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Extent of adoption and its limiting factors affecting improved vegetable cultivation practices by small farmers in the eastern Himalayan region

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Abstract

The study was conducted in 13 purposively selected Krishi Vigyan Kendra (KVK) districts in the Northeastern region. A total of 130 farmer respondents from both adopted and non-adopted villages were selected using proportionate random sampling. Data were collected from these respondents through personal interviews using a pre-tested structured schedule. The findings indicate that more than half of the respondents from both KVK-adopted and non-adopted villages demonstrated a medium level of adoption of improved vegetable cultivation practices. However, practices such as the recommended seed rate, soil and seed treatment, plant protection measures, and water management were more widely adopted by farmers in adopted villages compared to those in non-adopted villages. Additionally, the study also found that out of 13 independent variables examined, education, caste, family type, training received, mass media exposure, and extension contact had a positively significant relationship with the extent of adoption of these practices. Notably, caste and extension contact emerged as the most influential factors affecting the extent of adoption in both groups of farmers.

Keywords: Adoption, adopted village, non-adopted village, vegetable cultivation, Krishi Vigyan Kendra, eastern Himalayan region

1. Introduction

Within the socio-economic, cultural, and ecological diversity of the Eastern Himalayan Region of India, stewardship in agriculture, horticulture, forestry, fisheries, livestock, and other natural resource sectors continues to be a main component of wise use of the region's natural legacy. It is a fact that there has been tangible progress in the agrarian sector in terms of technological adoption in agriculture and allied sectors, subsequently improving agricultural production and productivity level, income and employment generation, etc. which have a direct impact on the overall socio-economic development and standards of living of the farming community in the region. This progress is largely attributed to the proper functioning of KVK in each district, which provides first-line extension services to the farmers. However, the significant contribution made by KVKs through their mandated programs and activities in the region has not been well studied and documented and thus remains poorly understood among the society at large. A primary understanding of the background information through systematic assessment of the value of the functioning of KVKs in existing initiatives and approaches could help set future location-specific policy and program directions in support of agriculture and other community-based natural resource management in the region. In the horticulture sector, vegetables have gained a multi-dimensional role in human society due to their

richness in antioxidants, vitamins, minerals, and dietary fibers making them indispensable components of a balanced diet.

Moreover, in a country like India, where about 40% of the population is vegetarian, the need for vegetables in our diet is evident (Kundu *et al.* 2020) ^[1]. The contributions of vegetables remained highest (59-61%) in horticulture crop productions over the last five years (Dwivedi *et al.*, 2024) ^[2]. Past studies have revealed that despite the introduction of numerous suitable technologies for vegetable production, there is a huge gap between potential yield and actual yield at farmers' fields in the region due to poor or no adoption of scientific cultivation practices by the farmers. Here, the key environmental and socio-economic factors significantly contribute to the adoption and diffusion of agriculture technologies (Lestrelin *et al.*, 2012) ^[3]. It is, therefore, of paramount importance to ascertain the extent of adoption of vegetable production technologies and to identify the factors that have a significant contribution towards their adoption. Hence, a study was carried out with the specific objectives (1) to determine the extent of adoption of selected improved practices of vegetable cultivation by small farmers and (2) to explore the relationship and contributory influence of personality traits of respondents on their extent of adoption of selected improved practices of vegetable cultivation in the region.

2. Materials and Methods

2.1 Location of study

The present investigation was conducted in 13 districts of the Eastern Himalayan Region consisting of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. The study was limited to those areas where KVKs have been functional for the past 20 years with full strength of scientific staff and necessary infrastructure. Thirteen KVK districts were selected, with 4 from Assam, 2 each from Mizoram and Tripura, and one (1) each from Arunachal Pradesh, Manipur, Meghalaya, Nagaland, and Sikkim chosen for this study (Table 1). From each district, 2 villages i.e. one KVK-adopted village and one non-adopted village based on production potential in different farming systems and relatively closer proximity with the respective KVK were selected for the study.

