



Socio-Economic Determinants of Awareness and Utilization of Millets and Its Value-added Products among Rural Consumers in Madurai District, Tamil Nadu, India

K. Subhalakshmi^{a++}, G. Selvarani^{a#*}, R. Velusamy^{a†},
K. Ramakrishnan^{a‡} and K. Prabakaran^{b^}

^a Department of Agricultural Extension and Rural Sociology, Agriculture College and Research Institute, TNAU, Madurai – 625 104, India.

^b Department of Agricultural Economics, Agriculture College and Research Institute, TNAU, Madurai – 625 104, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/jeai/2024/v46i82751>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/121289>

Original Research Article

Received: 06/06/2024

Accepted: 06/08/2024

Published: 09/08/2024

⁺⁺ PG Scholar;

[#] Associate Professor;

[†] Professor and Head;

[‡] Professor;

[^] Professor (Agricultural Statistics);

*Corresponding author: E-mail: selvarani.g@tnau.ac.in;

Email: subhalakshmik2001@gmail.com;

Cite as: Subhalakshmi, K., G. Selvarani, R. Velusamy, K. Ramakrishnan, and K. Prabakaran. 2024. "Socio-Economic Determinants of Awareness and Utilization of Millets and Its Value-Added Products Among Rural Consumers in Madurai District, Tamil Nadu, India". *Journal of Experimental Agriculture International* 46 (8):682-92. <https://doi.org/10.9734/jeai/2024/v46i82751>.

ABSTRACT

Milletts are sustainable and nutritious alternative to cereals. Milletts are utilized due to its potential in attaining food security. This study was conducted in Madurai district to assess the awareness and utilization of milletts and its value-added products among rural consumers. A sample size of 75 respondents were selected from three blocks such as Sedapatti, T.Kallupatti, Usilampatti using random sampling method. The data for this study was collected through personal interview technique using pre tested interview schedule. Value-added products of milletts were categorized into ready to eat, ready to cook, instant mix and snacks. The statistical tools such as descriptive statistics, correlation and regression analysis were used to assess the awareness and utilization of milletts and its value-added products among rural consumers and analysed the data using SPSS software. Majority of them were aware of millet flour, millet roti, millet kali and millet murukku. Most of the rural consumers had utilized millet in the form of millet kali (100.00%) and millet roti (96.00%). Age, educational status, occupational status, annual income, family size, information source utilization, period of consumption of milletts had shown significant and positive relationship with awareness and utilization at one and five per cent level of significance. The R^2 square value of awareness (0.726) and utilization (0.518) of milletts and its value-added products were observed in this study. Milletts and its value-added products' awareness and utilization can be increased through awareness campaigns, demonstrations and trainings.

Keywords: Millet awareness; milletts value-added products; rural consumers; utilization.

1. INTRODUCTION

The consumption of milletts dates back to 7000 years. India is one of the largest producer and consumer of milletts among the world. Milletts are small-seeded grasses grown both as cereal crops and as fodder for animals. Milletts are significant crop in the semiarid tropic regions of Africa and Asia. There are eight types of milletts namely sorghum, pearl millet, finger millet, kodo millet, barnyard millet, little millet, foxtail millet and proso millet. Key characteristics of milletts are drought resistance and climate change resilience. Milletts are known as the "powerhouse of nutrients" because they are abundance in vitamins, minerals, proteins, fiber, amino acids, and other nutrients [1,2].

Milletts are also called as "cereals of the poor" due to its significant role in enhancing economic source of the farmers and assist in reducing global hunger. The important properties of milletts are gluten free, low glycemic index, atherosclerogenic effects and anti-tumorigenic [3-6]. Milletts are also containing tannins, phenols and phytates which prevents cell damage and aids in promoting anti-aging [7,8]. Milletts are consumed due to its various health benefits such as helps in weight reduction, controls blood sugar level, helps in detoxifying body, lower the cholesterol levels and prevents anemia [9,10]. This study was carried out to observe the following objectives were

- To study the socio-economic characteristics of rural consumers in Madurai district.
- To assess the awareness and utilization of milletts and its value-added products among rural consumers.
- To analyse the relationship of profile with awareness and utilization of milletts and its value-added products among rural consumers.

