Utilization patterns and factors associated with utilization of dairy farming technologies under sugarcane based farming systems in Indo-Gangetic Plains of India

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Abstract
To overcome the low development trend of the dairy farming, utilisation of technologies by the farming community is of utmost importance from economic wellbeing of the enterprise as well as environment point of views. Hence an attempt has been made to investigate the actual level of technology utilization at farmers' level along with factors affecting the same. The study was conducted in purposely selected, three sugarcane growing regions *viz*., Eastern, Central and Western U. P. Thus, 3 regions, 3 districts, 6 *tehsils* 12 villages and 240 farmers constituted the sample size. The data collection was done with the help of pre-tested structured interview schedule through personal interview and observation methods. Most of the farmers were of old age, had education up to high school, medium family educational status, maintained small families, have joint families, had medium level of social participation, decisions were taken by the family head on the basis of economic factors, average land holding was 1.78 ha, belonged to the marginal category of farmers, 49.17 per cent had low level of annual income (<Rs. 2.17 lakh), small herd size (59.58 %) of less than 3.16 standard animal unit dominated by non-descript animals, the annual average milk production/household was also highest (3602.50) in Western UP, medium mass media exposure and medium extension contact, sugarcane was found to be the major crop which covered 32.95 per cent of total cropped area with average yield of the 708.58 q ha^{-1}. As far as overall technology utilization was concerned, majority (43.33 %) of the farmers fell in the medium utilization category; the mean technology utilization index was 45.52 showing a technology utilization gap of about 54.48 per cent and Western Uttar Pradesh fared well in utilization of dairy farming technologies. The family educational status, income from sugarcane, herd size and mass media exposure were the major factors affecting the utilization of dairy farming technology under sugarcane based farming situation
Key words: Dairy, sugarcane, technology, utilization and factors

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I.   Introduction
        Areas under sugarcane based dairy farming offer an excellent opportunity for development of the dairy sector as sugarcane contributes a lot to the dairy farming in the form of fodder, fuel, litter and housing material. Kung (1978), Kevelenge *et al.* (1983), Nasseven (1986) and Wanapat (1990) reported that among the many food crops cultivated by farmers, sugarcane represents an example whose by-products can maximally be utilized. Sugarcane and its by-products (bagasse, molasses, leaves, tops and stalks) have successfully been used as cattle feed in intensive production systems. In low-producing dairy cows in India, feeding sugarcane tops (51% dietary level) twice daily was the most efficient practice for optimal nutrient utilization (Bandeswaran *et al*., 2012).

        It is mainly grown under the highly fertile irrigated agri-ecosystem of the country of which Indo-gangetic plain region is the major contributor to the area and production of sugarcane crop. Under the indo – gangetic plain region, Uttar Pradesh is main constituent as it has highest area, 2151 thousand ha under sugarcane crop in the year 2019-20 with a production and productivity of 173816 thousand tonnes and 80.81 tonnes ha^{-1}, respectively (Anonymous, 2020).

The State is also the largest contributor to the national milk production with a contribution of around 16.26 per cent. It has the second highest cattle and highest buffalo population in the country. But productivity in 2018-19 of crossbred cow, non-descript cow and buffalo was 7.36, 3.07 and 4.54 l/day which is well below the productivity in the progressive States (Anonymous, 2019-20). Furthermore, barring Bihar ($294), U. P. is one of the poor State as average annual per capita income was just $ 436 in 2011 as compared to $1,410 for India as a whole (World Bank, 2014). Thus, increasing the per capita income is the need of the hour for improving the standard of living but it cannot be achieved without increasing the productivity of dairy sector immediately as it is the main stay of the small holder farmers which constitute the majority. This in turn helps in reducing the animal population, arresting of climate change by the way of reduced emission of methane gas and doubling the income of farmers. Since sugarcane is the major crop in U. P. and grown in 59 out of 75 districts, the efforts to increase the production and productivity of dairy animals in U. P. will not be successful until and unless it is mainly increased under the sugarcane based dairy farming. For proper development of any sector technology utilization plays the pivotal role. To date, despite all the positive trends in dairy farming, the level of innovative orientation is not sufficiently high in many parts of the country. Many scientists [Strekozov, *et al.,* 2019, Sharipov, 2019, Surovtsev, 2018, Surovtsev, 2018, Mark*, et al.*, 2018 & Konstantinov *et al.*, 2018] have confirmed that the use of innovative technologies is the key factor to provide a required level of enterprise competitiveness. The studies by leading scientists [Krapchina and Kotova, 2015 & Sitdikov *et al.*, 2020] and experience of agri-producers show that the pace of technological modernization of livestock farming remains slow. To overcome the low development trend of the dairy industry, utilisation of technologies by the farming community is of utmost importance from economic wellbeing of the enterprise as well as environment point of views. Hence an attempt has been made to investigate the actual level of technology utilization at farmers' level along with factors affecting the same.

