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A Comparative Analysis of Economic Losses and Efficiency in Crop and Dairy Production System in Tamil Nadu, India

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ABSTRACT

An economic evaluation of crop and dairy production system study was taken up in the Erode district of Tamil Nadu, India to study the post-harvest losses in crop production system, milk losses in dairy production system, to analyse the factors influencing the post-harvest losses and milk losses and finally analyze the resource use efficiency and technical efficiency of crop and dairy production system. In crop production system, net income was higher in turmeric than sugarcane by 10.98 per cent. The gross income and net income was higher in foreign breed by 99.95 per cent and 79.24 per cent over local breed respectively and hence turmeric and foreign breed are more profitable in crop and dairy production system respectively. The post-harvest losses in turmeric production were 0.048 per cent of total production. Milk losses in dairy production system due to various diseases were 9.97 per cent in local breed and 13.34 per cent in foreign breed. The education and inadequate storage had significant positive influence on post-harvest losses. The milk fever, Mastitis and foot and mouth disease in local breed had influence on milk losses. In foreign breed, milk fever and Mastitis had significant positive influence on milk losses. In crop production system, the planting material, manures and fertilizer, irrigation and human labour were significant in turmeric production. In sugarcane production, planting material and irrigation were positively significant. In dairy production system, green fodder, dry fodder and human labor were significant in local breed. With respect to foreign breed, green fodder, dry fodder and concentrates were positively significant. The mean technical efficiency and scale efficiency of sugarcane and turmeric was almost similar in crop production system. In dairy production system, the mean technical efficiency and scale efficiency of foreign breed and local breed was almost similar. The policy advocacy is finally suggested for Agriculture Department, Animal Husbandry Department and Government for minimizing economic losses, for achieving efficiency in production systems and finally for sustainable agricultural development of the region.

Introduction

India has a considerable livestock, poultry population and crop wastes. The earlier studies on integrated agricultural development focused mainly on development of sustainable farm plans, but, very little accessible information actually exists on the assessment of economic losses and efficiency in India, especially in Tamil Nadu which is a prelude for sustainable development. Further, there are only a few attempts of comparing these losses and efficiency between crop and dairy production system. Keeping all these different facets, this particular study was proposed in Erode district of Tamil Nadu. Erode district ranks high in crop production and milk production. In crop production, turmeric and sugarcane covers the major area of the district and hence this study mainly concentrates on turmeric and sugarcane in crop production system. Also, an attempt was made to compare the local breed production system and foreign breed production system in dairy production system.

Objectives

The general objective of the study is to compare the economic losses and efficiency in crop production system and dairy production system. The specific objectives are as follows:

1. To estimate the cost and returns in crop production system and dairy production system.
2. To study the post-harvest losses of turmeric production system and milk losses of dairy production system.
3. To assess the factors influencing post-harvest losses in turmeric production system and milk losses in dairy production system
4. To study the resource use efficiency and technical efficiency in both crop and dairy production system.

Tools of Analysis

Production function analysis

In the present study, production function analysis was employed to evaluate the resource use efficiency of turmeric, sugarcane and milk production. Cobb- Douglas production function was employed for the study.

Crop production system

The form of regression model used was

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} \mu_t$$

Where,

Y	=	Sugarcane/ turmeric yield (Kg / ha.)
X_1	=	Quantity of planting material ((Kg/ setts)/ ha.)
X_2	=	Quantity of manures and fertilizer (Kg / ha.)
X_3	=	Human labor (man days / ha.)

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X_4 = Number of Irrigations
μ_t = Error term
a, b_1, b_2, b_3,b_4 = Parameters to be estimated

Dairy Production System

The form of regression model used was

$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} \mu_t$

Where,

Y = Milk yield (Litre / cow/ lactation)
X_1 = Quantity of green fodder (kg / cow/ lactation)
X_2 = Quantity of dry fodder (kg / cow/ lactation)
X_3 = Quantity of concentrates (kg / cow/ lactation)
X_4 = Human labor (man days /lactation)
μ_t = Error term.
a, b_1, b_2, b_3,b_4 = Parameters to be estimated.