2. METHODOLOGY

The study was carried out in Madurai district due to its diverse production of milletts. In Madurai, production of sorghum was 16,267 tonnes followed by pearl millet production (1,017 tonnes), kodo millet production was 399 tonnes, finger millet production (32 tonnes) and other milletts production such as barnyard millet and foxtail millet production were up to 22243 tonnes during 2022-2023 [11]. Among 13 blocks in Madurai district, three blocks were purposively selected namely Sedapatti, T.Kallupatti, Usilampatti based on area and production of milletts. Totally, five villages were purposively selected from three blocks. A total of 75 rural consumers were randomly chosen from Seelnaickanpatty village, Thadaiyampatty village in Sedapatti block, S. Keelapatty village, Silaimalaipatty village in T.Kallupatti block and Alligundam village in Usilampatti block. In this way, 15 respondents were randomly selected from each village. A list of milletts' value-added

products was prepared with the help of extension scientists. Millets' value-added products such as murukku, chips, laddu, puffs, energy bars, muesli, ice cream, chocolate, pakoda, mixture, thattuvada, kali, soup sticks, roasted millets and puffed millets were classified as ready to eat and ready to cook millets' value-added products are papad, pasta, noodles, poha flakes, malt, flour, vermicelli, semolina, pizza base. Millet instant mixes comprise of idly and dosa batter, upma mix, pongal mix, laddu mix, khichdi mix, idiyappam mix, paniyaram mix, rava idly and dosa mix, bisibele bath mix, porridge mix, health mix, soup mix. Millets' snacks consist of cookies, bread, cakes, muffins, pudding, burger buns, roti, vada, halwa, kolukkatai, smoothie, pancake, shakes and juice. In this study, awareness and utilization level of millets and its value-added products were assessed among rural consumers. Data on rural consumers were collected using pre-tested interview schedule. The statistical tools such as descriptive statistics, correlation and regression analysis were used in the study.

Data was analysed with the help of SPSS software.

3. RESULTS AND DISCUSSION

Findings obtained through data analysis were interpreted below.

3.1 Socio-Economic Characteristics of the Rural Consumers

From the Table 1, it could be inferred that less than half of the rural consumers were belonged to the age category of more than 45 years (40.00%) and secondary education category (32.00%). From the findings, it is elucidated that more than half of the respondents were male (57.30%) and their occupation were farming (61.30%). Slightly more than half of the respondents were belonged to ₹ 1,00,001 to ₹ 2,00,000 annual income category (50.70%) and nuclear family category (54.70%). Less than half (48.00) of the rural consumers had four to five members in their family [12,13].

Table 1. Socio-economic characteristics of the respondents

S.No.	Socio-economic characteristics	Number (n=75)	Per cent
I)	Age		
1.	Up to 35 years	26	34.70
2.	Above 35 to 45 years	19	25.30
3.	More than 45 years	30	40.00
II)	Gender		
1.	Male	43	57.30
2.	Female	32	42.70
III)	Educational status		
1.	Illiterate	15	20.00
2.	Functionally literate	5	6.70
3.	Primary education	4	5.30
4.	Middle education	18	24.00
5.	Secondary education	24	32.00
6.	Collegiate education	9	12.00
IV)	Occupational status		
1.	Farming alone	46	61.30
2.	Farming + Wage earner	16	21.30
3.	Farming + Business	8	10.70
4.	Farming + Services	5	6.70
V)	Annual income		
1.	Up to ₹ 1,00,000	30	40.00
2.	₹ 1,00,001 to ₹ 2,00,000	38	50.70
3.	₹ 2,00,001 to ₹ 3,00,000	7	9.30
VI)	Family type		
1.	Joint family	34	45.30
2.	Nuclear family	41	54.70
VII)	Family size		
1.	Upto 3 members	5	6.70

S.No.	Socio-economic characteristics	Number (n=75)	Per cent
2.	4-5 members	36	48.00
3.	More than 5 members	34	45.30

3.2 Awareness and Utilization of Millets and its-Value Added Products among Rural Consumers

Rural consumers were well aware about types of millets (98.30%). Majority of the respondents (93.30%) had utilized pearl millet followed by finger millet (89.30%), sorghum (85.30%), kodo millet (77.30%), barnyard millet (72.00%), foxtail millet (69.30%), little millet (64.00%) and proso millet (58.70%).

