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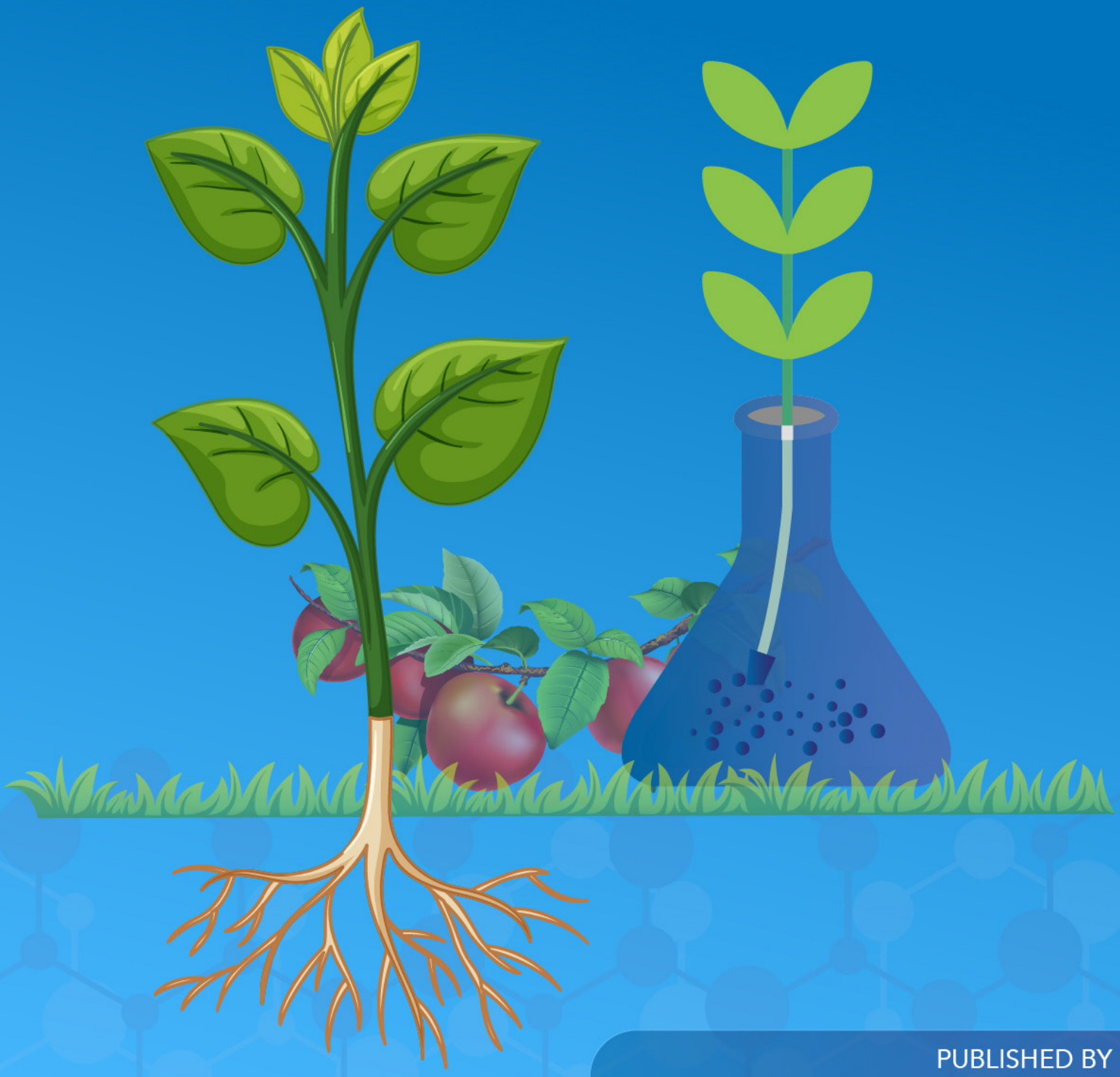

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COVID-19 Concerns and Resources Allocation on Smallholder Rice Farms in Cote D'ivoire