II.   Methodology

The Indo-Gangetic Plains (IGP) in India mainly comprises of five states viz., Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal. Among these state the state of Uttar was selected purposively to conduct the study as area wise it is the fifth largest, the most populous, it has highest area, 2151 thousand ha under sugarcane crop in the year 2019-20 with a production and productivity of 173816 thousand tonnes and 80.81 tonnes ha^{-1}, respectively (Anonymous, 2020) produced 37.77 million tonnes of milk during 2016-17 occupying first rank in milk production in the country (Anonymous, 2016-17). It also has large livestock population, i.e. 68.715 million which include 19.557 million cattle (28.67%), 30.62 million buffaloes (44.56%) and rest are the other livestock (Anonymous, 2019-20). Sugarcane cultivation is mainly concentrated in 3 Regions; hence these regions were selected purposively for conducting the study. Faizabad, Sitapur and Muzaffarnagar districts from Eastern, Central and Western U. P. were randomly selected, respectively. From each selected district, two tehsils and from each selected *tehsil*, 2 villages were selected randomly. For selection of the respondents, a pilot survey of the selected villages was carried out and a list of farmers practicing sugarcane farming from 5 years, generating substantial part of agricultural income from sugarcane crop related activities either through its cultivation or doing related activities such as share cropping, labour, running crushers, transportation of sugarcane, etc. were shortlisted irrespective of whether they were having their own land or not. Farmers were categorised on the basis of land holdings i. e, landless, marginal, small, semi-medium, medium and large categories as per government of India classification. On the basis of proportionate random sampling method, from each selected village, a total of 20 farmers were selected subject to condition that at least one farmer must be there in each category. Thus, a total of 240 such farmers constituted the sample size. The data collection on was done through personal interview and observation methods during the year 2016. Data were analysed by using suitable tools and techniques.
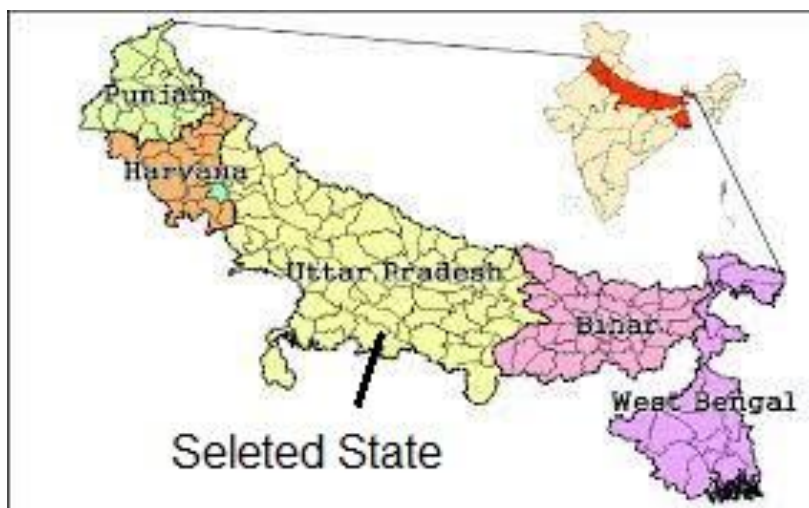
Figure 1 Indo Gangetic Plain Region of India

Utilisation pattern of farming technologies refers to the actual utilization of the same by the farmers. This was measured with the help of a schedule which was developed for the purpose and scoring was done in 3 point continuum *viz.*, most utilized, utilized and not utilized with corresponding scores of 2, 1 and 0. A technology utilization index was calculated as under:

$$\text{Technology utilization index} = \frac{\text{Obtained score}}{\text{Obtainable score}} \times 100$$

Frequency, percentage and weighted mean score were calculated for each technology to determine the use of respective technology. The weighted mean score was calculated as below:

$$\overline{X} \, w = \frac{\sum WX}{\sum W}$$

Whereas,

$\overline{X}$ w represents the weighted mean

X represents the variable values i.e., X1, X_2, X_3--------------, Xn

W represents the weights attached to the variable values i.e., W_1, W_2, W_3, ------------, Wn

The farmers were categorized into low, medium and high utilization categories on the basis of cumulative square root frequency method.

Results and discussion: Results are presented and discussed in following subheads:

Profile of the farmers

Profile of farmers consist of social, personal, psychological, economical and communicational traits which deals with their technological use pattern, relationship with other members of the social system as well as their social and economical status in the society.

Table 1: Profile of farmers

(n = 240)

Sl. No.	Category	Frequency	Percentage
A.	**Socio-personal variables**		
1.	**Age (in years)** (Mean-48.12 and range-18 to 78)		
	Young (Up to 35)	50	20.83
	Middle (36-50)	94	39.17
	Old (Above 50)	96	40.00
2.	**Education of family head**		
	Illiterate	37	15.42
	Primary	34	14.17
	Middle	42	17.50
	High School	62	25.83
	Intermediate	37	15.42
	Graduate	22	9.16
	Post Graduate & above	6	2.50
3.	**Family educational status** (Mean- 342.19 and range- 100 to 583.33)		
	Low (< 293.33)	70	29.16

