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Effects of Dairy Farm Training: A Path Analysis

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ABSTRACT

The study was conducted to ascertain the direct and indirect effects of training on knowledge, adoption, and income of trained dairy farmers in comparison to non-trainees. The propensity score matching method was used to avoid selection bias and build a statistical comparison group. A trained group of dairy farmers was significantly higher in knowledge and adoption of scientific dairy practices. Trained farmers were generating twice the net annual income from dairy farming than the un-trained dairy farmers. Training participation significantly contributed in predicting knowledge and positively influenced adoption and income. The path analysis indicated that entrepreneurial behaviour was the most crucial variable that directly and indirectly affected knowledge. Entrepreneurial behaviour affected adoption, most directly, while attitude towards dairy farming affected adoption, most indirectly. Net annual income was most directly affected by dairy herd size and largely through the landholding of the respondents. The results suggest that organization of dairy farmers' training by moulding their entrepreneurial behaviour, attitude, and economic motivation would be more effective in achieving a desirable outcome.

INTRODUCTION

In India, dairy farm activity contributes to generating meaningful income for small and marginal rural households. More than 70 million rural households scattered throughout the country are involved in milk production (Sunil et al., 2016). The livestock sector has a significant positive impact on equity in terms of income, employment, and poverty reduction in rural areas (Ahuja and Redmond, 2001). However, dairy farming in India is characterized by producing a small quantity of milk traditionally by widely spread rural mass through rearing small dairy units without or little use of scientific practices. Dairy farming confronts various problems, including low productivity primarily due to breed deterioration, a rise in the population of non-descript animals, a chronic shortage of feed and fodder, poor management practices etc. (Patil et al., 2009). Besides, dairy farmers' non-exposure to technology, lack of knowledge, lower confidence in technology, non-availability of inputs, lack of motivation, unfavourable attitude etc., are another side in the non-adoption of scientific dairy practices. Hicks (1987) stated the importance of formal or informal education and training in explaining differences in productivity and income between countries. Education and training are essential for those functions which require adaption to change. In India, the appropriate training of practicing farmers received the attention of various educational institutions in varying degrees (Dubey et al., 2008).

The Krishi Vigyan Kendras (KVKs) - the first-line transfer of technology programme of ICAR - offers a very real opportunity by organizing training to impart knowledge of scientific practices to enhance adoption and raise the income of trainees through their farming activity. During 2011-16, KVKs organized 2,28,098 trainings for farmers and farm women on agriculture and allied subjects (Annual reports of various years, DARE). National Institute of Labour Economics Research and Development (NILERD) reported that each KVK trained about 100 person annually on agri-

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preneurship and about 25 per cent trained persons started self-employment ventures. The Comptroller and Auditor General (CAG, 2008) reported that 53 per cent of the KVKs did not conduct training's impact assessment, and only 0.34 percent of the total rural youth trained could gain self-employment. Sharma et al., (2013) opined that farmer training centres had failed to have the desired impact by and large. While some of the KVKs effectively contributed to the technology development and promotion process, many are plagued with several problems. Sajeev et al., (2021) recommended that both extensive and intensive hands on-training programmes should be emphasized for farmers and rural youth through proper training need assessment. A lot more needs to be done to improve its performance, including the public perception of the role and contribution of KVKs. In fact, it is essential to know actually what happens to the trainees after they returned home. In this context, an attempt was made to determine the direct and indirect effects of training participation and other selected independent variables on knowledge, adoption, and income through dairy farming by using path analysis.

METHODOLOGY

The present ex-post-facto study was conducted in Maharashtra state during 2017-18. All the KVKs located in Maharashtra were pre-assessed through a structured questionnaire and procured information about the number of dairy farm trainings, duration, and beneficiaries. Three KVKs, namely Sisa (Dist. Akola), Karda (Dist. Washim), and Pal (Dist. Jalgaon), were selected as these KVKs had organized the highest number of 5 days or more duration dairy farming trainings during the year 2011 to 2013 (reference period). This reference period was selected keeping in mind that the impact of any training takes at least a few years to be visible. The list of trainees was procured from each selected KVK. A total of 30 trainees were selected randomly from an operational area of each KVK, who owns at least one dairy animal. Then, across three districts equally distributed 270 non-trainees randomly selected from purposively chosen three villages within the operational but least intervened area of all three KVKs. Non-trainees who own a minimum of one dairy animal but never attended any dairy training were randomly selected.