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ABSTRACT

Covid-19 has caused a great deal of concern among the population, particularly in rural areas. Smallholder farmers have reacted in various ways to these concerns and to the psychological stress associated with the spread of the virus. This study analyzes the correlation between producers' concerns about COVID-19 and productive resource allocation decisions on smallholder rice farms in Côte d'Ivoire. Using cross-sectional data obtained from 1359 households in the Poro, Tchologo and Tonkpi regions through a stratified random sampling technique where each village was considered a stratum, the study uses descriptive statistics, chi-2 tests and Pearson correlation tests to achieve the objectives. The results indicate that producers' concerns are related to family, travel, finances and product availability. These concerns vary from region to region. In addition, the results indicate that concerns about COVID-19 led producers to reduce inputs used on the plots and to increase labor for cultivation activities. The study makes several recommendations, including the psychological consideration of small-scale producers in rural areas and the effective subsidization of inputs during health crises to avoid food insecurity problems.

INTRODUCTION

In March 2020, the World Health Organization (WHO) declared the outbreak of the COVID-19 virus, which first appeared in China and then spread to the rest of the world, a global pandemic (INS, 2020). By the end of September 2020, the virus had infected nearly 30 million people worldwide and caused nearly one million deaths (WHO, 2021). Although there has been a delay in the number of cases in sub-Saharan Africa, the continent has not been spared, which has exacerbated the vulnerability of already precarious health systems (Akinyemi *et al.*, 2022).

Several researchers associate COVID-19 with economic downturns and increased poverty rates in many developing countries, particularly in Africa (Laborde *et al.*, 2021; Zeufack *et al.*, 2020). In response to this global challenge, African countries have complied with WHO recommendations such as containment, travel restrictions, sheltering, physical separation, and certain hygiene procedures to control the spread of the virus and save their health infrastructure (Durizzo *et al.*, 2021). These measures have led to an increased risk of food insecurity, leading to Covid-19 being considered a hunger pandemic (Tabe-Ojong *et al.*, 2022).

In Côte d'Ivoire, the first case of Covid-19 was recorded in March 2020, prompting the government to adopt a series of measures to reduce the risk of contamination. These measures ranged from closing schools to isolating the economic capital (Abidjan) from the rest of Côte d'Ivoire, with all of its corollaries (OIM, 2020).

In rural areas, the population has been informed of the pandemic, largely through traditional information channels such as television and radio. Household anxiety about Covid-19 is very high and this feeling of anxiety among heads of households appears to be somewhat higher among women than men (INS, 2020). Due to the rapid increase in the number of new cases, Covid-19 has caused panic, uncertainty, anxiety, income and expenditure pressures, resulting in psychological and socioeconomic disorders (Zhang & Ma, 2020).

In addition to inadequate health infrastructure and personnel, rural populations face uncertainties regarding the availability of food, production inputs, and several other agricultural needs due to Covid-19-related concerns, hence the research question of this study: is there a correlation between producers' concerns and the allocation of productive resources? The overall objective of this study is to identify the links between smallholder producers' perceptions of the spread of Covid-19 and the resources used on rice farms at the onset of the health crisis. More specifically, this study aims to :

- Identify the different perceptions of smallholder rice farmers of the possibility of Covid-19 spread ;
- To measure the correlation between perceptions of Covid-19 spread and the amount of resources used on rice farms in Côte d'Ivoire.

The relevance of this study lies in the fact that most studies (Akinyemi *et al.*, 2022; Adjet *et al.*, 2022; Greteman *et al.*, 2022) on Covid-19 have focused on people's perceptions, knowledge, and application of government

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restrictive measures. However, almost no studies have examined the links between Covid-19 concerns and on-farm resource allocation decisions. This study comes to fill that gap. Furthermore, the choice of rice as a crop is highly suggestive given that rice has become the main food of both urban and rural populations in Côte d'Ivoire (Gniza, 2023). As a result, rice is a strategic crop for social stability and food security in Côte d'Ivoire, especially in times of health crisis.