	Medium (293.34-391.07)	97	40.42
	High (>391.07)	73	30.42
4.	**Family size** (Mean- 6.97 and range- 1 to 29)		
	Small (< 6)	102	42.50
	Medium (6 to 9)	86	35.83
	Large (>9)	52	21.67
5.	**Family type**		
	Nuclear	101	42.08
	Joint	139	57.42
6.	**Social participation** (Mean –17.10 and range- 7 to 56)		
	Low (<15.48)	90	37.50
	Medium (15.48 to 27.16)	123	51.25
	High (>27.16)	27	11.25
7.	**Decision making pattern**		
7.1	**Style of decision making**		
	By the family head	135	56.25
	Jointly by adult male members	2	0.83
	Jointly by adult female members	11	4.58
	Jointly by all members of the family	56	23.33
	By the family head+ other adult male members	7	2.92
	By the family head+ adult female members	28	11.67
	Jointly by adult male members + adult female members	1	0.42
7.2	**Basis of decision making**		
	Economic considerations	135	56.25
	Social and psychological consideration	4	1.67
	Situational factors	11	4.58
	Economic considerations + social and psychological consideration	7	2.92
	Economic considerations + situational factors	27	11.25
	Economic considerations + social and psychological consideration +situational factors	56	23.33
B.	**Socio-economic variables**		
1.	**Occupation (Main + Secondary)**		
	Agriculture + dairy	152	63.33
	Labour + dairy	25	10.42
	Agriculture + dairy + service	10	4.17
	Labour + dairy + business	6	2.50
	Agriculture + dairy + labour	25	10.42
	Agriculture + dairy + business	14	5.83
	Agriculture + dairy+ service + business	2	0.83
	Agriculture + dairy + business + labour	5	2.08
	Agriculture + dairy+ service + labour	1	0.42
2.	**Operational land holding** (Mean -1.78 and range -0 to 14 ha)		
	Landless (0)	31	12.92
	Marginal (<1 ha)	97	40.42
	Small (1-2 ha)	56	23.33
	Semi-medium (2-4 ha)	30	12.50
	Medium (4-10 ha)	14	5.83
	Large (>10 ha)	12	5.00
3.	**Cropping pattern**		
	Crops/Total area	Average Area/	Percentage to	Average Yield

	(In ha)	household (In ha)	total cropped area	(q ha^{-1})
a.	**Cereal, pulses, oilseeds and other crops**			
i)	*Kharif*			
	Paddy (204.23)	0.85	22.67	41.68
	Black gram (33.25)	0.14	3.69	13.21
	Sesame (39.45)	0.16	4.38	11.14
	Cow pea (0.95)	0.004	0.11	37.50
	Maize (11.30)	0.05	1.25	40.00
	Bajra (9.90)	0.04	1.10	20.31
ii)	*Rabi*			
	Wheat (165.85)	0.69	18.41	35.74
	Mustard (42.50)	0.18	4.72	21.43
	Lentil (5.90)	0.02	0.65	20.00
	Potato (9.85)	0.04	1.09	268.53
iii)	*Zaid*			
	Mentha (17.30)	0.07	1.92	110.40 (l/ha)
	Okra (4.20)	0.02	0.47	65.00
	Maize (1.70)	0.01	0.19	30.00
b.	**Fruit crops**			
	Mango (8.90)	0.04	0.99	82.86
c.	**Fodder crops**			
i)	*Kharif*			
	Chari (13.24)	0.06	1.47	428.77
ii)	*Rabi*			
	Berseem (11.73)	0.05	1.30	453.11
	Oat (4.68)	0.02	0.52	250.60
iii)	*Zaid*			
	Chari (19.13)	0.08	2.12	372.22
Overall fodder		**0.21**	**5.41**	**418.53**
d.	**Cash Crop -Sugarcane**			
	Autumn (40.00)	0.17	4.44	775.24
	Spring (73.20)	0.31	8.12	751.47
	Late (84.85)	0.35	9.42	675.00
	Ratoon (98.80)	0.41	10.97	632.60
Overall		**1.24**	**32.95**	**708.58**
4.	**Annual income** (Mean – Rs. 269287 and range- Rs. 52705 to 1231441)			
	Low (< Rs. 216617.00)	118		49.17
	Medium (Rs. 216617 to 431129)	90		37.50
	High (> Rs. 431129)	32		13.33
5.	**Herd size** (Mean- 3.22 and range- 1.3 to 10.39 standard animal units)			
	Small (<3.16)	143		59.58
	Medium (3.16-5.40)	67		27.92
	Large (>5.40)	30		12.50
C.	**Communication variables**			
1.	**Mass media exposure** (Mean-5.91 and range- 1 to18)			
	Low (< 4.34)	96		40.00
	Medium (4.34-9.00)	102		42.50
	High (> 9.00)	42		17.50
2.	**Extension contact** (Mean-8.91and range- 2 to 21)			
	Low (< 7.55)	96		40.00
	Medium (7.55-11.54)	99		41.25
	High (>11.54)	45		18.75

Most of the farmers (40.00%) were of old age, had education up to high school (25.83%), medium family educational status (40.42%), maintained small families (42.50%), have joint families (57.42 %), had medium level of social participation (51.25 %), decisions were taken by the family head on the basis of

economic factors (56.25%), practicing agriculture as primary along with dairy as secondary occupation (63.33%), average land holding was 1.78 ha, belonged to the marginal category (40.42%) of farmers, 49.17 per cent had low level of annual income (<Rs. 2.17 lakh), medium mass media exposure (42.50%) and medium extension contact (41.25 %). Most utilized mass medium was found to be the mobile phone and most contacted source for acquisition of information was fellow farmers/progressive farmers. Sugarcane was found to be the major crop which covered 32.95 per cent of total cropped area with average yield of the 708.58 q ha^{-1}. Paddy, wheat and mentha were the other major crops of *Kharif, Rabi* and *Zaid* seasons', respectively. Chari was grown by the farmers in Kharif and Zaid seasons while berseem and oat were in *Rabi* season. These fodder crops occupied 5.41 per cent of total cropped area. Most of the farmers (59.58 %) of less than 3.16 standard animal unit dominated by non-descript animals (Table 1). This finding is in the contrast of the findings of Meena (2003), Singh (2005), Kumar and Chand (2008), Rajput (2010), Tak (2010), Verma (2012) and Sachan (2013) who revealed that majority of the respondents had medium herd size. Prevalence of small herd size may be due to the mechanization of agriculture resulted in reduction of bullock population, poor marketing facilities and weakening network of dairy cooperative led to the non-remunerative prices of milk and milk products forced the farmers to practice the dairy farming at small scale to fulfill their own needs only. Diversification of agriculture is becoming indispensable in eve of the dwindling land holding size and dairy farming is the natural choice among the various enterprises because of its symbiotic relationship with crop farming. Thus, dairy development must be initiated with full force and zeal through honestly implementing the ongoing programmes, promotion of commercial dairy farming, establishment and strengthening of dairy cooperative networks, capacity building of the farmers, development of the infrastructural facilities and establishment of small processing units.