A pre-tested semi-structured interview schedule was used to collect data through personal contact. The knowledge about scientific dairy farming about animal nutrition, breeding, management, and health aspects was measured using a scale developed by Biswas et al., (2015). After going through various literature and discussion with the experts, 21 scientific dairy practices were identified in the areas of feeding, breeding, management, and health of dairy animals. It was measured on a three-point continuum viz. 'continuously', 'tried it once & rejected' and 'never tried it at all' with respectively assigned scores 2, 1, and 0. The overall adoption level of scientific dairy practices was measured based on 'Adoption Index' with scores range from a minimum of 0 to a maximum of 42.

$$\text{Adoption index} = \frac{\text{Total adoption score obtained by respondent}}{\text{Maximum obtainable adoption score by respondent}} \times 100$$

Income was calculated by converting per day milk yield in terms of the current price per litre farmer received and then subtracted per day total expenditure on feeding, labour, and health to obtain net income in dairy farming. Calculated net annual income from dairy farming was grouped in low, lower medium, medium, upper-medium, and high levels using the cumulative square root frequency method. The data were also collected for other selected independent variables through the personal interview method.

Propensity score matching (PSM) method was used to avoid selection bias, build a statistical comparison group of non-trainees comparable to trainees, and find closest matches with trainees by applying logistic regression. The nearest neighbour matching method was used. Nearest neighbour matching induced the same balance in baseline covariates as did optimal matching (Austin, 2014). No exact matches were found in the trained and untrained group; hence nearest neighbour matching within a specified calliper distance (Rosenbaum and Rubin, 1985) was used. There is no uniformly agreed-upon definition of what constitutes a maximal acceptable distance (Austin, 2011). Defining a small calliper will usually result in better balance at the expense of finding fewer units (Thoemmes, 2012). In this context, a calliper distance of maximum 0.11 and below was used (Table 1) to obtain ten non-trainees from each village on selected covariates. In the first step, the probability of participating in training was estimated through a formal logit regression model as follows.

$$\text{Ln } (Pi /1- Pi) = \alpha + \Sigma\beta iXi + \Sigma Di + ei$$

Where, the left-hand side represents the log of odds of participating in training and X is the vector of continuous independent variables and D is vector of dummy independent variables.

The covariates like gender, marital status, age, category, family type, and experience in dairy farming significantly influenced the likelihood of being a trainee before matching propensity scores among trainees and non-trainees. After nearest neighbour matching

Table 1. Match tolerance value (calliper) used in propensity score matching

KVK (District)	Selected least intervened block (Tehsil)	Selected Villages from least intervened block (Tehsil)	Used calliper/match tolerance value*
KVK, Sisa (Akola)	Barshitakali	Parbhavani	0.011
		Ghota	0.110
		Morhal	0.110
KVK, Karda (Washim)	Karanja (L)	Inza	0.022
		Kamathwada	0.019
		Girda	0.019
KVK, Pal (Jalgaon)	Bodwad	Kolhadi	0.038
		Mannur	0.026
		Salshingi	0.029

*A value of 0 means exact matches only while a value of 1 means any control would match any case.

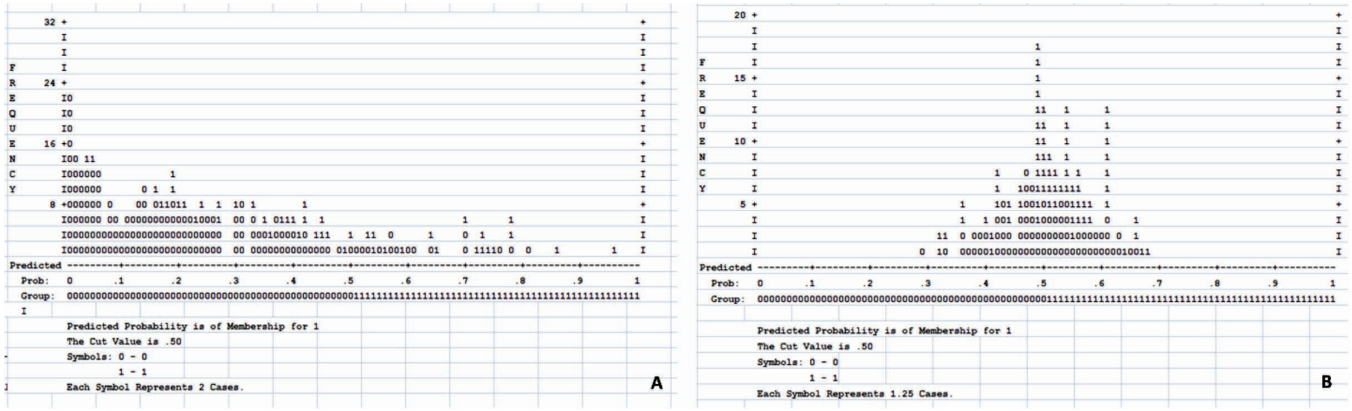

Figure 1. Observed group and predicted probabilities before [A] and after [B] matching trainees (n=90) and non-trainees (n=270)

