	20.8	49	40.8
Up to Secondary	16	13.3	13	10.8	29	24.2
High School	7	5.8	10	8.3	17	14.2
Intermediate	3	2.5	5	4.2	8	6.7
Total	60		60		120	100.0
χ^2			0.439			P>0.05

Table 2: Distribution of respondents according to main occupation

Education	Hamirpur		Kanpur		Total	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Agriculture	27	22.5	34	28.3	61	50.8
Service	10	8.3	10	8.3	20	16.7
Business	16	13.3	13	10.8	29	24.2
Agirulcture labour	4	3.3	1	0.8	5	4.2
Agro-based enterprises	3	2.5	2	1.7	5	4.2
Total	60	2.5	60	50.0	120	100.0
χ^2			2.060			P>0.05

Table 1 reveals that distribution of women respondents according to education, qualification, maximum 20 per cent of women belong to Hamirpur were educated up to primary level where as 20.8 per cent of respondents from Kanpur educated up to primary level. 13.3 per cent of women from Hamirpur and 10.8 per cent of women from Kanpur were educated up to secondary level education follow by 5.8 per cent of women from Hamirpur and 8.3 per cent of respondents from Kanpur educated up to high school level 8.3 per cent of respondents from Hamirpur and 5.8 per cent of women respondents from Kanpur have no education only 2.5 per cent of women educated intermediate level.

Table 2 indicate the distribution of respondents as main occupation 22.5 per cent respondents from Hamirpur and 28.3 per cent respondents farm Kanpur were doing Agriculture, whereas 13.3 per cent respondents from Hamirpur and 10.8 per cent respondents from Kanpur were doing business and 8.3 per cent of respondents from Hamirpur and 8.3 per cent of respondents from Kanpur were doing service 3.3 per cent respondents of Hamirpur and 0.8 per cent respondent from Kanpur were engaged in Agriculture labour, Only 2.5 per cent respondents from Hamirpur and 1.7 per cent from Kanpur was attached in Agro based enterprises. .

Table 3 shows that 3 per cent women of Hamirpur told that they feel problem working in high temperature, and having a mean score 0.96, that placed it I rank priority problem of summer season. Whereas, 42.5 per cent women of Kanpur also admitted the same and placed it I rank with a mean score 0.93. Low humidity due to high temperature also affects working in field and 61.7 per cent women of Hamirpur and 26.7 per cent women of Kanpur admitted it. This was considered Ii rank with mean score 0.82 and 0.77 most affecting problem of Hamirpur. Heat waves of north India commonly known as Ioo hinders the workers as long time working in sun may affect body and can cause dehydration/water loss, 26.7 per cent women of Hamirpur and 25.0 per cent women of Kanpur admitted this point and placed it II ranked problem of summer. Intense sun light may causes sun burn in long run dermal tissue/ skin in directly affected in intense sun.

15.0 per cent women of Hamirpur and 13.3 per cent women of Kanpur admitted it and placed it V rank with mean score 0.65 and 0.63.

Thus, distribution of both combined district, maximum 88.3 per cent women considered high temperature the most affecting problem of summer with mean score 0.95 placed I rank. 58.4 per cent women think that humidity affects working in field with mean score 0.80 it is II rank in list. Problem of working in heat waves stands III rank in the districts as 51.7 per cent women admit it with mean score 0.76. Working in intense sun light and getting dermal loss stands IV rank as 28.3 per cent women of both districts admit it with a mean score of 0.64.

Table 3: Distribution of respondents according to causes of summer season problems

Causes	Hamirpur				Kanpur				Total			
	Yes	No	Mean Score	Rank	Yes	No	Mean Score	Rank	Yes	No	Mean Score	Rank
High Temperature	45.8	4.2	0.96	I	42.5	7.5	0.93	I	88.3	11.7	1.89	I
Low humidity	31.7	18.3	0.82	II	26.7	23.3	0.77	II	58.4	41.6	1.59	II
Increase heat wave	26.7	23.3	0.77	III	25.0	25.0	0.75	III	51.7	48.3	1.52	III
Direct contact of sun ray with dermal tissue	15.0	35.0	0.65	IV	13.3	36.7	0.63	IV	28.3	71.7	1.28	IV

Table 4: Distribution of respondents according to causes of rainy season problems

Causes	Hamirpur				Kanpur				Total			
	Yes	No	Mean Score	Rank	Yes	No	Mean Score	Rank	Yes	No	Mean Score	Rank
High Temperature	45.0	5.0	0.95	I	41.7	8.3	0.92	I	86.7	13.3	1.87	I
Increase population of micro-organism	16.7	33.3	0.67	II	18.3	31.7	0.68	II	35.0	65.0	1.35	II
Increase insect and pest population	38.3	11.7	0.88	III	35.0	15.0	0.85	III	73.3	26.7	1.73	III
Low intensity of sun ray	23.3	26.7	0.73	IV	20.8	29.2	0.71	IV	55.9	55.9	1.44	IV

Table revealed that 45.0 per cent women from Hamirpur and 41.7 per cent of women from Kanpur admitted that working in high humid climate is difficult having a mean score 0.95 and 0.92 respectively they placed it at rank I. Among various rainy reason problems 38.5 per cent Hamirpur women admitted of difficulties due increased insects and pests. 16.7 per cent women from Hamirpur said that they are affected by micro-organism in rainy season having a mean score 0.67, placed it at IV rank. Whereas, 18.3 per fcent women of Kanpur admitted the same and with a mean score 0.68 placed it at IV rank.

Increase in number of insects pests and low intensity of sun rays are other factors which affect working in rainy season.

overall tables shows that maximum 86.7 per cent women from both the districts were agree on the point that they fell uncomfortable and were being affected working in high humid climate having a mean score of 1.87 they placed it at rank I among all rainy season, 73.3 per cent women accepted increased number of insects-pests in the rainy season and their adverse effect on the work with a mean score of 1.73, they placed it at rank II. 41.1 per cent women agreed that low intensity of sun ray affect working as in high humid, low sunray creates more sweaty and dryness and dehydration with mean score 1.44. It was II rank problem of rainy season. Effect of micro-organism on work was comparatively low as only 35.0 per cent women agreed that micro-organism affect working in rainy season with mean score 1.35 it was IV rank problem.

Conclusion

It was concluded that mostly women farmers faced various problems while working in agriculture. These are physical, chemical, occupational, seasonal, biological and others etc. cause of these problem in inappropriate uses of tools or machineries has highest frequency and fatality rates of injury, lacking of awareness, Exposure to pesticide and other agrochemical constitutes a major causes of occupational risk which may result in poisoning, death, in certain cases and reproductive impairment. Exposure to weather, close contact with plants or animals, long and lengthy working posture and hours are hazardous. Disease and accidents causes by agricultural work also conditioned by a range of factors such as climate, harmful plants and insects, population density, living condition, lack of knowledge about tools, lack of education, training, technological development, quality of service etc.

Recommendation and Suggestion

* Farm women need to be educated about how to operate different equipments.
* Extension facilities should reach each and every village, remote areas so that every worker could know about latest trends.
* Government also implements various plants for betterment of farm women, extension services help workers to know and understand about the plants.
* Workers should wear long boots so that they can be safe from insects and other pests, snakes etc while working in rainy season and in between herbs, shrubs and watery farm.
* They should know about sustainable agriculture, insect-pest management, organic agriculture and environment protection measure.

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Review Article

Precision Animal Nutrition (PAN): A Way to Sustainable Dairy Production

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Abstract

Precision Animal Nutrition, is to provide the animal with the feed that precisely meet its nutritional requirements for optimum production efficiency, produce better quality livestock products and contribute to the cleaner environment and thereby ensure profitability. It is to enhance the production efficiency along with production of quality produces for the end users contributing to economical and cleaner environment. The use of strategies such as accurate feed formulation, restricted use of dietary proteins, strategic supplementation of essential nutrients, use of feed additives, feeding of total mixed ration, proper monitoring of dry matter intake and feed-bunk management, use of diagnostic techniques for early detection of diseases, least cost ration formulation and manure analysis etc. will ensure the accomplishment of the objectives of precision feeding.

Keywords: Precision; Feeding; Nutrition; Animal.

Introduction

With the rise in world's human population, better economic standard, awareness on health and increase preference of animal protein had subsequently increased the demand of animal products. The consumption of animal products is expected to be about 70% higher in 2050 than what it was in 2005 (FAO, 2009) and according to another projection the demand for meat and milk is expected to be 58% and 70% respectively higher in 2050 than their levels in 2010, and majority of this increase will originate from developing countries (FAO, 2011a). To satisfy today's demand for such products; livestock sector has to greatly increase its production potential. But, with the increase in consumers concerns over safe, nutritious, wholesome, natural and quality assured food products for consumption the production of quality animal products is also the need of the day.

Apart from producing quantity and quality products the dairy enterprise should be economically viable and sustainable. With the narrower profit margins, increased fluctuations in product prices and growing environmental scrutiny, requires more accurate accounting of inputs/outputs to remain the enterprise sustainable and profitable. But, the present traditional livestock production system involves use of high inputs, presence of indiscriminate and objectionable residues in animal products that are associated with various health ailments, enteric emission and excretion of excess nutrients such as Nitrogen, Phosphorus and other compounds as manure causing environmental pollution. And the factors, such as scarcity of land and water, on going global warming accompanied with large variations in climatic conditions, increased competition for arable land and fossil fuels will further pose a great challenge to sustainability of traditional feed and food production system.

In this context, the concept of '*Precision Feeding*' that comprises effective use of available resources, inclusion of quality feeds posing minimum negative impact on environment will be a viable alternate to overcome the challenges of present animal feeding practices and to support the targeted production. '*Precision Animal Nutrition' (PAN)* as defined by Reddy and Krishna (2009) is to provide the animal with the feed that precisely meet its nutritional requirements for optimum production efficiency, produce better quality livestock products and contribute to the cleaner environment and thereby ensure profitability.

In reference, to developed countries and some intensive commercialized production system of developing countries, the precision feeding consists of utilization of high quality feed resources and ensures its consistent delivery to animals by using computerized technologies. However, these advanced automatized technologies are difficult to be implemented in developing countries due to lack of resources and infrastructure and predominance of extensive and mixed livestock production systems there. For the diverse production systems prevailing in developing countries, the term precision feeding and balanced feeding can be used interchangeably (Makkar and Ankers, 2014) as both aims to provide ration as per the nutrient requirement of animals, maintains rumen health, maximise microbial protein synthesis that overall enhances the feed efficiency. This will lead to increased productivity, reduce nutrient excretion, decrease feed cost input, enhance animal health, and contribute to cleaner, greener environment and sustainable production system.

With the growing concerns over environment, the livestock farms are focussed to reduce the manure nutrient excretion and soil nutrient accumulation. Recently, the US department of Agriculture –National Resource Conservation Service (USDA-NRCS) has identified the need to reduce manure nutrient through improved feed management on farms with animal feeding operations, and have developed a national standard (NRCS, 592) to be used as part of the nutrient management planning process (NRCS USDA, 2003). The purpose of feed management plan as mentioned in NRCS, 592 standard is

1. To supply the quantity of available nutrients required by livestock while reducing the quantity of nutrients excreted and to,
2. Improve net farm income by feeding nutrients more efficiently (Fox, et al., 2006)

The implementation of the practices outlined in New York (NY NRCS USDA, 2005) Feed Management Standard is actually the precision feeding. According to this, precision feeding is a site-specific practice that involves accurate diet formulation and delivery to each group of animals in the herd, and evaluating and improving the feeding program on a specific farm on a daily basis. To adapt the Precision Feeding program certain specific information of farm, group and individual animals must be known. The site-specific data here means, average animal body weight, production level, accurate feed requirement as per the physiological status, feed analysis and environmental factors etc. It should emphasis on delivery of the same form of ration every day to every cow, as due to profound genetic selections of feed and fodders the NRC standard nutrient composition tables may not be used for accurate ration formulations. So, feed analysis shall be conducted more often for diet adjustments. Likewise, to monitor the nutrient excreted and accumulated in the soil the manure analysis should also be done periodical.

Objectives of PAN

1. To improve the efficiency of production
2. Efficient utilization of available feed resources
3. Reducing the overfeeding and quantity of nutrients excreted.
4. Improve net farm income by feeding nutrients more efficiently.
5. Enrichment of products for the well being of the consumer.
6. Decreased emission of environmental pollutants (e.g. nitrogen, phosphorus and methane)

Effective Measures to Attain PAN

Accurate Feed Formulation

Formulation of ration should be exactly as per the requirements of animals. It is known that the actual nutrient requirement depends on;

a. *Animal Factors* (production level, genetic potential, gender, age, body weight and health status)
b. *Environmental Factor* **(**ambient temperature, humidity, space allowance, stress factors)
c. *Nutritional Factors* (nutrient composition, digestibility and level of anti nutritional factor)

Usually nutritionist formulate the rations as per the nutritional recommendation which often

contains significant safety factors because nutritional requirements and availabilities for all types of cattle, feeds and environment or management conditions are at variance. The extra nutrients contained in these safety factors to ensure that nutrient requirements were met often increased nutrient excretion and contributed to adverse effects on water and air quality. Thus, an accurate assessment of both animal requirements and dietary nutrient supply is economically and environmentally important. Hence Cornell Net Carbohydrate and Protein System (CNCPS) have been developed to evaluate diet and animal performance.

Nutrition Model Designed for Precision Feeding: Cornell Net Carbohydrate and Protein System (CNCPS)

The CNCPS is a mathematical model developed from basic principles of rumen function, microbial growth, feed digestion and passage and animal physiology (Reddy and Krishna, 2009). It is utilized to accurately predict farm specific animal requirement, absorbed nutrients from available feedstuffs and nutrient excretion that particularly will result in optimizing rumen health to maximize forage utilization and microbial protein production. To make these predictions, feed content of carbohydrate (starch, sugars, NDF, lignin) and protein fractions (total, soluble, and unavailable, amino acid profile) and their digestion rates along with fat and ash content must be determined.

To accomplish real/accurate diet formulation feed analysis should be the part of periodic works done on the farm. Chemical analysis along with the other quick assays such as NIRS, XFS, laser and in vitro techniques can also be used for certain prediction equations.

Restricted Use of Dietary Proteins

Dairy cows utilize feed crude protein (CP) with greater efficiency than other ruminants but still excrete about 2-3 times more N in manure than they secrete in milk. This increases both cost of milk production plus environmental N pollution. Dietary CP supplies absorbed amino acids but extra CP not utilized for production is lost in the urine. Urinary nitrogen is the most polluting form of excretory nitrogen because much of it is lost as atmospheric ammonia or into surface and ground water. . In the trial by (Broderick 2003) energy density was increased by reducing forage from 75, to 62 and 50% of dietary DM, giving diets with 36, 32, and 28% NDF; dietary CP was fed at 15.1, 16.7, and 18.4% of DM at each NDF level. There was no interaction between energy density and CP level; that means that the cows responded to CP the same way at all 3 energy levels. Milk and protein yield both increased with the first CP increment, but there was no difference between production at 16.7 and 18.4% CP. There was a linear increase in N excretion with increased CP in the diet and most of the extra manure N was found in the urine. The entire incremental urinary N was excreted as urea, the form that can be quickly broken down and lost as volatile ammonia (Broderick, 2003). Overfeeding of protein actually suppress the production as 7kcal of net energy is required to convert 1 g of N to urea (NRC, 2001).

Feeding of Rumen Undegradable Protein (RUP) and Protected Amino Acids

Feeding less CP, even from high RUP sources, reduces production because microbial protein is reduced. Low soluble fishmeal and canola meal were more effective sources of RUP than heated soybean products. Supplementing rumen-protected methionine allows for some reduction in dietary CP without losing milk yield as studied by Krober et al (2000) where supplementing RP-Met to a 14.7% CP diet resulted in milk protein secretion equal to that of 17.5% CP diet, but at 31 versus 27% conversion of dietary N to milk N.

For tracking the CP content of actual diet fed, frequent sampling and analysis of feed ingredients is crucial. Monitoring Milk Urea Nitrogen (MUN) can also be used to assess both dietary CP and urinary N excretion in lactating cows and thus is a very useful technique to assess the adequacy of protein feeding. Urea is the primary form of excretory N in mammals and blood urea equilibrates rapidly throughout body fluids, including milk and MUN concentrations reflect blood urea (Rook and Thomas 1985) and equilibrium between blood and milk occurs within 1 to 2 hours (Gustafsson and Palmquist 1993). Therefore, MUN serves as a useful index of inefficient N utilization in the lactating dairy cow (Kohn et al 2002). Broderick and Clayton (1997) reported a strong relationship between dietary CP concentration, expressed either on DM or energy basis, and MUN. Urea in body fluids, including milk, results not only from excess protein degradation in the rumen but also from N inefficiency caused by excess supply of protein to the tissues.

Strategic Supplementation of Essential Nutrients

Especially in semi organized and small holding livestock production system, crop residues constitute the major source of roughage for livestock, But, as

they are nutritionally poor and serve as bulk for feeding there is need to improve their nutritive value in terms of digestion and intake. Ammonia treatment through urea hydrolysis is a promising method because of simple technology and low cost involved. Ammonia treatment of wheat straw significantly enhanced the soluble phenolics by 52% and decreased the total cell wall phenolics by about 12% (Reddy and Singh 1992). The CP content was enhanced to 10.37% from 2.59 while ME content was enhanced to 1.99 Mcal/kg DM from 1.62.

