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Technological responsiveness of organic production system in *Terai* region of West Bengal, India

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Abstract

Organic agriculture has witness multi-dimensional growth rate in India as farmers has been adopted it for varied reasons. These reasons sometime were high input intensive conventional agricultural, then understanding ill effects of conventional agriculture in the form of reduced soil fertility, food toxicity or increasing cost and diminishing returns. Then arises farmers organizations, those systematically adopted the commercial organic agriculture to capture emerging market opportunities and premium prices. During the study many witnesses come into front where farmers were practicing traditional method to grow food crops without any organic input. This study was focused to understand the categories of farmers by measuring their level of awareness about recommended organic producing technologies and other influential socio-economic variables. To measure the awareness level of farmers about organic farming technologies and to understand the relationship between socioeconomic variables and awareness about organic farming technologies. The Terai region of West Bengal i.e., Coochbehar, Jalpaiguri, and Alipurduar were selected purposively for the study. The study revealed that respondents had a high level of awareness of nutritional supplement techniques, plant protection techniques, and soil & cultural practices, but moderate awareness was found in growth-promoting techniques. Coochbehar, Jalpaiguri, and Alipurduar districts were at par in respect of awareness of growth promoter techniques and plant protection techniques but were statistically different in case of soil & cultural management techniques, Socio-economic characteristics like possession of assets, participation in social organizations, and a number of trainings received by them had significantly influenced the level of awareness on organic farming.

Keywords: Awareness level, organic farming, organic soil health management, cultural practice, nutrient inputs, growth promoter, plant protection technologies, terrain of India

1. Introduction

Organic farming is a buzzing word among all modern agricultural practices in recent era as it not only provides healthy food, soils, plants, and environments but also ensure long term sustainability of the production system (Makadia and Patel, 2015; Tsvetkov *et al*., 2018) [11, 19]. This is one of the agricultural interventions with a combination of crop production with traditional wisdom with a good blend of modern non-chemical technologies (Brković *et al*. 2016) [1]. There are several benefits of organic farming, these are nutritional benefits and health safety; environmental impact; and Socio-economic impact (Das *et al*, 2020) [5]. Simultaneously, consumer preference also changed over the decade, growing consciousness about non-chemical treated food, food with no added preservatives, indigenous or local variety of crop, increases demand of organic farming (Jansen, *et al.* 2020) [8]. Various public and private extension interventions help to motivate farmers to shift towards organic farming, hence created awareness and knowledge about organic farming and related innovative technologies. The major solution for the problem of present agricultural society and of natural resource degradation may be development and promotion of organic farming (Chabet, 2021) [4]. In Palaghar region of Maharashtra, majority of the consumers were aware of organic vegetables and ready to pay premium price up to 5 to 10 percent, the legislative measures and government assurance would be effective in ensuring trust and quality of organic vegetables. Although majority of the customers were aware about the health risks of consumption of inorganic vegetables but still, they prefer to buy inorganic vegetables only. The reasons for this tendency of the consumers were found out as non-availability of organic vegetables and also the issues of identification (Raval, 2019) [17]. Similarly horticultural farmers of Khordha district of Odisha were aware of all the organic farming practices though they were not using them regularly, probably due to some constraints such as time consuming, transportation, inadequate credit facilities, and

inadequate storage facility, climate change, capital intensive, lack of extension agents, technical know-how (Patro, 2016) [14]. In case of Uttarakhand, around 40 percent of the farmers had favorable believe towards organic farming and were about basic facts of organic farming such as it sustainability, health benefits and non-permissibility of chemical fertilizers and herbicides (Singh and George, 2012) [18]. High awareness of organic farming was observed among the undergraduate students of a Nigerian University but had inadequate knowledge on certification procedures causing slow rate of adoption (Iyagba and Amesi, 2016) [7]. With the increasing demand for organic products necessities the assessment of farmer's knowledge level, awareness level and level of adoption regarding scientific management of organic crop cultivation and livestock farming as well. So that research can effective boost organic farming among different communities in India (Johnson *et al*, 2023) [9].

