Estimating the Correlates of Adoption Gap in Scientific Broccoli (*Brassica oleracea* var. *italica*) Cultivation

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ABSTRACT

In the changing climate scenario, there is a need for promoting awareness on high value vegetable cultivation in a scientific manner along with the quality assured way to ensure the sustainable livelihood status of the rural poor in our country. The knowledge intensive society always emphasizes the creativity and the positive adoption behaviour of the rural peasants for empowering them towards their access to social resources. It is obvious to know the adoption gap as a complex phenomenon arises with the help of mutual interactions between different socio-personal and socio-economic attributes of human being to refocus the adoption behaviour of an individual on any newly introduced crop. In such a research perspective the present study was conducted to estimate the adoption gap of the hi-value vegetable, broccoli growers with respect to their biophysical, socio-economic and socio-psychological attributes. The study was conducted at Cooch Behar-II block of West Bengal. The purposive as well as multistage random sampling procedures were followed to select the respondents of the study. The adoption gap was operationalized as a consequent variable. Fourteen antecedent variables were selected for the present study to explore the contribution in characterising the adoption gap of broccoli farmers. The data were collected with the help of structured interview schedule through personal interview method. The collected data were processed through descriptive statistics, correlation analysis and multiple regression analysis. The antecedent bio-physical variables like curd width, curd weight, yield; the socio-economic antecedent variables namely education , economic status, benefit cost ratio and horizontal expansion and the socio-psychological antecedent variables like risk orientation and knowledge were found strongly and negatively associated with adoption gap of broccoli farmers. The predictor variables namely benefit cost ratio, effective farm size and economic status were strongly and negatively contributing in case of characterising the adoption gap of broccoli farmers. The antecedent variables altogether explained 86.20 % variations embedded with the consequent variable, adoption gap of broccoli growers.

***Key words**: Broccoli growers; Bio-physical and psychological orientation;*

To avert the risk of climate change in case of traditional vegetable cultivation, the quality assured high value vegetable cultivation plays the pivotal role in case of delineating the sustainable livelihood pattern of the vegetable growers in our country. The high value vegetable has the potentiality to replace the traditional vegetable in rural areas for generating empowerment and augmenting the annual earning of the rural family. Broccoli being a high value vegetable has the potential to replace the traditional vegetable like cauliflower due to its market demand, nutritional efficiency and it can be grown to diversify the cropping pattern in the niche of climate change. Among the cole crops, broccoli is more nutritious than other cole crops. It is fairly rich in carotene and ascorbic acid and appreciable quantities of thiamine, riboflavin, niacin and iron (*Thapa and Rai, 2012*). Apart from this, broccoli also contains anti cancer properties such as diindolylmethane and small amounts of selenium. The diindolylmethane found in broccoli is a potent modulator of the innate immune response system with antiviral, anti bacterial and anti cancer activity. Broccoli also contains the compound glucoraphanin which can be processed into an anti cancer compound sulforaphane (*Mukherjee and Mishra, 2012*). Because of the medicinal and nutritive value, there is tremendous demand for broccoli in domestic and foreign

market. As a consequence the cauliflower growers of Cooch Behar and other surrounding districts of Terai zone of West Bengal are gradually adopting the broccoli cultivation (*Saha et al., 2006*).

The above mentioned facts reveal that in West Bengal there is a lot of scope to grow the high value vegetable like broccoli in scientific manner to ensure nutritional status and sustainable livelihood of rural poor. It would not be exaggerative that broccoli can also be an alternative to the rural farming community within a basket of high value vegetables. In the knowledge intensive society the scientific knowledge of growing such a sensitive high value vegetable inculcates the adoption and diffusion of information associated with broccoli cultivation. The adoption of any scientific practice is a complex decision due to its multi co-linearity nature. So, adoption of scientific broccoli cultivation needs special consideration of different biophysical socio-economic and socio-psychological attributes of the growers. The imprint of analyzing the adoption gap delineates the clear and reckoning reasons behind adoption and horizontal expansion of any newly introduced crop. The food self sufficiency cannot give impetus to the national economy by developing different mechanism to utilise the available resources but also the movement should be created to earn foreign exchequer by giving due importance to the exportable agricultural products (*Saha et al, 2011*). The intensive agricultural approach basically laden with ideas of high cost and high return enterprises had led our society to move pro-adoptive rather than pro-adaptive in regard to responding package of technologies recommended by the technology generating ends (*Pradhan et al, 2009*). The adoption gap implies the appropriate strategy mover for preparing a plan to reorient the farming community towards socialization of any new technology (*Suman, 2012*). Keeping all these in view, the present paper envisages the estimation of adoption gap of the broccoli growers with respect to their social attributes.

