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Evaluation of the agricultural vocational training programmes conducted by the Krishi Vigyan Kendras (Farm Science Centres) in Indian Punjab

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Abstract

Krishin Vigyan Kendras-KVKs (Farm Science Centres) have been established by the Indian Council of Agricultural Research in 569 districts. The trust areas of KVKs are refinement and demonstration of technologies, and training of farmers and extension functionaries. Imparting vocational trainings in agriculture and allied fields for the rural youth is one of its mandates. The study was undertaken to do a formative and summative (outcome and impact) evaluation of the beekeeping and mushroom growing vocational training programmes in the Indian state of Punjab. One-group pre and post evaluation design was employed for conducting a formative and outcome evaluation. The knowledge tests were administered to 35 beekeeping and 25 mushroom cultivation trainees, before and after the training programmes organized in 2004. The trainees significantly gained in knowledge. A separate sample of 640 trainees, trained prior to 2004, was selected for finding the adoption status. Out of 640, a sample of 200 was selected by proportionate sampling technique out of three categories, namely: non-adopters, discontinued-adopters and continued-adopters for evaluating the long-term impact of these training programmes. Ex-post-facto one-shot case study design was applied for this impact analysis. The vocational training programmes have resulted in continued-adoption of beekeeping and mushroom cultivation enterprises by 20 % and 51 % trained farmers, respectively. Age and trainee occupation had significant influence on the adoption decision of beekeeping vocation, whereas education and family income significantly affected the adoption decision of mushroom cultivation. The continued adopters of beekeeping and mushroom growing had increased their family income by 49 % and 24 %, respectively. These training programmes are augmenting the dwindling farm income of the farmers in Indian Punjab.

Keywords: Krishin Vigyan Kendra, KVK, vocational training programmes, mushroom cultivation, beekeeping, formative evaluation, outcome evaluation, impact evaluation, adoption, economic benefits

1 Introduction

India faces the most challenging task of transferring the fast emerging agricultural technologies to sustain the increase in farm productivity and economic viability of farming. A variety of extension programmes are implemented for creating awareness, educating and motivating the farmers, farmwomen and rural youth to adopt and manage the new agricultural technology in the fields/homes. This is one of the major contributing factors for making India a food surplus country (Samanta & Gowda, 2003). India has multiple public extension systems. The Indian Council of Agricultural Research (ICAR) institutes, State Agricultural Universities extension system and State Agricultural Departments are involved in transfer of technology. The Department of Agriculture and Cooperation under the Union Ministry of Agriculture and the Provincial (state) Departments of Agriculture are primarily responsible for the transfer of technology to the farmers. National agricultural extension systems worldwide, including India, have undergone major changes during the past two or more decades (Swanson, 2008). In 1998, the government extension system of the Union Ministry of Agriculture and the Provincial Departments of Agriculture switched to Agricultural Technology Management

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Agency (ATMA), a decentralized model of extension as a part of the World Bank–financed National Agricultural Technology Project (NATP) (Singh *et al.*, 2006). ATMA is implemented by the state agricultural and allied departments and has linkage with the Krishi Vigyan Kedndras (KVKs): Farm Science Centres, the university research stations and farmer organization for formulating strategic research and extension plan (SREP) for a particular area.

The ICAR is responsible for agriculture research and education through its institutions and 45 state agricultural universities, one central agricultural university and four deemed universities. It also operates an extension system by itself called "first line extension system". The ICAR in 1973 appointed a Committee under the Chairmanship of Dr Mohan Singh Mehta for formulating the institutional design of KVKs for providing vocational training in agriculture and allied vocations for the rural youth with emphasis on 'learning by doing' for generating self employment. The first KVK was established in 1974 at Pondicherry under the administrative control of the Tamil Nadu Agricultural University, Coimbatore.

Till 2008, 562 KVKs were set up at district headquarters all over India for providing different services to the farmers, farm women and rural youth. In Punjab 16 KVKs have been established so far under the control of the Punjab Agricultural University (PAU), Ludhiana, India. In this paper we have made an attempt to evaluate the benefits of vocational training programmes to the farmers of Punjab.

Punjab leads all the Indian states in terms of agriculture productivity, infrastructure, health care and per capita income. Agriculture has taken tremendous strides in the state since the advent of the green revolution in the mid 1960s. With less than 1.5 % area of the country, it contributes 65 and 45 % of wheat and rice to the central pool in India. Punjab produces 2.5 % rice, 3 % wheat and 2 % cotton of the world production (Anonymous, 2006). Despite these advancements, the negative externalities associated with the modern agriculture and fragmentation of land holdings led to farmers getting caught in the debt trap of the money lenders. Fragmentation of the operational land holdings increased from 1.02 to 1.23 million. The percentage of farmers with less than 1ha land holding increased from 19.21 % (197,323) in 1980-81 to 34.41 % (424,584) in 2003-04 and the farmers with more than 10 ha decreased from 73,941 (7.19 %) to 58,371 (4.73 %) (PAU, 1998, 2003). Fragmentation prevented economies of scale in production and resulted in higher variable cost of production and reduced net income. The marginal farmers are leasing out their land in distress as fragmented small land holdings are insufficient to make both ends meet. Although per hectare productivity has increased since early 1970s, per farm family income has decreased due to subdivision of land holdings and rising cost of cultivation [1] . With increasing pressure on land for more production per-unit area through adoption of modern technologies and use of capital inputs, marginal and small farmers are unable to keep pace with the rapid technological advances in crop production. Therefore, extension endeavours are directed towards net income increase from agricultural and allied activities. To augment the farmers' income different vocational trainings are being conducted by the PAU and its KVKs, especially for the youth.