Theoretical Framework : The Theory of Planned Behavior

The theory of planned behavior, according to Ajzen (1985, 1991), emerged in the field of social psychology as a means of predicting behavior. It is based on the observation that individuals make reasoned decisions, and that behavior is the result of the intention to engage in it. The stronger the intention, the more effort the individual will make to move towards that behavior, and the more likely it is that he or she will engage in that behavior (Steg & Nordlund, 2013). The intention will not be expressed in the behavior if it is physically impossible to accomplish or if unexpected obstacles stand in the way.

Intention is a central factor in this theory. Intentions are supposed to reflect the motivational factors that influence behavior; they indicate the extent to which people are willing to invest themselves in a given behavior. Although some behaviors may in fact meet this requirement very well, most depend, at least to some extent, on non-motivational factors such as the availability of the necessary opportunities and resources (e.g. time, money, skills, cooperation from others) (Ajzen, 1985).

According to Ajzen (1991), there are three determinants of behavioral intention : (i) Attitude (one's own opinion of the behavior): attitude is an individual's favorable or unfavorable feeling towards a specific behavior. An individual will intend to adopt a certain behavior when he evaluates it positively. Attitudes are determined by an individual's beliefs about the consequences of performing the behavior (behavioral beliefs), weighted by the evaluation of these consequences (outcome evaluations). Thus, attitude is an individual's dominant belief about whether the outcome of his or her behavior will be positive or negative (Fishbein & Capella, 2006); (ii) Subjective norm (others' opinions of behavior): subjective norms are assumed to be a function of beliefs about whether individuals approve or disapprove of behavior. The beliefs underlying subjective norms are normative beliefs. Normative social influence is defined as the influence of other people that induces us to conform in order to be liked and accepted by them (Aronson & Wilson, 2005). Although an action may not be accepted or approved by an individual, normative social influence exerts pressure on the individual to conform to the social norms of the group. Normative social influence has been shown to exert a strong persuasive influence on individuals. An individual will intend to adopt a behavior when he perceives that important people think he should. Significant others may be a spouse, close friends or doctor, among others; (iii) The degree of control over the perceived behavior (self-efficacy towards the behavior): refers to the perceived ease or difficulty of performing the behavior and is assumed to reflect past experience as well as anticipated impediments and obstacles. This variable can influence the implementation of the behavior either indirectly or directly.

The theory of planned behavior has been able to explain various ecological behaviors. Steg and Nordlund, (2013) found that variables in this theory, especially perceived attitudes and behavioral control, could predict pro-environmental behaviors. The ability of this theory to predict behavior rises when other motivational factors are included in the model, such as personal norms and identity (Nigbur *et al.*, 2010). Our work is based on Ajzen's theory of planned behavior.

MATERIALS AND METHODS

Sampling procedure and data

This study uses cross-sectional data from a survey commissioned by the World Bank among rice-growing households in Côte d'Ivoire as part of an economic inclusion project in the rice sector in October 2020, i.e. 7 months after the first case of Covid-19 appeared in Côte d'Ivoire. Considering their importance in rice production and the diversity of the agro-ecological zone, three regions were selected for design: the Tonkpi, Tchologo and Poro regions. Taking into account the intensity of rice production in the villages, 20 villages were selected in each region. In each village, 25 households were selected by stratified random sampling, where each village was considered a stratum. Thus, 1500 households were surveyed, but only 1359 households were selected for this study because they were growing rice in the current season.

The survey collected both quantitative and qualitative information. The quantitative information includes farmers' socioeconomic and demographic characteristics, income, equipment, quantities of inputs and labor used, area cultivated, and any other information that is relevant to this analysis. The qualitative survey examined farmers' perceptions and concerns related to Covid-19. These data form the basis of this study. Producer concerns were collected on six issues : family, employment, finances, mobility, transportation, activities, food, and products. Producers' levels of concern were measured on 5-point, fully anchored, bipolar Likert-type scales ranging from 1 to 5 based on the degree of concern : 1- not at all concerned; 2- not concerned; 3- neutral; 4- concerned and, 5- very concerned.