Seasonal calendar of fodder scarcity: In sugarcane growing area, generally green fodder is available round the year as in these areas major part of the land is found to be irrigated. Even then it is important to ascertain the period of green fodder scarcity to suggest the some corrective measures like adoption of crop rotation for round the year green fodder production, preparation of silage from sugarcane tops and other crops to meet out the demand of green fodder to maintain the productivity of animals. Seasonality analysis is a very important PLA tools to identify problems regarding maintaining green fodder availability to dairy animals. The seasonality analysis for "scarcity of green fodder" in study area (Figures 2), indicate that there was deficit of green fodder twice in the year, the first period was found to be from 15th April to 15th June and second period was observed to be from 15th September to 15th October. From 15th April harvesting of sugarcane reached to an end and at the same time berseem as well as other crops were also about to mature. Further, new crop of *chari* was also observed to be sown during the last fortnight of May which take at least one month to be ready for harvesting. During this period wild grasses and weeds were also not available in the sugarcane fields as it is the time of hoeing in the sugarcane fields which destroys the weeds and grasses.
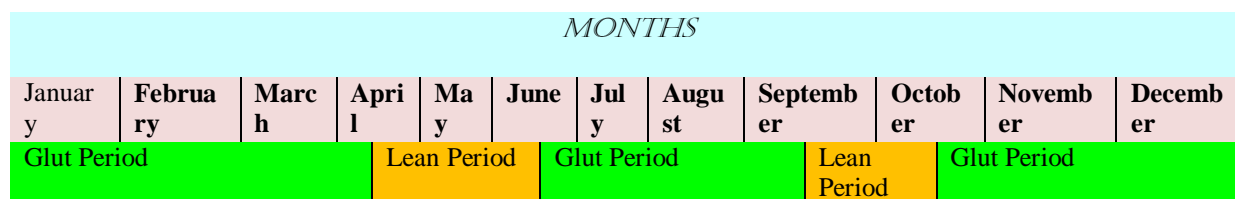
MONTHS											
January	February	March	April	May	June	July	August	September	October	November	December
Glut Period				Lean Period		Glut Period			Lean Period	Glut Period	

Fig. 2 Seasonal calendar for scarcity of green fodder

During the second period i.e., from 15th September to 15th October, *chari* crop reached to its declining phase and sugarcane harvesting yet to be started because of that scarcity of fodder was noticed. Though weeds and local grasses were available in the sugarcane fields but due to problem of lodging of cane crop, farmers do not allow collection of weeds and grasses. To mitigate fodder scarcity during the 15th April to 15th June farmers may be advised for ensiling of sugarcane tops. However, for the second period of green fodder scarcity which lasted from 15th September to 15th October, the farmers may be advised to grow perennial grasses on the bunds of the fields.

Herd composition: The result in Table 2 indicate that on an average the farmers had 1.26, 1.11, 0.74, 0.51 and 0.10 non-descript buffalos, *Murrah* buffalos, crossbred cows, nondescript cows and indigenous cows (*Sahiwal*) per house hold, respectively. In totality, per house hold 3.73 dairy animals were found to be possessed by the farmers. In the study area, 33.89, 29.75, 19.91, 13.65 and 2.80 per cent of nondescript buffalos, *Murrah* buffalos, crossbred cows, nondescript cows and indigenous cows (*Sahiwal*), respectively were the major constituent of dairy animal population.

Table 2: Herd composition

Category	Cow			Buffalo		Total
	Indigenous (Sahiwal)	**Crossbred**	**Nondescript**	*Murrah*	**Non-descript**	
In milk	13	80	37	100	123	353
Dry	2	22	5	11	15	55
Heifer	2	15	10	35	46	108
Calves	8	61	34	95	99	297
Bull/Bullock	0	0	36	25	20	81
Total	25 (0.10)	178 (0.74)	122 (0.51)	266 (1.11)	303 (1.26)	894 (3.73)
Percentage	2.80	19.91	13.65	29.75	33.89	100.00

Note: Figures in parenthesis indicate average animal per household

It is clear that farmers of the study area preferred buffalo instead of cow as buffalo constituted 63.64 per cent of the total animals. It might be due to the price of buffalo milk is comparatively high, preference for buffalo milk over cow milk for consumption, more fat in buffalo milk and bullocks are no more required due to mechanization of agriculture. Further, it was also observed that out of the total animals 47.54 per cent of them were non-descript this resulted in low milk productivity and net income. It might be due to the unavailability of purebred animals in the local markets, high cost of them, inadequate funds with the farmers, irregular and piecemeal payment of sugarcane dues limiting the availability of a large amount of the fund at a time, inadequate credit facilities in rural areas and fear of legal actions in case of default in loan payment among the farmers specially resource poor ones distract them to avail loan from banks. These animals can be up-graded to high yielding breed through continued supply of semen for AI in the particular area of good high yielding single breed for a long period of time and adoption of proper feeding of animals to improve the productivity.