using minimum calliper distance or tolerance value, all the covariates had exhibited non-significant influence on the probability of participating in training. Thus, after employing propensity score matching with selected covariates among trainees and non-trainees, all covariates showed a non-significant difference, indicating that all the covariates were sufficiently matched.

Lastly, 90 non-trainees matched with 90 trainees - equally divided across all three KVKs - were considered in the study for further analysis by using statistical tools, i.e., mean, median, Mann Whitney U test, t-test, regression coefficient, and path coefficient. Regression analysis was employed to fit the models of selected independent variables, and multicollinearity diagnostic was used to check the observed relationship in the independent variable's contribution that could exercise influence jointly through other independent variables. In multicollinearity diagnostic, variance inflation factors (VIFs) were found under recommended five (Rogerson, 2001; Akinwande et al., 2015), indicating independent variables included in the regression model were moderately correlated. The path analysis technique suggested by Akintunde (2012) was employed to get a clear picture of the direct and indirect effects of the independent variables on knowledge, adoption, and income through dairy farm activity. According to Li (1955), the path coefficient is the absolute number without any physical unit, whatever the actual units of measurement for the variables.

RESULTS AND DISCUSSION

Knowledge, adoption, and income differential

The mean ranks of knowledge and adoption of scientific dairy farming practices across trained and un-trained dairy farmers were significant. It implies that trained dairy farmers had higher knowledge and subsequent adoption of scientific dairy practices. About 20 per cent of trainees and 5.55 per cent non-trainees had a high level of knowledge related to breeding, feeding, management, and health practices of dairy farming. These results go in line with the findings of Patel (2014) and Singh et al., (2016), who reported highly significant differences among trainees and comparison groups. The maximum proportion of trainees (67%) and non-trainees (58%) had medium-level adoption of scientific dairy practices. Trainees had significantly higher adoption of scientific dairy practices as compared to non-trainees. Murai (2009) and Halakatti (2007) also reported a significant difference in adopting scientific dairy practices among trainees and non-trainees. The results further revealed a significant difference in the average net annual income of dairy farm activities. A large proportion of the trainees (34.45%) and non-trainees (51.11%) had a low level (below ₹ 20,000) of net annual income from dairy farming. The average net annual income generated by trainees (₹ 89,820) in dairy farming was found significantly higher than non-trainees (₹ 40, 655). Trainees were generating twice the net annual income as compared to un-trained dairy farmers. These findings are in agreement with the findings of Lal (2009), Murai (2009); Kumar (2012); Gautam (2014). These differentials in knowledge, use of scientific practices, and income from dairy farming might be attributed to the training intervention of KVKs (Table 2).

Regression analysis

Training participation, entrepreneurial behaviour, attitude ($p<0.001$), and experience ($p<0.05$) were contributed significantly in explaining the variability in the knowledge of scientific dairy practices. Entrepreneurial behaviour ($p<0.001$), use of informal sources, economic motivation, and social participation ($p<0.01$) in adoption contributed positively with high significance, while

Table 2. Knowledge, adoption and income generation among trained and un-trained dairy farmers

Variables	Respondents	Median	Mean rank	Effect size (r)	Mann Whitney U	Z
Knowledge	Trained	49	113.21	- .44	2006.0	- 5.858***
	Un-trained	36	67.79			
Adoption	Trained	24	102.21	-.23	2996.0	- 3.020**
	Un-trained	21	78.79			
		Mean	S.E.		't' value	
Net annual income	Trained	89820.00	±19695.87		2.394*	
	Un-trained	40655.56	± 5807.34			

Significance *($p<0.05$), **($p<0.01$), ***($p<0.001$)

attitude contributed significantly (p<0.05). Highly positive significance was recorded in predicting dairy farmers' net annual income by dairy herd size and milk productivity. Mass media exposure was also a significant contributing factor in net annual income. Training participation had a positive regression coefficient but contributed non-significantly to the determination of adoption (0.24) and net annual income (8.95). Kharga et al., (2021) reported that training exposure was positively and significantly contributing towards the net profit from the enterprises in West Bengal. It implies that knowledge of scientific dairy practices of trained dairy farmers significantly affected, while adoption and income affected positively but non-significantly. Regression models were fitted using 12 independent variables and could explain 67, 71 and 81 per cent variability in determining knowledge, adoption, and net annual income, respectively. In each model, the variations were highly significant at a 1% level of probability (Table 3).

