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ECONOMICS OF MILK PRODUCTION OF MAJOR DAIRY BUFFALO BREEDS BY AGRO-ECOLOGICAL ZONES IN PAKISTAN

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ABSTRACT:- This study was designed to compare costs of rearing and returns received from major dairy buffalo breeds (Nili-Ravi and Kundhi) in various agro-ecological zones of Pakistan. For this purpose, 219 buffalo farmers were randomly selected from mixed and rice-wheat cropping zones of Punjab and Sindh provinces, mixed cropping zone of Khyber Pakhtunkhwa (KPK) province, coastal zone of Sindh and mountainous-AJK. Of these, 155 and 64 were Nili-Ravi and Kundhi buffalo breed farmers, respectively. The study revealed that among the structure of cost components, feed cost occupied the major share in total cost of milk production. Milk production of buffaloes of Nili-Ravi and Kundhi breeds were 2889 and 2375 liter per annum, respectively. Total costs of milk production of Nili-Ravi and Kundhi buffalo breeds were Rs.96155 and Rs.90604 per annum, respectively. Net income per liter from milk of Nili-Ravi and Kundhi breeds was Rs.12 and Rs.11, and benefit-cost ratios were 1.4 and 1.3, respectively. Hence, Nili-Ravi buffalo breed is more productive and yields better returns over Kundhi breed. Moreover, buffalo milk production is a profitable business in the country except in coastal areas of Sindh, where investment in milk production just covers the cost of production due to comparatively higher feed prices and low milk prices. Econometric analysis of milk production in the country revealed that use of green fodder and concentrates contribute positively and significantly to milk production.

Key Words: Buffalo; Breeds; Nili-Ravi; Kundhi; Cost-benefit Ratio; Economics; Milk Production; Pakistan.

INTRODUCTION

The agriculture sector plays a vital role in the economy of Pakistan. It currently contributes 21% to GDP and employs 44% of the country's labour force. Moreover, 60% of the rural population depends upon this sector for its livelihood. It has a fundamental role in ensuring food security, generating overall economic growth, reducing poverty and the transformation towards industrialization. The livestock subsector contributed more than half to the agricultural value added (55.1%) and one-tenth to national GDP (11.6%) during 2011-12. This is the fastest growing sub-sector of agriculture sector and exhibited a growth of 4.0% in 2011-12. Pakistan with current estimates is the 4th largest milk producing country in the world with 47.9 mt of milk produced during 2011-12 of which 38.7 mt is available for human consumption (GoP, 2012).

Buffalo is the main dairy animal of Pakistan with total population of

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32.7 million (GoP, 2012), which puts the country at 2nd position after India with 111.3 million and before China with 23.6 million (FAO, 2012). Buffalo population has increased in Pakistan by 36.3% since 2001-02. About two-third (62%) of the national milk supply comes from buffaloes (GoP, 2012). Punjab and Sindh are major provinces by buffalo population and had 64.9% and 26.9% of the total population in the country, respectively. While, Khyber Pakhtunkhwa and Balochistan had 7.1% and 1.2% of the total buffalo population, respectively (GoP, 2006). Major buffalo breeds of Pakistan are Nili-Ravi and Kundhi, while buffaloes of Azi-kheli breed also present in a sizeable number. Nili-Ravi and Kundhi breeds are mainly found in irrigated plains of Punjab and Sindh, respectively and Azi-kheli breed is mainly localized in the Swat valley in Khyber Pakhtunkhwa (Khan, 2003). Shares of Nili-Ravi and Kundhi breeds in total buffalo populations of Punjab and Sindh are 90.6% and 79.3%, respectively (GoP, 2006).

Buffaloes are mainly kept in the country under subsistence and rural market oriented set ups. Herd size in buffaloes is small. When raised as buffaloes, 15.7% are kept in herd size of 1-2, 77.3% are kept in herd size of 1-10 and only 7.0% are raised in herds of size greater than 50 (GoP, 2006). During past five years, the prices of both the liquid milk (loose and packed) have been more than double, whereas on the production side, the national milk production has increased by 13.5%. While during the same period, the population of the country has increased by 8.1% (GoP, 2010).The population growth, increase in per capita income and the potential for export is fueling the demand for livestock and livestock products (GoP, 2012).

