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Relationship between adaptation strategies made by farmers during COVID-19 pandemic with their profile characteristics

[1]C Vaishnavi, [2]Shivanand K Kammar, [3]Goudappa SB, [4]Vijaya B Wali and [5]Prashanth B

[1]Research Scholar, Division of Agricultural Extension, ICAR-IARI, New Delhi, India

[2]Associate Professor, Department of Agricultural Extension Education, University of Agricultural Sciences, Dharwad, Karnataka, India

[3]Professor and Head, Department of Agricultural Extension, University of Agricultural Sciences, Raichur, Karnataka, India

[4]Assisstant Professor, Department of Agricultural Economics, University of Agricultural Sciences, Raichur, Karnataka, India

[5]Research scholar, Department Agricultural Extension Education, University of Agricultural Sciences, GKVK, Bangalore, Karnataka, India

Corresponding Author: C Vaishnavi

Abstract
The COVID-19 pandemic has profoundly impacted global economies, including India, where agriculture serves as a backbone. This research delves into the adaptation strategies employed by Indian farmers in response to the pandemic's challenges. Through a comprehensive study conducted in Raichur district of Karnataka and YSR Kadapa district of Andhra Pradesh during 2021-22, the research investigates how various factors such as socio-economic status, communication patterns, risk-taking behavior, and innovativeness influence these strategies. Data from 180 farmers were analyzed using statistical methods, revealing significant correlations and contributions of different profile characteristics to adaptation strategies. Results suggest that factors like age, social participation, farming experience, communication, family size, economic motivation, risk orientation, and management orientation play crucial roles in shaping farmers' responses to the pandemic. Notably, psychological factors influenced adaptation levels, with moderate psychological impact aligning with medium levels of adaptation.

Keywords: COVID-19, adaptations, correlation

Introduction
The recent outbreak of the novel SARS-CoV-2 virus, also called corona virus 2019 (COVID-19), has evolved into one of the most serious pandemic situations in the past hundred years [Dhama *et al*., 2020] [1]. With the loss of commerce, trade, tourism, and major impacts on global supply chains, the economic impacts of the outbreak were vast both within India and globally. Due to widespread COVID-19 mitigating measures taken at the national level, economic activities relating to Indian farming systems as well as farmers throughout the country had suffered several serious setbacks because of the exceptional circumstances, which arguably outweighed the direct COVID-19 impacts [Dev 2020, Kumar *et al*., 2020] [3, 4]. Agriculture plays a vital role in Indian economy. 54.6% of the total work force is engaged in agriculture and allied sector activities [Census, 2011] [5] and accounts for 18.8 per cent of GVA of the economy [Economic survey 2021-22] [6]. Among the rural households 70 per cent of them still depends primarily on Agriculture for their livelihood, with 82 per cent of farmers being small and marginal [FAO report]. Risks including insufficient rainfall, price volatility, and mounting indebtedness are faced annually by Indian farmers, whose economic conditions are very vulnerable. However, the COVID-19 pandemic's hazards and the lockdown imposed presented them with additional challenges and compounded twice their anguish [WBCSD report, ICAR report].

With disruptions in supply chain, marketing linkages and no enough financial resources for purchasing critical inputs, difficulties in availing labor timely, closure of many mandis, farmers left with burden of increased debts and highly stressed [Patnaik, 2020] [11]. Along with this the reverse migration of family members and daily wage workers created additional financial burden on the farmers and also created fluctuations in the wage rates. In addition to impact on agriculture, most of the rural people were deprived of basic medical facilities and proper health check-ups, timely treatment if infected with COVID-19 [Shammi *et al*., 2020] [12]. Thus ruralites left with great fear of infection. [Vaishnavi *et al*., 2024] [13].

In addition to all these aspects, there were brief reporting's regarding the resilience shown by the farmers by implementing various adaptation strategies with regard to their health, farming activities. (Marwanti, S. and Antriyandarti, E., 2020) [14]. Farmers had faced difficulties because of the climate change and several other reasons for centuries, but they never gave up their hope and fought back since they were famed for their optimism and different

adaptation strategies according to the need. Similarly, though the consequences of the crisis for farmers and their families were immediate, many farmers tried their best to overcome their hurdles. As reported by the media and the other relevant studies, farmers resorted to health, psychological, marketing adaptations (Sukhpal, S., 2020) [15], changes in cropping patterns along with the changes in expenditure patterns to stabilize their economic situation. But all these adaptations differs with region, socio-economic status of the farmers, their communication variable, risk taking behaviour, innovativeness etc. All these aspects need to be further probed to better understand the level of adaptations made and various factors affecting it to better understand the scenario and formulate suitable implications accordingly.