Voluntary intake of feed may be increased not only by physico-chemical treatment (chopping and ammoniation) but also through enhanced rumen fermentative digestibility by supplementation of critical nutrients (Reddy 1989), which stimulates intake of feed. Inspite of promising effects of urea ammoniation of straws the technology has not been adopted well at field level. Supplementation with locally available feed resources, such as caged poultry droppings (CPD), sugarcane molasses, deoiled rice bran would help in improving feed utilization. Strategic supplementation increases the efficiency of ruminant productivity on straw-based diets (Leng 1991) and thus paves the way for developing 'environment-friendly' livestock production system.

Use of Feed Additives

Feed additives play a pivotal role in achieving increased feed efficiency by increasing digestibility of nutrients and reduced environmental load per unit of animal product. These include probiotics, prebiotics, organic acids, fibrolytic enzymes, plant extract, ionophore antibiotics, antioxidants from plant origin (catechins, flavonoids), feed emulsifiers (Lecithin, lysolecithin) that helps in better digestion and fat absorption and toxin binders (bentonite, alumina silicate), certain vitamins and minerals etc. Due to overuse and because of problem of residual effect the use of antibiotics have breed stopped in animal diet. Only certain selected and proven group of ionophores antibiotics are in current usage. Review of literature on beneficial effects of ionophores (Tedeschi et al, 2003) revealed that monensin might decrease protein degradation in the rumen and increased feed protein utilization by 3.5 percentage units. Ionophores could decrease methane production by 25% and decreased feed intake by 4% without affecting animal performance. The others ionophores such as, monensin, lasolacid, salinomycin etc are also known to regulate rumen fermentation and propionate production. The organic acids like fumarate and malate also enhance propionate production and reduce methane production. The use of exogenous fibrolytic enzyme like cellulase and xylanase increases the forage utilization and enhances the production efficiency of ruminants. Plant extracts have been conceived as potential natural alternatives for enhancing livestock productivity. Plant secondary metabolites, in some instances, have inhibiting effect on methane, which is most likely mediated through their effect on rumen protozoa, since elimination of rumen ciliates can reduce methane emission and reduce rumen proteolysis. Plant secondary metabolites such as condensed tannins may be used as organic protectant of protein from rumen degradation thus providing more dietary and microbial protein post-ruminally for production purposes. The feeding of yeast (*Saccharomyces cerevisae*) increased bacterial population and fibre degradation in the rumen leading to increased feed intake and flow of microbial protein.

It is usually not possible to meet the requirement of all minerals through feed and fodder alone for higher production. In alternate to this, providing area specific mineral mixture based on the deficiency of mineral in soil, plants and animals in different agro-climatic zones is the most appropriate and cost effective strategy of mineral supplementation. (Gowda et al, 2013). The feeding of free choice mineral supplementation is not assumed to be a good practice in terms of precision feeding, because there occurs the complex interaction among certain minerals and the excess of some may effect the utilization and absorption of other minerals, like excess selenium affects sulphur utilization. Therefore, the method of supplementing the most deficient minerals through area specific mineral mixture by analyzing the mineral status of soil, feed, fodders and animal of the region is most desirable strategy to overcome the mineral deficiencies in livestock.

Feeding of Total Mixed Ration or Complete Feed

The main principle of feeding total mixed ration is that all the ingredients (roughage and concentrate) are proportionally mixed and offered to the animal. The advantage of TMR feeding system is that uniform concentrate intake occurs for the day, than it is offered twice or thrice daily in the conventional feeding system. This enhances the digestibility of roughages, minimizes wastage, selectivity, reduces the nutrient loss and results in increased microbial protein synthesis and thereby improves the productivity and profitability. Concept of complete feeds allows incorporation of crop residues and unconventional feeds along with concentrate

ingredients in a uniform mixture of mash or pellets by employing certain feed processing interventions like grinding, mixing and extruding. It makes rumen environment more stable with reduced energy loss, better ammonia utilization and stabilizes the acetate to propionate ratio. The utilization of low quality roughage can also be improved through complete feeds because of the readily available nitrogen and energy (Gowda et al, 2013).

Proper Monitoring of Dry Matter Intake

Monitoring of DMI is necessary to improve accuracy of ration formulation and animal performance. Proper ration formulation relies on many inputs from the farm, including animal body weight, feed inventory, and actual dry matter intakes. To decrease nutrient excretion per unit of milk produced, actual dry matter intakes must be known in order to ensure adequate grams of each nutrient are provided to support animal requirements. The data obtain can also be used as a diagnostic tool for forecasting various metabolic diseases.

Feed-Bunk Management

The objective is to increase intake and consistency of animal performance. This includes regular cleaning of mangers and pushing feed up several times daily etc. The consistent performance, and feed intake, allows for more accurate ration formulation for any production level.

Use of Diagnostic Techniques for Early Detection of Diseases

Use of metabolic profile test for non esterified fatty acids (NEFA), beta- hydroxy butyric acid, blood urea nitrogen (BUN), milk urea nitrogen (MUN) and creatinine serve as useful indicators for early diagnosis of diseases and to track the changes in ration formulation and feeding management.

Least Cost Ration Formulation

Recently apart from manual methods of ration formulation, software based program for ration computation are extensively being used by organized farms and feed manufacturers for forming low cost diet. It involves linear programming and software facilities. The basic information required is nutrient requirement, nutrient composition and cost of ingredients, its level of inclusions etc. These information and data is to be entered into the computer for ration computation.

Regular Assessment of Certain 'Indicators' To Track the Impact of Changes in Ration Formulation These 'indicators' fall into two categories: short-term (milk production, milk components, and milk urea nitrogen) and long-term (body condition score, replacement heifer growth, lactation persistency, and reproduction). Both sets of tools are required to accurately evaluate a herd.

Manure Analysis

Manure needs to be analyzed two ways: visual observation to determine what is not being digested by the cow, and the second is a manure nutrient analysis at time of land application. If large fiber particles or corn grain is evident in visual observation, rations and feeding management need to be addressed. As dietary N and P levels are decreased, manure nutrient concentrations will be decreased.

Conclusions

The concept of Precision feeding of the livestock is to enhance the production efficiency along with production of quality produces for the end users contributing to economical and cleaner environment. The use of strategies such as accurate ration formulation, reducing overfeeding of nutrients, strategic supplementation, use of feed additives and feed processing technologies will ensure the accomplishment of the objectives of precision feeding.

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Review Article

Neutrigenomics: A Novel Tools for Livestock and Poultry Health, Production & Nutrition

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Abstract

Nutrigenomics is a branch of nutritional genomics and is the study of the effects of foods and food constituents on gene expression. involve scientific understanding of human or animal genomic/genetic contributions and responses to diet/feed. The nutrigenomics considers how things in diet influence individuals genome, and how this interaction modifies phenotype, i.e., how diet alters biological systems to promote either health or disease. Nutrigenetics, on the other hand, aims to figure out how any one of us is genetically programmed to respond in a particular way to a given dietary nutrient. Application of nutrigenomics could help enhance our understanding of how nutrition influences various biological pathways and homeostatic control; how this regulation is disturbed in the early phase of diet-related/deficiency diseases and to what extent individual genetic makeup contribute to such diseases. Numerous studies in humans, animals, and cell cultures have demonstrated that macronutrients, micronutrients and naturally occurring bioreactive chemicals regulate gene expression in diverse ways. Although relatively new technologies, the various genomics applications searching for new biomarkers already have found their way to many nutritional applications. Nutrigenomics can be used to identify the specific markers to manipulate gene expression through use of nutrients or their combinations so as to improve productive as well as overall animal performance. Nutrigeonmics will be a path breaking tool through identification of pathways and candidate genes responsible for dietary induced diseases and ultimately reduction in production losses due to these diseases in animals.

Keywords: Broiler; Genome; Metabolome; Markers; Nutrigenomics.

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Introduction

Over the last decade, advances in the biochemical technologies available for examining functional genomics have provided a number of new molecular tools for evaluating responses to nutritional strategies. These tools are largely based on an understanding of the expression and control of specific genes and gene products and have lead to the development of the sciences associated with nutrigenomics. Bioactive food compounds can interact with genes affecting transcription factors, protein expression and metabolite production. The study of howgenes and gene products interact with dietary chemicals to alter phenotype and conversely, howgenes and their products metabolize nutrients is called nutritional genomics or "nutrigenomics" (Kaput *et al., 2005*).

Nutrigenomics is the study of gene expression or metabolic pathway depending on different food

material. In recent year, nutrigenomics has gained special attention due to its great potentiality for treating chronic disease. In last few decades, it is established that proper nutrition or diet can fight against several diseases. Nutrition genomics or nutrigenomics is the study to understand the nutritional effect on gene expression. In order to explore the importance of diet and diet formulation, it is necessary to understand the physiological, biochemical and metabolic pathways when observing the responses of organisms towards dietary components. The interaction between human gene and environmental factors that cause several human diseases was first investigated in USA (Amin *et al., 2012*). Nowadays, advancement in molecular biology techniques provides us the opportunity to study the interaction between diets, metabolic pathway and gene expression. It is now well established that dietary requirement varies from one individual to another and thus random diet can cause different health related problem such as, body weight, blood pressure, blood sugar, etc. In a detail study Huang *et al*. 2011 stated that "The consumption of nuts, a diet high in carbohydrates and protein, green tea and red wine as well as the supplementation with policosanol and red yeast rice extract can be considered for improvement of the lipid profile, while the supplements of guggulipid, garlic, chromium, vitamin C, magnesium-pyridoxal-phosphate-glutamate, tocotrienols and absorbitol cannot be recommended". Whereas, in an another investigation demonstrated the correlation between diet and prostate cancer. There are several examples of nutrigenomics such as, lactose intolerance symptom which is characterized by insufficient production of lactase enzyme due to genetic variability in lactase gene (Swallow, 2003). People with lactose intolerance symptom are recommended for lactose free diet for better health. Phenylketonuria is an another classical example of nutrigenomics which is directly related to metabolic pathway disorder. Several research groups are engaged in seeking to understand the relationship between dietary/nutritional factors and the expression of genes, metabolic and physiological changes in the body. This research will give us a better understanding of homeostasis in the body, the control and expression of genes and also the metabolic pathways involved in it. Not only human, nutrigenomics study is also important in different other sectors like poultry farm and pig meat industries. In recent year, the demand of chicken and pork is increasing rapidly. Feed efficiency is an important factor in these industries which can be achieved through nutrigenomics research. Till date this area is not so explore. A greater understanding of these mechanisms will lead us to sustainable fisheries more production and other aquaculture activities.

The nutrients and other components of food serve as the key factor in controlling gene expression and transcription (Sales *et al*., 2014). It is not an approach to the basic nutrition provided by food but a rather wide area beyond it. It is already proved that pattern of gene expression varies from one individual to other due to single nucleotide polymorphism or SNPs. The types of food and its consumption quantity are thus very important for health and development of the body. Several research on nutrigenomics concluded that food with bioactive compounds are beneficial for health. Nutrigenomics studies gives opportunities for fundamentally new approaches to nutritional research that enables global study of gene expression and its effects. In this present review, we have documented the importance of nutrigenomics in animal health and diet related gene expression.

The nutritional genomic area includes two parts, nutrigenomics that is the study of interaction between dietary components and the genome and the regulating changes in proteins and other metabolism another one is nutrigenetics that identify the response to dietary components with regard to genetic differences. The new technologies like, genomics and proteomics.

Nutrient Gene Interaction

Genes are turned on and off according to metabolic signals that nucleus receives from internal factors, e.g. hormones, and external factors like nutrients, which are among the most influential of environmental stimuli. Numerous dietary components can alter genetic events, and thereby influence health. In addition to the essential nutrients, such as carbohydrates, amino acids, fatty acids, calcium, zinc, selenium, and vitamin A, C and E, there is a variety of nonessential bioactive components that seem to significantly influence health. These essential and nonessential bioactive food components are known to modify a number of cellular processes associated with health and disease prevention, including carcinogen metabolism, hormonal balance, cell signaling, cell cycle control, apoptosis, and angiogenesis. Often bioactive food components will modify several processes simultaneously. The complex mixture of natural substances that supplies both energy and building blocks to develop and sustain organism nutrients has variety of biological activity like antioxidants

(act as a free radical scavengers), nutritional hormone (potent signaling molecules) and phytochemicals (modulator for animal health and production). The essential nutrients imbalance of macronutrients in sub optimal level or even toxic concentration of certain feeds may cause many diseases and disorders.

Gene Expression Profiling

Microarray technology is a powerful tool f or the global evaluation of gene expression profiles in tissues and for understanding many of the factors controlling the regulation of gene transcription. This technique not only provides a considerable amount of information on markers and a predictive factor that may be potentially characterize a specific clinical picture, but also promisesnew applications for therapy. The use microarray evaluating nutritional strategies and nutrition effect by individual gene marker have variable response in individual animal receiving same level of feeds and also possible to compare gene expression patterns in group of animals. It is also to identify specific similarities and differences in nutrient effects across a number of genes.

Nutrigenomics in Animal Sector

In recent year, nutrition research gains a special attention due to its vast application in several branches of science. It is already proved that not only environmental cues but several other factors are associated with animal health. Nutritional genomics is a recent off-shoot of this genetic revolution. Recent research indicated that bioactive material present in diet alone act as a transcriptional factor or interact with transcription factor and regulate the expression of metabolic genes (Sales *et al.*, 2014).

Advantages of Nutrigenomics in Ruminants

- Improves ruminant health
- Improves production of milk fat
- Improve fertility and reproductive performance

Nutrigenomics in Poultry Birds

Maysa *et al.,* (2009) reported that the effect of organic selenium (sel-plex™) on productive, reproductive and physiological traits of bandarah local strain. Fertility and hatchability percentages were significantly increased in treated groups but hatched chicks weight was increase supplementation in the diets had improved the productive, reproductive and physiological traits in females and males of Bandarah local strain. Live body weight of females was significantly increasedwith increase of hens age, but no significant effect on feed consumption as the age of birds increased. Egg production percentage, egg weight, egg quality and selenium content in yolk and albumen were significantly increased for hens fed SelPlex™ supplementation Semen ejaculate volume, advanced motility (%), alive sperm (%) and spermconcentration were significantly increased by Sel-Plex™ supplementation in cock's diet. Selenium is an essential component of at least 25 selenoproteins involved number of physiological function, including reproduction and fertility of hens. Supplementation of organic and inorganic selenium in hens revealed that energy production and protein translation was greater in oviduct when organic selenium added to feed. This is not observed in the supplementation of inorganic selenium (Brennan *et al.,* 2011). Improving broiler breeder by optimizing nutrition with specific feed rations is possible.

Conclusion

Traditional research related to animal nutrition is mainly deals with either deficiency or excess of the particular nutrient which leads to ill health as well as decreased animal production. But genomic revolution has propelled the development of several new technologies that can be applied in nutritional sciences. New techniques like genomic, proteomic, metabolomic, and bioinformatics are now making their ways to solve the intervening puzzle between nutrient and genes. This era of newer technologies have the potential to improve the nutritional assessment and measures of bioavailability of various nutrients to get sustainable livestock production. The application of these innovative tools and the concepts developed from genomic studies assures to revise the thinking of researches engaged in nutritional science to improve animal health and ultimately the production and recently various clinical trials deals with nutritional research have proved the relationship among diet, health, disease and production.

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Review Article

Asexual Propagation Techniques: Novel Approach for Raising Quality Planting Material of Guava

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Abstract

The greatest handicap in guava plantation is discriminate multiplication and non-availability of quality planting material that adversely affect the guava production and productivity. The initial planting material is basic requirement on which the final crop depends both in quality and quantity. In view of the high return and the potential for processing, there is a tremendous scope for bringing substantial additional area under guava crop in India. Therefore, rapid methods of propagation become very important when planting materials are limited due to scarcity of clone or varieties or due to sudden expansion in acreage. Thus, it has become imperative to standardize the time and propagation methods for guava under open conditions. A comprehensive work done in India and abroad on propagation studies in guava have been reviewed under different techniques for guava propagation.

Keywords : Guava; Propagation Techniques; Quality Planting Material.

Introduction

Guava (*Psidium guajava* L.) belonging to family Myrtaceae has originated in tropical South America (Pathak and Ojha 1993). It is considered to be one of the exquisite, nutritionally valuable and remunerative crop. Besides its high nutritional value, it bears heavy crop every year and gives good economic returns (Singh *et al*., 2007). The tree is fairly salt and drought-resistant and can be grown on a variety of soils. This has prompted several farmers to take up guava orcharding on a commercial scale (Singh *et al*., 2003). In recent years, guava is getting popularity in the international trade due to its nutritional value and processed products (Singh, 2005). Guava exceeds most other fruit trees in productivity, hardiness and adaptability. The fruits are used for both fresh consumption and processing and has great market potential due to their delicious taste and aroma. The fruits after removal of seeds may be utilized to make products such as jam, jelly, cheese, juice, canned segments, nectar etc. They are used mostly for squashes and juices, however the most commercial use of guava is for jelly preparation due to good source of pectin (Adsule and Kadam, 1995).

In view of the high return and potential for processing there is tremendous scope for bringing substantial additional area under guava crop in India as well as with the changing horticultural scenario in India, demand of genuine planting material has been increased tremendously. Demand of planting material has encouraged establishment of a large number of nurseries to cater the acute shortage of quality planting material. Non availability of quality planting material and consequent substitution of poor quality seedling has adversely affected the guava production and productivity (Singh *et al.,* 2005). Therefore, rapid and successful propagation technique is required to meet the requirement of

quality planting material of guava throughout the year. While, choosing a particular technique for propagation of guava, the time of operation and method should be taken into consideration. As the success of each method vary from region to region due to variation in agro climatic conditions. Any particular method which may be successful at one place may not prove useful at other. Similarly, a particular method successfully adopted will vary from place to place due to environmental factors such as temperature, relative humidity etc.