Nili-Ravi and Kundhi buffalo breeds are the best buffalo breeds in the world with maximum milk production potential of 5000 and 3500 liters per lactation, respectively. While, national average milk production per lactation of Nili-Ravi and Kundhi buffaloes are about 2300 and 2000 liters, respectively (Iqbal and Ahmad, 1999). So, there is a yield gap of about 40-50% in the observed and potential milk yield of buffaloes in the country. One of the major reasons of low milk production in Pakistan is absence of optimal level of feed and fodders (Chaudhry and Ahmad, 1987). Available literature on milk production suggests that milk production depends on the breed of animal, feeding optimal level of feed and fodder, management and location/region of the dairy farm. Similarly, other factors include age of the animal at the time of first calving, number of lactations and health status of the animal (Rao, 1985). A study about factors affecting milk production in buffaloes by Hussain et al. (2010) declared green fodder, lactation number and labour hours as main factors affecting milk production.

Milk is the primary commodity of daily consumption and consumers are always concerned about its prices. That's why the demand for raw milk is high as compared to processed milk. On the producer side, cost of production is of great concern. The prices of some essential inputs of dairy farming are fluctuating and almost increased by 100-200% during the last one decade, which push the cost of production and

minimize the profitability for dairy farmers (IFCN, 2009). This has inversely affected milk production, even drove out small dairy farmers from the sector and discouraged new investment. Supply of milk is not sufficient to meet the domestic consumption and powdered milk is imported every year to fill this gap. This study aims to carry out in-depth economic analysis of buffalo milk production in main ecologies of Pakistan as well as to find out inventory of buffaloes at the sampled farms, to determine milk productivity and economics in main agro-ecological zones of the country.

MATERIALS AND METHOD

Major agro-ecological zones were purposively selected for this study from all over the country. Formal survey was carried out for data collection in June and July, 2011. In total, 219 buffalo keeping farmers were interviewed from all over the country by using a well-structured questionnaire. The farmers were interviewed from zones by considering their relative shares in provincial buffalo population (Table 1). Cost and returns of buffalo milk production of Nili-Ravi and Kundhi buffalo breeds were calculated by agro-ecological zones on per annum basis, as lactation length of Nili-Ravi buffalo breed ranged from 290 to 330 days (Hussain et al., 2006) and of Kundhi breed is 345 days (FAO, 2010). Gross cost of milk production includes feed costs, labour, depreciation, interest and miscellaneous expenses, etc. Fixed costs include depreciation charges on buffaloes, capital investment, and interest on own as well as borrowed capital (Chaudhry and Ahmad, 1987). Interest on the value of the animals, is charged at half of the normal interest rate (5.25%) and depreciation is charged at 5.5%. Depreciation on present values of concrete, mud and mixed type of sheds were charged at 2.5%, 5.0% and 4.0%, respectively. Animal units by livestock

Table 1. Distribution of sample farmers in different agro-ecological zones

Main breed	Province	Agro-ecological zones	Percent share of the zone in buffalo population in provinces*	Districts surveyed	Number of farmers interviewed
Nili-Ravi	Punjab	Mixed cropping**	50.3	Jhang	50
		Rice-wheat**	15.0	Gujranwala	15
	Khyber Pakhtunkhwa	Mixed cropping**	76.3	Peshawar, Mardan and Dera Ismail Khan	45
	AJK	Mountainous	-	Muzaffarabad, Mirpur and Rawalakot	45
Kundhi	Sindh	Mixed cropping**	18.3	Hyderabad	14
		Rice-wheat**	28.9	Larkana	22
		Coastal Zone	35.7	Badin and Thatta	28
Total	-	-	-	-	219

** On the basis of livestock census 2006*
*** Agro-ecological Zones' data used for Multiple Regression analysis*

types used to determine shed cost on per animal unit basis, while the shed cost per wet buffalo was derived by multiplying it with 1.5 (Table 2).

The variable costs for milk production are feeding, labour and miscellaneous costs. Miscellaneous expenses for milk production include de-worming, vaccination and animal treatment, insemination, dairy equipment repair and electricity charges etc. Fodder prices, wheat straw prices and their feeding amount per day during fodder scarcity and abundance months were considered while calculating fodder cost. Number of fodder abundance and scarcity months in mixed, rice-wheat cropping zones, coastal and mountainous areas are eight and four, respectively (FAO, 2002 and Sarwar et al., 2002). Major concentrates fed to the milking buffaloes are oilseed cakes, choker and vanda. Cost of individual concentrates (CIC) was calculated by equation 1.

CIC = QCD x PRC x FDS (1)

where,

QCD = Quantity of a concentrate fed per day (kg)

PRC = Price of concentrate per kg (Rs.)

FDS = Number of feeding days of a concentrate per annum

Then, total concentrates feeding cost (CFC)was calculated by the equation 2.

CFC = MCC + GRC + MOC + SSC + OLC (2)

where,

MCC = Cost of major concentrates

GRC = Cost of grains (wheat and maize)

MOC = Cost of molasses (gur)

SSC = Cost of salt and spices

OLC = Cost of oil

Annual expenditures on veterinary care on per animal per annum basis (VCC) were estimated by the equation 3.