Table 1 summarizes the characteristics of the producers in our sample for the quantitative survey. The majority of producers in the sample are male (92%), belong to a group (62.55%), have an average age of 46.57 years, have participated in at least one rice training course, and have 2.95 and 17.70 years of education and experience in rice production, respectively. On average, the sampled

farmers have a household size of 5.86 persons in which 48.77% are children under 15 years of age, 25.09% are young people between 15 and 24 years of age, 22.25% are mature adults between 25 and 60 years of age, and 3.89% are old people over 60 years of age. After the start of Covid-19 in Côte d'Ivoire, smallholder rice farmers in the study area used an average of 8.20 kg/ha of pesticides, 43.30 kg/ha of urea, 88.43 kg/ha of NPK and 81.01 kg/ha of rice seed. In terms of labor, farmers used an average of 88.85 man-days/ha from their household and 126.41 man-days/ha from outside the household. The average cultivated area is 1.13 ha and these plots received an average of 1 visit from the extension agents.

Table 1: Description of the producer, household, farm and productive resources

Variable	Mean	Std. Dev.
Producer characteristics		
Sex (male = 1)	0.920	0.272
Age	46.574	12.08
Education (in years)	2.953	4.146
Experience (in years)	17.701	12.268
Number of participation in rice training	1.064	1.944
Membership in a group	0.625	0.484
Household characteristics		
Household size	5.866	2.801
Number of Kids in the household	2.861	2.075
Number of Youth in the household	1.472	1.283
Number of Mature in the household	w1.305	0.940
Number of Old in the household	0.228	0.500
Inputs allocation		
Amount of pesticide applied (kg/ha)	8.202	6.463
Amount of Urea applied (kg/ha)	43.301	51.333
Amount of NPK applied (kg/ha)	88.433	86.801
Amount of Seed used (kg/ha)	81.013	66.714
Labor allocation		
Amount of family labor used (man-day/ha)	88.853	86.122
Amount of non-family labor used (man-day/ha)	126.415	104.001
Plot characteristics		
Plot size	1.132	1.082
Number of extension visits received	1.131	2.136
Observations	1359	

Source : Author

Data analysis

Cronbach's alpha statistical test was performed to ensure the internal consistency of the factorial construction and the reliability of the scale with a cut-off value of 0.7 (De Vaus, 2002). Next, the data were summarized using frequencies and percentages. Cross-tabulations were performed to assess the relationship between levels of Covid-19 concern and different regions of origin of producers. A series of Chi-2 tests were performed to test for differences in responses. Finally, a series of Pearson's correlation tests were conducted to test the relationship between growers' concerns and the allocation of productive resources in smallholder rice farms in the midst of a health crisis.

RESULTS AND DISCUSSION

Producers' concerns related to the possibility of Covid-19 spread

Producer concerns were collected on 2 groups of criteria: concerns about family and displacement and concerns about finances and product availability.

Concerns about family and displacement

Observation of Table 2 shows that there is a significant difference in how producers perceive the possibility of Covid-19 spreading depending on where they live. The vast majority (over 50%) of producers in each region are very concerned about their family being infected or a family member losing their job to Covid-19.

Table 2: Producer concerns related to covid-19 with respect to family and transportation

What do you think about the possibility that, due to the spread of Covid-19:	Frequencies and percentages (in brackets) by region				
	Poro	Tchologo	Tonkpi	Total	P-value
You or your family could be infected?					0.000
Not at all concerned	20 (4.38)	26 (4.91)	0 (0.00)	46 (3.38)	
Not concerned	7 (1.53)	27 (5.09)	4 (1.08)	38 (2.80)	
Neutral position	11 (2.41)	28 (5.28)	2 (0.54)	41 (3.02)	
Concerned	120(26.26)	209(39.43)	90 (24.19)	419 (30.83)	
Very concerned	299(65.43)	240(45.28)	276(74.19)	815(59.97)	
You or a member of your family will lose your job ?					0.000
Not at all concerned	17 (3.72)	30 (5.66)	5 (1.34)	52 (3.83)	
Not concerned	17 (3.72)	51 (9.62)	15 (4.03)	83 (6.11)	
Neutral position	13 (2.84)	33 (6.23)	9 (2.42)	55 (4.05)	
Concerned	158(34.57)	210(39.62)	115(30.91)	483(35.54)	
Very concerned	252(55.14)	206(38.87)	228(61.29)	686(50.48)	
You may have to stay home for several weeks					0.000
Not at all concerned 1	11 (2.41)	24 (4.53)	0 (0.00)	35 (2.58)	
Not concerned 2	16 (3.50)	55 (10.38)	2 (0.54)	73 (5.37)	
Neutral position 3	3 (0.66)	9 (1.70)	4 (1.08)	16 (1.18)	
Concerned 4	159(34.79)	212(40.00)	115(30.91)	486(35.76)	
Very concerned 5	268(58.64)	230(43.40)	251(67.47)	749(55.11)	
You cannot use public transportation and roads as you usually do ?					0.000
Not at all concerned	11 (2.41)	17 (3.21)	0 (0.00)	28 (2.06)	
Not concerned	6 (1.31)	34 (6.42)	3 (0.81)	43 (3.16)	
Neutral position	0 (0.00)	8 (1.51)	4 (1.08)	12 (0.88)	
Concerned	154(33.70)	216(40.75)	122(32.80)	492(36.20)	
Very concerned	286(62.58)	255(48.11)	243(65.32)	784(57.69)	
Total	457	530	372	1359	