Economic efficiency

Estimate of the parameters $b_{1....}b_6$ were elasticity's of Y with respect of j^{th} input. The marginal products of the resources were derived from these elasticity coefficients. The marginal productivities of significant inputs were worked out at its geometric mean level and compared with its MIC in order to estimate the efficiency. Equality of MVP_j to the MIC of input 'j' indicates the optimum resource use of a particular input. Ratio of $MVP_j$to the MIC of input 'j' indicated the degree of resource use efficiency.

Data Envelopment Analysis

In present study, Data Envelopment Analysis model was used to estimate the technical and scale efficiency. Data Envelopment Analysis (DEA) is the methodology employed in order to estimate the relative efficiency of farms that operate under similar conditions and used the same number of inputs to produce identical outputs. Their difference lied solely on the quantities of inputs and outputs. It is a non-parametric approach. Crop production was used as an output (Y) in the present case and for crop production system, the inputs(X) were quantity of planting material, quantity of manures and fertilizer, number of human labour and number of irrigation. Milk production was used as an output (Y) in the present case and green fodder (Kg/lactation /cow), dry fodder (Kg/lactation /cow), Concentrates (Kg/lactation /cow), and human labour as inputs (X) for dairy production system. The software DEAP version 2.1 developed by Coelli was used to estimate DEA scores. Farm's efficiency scores were calculated under constant and variable return to scale assumptions (CRS and VRS).

Tobit Analysis

The factors affecting post-harvest losses in turmeric production system and milk losses in dairy production system were studied by using Tobit model.

The Tobit model is specified as

Yi = β' Xi +μi, if β' Xi +μi, > 0
= 0, β' Xi +μi, < 0 ------- (6)
i = 1, 2, 3, ...,N

Where, N denotes the number of observations, Y_i, the dependent variable, X_i, a vector of independent variables, β, a vector of unknown parameters, and μ_i, an independently distributed error term assumed to be normal with zero mean and constant variance σ^2.

Crop production system

Y = f (EDUC, STORAGE, WEATHER) +μ
Y = Post-harvest losses in kg if exist
= 0, otherwise
EDUC = Education of the respondent
STORAGE = Inadequate Storage facilities (1- if he/she has inadequate storage facilities,
0, otherwise)
WEATHER = Adverse weather (1-if adverse weather, 0-otherwise).
μ = Random error term

Dairy production system

Y1 = f (MILKF, UDD, FMD) +μ
Y1 = Milk losses in litres
MILKF = Milk fever (1- presence of disease incidence, 0-otherwise)
UDD = Udder disease (1- presence of disease incidence, 0-otherwise)
FMD = Foot and mouth disease (1- presence of disease incidence, 0-otherwise)
μ = Random error term

The Tobit model was analyzed using STATA 11 econometric package

Result and Discussion

Cost and returns in crop production system

It could be seen from Table 1 that the total cost of cultivation was higher in sugarcane than turmeric by 31.65 per cent. In both the crops, variable cost accounted for a higher proportion as compared to fixed cost. Gross income was higher in sugarcane than turmeric by 8.33 per cent. Net income was higher in turmeric than sugarcane by 10.98 per cent due to decreased cost of cultivation in turmeric.

Cost and returns in dairy production system

It could be seen from Table 2 that the total cost of production was higher in foreign breed by 129.00 per cent than local breed. Variable cost accounted for a higher proportion than fixed cost in both the breeds. In spite of higher cost of production, gross income and net income was higher in foreign breed by 99.95 per cent and 79.24 per cent respectively due to higher milk yield in foreign breed production system.

Post-harvest losses in turmeric

The post-harvest losses of turmeric production system are presented in Table 3. In sugarcane cultivation, there was no post-harvest loss and hence it was not reported in this study. It could be seen from the table that the post-harvest losses in turmeric production was 0.48 Kg. /T or only 0.048 per cent of production which might be due to the fact that turmeric is a spice and condiment crop.

Among the components of post-harvest loss, storage occupied the highest proportion with 52.08 per cent followed by transport loss with 20.83 per cent. The proportion of post-harvest loss in harvesting and handling operation was 16.67 per cent and 10.42 per cent of total loss respectively.

Factors influencing post-harvest losses in turmeric

The factors influencing post- harvest losses of turmeric cultivation in sample farms were studied by using Tobit model and the results are presented in Table 4.