From the Table 2 and Fig. 1, It is observed that Cent per cent of the rural consumers (100.00%) were aware about millet murukku and millet kali followed by millet laddu (93.30%), roasted millets (89.30%), puffed millets (86.70%), millet mixture (86.70%), millet pakoda (84.00%), millet thattuveda (80.00%), millet chocolate (66.70%), millet chips (60.00%), millet ice cream (52.00%), millet puffs (17.30%), millet soup sticks (6.70%), millet energy bars (6.70%) and millet muesli (5.30%). It could be inferred that cent per cent of the respondents (100.00%) had utilized millet kali followed by millet murukku (89.30%), millet

laddu (74.70%), millet thattuveda (73.30%), millet pakoda (69.30%), millet mixture (65.30%), roasted millets (53.30%), millet chips (50.70%), millet chocolate (46.70%), puffed millets (21.30%), millet ice cream (16.00%), millet puffs (8.00%), millet energy bars (5.30%), millet soup sticks (4.00%) and millet muesli (4.00%).

Awareness and utilization of millets – Ready to Cook products were presented in the Table 3 and Fig. 2. It is elucidated that cent per cent of the respondents (100.00%) were aware about millet flour followed by millet papad (77.30%), millet semolina (73.30%), millet poha flakes (70.70%), millet vermicelli (46.70%), millet noodles (37.30%), millet pasta (18.70%), millet malt (14.70%) and millets pizza base (13.30%). It is found that less than half (44.00%) of the rural consumers had utilized millet flour followed by millet papad (41.30%), millet semolina (37.30%), millet poha flakes (34.70%), millet vermicelli (28.00%), millet noodles (24.00%), millet malt (10.70%), millet pasta (9.30%) and millet pizza base (2.70%).

Table 2. Awareness and utilization of millets – Ready to Eat products

S. No.	Value-Added Products of Millets	Rural consumers			
		Aware		Utilized	
		Number (n=75)	Per cent	Number (n=75)	Per cent
I	Ready to Eat				
1.	Millet murukku	75	100.00	67	89.30
2.	Millet Chips	45	60.00	38	50.70
3.	Millet laddu	70	93.30	56	74.70
4.	Millet puffs	13	17.30	6	8.00
5.	Millet energy bars	5	6.70	4	5.30
6.	Millet muesli	4	5.30	3	4.00
7.	Millet ice cream	39	52.00	12	16.00
8.	Millet chocolate	50	66.70	35	46.70
9.	Millet pakoda	63	84.00	52	69.30
10.	Millet mixture	65	86.70	49	65.30
11.	Millet thattuveda	60	80.00	55	73.30
12.	Millet kali	75	100.00	75	100.00
13.	Millet soup sticks	5	6.70	3	4.00
14.	Roasted millets	67	89.30	40	53.30
15.	Puffed millets	65	86.70	16	21.30