The Indian Parliamentary Standing Committee on Agriculture (1995) reported that no realistic, technical and economic analysis was ever conducted to evaluate the implementation and adoption. It suggested that impact evaluation of the trainings organised by the KVKs should be conducted to identify the constraints and impacts (Anonymous, 2002). This role has to be performed by extension education specialists with the coordination of the biological scientists. Agricultural education and research systems in India have not paid due attention to programme evaluation. This study, therefore, seeks to evaluate the outcome and impact of beekeeping and mushroom cultivation training programmes conducted by the KVKs in the Indian state of Punjab.

1.1 Evaluation Research: Theoretical Orientation

Research and evaluation both are the modes of scientific inquiry (Douglah, 1996). Evaluation research is form of applied social science. Field of evaluation research is the application of scientific methods to measure the implementation and impacts of a programme for decision-making purpose (Rutman, 1984). The purpose of evaluation helps in identifying the key evaluation questions, on the basis of which appropriate form of evaluation, appropriate model of evaluation and design of research can be selected (Peshin *et al.*, 2009). Commonly, two main types of evaluation, based on the purpose of evaluation, are formative and summative valuation (Scriven, 1967). Formative evaluation reports to the programme by identifying shortcomings and their remedies, whereas summative evaluation reports about the outcomes/impacts of the programme (Scriven, 1991).

The use of scientific methods to measure the impact of agricultural development programmes differ among disciplines. Economists advocate cost benefit analysis an major tools of evaluation. Social scientists advocate application of Bennett hierarchy (Bennett, 1975) or logic model (inputs-outputs-outcomes-impacts) for evaluating extension programmes. The research designs for outcome/impact evaluation are either experimental or quasi-experimental (Campbell & Stanley, 1966). But

[1] Sources: Statistical Abstract of Punjab, 2005 and Department of Agriculture, Govt. of Punjab. 2005

selecting an appropriate design is helpful in measuring the outcome/impact of the programme (Peshin *et al.*, 2009).

Randomized experimental designs are not practical in many extension programmes, mainly due to randomization difficulties. Experimental designs that are not randomized are quasi-experimental (Campbell & Stanley, 1966). There are different quasi-expermental designs, namely one-group before and after comparison, one-group time series design, one-shot case study and non-equivalent control group design. In these designs the researcher can manipulate or observe the manipulation of treatment. Quasi-experimental design where manipulation of treatment is not possible is called ex-post facto design. In this design there is a built-in estimate of the counterfactual, so that the design is a true impact evaluation design but with lower power, in principle, than other quasi-experimental designs (Mohr, 1995).

The theoretical base of evaluation and research designs and the practicability of these were taken into consideration for selecting the appropriate methods to measure the outcome and impact of vocational training programmes. The evaluation indicators selected in the study were; reaction of trainees, adoption status and economic benefits of the training programmes.

2 Methods

2.1 Research design

One-group pre and post evaluation research design was employed to study the reactions and knowledge gain of the trainees attending the vocational training programme after 2004. Ex-post-facto, one-shot case study design was employed for conducting the summative evaluation (impact evaluation) to study the adoption and impact of vocational training programmes conducted by the selected KVKs prior to 2004.

2.2 Locale of the study and sampling plan

The study was conducted in the Indian state of Punjab. Sixteen KVKs have been set up in Punjab under the control of the PAU. By the end of the year 2000-2001, nine KVKs were established in Punjab. These nine KVKs were selected to find out the different vocational training courses organised and the number of trainees trained in these courses. Out of the nine KVKs, three KVKs namely Ferozepur, Sangrur and Hoshiarpur, with maximum number of vocational training courses (beekeeping and mushroom cultivation) conducted continuously, in 1998-1999, 1999-2000 and 2000-2001[2] were selected to study the adoption status and long-term impact of the vocational training programmes. To study the knowledge gain and reactions of the trainees regarding various components of teaching learning situation, one training course from each of the selected vocational training courses organized in 2004-05 were taken up from each of the three selected KVKs.

In this formative and summative (outcome and impact) evaluative study all the four indicators of evaluation of training programme, as identified by Kirkpatrick (1996), were measured. The reactions with respect to different aspects of teaching learning situations namely, teacher, subject matter, physical facilities and teaching materials, learning (knowledge gain), adoption and impact.

Two separate samples were drawn for conducting the formative and summative evaluation. For the summative evaluation, a total of 1041 trainees imparted training in the bee-keeping and mushroom cultivation in 1998-99, 1999-2000 and, 2000-2001 by the three selected KVKs formed the population. Out of these 1041 trainees, efforts were made to get the response through mail whether they had set up the enterprise after getting training, were continuing with the enterprise or had discontinued the enterprise. Letters were mailed to all the 1041 trained personnel. Response of only 640 trainees was received in this regard.

Six hundred and forty trainees were classified into three categories in terms of adoption status namely: continued adopters, discontinued adopters and non-adopters[3]. Out of 640, a sample of 200 respondents was selected proportionately from these three categories to study the factors effecting adoption decision, reasons for non-adoption and discontinuance, and economic impact of the enterprises (Table 1)[4].

A separate sample of all the 59 trainees (bee-keeping 35 and mushroom cultivation 24) who attended the bee-keeping and mushroom cultivation training courses organized in 2004-05 at the selected KVKs was taken up to study the reactions and gain in knowledge of the trainees.