Source : Author

In the Tchologo region, less than half of producers (45% and 38% respectively for the risk of infection and job loss) are very worried. The same is true for concerns about travel restrictions. A total of 55.11% of producers said they were very worried about staying at home for several weeks, while 57.69% said they were very worried about not using public transportation. A significant proportion (at least 13%) said they were not worried about a household member losing their job (table 2). This could be because these producers own their own off-farm activities (food trade, farm machinery repair, etc.).

Concerns about finances and product availability

Table 3 reveals that a total of 55.04% and 56.73% of producers respectively said they were very worried that they would not be able to carry out their activities as usual and that their finances would be negatively affected.

Table 3: Producer concerns related to covid-19 with respect to activities and availability of goods

What do you think about the possi-bility that, due to the spread of Covid-19 :	Frequencies and percentages (in brackets) by region				
	Poro	Tchologo	Tonkpi	Total	P-value
You cannot perform your normal activities					
Not at all concerned 1	11 (2.41)	25 (4.72)	0 (0.00)	36 (2.65)	
Not concerned 2	9 (1.97)	44 (8.30)	2 (0.54)	55 (4.05)	
Neutral position 3	5 (1.09)	4 (0.75)	5 (1.34)	14 (1.03)	
Concerned 4	168(36.76)	214(40.38)	124(33.33)	506(37.23)	
Very concerned 5	264(57.77)	243(45.85)	241(64.78)	748(55.04)	
Your finances will be affected ?	1	2	3	Total	0.000

Not at all concerned	14 (3.06)	28 (5.28)	0 (0.00)	42 (3.09)	
Not concerned	11 (2.41)	44 (8.30)	2 (0.54)	57 (4.19)	
Neutral position	11 (2.41)	23 (4.34)	2 (0.54)	36 (2.65)	
Concerned	147(32.17)	199(37.55)	107(28.76)	453(33.33)	
Very concerned	274(59.96)	236(44.53)	261(70.16)	771(56.73)	
Your ability to obtain food is limi-ted					0.000
Not at all concerned 1	16 (3.50)	33 (6.23)	1 (0.27)	50 (3.68)	
Not concerned 2	42 (9.19)	66 (12.45)	5 (1.34)	113 (8.31)	
Neutral position 3	3 (0.66)	6 (1.13)	2 (0.54)	11 (0.81)	
Concerned 4	142(31.07)	199(37.55)	111(29.84)	452(33.26)	
Very concerned 5	254(55.58)	226(42.64)	253(68.01)	733(53.94)	
Your ability to purchase other goods and services is limited					0.000
Not at all concerned 1	11 (2.41)	28 (5.28)	0 (0.00)	39 (2.87)	
Not concerned 2	8 (1.75)	54 (10.19)	3 (0.81)	65 (4.78)	
Neutral position 3	4 (0.88)	11 (2.08)	3 (0.81)	18 (1.32)	
Concerned 4	183(40.04)	215(40.57)	120(32.26)	518(38.12)	
Very concerned 5	251(54.92)	222(41.89)	246(66.13)	719(52.91)	
Total	457	530	372	1359	

Source : Author

In addition, 53.94% and 52.91% of producers said they were very worried about the ability to obtain food and the availability of goods, respectively. The Tonkpi region has the highest level of concern (64.78%, 70.16%, 68.01% and 66.13% respectively for activities, finances, food and goods), with the Tchologo region still having the lowest percentage (table 3).