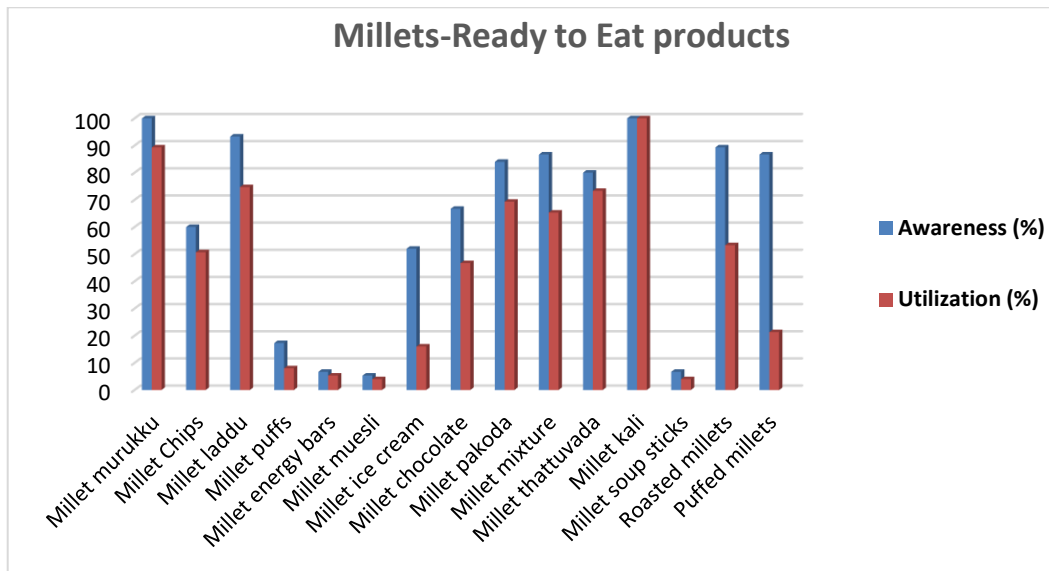


Fig. 1. Awareness and utilization of millets – Ready to Eat products

Table 3. Awareness and utilization of millets – Ready to Cook products

Sl	Ready to cook	Aware		Utilized	
		Number (n=75)	Per cent	Number (n=75)	Per cent
1.	Millet papad	58	77.30	31	41.30
2.	Millet pasta	14	18.70	7	9.30
3.	Millet noodles	28	37.30	18	24.00
4.	Millet Poha flakes	53	70.70	26	34.70
5.	Millet malt	11	14.70	8	10.70
6.	Millet flour	75	100.00	33	44.00
7.	Millet vermicelli	35	46.70	21	28.00
8.	Millet semolina	55	73.30	28	37.30
9.	Millet pizza base	10	13.30	2	2.70



Fig. 2. Awareness and utilization of millets – Ready to Cook products

It could be inferred from the Table 4 that majority (85.30%) of the rural consumers were about millet idly & dosa batter followed by millet Pongal mix (82.70%), millet upma mix (77.30%), millet laddu mix (76.00%), millet idiyappam mix (73.30%), millet health mix (69.30%), millet porridge mix (62.70%), millet paniyaram mix (52.00%), millet rava idly dosa batter (50.70%), millet khichdi mix (42.70%), millet bisibele bath mix (18.70%) and millet soup mix (32.00%). It is elucidated from the Table 3 that more than half (52.00%) of the rural consumers had utilized millet porridge mix followed by millet health mix (46.70%), millet idiyappam mix (25.30%), millet idly dosa batter (18.70%), millet rava idly & dosa mix (17.30%), millet upma mix (14.70%), millet khichdi mix (14.70%), millet laddu mix (10.70%), millet Pongal mix (8.00%), millet paniyaram mix (8.00%), millet soup mix (5.30%) and millet bisibele bath mix (4.00%).

From the Table 5 and Fig. 3, It is found that cent per cent (100.00%) of the rural consumers were aware about millet roti followed by millet kolukkatai (93.30%), millet cookies (92.00%), millet vada (89.30%), millet bread (72.00), millet cakes (69.30%), millet halwa (41.30%), millet juice (32.00%), millet pancake (18.70%), millet smoothie (16.00%), millet shakes (10.70%), millet muffins (9.30%) and millet pudding (6.70%), millet burger buns (5.30%). It could be inferred that Majority (96.00%) of the rural consumers had utilized millet as roti followed by millet kolukkatai (90.70%), millet vada (78.70%),

millet cookies (78.70%), millet bread (69.30%), millet cakes (65.30%), millet halwa (18.70%), millet juice (17.30%), millet muffins (8.00%), millet shakes (8.00%), millet pancake (5.30%), millet pudding (5.30%), millet burger buns (4.00%) and millet smoothie (2.70%).