2.3 Tools of data collection

The practices as recommended in the manuals of mushroom cultivation and bee keeping published by the PAU, Ludhiana were selected for the study. Two research schedules (survey instrument) were constructed for the data collection for each of the selected vocational training courses.

[2]The training courses conducted up to 2000-2001 were selected to study the long-term impact. Therefore, training courses conducted from 2002 onwards were not selected for the study.

[3]In the innovation-decision process (Rogers, 2003, p.170), at confirmation stage the individual (or other decision-making unit) can take the decision for continue-adoption or discontinuance or continued rejection (non-adoption). Discontinuance is a decision to reject a technology after having previously adopted it, non-adoption is rejection of the technology and continued-adoption is to continue with the technology about which decision has previously been made (Rogers, 2003)

[4]From hence on they will be referred to as past trainees

Table 1: *Sampling plan for the study for summative (impact) evaluation*

Name of course	*Name of KVK*	*Number of trained farmers*		*Sample category*		
		Total	Sample	Continued adopter	Non-adopter	Dis-continued
Beekeeping	Ferozepur	63	20	7	9	4
	Hoshiarpur	64	20	6	10	4
	Sangrur	306	95	56	30	9
	Total	433	135	69	49	17
Mushroom cultivation	Ferozepur	59	19	4	11	4
	Hoshiarpur	80	25	6	14	5
	Sangrur	68	21	3	12	6
	Total	207	65	13	37	15
	Grand Total	640	200	82	86	32

The first research schedule consisted of questions related to the profile of the respondents, knowledge test and reaction of the trainees regarding various aspect of teaching learning situation of the training courses.

To find out the self correction of the mushroom cultivation and beekeeping knowledge tests, these were pretested with 20 non-sampled trainees. After pre-testing the numbers of test items deleted were: 11 and 15, and the number of items added were: 9 and 26 in mushroom cultivation and beekeeping knowledge tests, respectively. The items deleted and added were based on the advice of the mushroom and beekeeping specialists from the disciplines of microbiology, entomology and extension education. Test-rest reliability estimation method was applied for estimating the reliability coefficient (Guilford, 2008). The reliability coefficient (r) was 0.993 and 0.995 for the mushroom cultivation and beekeeping knowledge tests, respectively. The final knowledge tests of mushroom cultivation and beekeeping consisted of 78 and 68 items, respectively. The second research schedule consisted of questions related to profile of the past trainees (who received training prior to 2004), adoption status and economic impact of the selected vocational training courses. The data regarding the adoption status, reasons for non-adoption/discontinuance and economic impact of the enterprises were collected by personal interview method using semi-structured interview schedule. This research instrument was pre-tested with 20 non-sampled trainees before its final use.

2.4 Operational definitions of variables

Gain in knowledge: Gain in knowledge was measured in terms of the difference between before and after training knowledge scores of the trainees. It was measured in terms of correct responses given by the trainees by way of recall on a knowledge test administered to them before and after the organization of each selected vocational training course.

Adoption status: It was measured in terms of the relative position of a respondent regarding adoption, non-adoption and discontinuation of an enterprise. These were measured in terms of percentage of past trainees setting up their enterprise, continuance / discontinuance with the enterprise, and non-adoption of the enterprise.

Economic impact: It refers to the economic returns of the respondents who were continued-adopters of mushroom or bee-keeping units in terms of generation of additional income. It was measured in Indian rupees (1 US $ = rupees 45 at 2005 rates) per unit per year and its proportion to the total household income.

2.5 Statistical analysis

The data were analysed by paired 't'-test to find out the statistical significance of the observed difference between pre-test and post-test training knowledge scores for selected bee-keeping and mushroom cultivation practices. The calculated value of 't' was tested at five percent level of significance. The trainees might have been sensitized due to administering of knowledge test before training (pre-test). There is interaction between the treatment and the pre-test (Campbell & Stanley, 1966) but it is not a threat to internal validity.

The effect of independent variables on the dependent variable (Table 2) was studied by using the computer based logit model (logistic regression function). The continued adoption / discontinued adoption of the mushroom and beekeeping enterprises (dependent variable in this case) is a binary variable indicating whether a person is the adopter of the new technology or not. The determinants could thus be estimated by using the linear probability model, probit model or logit model. The lin-

Table 2: *Operational definitions of variables and their coding in the empirical model of adoption decision.*

Dependent variable	
Y_i	Trainee adoption decision takes the value of 1 if the trainee adopted either beekeeping or mushroom cultivation after training (continued/discontinued adopter), otherwise 0 if trainee did not adopt these enterprises (non-adopter)
Independent variables	
Age (X_1)	Age of the trainee measured in years
Education (X_2)	Formal education level of trainee measured in number of formal schooling years
Family type (X_3)	Joint family a score of 1 and nucleolus family a score of 0
Family occupation (X_4)	If main occupation farming: 1 otherwise 0
Trainee occupation (X_5)	If main occupation farming: 1 otherwise 0
Social participation (X_6)	Member of any social organization: 1 otherwise 0
Previous training experience (X_7)	In case of previously trained :1 otherwise :0
Family income (X_8)	Annual income of a family in Indian rupees (1 US $= 45 rupees at 2005 rates)
Farm size (X_9)	Landholding in hectares

ear probability model was used by Singh (2003) but had many inherent limitations such as non-normality of distribution, heteroscedasticity, values of estimated probabilities falling outside the interval of zero and one, and very small value of R^2. Also, the assumption of linear relationship between the value of an independent variable and probability of dependent variable is not a realistic assumption (Gujarati, 1999). The probit and logit models, thus, provide better alternatives for such estimation. Major difference between the two models is the flatness of tails of their cumulative distribution functions (CDFs). Logit model has slightly flatter tails (Greene, 2002), which means that probit curve approaches the axes more quickly than the logit curve. Gujarati (1999) points out that the choice between the two methods is largely of the convenience of estimation and availability of suitable computer programmes.