Terai region of West Bengal has recently come forward to practice organic farming although it was introduced in around 10-15 years ago but confined within limited farming clusters. Due to pro-active efforts of both public and private extension agents' awareness on organic farming technologies increased manifold in recent years. In this context, awareness of the farmers regarding organic production technology in *Terai* region of West Bengal were taken into consideration in the present study.

2. Materials and Methods

The *Terai* region of West Bengal constitute with the plains of Darjeeling district, total landmass of Jalpaiguri and Alipurduar and upper region of Cooch Behar district in the Northern part of West Bengal. Among these, Cooch Behar, Jalpaiguri and Alipurduar district were selected for the study purposively. Organic clusters had been selected from each district purposively based on the information gathered from office of Dy. Director of Agriculture of respective districts. A sample of 450 farmers was selected randomly from certain organic farming areas of these districts taking 150 farmers from each of Cooch Behar, Jalpaiguri and Alipurduar district.

A list of organic technology exposed to the respondents and asked whether it was known to the respondent; and whether they adopted it or not. Organic technologies on Soil Health Management, Cultural Practice, Nutrient Inputs, Growth Promoter and Plant Protection were taken into consideration, and collected responses with the help of a two-point scale indicating "yes" or "no" with corresponding scores of 1 and 0 respectively. The list of organic technology was collected from (Hanglem, 2017 and Karthika, 2013) [6, 10] and vetted by the experts from the University and the State Line Department officers. Those technologies were only considered in final list which shown discrimination (in Reliability analysis) over different types of respondents during pilot survey.

In the present study, maximum and minimum value of data set, mean, standard deviation, covariance was calculated of each of the selected districts. Then, technology-wise percentage of different levels of awareness (low, medium and high) was analyzed. A Tukey test is a post-hoc test, which applied in this research data set to understand homogeneity between districts regarding awareness on organic techniques. To find out Area-wise Awareness Quotient (AQ) on different organic production techniques F-ratio was used. Measurement of average Awareness Quotient helps researcher to understand ability to reflect hypothesis and findings without judgement or bias or negative feelings. Correlation coefficients are indicators of the strength of the linear relationship between two different variables x and y, here in this study socio-personal characters (x) and awareness level on all organic technology (y).

3. Results and Discussion

3.1 Demographic variables and their nature of distribution in the sampling area:

Table 1 depicts listed socio-economic variables their district wise and overall distribution. Overall findings from the present study that responding farmer were between the age of 29 years to 65 years with 45 years as mean age. Education level of respondents ranges from illiterate to secondary level. Both nuclear and joint families were found among the respondents of the study area with number of family members ranging from 2 to 10. The average number of family members found was 3- 4 (table value 3.67 ~ 4) per family. Land holding of the respondents ranged from 1 acre to 10 acre with mean holding of 3.2 acre on an average.

Table 1: Descriptive statistics of the sample (N=450)

Socio-personal characters	Scale	Segregation	Min.	Max.	Mean	Std. Deviation	Co-variance
Age	Chronological Year	COB	32	65	46.33	7.451	55.523
		JAL	29	57	45.21	6.408	41.062
		APD	37	64	44.29	5.263	27.697
		Overall	29	65	45.28	6.462	41.756
Education	Number years acquired for formal education	COB	1	3	2.08	0.487	0.237
		JAL	1	3	2.00	0.435	0.189
		APD	1	3	2.13	0.445	0.198
		Overall	1	3	2.07	0.457	0.209
No of family member	Number	COB	2	10	3.43	1.286	1.653
		JAL	2	6	4.03	1.039	1.080
		APD	2	6	3.56	0.962	0.925
		Overall	2	10	3.67	1.129	1.275
Land holding	Acre	COB	2	8	3.45	1.422	2.021
		JAL	2	5	3.04	0.574	0.329
		APD	1	10	3.11	1.142	1.305