In rural areas, consumers bought raw millets or consumers used millets produced in their own field. Then, they do millet processing, which involves milling, roasting, and grinding the millets to get millet flour. Millet flour was utilized to make various dishes such as millet dosa, idiyappam, porridge, and kali. That's why most of the millets' value-added products were not utilized by them [14-16].

3.3 Relationship of Profile with Awareness and Utilization of Millets and its Value-Added Products among Rural Consumers

It could be seen from Table 6 that variables such as age, educational status, occupational status, annual income, family size, information source utilization, attitude towards millets and its value-added products had shown significance and positively correlated with awareness at one per cent level of significance. The variables such as land holding, family type, period of consumption of millets, social participation, scientific orientation had shown significant and positively correlated with awareness at five per cent level of significance.

Table 4. Awareness and utilization of millets – Instant mixes

III	Millet instant mixes	Aware		Utilized	
		Number (n=75)	Per cent	Number (n=75)	Per cent
1.	Millet idly & dosa batter	64	85.30	14	18.70
2.	Millet upma mix	58	77.30	11	14.70
3.	Millet pongal mix	62	82.70	6	8.00
4.	Millet laddu mix	57	76.00	8	10.70
5.	Millet Khichdi mix	32	42.70	11	14.70
6.	Millet idiyappam mix	55	73.30	19	25.30
7.	Millet paniyaram mix	39	52.00	6	8.00
8.	Millet rava idly & dosa mix	38	50.70	13	17.30
9.	Millet bisibele bath mix	14	18.70	3	4.00
10.	Millet Porridge mix	47	62.70	39	52.00
11.	Millet health mix	52	69.30	35	46.70
12.	Millet soup mix	24	32.00	4	5.30

Table 5. Awareness and utilization of millets – Snacks

IV	Snacks	Aware		Utilized	
		Number (n=75)	Per cent	Number (n=75)	Per cent
1.	Millet cookies	69	92.00	59	78.70
2.	Millet bread	54	72.00	52	69.30
3.	Millet cakes	52	69.30	49	65.30
4.	Millet muffins	7	9.30	6	8.00
5.	Millet pudding	5	6.70	4	5.30
6.	Millet Burger buns	4	5.30	3	4.00
7.	Millet roti	75	100.00	72	96.00
8.	Millet vada	67	89.30	59	78.70
9.	Millet halwa	31	41.30	14	18.70
10.	Millet kolukkatai	70	93.30	68	90.70
11.	Millet smoothie	12	16.00	2	2.70
12.	Millet pancake	14	18.70	4	5.30
13.	Millet shakes	8	10.70	6	8.00
14.	Millet juice	24	32.00	13	17.30