Table 1: State and Host-wise distribution of selected KVKs with > 20 years of functioning in NE Region

State	KVK	Year of Establishment
Assam	Cachar	1994
Assam	Golaghat	1994
Assam	Kokrajhar	1985
Assam	Sonitpur	1979
Arunachal Pradesh	West Siang	1979
Manipur	Imphal West	1979
Meghalaya	West Garo Hills	1979
Nagaland	Dimapur	1979
Mizoram	Kolasib	1979
Mizoram	Lunglei	1994
Sikkim	East Sikkim	1982
Tripura	South Tripura	1984
Tripura	West Tripura	1979

2.2 Sampling framework

The study covered 260 small farmers, with 20 farmers from each district 10 each from adopted and non-adopted villages, were randomly selected. Any farmer having a land holding size of 1-2 ha (small farmer) in the adopted who had been directly associated with or received technical support from the KVK in carrying out their vegetable farming activities for the last twenty years was considered a respondent (beneficiary). While a farmer respondent from non-adopted village received no or/ least technical support and intervention from KVK under the present study.

2.3 Measurement of variables

The scales developed by Trivedi and Pareek (1964) [4] were adopted to measure socioeconomic variables such as; age, education, caste, family type, and family size were measured with the help of scales developed by Trivedi and Pareek (1964) [4] with slight modifications. The other variables, such as primary occupation, annual income, size of operational land holding, type of primary farming activities, farming experience, training received, mass media exposure, and extension contact were measured with the help of schedules structured for the study.

Improved vegetable cultivation practices and their specific recommendations were listed from a package of practices to measure the extent of adoption by the farmers in the region. The sampled respondents were then given a schedule

with questions against each selected practice, using a 4-point Likert-type scale, with scores of 3, 2, 1, and 0 assigned to each response type. The mean adoption scores were calculated for each practice as well as for all the practices combined. Finally, based on the scores obtained, the respondents were classified into three categories by following the procedure adopted by Dasgupta (1989) [5].

2.4 Data collection

A comprehensive schedule was developed, encompassing all aspects of the personal and socio-economic variables of the respondents, as well as mandated activities such as frontline demonstrations, skill training programs, and other extension programmes/ activities conducted by KVKs in the region. This schedule was finalized after pretesting in a non-sampled area, ensuring alignment with the study's objectives. Data were collected by personally approaching and interviewing the selected respondents at their homes or fields, which enabled the to record the responses of the farmers in the schedule with the help of KVKs scientific staff.

2.5 Statistical analysis

In order to determine the relationship between the extent of adoption of improved vegetable cultivation practices and socio-economic variables, Spearman's rank order correlation of coefficients was calculated by using the given formula-

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

Where, r_s = Spearman's rank order correlation coefficients

d^2 = square of the difference of the corresponding rank

Regression analysis was employed to ascertain the contribution of independent variables on dependent variable by using the following formula-

$Y =$

$$a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13}$$

Where,

Y = dependent variable (extent of adoption of improved vegetable cultivation practices)

a = constant, b = regression co-efficient

x_1 =age, x_2 = education, x_3 = caste, x_4 = family type, x_5 = family size, x_6 = primary occupation, x_7 = annual income, x_8 = size of operational land holding, x_9 = type of primary farming activities, x_{10} =farming experience, x_{11} = training received, x_{12} =mass media exposure and x_{13} =extension contact. The calculated value of 't' was compared with the table value of 't' at 0.05 and 0.01 level of probability.

Fisher 't' test, $t = r\sqrt{\frac{n-2}{1-r^2}}$ with (n-2) d. f.

Where, r = observed co-efficient of correlation, n =number of observation

d. f. =degree of freedom, and $t = \frac{B}{S}$ with (n-k) d.f.

3. Results and Discussion

3.1 Extent of adoption of vegetable cultivation practices

Table 2 indicates that the majority of the respondents (56.15%) were found to have a medium level of adoption of improved vegetable cultivation practices, followed by high (26.93%) and low (16.92%) levels, respectively, among small farmers in (adopted villages). Similarly, over half of the respondents (54.62%) were also observed to have a

medium level of adoption, followed by low (34.61%) and high (10.77%) levels among small farmers in (non-adopted villages) in the study area. The corresponding mean scores of adoption by beneficiary and non-beneficiary respondents indicate that farmers, by and large, practiced improved vegetable cultivation practices notwithstanding the specific recommendations.