It could be observed from the table that education had positive influence on post -harvest loss which was due to the fact that more literate the respondents, the more awareness of minimizing the post -harvest loss. This was due to the fact that in the study area, the farmers were more literates with a literacy rate of 80.00 per cent. The variable inadequate storage had significant positive influence on post-harvest losses at one per cent level of significance. Similar positive influence of inadequate storage on post-harvest loss was reported by Marisa et al., in onion (1994) and Basavaraja et al., (2007) in food grains in vegetable production.

Table 1. Costs and returns for crop production system

(in Rs. /ha)

S. No.	Particulars	Turmeric	Sugarcane
1.	Fixed cost	7181.84 (10.91)	8786.84 (10.14)
2.	Variable cost	58632.00 (89.09)	77858.00 (89.86)
3.	Total cost of cultivation	65813.84 (100.00)	86644.84 (100.00)
4.	Gross income	150000.00	162500.00
	Net income	84186.16	75855.16

Table 2. Costs and returns for dairy production system

(in Rs./cow/lactation)

S.No	Particulars	Local breed	Foreign breed
1.	Fixed cost	481.60 (2.01)	896.00 (1.63)
2.	Variable cost	23452 (97.99)	53911.20 (98.37)
3.	Total cost of production	23933.60 (100.00)	54807.20 (100.00)
4.	Gross income	57507.00	114985.00
	Net income	33573.40	60177.80

Figures in parentheses indicate percentage to total

Table 3. Post- harvest losses of turmeric production system

(in Kg./T.)

S.No	Particulars	Turmeric
1.	Harvesting	0.08 (16.67)
2.	Handling	0.05 (10.42)
3.	Transport	0.10 (20.83)
4.	Storage	0.25 (52.08)
	Total	0.48 (100.00)

Figures in parentheses indicate percentage to total

Table 4. Factors influencing post-harvest losses of turmeric cultivation

S.No.	Variables	Elasticity	Coefficient	Standard error
1	Constant		-11.26^{NS}	11.41
2	Education	0.07	7.66**	2.92
3	Inadequate Storage	0.34	39.66**	9.00
4	Adverse Weather	0.03	3.76^{NS}	8.22
5	Log likelihood		-119.90	

Note: **Significant at 1 per cent level, *Significant at 5 per cent level, NS- Non-significant

Table 5. Milk losses in dairy production system

(In litres/cow/lactation)

S.No	Name of the constraints	Local breed	Foreign breed
1.	Milk fever	12.00 (6.09)	28.00 (6.59)
2.	Foot and mouth disease	120.00 (60.91)	285.00 (62.63)
3.	Mastitis	65.00 (32.99)	140.00 (30.77)
	Total	197.00 (100.00)	455.00 (100.00)
	Total production	1975.00	3410.00

Figures in parentheses indicate percentage to total

Table 6. Factors influencing milk losses in local breed

S.No	Variable	Elasticity	Co-efficient	Standard error
1.	Constant		1.34^{NS}	1.46
2.	Milk fever	0.19	13.29**	1.40
3.	Mastitis	0.88	63.27**	1.53
4.	Foot and mouth disease	1.69	121.39**	1.47
5.	Log likelihood		-87.17	

Note: ** Significant at 1 per cent level; *Significant at 5 per cent level; NS-Non-significant

Table 7. Factors influencing milk losses in foreign breed

S.No	Variable	Elasticity	Co-efficient	Standard error
1.	Constant		10.70	25.61
2.	Milk fever	0.01	7.13	24.96
3.	Mastitis	0.30	146.69**	26.80
4.	Foot and mouth disease	0.53	258.95**	27.34
5.	Log likelihood		-174.00	

Note: **Significant at 1 per cent level, *Significant at 5 per cent level, NS-Non-significant

Table 8. Resource use Efficiency in Turmeric Production

S. No.	Variables	Regression coefficient	Standard error	MVP/ MIC ratio
1.	Regression Constant	5.34**	0.41	
2.	Planting material (Kg/ha)	0.21**	0.06	0.53
3.	Manures and fertilizer (Kg/ha)	0.09**	0.03	0.133
4.	Human Labour (man days/ ha)	0.15*	0.06	5.93
5.	Irrigation (Numbers/ha)	0.10**	0.03	0.125

R^2 = 0.902 R^2 = 0.889 F- ratio = 69.09 N = 35

Note: ** Significant at 1 per cent level, * Significant at 5 per cent level**,** NS -Non-significant