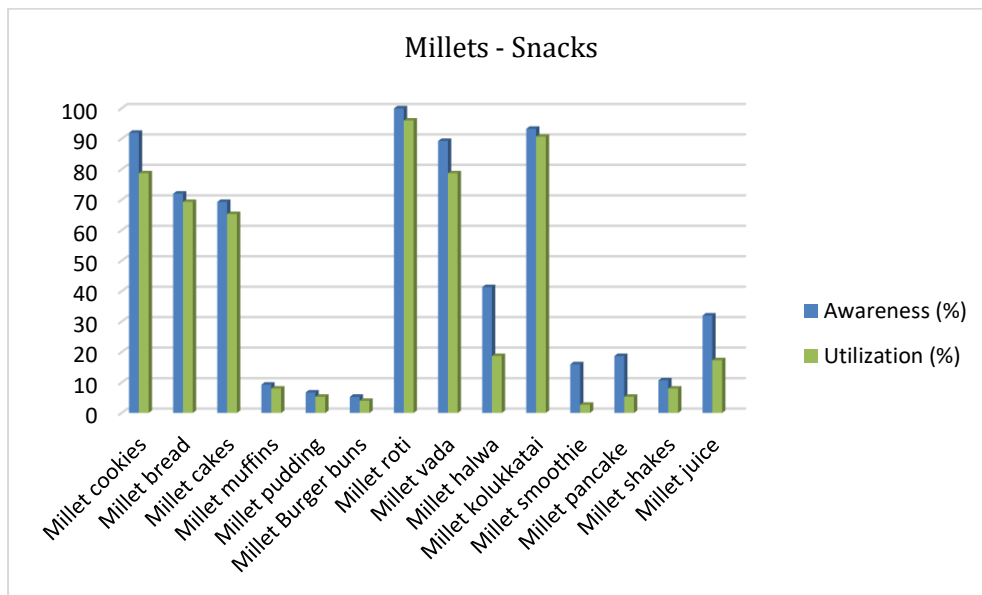


Fig. 3. Awareness and utilization of millets – Snacks

The R² value 0.726 revealed that 72.60 per cent of the variation in the awareness level were described by the 16 independent variables selected for the study. F value was significant at one per cent level of significance. It can be inferred that regression coefficients of land holding, annual income,

family type, family size and information source utilization were positively related to awareness at one per cent level of significance. Regression coefficients of occupation and period of consumption of millets were positively associated with awareness at five per cent level of significance.

Table 6. Relationship of profile with awareness of millets and its value-added products among rural consumers

Variable Number	Variables	Rural consumers (n=75)			
		Correlation (r value)	Regression co-efficient	t value	P value
X ₁	Age	0.492**	-0.182 ^{NS}	-1.603	0.114
X ₂	Gender	0.176 ^{NS}	0.063 ^{NS}	0.754	0.454
X ₃	Educational status	0.382**	0.012 ^{NS}	0.104	0.918
X ₄	Occupational status	0.301**	0.070*	0.801	0.037
X ₅	Land holding	0.280*	0.241**	2.837	0.006
X ₆	Annual income	0.351**	0.340**	3.591	0.001
X ₇	Family type	0.039*	0.207**	2.672	0.010
X ₈	Family size	0.350**	0.270**	3.320	0.002
X ₉	Period of consumption of millets	0.062*	0.072*	0.874	0.046
X ₁₀	Information source utilization	0.721**	0.306**	2.925	0.005
X ₁₁	Decision making pattern	-0.165 ^{NS}	-0.014 ^{NS}	-0.180	0.858
X ₁₂	Social participation	0.242*	-0.107 ^{NS}	-1.343	0.184
X ₁₃	Scientific orientation	0.296*	0.024 ^{NS}	0.175	0.862
X ₁₄	Innovativeness	0.084 ^{NS}	0.120 ^{NS}	1.470	0.147
X ₁₅	Trainings undergone	-0.005 ^{NS}	-0.046 ^{NS}	-0.574	0.568
X ₁₆	Attitude towards millets and its value-added products	0.325**	-0.161 ^{NS}	-1.245	0.218

R² value = 0.726 F value = 9.598**
 * - Significant at five per cent level

** - Significant at one per cent level
 NS - Non-Significant

Information source utilization plays an important role in enhancing the awareness of millets and its value-added products. This might be a reason for the positive and significant association between information source utilization and awareness. Age, education, family type, family size, social participation, scientific orientation could be responsible for increasing the awareness of millets and its value-added products. Majority of the rural consumers is possessing farm land, doing farming as their sole profession and consuming millets for prolonged period could be reason for positive and significant association between land holding, occupational status, period of consumption of millets and awareness of millets and its value-added products.

It could be seen from Table 7, variables such as age, educational status, annual income, information source utilization, attitude towards millets and its value-added products had shown

significance and positively correlated with utilization level at one per cent level of significance. The variables such as occupational status, land holding, period of consumption of millets, social participation had shown significant and positively correlated with utilization at five per cent level of significance.

The R² value 0.518 revealed that 51.80 per cent of the variation in the utilization level were elucidated by the 16 independent variables selected for the study. F value was significant at one per cent level of significance. It can be inferred that regression coefficients of occupation and period of consumption of millets were positively related to utilization at one per cent level of significance. Regression coefficients of age, land holding, annual income and information source utilization were positively associated with utilization at five per cent level of significance.