Region wise milk production in UP: The results in table 3 depict that standard milch units per household were highest i.e. 2.28 in Western UP followed by 1.59 in Eastern UP and lowest; 1.33 in Central UP. The annual average milk production/household was also highest (3602.50) in Western UP followed by 1963.75 liters in Eastern UP and lowest 1796.25 liters in Central UP. In relation to the lactation milk yield it was highest (1606.65) in Western UP followed by 1359.29 in Central UP and 1229.59 liters in Eastern UP. The results clearly indicate the significant regional disparities in dairy farming and it might be the results of variation in technologies usage pattern, herd composition, geographical location and implementation differences of government policies as well as programmes.

Table 3: Region wise milk production in UP

Sl. No.	Variables	Regions		
		Eastern UP	**Central UP**	**Western UP**
1	Standard milch unit /household	1.59	1.33	2.28
2	Annual average milk production/household (in Litres)	1963.75	1796.25	3602.5
3	Ave. milk production/milch unit/lactation (in Litres)	1229.59	1359.29	1606.65

Distribution of farmers according to the utilisation of dairy farming technologies: This subhead deals with the distribution of farmers according to the utilization of technologies under major areas of dairy farming. The utilization indices were calculated and farmers were categories on the basis of indices values by following cumulative square root of frequency method.

Breeding: A close observation of the results presented in Table 4 show that the majority (40.08 %) of the farmers were utilizing breeding technologies up to medium extent closely followed by those (35.00 %) who were utilizing these to a high extent while, 25.00 per cent of them could manage to a low extent. The mean

utilization index was 53.59 depicting a 46.00 per cent gap in technology utilization. It can be concluded that majority of the farmers were utilizing the technologies to a medium extent. This might be due to the unavailability, untimely availability of technologies and lack of fund.

Feeding: A cursory look at the Table 4 reflects that in case of feeding, the extent of technology utilization was found to be 37.84 which depict a gap of 62.00 per cent. The majority (51.25%) of the farmers fell in the category of low utilization followed by 32.08 and 16.67 per cent in the categories of medium and high utilization, respectively. It clearly indicate that majority of the farmers utilized the feeding technologies to a low extent. This may be attributed to the discouragement of farmers from using the technologies due to less profit in dairy farming resulted from the non remunerative prices of milk. Poverty and unawareness might be the other reasons for low utilization.

Table 4: Distribution of farmers as per the major area wise utilisation of dairy farming technologies

(n = 240)

Sl. No.	Major areas	Categories	Frequency	Percentage
1.	Breeding (Mean- 53.59)	Low (<34.73)	60	25.00
		Medium (34.73-71.43)	96	40.08
		High (>71.43)	84	35.00
2.	Feeding (Mean- 37.84)	Low (<35.42)	123	51.25
		Medium (35.42-52.86)	77	32.08
		High (>52.86)	40	16.67
3.	Management (Mean- 33.18)	Low (<27.85)	86	35.83
		Medium (27.85-44.05)	101	42.08
		High (>44.05)	53	22.08
4.	Health care (Mean- 64.54)	Low (<58.94)	70	29.17
		Medium (58.94-74.28)	93	38.75
		High (>74.28)	77	32.08
5.	Fodder production (Mean- 53.72)	Low (<49.83)	69	28.75
		Medium (49.83-69.30)	115	47.92
		High (>69.30)	56	23.33
6.	**Overall** (Mean- 45.52)	Low (<38.59)	69	28.75
		Medium (38.59-54.17)	104	43.33
		High (>54.17)	67	27.92

Management: Results presented in Table 4 show that majority (42.08 %) of the farmers utilized management technologies to a medium extent followed by 35.83 and 22.08 per cent of them utilized the same to low and high extents, respectively. The average utilization was 33.18 which showing a gap of about 67.00 per cent. This indicates low utilization of management technologies by majority of the farmers. This could be a consequence of subsistence dairy farming followed by the majority of the farmers. They were rearing animals to produce milk and milk products for their own use and in turn not paying much attention towards the scientific management of dairy herd. In light of above finding, it may be suggested that farmers should be encouraged for commercializing of dairy farming which will encourage them for utilization of scientific management practices.

Health care: Majority (38.75 %) of the farmers fell in the category of medium utilization followed by 32.08 and 29.17 per cent of them fell in the categories of high and low, respectively. Mean utilization index of health care technologies was 64.54 depicting a good level of use. Comparatively more use of health care technologies owed to the resultant considerable loss in case of animal death, reduction of milk yield and market value of animals. Further, it is suggested that those who were utilizing health care technologies to a low extent should also be encouraged for better use through awareness campaigns, trainings and meetings (Table 4).

Fodder production: In case of fodder production, it was found that majority (47.92 %) of the farmers were utilizing the technologies to medium extent followed by 28.75 and 23.33per cent of them utilizing to low and high extents, respectively. The mean utilization was 53.72 depicting a gap of 46.28 per cent. Medium level of fodder production technology use might be attributed to the less attention of the farmers towards fodder crops in comparison to the commercial crops like sugarcane, mentha, vegetables, etc owing to the direct monetary benefits (Table 4).