In the end, not only is there a great deal of concern among growers, but growers in the Tonkpi region (in the west of the country) were found to be much more worried about the possibility of Covid-19 spreading than those in other regions (Poro and Tchologo). This result is contrary to that of Adjet *et al.* (2022) who show that in the eyes of the respondents Covid-19 is a new pathology and could not spread in Côte d'Ivoire because of a certain "genetic immunity". This could be explained by the timing of the survey (just after the first case was detected in Côte d'Ivoire). However, these results on regional differences in the perceived spread of Covid-19 are similar to those found by several authors (Strobel *et al.*, 2020; INS, 2020; IOM, 2020; Mueller *et al.*, 2021; Greteman *et al.*, 2022; Akinyemi *et al.*) These authors have shown that concerns about Covid-19 could differ from one area to another depending on several factors such as access to good information, access to quality health care services, etc. In our study, in addition to these reasons, the concern of producers in the Tonkpi region was amplified by the occurrence of more cases of contamination than in the other two regions (INS, 2020), the lack of adequate sanitary facilities, and the deterioration of road infrastructure leading to the country's capital. In addition, producers in this region have an extroverted economy based on coffee and cocoa plantations. Thus, the restriction on travel and the isolation of the economic capital (Abidjan), the main channel for the sale of agricultural products, has accentuated the concerns of producers in this region.

Correlation between Covid-19 concerns and productive resource allocation

Cronbach's alpha is greater than 0.7 (alpha = 0.82), which confirms the adequacy of the associated items in the concern level constructs. The relationship between Covid-19 concerns and productive resource allocation was tested using Pearson's correlation coefficient.

Covid-19 Concerns and Input Allocation on Rice Farms

Table 4 presents the result of the correlation test between farmers' concerns and the allocation of inputs such as pesticides (herbicides), basal fertilizer (NPK) and cover fertilizer (Urea). Overall, the results reveal a significant negative correlation between concerns about Covid-19 and input allocation, especially for fertilizer. This means that farmers' concerns about the possibility of Covid-19 spread partly explain the reduction of inputs used on the plots durin g the pandemic period. This result is consistent with that of Ebel *et al.* (2022) who showed changes in farm management due to Covid-19, based on the agricultural practices applied by producers. These authors found that 28% of producers changed their fertilizer application practices in two rural U.S. states, Montana and South Dakota. In our study area, producers adopted adaptive and anticipatory strategies in light of changing conditions. This strategy has been to cut back on certain pockets of spending that they do not feel are too critical to the success of their operations. Thus, instead of using 200 kg of NPK per hectare, they prefer to reduce it to 100 kg/ha. Also, instead of using post-emergent herbicides, they prefer to do manual weeding.

Table 4: Correlation between Covid-19 concerns and input allocation

What do you think about the possibility that, due to the spread of Covid-19:	Phyto	Urea	NPK
you or your family could be infected?	-0.072**	-0.122***	-0.116***
Your finances will be affected ?	-0.088***	-0.123***	-0.137***
You or a member of your family will lose your job ?	-0.065**	-0.109***	-0.100***
You cannot use public transportation and roads as you usually do ?	-0.021	-0.095***	-0.100***
You cannot perform your normal activities	-0.046*	-0.130***	-0.127***
You may have to stay home for several weeks	-0.037	-0.122***	-0.135***
Your ability to obtain food is limited	-0.043	-0.142***	-0.151***
Your ability to purchase other goods and services is limi-ted	-0.048*	-0.144***	-0.163***

Source : Author

Covid-19 Concerns and Seed and Plot Allocation

Table 5 shows that there is no statistically significant correlation between levels of concern and seed and plot allocation. Furthermore, the correlation coefficients are very low (close to zero), implying that seed and plot allocation during the pandemic period cannot be explained by farmers' concerns. This result is consistent with Martey *et al.* (2022) who show that the effect of Covid-19 on land allocation is not significant on rice-allocated plots in Ghana. In our study area, this is explained by the fact that land is part of farmers' personal endowments while the vast majority of seeds used by farmers come from previous harvests. Thus, the occurrence of events does not a priori influence the allocation of these resources.