Guava is multiplied by many methods of propagation and different degree of success have been achieved by various propagation techniques viz., 93.3% with patch budding (Kumar *et al*., 2007), 77.33% with wedge grafting (Gurjar *et al*.,2012), 71.22% with cuttings (Rahman *et al*., 2003) and 83.15% rooting success with air layering (Rymbai and Reddy, 2010). Propagation by patch budding, wedge grafting, air layering and cutting have been attempted by various investigators (Samson, 1986) and are presented below.

Propagation by Patch Budding

Pandey *et al*. (1979) reported that swollen buds gave better bud take than dormant buds and patch-budding showed highest (90 percent) bud take in May as compared to chip budding performed during April to August in guava. Similarly, Mehrotra and Gupta (1984) revealed that the highest (70.12 percent) success in patch budding of guava was obtained when seedlings were budded during May. Results of Rao *et al.* (1984) revealed that July and August months were optimum time for budding of guava where maximum success of 74 percent in patch budding during July and 62 percent in August with forket budding were obtained. Similarly, Gupta and Mehrotra (1985) obtained highest (82.50 percent) patch budding success in May which was closely followed by 80.00 percent success in June where, the patch budding success in May and June was significantly better than that from April to September. Kaundal *et al.* (1987) obtained maximum success (87.50 percent) in patch budding during May as compared to shield budding performed at monthly intervals from April to September. Results of Aulakh (1998) showed highest (95.60 percent) percentage of successful survival of plants in guava when patch budding was performed on 14th June. Singh and Pandey (1998) reported that the best time for budding in guava was July.

Results of Patel *et al.* (2005) revealed that in patch budding highest (84.08 percent) success and minimum number of days (27.67) for sprouting in cultivar Allahabad Safeda was observed when budding was performed on seven guava cultivars in the month of February-March.

Kumar *et al.* (2007) conducted an experiment at ZRSKA, Ballowal, Saunkhri during 2005-06 on guava to standardize time of patch budding under the rainfed conditions in lower Shivaliks of Punjab and reported maximum (93.30 percent) success in mid June patch budding and observed minimum number of days (18.0) were required for bud sprouting in mid June.

Results of Babu and Yadav (2007) showed that the response of guava to patch budding during third week of February, was found to be excellent with respect to time taken for bud-take (18 days), percent bud sprout (95 percent) and survival percentage (90.0 percent) at two months after patch budding. Similarly, Patel *et al.* (2007) reported highest (84.08 percent) patch budding success and minimum (27.67) number of days taken for sprouting in guava cultivar Allahabad Safeda during February-March. Babu *et al.* (2009) conducted an experiment on budding at the experimental farm of the Division of Horticulture, ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2004 and 2005. Budding was practiced in both white flesh (Hybrid-1, Selection-11, Allahabad Safeda and Lucknow-49) and red flesh (Selection-1 and hybrid-4) genotypes.To fix the appropriate method of budding for vegetative/ clonal propagation of guava, two budding methods viz., patch budding and shield budding were tried out during the third week of January 2004 and 2005 where it was revealed that patch budding was superior over shield budding for per cent bud sprout.

Results of Mehrotra and Gupta (1984) recorded maximum (20.5 cm) sprout length with patch budding in June. Gupta and Mehrotra (1985) in their study of patch budding recorded that highest (22.7 cm) shoot length was obtained in May. Similarly, Kaundal *et al.* (1987) while, comparing patch and shield method of budding recorded maximum (25.26 cm) budling length in May with patch budding which was significantly greater than the budling length in case of patch budding done in August (10.79 cm) and September (5.29 cm). Aulakh (1998) reported that maximum (46.6 cm) shoot length was obtained on 14th June. Kumar *et al.* (2007) reported maximum (14.9 cm) shoot length and number of leaves (12.7) in patch budded guava plants. Patel *et al.* (2007) reported maximum (36.89 cm) length of sprouts, number of leaves/plant (29.67) and leaf width (5.59 cm) with patch budding in cultivar Allahabad Safeda among different cultivars of guava under mid hills of Meghalaya.

Sohnika *et al*., 2015 reported that among all propagation methods, patch budding performed during 15 to 21 August under Jammu sub-tropics showed highest per cent success (92.07%) recorded after 90 days of propagation.

Propagation by Wedge Grafting

Patil (2004) reported that maximum success was achieved through wedge grafting (91.6 percent) in mid- August among all propagation methods and mid-August wedge grafting took minimum days to sprout. Results of Singh *et al.* (2007) revealed that maximum success of wedge grafting was obtained in greenhouse (88.63-94.33 percent) as well as in open field conditions (66.6-78.63 percent) during November to February in guava (*Psidium guajava* L.) cultivars Allahabad Safeda and Sardar. Similarly, Visen *et al.* (2010) reported that wedge grafting has tremendous potential for multiplying plants rapidly either in greenhouse or open conditions in guava (*Psidium guajava* L.) and obtained maximum (81.71 percent) success of wedge grafting in greenhouse during September and December. Singh *et al.* (2011) reported wedge grafting success ranging from 28-99 percent being maximum (99 percent) in guava cultivars in the month of February in open field conditions.

Syamal *et al.* (2012) carried out an investigation during 2009 at the Banaras Hindu University, Varanasi where Wedge grafting performed on Allahabad Safeda (V1), Lucknow-49 (V2) and Allahabad Surkha (V3) during four months, viz., July (M1), August (M2), September (M3) and October (M4) under polyhouse as well as in open field conditions and was revealed that wedge grafting in the month of July gave better result in polyhouse (77.17 percent) when in open field condition (66.43 percent). Similarly, Gurjar *et al*. (2012) reported that wedge grafting in guava showed maximum bud bursting percentage in the month of Ist November in polyhouse and open field condition (67.65 percent) in the month of 1st February. The maximum graft survival percentage was recorded in the month of 1st January in poly house (94.08 percent) and open field condition (77.33 percent) in the month of January.

Joshi *et al*., 2014 carried out an experiment during 2010-11 and 2011-12 at BHU, Varanasi where minimum number of days taken for sprouting of buds was recorded in the treatment combination Local guava rootstock + wedge grafting with polycap under polyhouse during February (9.17 days), July (9.70 days) and November (12.56 days) months. However, the bud took maximum time for sprouting in treatment L-49 rootstock + shield budding under open conditions when propagation was done during November (39.16 days). The experiment was repeated during 2011-12, almost similar trends were observed. Earlier sprouting of bud was observed in polyhouse as compared to open field conditions. This might be due to the fact that under polyhouse conditions creation of high humidity around bud scions reduced the desiccation of active tissue of scion bud as compared to open field conditions. Similarly, the maximum sprouting was also recorded in the treatment combination local guava seedling rootstock + wedge grafting with polycap under polyhouse in November (96.08%), February (93.95%) and July (91.13%) followed by local guava rootstock + wedge grafting under polyhouse. However, minimum sprouting was recorded in the treatment L-49 rootstock + shield budding under open conditions when propagation was done during February (49.08%), July (55.59%) and November (45.98%) during 2010-11.

Propagation by Cuttings

Kilany and Gabr (1986) reported that rooting in hardwood cuttings of guava was very poor (1.67-4.67 percent only), it ranged from 18.3 to 57.5 percent in leaf-bud cuttings and was highest (81.4 percent) in semi-hardwood cuttings treated with 2500 ppm IBA + 10 ppm á-naphthol planted during September in a 1:1 mixture of sand and peat moss. Rahman *et al.* (1988) revealed that leafy tip cuttings of guava gave 90.11 percent, 94.44 percent and 94.44 percent rooting treated with 3, 6 and 12 ppm paclobutrazol, respectively, after six weeks of planting in July-August whereas, no rooting was observed in control.

Rahman *et al*. (1991) reported that 10-12 cm long guava tip cuttings with at least 4 leaves, dipped in paclobutrazol for 24 hours and planted between mid June and end of September in sand under unheated greenhouse with 78-80 percent RH and natural light conditions gave the highest (94 percent) rooting percentage in mid-August planting.

Manan *et al*. (2002) reported highest per cent success (51.24 percent) in guava cuttings treated with IBA at 500 ppm. Rahman *et al*. (2003) observed maximum (71.22 percent) sprouting per cutting within 17.68 days in softwood cuttings treated with 1000 ppm NAA in the month of August. Results of Ayaz *et al*. (2004) revealed that treatment of guava cuttings with 60 ppm paclobutrazol resulted in maximum (73.3 percent) cutting success in fresh softwood cuttings of guava having 3-4 leaves.

Ullah *et al*. (2005) reported maximum (71.22

percent) sprouting in softwood cuttings of guava cv. Allahabadi treated with paclobutrazol in August. They observed more number of branches (3.44), maximum root weight (1.46 g) and better survival (57.22 per cent) in softwood cuttings of guava treated with paclobutrazol at 1000 ppm solution in August. Maximum number of roots (59.66) and lengthy shoot (8.24 cm) were recorded in soft wood cuttings of guava treated with IBA at 1000 ppm in August. Similarly, Abdullah *et al*. (2006) revealed that the guava species is amenable for clonal propagation by mature stem cutting and recorded maximum number (32.7) of primary roots in guava cuttings treated with 0.8 per cent IBA solution which was followed by 0.4 per cent IBA treatment and lowest (58.3) was in cuttings without IBA treatment. The highest (60 percent) rooting percentage was observed in the cuttings treated with 0.4 percent IBA solution which was followed by rooting in cuttings treated with 0.2 percent IBA.

Marinho (2009) reported that fourty day after planting, 76 percent of the mini cuttings rooted and emitted aerial part and thirty-five days after been planted, these mini cuttings, with average length of 13.56 mm, presented 100 percent of rooting. Kareem *et al*. (2013) reported that softwood cuttings of guava treated with IBA 4000 ppm gave maximum (92.17 percent) survival percentage of plants which was followed by 85.50 percent with IBA 2000 ppm in month of August. Similarly, Rahman *et al.* (2003) revealed that softwood cuttings of guava treated with paclobutrazol gave good performance as compared to IBA and NAA in August. They obtained more branches (3.44), maximum root-weight (1.46 g) and more number of branches (3.44) in softwood cutting treated with paclobutrazol at the 100 ppm solution while, maximum (59.66) number of roots and lengthy shoot (8.24 cm) was recorded in softwood cuttings treated with IBA at 1000 ppm. Similarly, early sprouting (17.68 days) and maximum root-length of 12.81 cm was observed in softwood cutting, treated with NAA at concentration of 1000 ppm.

Results of Ayaz *et al*. (2004) revealed that 60 ppm paclobutrazol resulted in maximum rooting (69.5 per cent), shoot length (24.3 cm), number of branches (4.3), number of roots (87.1) and root volume per plant (1.64 cm^3) in fresh softwood cuttings of guava having 3-4 leaves. Among various dipping period five hours dipping resulted in maximum rooting (30.1 per cent), shoot length (10.6 cm) and number of roots (47.2), while, four hours dipping resulted in the maximum number of branches (2.6) and root volume per plant (1.05 cm^3). The highest number of (23.75) roots was recorded in the cuttings treated with IBA at 4000 ppm and significantly maximum root length (4.13 cm) was noted in the cuttings treated with IAA 3000 ppm in April (Wahab *et al.*, 2001). Sohnika *et al*., 2015 under Jammu sub-tropics reported that the time of propagation, soil media and their interaction had a significant effect on percentage of rooted cuttings of guava they observed that after 90 days of planting highest (78.69 per cent) success was recorded in vermiculite + sand + FYM (1:1:1) during 15th-21st of August.

Propagation by Air Layering

Sharma *et al.* (1991) revealed that air layering carried out on 10th July resulted in the highest (67.70 percent) per cent success as compared to air layering performed on 10th July, 25th July or 10th August on eight year-old guava tree. Singh *et al*. (1992) reported highest survival (75.63 percent) with 75 per cent defoliation followed by complete defoliation (64.18 percent) in air layers of guava at 45 and 120 days after planting in the field. Bhagat *et al*. (1999) reported highest rooting (94.67 percent) and survival (78.33 percent) in air layers of guava when treated with 4500 ppm IBA.

Results of Rymbai and Reddy (2010) revealed that high percentage of rooting and root characters of air layers of guava have been successfully achieved by exogenous application of IBA at 4000 ppm and air layering performed on 15th August gave maximum rooting success (77.94 percent). Rymbai and Reddy (2011) carried an experiment during 2008- 09 and reported that highest (77.94 percent) rooting was obtained in 15th August air layering of guava and showed a possibility of obtaining good quality planting material using air layering (at 15th June, 15th July and 15th August).

Kumar and Syamal (2005) reported that IBA at 3000 ppm recorded the length (11.30 cm) of primary roots per air layer, average number of secondary roots (10.72) while, IBA at 4000 ppm recorded the highest value for diameter of roots (2.30 mm). Results of Sharma *et al.* (1991) revealed that treatment of air layers with 10000 ppm IBA resulted in the highest number, length, diameter and weight of roots after carrying out air layering on 10 July, 25 July or 10 August in 1990 on eight-year-old guava tree. Patel and Pasaliya (1995) reported that NAA at 9000 ppm applied immediately after ringing gave the highest number of primary and secondary roots and heaviest root fresh and dry weights when IBA, NAA or IAA at 3000, 6000, 9000 ppm was applied after ringing or 10 to 20 days later on rooting in air-layered shoots of guava cv. Lucknow-49. Athani *et al*. (1999) reported that longest (11.15 cm) root length was noticed in cultivars GW-1 and GR-2, SR-1 has the

shortest roots (2.8 cm), CIW-4 had the highest number of roots (12.3) and SR-3 had the lowest number of roots (1.0) when air layering was performed in guava cultivars. Patel *et al*. (2005) reported that maximum (36.89 cm) length of sprout, leaves/plant (29.67) and leaf width (5.59 cm) were recorded in Allahabad Safeda while, maximum rootstock girth (3.82 cm), sprout girth (2.71 cm) and leaf length (10.95 cm) were recorded in cultivar hybrid-1 among air layered seven cultivars of guava.

Sarkar and Ghosh (2006) reported that air layers of guava prepared during June and July showed maximum number of primary and secondary roots in alluvial zone. Results of Rymbai *et al*. (2012) revealed that maximum number of primary and secondary (1.80 + 22.44) roots, length of longest (10.78 cm), fresh (2.72 g) and dry (0.51 g) root weight, establishment percentage (83.33 per cent), number of leaves (6.67) at 45 days after transplanting (DAT) and (13.83) at 60 DAT and minimum (8.67) number of days for buds sprouts were recorded in air layered plants of guava during 2008-09. Ghosh and Ranjan (2005) reported that air layering in September, October and November resulted in highest (85 percent) rooting success when performed on the 10th of each month from January 2001 to December 2002 in guava cv. L 49.

Socio-Economic Impact of the Study

In view of increasing costs of labour and inputs, farming has become less remunerative. Today, farmer is in search of new alternative, especially when several incentives under Horticulture Mission and export promotion are provided by the Government. Fruit plants yield much higher than ordinary field crops and are certainly far more remunerative. Healthy and good quality plant material is the foundation of successful fruit industry in the country. The maintenance of purity is easy in vegetatively propagated fruit crops as compared to seed propagated ones, still it requires a close monitoring at different stages in the nursery to avoid mixing with other varieties. Due to lack of standard propagation technique farmers generally prefer to raise guava plants through seeds which does not give true to type planting material and they do not get good remuneration from their produce. These studies revealed that there is great potential of propagation by vegetative techniques in guava for nursery stock production of commercial scale. The selection of appropriate site adapted phenotypes and elite genotypes with excellent fruit bearing and flesh quality and manipulation of cultural environment are important to improve the quality of planting stock for optimum gains. Further the propagation technique of nursery stock production is simpler and cheaper and can be used even by unskilled nursery growers. Hence the standardization of method of propagation will facilitate the large scale multiplication of genuine planting material by farmers, which will help the farmers to fetch good price in market thus raising their socio-economic condition.

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Review Article

Role of Biosensors in the Field of Veterinary Practice

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Abstract

The early and on-site detection of pathogen is of utmost important as far as rapid diagnosis of disease is concerned. We also need to be prepared for the re-emerging diseases of livestock. The conventional methods of pathogen detection like immunoassays, PCR needs to be replaced with a very accurate, highly specific, on the door, rapid methods as the biosensors does. A lot of research work is being carried out all over the world to develop various biosensor techniques for early detection of veterinary pathogens. The success of this technique lies in their validation and commercialization. It can be a great aid to the veterinarian and scientist to diagnose and control the outbreaks. However, many hurdles still need to be cleared before transferring this technology from the laboratory to the field.

Keywords: Biosensor; Bioreceptors; Transducers; Pathogens.

Introduction

A biosensor is an analytical device with a specific bio-recognition element (enzymes, hormones, nucleic acid, and cells) immobilized on the surface of a sensor which is connected to a transducer that transmits and interprets the signal. Biosensors comprises mainly of two components: a biorecognition element or a bioreceptor which recognize the desired analyte and a transducer yielding a digital electronic signal which is proportional to the concentration of a specific analyte.

Conventional methodologies for pathogen detection require specialized technical staff, equipment, and is arduous, time taking and costly. There is lack of uniformity and lack the convenience of on–site testing. By the time a diagnosis is made, the disease condition may aggravate affecting more animals and even death may occur. Although molecular methods of pathogen detection have better sensitivities and rapid than antibody based assays but these methods require skilled personals and equipment, and are costly (Arora et al., 2006).

Therefore we need a cost effective, less time consuming, highly specific analytical tools for the rapid disease diagnosis and the Biosensors fits into that. Biosensors are becoming important in a broad range of analysis. Miniaturisation, reduced cost and the enhanced processing power increased the analytical capabilities of such devices. Biosensors are highly specific, easy to use, require only small sample volume, rapid, accurate, stable and capable of yielding onsite results.