Logit model is slightly simpler to estimate than the probit model (Berhanu *et al.*, 2003; Adeogun *et al.*, 2008). Hence, the logit model[5] was selected for estimating the influence of the socio-personal attributes on the adoption decision. Examining the determinants of adoption of a technology is important for better understanding of the phenomenon in order to draw some meaningful policy inferences. These determinants were, therefore, estimated by using binary logistic regression model (logit model), which is described by the following two equations.

$$Y_i = F(Z_i) \quad (1)$$

$$Z_i = b_0 + \sum b_i X_{ji} \quad (2)$$

Where, Y_i is the observed status of adoption of the i^{th} household (whether a particular trainee is the adopter for a technology or not) and Z_i is an unobserved index value such that if Z_i exceeds some threshold value Z^*, the trainee is an adopter, otherwise not. Using binary logistic regression equation, X_j was the set of explanatory variables (Table 2) supposed to influence the incidence of adoption of technology. The model was estimated by using the software STATA 9.0.

3 Results

The empirical results have been discussed under the sub-sections: descriptive statistics, formative and outcome evaluation and impact evaluation.

3.1 Descriptive statistics

The descriptive statistics of the samples selected for conducting formative, outcome and Impact evaluation is given in Table 3. It is evident from the data that only youth attend the vocational training programmes, and almost all of them are educated with average formal education up to class 10. The trainees were predominantly

[5]The problem of adoption of a new technology was represented as $P_i = 1/(1 + e - Z_i)$, where P_i is the probability of adopting new technology and $Zi = b_0 + \sum b_i X_{ji}$, X_j being the set of explanatory variables. By appropriate transformations the model can be expressed as $\log n(P_i/(1 - P_i)) = Z_i = L_i$. Here, L_i is the log of odds ratio and hence, called Logit. We cannot estimate the above function by OLS technique but by maximum likelihood procedure. For more details see Greene (2002).

Table 3: *Descriptive statistics of trainees*

	Formative evaluation sample (n= 59)		*Impact evaluation sample (n=200)*	
	Mushroom cultivation (n=24)	*Beekeeping (n=35)*	*Mushroom cultivation (n=65)*	*Beekeeping (n=135)*
Average age (No. of years)	25.7 ±5.7	26.9 ±7.8	30.6 ±8.4	30.7 ±10.2
Average number of formal schooling years	10 ±1.7	10 ±2.9	11 ±1.6	10 ±2.7
Education (%)				
Illiterate	0	3	0	2
Primary (5th pass)	0	9	0	5
Middle (8th pass)	4	6	11	12
Matriculate	54	40	43	45
Senior secondary(10+2)	38	37	32	20
Graduation & above	4	5	14	16
Family type (%)				
Nucleus family	29	34	14	9
Joint family	71	66	86	91
Main occupation of trainees (%)				
Agriculture	58	83	82[1]	88[2]
Others (service, business, labour, student and unemployed)	42	17	18	12
Family occupation (%)				
Agriculture	79	97	94	95
Others (service, business and labour)	21	3	6	5
Family background (%)				
Rural	96	97	97	100
Urban	4	3	3	0
Member of a society/organisation	0	11	46	38
Average landholding (ha)	2.41 ±2.82	3.35 ±4.03	5.16 ±5.14	4.13 ±6.81
Landless (%)	25	6	11	12
Farm size (%)[3]				
Marginal (less than 1 ha)	22	6	14	10
Small (1-2 ha)	11	27	14	23
Semi medium (2-4 ha)	28	37	15	30
Medium (4-10 ha)	33	27	33	24
Large (10 ha & above)	6	3	24	13
Average family income ($)[4]	1690 ±1909.3	1800 ±1954.6	3120 ±2617.9	2797 ±3777.9

[1]; Out of these, 16 % have adopted beekeeping as their main occupation
[2]; Out of these, 5 % have adopted mushroom cultivation as their main occupation
[3]; Categorization of land holding (farm size) is based on the categories used by Anonymous (1987 and 1994)
[4]; Not corrected for annual inflation rate since 2005
Note: Percentage of farmers has been rounded up to the nearest whole number

from rural background having agriculture as their main occupation.

In case of mushroom cultivation the majority of the respondents (96 %) were 35 years of age or below. All the respondents were literate. Majority of the respondents were from rural areas, with agriculture being the major family occupation. None of the respondent was a member of any organization like cooperatives, *panchayats*[6], farmers' organization. Majority of them belonged to small (landholding1-2 ha) and medium (landholding 4-10 ha) category of landholding. About 80 % of the respondents had their family annual income up to US $ 2640 (at 2005 rate of inflation) per annum. In case of bee-keeping the majority of the respondents (85 %) were in the age group of 35 years or below and were lit-

[6]In India, *panchayats* are the democratically elected bodies at village level

erate (97 %). Out of literate majority was educated upto grade 10. Majority of the trainees belonged to joint family and were married. Majority of the respondents were from rural areas and had agriculture as their main occupation. Majority of the respondents belonged to small to medium categories of land holding. Only 14 % of the respondents had their family annual income above US $ 2640 per annum. The average annual income of the sampled trainees for formative evaluation was $ 1690 (mushroom trainees) and $ 1800 (beekeeping trainees). In case of the sampled trainees of mushroom and beekeeping for impact evaluation it was $ 3120 and $ 2797, respectively (Table 3).