Distribution of farmers on the basis of overall utilization of dairy farming technologies: As far as overall utilization was concerned, majority (43.33 %) of the farmers fell in the medium utilization category followed by 28.75 and 27.95 per cent of them fell in the categories of low and high, respectively. The mean utilization index was 45.52 showing a technology utilization gap of about 64.00 per cent. This eventually reflects that farmers utilized dairy farming technologies to medium extent hence hypothesis that utilisation pattern of farming technologies by the farmers will not be low is accepted. Low preference to dairy farming as major part of income accrued from sugarcane, absence of effective network of dairy cooperative leading to the non-remunerative prices of milk, mechanization of agriculture, increasing use of chemical fertilizers in agriculture, lack of proper support to the farmers on part of government, lack of proper knowledge about the dairy farming among the farmers, improper implementation of dairy development programmes, lack of infrastructaral facilities, etc. discouraged the farming community to practice dairy farming enthusiastically resulted in medium level of technology use (Table 4).

Region wise utilsation and utilization gap of dairy farming technologies in UP: Further the region wise technology utilization and gap in utilization was worked out and presented as under:

Eastern Uttar Pradesh: Results presented in table 5 indicate that the usage of technologies related to health care was found to be the maximum (60.38) followed by fodder production (55.77), breeding (45.47), feeding (36.02) and management (29.02). The overall technology utilization in the region was 43.25 depict a gap of 56.75. This gap needs to abridged if dairy farming to be used as an instrument for improving the income of the rural masses, avenue for employment and poverty reduction. This may be developed by breed improvement, practical training to the farmers, motivation of them and ensuring remunerative prices of milk. Results show that management related technologies were least utilized and it might be due to the lack of knowledge among the farmers, lack of resources and unavailability of proper practical information. This could also be a consequence of subsistence dairy farming followed by the majority of the farmers. They were rearing animals to produce milk and milk products for their own use and in turn not paying much attention towards the scientific management of dairy herd. In light of above finding, it may be suggested that farmers should be encouraged for commercializing of dairy farming which will encourage them for utilization of scientific management practices.

Central Uttar Pradesh: Results in table 5 indicate that the usage of technologies related to health care was found to be the maximum (60.25) followed by fodder production (50.48), breeding (41.88), feeding (33.20) and management (25.71). The overall technology utilization in the region was 39.79 depict a gap of 60.21. The highest gap (74.29) in utilization was found to be in case of management practices and it is most important factor in harnessing the genetical productivity potential of animal hence farmers need to be educated and motivated to use good dairy farming practices. Health care technologies were utilized maximally as these are directly related to life of animals and financial outcome.

Table 5: Region wise utilsation and utilization gap of dairy farming technologies

Sl. No.	Major areas	Average technology utilization index				Technology utilization gap			
		Eastern UP	Central UP	Western UP	Overall UP	Eastern UP	Central UP	Western UP	Overall UP
1	Breeding	45.47	41.88	73.44	53.59	54.53	58.13	26.56	46.41
2	Feeding	36.02	33.20	44.30	37.84	63.98	66.80	55.70	62.16
3	Management	29.02	25.71	44.82	33.18	70.98	74.29	55.18	66.82
4	Health care	60.38	60.25	73.00	64.54	39.63	39.75	27.00	35.46
5	Fodder production	55.77	50.48	54.90	53.72	44.23	49.52	45.10	46.28
6	**Overall**	43.25	39.79	53.51	45.52	56.75	60.21	46.49	54.48

Western UP: It was observed that the usage of technologies related to breeding was found to be the maximum (73.44) closely followed by health care (73.00). Usage of fodder production, management technologies and feeding was 54.90, 44.82 and 44.30, respetively. The overall technology utilization in the region was 53.51 depict a gap of 46.49. It could be concluded that the farmers of Western UP are giving good priority to the animal breeds, AI, vaccination, fodder production and management of animal. They need to be sensitized further on feeding of animals. On an average their technologies usage was more than 50 per cent, however, for more production it needs to be further increased by way of training, motivational lectures and government support.

Utilization and gap in utilization of dairy farming technologies in Uttar Pradesh: The mean utilization index was 45.52 showing a technology utilization gap of about 54.48 per cent. Western Uttar Pradesh has the maximum utilization (53.51) followed by Eastern Uttar Pradesh and Central Uttar Pradesh with an utilization index values of 43.25 and 39.79, respectively. This shows that Western Uttar Pradesh fared well in utilization of dairy farming technologies. It might be due the preference of milk and milk products in human diet, socio-cultural variations, herd composition, more resources with the farmers and practicing dairy as an entrepreneur in comparison to other regions of UP.

Table 6: Region wise technolg utilization (ANOVA)   **N=240**

Technology Utilisation	Sum of squares	df	Mean Square	F	Sig.
Between Regions of UP	8145.962	2	4072.981	22.998**	.000
Within Regions	41973.221	237	177.102		
Total	50119.184	239			

Table 7: Multiple Comparisons (Tukey HSD)

Region wise comparison	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Central UP V/s Western UP	3.46591 -10.25568[*]	2.10418 2.10418	.228 .000	-1.4969 -15.2185	8.4287 -5.2929
Eastern UP V/s Western UP	-3.46591 -13.72159[*]	2.10418 2.10418	.228 .000	-8.4287 -18.6844	1.4969 -8.7588
Eastern UP V/s Central UP	10.25568[*] 13.72159[*]	2.10418 2.10418	.000 .000	5.2929 8.7588	15.2185 18.6844

*. The mean difference is significant at the 0.05 level

Table 8:Homogeneous Subsets (Tukey HSD’[a])

Regions	N	Subset for alpha = 0.05	
		1	2
Eastern UP	80	43.2528[b]	
Central UP	80	39.7869[b]	
Western UP	80		53.5085[c]
Sig.		.228	1.000