Basic characteristics (Stoytcheva, M et al 2009) of a biosensor includes linearity (linearity of the sensor should be high for the detection of high substrate concentration), sensitivity (value of the electrode response per substrate concentration), selectivity (chemicals interference must be minimized for obtaining the correct result) and the response time (time necessary for having 95% of the response). The

first description of a biosensor was made in 1962 by Clarke which was an amperometric enzyme electrode for glucose.

Classification of Biosensors

Biosensors are mainly classified based on the basis of bioreceptors and the transducers.

Bioreceptors

A bioreceptor is a molecular species that exploits a biochemical mechanism for recognition (Sharma H et al 2013). Biorecognition elements have recognition properties, which can be applied to produce either an affinity or a catalytic sensor. A diverse range of molecules such as nucleic acids, enzymes, antibodies, cell receptors etc. can be used as the sensing element in biosensors (Ibtisam E. Tothill, 2001). Bioreceptors are accountable for binding the concerned analyte to the sensor for measurement. In catalytic sensors, the change in the concentration of a component resulting from the catalysed reaction is detected to yield a signal. The binding event between the receptor and the desired analyte is monitored, in an affinity sensor. Bioreceptors can broadly be classified into following distinct classes:

Antibody-Antigen Bioreceptor

Affinity sensors use mainly antibody-antigen binding reactions. Antibodies probes can be polyclonal, monoclonal or recombinant. Antibodies are the most popular class of biorecognition probes because of their high binding affinity and target specificity.

Enzymatic Bioreceptor

Enzymes are used extensively in biosensors as the catalytic component; the most important group has been the oxido-reductases.

Nucleic Acids (DNA) Bioreceptor or Genosensors

It integrates an oligonucleotide with a signal transducer. The DNA probe is immobilized on the transducer and acts as a biorecognition molecule to detect DNA/RNA fragments. DNA biosensors are currently used in the detection of infectious diseases and the genetic abnormalities.

Cellular Structures or Cellular Bioreceptor

Whole cells such as bacteria, yeast, fungi, plant and animal cells have also been used as the bioreceptors by integrating their general metabolic status. This usually involves detecting oxygen or substrate consumption, the production of carbon dioxide or metabolites, detection of bacterial luminescence (Tothill and Turner, 1996).

Biomimetic Bioreceptor

Biomolecules are poorly stable. Various methods are being tried to improve the stability of these molecules such as by using diethyl amino ethyl (DEAE) dextran, lacitol, and sugar derivatives or artificial receptors or biomimics like molecularly imprinted polymers (MIP).

Transducers

A transducer converts the biorecognition event into a measurable signal. They are mainly classified as electrochemical, optical, mass based and calorimetric with the first three being the most commonly employed and universal for pathogen detection.

Electrochemical Biosensors

It measures the change in electrical properties following biorecognition, as a result of change in ion concentration during a reaction. Electrochemical biosensors are further classified into amperometric, potentiometric and impedimetric or conductometric.

Amperometric biosensors measure the generated current at a constant voltage and are the most commonly used class of electrochemical biosensors. Potentiometric biosensors measure difference in voltage at zero current. Impedimetric or conductometric biosensors function by measuring the change in electrical resistance/conductance of the solution.

Optical Biosensors

It measure changes in intensity of light. Detection elements in such biosensors are frequently based on luminescence, fluorescence, phosphorescence, colorimetry, reflectance, interference, spectroscopy, and surface plasmon resonance (SPR). Fluorescence and SPR–based biosensors are most commonly used. SPR biosensors are used for monitoring biological interactions and for detection of small, medium and large analyte.

Mass–Based Biosensors

It detects a change in mass that occurs following

the interaction between the biorecognition element and the target analyte. The change in frequency is proportional to the mass of absorbed material. It generally uses piezoelectric materials that change their resonant frequency, following the change in mass, generating acoustic waves. The most commonly used piezoelectric biosensors make use of Quartz Crystal Microbalance (QCM).QCM was used for detection of *Candida albicans*. (Muramatsu et al 1986).

Role of Biosensors in Diagnosis of Diseases of Livestock and Poultry

A number of antibody based biosensors have been developed for detection of viral pathogens of veterinary significance like Avian influenza virus (AIV) subtype H5N1, Bovine viral diarrhea virus (BVDV), Rabies virus, Swine origin influenza virus (S–OIV) subtype H1N1 by using electrochemical and optical transducers and Duck hepatitis virus serotype1 (DHV1), Foot and mouth disease virus (FMDV), Infectious bursal disease virus (IBDV), Porcine Rotavirus using optical transducers, Coxsackie virus B4 using mass based transducers (Ayyar et al 2013). Biosensors are used for the detection of *E. Coli* O157:H7 in food samples (Li D et al 2011). A cell based biosensor technique was used to detect various numbers of pathogens and toxins (Banerjee, P et al 2011). Biosensor technique for *Salmonella* detection was developed by Seo et al. (1999). Ye et al. (1997) described a piezoelectric biosensor for detection of *Salmonella typhimurium*. Pizoelectric immunosensors were developed for detection of *Vibrio cholera, Candida albicans, Salmonella typhimurium, L. monocytogenes.*

Other Applications

An immuno-affinity fluorimetric biosensor was developed for detecting and quantifying Aflatoxins. Biosensor has also been used for detection of aflatoxin in milk samples (Parker, C.O et al 2009). Biosensors can be used for the quality control of milk and meat. A multi-enzymatic amperometric biosensor for estimation of lactose in fresh raw milk was developed by Eshkenazi et al. (2000). This method may be used as a cheaper on-line lactose measurement technique in the milking parlour. An amperometric glucose sensor named meatcheck has been successful commercialized. The meatcheck is a four-electrode array attached to a knife, which is inserted into meat to measure the glucose gradient immediately below the surface. The extent of the gradient is related to microbial activity on the surface of the meat and is regarded as a sound indicator of meat quality. This device provides results in seconds whereas laboratory based microbiological tests takes days. Concentration of lactic acid is an important parameter for the meat industry as it indicates the state of fresh meat. Bergann et al. (1999) reported an enzymatic biosensor based on immobilised lactatoxidase as bioreceptor and an amperometric transducer. The biosensor estimates lactic acid without special sample preparation, very quickly and at low cost. A disposable screen printed amperometric progesterone biosensor was developed by Pemberton et al. (1998) for the detection of estrous cycle. The basic principle is the reduction in the binding of alkaline phosphatase labelled progesterone to the sensor surface in the presence of endogenous milk progesterone. Similar effort was made (Claycomb et al. 1998) for estrous detection by using optical transducer. Setford et al. (1999) developed a field based screening method using amperometric biosensor for detection of beta lactams in milk.

A surface plasmon resonance biosensor (SPR) was used for detection of sulfamethazine enrofloxacin and its metabolite, ciprofloxacin residues in milk in milk (Mellgren et al., 1996). SPR developed by the Pharmacia BIA core indicated the occurrence of less than 0.9 mg of sulfamethazine per kg of milk with the advantages of freedom from sample preparation, high sensitivity, rapid and full analysis in real time for the control of residues and contaminants in food (Maria et al 2003). The drug residue of salbutamol was analysed in the urine samples of calves using SPR (Elliot et al 1998).

Conclusion

Biosensors can be proved as an efficient analytical tool to the animal disease diagnosis, quality control of meat, milk. This review summarizes the present developments in the field of veterinary science. Since the inception of biosensors some fifty years back, its commercialization in the field of pathogen detection is in its nascent stage. The main reason being the lack of sensitivity, stability and applicability to unprocessed samples. Stability has been a concern while working with the antibody–based biosensors which mainly uses polyclonal or monoclonal antibodies. Lots of lab work has been done on development of biosensors for detection of veterinary viral pathogens but hardly any find its market value and it can be concluded that biosensing for veterinary pathogens is still a distant dream. As biosensors is a fast, simple, have an on-site

application and cost efficient technique, it has an evident advantages compared to traditional analytical techniques and therefore future hold great promises provided all the concerns are fully addressed.

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Review Article

Bioterrorism: Significance in Livestock Production and Bio-Security Measures

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Abstract

Bioterrorism can be described as hazardous effects produced due to the intentional release or dissemination of biological agents. They may be naturally occurring bacteria, viruses, or toxins, and may be in a naturally occurring or a human-modified form. Bioagents are readily available in the modern world and are relatively inexpensive to produce, store and transport from one country to another and can affect livestock health & productivity. The increased bioterrorism is due to the advances in biotechnology, the increased availability of dual-use materials and the ease of transporting biological agents across borders. Bio-security is implementation of measures to prevent the introduction of infectious agents into a healthy population of animals or limit the spread of disease by adopting isolation, traffic control, sanitation, vaccination, serological monitoring of diseases and air quality etc. The bioterrorism has significance not only in livestock but also indirectly affecting the human health and safety hence it is important to bring awareness on bioterrorism.

Keywords: Bioterrorism; Bacteria; Viruses; Toxins; Vaccination; Serological monitoring.

Introduction

Healthy and productive livestock produces a wide variety of food products for direct and indirect human consumption and processing. These products include blood, eggs, meat and meat products, milk and dairy products, viscera as well as rendering by-products. Animal food products from healthy and productive livestock improve farmers' access to both domestic and international markets. Bioterrorist attack the Economic hub of country.

Bioterrorism is terrorism involving the intentional release or dissemination of biological agents. These agents are bacteria, viruses, or toxins, and may be in a naturally occurring or a human-modified form (Atlas, 1998). Bioterrorism can be defined as deliberate release of viruses, bacteria or other germs to cause illness or death (Sharma, 2010). Cultured & genetically engineered biological organisms (bio-weapons) is the most dangerous of all existing weapons technologies (Henderson, 1999). Bio-weapons are defined as biological organisms and substances derived directly from living organisms that can be use to cause death or injury to humans, Animals or Plants (Dudley & Woodford, 2015).

Bioterrorism is defined as "the use of microorganisms or toxins derived from living organisms to cause death or disease in humans, animals, or plants in civilian settings" (Huxsoll *et al.,* 1987). Although the possible motivations behind an attack of this kind are numerous, the most important aspect of bioterrorism is to be able to recognize the signs or clues that an attack has

occurred as soon as possible. When attempting to detect a bioterrorist attack, some indications that a biological agent has been released include: 1) an abnormal grouping of illnesses or deaths that may be temporal or geographical in nature that affect a large number of people or animals, which may include unusual or unexplained symptoms; 2) healthy individuals become ill suddenly; 3) unusual symptoms for a particular area arise; 4) an unusual age distribution among affected individuals; or 5) the disease appears outside of its "typical" season.

History of Bioterrorism

The first intentional spreading of an animal pathogen on a large scale seems to have been organized in the year 801, in the context of a lengthy war between the Prince of Benevent (ruling the former eastern roman empire) and the Emperor Charlemagne, (ruling his western European empire). The way in which the disease was spread remains unclear, but the event was discussed at the time by those who suffered this criminal epizootic. According to the Chronicle of Agobard (779–840, archbishop of Lyons, France), many people did not believe the story: they wondered how a 'poisonous powder' could be harmful only for the bovine species, and how such a small amount of this powder could be effective. The true nature of the 'powder' has of course not been known, but could have simply been small ground pieces of infected tissues taken from animals affected with Rinderpest. Germans carried out carefully planned and executed clandestine operations during World War I. There were substantially supported allegations made that German secret agents had prepared and inoculated or spread cultures of Anthrax and Glanders. These microbes were intended to kill cattle, sheep, horses or reindeer. Attacks were targeted against Argentina (1916–1917), France (1917), Norway (1916), Romania (1915–1916), Spain (1915–1918) and the United States of America (1915–1916), but their success remained questionable (8,9). Before and during the First and Second World Wars, many experiments and field trials were conducted in countries in Europe and the USA, using various infectious agents, but it seems that these agents were never released in the battlefield.

Many of the potential agents that are used in bioterrorism are zoonotic. Zoonotic organisms are organisms that can be transmitted from animals to humans. This is an important fact to consider when dealing with zoonotic diseases. First, some diseases may manifest symptoms in animals before they are seen in humans. Second, animals -including pets, livestock, and wildlife- may serve as sentinels. A sentinel is an individual in a group or population that is susceptible to a disease being monitored for the appearance of the causative agent ("sentinel"). These sentinels can also serve as vectors and spread the disease to large areas in the case of wildlife that can travel long distances, which makes them potential sources of infection for both humans and other animals.

In a disease control program, one should first understand the disease transmission mode i.e direct contact with infectious material, indirect contact through contaminated food and water or by vectors and aerosol transmission.

Producers in the animal industry also play a part in disease control and bio-security. Maintaining a healthy herd will reduce the risk of outbreaks of disease. This can be done by implementing a protocol that includes vaccination and proper hygiene for both animals and handlers. It is also important for producers to purchase animals from a reputable source and to quarantine all incoming animals before introducing them to the rest of the herd. In addition, sick animals should be identified as quickly as possible and quarantined from the rest of the herd. The herd veterinarian should be contacted immediately if unusual illness or signs are noticed. Table scraps and garbage should not be fed to farm animals. Producers should also control insects, birds, rodents and other animals that may introduce and spread disease on their farm, while paying particular attention to feed storage areas.

Other biosecurity measures that the producer can implement on the farm include controlling the flow of traffic into the farm and regulating visitors. Some suggestions to control the flow of traffic include posting signs regarding entry and exits, and guidelines to be followed in farms keeping the gate locked when not in use, and keeping all unused buildings locked. Vehicles that enter and leave the farm should be clean and sanitized to avoid the transfer of dirt, mud, or manure and parked away from livestock areas and barns, preferably on concrete. Visitors to the farm should be kept to a minimum. Be sure that they have on clean clothing and boots that have been disinfected or provide them with disposable plastic boot covers. Do not take visitors to livestock areas or barns unless it is necessary. It is also a good idea to monitor and document all visits to your farm. Concerning personnel and animal handlers, prescreen new employees and train them to spot common disease signs and patterns, so they can recognize

abnormalities in the herd. Personnel that visit or work on multiple farms should: 1) wash hands thoroughly with disinfectant soap before and after accessing livestock areas; 2) use clean coveralls and rubber or disposable boots for each farm; 3) place dirty coveralls in a plastic bag after each farm visit; 4) and clean and disinfect boots after each visit. It is also a good practice to always have on hand the contact information for the herd veterinarian, the state veterinarian office, USDA/APHIS area office, animal extension personnel, and the state public health and agriculture departments.

Biosecurity is the prevention of disease causing agents entering or leaving any place where farm animals are present (Defra, 2003) which will aid in prevent the entry and control the pathogens in and around the farm (Stoltenow, 2008).

Advantages of Bio-security in Terms of Livestock Production

- Improve Health performance
- Greater productivity & Reproducibility
- Reduced Disease infestation
- Early detection and management of any diseases
- More Profit through livestock production
- Reduced costs if there is an outbreak of disease, pests or weeds – early detection and sound farm biosecurity practices may result in faster eradication and shorter quarantine periods.

Basic Bio-security

The vulnerability of the animals on a ranch/farm to disease is influenced by a number of factors including: cleanliness, stress, nutrition, and other management factors; these are all aspects that can be managed. The three main issues to address in a successful bio-security management program are isolation, traffic control, and sanitation.

Isolation

The most important step in disease control is limiting contact, co-mingling, and movement of livestock. This issue is of special importance for new animals arriving on the farm/ranch, including replacement animals, breeding animals, or animals returning from livestock shows. Even co-mingling between established groups of livestock on the farm/ranch should be minimized. An important biosecurity option on ranches is to separate livestock by age and/or production groups. Isolation of animals can be particularly difficult during natural disasters because of damage to facilities and or perimeter fences or lack of feed resources. Isolate sick animals, especially animals with unfamiliar symptoms or those with symptoms that do not improve with usual treatment.

Traffic/Movement Control

Traffic control within the operation should be designed to stop or minimize contamination of animals, feed, and equipment. It is important to remember that traffic includes more than vehicles. All animals and people should be considered when addressing the issue of traffic. Restrict people to places where they need to be. Limit visitors' access to barns and lots. Post a warning sign asking visitors to keep out and giving instructions or a telephone number to call instead of entering the operation. Keep a record of all visitors that enter the premises. Visitors to a ranch/farm operation present several potential problems. Consideration should be given to a visitor's previous stops; both the people and their transportation are potential contaminants. Be aware of foreign visitors and ban footwear, clothing, and other products from foreign countries. People who have traveled outside of the United States should be denied access to a ranch/farm for a minimum of 14 days to control accidental introduction of foreign animal diseases (FAD). Disposable boot covers may be a better option than footbaths to contain contamination from soil and manure. Other animal traffic concerns include pets, dogs, cats, horses, wildlife, rodents, and birds. Traffic control within the operation should be designed to stop or minimize contamination of livestock, feed, feed handling equipment, and equipment used on animals.

Sanitation

The sanitation component of bio-security addresses the issue of the disinfection of people, equipment, animals, and material entering the ranch/farm and the maintained cleanliness of people and equipment. Avoid using common syringes and needles for vaccination, blood testing, or administering animal health product. Be vigilant when working with sick animals: move from healthy to sick animals during the day, never vice-versa. An important objective of sanitation is to prevent fecal contaminates from being ingested by livestock. The use of separate equipment for feed handling and manure/dead animal removal is optimal. If the same equipment is utilized for manure and feed handling, perform thorough cleaning and disinfection.

Additionally, loaning of equipment or trailers presents another opportunity for pathogen

introduction to the ranch/farm. Cleaning of facilities and equipment between groups of livestock during processing is a good management practice to reduce pathogen transmission.