METHODOLOGY

The study was conducted at Cooch Behar-II block of West Bengal. The purposive as well as multistage random sampling procedures were followed to select the respondents of the study. The district, block and village were selected purposively as the area had been highly potential with respect to broccoli cultivation and demographic advantages. An exhaustive list was prepared with the help of block and panchayat officials. From the exhaustive list, hundred respondents were selected through simple random sampling procedure. Fourteen antecedent variables were selected for the present study to explore the contribution in characterizing the adoption gap of broccoli farmers. The data were collected with the help of structured interview schedule through personal interview method. The collected data were processed through descriptive statistics, correlation analysis and multiple regression analysis.

RESULTS AND DISCUSSION

Table 1 presents the distribution of respondents according to the biophysical characters of broccoli and social attributes of broccoli growers. The variable curd width was distributed with a coefficient of variation (CV)

Table 1. Distribution of the predictor and predicted variables

Predicted Variables	Range	Mean	SD	CV
Adoption gap of technology	55-75.26	61.86	4.16	6.72
Predictor variables				
Curd width of Broccoli (X_1)	8.5-10.00	8.74	0.27	3.13
Curd weight of Broccoli (X_2)	734-790.00	746.23	9.68	1.30
Yield of Broccoli (X_3)	30-34.84	32.29	1.21	3.76
Benefit cost ratio of Broccoli (X_4)	3.66-4.11	3.82	0.10	2.51
Age (X_5)	29-48.00	38.45	4.66	12.11
Education (X_6)	3-14.00	7.74	2.46	31.84
Family size (X_7)	4-8.00	5.80	1.17	20.23
Educational aspiration (X_8)	4-10.00	7.04	2.10	29.78
Total farm size (X_9)	4-16.00	7.58	2.05	27.00
Effective farm size (X_{10})	0.3-1.30	0.78	0.21	26.77
Economic status (X_{11})	7-16.00	11.21	2.78	24.81
Risk orientation (X_{12})	14-35.00	26.58	2.72	10.24
Knowledge (X_{13})	6-9.04	6.80	0.79	11.64
Horizontal expansion (X_{14})	1-9.00	2.90	1.64	56.38

value of 3.13 which shows higher consistency of the distribution. The biophysical attributes like curd weight and yield were distributed with higher level of consistency. The distribution pattern of socio economic variables like benefit cost ratio, education, farm size, educational aspiration, total farm size, effective farm size, economic status, risk orientation and knowledge showed the higher level of consistency in distribution. The variables like horizontal expansion distributed with a low level of consistency. The dependent variables of adoption gap distributed with higher level of consistency.