Table 2: Extent of adoption of improved vegetable cultivation practices by the small farmers

Category	Score Range	Distribution of Respondents								Mean Difference
		Adopted Village (n ₁ =130)				Non-Adopted Village (n ₂ =130)				
		F	%	Mean	S.D.	F	%	Mean	S.D.	
Low	<16.47	22	16.92	20.45	3.98	45	34.61	18.02	4.25	2.43
Medium	16.47 -24.43	73	56.15			71	54.62			
High	>24.43	35	26.93			14	10.77			
Total		130	100.00			130	100.00			

3.2 Improved practice-wise adoption of vegetable cultivation

The results presented in Table 3 revealed that cent percent of respondents in both adopted and non-adopted villages had reported adoption of improved vegetable cultivation practices like the selection of improved variety/ HYV, selection of seedlings, spacing maintenance (plant to plant distance, and row to row distance), recommended sowing time/ planting time, transplanting in the main field and inter-cultural operations (weeding, thinning, gap filling, etc.). Additionally, two practices, namely recommended dose of manure and fertilizer application, and irrigation management practices were adopted by all respondents in the adopted villages. However, further it reveals that

beneficiary respondents had a higher adoption level of the recommendations under selected practices such as recommended seed rate, soil and seed treatment with bio-agents (Neem Cake @50g and bio-agent *Trichoderma viride* @10g/m² area), recommended doses of manures and fertilizers application and plant protection (IPM/IDM) compared to non-beneficiary respondents as evident from their corresponding total score values against such practices (Table 3). The findings conform with that of the study by Singh *et al.* (2019) ^[5] concerning recommended seed rate, seed treatment, and selection of varieties. The study exhibits a low level of adoption related to IPM techniques by the farmers of both categories was supported by the findings of Chowdhury and Ray (2020) ^[6].

Table 3: Practice-wise extent of adoption of vegetable cultivation practices

Practice	Distribution of Respondents (n ₁ =130, n ₂ =130)											
	To a great extent		To a significant extent		To a little extent		Not at all		Total Adoption		Total Score	
	AV (f ₁)	NAV (f ₂)	AV (n ₁)	NAV (n ₂)	AV (n ₁)	NAV (n ₂)	AV (n ₁)	NAV (n ₂)	AV (n ₁)	NAV (n ₂)	AV (n ₁)	NAV (n ₂)
Selection of improved variety/ HYV	35	24	81	75	14	31	0	0	130	130	281	253
Recommended seed rate	20	2	75	57	15	29	20	42	110	88	225	149
Soil and seed treatment with bioagents (neem cake@50g and bio-agent <i>Trichoderma viride</i> @10g/m ² area)	16	8	56	43	38	13	20	66	110	64	198	123
Selection of seedlings	53	34	59	69	18	27	0	0	130	130	295	267
Spacing maintenance (Plant to plant distance and row to row distance)	41	31	84	78	5	21	0	0	130	130	292	270
Recommended sowing time/ planting time	38	33	92	92	0	5	0	0	130	130	298	288
Transplanting in the main field	54	34	76	77	0	19	0	0	130	130	314	275
Recommended doses of manures and fertilizers application	43	12	77	46	10	52	0	20	130	110	293	180
Interculture operations (weeding, thinning, gap filling etc.)	53	39	73	89	4	2	0	0	130	130	309	297
Plant protection (IPM/IDM)	21	7	70	61	20	22	19	40	111	90	223	165
Water management practices	18	9	58	52	54	60	0	9	130	121	224	191

AV-Adopted Villages, NAV-Non-adopted Villages

3.3 Relationship and influence of personality traits of respondents with and on their extent of adoption of improved vegetable cultivation practices