		Overall	1	10	3.20	1.114	1.240
Agricultural asset possession	Sum of score assigned to different agricultural assets	COB	2	10	5.60	1.860	3.459
		JAL	4	10	5.91	0.701	0.491
		APD	3	15	6.24	1.880	3.536
		Overall	2	15	5.92	1.594	2.542
No. of training received	Number	COB	0	20	2.65	2.638	6.959
		JAL	3	4	3.77	0.421	0.178
		APD	0	4	1.87	1.427	2.036
		Overall	0	20	2.76	1.909	3.645
Social participation	No. of organisations participated as member	COB	0	1	0.91	0.293	0.086
		JAL	1	1	1.00	0.000	0.000
		APD	0	1	0.85	0.356	0.127
		Overall	0	1	0.92	0.272	0.074
Outside contact	Sum of score assigned to visit on outside places	COB	1	9	2.12	1.542	2.377
		JAL	3	6	3.75	0.931	0.867
		APD	1	3	1.37	0.749	0.561
		Overall	1	9	2.41	1.498	2.244
Contact to extension personnel	Sum of scores assigned for contact with different extension personnel	COB	7	15	10.17	1.696	2.875
		JAL	8	13	11.33	1.266	1.604
		APD	7	13	10.31	1.808	3.270
		Overall	7	15	10.60	1.682	2.829
Mass media exposure	Sum of scores assigned for contact with different mass medial	COB	5	15	8.81	2.045	4.181
		JAL	6	12	8.37	1.440	2.075
		APD	5	15	7.56	2.662	7.088
		Overall	5	15	8.25	2.163	4.679

Agricultural asset possession was assessed by possession of draught animals, power tillers, tractor, sprayer, duster, pump set other minor equipment etc. with assigned scores as per their monetary value with 1 score; and it was found that asset score varied from 2 to 15. Mean asset possession of 5.92 score denotes that the respondent families were having lower level of agricultural asset possession.

In case of training received, it was found that the responding farmers had taken 1 (table value 2.76 ~3) numbers of training on an average ranging from no training to a maximum of 10 numbers of trainings per respondent. Social participation was the membership of different social organizations like groups, clubs etc. and it was found that respondents were engaged with maximum 1 village level organizations, which may be said that they had a low level of social participation. Each and every farmer and farm woman are associated with at least one such social group for their own development. Whereas, outside contact was calculated on the basis of frequency of visit to places for promotion of their farming practices and respondents scored up to 9 as maximum limits with mean score of pretty less as 2.41 per respondent.

Score of contact to extension personnel varies from 7 to 15 with average value of 10.60 which indicates that *terai* farmers are maintaining good contact with extension agents to gather agricultural information. Mass media score ranges between 5 to 15 with mean score of 8.25 indicates that they are also in exposure with the proper influential factors that may be utilized for their behavioural change towards adoption of organic farming practices. These results had resemblance with past researchers as well (Poyyamoli and Padmavathy, 2011) [15].

In this study four organic production technologies were considered to understand their level of awareness and, categorized in low level (up to 33.33%) of awareness score against each technology), similarly for moderate level (more than 33% to 67%) for high level (more than 67% score). To better understanding this distribution further grouped as per their level of awareness

It can be revealed from the figure a. that on average 24- 26 percent from the study area had low level of awareness about different organic production technologies.

Then if we compare figure (b & c) then it can be understood that for nutritional supplementary techniques 40 percent of the respondents are in moderate category and 21 percent have high level of awareness, followed by Growth Promoting techniques 39 percent again in moderate category and 11 percent only had high level of awareness.

For plant protection and soil & cultural management techniques majority respondents had higher level of awareness i.e., 31 percent and 37 percent respectively.

Table 2: Technology-wise distribution of level of Awareness level

Type of technology	Awareness level (N=450)		
	Low (up to 33%)	Moderate (>33 to 67%)	High (>67%)
Nutritional supplementary techniques	21.3	34.70	44.00
Growth promoting techniques	22.2	34.30	22.20
Plant protection techniques	21.3	15.60	63.10
Soil & cultural management techniques	21.3	3.10	75.60