Table 2 envisages the correlation coefficient of fourteen predictor variables with respect to adoption gap. The biophysical parameters like curd width, curd weight, yield and benefit cost ratio had negatively and significantly associated with the adoption gap of broccoli growers. The variable curd width and curd weight basically contributes to the yield and benefit cost ratio. In case of broccoli yield and benefit cost ratio are the function of curd width and curd weight. These four predictor variables are basically contributing to the relative advantage of the high value vegetable broccoli over the traditional vegetable cauliflower. So the higher degree of relative advantage leads to the negative adoption gap of broccoli growers with respect to scientific broccoli cultivation. These may be the plausible reason in case of explaining the significant and negative association between the four biophysical predictor variables and the adoption gap of broccoli growers. The socio personal variable of education had been significantly and negatively associated with the adoption gap of broccoli growers. A movement in a negative direction on the ladder of education had made the respondent enough critical to the available choices. Education increases the exposure of an individual towards any new innovation that is why the variable education is negatively associated with the adoption gap of broccoli growers. The variable economic status had also negatively and significantly correlated with the adoption gap of the broccoli growers. The well off section of the society can take the venture to go along with the new innovation. They have the efficiency to become more venturesome and cosmopolite in nature which ultimately help them to seek information regarding new practices. That's why the variable economic status had shown negative association of adoption gap of broccoli growers. Risk orientation of broccoli growers had also significantly and negatively associated with the adoption gap of broccoli growers. Risk or uncertainty is the inevitable phenomenon in case of adopting new innovation. The individual with higher level of risk orientation can predict the threat embedded with the innovation and simultaneously manage the enterprise with the help of their own acumen and resources. This may be the reason; the variable risk orientation had shown negative association with adoption gap of broccoli growers. The variable knowledge regarding the cultivation practices had recorded a negative and significant correlation with the adoption gap of broccoli growers. Knowledge about anything makes a trivial individual to a swashbuckling one. It increases the confidence of an individual to practice the innovation through building an epitome of cognitive attributes regarding any innovation. That's why the variable knowledge had shown negative association with adoption gap of broccoli growers. The variable horizontal expansion had also shown negative and significant correlation with the adoption gap of broccoli growers. Horizontal expansion implies the expansion of innovation from one end to another. The expansion and adoption are mutually exclusive phenomenon as expansion occurs through adoption. If adoption gap increases automatically the expansion of the technology decreases. These may be the plausible reason behind the negative association

Table 2. Correlation coefficient (r) of adoption gap with respect to predictor variables

Variables	(r)
Curd width of Broccoli (X_1)	-0.701**
Curd weight of Broccoli (X_2)	-0.627**
Yield of Broccoli (X_3)	-0.687**
Benefit cost ratio of Broccoli (X_4)	-0.872**
Age (X_5)	0.098
Education (X_6)	-0.345*
Family size (X_7)	-0.089
Educational aspiration (X_8)	-0.179
Total farm size (X_9)	-0.167
Effective farm size (X_{10})	-0.152
Economic status (X_{11})	-0.297**
Risk orientation (X_{12})	-0.710**
Knowledge (X_{13})	-0.697**
Horizontal expansion (X_{14})	-0.567**

** Significant at 1% level of significance

* Significant at 5% level of significance

between horizontal expansion of broccoli cultivation and the adoption gap of broccoli growers.

Table 3 explores the multiple regression analysis of adoption gap with respect to fourteen predictor variables. The astounding fact is that the variables benefit cost ratio of broccoli enterprise, effective farm size for broccoli cultivation and economic status of broccoli grower are contributing significantly and negatively in case of characterizing the adoption gap of broccoli growers in presence of other predictor variables. The increased level of benefit cost ratio, effective farm size, economic status make a farmer more endowed with knowledge, exposure and new information. Ultimately it helps in case of taking risk to fully practice the new innovation in their own field with the help of their resources. Consequently, these variables exert the negative impact in case of characterizing the adoption gap of broccoli growers.

Table 3. Multiple regression analysis of adoption gap with respect to predictor variables

Variables	β	'b'	SE of 'b'	't'
Curd width of Broccoli (X_1)	-0.035	-0.528	2.990	-0.177
Curd weight of Broccoli (X_2)	-0.093	-0.039	0.079	-0.503
Yield of Broccoli (X_3)	-0.102	-0.349	0.327	-1.068
Benefit cost ratio of Broccoli (X_4)	-0.714	-30.948	5.631	-5.496**
Age (X_5)	0.045	0.040	0.048	0.832
Education (X_6)	-0.069	-0.116	0.120	-0.971
Family size (X_7)	0.005	0.018	0.228	0.079
Educational aspiration (X_8)	0.007	0.014	0.115	0.129
Total farm size(X_9)	-0.016	-0.033	0.207	-0.159
Farm size (X_{10})	0.261	0.052	1.560	3.336**
Eco. status (X_{11})	-0.339	-0.507	0.155	-3.261**
Risk orientation (X_{12})	0.014	0.021	0.128	0.161
Knowledge (X_{13})	0.084	0.443	0.530	0.835
Horizontal expansion (X_{14})	-0.116	-0.295	0.169	-1.751