Hence the purpose of the research is to investigate the adaptation strategies employed by farmers and to analyze the relationship between these adaptation strategies and factors such as the farmers' socio-economic status, communication patterns, risk-taking behavior, innovativeness. By examining these aspects, the research aims to provide insights into the complex dynamics of farmer adaptations during the pandemic and to inform the development of appropriate interventions and policies.

Methodology

The study was conducted in Raichur district of Karnataka and YSR Kadapa district of Andhra Pradesh during the year 2021-22. Ex-post-facto research design was used for this study. Based on the diversity of crops grown and type of cropping ecosystems present in the villages, 5 taluks of Raichur and 4 mandals of Kadapa were selected for conducting research. From each taluk and mandal one or two villages were selected randomly thus, finally considering 12 villages. Among these 12, six villages were with irrigated farming ecosystems and remaining six were with dry land farming ecosystems. From each such selected villages, 15 farmers were selected through simple random sampling method. Thus, the total sample size taken for this study purpose was 180 respondents.

Data regarding personal, social, communication, and economic variables were gathered from respondents using a standard questionnaire. The adaptations were classified into health and psychological, financial and marketing adaptations. Using mean and standard deviation, the farmers were then classified into low, medium, and high impact categories based on the scores obtained from the schedule developed for the study to assess the adaptation strategies made by the farmers during COVID-19. The relationship between profile characteristics and adaptation strategies was examined using Karl Pearson's correlation coefficient. Multiple regression was used to determine each profile characteristic contribution to the various adaptation strategies made, as well as its rate of increase or decrease with unit change in the profile characteristic. All statistical analyses were performed using SPSS software.

Results and Discussion
Profile characteristics of the farmers

The profile characteristics of the total farmers considered for the study showed that majority (78.33%) of them were under middle age group of 31-50 years. With respect to their education levels 25.00 per cent of them were illiterates and 20.00 per cent were high school passed out. 58.89 per cent farmers has medium family size. The COVID-19 infected respondents were 21.67 per cent. The farming experience found was medium (47.78%) to high (36.67%). 45.00 per cent farmers were having semi medium land holding (5.01-10.00acres). Most of them possessed livestock i.e., buffaloes (39.44%), cows (22.78%). The annual income was found medium (40.00%) to high (31.67%) and the level of social participation was also medium among 40.00 per cent farmers. With respect to the communication variable high contact with personal localites reported by 36.67 per cent and 43.33% farmers reported medium level of contact with extension personnel. The mass media exposure reported was medium (37.22%) followed by high (33.33%) and the social media exposure was low (41.11%). With respect to economic motivation an equal per cent (35.00%) farmers has medium and high levels each and 37.78 per cent expressed lower levels of risk orientation. Two fifth (40.00%) farmers were with medium level of innovativeness and 44.44 per cent said that they has medium level of management orientation.

Categorization of the farmers based on their overall adaptations made

Table 1: Distribution of respondents according to the adaptation strategies followed under different agricultural situations

Sl. No	Adaptation categories	Agricultural situations					
		Irrigated (n=90)		Dry land (n=90)		Total (n=180)	
		F	%	F	%	F	%
1	Low	25	27.78	26	28.89	58	32.22
2	Medium	46	51.11	32	35.56	64	35.56
3	High	19	21.11	32	35.56	58	32.22
		$\bar{X}$ = 38.42 σ =3.74		$\bar{X}$ = 37.46 σ =3.56		$\bar{X}$ = 37.93 σ =3.67	

F = Frequency % = Percentage $\bar{X}$ = Arithmetic mean, σ = Standard deviation

In particular, psychological factors play a key role in the way people make adaptations in the case of epidemics. The majority of farmers had moderate psychological impact, which had contributed to their medium levels of adaptation strategies. Despite the fact that the majority of respondents had high extension personnel contact, there were those who had just a moderate degree of risk orientation and inventiveness, which may have discouraged farmers from making greater financial, marketing adaptations, as well as making changes in farming activities. Also low educational levels, limited health access, reluctance to seek health care and communal culture are alleged to be the causes of

medium compliance in implementing health protocols in their daily life.