3.2 Formative and outcome evaluation

Formative evaluation of the training programmes conducted in 2004-05 was undertaken to report about the reaction of trainees regarding the implementation of these training programmes and knowledge outcome thereof.

Reactions of the trainees: The reactions with respect to the trainers, subject matter, physical facilities and teaching materials were studied. A majority of the trainees, 74 % in beekeeping and 63 % in mushroom cultivation considered the training course very useful. Majority of trainees (66 % for beekeeping and 58 % for mushroom cultivation) were satisfied with the duration of the training courses Eighty-nine percent in beekeeping and 100 % of the respondents in mushroom cultivation expressed that the month of September was best suited for training. Rest (11 % respondents in beekeeping) preferred the month of December, after sowing of the dry season (*rabi*) [7] crops.

Seventy-one percent of the respondent in beekeeping and 75 % in mushroom cultivation training course were fully satisfied with the need based applicability and utility characters of subject matter content, whereas 29 % and 25 % trainees in beekeeping and mushroom cultivation training course, respectively were satisfied with the subject matter content of the training course. The majority of respondents (71 % and 79 %) in beekeeping and mushroom cultivation training course were fully satisfied with the practical training. Most of the trainees (91 % and 88 % in beekeeping and mushroom cultivation) were satisfied with the printed literature distributed during the training. The trainees were not provided lodging facilities and no field visits for the trainees were conducted during the training courses. So there is a need to give emphasis on arranging field visits and lodging facilities for the trainees. If lodging facilities are provided, farmers from distant places can also attend training programmes organized by the KVKs.

[7] Synonymous with dry season, covering the period November through April

In beekeeping courses 74 % and in mushroom training courses 54 % consider trainers as highly knowledgeable, whereas in case of the later a considerable number of respondents (46 %) reported that the trainers had medium level of knowledge. The respondents felt that resource persons were explaining with examples and the content were in proper sequence. Similarly, the majority of the trainees were of the view that the style of presentation was very good and the language used was easy. The data further revealed that the majority of the trainees (63 % and 75 %) in beekeeping and mushroom cultivation were satisfied with the use of audio visual aids in training.

Gain in knowledge about different practices of beekeeping: The data in Table 4 pertain to the gain in knowledge of the respondents with respect to various practices of beekeeping. The t-values of difference between pre and post training mean knowledge score of all the practices of beekeeping were significant ($p < 0.05$). Pre-training mean knowledge score ranged between 0.11 (in case of breeding of honey bees) and 4.34 (in case of management of boxes). In practices such as breeding of honeybees and bee enemies they had comparatively little pre-training knowledge but after training, significant gain in level of knowledge was achieved in all the practices. The post training mean knowledge scores on different practices of beekeeping ranged between 3.77 and 23.30.

Gain in knowledge about different practices of mushroom cultivation: The data in Table 4 pertains to pre and post training mean knowledge scores of the respondents with respect to various practices of mushroom cultivation. The differences between pre and post training mean knowledge score of all the practices of mushroom cultivation were significant. The difference of pre-training mean knowledge score of various practices ranged from zero (in case of crop management) and 0.46 (in case of compost preparation). In all the practices the trainees possessed comparatively less pre-training knowledge. There was a significant gain in the knowledge of all the practices, except food value of mushroom and spawning. More emphasis should be given to these practices during training courses conducted by the KVKs.

Overall knowledge gain: The pre-training mean knowledge score of the trainees of beekeeping was 13.20, which increased to 63.43 after the training. There was an increase of 50.23 in the mean knowledge score, which is significant at the level $p < 0.01$. In case of mushroom cultivation, the mean knowledge score before training was 1.54 and increased to 51.67 after the training. This gain in knowledge is also significant at $p < 0.01$ (Table 5).

Table 4: *Gain in knowledge of trainees about different beekeeping and mushroom cultivation practices*

	Maximum knowledge score	*Mean knowledge score of the trainees*		*t-value*
		Pre-training	*Post-training*	
A. Beekeeping (n=35)	78			
Breeding of honeybees	6	0.11	3.77	10.841**
Bee flora	8	1.69	6.17	9.772**
Management of boxes	30	4.34	23.20	15.711**
Bee enemies	6	0.66	4.68	15.076**
Production of honey	9	1.68	6.97	11.646**
General information about beekeeping	19	3.71	16.28	14.110**
B. Mushroom cultivation (n=24)	68			
Variety / cultivation methods	7	0.42	7.04	26.610**
Compost preparation	21	0.46	11.75	18.358**
Filling + spawning	8	0.12	2.67	9.007**
Casing	6	0.12	4.62	14.003**
Crop management	22	0.0	5.04	15.978**
Food value	4	0.04	1.63	9.349**

** significant at $p < 0.01$ with $df = 34$ and 23 in case of beekeeping and mushroom trainees, respectively.

Table 5: *Overall mean knowledge score of trainees about beekeeping and mushroom cultivation (before and after)*

Training course	*Pre-training*	*Post-training*	*Difference*	*t-value*
Beekeeping (n=35)	13.20 ±18.56	63.43 ±10.97	50.23** ±19.29	15.403 (d.f=34)
Mushroom cultivation (n=24)	1.54 ±2.93	51.67 ±10.80	50.13** ±10.67	23.00 (d.f=23)

** Difference significant at $p < 0.01$

3.3 Summative/Impact Evaluation

The Impact evaluation is summative in nature. The summative evaluation of the vocational training programmes was conducted to assess their impact. The indicators of evaluation were: adoption status, economic benefits in terms of generation of additional income; multiplier effect and returns on the amount spent by the KVKs on the vocational training courses.