Table 9. Resource use Efficiency in sugarcane Production

S.No.	Variables	Regression coefficient	Standard error	MVP/ MIC ratio
1.	Regression Constant	6.91**	0.61	
2.	Planting material (Kg/ha)	0.46**	0.05	1.00
3.	Manures and fertilizer (Kg/ha)	-0.002 ^{NS}	0.02	-
4.	Human Labour (man days/ ha)	-0.10*	0.05	-62.10
5.	Irrigation (No/ha)	0.14**	0.05	0.35

R^2 = 0.958 R^2 = 0.952 F- ratio = 171.08 N = 35

Note: **Significant at 1 per cent level; *Significant at 5 per cent level; NS-Non-significant

Table 10. Resource use Efficiency in milk Production for local breed

S. No.	Variables	Regression coefficient	Standard error	MVP/ MIC ratio
1.	Regression Constant	3.53**	0.38	
2.	Green fodder (Kg/cow/lactation)	0.34**	0.05	0.28
3.	Dry fodder (Kg/cow/lactation)	0.06*	0.03	0.10
4.	Concentrates (Kg/cow/lactation)	0.001 ^{NS}	0.001	-
5.	Human labour (man days)	0.06**	0.02	2.72

R^2 = 0.870 R^2 = 0.852 F- ratio = 50.19 N = 35

Note: **Significant at 1 per cent level; *Significant at 5 per cent level; NS-Non-significant

Table 11. Resource use Efficiency in milk Production – Foreign breed

S. No.	Variables	Regression coefficient	Standard error	MVP/MIC ratio
1.	Regression Constant	4.95**	1.45	
2.	Green fodder (Kg/cow/lactation)	0.16**	0.06	0.14
3.	Dry fodder (Kg/cow/lactation)	0.05*	0.02	0.09
4.	Concentrates (Kg/cow/lactation)	0.08**	0.03	1.77
5.	Human labour (man days)	0.13 ^{NS}	0.25	-

R^2 = 0.791 R^2 = 0.763 F- ratio = 28.33 N = 35

Note: **Significant at 1 per cent level;* Significant at 5 per cent level; NS-Non-significant

Table 12. Technical efficiency and scale efficiency of crop production system

S.No.	Parameters	Technical efficiency		Scale efficiency	
		Turmeric	Sugarcane	Turmeric	Sugarcane
1.	Mean	0.95	0.98	0.96	0.98
2.	Minimum	0.86	0.85	0.87	0.88
3.	Maximum	1.00	1.00	1.00	1.00

Table 13. Frequency distribution of crop production system on Technical efficiency

Frequency levels	Technical efficiency		Scale efficiency	
	Turmeric	Sugarcane	Turmeric	Sugarcane
< 95	8 (22.86)	9 (25.71)	6 (17.14)	8 (22.86)
96-98	10 (28.57)	12 (34.29)	11 (31.43)	12 (34.19)
> 98	17 (48.57)	14 (40.00)	18 (51.43)	15 (42.86)
Total	35 (100.00)	35 (100.00)	35 (100.00)	35 (100.00)

Table 14. Technical efficiency and scale efficiency of dairy production system

S.No	Parameters	Technical efficiency		Scale efficiency	
		Local breed	Foreign breed	Local breed	Foreign breed
1.	Mean	0.96	0.97	0.97	0.98
2.	Minimum	0.88	0.81	0.85	0.84
3.	Maximum	1.00	1.00	1.00	1.00

Table 15. Frequency distribution of dairy production system on Technical efficiency

Frequency levels	Technical efficiency		Scale efficiency	
	Local breed	Foreign breed	Local breed	Foreign breed
< 95	8 (22.86)	7 (20.00)	10 (28.57)	9 (25.71)
96-98	11 (31.43)	10 (28.57)	11 (31.43)	12 (34.29)
> 98	16 (45.71)	18 (51.43)	15 (42.86)	14 (40.00)
Total	35 (100.00)	35 (100.00)	35 (100.00)	35 (100.00)

Milk losses in dairy production system

Milk loss in dairy production system was due to milk fever, foot and mouth disease and mastitis in the study area and the results are presented in Table. 5. It could be observed from the table that milk losses in dairy production system due to various diseases were 9.97 per cent in local breed and 13.34 per cent in foreign breed. The foreign breed system exhibited both higher production and higher milk losses. Among the diseases, foot and mouth disease occupied a highest proportion with 60.91 per cent and 62.63 per cent in both local and foreign breed respectively. Also, in both local and foreign breed, mastitis occupied the next highest proportion of 32.99 per cent and 30.77 per cent respectively. Milk fever formed the last with 6.09 per cent and 6.59 per cent respectively in local and foreign breed. Thus it could be concluded from the table that foreign breed production system exhibited higher milk losses and in both the production systems, foot and mouth disease contributed more to the milk losses.