With regard to anxiety about being ill and maybe infecting their neighbours as well, the majority of farmers, do have adopted some basic health and psychological precautions, reporting no major differences (Wang *et al*., 2020) [16]. Changes in agricultural expenditure were seen with both types of farmers, with irrigated farmers experiencing a modest rise in fertilizer and labour costs. The main difference between them arises in the area of financial adaptation, where the dry land farmers made more borrowings and decreased their extra expenditures more due

to their low income and weaker financial stability than the irrigated farmers. With the marketing adaptations, slightly greater adaptations were seen with the irrigated farmers growing horticulture crops, due to the perishable nature of the produce.

Relationship between profile characteristics and health, psychological adaptations followed by farmers
The Correlation coefficient was calibrated to find out the relationship between independent variables and the health, psychological adaptations followed by farmers in response to COVID-19 pandemic.

Table 2: Relationship between profile characteristics and health, psychological adaptation strategies followed by the farmers

Variable No.	Profile characteristics	Correlation Coefficient (r)		
		Irrigated (n=90)	Dry land (n=90)	Total (n=180)
1.	Age	0.396**	0.523**	0.234**
2.	Education	-0.133	-0.179	-0.145
3.	Family Size	0.120	0.234*	0.173*
4.	COVID-19 infection	0.282**	0.183	0.215**
5.	Farming experience	0.171	0.320**	0.198*
6.	Land holding	0.012	0.094	0.044
7.	Livestock possession	-0.099	0.086	-0.050
8.	Annual income	-0.139	0.070	0.042
9.	Social participation	0.214*	0.301**	0.244**
10.	Communication variable	0.206*	0.220*	0.207*
11.	Economic motivation	-0.115	0.046	0.024
12.	Risk orientation	-0.052	-0.016	-0.034
13.	Innovativeness	0.124	0.184	0.142
14.	Management orientation	-0.081	0.072	-0.043

Age and health, psychological adaptations
There exists a positive and significant correlation between the farmers' age and the adaptations they made. The reason was that middle aged and elderly farmers had a greater psychological impact and more fear about their health. They accepted more precautionary measures to better avoid infection and protect themselves and their family members. Also they were the people in their home, mostly moving out, even to buy necessities. So, because of the threat of reverse migratory workers and the severity of the infection due to their ongoing health complications, they mostly followed precautionary measures and government regulations.

Family size and health, psychological adaptations
A positive and significant correlation was discovered between the two among dry land farmers and the pooled score of all farmers. As the number of family members increased, so did the number of adaptations made by different members, and the frequency of use of preventive measures such as wearing masks, washing hands, providing financial and mental support to one another got increased.

COVID-19 infection and health, psychological adaptations
A clear, positive and significant relationship was noticed between infected individuals and the adaptations they made. It was true that those who had been infected had made many health changes in order to prevent the spread of the disease to others and also to protect themselves from becoming infected again. They even encouraged others in their family and village to take preventive measures and strengthen them

mentally in order to avoid stress.

Farming experience and health, psychological adaptations
Farming experience has positive significant association with psychological adaptations made. The reason could be that the majority of the farmers were in their middle and old age and had more farming experience. Because age correlates with the adaptations made, farming experience indirectly correlates with it.

Social participation and health, psychological adaptations
In all three categories, farmers showed a significant, positive correlation in terms of social participation and health adaptations. People who need to participate in different activities and necessitated to go out within a limited time and area, followed strict adaptations either by force or voluntarily to protect themselves from infection during the necessary movements as they faced different kinds of people in the society.

Communication variable and health, psychological adaptations
These two showed a significant positive correlation with each other. People who communicated more with either personal localites or extension functionaries were at a higher risk of infection and adhered to at least basic adaptations such as masking their faces during interaction. Furthermore, with more social media and mass media exposure, they had gained greater awareness and effectively implemented those strategies.