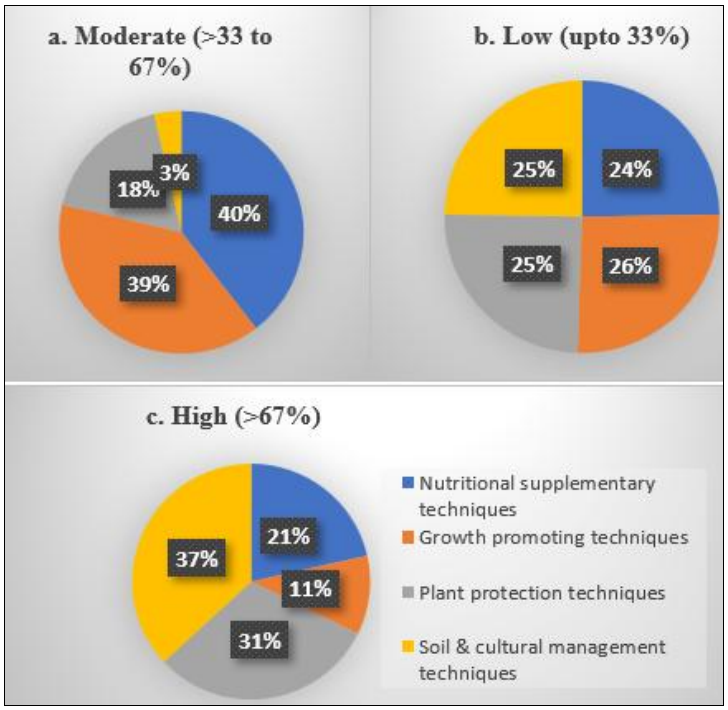

Fig 1: Distribution of respondents according to the levels of awareness on organic technology (N=450)

3.2 The following section depicted the technology-wise awareness level

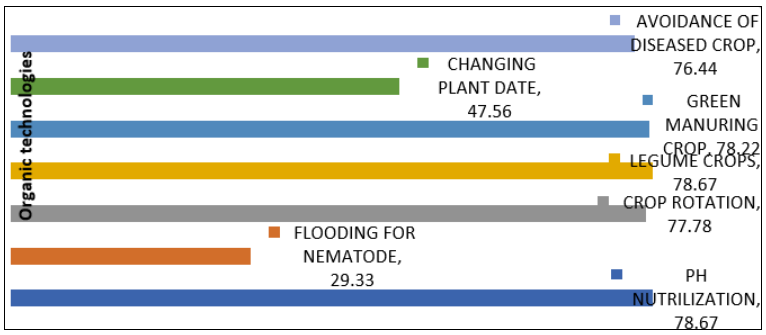

Fig 2: Percentage of respondents aware of cultural practices for organic farming

It is clearly visible from the Fig 2. that more than three fourth (76.44%) respondents had aware about avoidance of disease crop; followed by 78.22 percent on green manuring crop, 78.67 percent on legume crop, 77.78 percent on crop rotation, 78.67 percent aware on pH neutralization technologies but very few (29.33%) of them knew about flooding technique to eradicate nematode from the effected field as well as for change of planting date to avoid disease and insect attack (47.56%) as a cultural practice. Again, there are similarities with other researchers [14].

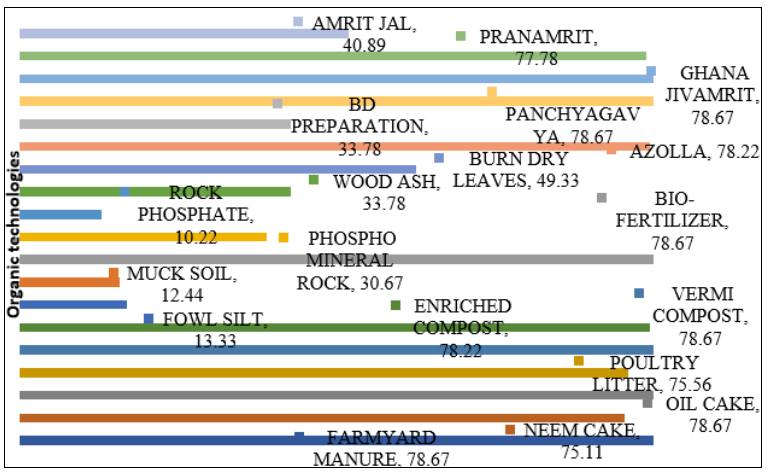

Fig 3: Percentage of respondents aware of nutritional technologies for organic farming