VCC = DWC + VAC + TRC (3)

where,

DWC = Cost of de-worming

VAC = Cost of vaccination

TRC = Cost of treatment

Cost of both permanent and occasionally hired labour and opportunity cost of family labour engaged in livestock farming was calculated on per annum basis on market rates. Then, labour cost per animal unit basis was calculated by the animal units of different types of livestock (Table 2), and labour cost per wet buffalo was calculated by multiplying with 1.50. Similarly, miscellaneous costs were also calculated. Initially, economics of buffalo production was calculated by two lactation groups. Group one comprised buffaloes in first lactation. Afzal et al. (2007) reported that buffalo milk yield remain low in 1st lactation as compared to following lactations. In group two, buffaloes in 2nd - 6th lactation were considered as it is believed that milk yield increases and touches its maximum level during this period. However, as significant differences in milk produ-ction per lactation and economics of milk production were not found and the cases of buffalo in first lactation were nominal. Thus, economics of buffalo milk production were calculated on overall basis, ignoring lactation

Table 2. Animal units by livestock types

Livestock types	Animal units	Livestock types	Animal units
Wet buffalo	1.5	Cow calf	0.2
Wet cow	1.0	Buffalo bull	1.2
Dry buffalo	1.2	Cow bull	1.1
Dry cow	0.8	Sheep/Goat	0.3
Buffalo heifer	0.6	Donkey	0.5
Cow heifer	0.4	Horse	1.2
Buffalo calf	0.3	Camel	1.2

Source: Ahmad et al., 1996.

number of the animals.

Statistical Package for the Social Sciences (SPSS-20) has been used for the descriptive data analysis. F-statistics were determined to compare the significance of differences between agro-ecological zones. The case in which computed F-statistics was found greater than tabulated value, the differences between the zones were statistically significant. Descriptive analysis revealed a wide variation in milk production per buffalo and milk prices across zones. Thus, data from main agro-ecological zones was used for the production function viz., mixed cropping and rice-wheat zones of both Sindh and Punjab and mixed-cropping zone of KPK. Moreover, use of production function was preferred over profit function. As, production function is technical, mathematical or physical relationship between inputs and outputs. Multiple regression analysis of buffalo milk production by assuming Cobb-Douglas form of the production function has been carried out as given by equation (4). Statistical package E-Views 5 was used for the analysis.

$$LnYLD = \beta_0 + \beta_1 LnGFC + \beta_2 LnWSC + \beta_3 LnCFC + \beta_4 LnLBC + \beta_5 LnMIC + \mu \quad (4)$$

where,

YLD = Milk production per buffalo per annum (liters)
GFC = Green fodder cost (Rs.)
WSC = Wheat straw cost (Rs.)
CFC = Concentrates feeding cost (Rs.)
LBC = Labour cost (Rs.)
MIC = Miscellaneous cost (Rs.)
β_0 = Intercept
βs = Coefficients with respect to GFC, WSC, CFC, LBC and MIC
μ = Error term, which may result due to errors in the production of milk, economic adversities or plain luck, or the aggregate effect of input variables not included in the production function.

RESULTS AND DISCUSSION

Inventory of Buffaloes at the Farms

Mean numbers of wet buffaloes of Kundhi breed and dry buffaloes of Nili-Ravi per farm were statistically different across agro-ecological zones (Table 3). Average number of wet buffaloes per farm of Nili-Ravi breed was highest in the mixed cropping zone of Khyber Pakhtunkhwa (4.8) and lowest in mixed cropping zone of Punjab (2.0). In Kundhi breed, average numbers of wet buffaloes per farm was the highest in the mixed cropping zones of Sindh (14.5) and lowest in coastal areas of Sindh (2.3). Similarly, in agro-ecological zones, where Kundhi was the main buffalo breed, maximum number of total animal units per farm was found in the mixed cropping zone of Sindh (31.9) and the lowest was observed in coastal areas of Sindh (9.1).