Means for groups in homogeneous subsets are displayed (Same Supersript), a uses Harmonic Mean

The technology utilization in Eastern and Central UP is lower in comparison to the Western UP. The difference in utilization of technologies was highly significant (F=22.998**). Further comparison showed that the Western UP outperformed the other two regions of UP in technology utilization (Tukey HSD). This proved that there was the significant difference among the regions of UP in technology utilization showing the regional imbalance in dairy development hence concerted efforts on the parts of the all stakeholders are needed to make the dairy farming a profit oriented enterprise. This can be achieved by strengthening of dairy cooperative networks, research back-up, positive government policies, development programmes, enhancing the economic motivation of the farmers, providing practical training, improving marketing networks, strengthening of infrastructure facilities, ensuring remunerative prices of milk and training farmers for profitable usage of dairy

farming by-products such as dung and left over materials for vermi compost making and animal urine for making of products to be used in organic farming (Tables 6, 7 &8).

Relationship between profile variables of farmers and utilization of dairy farming technologies: Results given in Table 9 reveal that education of the family head, family educational status, family size, social participation, land holding, total area under sugarcane, total cropped area, annual income from sugarcane, annual income from other crops, annual income from dairy, gross annual income, herd size, mass media exposure and extension contact were highly significantly positively correlated with utilization of technologies irrespective of the regions indicating that these variables may be given priority to improve the technology utilization.

Table: 9   Relationship between profile variables of farmers and utilization of dairy farming technologies

N=240

Sl. No.	Variables	Correlation coefficient (r value)			
		Eastern UP	Central UP	Western UP	Overall UP
1	Age	0.098	0.283*	0.146	0.144*
2	Education of family head	0.449**	0.387**	0.362**	0.415**
3	Family education status	0.523**	0.502**	0.404**	0.527**
4	Family size	0.374**	0.353**	0.271*	0.263**
5	Social participation	0.617**	0.655**	0.517**	0.546**
6	Land holding	0.561**	0.703**	0.499**	0.542**
7	Total area under sugarcane	0.554**	0.663**	0.479**	0.531**
8	Total cropped area	0.550*	0.681**	0.446**	0.530**
9	Annual income from sugarcane	0.654**	0.730**	0.644**	0.643**
10	Annual income from other crops	0.661**	0.654**	0.442**	0.565**
11	Annual income from dairy	0.183	0.182	0.166	0.241**
12	Annual income from other sources	-0.350**	-0.513**	-0.290**	-0.233**
13	Gross annual income	0.604**	0.685**	0.499**	0.600**
14	Herd size (Anim. Unit)	0.378**	0.221*	0.477**	0.464**
15	Mass media exposure	0.741**	0.664**	0.663**	0.654**
16	Extension contact	0.715**	0.706**	0.607**	0.630**

*<p=0.05 and **<p=0.01

Annual income from other sources was found to be highly significantly but negatively correlated with utilization of dairy farming technologies which provide an insight that the farmers those who have their earning from other sources are not much bothered about the dairy farming as their financial needs were met, however, they needs to be sensitize to earn more by giving proper attention to dairy farming also.

Impact of profile variables on utilization of dairy farming technology in Eastern Uttar Pradesh region (Stepwise regression analysis)
After determining the simple regression, stepwise regression was carried out with the use of SPSS software to single out the important contributory variables and their overall contribution in explaining the variation in coefficient of determination. The equation of best fit is as follows:
$Y = 25.065 + (-0.904 * X_8) + 0.419 * X_9 + 0.858 * X_{10} + 0.466 * X_{15} + e$
It was observed that total cropped area (X_8), income from sugarcane (X_9), income from other crops (X_{10}) and mass media exposure (X_{15}) found to be the major contributory factors in explaining the variation in utilization of dairy farming technology under sugarcane based farming situation in Eastern Uttar Pradesh with a contribution of 67.30 per cent (R^2=0.673). It might be due to that income from sugarcane (X_9), income from other crops (X_{10}) and mass media exposure (X_{15}) may contribute in quality of decisions, improve participation in development programmes, income helps in purchasing of good inputs.

Table 10: Impact of profile variables on utilization of dairy farming technology in Eastern Uttar Pradesh region (Stepwise regression analysis)

(n=80)

Sl. No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Total cropped area (X8)	-0.904	-4.194***	0. 614
2.	Income from sugarcane (X9)	0. 419	2.746**	0.000
3.	Income from other crops (X10)	0. 858	4.397***	0.000
4.	Mass media exposure (X15)	0.466	5.398***	0. 320

*<p=0.05, **<p=0.01 and ***<p=0.001
Adjusted R^2 = 0. 673, Constant= 25.065, F=8.491**, p<0.01 (t $_{Tab.}$ two tailed = 2.576)

The contribution of total cropped area was found to be negative which may be because of more focus of farmers on crop farming. In Eastern UP still dairy farming could not achieve the status of alternative occupation for income generation and livelihood security due to dominance of non descript low yielding cow and buffalo in the herd. The farmers should be sensitized to give proper attention to the dairy enterprise also so that they should earn more.

Impact of profile variables on utilization of dairy farming technology in Central Uttar Pradesh region (Stepwise regression analysis): Out of the 15 variables, 3 variables were found to be the important contributory variables and their overall contribution in explaining the variation in coefficient of determination was 67 per cent. The equation of best fit is as follows:
Y= 25.650+0.255* X_2+0. 592* X_9+ (-0.295* $X_{12)}$ + e
It was observed that education of family head (X2), annual income from sugarcane (X9) and annual income from other sources (X12) found to be the major contributory factors in explaining the variation in utilization of dairy farming technology under sugarcane based farming situation in Central Uttar Pradesh (Table 11).