Future Prospect

1. Enactment of national & International laws against the bio-terrorism.
2. Need to support increased investment & research efforts aimed at eliminating threats of Bio-terrorism.
3. Need to Develop a Vaccine & drugs not only to combat infectious diseases, but also to counter bio-terrorism.
4. Need to develop genetically modified organism.
5. Development of Antidotes against different bioterror agents.
6. To enhance national and civil defense systems to contain and counteract the use of biological agents in the manufacture of bio-weapons.

Conclusion

1. Bio-terrorism presents a major threat to the National & Global security in terms of livestock production.
2. Prevention is the cheapest and most effective measures of bio-security.
3. Adequate bio-security measures in the vaccine/ drug production & research laboratories should be designed carefully to avoid dangerous bio-materials & sensitive information for bio-terrorism.
3. Updating the knowledge of field veterinarian or farmers.
4. Rapid diagnosis of emerging infectious diseases is essential for maintaining livestock production.
5. Efforts may be done to make the country free from economically important infectious diseases. Since Rinderpest, the premier scourge of cattle, has already been eradicated from India, the focus is now on control and eradication of Foot and Mouth Disease, Peste des Petitis Ruminants (PPR), Brucellosis, Swine Fever and other diseases having major impact on productivity.
6. A national institutional mechanism, in collaboration with the ICAR and other institutions would be put in place to deal with the issue of Bio-terrorism & bio-security in the livestock sector.

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Original Article

Light Management in Broilers: An Overview

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Abstract

Broilers are reared in various production systems. The three important aspects of light which play a pivotal role in determining the production performance of broilers are intensity, duration and colour. It has been noted that broilers grow better during constant photoperiod while darkness is important for the welfare of the birds. Further, Broilers under blue or green light become significantly heavier than those reared under red or white light. Thus, it is necessary that a particular lighting program considering production and welfare concerns may be standardized and followed for optimum production performance in broiler operation

Keywords: Broilers; Photoperiod; Light Intensity; Scotophase.

Introduction

Globally, chickens are reared in a variety of production systems. These include outdoor enclosures that basically utilize natural climatic conditions, production house of various sizes and construction that have little to extensive control over light and other environmental factors, and very large homogeneous houses that allow precise control of environmental factors, including temperature, humidity, air velocity, rate of air exchange, gases, light intensity, duration and color. Light as an environmental factor which consists of three different aspects: intensity, duration, and wavelength. Light intensity, color, and the photoperiodic regime affect the physical activity of broiler chickens (Lewis and Morris, 1998).

The broiler producer must consider several critical factors in the design of a lighting program. Housing type is the first concern. Some broiler houses have dark and light colored curtains in facilities but most of the broilers are reared in clear curtained sidewall housing. Broiler producers with clear curtains and/or open sidewall houses are restricted in lighting alternatives and are forced to design lighting programs around the limitations of natural daylight/length. Houses with dark curtains or solid sidewalls allow the producer to establish lighting systems that control intensity, duration, and wavelength throughout the growth period. When considering lighting programs as a management tool, both light intensity and duration are factors that are normally considered. In most situations, light provided by incandescent sources is used.

Vision

The most important visual abilities of poultry are spectral and flicker sensitivities as well as accommodation and acuity. Domestic fowl have a number of adaptations to their color apparatus not shared by humans. They possess three photoreceptors compared with just two (rods and cones) receptors in humans. The additional photoreceptor is a double cone, but its function is not clear, though it does respond to incident light (Prescott and Wattes, 1999; King-Smith, 1971). Birds have four photo reactive pigments associated with cone cell that are responsible for photopic color vision, while humans have only three pigments. The pigments in bird cones are maximally sensitive at wavelengths of 415, 455, 508 and 571 nm, while those of humans are maximally sensitive to wavelengths of 419, 531 and 558 nm (Yoshizawa, 1992; Dartnall *et al.,* 1983).

Light

Light is a powerful exogenous factor in control of many physiological and behavioral processes. Light may be the most critical of all environmental factors to birds. It is integral to sight, including both visual acuity and color discrimination (Manser, 1996). Light allows the bird to establish rhythmicity and synchronize many essential functions, including body temperature and various metabolic steps that facilitate feeding and digestion. Of equal importance, light stimulates secretory patterns of several hormones that control, in large part, growth, maturation, and reproduction.

Spectral Sensitivity of the Domestic Fowl

The spectral sensitivity of broiler fowl has been determined in a behavioural test. Generally, the birds showed a peak sensitivity between 540<l <577 nm. The results agree with electrophysiological data between 507<l <694 nm and psychophysical data between 500<l <700 nm, data showed higher sensitivities between 380<l <507 nm compared with electro-physiological findings. Findings confirm that broilers can 'see' into the UVA range and that their spectral sensitivity is different to the human. The implication of this is that the measurement of light intensity in poultry housing using the lux unit does not accurately describe the intensity perceived by fowl (Prescott and Wattes, 1999).

Blue light has a calming effect on birds, while red will enhance feather pecking and cannibalism. Blue-green light stimulates growth in chickens, while orange-red stimulates reproduction (Rozenboim *et al.,* 1999).

Light Intensity

Broiler behavior is strongly affected by light intensity. Generally, brighter light will foster increased activity, while lower intensities are effective in controlling aggressive acts that can lead to cannibalism. Varying light intensities are often applied to manage the birds. Light intensity has significant effect on blood biochemical parameters like pH, Na^+, K^+, Cl^-, pCO_2 and Hb concentrations (Olanrewaju *et al*., 2012).

Young chick (1 to 28 days of age) generally prefer brighter light (~20 lx) and broilers prefer blue or green light over red or white light.(Berk, 1995; Prayitno *et al*., 1997).

Photoperiod

Duration of the photophase or photoperiod is the second major aspect of light that will alter broiler performance. Different photoperiodic regimes have been applied and tested over the years, while almost all of them have been shown to improve broiler welfare with conventional near-continuous lighting (Gordon, 1994). Lighting duration is largely dependent upon the age of chickens involved and type of housing in use. Research and discussion continue in an attempt to define the optimal photoperiodic regime suitable for broiler chickens. However, results to date suggest an absolute minimum uninterrupted dark period of 4 hours should be given, but the requirements for sleep may be higher at certain points of the growing period (Blokhuis, 1983).

Scotophase

Broiler lighting schedules can be characterized in a number of ways, including the number of hours of scotophase (darkness) and how many periods of darkness are included in each 24 hour (h) cycle. Research has shown that darkness is as important to growth and health of broilers as light. It was hypothesized that short photoperiods early in life will reduce feed intake and limit growth. Recent research comparing 12 hour light (L):12 hour dark (D), 16L:8D and 20L:4D lighting schedules demonstrated clearly that longer periods of darkness prevent regular access to feed and consequently reduce feed intake and limit growth. (Classen, 2004a). Classen *et al*. (2004b) also compared lighting programs with 12 h of darkness per each 24 h period

provided in 1, 6, or 12 h intervals. Their study indicated that early growth rate was significantly reduced by longer periods of darkness, but gain from 14 to 35 day (d) as well as final body weight was not affected by lighting programs. Feed conversions were higher for 12 L: 12D and two 6L: 6D periods per each 24 h period than 12 (1L:1D) periods per each 24 h period. The 12L: 12D treatment resulted in lower mortality than the 12 (1L: 1D) treatment and the 2 (6L: 6D) was intermediate.

Gait scoring has been proposed as an indicator of leg health and consequently broiler welfare (Sanotra *et al*., 2002; Garner *et al*., 2005). Broilers reared under a 2 (6L:6D) until 33 d of age showed higher gait scores, thus more leg problems and poorer general welfare, than broilers reared under a 12 (1L:1D) schedule (Garner *et al*., 2005) Longer dark periods were associated with lower mortality and improved gait scores. Reduced early growth which increased leg strength was proposed as the rationale of this effect. Broilers reared under longer periods of darkness are reported to experience better health than counterparts under long daylight conditions. Melatonin is a hormone released from the pineal gland that is involved in establishing circadian rhythms of body temperature, several essential metabolic functions that influence feed/water intake patterns and digestion and secretion of several lymphokines that are integral to normal immune function (Apeldoorn *et al*., 1999).

Daily dark periods are necessary to establish normal secretory patterns of melatonin. Melatonin, which is synthesized in the pineal gland and retina of birds, is released during the hours of darkness in response to the activity of serotonin-N-acetyltransferase, the enzyme that catalyzes the synthesis of melatonin in both the retina and pineal gland (Binkley *et al*., 1973). Birds provided with sufficient dark periods have fewer health related problems, including sudden death syndrome, spiking mortality and leg problems than those maintained in continuous or near continuous light (Apeldoorn *et al*., 1999; Moore and Siopes, 2000). Livability, average BW, feed conversion rate and percentage condemnations were improved in broilers exposed to restricted photoperiods, as compared to broilers subjected to continuous light (Classen, 2004a).

Increased heterophil: lymphocyte ratio is an accepted indicator of stress in chickens. Broilers reared under continuous light had a higher heterophil: lymphocyte ratio and experienced greater fear response, as indicated by increased tonic immobility time than birds reared under a 12 hour light: 12 hour dark photoperiod (Zulkifli *et al*., 1998). Continuous light disrupts the diurnal rhythm and has some welfare concerns. Among those are high prevalence of leg and skeletal disorders in poultry and affected birds may even experience difficulty in getting to feed and water. In addition, use of continuous or near-continuous light has proved to be stressful and results in greater mortality (Sanotra *et al*., 2001, 2002; Wong-Valle *et al*., 1993; Freeman *et al*., 1981).

Introduction of a moderate day length of 16 hour is associated with potential welfare benefits including lower physiological stress, improved immune response, increased sleep, increased overall activity and improvement in bone metabolism and leg health (Gordon, 1994; Davis *et al*., 1997; Rozenboim *et al*., 1999b; Classen *et al*., 2004b).

Constant Photoperiod

When photoperiod is maintained at a constant level throughout the growth cycle of broiler chickens, shorter day length is associated with slower growth. If given a choice, chickens prefer to eat during the photoperiod, although they will eat during darkness if insufficient periods of light are provided (Li *et al*., 1995).

Intermittent Lighting

Research on intermittent lighting has been extensive but complicated by a wide variety of light-dark cycles and management systems. However, intermittent lighting programs have frequently resulted in superior broiler productivity in comparison to constant light. (Classen, 2004a; Rahimi *et al*., 2005) Intermittent lighting frequently reduces the incidence of leg disorders and has also been shown to reduce sudden death syndrome. Circadian (daily) rhythms in activity and metabolism are well recognized in diurnal poultry species. Entraining endogenous circadian rhythms can be accomplished by a number of factors such as housing, but light is almost certainly the most important factor.(Buckland, 1975; Simmons, 1986; Classen and Riddel, 1989; Classen, 2004). Alternative lighting programs can be classified into

- Intermittent (e.g., 1hour light:3 hour darkness repeated (Wilson *et al*., 1984),
- Restricted (e.g.,16 hour light:8 hour darkness (Robbibs *et al*., 1984),
- Combination of intermittent and restricted (e.g., 12 hour light followed by 15 min light:2 hour

darkness repeated over 12 hours (Quarles and Kling,1974),

- Increasing photoperiod schedules (Renden *et al*., 1996).

Broilers on intermittent photoperiods exhibited less stress, as measured by plasma corticosterone, than counterparts on continuous light. Plasma corticosterone is known to be elevated in stressed broilers (Buckland *et al.*, 1974; Puvadolpirod and Thaxton, 2000a-d; Puvadolpirod and Thaxton, 2000a-d; Olanrewaju *et al*., 2006).

Male broiler chickens raised in near continuous lighting (23hour light:1 hour darkness) and intermittent lighting (1 hour light: 3 hour darkness, I hour light) repeatedly had higher growth rates, higher plasma growth hormone levels and testosterone concentrations than birds under a continuous lighting (24 hour light: 0 hour darkness) regimen (Kuhn *et al*. 1996). Performance of broiler chickens is improved by intermittent lighting of repeated cycles of 1 hour light and 2 hour darkness schedules compared to continuous lighting.

Increasing Photoperiod

Male broilers subjected to an increasing photoperiod had larger testes and higher plasma androgen concentrations at 7 week than birds under a continuous light regimen. Chickens reared under increasing photoperiod had higher plasma androgen concentrations at 7 week compared to those under constant photoperiod, but light intensity had no effect (Charles *et al*. 1992).

Lighting program beginning with an extended dark period and thereafter gradually increasing the day length results in reduced early growth rate, reduced feed intake and improved feed conversion ratio, compensatory growth, stimulated sexual maturity as early as 7 week and improved chicken livability when compared with those exposed to near continuous constant photoperiod program (Charles *et al*. 1992). Potential health benefits associated with increasing photoperiod may result from reduced early growth rate, increased activity, increased and rogen hormone production, changes in metabolism or combinations of these factors (Classen and Riddell, 1989).

Color of Light

It is dictated by wavelength and it exerts variable effects on broiler performance. None of the commonly used types of fluorescent light emits appreciable amounts of ultraviolet A light (UVA, ë 320-400 nm). Daylight has a relatively even distribution of wavelengths between 400 and 700 nm. Birds sense light through their eyes (retinal photoreceptors) and through photosensitive cells in the brain (extra-retinal photoreceptors). The ability of chickens to visualize color is similar to that of humans, but they cannot see as well when exposed to short wavelengths (blue-green). Specific light wavelength may have an impact on production and characteristics of broilers. During the early period, short wavelengths appear to stimulate growth. However, when the bird approaches the time of sexual maturity, long wavelengths (orange-red) increase growth and are effective in stimulating sexual hormonal pathways that culminate in fertile egg production. Growth in broilers is affected by light spectra. Broilers under blue or green light become significantly heavier than those reared under red or white light. Green light accelerates muscle growth and stimulates growth at an early age, whereas blue light stimulates growth in older birds (Halevy *et al*., 1998) (Rozenboim *et al*., 1999a, b; 2004).

Conclusion

Light management in broilers has multidimensional effect on the bird's welfare as well as producer's profit. Hence, variations in light source, duration, color and intensity have to be judiciously handled. Further, a particular lighting program considering production and welfare concerns may be standardized and followed for optimum production performance in broiler operation.

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Review Article

Green Biotechnology and Scope of Genetically modified Crops: Facts and Prejudices

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Abstract

Biotechnology is a modern science with old roots. It can be considered a game changer in many ways as it has inherent solutions for many hurdles modern society is facing today. One of the most important branches of Biotechnology is Green or Agro-biotechnology, which is the application of biotechnological tools and techniques to genetically improve organisms, crops for the betterment of ever burgeoning population. Green biotechnology holds promise in producing crops with high yields and nutritional content, insect resistance, longer shelf life, and various other traits like production of vaccines (edible vaccines), monoclonal antibodies phytoremediation and so on. Biotech crops are supposed to need lesser water, fertilizers, herbicides, almost nil tillage requirement, lesser need to spray so less fuel consumption, reduced CO_2 and N_2O emissions. Inspite of all these advantages, the acceptance of genetically modified plants have become mired in controversies regarding their safety, applicability and their effects on the environment. This review deals with various positive and negative aspects of green biotechnology, trying to shed an unbiased light on the actual scenario because this technology actually has the potential to feed millions of poverty stricken, undernourished people on the earth. How far this goal is reached, still remains to be seen.

Keywords: Green Biotechnology; Genetically Modified Organisms; Green Revolution; Golden Rice.

Introduction

Biotechnology, among all biological sciences, has emerged as the harbinger of almost all the relevant scientific discoveries that modern science could boast of. This century, undoubtedly, belongs to this discipline, as only it has the potential to bring unprecedented advances in human and animal health, agriculture and food production, manufacturing and sustainable environmental management. Broadly Biotechnology may be defined as Convention on Biodiversity that include molecular techniques for diagnosis, breeding, tissue culture, exploitation of naturally occurring microorganisms for fermentation and inoculums for crop (e.g., mycorrhizas). According to Organization for Economic Cooperation and Development, it is the appliance of science and technology to living organisms, as well as, parts, products and models thereof, to alter living or non living materials for the production of knowledge, goods and services. The term is believed to be stamped in 1919 by Hungarian agricultural economist Karl Ereky in his paper entitled "Biotechnology of meat, fat and milk production in large scale agricultural enterprises".

Whole rainbow code of 'domains' of

biotechnology have been developed of which , specifically agricultural (Green) biotechnologies, industrial (White) biotechnologies, aquaculture (Blue) biotechnologies, and healthcare (Red) biotechnologies are better recognized (AGRIFOR Consult, 2005). Apart from these, there is yellow biotechnology which deals with nutrition biotechnology, gray biotechnology concerning the problems of environment protection, Brown biotechnology for deserts and arid regions, gold one allied with bioinformatics, computer science and chip technology, violet concerning law, ethical and philosophical issues and dark biotechnology dealing with bioterrorism and biological weapons. (Kafarsky, 2012) Genetic modifications (GM) argue new characters or "traits" that are not naturally present in the organism. Encompassed manipulation in genetic modification includes; Transferring of genes, Modifying information in a gene i.e. gene editing, Moving, deleting, or multiplying genes within a living organism and grafting pieces of existing genes, or construction of new genes. The plants which are developed using these biotechnological techniques are generally called as genetically modified organisms or GMOs. The World Health Organization defines genetically modified organisms (GMOs) as "organisms in which the genetic material (DNA) has been altered in a way that does not appear naturally" (WHO 2002)

This review paper is mainly concerned with the green biotechnology which is maneuvering biotechnological processes in agriculture with the aim of improving nutritional quality, yield, economics and various other specifications useful while raising the crops. Likewise Genetic modifications also known as genetic engineering, genetic manipulation, gene technology or recombinant technology are considered to be the pillars of green biotechnology. Objective of green biotechnology is to produce more environment friendly farming solutions as an alternative to traditional agriculture and animal breeding systems. It includes various non-contentious technologies for remodeling food security such as molecular assisted breeding for desirable characteristics and tissue culture for mass proliferation of healthy planting material.