Factors influencing milk losses in local breed

The factors influencing milk losses in local breed in sample farms are furnished in Table 6. It could be observed that the variables milk fever, mastitis and foot and mouth disease in local breed had significant positive influence on milk losses at one per cent level of significance. Among the three diseases, foot and mouth disease had more significant influence followed by mastitis and lastly by milk fever which is in line with the intensity of disease prevalence in the study area.

Factors influencing milk losses in foreign breed

The factors influencing milk losses in foreign breed in sample farms are furnished in table 7. It could be observed from the table that the foot and mouth disease in foreign breed had high significant positive influence on milk losses at one per cent level of significance. Mastitis had the next highest positive significant influence on milk fever and their influence was according to the disease prevalence in the study area.

Resource use Efficiency of crop production system

Turmeric production system

The estimated Cobb-Douglas production function for turmeric production system is furnished in Table 8. From the table, it could be observed that the adjusted co- efficient of multiple determination (adjusted R^2) was 0.889, which indicated that the 88.90 per cent of variation in total turmeric production was explained by the four variables selected for the analysis. The elasticity of all the four input variables was positive and significant. Among the four variables, the planting material, manures and fertilizer and, irrigation were significant at one per cent level with the elasticity of 0.21, 0.09 and 0.10 respectively. One per cent increase in planting material, manures and fertilizer and, irrigation, ***ceteris paribus,*** would increase the turmeric production by 0.21, 0.09 and 0.1 per cent respectively. The human labour variable was significant at five per cent level with an elasticity of 0.15, which indicated that one per cent change in this variable, ***ceteris paribus,*** would increase the yield of turmeric by 0.15 per cent.

The marginal value product (MVP), marginal input cost (MIC) and the ratio between these two were worked out for each input to understand the efficiency of input use. The input is used efficiently if the ratio between MVP and MIC is one. A ratio of more-than-one and less-than-one would indicate under-utilization and over- utilization respectively. It could be observed that the ratio of marginal value product to the marginal factor cost was more than unity for human labour indicating that the resource was under-utilized and there is a scope for increasing the use of resource in the study area. The ratio of marginal value product to the marginal factor was less than one for planting material, irrigation and manures and fertilizer which indicated they were over utilized.

Sugarcane production system

The estimated Cobb-Douglas production function for sugarcane production system is furnished in Table 9. From the table, it could be observed that the co- efficient of multiple determinations (adjusted R^2) was 0.952, which indicated that the four variables selected for the analysis had explained 95.20 per cent variation in total sugarcane production. Among the four variables selected for the analysis, the elasticity for the planting material and irrigation were significant at one per cent level with an elasticity of of 0.46 and 0.14 respectively. One per cent increase in the planting material and irrigation, ***ceteris paribus***, would increase the sugarcane production by 0.46 and 0.14 per cent respectively. On the other hand, one per cent increase in human labour would reduce the sugarcane yield by 0.10 per cent because the elasticity of human labour was found to be negatively significant.

It could be observed that the ratio of marginal value product to the marginal factor cost was unity for planting material indicating that the resource was at optimum level. The variables like irrigation and human labour were over utilized as the aforesaid ratio is less than one and hence these resources should be rationally used.

Resource use Efficiency of dairy production system

Local breed production system

The estimated Cobb-Douglas production function for dairy production system is furnished in Table 10 for local breed. From the table, it could be observed that the co- efficient of multiple determination (adjusted R^2) was 0.852, which indicated that the four variables selected for the analysis have explained 85.20 per cent variation in total milk production. Among the four variables, the green fodder and human labour were significant at one per cent level with elasticity of 0.34 and 0.06 respectively. One per cent increase in green fodder and human labour, ***ceteris paribus***, would increase the milk production in local breed by 0.34 and 0.06 per cent respectively. The dry fodder variable was significant at five per cent level with an elasticity of 0.06, which indicating that one per cent change in this variable, ***ceteris paribus,*** would increase the milk yield by 0.06 per cent.