Adoption status: The adoption status with respect to continued adoption, discontinuance and non-adoption was based on the sample of 640 trainees from whom the response was received. While the proportion of the beekeeping trainees adopting such enterprise was 63 %, mushroom cultivation was adopted by 43 % of the trainees. The percentage of non-adopters was on higher side (57 %) in case of mushroom cultivation. In case of beekeeping the percentage of non-adopters was 37 %. Twenty percent and 53 % of the beekeeping and mushroom cultivation adopters respectively had discontinued the enterprises over time. Thus effectively 51 % and 20 % trainees were continued adopters of bee keeping and mushroom cultivation, respectively. This shows that the adoption in case of beekeeping is higher as compared to mushroom cultivation and discontinuance is higher in case of mushroom cultivation. The reasons for discontinuance of the beekeeping enterprise were lack of follow-up guidance by the KVKs (41 %), shortage of time (35 %) and problem of bee flora (23 %). Mushroom enterprises were discontinued because of marketing problem (87 %) and low economic return (53 %). In case of beekeeping, the major reasons for the non-adoption were financial constraints in setting up the units (67 %) and trainees subsidiary occupations(22 %).In case of mushroom, the reasons for non-adoption were shortage of family labour (68 %) and lack proper expertise in mushroom growing (38 %).

Out of 640 trainees, a sample of 200 was selected (as discussed in section 2.2) for analyzing the influence of independent variables with adoption decision, economic benefits and multiplier effect.

Influence of socio-economic variables on adoption decision: An enormous research literature has accumulated about socio-economic variables influncing the adoption decision (Rogers, 2003; Pattanayak *et al.*, 2003). Rogers (1962, 2003) in “diffusion of innovation theory” generalized socio-economic and personal-

Table 6: *Binary logistic regression of the socio-personal variables with the adoption of beekeeping and mushroom enterprises*

	Beekeeping			*Mushroom cultivation*		
Variable	*Coefficient*	*Standard error*	*Z value*	*Coefficient*	*Standard error*	*Z value*
Age	0.07515	0.3263	2.30*	0.08513	0.08841	0.96
Education	-0.0826	0.1105	0.75	1.9467	0.8866	2.20*
Family size	-0.2947	0.9231	0.32	2.899	1.702	1.70
Family occupation	-0.1698	0.9085	0.19	0.947	1.807	0.52
Trainee occupation	2.2718	0.8860	2.56*	0.954	1.733	0.55
Family income	0.4520	0.4048	1.12	6.204	3.131	1.98*
Social participation	-0.3579	0.5225	0.69	1.556	1.315	1.18
Previous training exposure	0.700	0.1209	0.58	-8.388	9.424	0.89
Landholding	-0.04986	0.03762	1.33	-0.4611	0.2455	1.18

* Significant at $p < 0.05$

log likelihood: beekeeping = -56.151; mushroom cultivation = -13.027

χ^2 statistics: beekeeping = 112.276; mushroom cultivation = 22.942

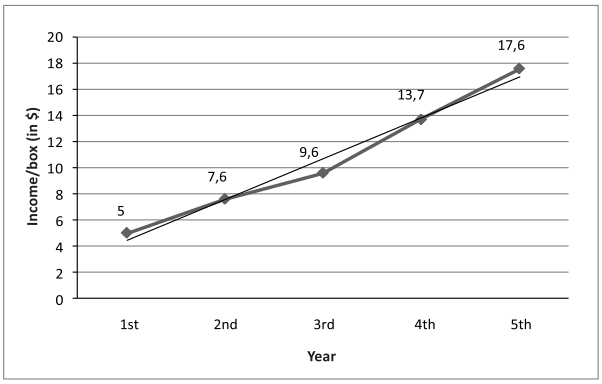

Fig. 1: *Average income per box of honeybee over time*

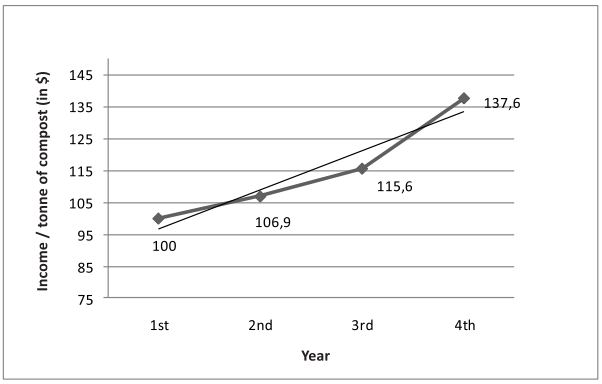

Fig. 2: *Average income per ton of compost over time*

ity variables associated with adoption decision. The socio-economic variables selected for this study are given in Table 2. Binary logistic regression analysis was applied to find out the influence of these variables on the adoption decision of beekeeping and mushroom cultivation enterprises (Table 6). In case of beekeeping, age and trainee occupation have a significant influence on adoption, whereas education and family income have significant influence on the adoption of mushroom cultivation. In case of beekeeping with the increase in age the chances of the adoption of this enterprise decrease. In case of the mushroom cultivation, the higher the family income and the education level, the higher the chances of adoption.

The chances of muticollinearity are non-existent in case of beekeeping as standard errors are small. In case of mushroom cultivation standard errors for family income and previous training exposure are greater than 2, thus chances of moderate multicollinearity.