History of Agriculture Biotechnology

Around 10000 years back, people in Middle east began to cultivate crops paving way for a settled sedentary life doing away with the nomadic life. To say that this event led to growth of various civilizations all around the world will not be an exaggeration. Settled life gave stability and time for people to think, innovate and invent. It is probable that cop improvement began as soon as farming did. Initially, it was unconscious selection of more vigorous individuals which slowly became more sustained and deliberate. The science of genetics was firmly established due to the works of Charles Darwin and Gregor John Mendel. Infact, Mendelian laws laid the foundation of modern plant breeding. The First green revolution occurred in 1960s and 70s when dwarf varieties of cereal crops along with increased mechanization and widespread use of nitrogen fertilizers, herbicides and pesticides led to remarkable raise in crop yield. Dr Norman Borlough is said to pioneer this green revolution by persuading the wheat breeders in Asia to use the technology and averting the critical food shortage in developing countries of Asia.

Now the world is again standing at similar juncture, where mouths to feed are becoming much more than the overall food production all over the world. The scenario is much graver in the developing and so called third world countries with over 95% of individuals being born in these countries. The world's population is predicted to double over the next 40 years, It is estimated that to meet these increased demands, food production must increase by at least 40% in the face of decreasing fertile lands and water resources. Shortage of enough resources to irrigate crops or purchase herbicides or pesticides, leading to a vicious circle of poor crop growth, falling yields and pest susceptibility (Christou et al., 2004). In short, we require another green revolution to mitigate this enormous difference between demand and supply of the food.

GM plant technology is an imperial approach that is being developed to combat such problems. The specific aspect of green biotechnology was reiterated by the European Commission in 2004: "Life science research can help European agriculture tackle its three main challenges: the shift in economic power away from primary producers (countries); the magnificent changes desired in agricultural infrastructure and systems; and the effect of trade globalization and liberalization that could lead to a 20% to 30% cut in EU agricultural output in the very near future (European Commission, 2002).

The current R&D emphasis is mainly on the development of varieties that show improved resistance to other biotic as well as abiotic stresses (e.g., drought and biofortified varieties), require lesser water, fertilizers, herbicides and pesticides, use lesser energy and are more environment and human friendly. Every now and then, companies involved

in the development of such genetically modified plants have introduced something new to the market but how far these varieties succeed in fulfilling the requirements of being safe and cheap remains to be seen.

Advantages of Green Biotechnology

The benefits of green biotechnology to farmers, environment, consumers and society are many. Biotech crops are able to:

- Increase yields by 6% - 30% on the same amount of land by producing sturdier varieties that are more vigorous, softer shells and longer shelf life.
- Genetically modified crops are resistant to insect and viral damage thereby significantly reducing the need to spray crops.
- Reduction in fuel consumption and resultant CO_2 production because of less tillage.
- Claims are there that their usage have already reduced the global environmental 'foot print' of production agriculture by 14% including reductions of CO_2 emissions in 2004 equivalent to taking 5 million cars off the road for one year.
- Production of better, secure and nourishing food and feedstuffs, like healthier vegetable oils; produce containing less harmful natural toxins such as mycotoxins.
- Reduce production cost of raw material by increasing economic viability of biofuel
- Allow farmers to grow more food more reliably in harsher climatic conditions.
- Reduce water usage to meet the Millennium Development Goal.
- Protect soils from erosion and compaction through less ploughing.

Green biotechnology indulges choice for farmers to help them adopt sustainable agricultural practices that can tackle tomorrow's challenges. Agriculture is a major source of green house gas emissions, contributing to almost 48% of total methane emission and 52% of N_2O emission. Agricultural practices like deforestation, cattle feedlots, usage of fuel for spraying the crops, tilling of the soil and fertilizer use currently account for about 25% of all green house gas emissions and 14% of all CO_2 emissions. With the help of green biotechnology, there will be supposedly be lesser fuel consumption on farms through a reduced need to spray crops, carbon sequestration and reduced fertilizer use and N_2O emissions and sturdier crops . Studies have shown that maximum Green house gases are emitted during fuel usage for spraying of crops (Barfoot and Brookes, 2009) or powering water pumps. GM crops need much less or almost nil tillage thus aiding in soil carbon sequestration. GM rice and canola have increased Nitrogen use efficiency (NUE) thereby reducing the need of fertilizers and also decreasing the input cost of the farmers. The yields can be improved (Bt maize in Spain 2007; Brookes 2007) along with course to suffer with water scarcity by using water more sustainably, reducing water loss and by improving drought tolerance.

Scenario of Green Biotechnology

Since 1995, farmers have been growing GE crops. In 2003, 7 million farmers in 18 countries, more than 85 percent of them resource-poor farmers in the developing world were planting biotech crops. Relatively one third of the world biotech crop area was cultivated in developing countries. In 2013, GM implanted area in USA was 70.1 million hectares including maize, soybean, cotton, alfalfa, papaya, canola, sugarbeet and squash whereas in Brazil, it was 40.3 mha covering maize, soybean and cotton. In India, the total area under GM cops was around 24.4 mha and Bt cotton is the only GM crop cultivated.

In 1980, first GMO patent was issued to a bacterium with an appetite for crude oil, ready to gobble up spills and in 1982, FDA Approved First GMO Humulin, insulin produced by genetically engineered *E. coli* bacteria to be commercially available in markets. Flavr savr, a delayed ripening variety of tomato developed by a USA based company Calgene, was the first commercially available genetically modified food in 1994 (James, 1996; Weasel and Lisa 2009) but was withdrawn from the market after sometime due to anti-GM hostility. A soyabean variety by the name 'Roundup Ready' incorporated with trait of herbicide tolerance especially against broad range herbicide Glyphosate was refined by Monsanto (Padgette et al., 1995). In 1996, insect resistance was introduced in maize by incorporating Bt gene of the soil bacterium *Bacillus thuriengiensis* responsible for producing an insect resistant protein called the Cry (Crystal) protein. Such Bt crops have been successful in many parts of the world. Rather than food crops, genetically modified cash crops are gaining more importance worldwide. Bt cotton currently occupies the largest area in Africa for any GM crop (ISAAA, 2009). Traits are also being incorporated in plants for the enmasse production of recombinant medicines and industrial products, like monoclonal antibodies, vaccines (edible vaccines), plastics and biofuels.(Sticklen 2005; Conrad 2005; Ma et al., 2003; Lal et al., 2007) though

the technology is still in its nascent stage and will take considerable time to be exploited commercially. First edible vaccine to show some promise in animal trials was against transmissible gastro enteritis (TGEV) in pigs (Lal et al., 2007). The first food product of biotechnology (an enzyme used in cheese production and yeast used for baking) appeared on the market in 1990. Ye et al. (2000) engineered rice that contained moderate levels of carotene and since then researchers have produced the much higher yielding 'Golden Rice 2' (Paine et al., 2005). In 2015, *Aqu Advantage salmon,* the first genetically modified animal to be approved for food use having the quality of growth all year round was introduced (Bunge 2015). GM plants are also being assessed for their role in selective removal of pollutants or phytoremediation. For example, plants have already been genetically engineered to grow on contaminated sites and accumulate heavy metal soil contaminants such as mercury and selenium to higher levels, thereby decontaminating the field and allowing recycling or removal of the accumulated heavy metals (Sasaki et al., 2006; Banuelos et al., 2007). Molecular farming to cultivate GM plant-derived pharmaceutical proteins (PDPs) is currently being pondered upon across the world (Ma et al., 2003). The first full-size native human recombinant PDP, human serum albumin, was demonstrated in 1990 (Sijmons et al., 1990). Hepatitis B vaccine are attempted to be produced in potatoes and lettuce, (Kapusta et al.,1999) vaccines for heat labile toxin produced by *E. coli* and Norwalk virus, 50, 51 human pro-insulin 52 and several monoclonal antibodies have already been tried but still commercial success is evading the companies involved.(Hiatt et al., 1998; During et al., 1990; Ma JK-C et al.,1995; Francisco et al.,1997; JA, Gawlak et al.,1997; Mayfield et al.,2003).

GMOs: The Controversy

Although much research and resources are being continuously drawn into the field of green biotechnology, the gains are not upto the expected level. There has always been a cloud of controversy over the acceptance of these GMOs. It can be rightly said that GM crop cultivation is the need of the hour but still it is regarded as the most misunderstood and controversial technology of this era. Although most governments support biotechnology as a strategic technique for the new millennium, the red-green contrast of biotechnology has been the result of long term cultivation approach by the media all over the world. Medical achievements have always been in positive light but advances in agri biotechnology were seen suspiciously (Morgan and Shanahan, 1996). In this light, it is imperative to assess the successes and failures of this branch of biotechnology and the prospects of new GM crop varieties reaching the market in upcoming decade. A survey in UK in 1999 showed that on average, there was a disliking towards green biotechnology and food and crop applications were considered hardly acceptable whereas medical (red) biotechnology was considered to be useful and to be encouraged (Bauer 2002). This feeling of distrust was more evident in Europeans as they see GMOs as risk to society and morally unacceptable (Gaskell et al., 2006)

Genetically modified (GM) crops are different from crop improvement by natural selection and breeding both technically and conceptually and pose different risks, conceptualized in various international laws. The Cartagena Protocol on Biosafety,(Secretariat of the Convention on Biological Diversity, 2000) an international agreement signed by 166 governments worldwide that seeks to protect biological diversity from the hazard stiffed by GM technology. The United Nations food safety body, Codex Alimentarius, acknowledged the importance of regular breeding and safety assessment (Codex Alimentarius, 2009; Codex Alimentarius, 2003). The fact that a GM crop is basically different from a natural crop is utilized by the industry in different ways. It acquires patent for the process and the product on the basis that the generation of a GM crop constitutes an "inventive process", thus making the GM crop patentable. On the other hand, GM foods are projected to be hardly different from non GM foods apart from the verity that they have more dietetics value and shelf life. The exchange of genetic material between unrelated species through a system apart from sexual reproduction is called horizontal gene transfer, or HGT. Genetic engineering involves intentional horizontal gene transfer. Reproduction, involves vertical gene transfer, as the genes are passed down through the generations from parent to offspring.

Genetic engineering blurs the natural barriers between species and kingdoms that have evolved

over millennia inducing unpredictable changes in the DNA, proteins, and biochemical composition of the resulting GM crop, which might prove toxic or have other detrimental effects like allergies and nutritional disturbances, as well as unforeseen effects on the environmental balance (Wilson et al., 2006; Schubert 2002). Just a single transformation at the level of the DNA can produce multiple pleiotropic effects with unknown outcomes because genes interact with one another and are regulated by a highly complex, multi-layered network of genetic and epigenetic development within the organism (Wilson et al., 2006). Genes from humans or animals can be transferred to plants or vice versa, potentially creating unpredictable Frankenstein monsters. Moreover, genetic engineering can introduce purely synthetic genes, thus, expanding the range of possible genes, effects of which may be beyond human imagination, for better or worse.

Supporters of GMOs claim that the technologies used are very precise and targeted (Wood et al., 2011) and the products would be as safe as the natural products as gene transfer also takes place naturally. However, these GM transformation methods are not reliant. Pattanayak et al., 2011 and Gabriel et al., 2011, found that ZFNs caused unintended mutations in human cell lines. In another investigation using human cells, CRISPR was found to cause unintended mutations in many regions of the genome.(Fu et al., 2013). To deal with these accusations, attempts are being made to transfer genes from a related organism or the same organism (so-called "cisgenesis" or intragenesis). For example, a gene from one crop may be inserted into another variety. However, Cisgenesis also involves the same genetic methods and thus the results may not be entirely predictable as new GM gene unit may contain genetic elements from other organisms, including bacteria or viruses causing unexpected effects. Experiments confirm that Cisgenic GMOs pose almost the identical danger to health and the environment as transgenic GMOs and can cause unanticipated changes to a plant (Nestle 2007; Taylor 2013; USFDA 1995; Graff et al., 2003).

The biotechnology companies BASF and Cibus have developed oilseed rape and canola with a technique involving altering a targeted gene by utilizing the cell's own gene repair system called as RTDS (Rapid Trait Development System) to specifically modify the gene sequence in situ, and does not involve inserting foreign genes or gene expression control sequences (Cibus.undated). Cibus markets its RTDS crops as natural and non-transgenic and as produced without the insertion of foreign DNA into plants (Cibus 2013; Cibus undated). Many detailed studies like whole genome sequencing of RTDS GMOs, analysis of targeted proteins produced by the RTDS developed plants and evaluation of functionality, utility, and safety will be required to assess the fidelity and efficacy of the RTDS process and the degree to which unexpected alterations take place at other locations in the genome during the entire process, as any new technology can't be deemed safe enough to be used unless tested for efficacy. RTDS is although more targeted than the traditional recombinant technology has its own pros and cons.

Facts and Findings

Various studies show that GM crops are safe (Wendel 2013) but these claims are not found to be totally unbiased as industry itself is involved in funding of these researches (Diels et al., 2011). Independent researches are few and far in between as these do not get the required financial support nor they gain access to GM cops who are protected by various patent based controls (Waltz, 2009). Usually the companies retain the right to block any publication which they deem a threat to their reputation (Scientific American 2009). Although a few scientists have claimed that acquiring the GM crop seeds has become easy as GM companies have entered research agreements with Universities (Johnson 2013), these claims are found to be controversial by many researchers who were faced with various legal formalities and hurdles while doing so (Carman 2013). Inspite of these challenges, scant studies have been conducted that clearly show the harmful effects of feeding GM seeds to rats (Séralini et al., 2007; GM Free Cymru, 2011; Robin, 2008). Workers involved in these trials had to face vicious defamation campaigns and loss of careers upon publishing their research findings proving that GM companies and Universities work hand in glove while dealing with the controversies and research studies regarding GM crops (Bittman 2011 ; US FDA, 2013). Toxicities and detrimental effects seen in lab and farm animals feeding studies clearly indicate the harms of long term feeding of GM crops. There have been reports of severe organ damage and increased rate of large tumor formation (Séralini et al., 2012; EndScience, 2014) altered blood biochemistry, multiple organ damage and potential effects on male fertility (Gab-Alla et al., 2012; El-Shamei et al., 2012), unexplained mortality (Pusztai 2002), sustained immune response against GM proteins and allergic reactions (Prescott et al., 2005; Lee et al., 2013), disturbed liver , pancreas and testes function (Malatesta et al., 2003; Malatesta et al., 2002; Vecchioet al., 2004), liver ageing (Malatesta

et al., 2008),liver and kidney toxicity (De Vendomois et al., 2009), intestinal abnormality (Fares et al., 1998) and various other deleterious effects. There is no evidence that commercialized GM food are safe to eat over the long term. Few studies that have been conducted on humans show problems but they were not followed up (Netherwood et al., 2004; T, Martin-Orue et al., 2004; Heritage, 2004 ; Yum et al., 2005). All GM crops should be commercialized only after conducting long term studies based on their response on human volunteers (American Association for the Advancement of Science (AAAS), Board of Directors (2012). As of 2015, 64 countries require labeling of GMO products in the marketplace (International Labeling Laws" Center for Food Safety).

In May 2014, Vermont in the US became the first state to pass a law to crave the labeling of foods that contain genetically modified organisms (GMO). Foods derived from GM crops have been consumed by hundreds of millions of people across the world for more than 15 years, with no reported ill effects. To stop the horizontal gene transfer between GM and non GM plants, physical isolation and genetic containment can be done. Physical isolation means that the crop must be bred in isolation at every stage of production. Whereas, genetic containment means building sterility and incompatibility systems to limit the transfer of pollen like, Genetic Use Restriction Technologies (GURTS) which interfere with fertility or seed formation. (Mascia and Flovell, 2004). In 2001, a highly publicized study showed that GM genes from GM maize had, by cross-pollination, contaminated wild maize in Mexico, the global centre for biodiversity of this species.(Quist and Chapela (2001) Similarly, Losey et al. (1999) claimed that Bt maize was harming the lifecycle of Monarch butterfly, an iconic species in American culture.

Conclusion

Agri biotechnology or the Green biotechnology is a branch of science we all love to hate but also can't do without. Much has been written to write off the technology which clearly has the potential to do wonders in the field of crop sustenance and reproducibility. It is undoubtedly the most promising branch which has the potential to feed the millions mouths which are added to the total world population every passing moment while the size of land under agriculture goes on shrinking. Green biotechnology is commonly considered as the next phase of green revolution. Some of the doubts regarding the safety and efficacy of GM crops are not unfounded. GM crops have been grown and used for decades now without any visible side effects as of now. The technologies involved in developing these GM crops are becoming more targeted day by day. GMOs have a great potential in not only increasing the crop yield or shelf life and reducing the carbon foot print of the cosmos but also can help in mitigating the effects of diseases (edible vaccine, pharmaceutical proteins, antibiotics), increase the nutritional value of food (Golden rice) Use of genetically modified food grade organisms as recombinant vaccine expression hosts and delivery vehicles creating new avenues for vaccinology is very promising. Various studies have shown that GM technology involves highly targeted gene transfer which is unlikely to cause unpredictable effects on the environment. Extensive safety testing of GM crops developed, and thorough risk assessment has shown that there are no varieties in use that pose risk to consumers (Wieczorek and Wright, 2012). Usually the GM cash crops are processed in such a manner that the formed product doesn't contain intact DNA or GM proteins. Proper labeling laws, stringent field trials of long duration and a positive public opinion is necessary to develop this promising branch so that we can harvest its benefit in the welfare of mankind meanwhile sustaining our environment.