Productivity of Nili-Ravi and Kundhi Buffalo Breeds

Productivity of Nili-Ravi breed was the best in the rice-wheat zone of Punjab and the poorest in mixed cropping zone of Khyber Pakhtunkhwa with total milk production per lactation of 3595 and 2320 litres, respectively (Figure 1). Productivity of Kundhi breed was the best in mixed cropping zone of Sindh and the poorest in coastal areas of the province with total milk production of 2622 and 2144 liters per lactation, respectively. Differences in produc-

Table 3. Mean number buffaloes and total animal units per farm

Livestock Types	Zones					
	Mixed-Punjab	Rice-wheat Punjab	Mixed-KP	Mountainous (AJK)	Total	Significance
Nili-Ravi Breed						
Wet Buffaloes	2.0 (1.3)	3.8 (2.5)	4.8 (7.2)	4.1 (5.6)	4.1 (5.6	0.518
Dry buffaloes	2.2 (1.1)	1.6 (112)	0.8 (1.3)	0.2 (0.4)	1.0 (1.2)	0.000***
Total Animal Units	9.9 (4.9)	10.5 (4.5)	14.7 (15.9)	13.0 (10.2)	10.1 (10.6)	0.992
Kundhi Breed						
	Mixed-Sindh	Rice-wheat Sindh	Costal-Sindh	Total	Significance	
Wet Buffaloes	14.5 (20.0)	11.9 (26.2)	2.3 (1.5)	8.3 (20.6)	0.050**	
Dry buffaloes	3.3 (5.6)	6.1 (15.6)	2.1 (3.3)	3.7 (8.8)	0.58	
Total Animal Units	31.9 (46.3)	29.1 (62.7)	9.1 (7.3)	21.0 (49.2)	0.069*	

****, ** and * Significant at 1%, 5% and 10% levels, respectively. Figures in parenthesis are standard deviations*

tivity of the buffalo breeds across zones are due to agro-climatic conditions, difference in farm resources and animal feeding and management practices etc. Mean milk productions per lactation of Nili-Ravi and Kundhi buffalo breeds in the country were 2889 and 2375 liters, respectively. Iqbal and Ahmad (1999) reported maximum milk production potential of Nili-Ravi and Kundhi breeds are 5000 and 3500 liters per lactation, respectively. By considering the productive potential of Nili-Ravi and Kundhi breeds, there are production gaps of about 42.2% and 32.1%, respectively. Iqbal and Ahmad (1999) reported that national average milk production of Nili-Ravi and Kundhi breeds were 2300 and 2000 liters per lactation, respectively. Thus, if these productivity figures are compared with that of present study, overtime improvement in milk productivity of both buffalo breeds can be conceived, which may be due to adaptation of better

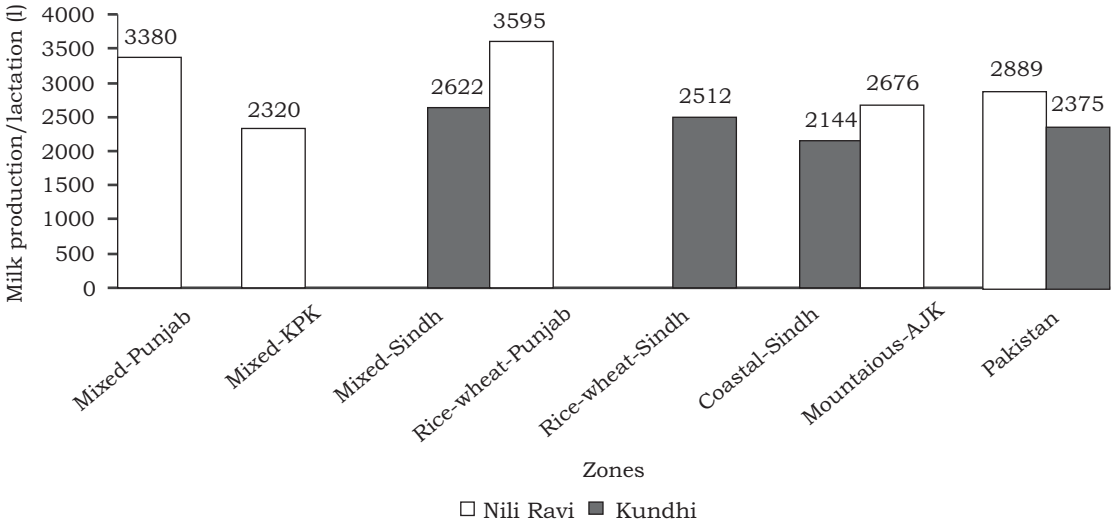

Figure 1. Productivity of buffalo breeds in major agro-ecological zones

feeding and animal care practices.

Cost and Returns of Milk Production

Feeding and labour costs are the main variable cost items. Inter-provincial comparison of feeding costs revealed that in the mixed cropping zone of KPK feeding cost was greater than in the mixed cropping zone of Sindh and Punjab (Figure 2). Similarly in the rice-wheat zone of Sindh, feeding cost was greater than in the rice-wheat zone of Punjab. This means that animals are better fed or feed resources are more expensive in KPK and Sindh provinces than in the Punjab. Labour cost was the highest in the mountainous-AJK and was the lowest in mixed cropping zone of Sindh province. Fixed cost was higher in the rice-wheat zones than in the mixed zones, which indicates better housing conditions and higher prices of the animals in these zones.