Direct and indirect effect of independent variables on knowledge, adoption, and income

Multivariate path analysis indicated that entrepreneurial behaviour had the highest positive and direct effect on knowledge (0.49) and adoption (0.56) of scientific dairy practices (Figure 2). Direct effect on knowledge was followed by attitude (0.26) and training participation (0.21) of respondents, while adoption was affected by economic motivation (0.18) and use of informal sources (0.15). The highest direct effects on net annual income from dairy farming were exercised by possession of dairy herd size (0.87), followed by mass media exposure (0.12) and milk productivity (0.11) of dairy animals. Economic motivation, attitude, and mass media exposure occupied the first three places in total indirect effects on knowledge and adoption of scientific dairy practices. The total indirect effect of landholding (0.29) on net annual income was found

Table 3. Regression analysis in predicting knowledge, adoption and net annual income using selected independent variables

Independent variables	Knowledge		Adoption		Net annual income	
	'b'	't'	'b'	't'	'b'	't'
Age	-.17	-1.95	-.19	-1.90	—	—
Education level	.51	1.00	.12	.20	-5.92	-1.49
Family education status	-1.12	-1.43	-.50	-.54	—	—
Farming experience	.20	2.19*	.22	1.97	—	—
Land holding	—	—	—	—	-3.33	-4.06***
Dairy herd	—	—	—	—	18.24	21.92***
Mass media exposure	-.22	-1.02	-.33	-1.25	5.42	2.49*
Extension contact	.75	1.88	.27	.57	-6.10	-1.69
Informal sources	-.25	-.52	1.88	3.34**	-4.04	-.92
Training participation	5.07	4.25***	.24	.17	8.95	.83
Social participation	.97	.93	3.29	2.65**	3.61	.38
Economic motivation	.03	.08	1.16	2.93**	1.58	.52
Entrepreneurial behaviour	.48	7.05***	.71	8.69***	-.43	-.68
Attitude	1.38	4.41***	.82	2.21*	.35	.12
Milk productivity	—	—	—	—	.51	2.69**
R square	.67		.71		.81	
F	28.6***		34.9***		57.9***	

Significance *(p<0.05), **(p<0.01), ***(p<0.001)

Table 4. Direct and indirect effect of independent variables on knowledge, adoption and net annual income of dairy farmers

Variable No.	Independent variables	Effect over								
		Knowledge			Adoption			Net annual income		
		Direct	Total indirect	Largest indirect through single variable	Direct	Total indirect	Largest indirect through single variable	Direct	Total indirect	Largest indirect through single variable
X1	Age	-0.16	0.15	0.13 (X4)	-0.15	0.23	0.11 (X4)	—	—	—
X2	Education level	0.05	0.08	-0.08 (X4)	-0.00	0.12	0.08 (X13)	-0.06	0.13	0.16 (X6)
X3	Family education status	-0.03	0.12	0.05 (X13)	0.01	0.12	0.07 (X1)	—	—	—
X4	Experience in dairy farming	0.17	-0.15	-0.12 (X1)	0.14	-0.13	-0.12 (X1)	—	—	—
X5	Land holding	—	—	—	—	—	—	-0.16	0.29	0.27 (X6)
X6	Dairy herd size	—	—	—	—	—	—	0.87	-0.00	-0.05 (X5)
X7	Mass media exposure	-0.07	0.31	0.14 (X13)	-0.08	0.30	0.16 (X13)	0.12	0.28	0.36 (X6)
X8	Extension agency contact	0.11	0.22	0.15 (X13)	0.03	0.23	0.17 (X13)	-0.07	0.26	0.20 (X6)
X9	Utilization of informal sources	-0.02	0.14	0.09 (X13)	0.15	0.13	0.11 (X13)	-0.04	0.16	0.17 (X6)
X10	Training participation	0.21	0.21	0.13 (X13)	0.01	0.21	0.15 (X13)	0.03	0.14	0.11 (X6)
X11	Social participation	0.04	0.20	0.14 (X13)	0.12	0.22	0.16 (X13)	0.02	0.11	0.11 (X6)
X12	Economic motivation	0.02	0.48	0.31 (X13)	0.18	0.45	0.36 (X13)	0.02	0.24	0.22 (X6)
X13	Entrepreneurial behaviour	0.49	0.25	0.16 (X14)	0.56	0.24	0.11 (X12)	-0.04	0.21	0.17 (X6)
X14	Attitude towards dairy farming	0.26	0.39	0.31 (X13)	0.12	0.47	0.36 (X13)	0.01	0.08	0.06 (X6)
X15	Milk productivity of dairy animal	—	—	—	—	—	—	0.11	0.24	0.24(X6)