Data presented in Table 4 show that 5 (five) independent variables namely; education, caste, training received, mass media exposure and extension contact of the farmers in adopted villages showed a positively significant relationship with their extent of adoption of improved vegetable cultivation practices. The variables such as caste, family

type, and extension contact of the farmers in non-adopted villages were found to have a significant relationship with their extent of adoption of improved vegetable cultivation practices as evident from their corresponding 'r' values. This implies that higher the level of these positively significant variables of the respondents, higher would be their extent of adoption of improved vegetable cultivation practices. Interestingly, an increase in annual income from different sources other than farming in both categories of

farmers showed no relationship with their extent of adoption of the improved vegetable technologies. This finding was supported by that of the study conducted by Umar *et al.* (2009) [7] and Singh *et al.* (2019) [5]. The findings regarding caste and educational status of the farmers conformed with that of the study conducted Chowdhury and Ray (2020) [6]. Patel *et al.* (2016) [8] also reported a significant correlation between mass media exposure and extension participation with their adoption of environment friendly practices in vegetable cultivation in Madhya Pradesh. Nasir and Eric (2022) [9] also revealed that extension contact like frequency of advisory contacts, access to market information through mass media exposure etc. significantly influenced farmers' decisions to adopt the improved wheat varieties. Hence, the concerned stakeholders in the region should make more efforts to improve and develop those dominant personality traits through different innovative extension approaches including capacity-building programmes supported by the provision of infrastructure facilities and inputs supply.

Table 4: Relationship and contribution of independent variables towards dependent variable

Independent variables	Adoption of technologies by the farmers (Dependent variable)					
	'r' value		Std. 'b' value		't' value	
	AV	NAV	AV	NAV	AV	NAV
Age	.109	-.012	.030	.006	.302	.056
Education	.197*	-.019	.228	.046	2.252*	.407
Caste	.191*	.208*	.154	.188	1.984*	1.976*
Family Type	.146	.174*	.051	.037	.433	.306
Family Size	.090	.133	.077	.163	.702	1.264
Primary Occupation	.108	-.068	-.091	.005	-.900	.047
Annual Income	.039	.097	.099	.029	.924	.276
Size of Operational Land Holding	.079	.172	.094	.157	.983	1.711
Type of Primary Farming Activities	.169	.150	-.147	-.112	-1.557	-1.081
Farming Experience	.019	.068	-.064	-.028	-.687	-.265
Trainings Received	.176*	.054	.172	.060	1.945*	.325
Mass Media Exposure	.279*	.159	-.082	.038	-.746	.370
Extension Contact	.214*	.197*	.174	.190	1.956*	1.958*
R ² -value			0.429	0.368		

*Significant at 5% level of probability

** Significant at 1% level of probability

AV-Adopted Village, NAV-Non-Adopted Village

The table also revealed that 4 out of 13 independent variables viz; education, caste, training received, and extension contact of the farmers in adopted villages, as shown by their significant 't' values, had significant contribution to their extent of adoption of improved vegetable cultivation practices and were considered as the most dominant factors affecting the adoption improved vegetable cultivation practices by the farmer in adopted villages. While only two variables- caste and extension contact had significant contribution to the extent of adoption of improved vegetable cultivation practices in case of farmers of non-adopted villages. This signifies that those positively significant variables had the highest contribution to the extent of adoption of improved vegetable cultivation practices in study areas. The R² value of 0.429 and 0.368 indicate that all the thirteen independent variables taken

together helped in explaining about 42.90% and 36.80% of the total variation in beneficiary and non-beneficiary respondents' extent of adoption in improved vegetable cultivation, respectively.

4. Conclusion

The study concludes that several important practices, despite their potential to significantly improve vegetable yield quality, were poorly adopted by the majority of respondents in both farmer categories. Technologies that are complex and demand more time and labour were particularly challenging for small farmers to implement according to specific recommendations. Most extension programs conducted by KVKs in remote areas, as well as information shared orally among farmers in adopted villages, were insufficient to enhance the adoption level of vegetable technologies. Additionally, many KVK scientists lacked specialization in extension, meaning they were generally not familiar with training methodologies and extension concepts. Therefore, proper training in conducting farmer training and engaging other stakeholders is essential for these scientists (Rohit *et al.*, 2020). The findings also suggest that extension agencies and other relevant departments should focus on influencing key factors through concerted extension efforts, providing financial assistance, and strengthening marketing facilities to bring about desirable changes in farmers' adoption behaviour towards improved vegetable technologies in the region.

5. Competing Interests

The authors have declared that no competing interests exist.

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