R^2= 0.862 ** Significant at 1% level of significance

The R^2 value being 0.862, it is to infer that altogether the fourteen predictor variables had explained 86.20 per cent variation embedded with the adoption gap of broccoli growers. Still 13.80 per cent variation is left unexplained. There is a scope to incorporate more number of contextual and realistic predictor variable in future study.

Table 4 reflects the factor analysis of fourteen predictor variables and one consequent variable for an intrinsic conglomeration of the variables to form a homophilous group or factor. The minimum level of factor loadings (0.521) is considered to have such conglomeration. It's found that association of variables for factor-1 has been comprised of curd width (X_1), curd weight (X_2), yield (X_3), benefit cost ratio (X_4), knowledge (X_{13}), horizontal expansion (X_{14}) and risk

Table 4. Factor analysis of predictor variables

Variables	Factor loadings	Square loadings	% of variance	Cumulative %	Rename
Curd width of Broccoli (X_1)	0.814	5.862	39.079	39.079	Biophysical and psychological orientation
Curd weight of Broccoli (X_2)	0.712				
Yield of Broccoli (X_3)	0.846				
Benefit cost ratio of Broccoli (X_4)	0.947				
Risk orientation (X_{12})	0.769				
Knowledge (X_{13})	0.835				
Horizontal expnsion (X_{14})	0.555				
Education (X_6)	0.583	2.844	18.959	58.038	Socio-economic and educational exposure
Total farm (X_9)	0.880				
Effective farm size (X_{10})	0.819				
Economic status (X_{11})	0.908				
Age (X_5)	-0.715	1.408	9.385	67.423	Socio-personal belongingness
Educational aspiration (X_8)	0.703				
Family size (X_7)	0.831	1.189	7.927	75.351	Family structure

Factor loadings>0.521

orientation (X_{12}) and the factor can be renamed as *biophysical and psychological orientation*. The percent of variance explained by this factor has been 39.079 and eigen value is found 5.862. The 2nd factor has encompassed 4 variables namely education (X_6), total farm size (X_9), effective farm size (X_{10}) and economic status (X_{11}) and can be renamed as *socio-economic and educational exposure*. This factor has explained 18.96 per cent of variance and eigen value is found 2.84. The 3rd factor comprises variables namely age (X_5) and educational aspiration (X_8) and can be renamed as *socio-personal belongingness*. This factor has explained 9.385 per cent of variance with eigen value of 1.408. The 4th factor has reticulated with one variable farm size and can be renamed as farm structure. It has explained 7.927 per cent of variance with Eigen value 1.189.

CONCLUSION

In the realm of climate change there is a need to promote scientific, quality assured high value vegetable for replacing the traditional vegetable to avert the climate change discourse. Also the scientific farming practices of high value vegetable ensures the exchequer from local as well as international markets for promoting their sustainable livelihood status in our country. The overwhelmed response of the vegetable growers from different corners of the country regarding high value vegetable cultivation once again proved the efficacy of market oriented enterprise development and manifestation. The broccoli being an alternative and remunerative vegetable in West Bengal has already established its worth towards sustainable livelihood promotion and nutritional security. In the light of this, the present study identified the biophysical and social correlates of adoption gap of broccoli growers of West Bengal. The present study concludes that the bio-physical parameters obviously played an important role for adoption of broccoli in West Bengal. Emphasis should also be given to the attributes like education, effective farm size, economic status, risk orientation and knowledge of the broccoli growers for its further promotion and minimize the adoption gap embedded with broccoli cultivation.

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