Table 11: Impact of profile variables on utilization of dairy farming technology in Central Uttar Pradesh region (Stepwise regression analysis)

(n=80)

Sl. No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Education of family head (X2)	0.255	3.881***	0.588
2.	Annual income from sugarcane (X9)	0.592	8.591***	0.000
3.	Annual income from other sources (X12)	-0.295	4.323***	0.000

*<p=0.05, **<p=0.01 and ***<p=0.001
Adjusted R^2 = 0. 670, Constant= 25.650, F=8.8876**, p<0.01 (t $_{Tab.}$ two tailed = 2.576)

It might be due to the better quality of informed decision taken by the educated person, better social net working, more income helps in purchasing good quality of inputs at the appropriate time and money in hand also save the cost of interest which would has been paid on borrowed capital. The better resource position improves the chances of technology utilization.

Impact of profile variables on utilization of dairy farming technology in Western Uttar Pradesh region: After determining the simple regression, stepwise regression was carried out with the use of SPSS software to single out the important contributory variables and their overall contribution in explaining the variation in coefficient of determination. The equation of best fit is as follows:
Y= 19.635+0.263* X_3+0.197* X_4+ (-0.293* X_{12}) + 0.249* $X14$+-0.355* X_{15}+ e

Table 12: Impact of profile variables on utilization of dairy farming technology in Western Uttar Pradesh region (Stepwise regression analysis) (n=80)

Sl. No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Family education status (X3)	0.263	3.256**	0.012
2.	Family size (X4)	0.197	2.151**	0.322
3.	Annual income from other sources (X12)	-0.293	-3.426***	0.000
4.	Herd size (X14)	0.249	2.971**	0.510
5.	Mass media exposure (X15)	0.355	3.718***	0.446

*<p=0.05, **<p=0.01 and ***<p=0.001

Adjusted R^2 = 0. 572, Constant= 19.635, F=6.7632**, p<0.01 (t $_{Tab.}$ two tailed = 2.576)

It was observed that family education status (X3), family size (X4), annual income from other sources (X12), herd size (X14) and mass media exposure (X15) found to be the major contributory factors in explaining the variation in utilization of dairy farming technology under sugarcane based farming situation in Western Uttar Pradesh with a contribution of 57.20 per cent (R^2=0. 572). Better family education status and mass media exposure help in better decision making and these factors also enhance the farmers' capability in acquiring the benefits of different development programmes. Family size and herd size (X14) acts as precursors of economic motivation thus, farmers strive to use more technologies (Table 12).

Impact of profile variables on utilization of dairy farming technology in Uttar Pradesh: Pooled analysis considering the whole of Uttar Pradesh as one entity shows that family educational status (X3), income from sugarcane (X9), herd size (X14) and mass media exposure (X15) were the major factors affecting the utilization of dairy farming technology under sugarcane based farming situation in Uttar Pradesh with a contribution of 60.00 per cent (R^2=0. 60) in coefficient of determination. The equation of best fit is as follows:
Y= 14.010+0.247* X_3+0.277*X_9+0. 245*X_{14}+0.282*X_{15} +e

Table 13: Impact of profile variables on utilization of dairy farming technology in Uttar Pradesh (Stepwise regression analysis) (n=240)

Sl. No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Family educational status (X3)	0. 247	5.266***	0.007
2.	Income from sugarcane (X9)	0.277	5.575***	0.000
3.	Herd size (X14)	0.245	5.575***	0.354
4.	Mass media exposure (X15)	0.282	4.900***	0.266

Adjusted R^2 = 0.600, Constant= 14.010, F=65489**, p<0.01 (t $_{Tab.}$ two tailed = 2.576)
*<p=0.05, **<p=0.01 and ***<p=0.001

The family educational status (X3) and mass media exposure (X15) enable the farmers in better understanding of the situation, taking the informed decisions, participation in developmental activities and acquiring the benefits from the developmental programmes thus, help in utilization of technologies. Income from sugarcane (X9) and herd size (X14) had add on effect on resourcefulness of the farmers make them capable of utilizing the technologies (Table 13).

Conclusion and Suggestions: It is concluded that majority of the farmers had medium level of utilisation of dairy farming technologies. The mean utilization index was 45.52 showing a technology utilization gap of about 64.00 per cent. Though the level of utilization is medium, however, except one or two aspects, the utilization remains under 50 per cent. The difference in utilization of technologies was highly significant. Further comparison showed that the Western UP outperformed the other two regions of UP in technology utilization. It poses a serious threat in improving the productivity further to meet out the futuristic demand. Need based, cost effective and feasible technologies to be disseminated to the farmers through most effective channels in the manner so that these could be understood properly and utilized. Use of technical words and jargons to be avoided in the literature meant for farmers. It is also suggested that farmers should be encouraged for commercializing of dairy farming which will encourage them for utilization of scientific management practices. For Eastern and Central UP regions, special programmes for dairy development to be devised and implemented. It was also observed that education of family head, family educational status, family size, total cropped area, annual income from sugarcane, income from other crops, annual income from other sources, herd size and mass media exposure were found to be the major contributory factors in utilization of dairy farming technologies in Uttar Pradesh. For improving the utilization these factors to be taken care of by encouraging the farmers for active participation in different programmes, ensuring timely action from official side, strengthening of extension mechanism and effective utilization of mass media for technology spread.

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