Multiplier effect: The multiplier effect of vocational training courses was pronounced in case of bee-keeping, as 25 persons had started this enterprise after learning from the successful beekeepers trained by the KVKs. These KVK trained beekeepers were a source of information and motivation for them to start the enterprises. This farmer-to-farmer diffusion added 36 % beekeepers to the continued adopters' category. In case of mushroom cultivation, the results were different, as only one farmer had started the mushroom unit after learning from successful mushroom growers.

Economic benefits[8]: The economic returns/ benefits in case of bee keeping increased as the size of unit increased. The data in Table 7 clearly indicates that in case of small units to start with, net income per box of beekeeping was US $ 4.1 and it was $ 11.9 in case

[8] At 2005 inflation rates

Table 7: *Net- income of beekeeping enterprise over time*

Number of boxes	First year		Second year		Third year		Fourth year		Fifth year	
	Number of beekeepers	Income / box ($)	Number of beekeepers	Income / box ($)	Number of beekeepers	Income / box ($)	Number of beekeepers	Income / box ($)	Number of beekeepers	Income / box ($)
Up to 10	51	4.1	40	5.6	22	6.1	12	9.9	4	11.7
10-20	10	5.5	12	8.2	13	9.6	4	10.5	1	12.4
20-30	2	8.0	5	9.2	4	10.3	5	12.2	5	12.8
30-40	1	8.6	4	10.3	7	12.2	2	14.9	1	17.4
40-50	2	9.9	0	–	1	14.2	3	16.6	1	17.6
Above 50	3	11.9	8	14.1	8	17.1	9	19.8	11	22.5

Table 8: *Net- income of mushroom cultivation enterprise over time*

Compost (in tons)	First year		Second year		Third year		Fourth year	
	No. of mushroom growers	Income / ton compost ($)	No. of mushroom growers	Income / ton compost ($)	No. of mushroom growers	Income / ton compost ($)	No. of mushroom growers	Income / ton compost ($)
Up to 2.5	8	88.2	8	93.6	5	96.7	0	–
2.5–5.0	1	81.8	1	127.1	1	124.4	0	–
5.0-7.5	0	–	0	–	0	–	0	–
7.5-10.0	1	128.4	1	125.6	1	135.3	1	138.9
>10	3	127.6	3	129.3	3	137.6	3	137.1

1 US $ =Rupees 45 (at 2005 rates)

of large units (more than 50 boxes). It shows a gradual increase in net income per box from a unit of 10 boxes ($ 4.1 per box) to more than 50 boxes ($ 11.9 per box). The return also indicates a positive trend over time. The average returns per box irrespective of the size of the unit increased from $ 5.0 in the first year of setting of the unit to $ 7.6 in the second year to $ 9.6 in the third year, to $ 13.7 in the fourth year, and $ 17.6 during the fifth year. This shows that profit per box increases over time (Figure 1) and with the increase in the size of the unit (Table 8). The marketing of the honey was either directly to consumers (33 %) or to large beekeepers (77 %) having got the AGMARK quality certification mark of the government. The price per kilogram of honey ranged between $ 1.1 to $ 2 for the study period. The majority (97 %) was selling unprocessed honey. Besides they were also selling honey wax (28 %) and honey bees(24 %).

In case of mushroom cultivation the economic returns/ benefit also increased as the size of unit increased. The data in Table 8 clearly show that in case of small units the net profit/ ton of compost was US $ 88.2 and US $ 127.6 in case of large unit (more than 10 tons compost). The returns also show a positive trend over time. The returns per ton compost increased from US $ 100.0 during the first year of setting up of the unit to US $ 106.9 during the second year, US $ 115.6 during the third year and US $ 137.6 in the fourth year. This also shows that profit increases over time (Figure 2). Both, time and unit size effect the returns of these enterprises. Mushroom was directly marked by the growers in vegetable markets after packing in polybags. The selling cost per kg of mushroom ranged between $ 0.77 to 1.55 over the study period.

The total additional income (net profit) generated by 69 beekeepers in 3-5 years was US $ 110,478, and in case of mushroom cultivation was US $ 67,030 by 13 mushroom growers. The total amount spend by the KVKs on training of 1041 trainees amounts to $ 4580 @4.4/trainee (excluding the salary of the trainers) which has generated a returns of $ 177,508 for the sample selected (200). This shows a return of $ 38.75 for every dollar spent on training, which is a conservative estimate as the net profit of only sampled adopters category was calculated. Training efficiency for the sample of 200 trainees is $ 201.70. Out of the sample of 200, eighty-two were the continued adopters (beekeeping 69 and mushroom cultivation 13). The expenses for training 200 trainees (excluding salary of the trainers) were $ 880, and the net returns of 70 continued adopters were $ 177,508. Thus the returns per dollar were $ 201.70.

Generation of additional income: In terms of generation of additional income for the continued adopters, the proportion of increase in the total household income ranged from half a percent to more than 80 % in case of beekeeping. Half a percent to 10 % was the increase

in household income in case of the 42 % of continued adopters, followed by 23 %, having an increase of 10-25 %. Similarly in case of mushroom cultivation about 54 % of the continued adopters had increased their family income by half a percent to 10 % followed by 23 % who had increased their family income by 25-40 % (Table 9). The average proportion of income generated by bee-keeping enterprise to the total household income was 24 %, whereas in case of mushroom cultivation was 49 %.