Figure 3. depicts that more than three forth (77.78%) of the respondent had awareness about Pranamrit; followed by 78.67 percent each on ghanajivamrit, panchyagavya, bio-fertilizer, vermi-compost, oil cake and farmyard manure; 78.22 percent of the were aware about azolla and enriched compost; 75.56 percent on poultry litter, and 75.11 percent on neem cake. But less than half (49.33%) of them had aware about burn dry leaves as a source of nutrient, followed by 40.89 percent aware about amritjal, 33.78 percent of them aware about BD preparation and wood ash; very few of them (13.33 percent, 12.44 percent, 10.22 percent respectively) were aware about fowl silt, muck soil, rock phosphate respectively as because these nutritional technologies for organic farming were less popular among farmers to provide nutritional requirement to plant. These results as per with past researchers as well (Nenna and Ugwumba, 2014; Benabise and Banciles, 2012; Charyulu and Biswas, 2010) [12, 2, 3].

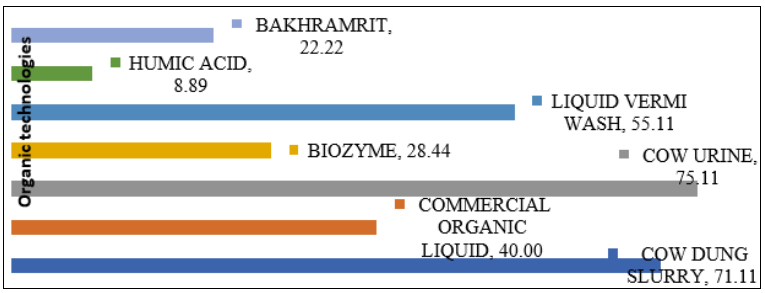

Fig 4: Percentage of respondents aware of growth promoters for organic farming

Figure 4, indicates that nearly three fourth (75.11%) of respondents were aware about cow urine as growth promoters for organic farming, followed by 71.11 percent, 55.11 percent and 40.00 percent were aware about cow dung slurry, liquid vermi wash and commercial organic liquid respectively. But very of them (28.44 percent and 22.22 percent) were aware about biozyme and bakhramrit respectively; only 8.89 percent about humic acid as because availability of biozyme in market was very limited, bakhramrit was practiced only few patches as supplementary product of cow dung and popularity or usage of humic acid as a growth promoter was not up to the mark.

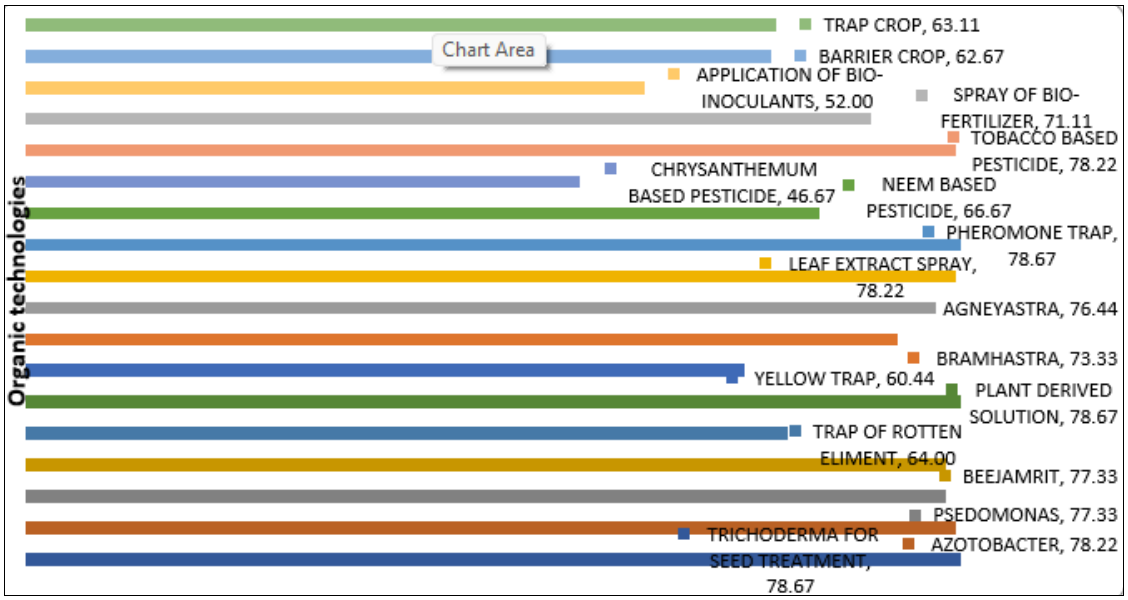

Fig 5: Percentage of respondents aware of plant protection technologies for organic farming