Nili-Ravi is main buffalo breed in Punjab, KPK and AJK. Mean fixed cost of keeping buffalo of Nili-Ravi breed was Rs.13096 in the surveyed areas of the country (Table 4). Total fixed cost of Nili-Ravi breed was the highest in mountainous areas of AJK and the lowest in mixed-cropping zone of KPK. Feeding cost accounted for 76.7% of the total variable cost in the study area. Green fodder cost was the main variable cost item for buffalo milk production in mixed and rice-wheat cropping zones of Punjab. In the mixed cropping zone of KPK, wheat straw and green fodder costs were main variable cost items, while in the mountainous AJK wheat straw cost was the major variable cost of buffalo milk production. Total cost of milk production per annum per buffaloes of Nili-Ravi breed was Rs.96155 in the surveyed areas, with the lowest in mixed cropping zone of Punjab (Rs.75345) and the highest in the AJK (Rs.115016).

Farm gate level, milk prices were the highest in AJK (Rs.61 liter^{-1}) and the lowest in mixed cropping zone of Punjab (Rs.31 liter^{-1}). Cost of milk production in Kundhi buffalo breed was Rs.35 liter^{-1} in the study area, with a minimum of Rs.22 liter^{-1} in mixed cropping zone of Punjab and maximum of Rs.46 liter^{-1} in mixed

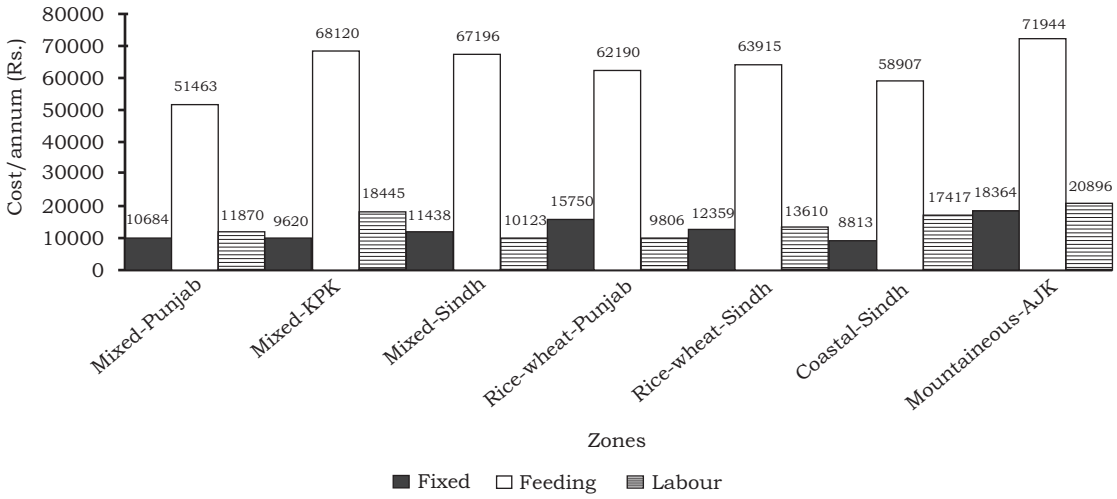

Figure 2. Main cost items for buffalo milk production by agro-ecological zones

Table 4. Economics of milk production of buffalo of Nili-Ravi breed

(Rupees per annum)