Relationship between independent variables and financial, marketing adaptations followed by farmers

Table 3: Relationship between profile characteristics and financial, marketing adaptation strategies followed by the farmers

Variable No.	Profile characteristics	Correlation Coefficient (r)		
		Irrigated (n=90)	Dry land (n=90)	Total (n=180)
1.	Age	0.057	0.221*	0.141
2.	Education	-0.171	0.004	0.016
3.	Family Size	0.256*	0.195	0.225**
4.	COVID-19 infection	-0.016	0.102	0.044
5.	Farming experience	0.131	0.319**	0.226**
6.	Land holding	0.015	-0.091	-0.029
7.	Livestock possession	-0.133	0.073	-0.102
8.	Annual income	-0.376**	-0.213*	-0.251**
9.	Social participation	0.202	0.053	0.096
10.	Communication variable	0.144	0.216*	0.176*
11.	Economic motivation	0.150	0.249*	0.160*
12.	Risk orientation	0.264*	0.350**	0.309**
13.	Innovativeness	0.059	0.029	0.046
14.	Management orientation	0.252*	0.388**	0.315**

*significant at 5% level, **significant at 1% level

Family size and financial, marketing adaptations
Adaptations of irrigated farmers and the pooled value of farmers showed a significant, positive correlation with family size. As the number of family members increases, so does their expenditure, and as there is a loss of income, they need to borrow more to meet their basic expenses for all the family members. There also reported increased sharing of responsibilities among family members as family size increases.

Farming experience and financial, marketing adaptations
There was a positive, significant correlation between farming experience and farming adaptations made, as expressed by dry land farmers and all farmers. With more farming experience, farmers will have a better understanding of the various options available to them, where to get financial assistance, what type of marketing strategy to use and how to choose a better one, and how to easily adapt to changing circumstances.

Annual income and financial, marketing adaptations
The findings revealed a negative, significant relationship between annual income and these adaptations. This was due to the fact that farmers with higher annual income tend to borrow less and rely more on their own financial income, savings to meet their expenses and vice versa.

Communication variable and financial, marketing adaptations
The findings revealed a positive, significant correlation between the variables mentioned. This was due to the fact that more communication interactions with extension personnel and their assistance, helped the farmers to sell their produce to government under MSP or associating with a FPO, selling their produce online etc. These opportunities helped farmer to make appropriate adaptations.

Economic motivation and financial, marketing adaptations
The farmers had a positive, significant relationship between

these two variables. The fact that farmers with economic motivation, tries to improve their farming situations and increase their returns from farm, they made different adaptations to gain more income.

Risk orientation and financial, marketing adaptations
The table results showed a significant, negative correlation between risk orientation and financial, marketing adaptations among all farmers. Farmers who are more risk averse will be more willing to take on new challenges and experiment with new financial and marketing strategies. They take more risks and react to situations accordingly.

Management orientation and financial, marketing adaptations
Management orientation correlated positively and significantly with financial and marketing modifications made by farmers in many areas. Farmers that are more management oriented, adopt various crop planning techniques, have timely production operations, and have acceptable marketing alternatives accessible to them. Similarly, they implemented several adaptation tactics appropriate for their farming scenarios.

Extent of contribution of profile characteristics to the adaptations made
Multiple regression analysis provides us with the information regarding the contribution of each Profile characteristic to the independent variable and its rate of increase or decrease with unit change in characteristics.

Extent of contribution of Profile characteristics to the health, psychological adaptations of the farmers
The results depicted that out of 14 characteristics, five characteristics had made significant contribution to the adaptations made, which includes, age (0.428) and Social participation (0.672) at 1% significance level, COVID-19 infection (0.321), farming experience (0.092) and communication variable (0.552) at 5% level of significance respectively.