Table 9: *Income of the beekeeping and mushroom cultivation enterprise in proportion to family income*

Increase in house hold income (%)	*Beekeeping (n=69)*		*Mushroom cultivation (n=13)*	
	Number	*%*	*Number*	*%*
05–10	29	42	7	54
10–25	16	23	0	0
25–40	9	13	3	23
40–67	10	15	1	8
67–80.5	5	7	2	15

4 Discussion

Evaluation of the extension activities and especially vocational training programmes conducted by the KVKs contributes to the academic output and also provides value judgment.

The trainers from different disciplines having masters and doctoral degrees provide specialized training to the farmers in crop production, crop protection and other areas of agricultural production. Vocational on campus training programmes are conducted for interested farmers and rural youth for setting up agri-enterprises. The results of the study show that majority of the trainees were satisfied with the vocational training provided by the PAU and its KVKs and has resulted in significant knowledge gain of the trainees. The impact evaluation results show that the vocational training programmes conducted are augmenting the farm income substantially.

The PAU and its KVKs have been successful in giving a flip to small scale apiculture and mushroom cultivation enterprises in the state of Punjab. The state of Punjab was not known for beekeeping or mushroom cultivation prior to 1976 and 1972, respectively. The efforts of the scientists at the PAU in development of technologies for beekeeping and mushroom cultivation, and their dissemination through training programmes at the main campus of the university at Ludhiana by the Directorate of Extension Education, and through its KVKs has resulted in making Punjab the number one state in honey and mushroom production.

There were only two beekeepers in the state in 1976. During the last two decades Punjab witnessed “honey revolution”. The number of beekeepers has increased to 22,000 (2003) to 25,000 (2010) and the number of boxes from five to 250,000 for the same period. The PAU Beekeepers Association was established by 166 trained beekeepers in 1998 for promotion of this enterprise. Presently it has a membership of 1200. The state produces 8500 tons of honey/year which is 25 % of the national production (Singh *et al.*, 2010, p.2). The efforts to popularize low cost mushroom cultivation in rural areas have resulted in production of 48000 tons/year, about 50 % of the national production. Out of 400 mushroom growers, 180 are small scale units (PAU, 2010).This implies that the results of this empirical study are in consonance with the overall beekeeping scenario in Punjab.

Our empirical study confirms that vocational training programmes are resulting in desired outcomes. The adopters of beekeeping have been able to generate addition income by 24 %. Thus if these results are extrapolated for 25 thousand beekeepers, the honey production has significantly augmented the income of the rural people. The rate of adoption was high in case of beekeeping (51 %) for the fact that beekeeping is round the year enterprise, whereas small scale mushroom cultivation is a seasonal activity. The higher percentage of the trainees taking up beekeeping is also due to the fact that in addition to the production of honey, other sub-products like honey wax also fetch the remunerative prices and it is also possible to multiply the bee colonies and market the colonies. The honey wax and bee colonies were sold by 28 and 24 %, respectively. The second reason for relatively low adoption rate in case of mushroom cultivation is that farmers do not get the specialized training from the scientists, whereas in beekeeping the specialist from the discipline are posted at every KVK. The other reasons for relatively low adoption of mushroom cultivation enterprise were that it is a seasonal crop, highly specialized, influenced by fluctuation in market price and having higher initial investment. However, the impact of the PAU research and extension systems in development and dissemination of mushroom technology since 1972, is significant. Our study confirms the contribution of trainings on enhancing mushroom production in the state. It has resulted in increase in family income by 49 %.

The socio-economic factors impacting the adoption of beekeeping and mushroom cultivation enterprises were not consistent with each other. Age has significant relationship with the adoption of beekeeping, whereas it had no influence on the adoption of mushroom cultivation. There are inconsistencies regarding the evidence about the relationship of age with adoption decision (Rogers, 2003; Pattanayak *et al.*, 2003). Years of formal education, social status, upward social mobility, landholdings are positively related with adoption (Rogers, 2003). But our study shows that education

and family income influenced the adoption decision in case of mushroom cultivation, and trainee occupation influenced the adoption of beekeeping enterprise. Farmer to farmer diffusion of mushroom technology was low compared to beekeeping. This is due to the fact that mushroom cultivation technology is complex. Only specialized hands-on training can make the farmers confident for adoption and use of technology. Kaur (1998) has also reported that adoption of beekeeping under Punjab conditions is higher than other vocations like mushroom cultivation.

The results of this study cannot be generalized for all the vocational programmes implemented by the KVKs in India. Based on above discussion there is a strong evidence that results of our study can be generalized for the mushroom and beekeeping vocational programmes conducted by the PAU and its 16 KVKs in Punjab. But this extension model as implemented in the state of Punjab can be replicated with the smallholder farmers in the developing countries.

5 Conclusion

The above findings clearly indicate that the KVKs are realising the objectives of the vocational training programmes in terms of achieving desired outcomes and impacts. The follow-up of the trainings by the KVKs will provide much needed guidance to the trainees and avoid discontinuance of the enterprises. The KVKs should also provide marketing information to the trainees. Beekeeping and mushroom growing enterprises do not require additional arable land, thus farmers with small and medium landholdings can augment their dwindling farm income. More regular and robust evaluation studies are required to determine the value of investing in farmers' education and trainings by the KVKs. Evaluation should be part and parcel of extension programmes, and should be undertaken on scientific lines to ensure the internal and external validity of the findings. There should a policy decision by the PAU to appoint an expert having research expertise in mushrooms for providing specialised training to farmers. Besides a policy decision on periodic scientific evaluation of the research and extension programmes must be made mandatory.

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