	Agro-ecological Zones									
	Mixed-Punjab		Rice-wheat Punjab		Mixed-KP		Mountainous -AJK		Total	
No of cases	50		15		45		45		155	
Fixed costs										
	Rs.	%	Rs.	%	Rs.	%	Rs.	%	Rs.	%
Amount of interest	4988 (2766)	46.7	7081 (2496)	44.9	4494 (1722)	47.0	8663 (5537)	47.2	6114 (3212)	46.8
Animal description	5225 (2897)	48.9	7418 (2615)	47.1	4708 (1804)	48.9	9075 (5801)	49.4	6405 (3365)	48.9
Depreciation on shed	471 (355)	4.4	1260 (490)	8.0	418 (392)	4.4	626 (561)	3.4	577 (431)	4.5
Total fixed	10684 (3785)	100	15759 (4675)	100	9620 (2171)	100	18364 (6356)	100	13096 (5131)	100
Variable costs										
Green fodder	44460 (4614)	68.8	50580 (7800)	68.8	27200 (12480)	29.1	15120 (1610)	15.6	31523 (13462)	41.8
Wheat straw	5839 (3543)	9.0	7875 (3083)	10.7	28133 (13046)	29.9	48108 (16377)	49.8	24780 (15400)	27.1
Concentrates	1164 (2136)	1.8	3735 (5516)	5.1	12786 (9785)	14.2	8416 (4475)	8.7	6892 (5599)	7.7
Total feeding	51463 (19670)	79.6	62190 (6317)	84.6	68120 (20827)	73.1	71944 (9587)	74.4	63283 (21782)	76.7
Labour	11870 (3941)	18.4	9806 (3981)	13.3	18445 (3290)	19.8	20896 (9763)	21.6	16200 (9558)	19.2
Miscellaneous	1328 (203)	2.1	1507 (1155)	2.1	6530 (6221)	7.1	3812 40(12)	3.9	3577 (4859)	4.1
Total variable	64661 (24159)	100	73503 (5488)	100	93094 (29638)	100	96652 (3138)	100	83059 (29265)	100
Total Cost	75345 (10514)		89262 (7866)		102714 (16713)		115016 (5118)		96155 (15906)	
Cost (Rs. liter^{-1})	22.0 (4.0)		25.0 (3.0)		46.0 (2.0)		43.0 (8.0)		35.0 (3.9)	
Returns										
Milk production (liters)	3380 (522)		3595 (1068)		2320 (397)		2676 (393)		2889 (739)	
Price(Rs. liter^{-1})	31.0 (2.0)		42.0 (15.0)		53.0 (7.0)		61.0 (6.0)		47.0(13.0)	
Gross income	104780 (18832)		150990 (30463)		122700 (23889)		163236 (23016)		131426 (35272)	
Net income (Rs. liter^{-1})	9.0 (2.0)		17.0 (11.0)		7.0 (4.0)		18.0 (9.0)		12.0 (6.0)	
Cost-benefit ratio	1.0:1.4		1.0:1.7		1.0:1.2		1.0:1.4		1.0:1.4	

Figures in parenthesis are standard deviations

cropping zone of KPK. Net income per liter of milk of Nili-Ravi buffalo breed was Rs.12 liter^{-1} in the study area, with maximum of Rs.18 liter^{-1} in mountainous AJK and the lowest of Rs.7 liter^{-1} in mixed cropping zone of KPK. Net income per liter of milk was high in the rice-wheat zone as

compared to mixed cropping zone of Punjab, due to higher farm gate level milk prices in the former zone. In the study area, benefit cost ratio of milk production of buffaloes of Nili-Ravi breed was 1.4. In all agro-ecological zones milk production was beneficial for the farmers with better benefit cost ratios, ranged from 1.2 to 1.7.

Kundhi breed is the main buffalo breed in all the agro-ecological zones of Sindh. Economics of milk production of buffaloes of this breed revealed that the total fixed cost per annum of buffalo was the lowest in coastal areas and the highest in rice-wheat zone of the province with mean value of Rs.10606 on overall basis (Table 5). In the surveyed zones of the Sindh province, feeding cost was 78.1% of the total variable cost. These findings are quite similar to that of Rao et al. (1991), who determined economics of buffalo milk production in India and reported that feeds and fodder costs together accounted for 70% of the total variable cost. However, Anwar and Younas (2000) reported that feeding cost accounted for 53.3% of the total variable cost of milk production in Toba Tek Singh district of Punjab, Pakistan. These findings indicate great change in share of feeding cost in total feeding costs over time. Concentrate feeding cost is the main variable cost item for buffalo milk production in all the agro-ecological zones except coastal areas of Sindh, where main cost item was green fodder due to higher fodder prices. In the surveyed areas, wheat straw and labour costs are other main variable cost items of buffalo keeping. Total cost of milk production per annum per buffalo of Kundhi breed was Rs.90604 in the study area, with lowest in coastal areas (Rs.88114) and the highest in mixed cropping zone of Sindh (Rs.92623).

Cost of production per liter of milk of Kundhi breed was Rs.37 in the study area, with the highest in coastal areas (Rs.41) and the lowest in mixed-cropping zone of Sindh (Rs.35). Farm gate level milk prices were the highest in rice-wheat zone followed by in the mixed cropping zone and coastal areas with an overall mean price of Rs.49 liter^{-1} in the study area. Net income was Rs.11 liter^{-1} in the study area, with a maximum of Rs.21 liter^{-1} in the rice-wheat zone, as the prices were substantially higher in this zone (Rs.58 liter^{-1}) as compared to other zones. In the study area, benefit cost ratio of milk production of buffaloes of Kundhi breed was 1.3. Benefit cost ratio of milk production was the highest in rice-wheat zone (1.6) due to higher milk prices. In the mixed cropping zone of the province benefit cost ratios was 1.5. In the coastal areas, milk prices and cost of milk production were equal with benefit cost ratio of 1.0, which is an indicative of subsistence nature of livestock farming in these areas. Thus, milk production of buffalo of Kundhi breed was beneficial in all the agro-ecological zones except in coastal areas, where investment in milk production just covers the cost of production.