Table 7. Relationship of profile with utilization of millets and its value-added products among rural consumers

Variable Number	Variables	Rural consumers (n=75)			
		Correlation (r value)	Regression co-efficient	t value	P value
X ₁	Age	0.435**	0.177*	1.204	0.020
X ₂	Gender	0.221 ^{NS}	0.254 ^{NS}	2.396	0.234
X ₃	Educational status	0.383**	0.063 ^{NS}	0.410	0.683
X ₄	Occupational status	0.264*	0.033**	0.290	0.005
X ₅	Land holding	0.053*	0.004*	0.035	0.032
X ₆	Annual income	0.397**	0.171*	1.387	0.021
X ₇	Family type	0.036 ^{NS}	0.118 ^{NS}	1.175	0.245
X ₈	Family size	0.090 ^{NS}	0.047 ^{NS}	0.445	0.658
X ₉	Period of consumption of millets	0.279*	0.300**	2.801	0.007
X ₁₀	Information source utilization	0.426**	0.266*	1.953	0.049
X ₁₁	Decision making pattern	0.001 ^{NS}	0.043 ^{NS}	0.423	0.674
X ₁₂	Social participation	0.242*	-0.289 ^{NS}	-2.788	0.549
X ₁₃	Scientific orientation	0.018 ^{NS}	0.137 ^{NS}	0.800	0.427
X ₁₄	Innovativeness	0.042 ^{NS}	-0.035 ^{NS}	-0.324	0.747
X ₁₅	Trainings undergone	0.196 ^{NS}	-0.271 ^{NS}	-2.602	0.012
X ₁₆	Attitude towards millets and its value- added products	0.016**	0.120 ^{NS}	0.716	0.477

R² value = 0.518 F value = 3.980**
 * - Significant at five per cent level

** - Significant at one per cent level
 NS - Non-Significant

If age increases, the chance of getting illness will increase. Millets and its value-added products will be utilized because of its health benefits. This might be a reason for positive and significant association between age and utilization of millets and its value-added products. Education, occupational status, land holding, annual income, period of consumption of millets, social participation of the rural consumers had increased the utilization of millets and its value-added products. This could be a reason for positive and significant association between these variables and utilization of millets and its value-added products. Various information sources like mass media, social media, educational and governmental institutions had escalated the attitude towards millets and its value-added products. This could be a reason for a positive and significant association between information source utilization, attitude and utilization of millets and its value-added products.

The findings indicate that high level of awareness was observed about the types of millets among rural consumers. The most commonly utilized millets were pearl millet, finger millet, sorghum and suggests that traditional millets have a stronger presence in rural diets. However, proso

millet was less utilized among the other types of millets. Traditional millets' value-added products such as kali, roti, murukku, kolukkatai and laddu had a high level of awareness and utilization among rural consumers. In contrast to that, millet novel products such as muesli, energy bars, ice creams, pasta, noodles instant mixes had a low level of awareness and utilization. We can increase the consumption of less utilized millets and its value-added products through awareness campaigns, demonstrations and trainings.

The variables such as age, education, occupation, land holding, annual income, period of consumption of millets showed a positive relationship with awareness and utilization of millets and its value-added products among rural consumers. Information source utilization plays a significant role in promoting millets and its value-added products. This study will help the policy makers and stakeholders to develop the policies and intervention strategies to promote millet-based diets.

4. CONCLUSION

Millets are also called by the name of miracle of grains due to their nutritional and health

benefits. we can broaden our dietary options by utilizing the versatility nature of millets. Most of the rural consumers were aware and utilized millets as roti, kali, porridge, idiyappam and as sweets and savouries. Age, education, occupation, land holding, annual income, period of consumption of millets, information source utilization, social participation, attitude towards millets and its value-added products had shown positive and significant relationship with awareness and utilization of millets and its value-added products. The R^2 square value of millet awareness and utilization of millets and its value-added products were between 0.5 to 0.7 shown that strong relationship between variables in this study. Age, occupation and annual income were the most influencing variable in consumer's awareness and utilization of millets and its value-added products in rural areas. Awareness campaigns, demonstrations and trainings, government subsidies will increase the millet cultivation and utilization among rural consumers.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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