Table 4: Multiple regression analysis of Profile characteristics and health, psychological adaptations made by the farmers (n=180)

Variable No.	Profile characteristics	Regression co-efficient	SE of regression co-efficient	't' value
X_1.	Age	0.428**	0.147	3.284
X_2.	Education	-0.125	0.026	-0.297
X_3.	Family Size	0.329	0.104	1.758
X_4.	COVID-19 infection	0.321*	0.130	2.560
X_5.	Farming experience	0.092*	0.078	2.248
X_6.	Land holding	-0.066	0.059	-0.486
X_7.	Livestock possession	-0.988	0.473	-0.613
X_8.	Annual income	-0.337	0.876	-1.461
X_9.	Social participation	0.672**	0.108	3.421
X_{10}.	Communication variable	0.552*	0.298	2.612
X_{11}.	Economic motivation	0.064	0.121	0.961
X_{12}.	Risk orientation	-0.568	0.902	-0.785
X_{13}.	Innovativeness	0.683	0.152	0.611
X_{14}.	Management orientation	0.101	0.044	1.604

*significant at 5% level, **significant at 1% level SE = Standard Error

The results of the model thus, can be interpreted as with every one unit increase in age, social participation, health and psychological adaptations will increase by 0.428 and 0.672 units respectively. Similarly a unit increase in infection rate, farming experience and communication variable creates an increase in adaptations made by 0.321 units, 0.092 units and 0.552 units respectively if all other Profile characteristics are kept constant. The R^2 value of the calculated data for this model shows that, 60.10% variation in adaptations made is caused by all the five profile characteristics collectively.

Extent of contribution of Profile characteristics to the financial and marketing adaptations made by the farmers

Out of all the Profile characteristics under study six characteristics have contribution at significant levels of 5% and 1% respectively. The model includes the profile characteristics *i.e.,* family size (0.460), farming experience (0.066), annual income (-0.337), risk orientation (0.154), management orientation (0.091) as significant at 1% level of significance and economic motivation (0.259) significant at 5% significance level.

Table 5: Multiple regression analysis of profile characteristics and financial, marketing adaptations made by the farmers (n=180)

Variable No.	Profile characteristics	Regression co-efficient	SE of regression co-efficient	't' value
X_1.	Age	0.040	0.021	1.895
X_2.	Education	0.020	0.096	0.211
X_3.	Family Size	0.460**	0.132	3.076
X_4.	COVID-19 infection	0.221	0.376	0.557
X_5.	Farming experience	0.066**	0.021	3.098
X_6.	Land holding	-0.130	0.033	-0.386
X_7.	Livestock possession	-0.030	0.022	-1.372
X_8.	Annual income	-0.337**	0.097	-3.465
X_9.	Social participation	0.189	0.109	1.732
X_{10}.	Communication variable	-0.160	0.027	-0.591
X_{11}.	Economic motivation	0.259*	0.120	2.165
X_{12}.	Risk orientation	0.154**	0.036	4.340
X_{13}.	Innovativeness	0.093	0.152	0.611
X_{14}.	Management orientation	0.091**	0.020	4.584

*significant at 5% level, **significant at 1% level, SE = Standard Error

The interpretation from the above model can be made as, for every one unit increase in family size and farming experience the financial, marketing adaptations will increase by 0.460 and 0.066 units respectively. Similarly, for every increase in one unit of risk orientation, management orientation and economic motivation, the adaptations made by farmers will increase by 0.154 units, 0.091 units and 0.259 units respectively. While increase in annual income causes decrease in adaptations by 0.337 units respectively provided all the remaining characteristics, except the considered ones are kept constant. The R^2 value for the model is 0.630, which explains that 63.00% variation in the financial, marketing adaptations made was contributed by the six characteristics when combined.

Conclusion

In conclusion, the analysis of profile characteristics of farmers revealed important insights into their adaptations in response to the COVID-19 pandemic. Psychological factors have emerged as key influencers, with most farmers exhibiting moderate levels of adaptation strategies. Despite high contact with extension personnel, factors like risk orientation and Innovativeness have only moderate influences, potentially limiting financial and marketing adaptations. Various correlations between profile characteristics and adaptation strategies highlight nuanced relationships. Age, COVID-19 infection, and social participation significantly influence health and psychological adaptations, while family size, farming experience, and economic motivation play significant roles

in financial and marketing adaptations. Furthermore, multiple regression analyses shed light on the combined effects of independent variables on adaptation strategies. Overall, these findings underscore the multidimensional nature of farmers' adaptations to crises like the COVID-19 pandemic. Understanding these relationships can inform targeted interventions and support mechanisms to enhance farmers' resilience in the face of future challenges.

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