It could be also observed that the ratio of marginal value product to the marginal factor cost was more than unity for human labour indicating that the resource was under-utilized and there is a scope for increasing the use of resource in the study area. The variables like green fodder and dry fodder were over utilized as the aforesaid ratio is less than one. Since green fodder and dry fodder accounted for the highest proportion of 49.42 per cent and 31.21 per cent of the cost of milk production, these resources should be optimally used.

Foreign breed production system

The resource use efficiency in milk production for foreign breed is presented in Table 11. From the table, it could be observed that the adjusted co- efficient of multiple determination (adjusted R^2) was 0.763, which indicated that the four variables selected for the analysis have explained 76.30 per cent variation in total milk production in foreign breed. Among the four variables, the green fodder and concentrates were significant at one per cent level with the elasticity of 0.16 and 0.08 respectively. One per cent increase in green fodder and concentrates, ***ceteris paribus***, would increase the milk production in foreign breed by 0.16 and 0.08 per cent respectively. The dry fodder variable was significant at five per cent level with an elasticity of 0.02, which indicated that one per cent increase in this variable, ***ceteris paribus,*** would increase the milk yield by 0.02 per cent.

It could also be observed that the ratio of marginal value product to the marginal factor cost was more than unity for concentrates indicating that the resource was under-utilized and there is a scope for increasing the use of resource in the study area. The variables like green fodder and dry fodder were over utilized as the aforesaid ratio is less than one. Since green fodder and dry fodder accounted for a highest proportion of 48.09 per cent and 27.16 per cent respectively of the cost of milk production, these resources should be optimally utilised

Technical efficiency of crop production system

The results of DEA, technical and scale efficiencies of turmeric and sugarcane is furnished in Table 12. It could be observed from the table that the variation in the levels of technical efficiency of turmeric ranged from 86.00 to 100.00 with mean efficiency of 95.00 per cent. The mean level of technical efficiency indicated that on an average five per cent of turmeric growers falling short of the maximum possible level of technology. Therefore it was possible to increase the turmeric yield by 5.00 per cent of turmeric growers on average by adopting the technology used by best performers. Likewise the variation in the levels of technical efficiency of sugarcane ranged from 85.00 to 100.00 with mean efficiency of 98.00 per cent. The mean level of technical efficiency indicates that on an average 2.00 per cent of sugarcane growers falling short of the maximum possible level of technology.

The scale efficiency of turmeric ranged from 87.00 to 100.00 per cent with mean scale efficiency of 96.00 and the scale efficiency of sugarcane ranged from 88.00 to 100.00 per cent with mean scale efficiency of 98.00 per cent. Similar high technical efficiency was reported by Sridhar (2013) who showed that the mean technical efficiency score of organic turmeric and inorganic turmeric was 96.36 per cent and 98.21 per cent respectively. Saranya (2014) also reported high technical efficiency of 94.00 per cent and 95.00 per cent respectively in sugarcane and groundnut. It could be concluded from above results that mean technical efficiency and scale efficiency of both turmeric and sugarcane farmers were almost similar.

The frequency distribution of technical and scale efficiency measures for turmeric and sugarcane farms has been furnished in Table 13. The technical efficiency measures indicated that 48.57 per cent and 40.00 per cent of the turmeric and sugarcane farmers belonged to most efficient category (more than 98 per cent) respectively. 28.57 per cent and 34.29 per cent of the farmers belonged to the medium efficient category (96.00 to 98.00 per cent) in both turmeric and sugarcane. The farmers' belonged to the least efficient category (less than 95.00 per cent) was 22.86 per cent and 25.71 per cent in turmeric and sugarcane respectively.

The scale efficiency measures indicated that 51.43 per cent and 42.86 per cent of the turmeric and sugarcane farmers belonged to most efficient category (more than 98 per cent) respectively. 31.43 per cent and 34.19 per cent of the farmers belonged to the medium efficient category (96.00 to 98.00 per cent) in both turmeric and sugarcane. The farmers' belonged to the least efficient category (less than 95.00 per cent) was 17.14 per cent and 22.86 per cent in turmeric and sugarcane respectively. Thus it could be concluded from the above results of technical and scale efficiency that for both turmeric and sugarcane, the most proportion of the farmers belonged to most efficient category followed by medium efficient category and lastly with low efficient category.