Table 5: Correlation between Covid-19 concerns and seed and plot allocation

What do you think about the possibility that, due to the spread of Covid-19:	Seed	Plots
you or your family could be infected?	0.011	-0.003
Your finances will be affected ?	-0.017	-0.002
You or a member of your family will lose your job ?	0.026	0.016
You cannot use public transportation and roads as you usually do ?	0.022	0.040
You cannot perform your normal activities	0.000	0.038
You may have to stay home for several weeks	0.014	-0.024
Your ability to obtain food is limited	0.044	-0.039
Your ability to purchase other goods and services is limited	-0.025	0.014

Source : Author

Covid-19 Concerns and Labor Allocation on Rice Farms

Table 6 presents the results of the Pearson correlation test between producer concerns and labor allocation on rice farms. The results reveal that the Pearson coefficient is positive and statistically significant indicating a positive association between farmers' concerns and labor allocation. The results further indicate a weak positive relationship between producers' concerns and family labor, explained by the high proportion of household members unable to work (more than 52% children and the elderly, see Table 1), while there is a strong positive relationship with non-family labor. These results are contrary to those of Ebel *et al.* (2022) and INS (2020). Ebel *et al.* (2022) showed that 34/1% of growers perceived a decrease in labor availability due to Covid-19 in two rural areas in the United States. The INS (2020) report also shows that 28.6% of producers in Côte d'Ivoire experienced a reduction in agricultural labor. But, this result is consistent with Martey *et al.* (2022) who show that 46% of producers said that Covid-19 resulted in increased family labor. In our study area, this is because producers use more labor to compensate for the reduction or elimination of weed control products such as herbicides (hand weeding instead of applying pre-emergent herbicides) and mechanization (hand plowing and threshing). In addition, membership in self-help groups (62.55% of our sample) facilitates access to cheap labor for various cultivation operations. From the producers' point of view, labor and inputs are substitutable (Gniza, 2023).

Table 6: Correlation between Covid-19 concerns and labor allocation

What do you think about the possibility that, due to the spread of Covid-19 :	Family labor	Non-family labor
you or your family could be infected?	0.084***	0.126***
Your finances will be affected ?	0.092***	0.129***
You or a member of your family will lose your job ?	0.073***	0.123***

You cannot use public transportation and roads as you usually do ?	0.097***	0.099***
You cannot perform your normal activities	0.086***	0.121***
You may have to stay home for several weeks	0.067**	0.089***
Your ability to obtain food is limited	0.079***	0.093***
Your ability to purchase other goods and services is limited	0.092***	0.121***

Source : Author

CONCLUSION

This study examined producers' levels of concern about the possibility of Covid-19 spread and possible correlations with resource allocations on smallholder rice farms in Côte d'Ivoire. The study showed that the vast majority of producers were very concerned about the possibility of the spread of Covid-19 with respect to their household, travel, activities, and availability of food and goods. The study showed that producers in the Tonkpi region were more concerned than others at this time due to the deterioration of the health system and road infrastructure and the occurrence of more cases of contamination compared to other regions. In addition, the study found that there was a negative and significant correlation between producers' levels of concern and chemical input allocation and a positive and significant correlation with labor allocation. This confirms the suspicion of substitutability between labor and chemical inputs from the producers' perspective.

From the above, the study makes four recommendations. First, promote awareness and information among rural populations to counteract rumors and false information. This could be done through extension agents who are already well integrated in the villages and who enjoy the trust of producers. Secondly, encourage community mobilization by relying on existing local mechanisms and through the organization of producers' groups, which will help cushion the effects of health crises. Third, begin to provide psychological support to producers in times of health crises so that they can remain effective in their activities (Tagne *et al.*, 2021). Finally, the study recommends an effective subsidy of inputs during health crises to allow producers to access inputs without any stress and ensure good production and effectively fight against food insecurity.

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