The value of adjusted R-square represent that independent variables of the model are explaining about 46.7% of the total variation in the milk production (Table 6). Durbin-Watson statistics indicates absence of first order autocorrelation (either positive or negative) among the explanatory variables of the model. Results ordinary least square regression analysis of buffalo milk production function indicate that

Table 5. Economics of milk production of buffalo of Kundhi breed

(Rupees per annum)

	Agro-ecological Zones							
	Mixed-Sindh		Rice-wheat-Sindh		Coastal-Sindh		Total	
No. of cases	14		22		28		64	
Fixed costs	Rs.	%	Rs.	%	Rs.	%	Rs.	%
Amount of interest	5323 (1356)	46.1	5644 (1299)	45.7	4200 (1241)	47.7	4920 (1241)	46.7
Animal depreciation	5576 (1421)	48.3	5913 (1361)	47.8	4400 (1300)	49.9	5177 (1300)	48.8
Depreciation on shed	639 (476)	5.5	802 (611)	6.5	213 (131)	2.4	509 (479)	4.5
Total fixed cost	11438 (2718)	100	12359 (2694)	100	8813 (2509)	100	10606 (2511)	100
Variable costs								
Green fodder	19228 (6883)	23.7	19080 (4071)	23.8	22968 (8965)	29.0	20813 (7439)	26.1
Wheat straw	20546 (5501)	25.3	19236 (2977)	24.0	17380 (9590)	21.9	18711 (5782)	23.4
Concentrates	27422 (9703)	33.8	25599 (1110)	31.9	18559 (12870)	23.4	22918 (9194)	28.6
Total feeding	67196 (15112)	82.8	63915 (10773)	79.8	58907 (16017)	74.3	62442 (13155)	78.1
Labour cost	10123 (6924)	12.5	13610 (4408)	17.0	17417 (8098)	22.0	14513 (6959)	18.1
Miscellaneous	3866 (2282)	4.8	2600 (1194)	3.2	2980 (1944)	3.8	3043 (1987)	3.8
Total variable	81185 (15526)	100	80125 (10046)	100	79301 (15864)	100	79998 (12951)	100
Total	92623 (12477)		92484 (7702)		88114 (12745)		90604 (12745)	
Cost liter^{-1}	35.0 (5.0)		37.0 (5.0)		41.0 (5.0)		37.0 (4.0)	
Returns								
Milk production (liters)	2622 (435)		2512 (221)		2144 (425)		2375 (414)	
Price Rs. liter^{-1}	51.0 (8.0)		58.0 (3.0)		41.0 (3.0)		49.0 (8.0)	
Net income Rs. liter^{-1}	16.0 (10.0)		21.0 (4.0)		0.0 (9.0)		11.0 (7.0)	
Income from milk	133722 (35128)		145696 (14696)		87904 (16021)		116375 (34173)	
Cost-benefit ratio	1.0:1.5		1.0:1.6		1.0:1.0		1.0:1.3	

Figures in parenthesis are standard deviations

Table 6. Results of Multiple Regression Analysis

Dependent Variable: Ln YLD (Milk production per buffalo per annum (liters)
Method: Least Squares
Sample: 146

Variable	Coefficient	Standard Error	t-Statistics	Probability
Constant	6.711	0.972	6.902	0.000***
lnGFC	0.177	0.042	0.410	0.000***
lnWSC	0.005	0.061	0.090	0.929
lnCFC	0.168	0.051	3.292	0.000***
lnLBC	-0.118	0.030	-3.948	0.000***
lnMIC	0.035	0.034	1.043	0.302

R-squared	0.515	Mean dependent var	7.964
Adjusted R-squared	0.467	S.D. dependent var	0.129
S.E. of regression	0.828	Akaike info criterion	-1.477
Sum squared residual	2.145	Schwarz criterion	-1.250
Log likelihood	43.667	F-statistics	10.635
Durbin-Watson statistics	2.013	Prob (F-statistics)	0.000

**** Significant at 1% level*

green fodder cost (lnGFC) and concentrate feeding cost (lnCFC) are significant positive contributors to buffalo milk production in the country (Table 6). The estimated coefficients of green fodder and concentrate feeding costs show 10% increase in expenses on green fodder and concentrates uses, increases buffalo milk production by 1.8% and 1.7%, respectively. Other variables considered in the production function viz. wheat straw and miscellaneous costs have expected positive signs but are statistically insignificant. The variable of labour cost (lnLBC) has a negative sign and is statistically significant, which implies that labour is somewhat over employed in buffalo milk production. The estimated coefficient of labour cost indicates 10% decrease in expenses on labour use increases buffalo milk production by about 1.2%.