Technical efficiency of dairy production system

The results of DEA, technical and scale efficiencies of local breed and foreign breed is furnished in Table 14. It could be

observed from the table that the variation in the levels of technical efficiency of local breed ranged from 88.00 to 100.00 with mean efficiency of 96.00 per cent. The mean level of technical efficiency indicated that on an average four per cent of local breed farmers were falling short of the maximum possible level of technology. Therefore it was possible to increase the milk yield by 4.00 per cent of local breed farmers on average by adopting the technology used by best performers. Likewise the variation in the levels of technical efficiency of foreign breed ranged from 81.00 to 100.00 with mean efficiency of 97.00 per cent. The mean level of technical efficiency indicated that on an average 3.00 per cent of foreign breed growers falling short of the maximum possible level of technology.

The scale efficiency of local breed ranged from 85.00 to 100.00 per cent with mean scale efficiency of 97.00 and the scale efficiency of foreign breed ranged from 84.00 to 100.00 per cent with mean scale efficiency of 98.00 per cent. Similar results found in Monika Michalickova et.al (2013) in dairy farms with a scale efficiency of 96.00 per cent. It could be concluded from above results that mean technical efficiency of both local and foreign breed farmers were almost similar.

The frequency distribution of technical and scale efficiency measures for local breed and foreign breed has been furnished in Table 15. The technical efficiency measures indicated that 45.71 per cent and 51.43 per cent of the local and foreign breed farmers belonged to most efficient category (more than 98.00 per cent) respectively. 31.43 per cent and 28.57 per cent of the farmers belonged to the medium efficient category (96.00 to 98.00 per cent) in both local and foreign breed. The farmers' belonged to the least efficient category (less than 95.00 per cent) was 22.86 per cent and 20.00 per cent in foreign and local breed respectively.

The scale efficiency measures indicated that 42.86 per cent and 40.00 per cent of the local and foreign breed farmers belonged to most efficient category (more than 98.00 per cent) respectively. 31.43 per cent and 34.29 per cent of the farmers belonged to the medium efficient category (96.00 to 98.00 per cent) in both local and foreign breed. The farmers' belonged to the least efficient category (less than 95.00 per cent) was 28.57 per cent and 25.71 per cent in foreign and local breed respectively. Thus the efficiency measures indicated that for both local and foreign breed, more proportion of farmers belonged to most efficient category followed by medium efficient category and lastly with low efficient category.

Conclusions

Turmeric was found to be more profitable as the net income was higher in turmeric than sugarcane by 10.98 per cent and at present, both the crops were raised in almost equal area among the sample farms. Hence the agriculture department should popularize turmeric cultivation among farmers. Similarly, foreign breed dairy production system was found to be more profitable with higher gross income and net income of 99.95 per cent and 79.24 per cent respectively over local breed dairy production system in spite of higher cost of production. Hence foreign breeds of dairy like Jersey and Holstein Friesian should be popularized among capital available farmers by the animal husbandry department. The result of post-harvest loss had showed that the loss was 0.048 per cent of turmeric production which was nevertheless a small quantity for a spices and condiment crop like turmeric. Further the post- harvest loss was influenced by education and inadequate storage. Hence the government should take intensive efforts in the pursuit of reducing post-harvest losses by conducting awareness programmes with the assistance from agriculture department, by constructing cold storage facility apart from strengthening the rural godowns in regulated market.

Milk losses in dairy production system due to various diseases were 9.97 per cent in local breed and 13.34 per cent in foreign breed. Further the milk losses were influenced by milk fever, mastitis and foot and mouth disease in local and in foreign breed, milk fever and mastitis had significant positive influence on milk losses. Hence intensive efforts should be undertaken by animal husbandry department to control these diseases by better vaccination programmes and awareness programmes on the onset of these diseases in pursuit of eliminating the milk losses. In turmeric, the planting material and manures and fertilizer were over utilized. In local breed and foreign breed, green fodder and dry fodder were over utilized and hence extension infrastructure of agriculture department should conduct training programmes on need based application of inputs and fodder.

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