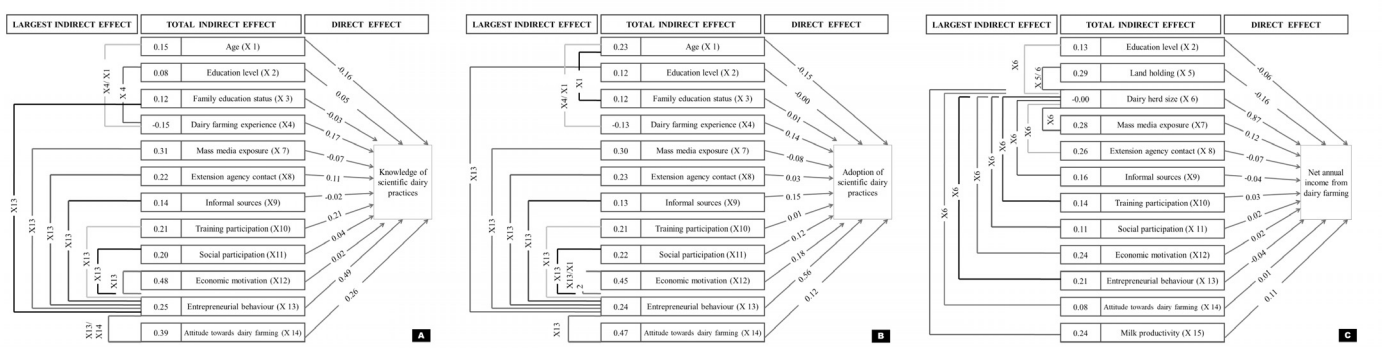

Figure 2 Path analysis showing direct and indirect effect of independent variables on knowledge of scientific dairy practices [A], adoption of scientific dairy practices [B] and net annual income from dairy farming [C]

to be high, followed by mass media exposure (0.28), extension contact (0.26), milk productivity (0.24), and economic motivation (0.24). Further, it was observed that 8 out of 12 selected independent variables had their largest indirect effect on knowledge and adoption of scientific dairy practices through entrepreneurial behaviour, whereas entrepreneurial behaviour had its indirect effect on knowledge through attitude and on adoption through economic motivation. Out of 12 independent variables, 11 had the largest indirect effect on net annual income through landholding. It might be due to proper utilization of by-products, fodder availability, and other resourcefulness of the respondents. The variables' rank order was dissimilar to its direct and indirect effects on knowledge, adoption, and income (Table 4).

Entrepreneurial behaviour was the most crucial variable affecting knowledge and adoption of scientific dairy practices. Dairy herd size was the major variable that directly affected the net annual income of the respondents. Training participation (0.21) was one of the important variables to have a direct and indirect effect on knowledge of scientific dairy practices. Entrepreneurial behaviour affected knowledge through attitude. Similarly, economic motivation affected adoption indirectly. Dairy herd size had shown its' indirect effect on income through the landholding of the respondents. Knowledge and adoption of scientific dairy practices were directly (0.21 and 0.01, respectively) and indirectly (0.21 and 0.21, respectively) affected due to training participation. Training participation had positive, direct (0.03) and indirect (0.14) effects on net annual income.

CONCLUSION

Trainees had more knowledge, adoption of scientific dairy practices, and income in dairy farming than non-trainees. Training participation significantly contributed to predicting knowledge and positively influenced the adoption and income of trained dairy farmers. However, a considerably small proportion of trainees had more extent of knowledge, adoption, and income. Thus, the study signifies an acute need for more extensive participation besides long-duration training. It was equally important to inculcate entrepreneurial behaviour, positive attitude, and economic motivation among trainees for better knowledge gain, adoption, and remuneration from dairy farm activity. Training institutes needs to provide continuous post-training extension support.

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