CONCLUSION AND RECOMMENDATIONS

Benefit cost ratios of milk production of Nili-Ravi and Kundhi buffalo breeds are 1.4 and 1.3, respectively. Therefore, it is concluded that buffalo milk production is a profitable business in the country except in coastal areas of Sindh, where investment in milk production just covers the cost of production. There are wide variations in milk productivity and profitability of buffaloes across main agro-ecological zones of the country. Study revealed that the uses of green fodder and concentrates increase the milk production in the country. However, the proportion of small milk producers in Pakistan is quite high, which hinders increase in milk production through increasing green fodder and concentrates feeding. Therefore, it is recommended that farmers should make selection of breeds after thorough consideration about their productive potentials and adaptability to local conditions. As the percentage share of different feed resources in total cost of production per annum vary greatly across cropping zone; therefore, animal nutritionists may find out optimum nutritional requirements of different

buffalo breeds keeping in view availability of fodder and forage resources in different regions of the country. Findings of the research should surely reach to the livestock farmers through mass media campaigns and agricultural extension services.

LITERATURE CITED

Afzal, M., M. Anwar and M. A. Mirza. 2007. Some factors affecting milk yield and lactation length in Nili-Ravi buffaloes. Pakistan Vet. J. 27(3): 113-117.

Ahmad, B., M. Ahmad and M.A. Chaudhry. 1996. Economics of livestock production and management. Research report published by Faculty of Agricultural Economics and Rural Sociology. University of Agriculture, Faisalabad, Pakistan. 191 p.

Anwar, M. and M. Younas. 2000. Cost of milk production in district Toba Tek Singh, Punjab, Pakistan. Pakistan J. Agric. Sci. 37(3-4): 186-190.

Chaudhry, A.M. and B. Ahmad. 1987. Cost of production of milk and beef in Faisalabad district 1981-82. Research report jointly published by Punjab Agricultural Research Coordination Board and University of Agriculture, Faisalabad, Pakistan.

FAO. 2002. Grassland and Pasture Crops. Country Pasture/Forage Resources Profiles, Pakistan. Available at http://www.fao.org.

FAO. 2010. International Buffaloes Federation, FAO Database. Available at http://www.ibfederation.com/breed.htm.

FAO. 2012. FAOSTAT. Available at http://faostat.fao.org.

GoP. 2006. Pakistan Livestock Census. Agricultural Census Organization, Statistics Division, Government of Pakistan, Lahore.

GoP. 2010. Economic Survey of Pakistan 2009-10. Economic Advisor's Wing. Ministry of Finance, Government of Pakistan, Islamabad.

GoP. 2011. Economic Survey of Pakistan 2010-11. Economic Advisor's Wing. Ministry of Finance, Government of Pakistan, Islamabad.

GoP. 2012. Economic Survey of Pakistan, 2011-12. Economic Affair Division, Government of Pakistan, Islamabad.

Hussain, M., A. Ghafoor and A. Saboor. 2010. Factors affecting milk production in buffaloes: A case study. Pakistan Vet. J. 30(2): 115-117.

Hussain, Z., K. Javed, S.M.I. Hussain and G.S. Kiyani. 2006. Some Environmental effects on productive performance of Nili-Ravi buffaloes in Azad Kashmir. J. Anim. Pl. Sci. 16(3-4).

IFCN. 2009. International Farm Comparison NetworkDairy Report. Available at http://www.verantwoordeveehouderij.nl.

Iqbal, M. and M. Ahmad. 1999. An assessment of livestock production potential in Pakistan: Implications for livestock sector policy. Pakistan Dev. Rev. 38(4): 615-628.

Khan, M.S. 2003. Azi-Kheli buffalo. An important genetic resource. Buffalo Newl. 18: 3.

Rao, B.D., T.G. Reddy and C.B. Singh. 1991. Economics of buffalo milk production on commercial dairy farms. Indian J. Dairy Sci. 44(1): 15-19.

Rao, B.S. 1985. Factors affecting the milk production: A case study. Indian J. Agri. Econ. 40(2): 169-

174. Sarwar, M., M. A. Khan, Mahr-un-Nisa and Z. Iqbal. 2002. Review Dairy Industry in Pakistan: A Scenario. Int. J. Agric. and Biol. 4(3): 420-428.

AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Author Name	Contribution to the paper
1.	Dr. Khalid Mahmood Aujla Director, SSD, PARC	Conceived the idea, Technical Input at every step, Overall Management of the article.
2.	Dr. Abid Hussain	Data entry in SPSS and analysis

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