Figure 5 reveals about awareness on plant protection technologies for organic farming. More than three forth (78.67%) of responding farmers were aware about pheromone trap, plant derived solutions, Trichoderma for seed treatment; 78.22 percent were aware about tobacco-based pesticide, leaf extract spray, Azotobacter. 77.33 percent were aware about Beejamrit (for seed treatment) and Psedomonoas; 76.44 percent about Agneyastra (sucking pest and insect); 73.33 percent about Bramhastra (heavy insect infestation); 71.11 percent about spray of biofertilizer; 66.67 percent about neem base pesticide. 64.00 percent were aware about trap of rotten elements (rotten fish, snails etc.) which was reported effective for controlling *gundhi* bug (*Leptocorisa acuta* L. *varicornis*) in rice field. 63.11 percent were aware about trap crop (marigold flower) to control soil borne pathogens; 62.67 percent about barrier crop; 52.00 percent about application of bio-inoculants; and 46.67 percent about chrysanthemum-based pesticide. Nearly half to three fourth of respondents were aware about plant protection technologies for organic farming as because of the influence of age-old traditional knowledge, intervention of public extension functionaries about pheromone trap, Trichoderma and Azotobacter etc.

3.3 Area-wise distribution of level of Awareness level of Selected Respondents

Table 3: Multiple comparisons for homogeneity of districts regarding awareness on organic techniques (Post-hoc Tukey test)

R	Cooch Behar	Jalpaiguri	Alipurduar
C	Mean difference (R ~ C)		
Nutritional Supplementary Techniques			
Cooch Behar	0.00	2.24*	2.15
Jalpaiguri	2.24*	0.00	0.09
Alipurduar	2.15	0.09	0.00
Growth Promoting Techniques			
Cooch Behar	0.00	1.09*	1.60*
Jalpaiguri	1.09*	0.00	0.50
Alipurduar	1.60*	0.50	0.00
Plant Protection Techniques			
Cooch Behar	0.00	3.26*	4.32*
Jalpaiguri	3.26*	0.00	1.06
Alipurduar	4.32*	1.06	0.00
Soil & Cultural Management Techniques			
Cooch Behar	0.00	0.64	0.79
Jalpaiguri	0.64	0.00	0.16
Alipurduar	0.79	0.16	0.00
All Organic Techniques			
Cooch Behar	0.00	7.23*	8.86*
Jalpaiguri	7.23*	0.00	1.63
Alipurduar	8.86*	1.63	0.00

*Significant at 5% level

Table 4: Area-wise Awareness Quotient on different organic production techniques

Type of organic technology	Average Awareness Quotient (AQ)			F-ratio	*p*-value
	Coochbehar (n=150)	Jalpaiguri (n=150)	Alipurduar (n=150)		
Nutrition supplementary techniques	0.467	0.579	0.575	3.526	.031
Growth promoting techniques	0.303	0.460	0.532	10.137	.000
Plant protection techniques	0.562	0.743	0.802	7.862	.001
Soil & cultural management techniques	0.599	0.690	0.712	2.021	.135
All organic techniques	0.496	0.635	0.666	5.700	.004

Table 3 and 4 illustrates about variability of awareness level among selected districts on different types of organic technology by analyzing mean difference.

Awareness level on nutrition supplementary techniques, growth promoting techniques and plant protection techniques are having significant difference among these districts. But, for soil & cultural management techniques districts were at par the table. To precisely know between which pair of districts the significant difference lies, a post-hoc test was employed.

Table 4 indicated the mean difference between selected districts about awareness on organic techniques. In case of nutritional supplementary techniques, Coochbehar and Jalpaiguri district had significant difference about awareness of farmers, whereas there is significant difference between Coochbehar & Alipurduar; and between Jalpaiguri & Alipurduar districts. The same result was found in case of growth promoting techniques and plant protection techniques, and H_0 is rejected in the case; whereas, all the districts are at par in case of soil & cultural management techniques which have already been found in table-4.