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Original Article

Re-visiting National Dairy Policy in the Light of Indian Dairy Sector

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Abstract

Deficiency to sufficiency' has been the much touted slogan in Indian dairying since it decided to traverse a path of organized development during the plan periods. With meager resources in terms of holding of land and livestock assets and other endowment, the milk producers have demonstrated their capabilities to accelerate milk production under a favourable policy regime. Today, India is the largest producer of milk in the World. Nearly two-thirds of India's population derives their livelihoods from livestock and specifically from dairying directly and indirectly.

Policy changes in the 1990s favouring liberalisation and globalization was aimed at effecting structural transformation in the national economy. The challenge is now that how could we make strategy, preferring a short-term reactive approach over a more coherent long term sustainable approach towards inclusive *growth,* a laid out policy framework in our planned development. The challenge is also that how could India plan to re-boot its economic growth model by moving from an external market-led approach to one with internal consumerism with a new focus on developing service industries to foster growth and development. India's urbanization has been driving growth without risking social security, shifting to more market-based interest rate and currency systems, reining in the state-owned enterprises that could impede innovation and making noise about curbing pollution. It could open up to foreign capital inflows for developing back end infrastructure facilities without harming the dairy cooperatives, which are striving to expand and strengthen their network to protect the interests of small dairy farmers for sustainable inclusive growth. It must open up completely too foreign capital inflows for developing the back end infrastructure facility creation instead to enjoy or break the old age Dairy Cooperatives motto, which need to expand and strengthen their network to protect the interests of small dairy farmers. It must do so on an *ex-post* basis that can be justified with legitimate national interest arguments rather than on an *ex-ante* basis that prevents flow of fund from coming into the extent it can and wants to.

Keywords: Globalization; Livestock; Urbanization; Consumerism.

Introduction

Dairying is an important activity in Indian economy contributing about 27 per cent of the agricultural gross domestic product (GDP), which is around 4.35 per cent of the national GDP. The total milk production has increased from 48.40 million

tonnes in 1988-89 to 132.4 million tonnes in 2012-13 (DAHDF, 2013-14). Dairying in India is more inclusive compared to crop production in the sense that it involves a majority of the vulnerable segments of the society for livelihoods. There are about 70 million families, who rear bovines in rural India, of which majority belongs to marginal and small operational land holding group. About 60 million families (41 percent of total rural households) keep female bovines, which are reared for milk production. Because of low cost of maintenance and multidimensional utility of animal resources, the bovine resource is far more equitably distributed compared to land, which has skewed ownership pattern. Therefore, from the perspective of income supporting economic avenue, encouragement of this sector has greater welfare footprint and ensuring social equity in the asset ownership (Shah & Datta, 2012)., (Singh & Datta ,2013)., (Kumar and Singh, 2008), (Birthal *et* al., 2002)

As per the latest available statistics from NSSO (2003-04), around 70 per cent of dairy animals were reared by the smallholders and they owned about 52 per cent of landholdings. Increase in agricultural holdings and their continuous subdivision among the family siblings seemed to be affecting the consolidation of milch animal holdings. But dairy sector in India has shown a strong growth in the face of price rise in dairy products. Dairy sector has been recognized to play a strategic role in promoting rural growth and reducing rural poverty in India (Singh & Datta, 2013).

The major challenges is how to organize sustained production and procurement from large numbers of small farmers, how to ensure adoption of the right technology and practices to generate quantity and quality output at a reasonable cost, how to obtain capital for ensuring good processing technology and meeting the high working capital requirements in a fluctuating business, how to deliver strong marketing efforts to compete and open nascent markets, and how to ensure effective ownership, management and control to ensure performance for its main stakeholders of producers, consumers and investors.

Promoting growth and increasing efficiency in production and marketing of dairy products have been the overarching concerns of Government of India. The establishment of an efficient value chain is more important for milk, which requires immediate transportation from farm to consumption centres or storage or conversion into less perishable forms. Further, value chain approaches can play a significant role in characterizing the complex networks, relationships and incentives that exist in the dairy sector. For past one & half decade, India has retained its position as the largest producer of milk in the world. Milk is now the largest agricultural commodity in physical as well as value terms.

The transition from deficiency to sufficiency has been achieved by a series of policy interventions by the government. It has been found that in the first phase of 'Operation Flood', growth rate of value-added products was 0.93 per cent per annum, but in the third phase, it became 9.10 per cent per annum. Further growth in the value added in dairy products will compel organized dairy industry to reinforce the upstream linkages in supply chain to secure additional quality of milk.

The study addresses the following issues: What are milk production and processing system in India and how these are going to shape in future? What are the ways and means to integrate the production and processing for smallholder dairy farmers? What kind of policy and institutional changes are necessary so that it may accelerate the inclusive growth process? With this background in nutshell study addresses the issues of milk production and value addition in dairy sector.

Source of Data

The study is largely based on the secondary data, available from National Sample Survey Organization (NSSO) unit level data on "Situation Assessment Survey of Farmers" 2003 and Annual Survey of Industries (unit level data of 1994-95, 1999-00 and 2010-11). Descriptive statistical method was used for the data analysis. Also used different studies conducted time to time by the DESM Division of NDRI time to time.

Structure of Indian Dairy Sector

In Indian context, dairy has become more inclusive as compared to crop production in the sense that dairying has involved majority of the vulnerable segments of the society for livelihoods. The estimated figures (Table 1) of total farm households in India was around 89 million in the year 2002-03, out of them 68 per cent were engaged in the dairy farming. Nearly 60.66 million households in India have been associated with dairying, and about 89 per cent of them belonged to landless, marginal and small landholders (<2 ha). It is also interesting to observe from Table 1 that about 54 and 16 per cent of milch dairy animals are owned by marginal and small farm households, respectively while they own 51.62 per cent of agricultural resources. Similarly the

households, who were landless also kept about 13 per cent of milch animals. The marginal farmers contribute more than half of national milk production. It is also interesting to note that the distribution of dairy animals was far more even among the farm households than that of farm land suggesting that with efficient input and output support services, dairying can serve as a major economic activity for the small, marginal and landless farmers. The largest contributors of the country's milk production are marginal category households; their share is 52.17 per cent of total Indian milk production. Combined share of landless, marginal and small dairy households in country's milk production is 77.34 per cent. Medium and large category households hold 48.37 per cent of land resources but their contribution in country milk production is only 22.67 per cent vis-à-vis combined landless, marginal and small categories that possess 51.63 per cent land but contribute 77.34 per cent of total milk production.

From this discussion it can be inferred that the future of Indian milk production lies in the hands of smallholder (less than 2 ha) dairy farmers. It is the smallholder dairy farmer that needs to be targeted by policymakers by incentivizing them to increase their milk production for they don't have land to increase their income from agriculture exclusively. The incentives should include a host of input provision, skill provision as well as institutional mechanism. Input provision include timely provision of normal as well as drought-resistant fodder seeds, accessible veterinary services, availability of water as well as electricity etc. Skill provision includes training in clean milk production, artificial insemination, treating minor injuries/wounds, feed/fodder preservation, milk preservation etc. Institutional mechanism include increasing their motivation towards cooperative framework, livestock insurance, securing loans (for housing as well as animals), better connectivity with dairy industry etc.

Table 1: Household level distribution pattern of the dairy animals in India

Particulars	Landless	Marginal	Small	Medium	Large	All
Estimated sample households keeping dairy animals (No. in Millions)	9.30	35.74	8.65	6.64	0.33	60.66
Total estimated sample household (No. in Millions)	17.33	53.43	10.72	7.60	0.37	89.44
% of household keeping dairy animal	53.64	66.90	80.73	87.37	90.33	67.82
% of milch dairy animals owned by the households	12.76	53.65	16.32	16.08	1.18	100
% contribution to total milk production	7.71	52.17	17.46	20.84	1.83	100
% of land owned by the households	0.012	29.28	22.34	40.41	7.96	100

Note: Landless: 0 to 0.002 ha., Marginal: 0.0021 to 1.00 ha., Small : 1.01 to 2.00 ha., Medium : 2.01 to 10.00 ha. and Large : e"10.001 ha.

Source: Authors' estimates based on unit level data of NSSO 59th round on Situation Assessment Survey of Farmers.

Till the economic liberalisation in 1991, cooperatives grew in a protective environment without any competition. And this phase made India one of the largest milk producers in the world. Now these cooperatives that we had set up in last 50 years are failing us because politics is overtaking them. Barely 15 per cent of our villages have cooperatives. This will lead to a milk crisis.

It is necessary to invite private sector to build back-end infrastructure in order to procure directly from farmer-producer organisations for aggregation, processing and marketing of the fresh dairy milk/ produce from the rural areas where role of cooperative is insignificant or nil. But the private sector is entering only where cooperatives are established to exploit the existing infrastructure. They are not tapping the potential of other villages and promoting milk production there. When a cooperative organizes producers into a structure, they invest their time and efforts that the private sector is reluctant to do. Interestingly in India, the highest milk producing state like UP where neither the role of cooperative nor the private players are visible to handle the milk. Similarly in West Bengal, where demand for dairy and dairy products are more, the cooperatives cannot act professionally. But acts on behalf of the milk federation as marketing role, including the rights over using its brand . It has effectively converted the established *three-tier cooperative* structure into *a two-tier* arrangement, where the key marketing function is with a company over which farmers have no control. The dairy farmers in turn receive no incentives from this structure. It seems the cooperatives do not pay competitive prices to their milk producers. Their value chains remain fragmented which favour the commission agents much more than the milk producers and the consumers.

Structural Changes Across the Different Industrial Organization of Dairy Industry in Post-Liberalized Era

In the new economic reforms post-1990 period, there have been many significant reforms like

Operation Flood-III (1985-96), De-Licensing (1991), Milk and Milk Products Order (1992), Amendment in MMPO (1999) and Abolition of Quantitative Restriction (QR) in Dairy Imports (2001) in Indian dairy sector. The major objective behind the different policy reforms was to create different arrangements (industrial organization) for value addition, favouring ~~of~~ smallholder dairy farmers. To ensure that the private players do not dominate the dairy sector, the government introduced a policy that restricted milk processing and product manufacturing to small firms and cooperatives. Only two private company's existed then- *Nestle* and *Milk food* Limited. Higher import duties on dairy and dairy products and stringent lincencing provisions for private dairy industries created a protected market that helped cooperatives to expand. The MMPO Act of 1992 aimed at bringing out orderly growth of the dairy processing capacities in the milk shed areas. Govt. of India amended MMPO-1992 in 1999 with the objective to infuse more investment in dairy industry. The impact of policy reforms was different on different industrial organization of dairy processing industry. The impact of this reform in the dairy industry was clearly reflected in terms of number of dairy units in organised sector, which rose from 432 in 1990-91 to 1493 in the 2010-11 (CSO, 2011-12). Therefore, it is very important to study structural changes across the different industrial organization in organized dairy industry in the post-reforms period.

Findings of Table 2 are clearly reflected that organized dairy industry has undergone dynamic changes (in terms of fixed asset, labour and GVA) across the different industrial organization. In the initial reform period (1994-95) 'other' type industrial organization (mainly small and medium size dairy plants) had occupied largest share (48.22 %) in terms of fixed asset formation, whereas in the post reform period (2010-11) it was the lowest (8%). This trend reflects that either these organizations have not maintained asset formation in the same pace as other organizations have done. At the same time cooperative organizations have observed small increment in fixed asset formation from 29.86 per cent to 33.58 per cent. Whereas, public and private sector industrial organizations have increased fixed asset formation. In the industrial organizations labour and capital are complementary and competitive to each other. Table 2 shows that proportional labour utilization in different industrial organization set-ups has not changed much vis-à-vis fixed asset formation. Cooperative sector has had maximum labour hiring in comparison of public, private and 'other' industrial organizations. Whereas, in the reform period private sector had increased labour hiring share from 6.11 per cent to 21.12 per cent. But proportional labour hired in 'other' industrial organization decreased from 38.82 per cent to 12.90 per cent. Correlation coefficient between labour and fixed asset increased from 0.28 to 0.64 between 1994-95 to 2010-11. It shows that fixed capital and labour are complementary to each other over the post reform period.

Gross value addition (GVA) is one the important indicators of sectoral profitability. Proportional share in terms of GVA was highest in cooperative sector (43.23%) and lowest (5.58%) in the private sector in the initial period of reform (1994-95). But over the reform period private sector increased GVA significantly, as also the cooperative sector. Whereas, 'other' industrial organization registered lowest share (8.81%) in the post reform period (2010-11). So, overall in the reform period private sector performance has been observed encouraging in terms of fixed asset creation, labour hiring and GVA. However, cooperative sector maintained its predominance in Indian dairy industry even in reform period also.

Table 2: Percentage share of fixed asset, labour and gross value addition (GVA) across the organised dairy (2010-11)

Type of Organization	Fixed Capital (%)	Quantity of Milk used (%)	Gini Coefficient of quantity of milk used	GVA (%)	Fixed Capital (%)
Public Limited Company	25.93	16.62	0.709	19.37	25.93
Private Limited Company	32.49	22.31	0.763	21.01	32.49
Co-operative Society	33.58	53.04	0.789	50.80	33.58
Others	8.00	8.03	0.669	8.81	8.00

Source: Authors' estimates based on unit level data of ASI (2010-11). ;**Others:** Individual Proprietorship, Joint family, Partnership, Govt. Departmental Enterprise, Public Corporation by Special act of Parliament/ legislator/PSU, Khadi & village industries commission, Handlooms and Others (incl Trusts, wakf board, etc).

Differential Arrangements to Link Milk Producers with Milk Processing Units

Most of the milk producers in the country belong to the categories of small and marginal farmers and landless households (Table 1). So, any strategy for increasing milk production as well as forward linkage with dairy factories must aim at benefitting small and marginal holders who are in advantageous position in terms of cost of production and their geographical location. Therefore, it can be assumed beyond any doubt that the future course of growth in the form of value-added products will be completely guided by the small and marginal holders. To link the smallholder milk producers with the organised dairy industry, it is important to visualise the structural changes in the Indian dairy industry. This information is helpful to infer whether industrial dynamics has been in favour of smallholder dairy farming or not. In this regard, Table 3 provides the results for structural changes in Indian dairy sector over the post liberalized period of 1994-95 to 2010-11. The study period can be classified into the two phases i.e. 1994-95/1999-00 is Pre MMPO-1999 and 1999-00/2010-11 Post MMPO-1999. Due to the growing pressure of competition from global players in the dairy sector, the tightening of the WTO Agreements as well as the anomalies in the license structure, the government made an amendment (in the year 1999) in the MMPO in 1992. The amendment allowed the dairy players to setup dairy processing units wherever and whenever they want to. MMPO-1992 was actually introduced in India to protect the interest of the cooperative as well as domestic small and medium size dairy plants. So, this amendment is one of the major policy amendments in the Indian dairy sector from government front in the post liberalized period.

From Table 3 it can be inferred that at the reform time (1994-95), organized dairy industry was mainly dominated by the cooperatives and others (mainly small and medium size dairy plants) in terms of ownership of dairy plant. These two subsectors constituted around 78 and 79 per cent, respectively of the total quantity of milk processed and number of dairy plants in the organized dairy sector. The private sector dairy plants were very less both in terms of numbers as well as milk handled by them. In the Pre MMPO-1999 period their share did not change much. At the same time, cooperative sector increased their share in terms of quantity of milk handled despite the fact that their number reduced drastically. It means that in the Pre MMPO-1999 period, the cooperative sector kept their reliance on consolidation of milk procurement and handling capacities and capabilities as even though they reduced their numbers they continued to increase their share in Indian dairy sector.

In the starting phase of Post MMPO-1999 period, the organized sector was mainly dominated by the cooperatives sector (42.09 per cent in the year 1999-00). Similar trend continued till the end of 2010-11 (Table 3). At the same time, the private sector processed 6.29 per cent of total milk handled in the organized sector with 21.26 per cent of the dairy factories. But at the end of 2010-11, this sector increased their share from 6.29 to 21.98 per cent with almost same proportion of dairy factories. It is estimated that the capacity created by the private dairies in the past 15 years equals the capacities created ~~set~~ by the cooperatives in over 30 years (Rakesh Mohan Joshi, 2011). Some of the big private players in the market today are *Hatsum Agro, Heritage Foods, Tirmula Milk Products, VRS Foods, Sterling Agro Industries, Dynamix Dairy Industries and Bhola Baba Dairy Industries*, each handling more than one million liters of milk per day (J. Sood, 2014). There are also a clutch of smaller private companies, handling 0.5 –I million liquid milk per day. Between 2013-13, Hyderabad- based *Heritage Foods* increased its milk procurement capacity tremendously so that its turn over grew by almost 16% in 2013 (Sood, 2014).

Similar but marginal incremental trend was observed in the public sector operated dairy industry. One important observation from Table 3 is dairy plants operating in the "Others" category, they decreased their numbers but at the same time they drastically lost their share in the milk processing in the organized sector. It may be conjectured that

Table 3: Dynamics of organized dairy Industry with respect of types of ownership (in%)

Type of Ownership	1994-95		1999-00		2010-11	
	Quantity of Milk Processed	No of factories	Quantity of Milk Processed		Quantity of Milk Processed	No of factories
Public	17.48	10.23	21.07	21.81	18.80	12.54
Private	4.62	11.13	6.29	21.26	21.98	32.16
Co-operative	45.98	33.39	42.09	12.76	50.59	28.42
Others	31.92	45.24	30.53	44.17	8.63	26.88

Source: Authors' estimates based on unit level data of ASI (1994-95, 1999-00 and 2010-11).
Others: Individual Proprietorship, Joint family, Partnership, Govt. Departmental Enterprise, Public Corporation by Special act of Parliament/ legislator/PSU, Khadi & village industries commission, Handlooms and Others (incl Trusts, wakf board, etc)

private sector owned dairy factories could be providing some kinds of sops to the farmers and they have consolidated their milk handling capacity as there is no proportional increase in number of their dairy factories.

Dairy sector in India has shown a strong growth in the face of price rise in dairy products. Further growth in the value added in dairy products will compel private milk processor to reinforce the upstream linkages in supply chain to secure additional quality of milk. Private processor needs to seize this opportunity to focus on milk procurements model for the future. The key will be to support farmer-driven dairy farming, with downstream companies/private players/ corporate/ organised processor playing the anchor role to involve service providers such as those supplying feed, genetics, health care and equipments.

Direct sourcing from the farmers is critical for milk processors and will require a dedicated focus to lift the quantity of the milk supplied maintaining quality. Large-scale corporate dairy farming is only likely to develop in the long term. In the meantime, medium-scale corporate dairy farming will be essential to secure sufficient milk supplies. Processors will have to play an anchor role for other stakeholders. This will help create integrated dairy companies in the milk production and in the processing and distribution of dairy products, yielding higher returns in value chain.

The conversion from an unorganised to an organised milk procurement chain will be continuous and a steady process. The National Dairy Development Board focuses on establishing linkage with the organized sector through NDP. Only Cooperatives are involved in this process. Analysis from 14 major state milk federations by Down To Earth shows that only five federations are chaired by elected members, while rest are headed by Government nominated Chairpersons. Nine federations have state government equity; six have over 51% government equity. The price hike of the milk is guided by the by the respective state government's representative as they treat dairy cooperatives as their private institutions because they constitute their vote banks. There have been instances where state governments used subsidies as bait to control these huge conglomerations of milk producers'. Recent hike of subsidy, per liter of milk by the Karnataka Milk Producers Federation Ltd (KMF), where more than 2.2 million dairy farmers are ~~as a~~ members of the state cooperative. Following this move, milk producers in other states like Tamil Nadu, Kerala and Maharashtra are demanding similar subsidies (Sood, 2014). Professionalisation which is core of the cooperatives is losing due to vested interested lobbies within the cooperatives. They are slowly loosing the market competitiveness. They are interested to operate within the same locations/areas where cooperatives established basic infrastructure and all kinds of enabling conditions for smooth operations as those private players realised that institutional building was a difficult task for them.

In order to overcome the issues that the dairy cooperatives face, both institutional and government intervention, it is necessary to organise the existing cooperatives into producer organisation/producer Company transcending the geographical boundaries of taluka or district while maintaining the basic tenets of cooperative principles.

Large-scale dairy farming is still evolving in India, with promising opportunities in the long term, but constrained in the near to medium term. Milk processors need to reduce their dependence on agents and engage directly with dairy farmers to source good quality milk. This includes investment in upstream linkages in the dairy value chain. It also requires processors to become more involved with service providers of feed, nutrition, genetics and animal health care. However, these processors will have difficulties in improving milk supplies without the support of these enablers.

The need to organise farmers, especially the small holders, is a well established fact. The basic purpose of the producers' company is to collectivise small farmers or producers for (a) backward linkage for inputs like feed, genetics, health care and equipments, credit, insurance, knowledge and extension services and (b) forward linkages such as collective marketing and processing,.

Market efficiency is the result of competition policies being implemented across the economy. It is necessary to invite private sector to build back-end infrastructure for aggregation, processing, packing and marketing of the fresh dairy produce in rural areas to procure directly from farmer-producer organisations. Their value chains remain fragmented which favour the commission agents much more than the farmer or consumer. This will create millions of 'off-farm' rural jobs, save on post-harvest losses, and create more efficient value chains giving a better deal to farmers and consumers alike, as also making more competitive. This will bring down food inflation of high value product like dairy & dairy base food products. Nobel laureates Finn Kydland and Edward Prescott show that in the absence of a competitive economy, despite monetary policies to contain

inflation, prices rise as the activities of businessmen are not subject to constraints. The relationship between competition and inflation is negative. With more competition, there is lower inflation. Therefore, the role of government departments in coordinating implementation of policies constraining egregious behaviour of firms is crucial for low inflation and growth.

The sector requires a fundamental paradigm shift in dairy-food system policy supported by institutional change, capacity development and investment, in order to move towards a sustainable production system and consumption patterns. At the heart of this effort is to gain collective bargaining power for small farmers/ producers. The collectives of farmers in the form of producer companies is gaining popularity among the farmers/ producers and among the promoting agencies primarily due to several advantages it carries in comparison to the conventional model of producers cooperatives.

Scope Indian Dairy Sector in Trade Circle

As of now, export of dairy commodities in India, constitute less than 1% of national milk production. The GoI provides incentive on export of SMP under Vishesh Krishi and Gram Udyog Yojana (VKGUY) with a Duty Credit Scrip equivalent to 5% of FOB value of export. There is no ban of export of milk products. The VKGUY could be expanded to other value added Indigenous milk Products/Ethnic milk products, for which there is considerable demand from the Indian diaspora. International prices of dairy commodities fluctuate significantly. There is no mechanism in India to hedge against price volatility in international market and currency fluctuations. These are not always advantageous for the domestic exporters. In the advanced exporting countries, these mechanisms exit.

Production of quality dairy products for export is an issue in India. Indian dairy products like SMP are traded at a discount of around 700 to 800 USD per tonne. India needs to invest in production of quality milk and milk products for which cold chain infrastructure for milk and milk products processing and marketing is critical.

As the market opens up, consumption trends associated with these markets will have increasing influence on the world trade. There is a vast potential for the export of dairy products, the cost of milk production in India being the lowest. In the 1990s, India started exporting surplus dairy commodities, such as SMP, WMP, butter and ghee. The Agricultural and Processed Food Products Export Development Authority (APEDA) regulated the export and import of dairy products till early 1990s. However, in the new EXIM Policy announced in April 2000, the Union Government has allowed free import and export of most dairy products.

The major destinations for Indian dairy products are Bangladesh (23.1%), UAE (15.4%), US (15.6%) and Philippines (8.9%). In terms of products, SMP is the most important product accounting for about 63% of total export volume, followed by ghee and butter (11.7%) and WMP. Export figures clearly demonstrate that the Indian dairy export is still in its infancy and the surpluses are occasional. Indigenous milk products and desserts are becoming popular with the ethnic population spread all over the world. Therefore, the export demand for these products will increase and hence, there is a great potential for export. On the other hand, there has been a sharp increase in import of dairy products (especially milk powders) after trade liberalisation. As per the latest report of Foreign Trade Statistics of December 2004, the imports of dairy products (milk and cream) has reached a cumulative total of 22.145 million tonnes for the period April - March 2004, as compared to only 1473 million tonnes for the same period during the previous year. The main reasons for sharp rise in imports are huge export subsidies given by developed countries (mainly the US and EU). India has recently concluded a tariff rate quota to deal with US, EU and Australia on imposing custom duty of 15% on imports of SMP and WMP up to 10,000 tonnes and 60% on imports beyond this level.

India allows imports of milk and milk products without quantitative limitations i.e. under Open General License (OGL), although tariff rate quotas (TRQ) apply and an import permit is required for TRQ. Moreover, Indian dairy import policy changes frequently to adapt to market conditions. In the case of SMP imports, the GoI varies both the quantity allowed under India's TRQ as well as applicable duty when domestic production was insufficient. Presently, the GoI has set the SMP TRQ for Indian Fiscal Year 2012/13 at 15 percent duty for upto 15,000 MT and milk powder imported above this TRQ of 15,000 MT attracts a 60 percent basic duty. It means that anyone can import SMP (HS Code 04021010) at 60% basic duty plus *0% CVD* (data is missing, please put data) (counter veiling duty) plus 4% SAD (special additional duty) which totals to 68.8%. Previous year, SMP imports under TRQ were allowed up to 50,000 MT at zero duty. In case of butter oil, imports under OGL, one has to pay 40% basic duty plus 0% CVD & 4% SAD.

The first important change that the multinational

retailers are likely to introduce is state of the art storage technology that the multinational retailers possess and which is not known to big domestic retailers. This technology is expected to improve the supply chain and prevent wastage in a big way. Estimates of wastage of food grains, fruits and vegetables in the country vary between 20% and 40% of the total produce. It is argued that a significant part of this wastage would be avoided if foreign investors bring in state of the art technology. The primary case being made for FDI in retail is that it will increase efficiency. One source of this is improvements in the supply chain. In particular, this argument is applied to perishable agricultural produce. The claim is that increased investment will reduce wastage. Efficiency gains can potentially lead to gains for producers, intermediaries and consumers. Turning to the recent Indian experience, Walmart and other foreign firms have been involved in the wholesale trade for some years. For example, the Bharti Walmart joint venture works with over 6,000 small farmers across six states. Indian corporations have tried to create retail chains without foreign help. What do these experiences teach us about the potential for transformation? In neither case has there been a huge change in the supply chain. Logically, either FDI in wholesale or domestic retail chains could have made investments to improve the efficiency of the supply chain. There have been small improvements, but no great transformation.

The second big change that the multinational retailers are likely to bring about is more international trade. A little reflection will convince that the magnitude of international trade depends on the extent to which arbitrage possibilities across countries can be made use of. Making use of arbitrage possibilities, one can buy a commodity in a country where it is cheaper and sell it in another country where it is dear. A company job is to identify the international arbitrage possibilities and trade accordingly to make profits. It stands to reason that a giant multinational trader, with its more elaborate procurement and distribution networks, will do the job more efficiently and extensively than a relatively small domestic retailer. But if that is so, entry of multinational retailers into the Indian market is likely to increase the volume of Indian international trade. In the recent year' different countries like Australia, New Zealand and EU have shown interest to sign the Free Trade Agreement (FTA) with India and in near future India will do it because of international obligations. But this kind of trade arrangement will affect very much to the Indian dairy and food sector. As we know that New Zealand, Australia, USA and EU countries are producing milk in large quantity (with huge subsidies) that not demanded in the country. Therefore in the name of FTA these countries will dump their agriculture produce especially dairy product in Indian market. As Indian dairy industry is mainly dominated by the cooperative sector which connect million of resource poor farmers to the market and still this sector in nascent stage of development. It is important that government keep dairy and food sector away from FTA otherwise this kind of smart move by the developed countries increases the arbitrage possible for dairy and food business for foreign big retailers. But as per FDI bill retailers would have to source 30% of their domestic sales from the domestic market. This would imply that they would have to market some Indian manufactures also, but the bulk of their sales should consist of foreign country primary agricultural goods or processed food products.

The third change refers to the scale of operation of big retail in India. The giant multinationals along with the domestic retailers with whom they are going to form joint ventures are going to have much greater financial power than the domestic big retailers alone. Therefore, in the new set-up, big organized retail is likely to cover a much larger portion of the market than before. There is concern in food and retail sector that some MNCs might use their monopsony power, their ability to access cheap products from domestic and foreign market, and use that monopsony power to give competition to domestic food companies. That's not a good basis for growth. Monopsony is a market similar to a monopoly except that a large buyer, and not seller, controls a large proportion of the market and drives the prices down. It is sometimes referred to as the buyer's monopoly. It will definitely affect the domestic cooperative and private player of Indian dairy sector.

Most of the milk processed in unorganized sector which operated at very low margin in rural area and most of these firms are tiny enterprises and do not fall under small and medium size enterprise. So there is very less scope for any foreign firm to purchase dairy products from tiny size enterprises. But, in organised sector there is scope for foreign firm to purchase dairy products by subcontracting or on some franchising format. This kind of linkages and subcontracts between the foreign firm and organized dairy firm increases the possibility or avenues for huge investment in dairy sector especially at the back end format (because of the conditionality of 50 percent investment in back end infrastructure facility creation).

To protect the small and medium producers, processors as well as the consumers would require

effective regulations. Effectiveness of regulations is a must which mainly depends not only upon the regulations themselves, but also on the regulator-and the environment in which they are implemented. Emergence of regulations can in turn be dependent upon these three. Will and wherewithal on part of the regulator on one hand and public pressure on the other are critical for successful implementation. Equally important, if the regulator does not have the requisite information or is constrained by factors beyond his control, then again, the regulations may not achieve the desired objectives. It essential to transform traditional supply chains from linear, sequential processes into adaptive supply chain networks in which communities of customer- centric, demand-driven, intelligently adapt to changing market conditions, and proactively respond to shorter, less-predictable life cycles.

In the last 15 years, the share of milk producers' share in consumer money has declined from 52% to 38% in USA and from 56% to 36% in UK (IFCN, 2011). As compared to that, Indian milk producers get more than 70% on an average and the milk producers affiliated to co-operatives get more than 80% share of consumers' rupee. The key question is whether the organized retail trade would be able to operate at low margins as practiced by GCMMF and other co-operatives, failing which they would not be able to maintain the farmer's share in consumer price. Neither do our farmers receive fair price for their produce, nor do consumers benefit from low prices. The issue is not just about converting our farmers from price-takers to price-makers (as that would have further complicated the equation among farmers, distribution agents and consumers), but to balance the need of different interest groups by addressing the root causes of anti-competitive practices, which are rampant all over the country.

Conclusions

Operation Flood Programme emphasis on developing smallholder-based dairy sector in the pre-liberalised era is justified on the ground that it realized the needs of the production base by the masses. The finding of study also indicates that still in India production system is dominated by smallholder dairy farmers. Major concern in this production system is the sustainability as in near future it is going to be more intensified. Therefore, it puts more pressure on feed and fodder resources. For sustainability of production first prerequisite is to increase sectoral profitability.

Value addition in milk is unavoidable if one has to enhance sector profitability, the same does not seem feasible unless the organized sector improves its penetration. Because, it is the involvement of the organized sector that will drive the growth by resorting to value addition in basic product and harnessing the consumer market. The mechanics of the organized sector penetration could be agency-specific as also area-specific. Need of the day is to provide quality of efficient input and output support services as provided by the co-operatives (Amul model at Gujarat, Nandani Milk Federation at Karnataka Model), private sector (Nestlé) and contract dairy farming. In the recent years some new dairy development models have been implemented and scaled up by the co-operative sector like New Generation Cooperatives (Dairy Producer Companies) such as producer companies in Saurashtra and Kutch region in Gujarat as Mahi Producer Company and in Rajasthan as Payas producer company. Whereas, in Punjab group of progressive farmers started Punjab Progressive Dairy Farmers Association. In the liberalised economy, the replication and scaling up of these models largely depends on the governance, institutional support and market forces.

It essential to transform traditional supply chains from linear, sequential processes into adaptive supply chain networks in which communities of customer-centric, demand-driven, intelligently adapt to changing market conditions, and proactively respond to shorter, less-predictable life cycles. In the last 15 years, the share of milk producers' share in consumer money has declined from 52% to 38% in USA and from 56% to 36% in UK (IFCN, 2011). As compared to that, Indian milk producers get more than 70% on an average and the milk producers affiliated to co-operatives get more than 80% share of consumers' rupee. Key question is whether the organized retail trade would be able to operate at low margins as practiced by GCMMF and other co-operatives, failing which they would not be able to maintain the farmer's share in consumer price. Neither do our farmers receive fair price for their produce, nor do consumers benefit from low prices. The issue is not just about converting our farmers from price-takers to price-makers (as that would have further complicated the equation among farmers, distribution agents and consumers), but to balance the need of different interest groups by addressing the root causes of anti-competitive practices, which are rampant all over the country.

In the globalised era food safety laws and their enforcement are important in the sense that without

standardization of products and adherence to quality and hygiene, the basic tenet of value addition would be defeated. It would be feasible only if the dairy industry moves towards accountability and transparency and for this increased involvement of the organized sector is truly unavoidable. Therefore, while creating values from the products manufactured is important, without a regulatory mechanism such a value will be self- defeating. So, there is a need to adopt "Good Manufacturing Practices" from production to processing level. Regulatory constraints on egregious behaviour of businessmen are crucial for welfare. Enforcement of laws, regulations and sanctions under different legislations should be done by in a composite manner. Large capital subsidies for building cold chain infrastructure is also something that needs to be looked at seriously—essentially, the trade-off is between spending money on subsidies that don't reach people and creating infrastructure that benefits everyone.

It is high time that the various stakeholders in the discussions relating to retailing in India start making a serious effort to understand how efficient or inefficient India's retailing infrastructure is today. And then how to make it more efficient for the consumers, the producers of consumer goods, those whose livelihood rests upon the retailing value-chain and, finally, the state and central governments who have to expand their tax revenue base to meet their revenue needs to provide better physical and social infrastructure to India's masses.

The most crucial fact about the retail sector is that it provides the largest employment in India and offers the best hope for employment for tens of millions of Indians in the years to come. Further, this is the only sector where relatively less-skilled or even unskilled workers can make a living. Hence, any threat to this employment-creation potential of this sector—especially when India suffers a major deficit in creating jobs or self-employment opportunities—has to be carefully studied keeping personal ideologies aside.

It is true that India's existing retailing ecosystem is highly inefficient. There is an unacceptable value-loss in both, the manufacturer and consumer prices, thereby depriving the manufacturer of a fair value for his effort while forcing millions of inflation-ravaged, low-income Indians to pay much more at the retail than what they should be paying. This ecosystem is also inefficient for the state governments in particular when it comes to getting their fair share of local taxes, and inefficient for the central government when it comes to getting its share of indirect taxes since many small and medium scale manufacturers can successfully evade the taxation net by using the current distribution channels comprising an abundance of middlemen. The highly fragmented and unorganised retail ecosystem also allows entry of spurious consumer goods in the supply chain; if any evidence is needed, one only has to visit retail outlets catering to relatively lower-income strata in the major cities or those located in the tier-2 or small cities and in rural India.

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Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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