Similarly in the studies of Raghavendra *et al.* (2023) [16] indicated awareness level was different among farmers of Andhra Pradesh compared to Karnataka regarding e-marketing but promotion of more participation in the efficient marketing system can boost the awareness and knowledge level.

3.4 Level of Awareness of overall Organic technologies and association of socio-economic variables

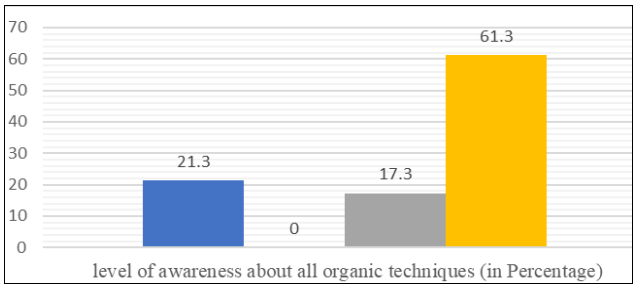

Fig 6: Level of overall awareness about all organic techniques

Table 5: Correlation between socio-personal characters and awareness level on all organic technology

Socio-personal characters	r- value
Age	0.010
Education	0.109
No of family member	0.091
Land holding	0.026
Asset possession	0.271**
Training received	0.158*
Social participation	0.198**
Contact with extension personnel	0.122
Mass media contact	0.070
Outside contact	0.098

**significant at the 0.01 level; *significant at the 0.05 level

Correlation coefficients (table 5) were calculated between awareness level and socio-personal variables of the respondents. As per the tabulated data asset possession, social participation had significant relationship with awareness at 1% level of significance, whereas training received was significant at 5% level. Although, age, education, no. of family members, land holding, contact with extension personnel, mass media contact, outside contact had no relation with awareness level on organic technology. The probable reason might be as organic farming is a labor-intensive agricultural practice higher asset possession helps to create interest and awareness about it among farmers; again, it is quite obvious that number of trainings received create more awareness about organic farming; and social participation is also influence individuals to aware and adopt this innovative agricultural technology to retrieve soil fertility and maintain long term sustainability of agricultural farm. Therefore, H_1: there is no relationship between socio-economic variable (Asset possession, Training received, and social participation) and awareness level on all organic technology is rejected.

In the studies of Patra *et al* (2023) [13] showed knowledge level of maize growers of Nagaland had significant relationship with their age, family size, mass media, social participation and education had significant relationship with their adoption level.

4. Conclusion

Terai farmers from selected clusters are between of 29 years to 65 years of age group with illiterate to secondary level of education, belongs from 2 member to 10-member family and with 0.33 acre to 3.33-acre land holding. They are having at least one pair of draught animals or sprayer or duster or harrow or pump set or any minor equipment, on an average attended 2 training programmes; engaged with maximum 2 village level organizations. From the results indicating range and mean score, it can be concluded that respondents were having low outside contact, comparatively high average contact to extension personnel and Mass media exposure. Responding farmers were having high level of awareness for nutritional supplementary techniques, plant protection techniques, soil & cultural management techniques, all organic techniques, whereas growth promoting techniques at moderate level. From different types of technologies listed in this study, majority of respondents are aware about avoidance of disease crop, green manuring crop, legume crop, pranamrit, ghanajivamrit, panchyagavya, bio-fertilizer, vermi-compost, oil cake, farmyard manure, azolla, enriched compost, poultry litter, neem cake, cow urine, cow dung slurry, liquid vermi wash and commercial organic liquid, pheromone trap, plant derived solutions, Trichoderma for seed treatment, tobacco based pesticide, leaf extract spray, Azotobacter, Beejamrit, Psedomonoas, Agneyastra, Bramhastra, spray of biofertilizer. The farmers of *terai* region of West Bengal are not homogeneous in awareness level on organic production technologies. Among selected socio-personal characteristics of sampled terai farmer's asset possession, social participation and training received are significantly correlated with awareness level of organic farming. As it is a general finding that if awareness level is more adoption is more, so, it can be concluded that to raise the level of adoption of organic farming in *terai* region of West Bengal, training should be given more, the farmers should be encouraged to take membership of social organizations like SHG or farmers' club and to approach well to do farmers at least in the first stages of adoption.

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