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Sustainability information and mental health: Evidence from rural farm enterprises in Nigeria

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ABSTRACT

In the drive towards sustainability, the role of mental health in shaping responses to information campaigns is critical. Specifically, We investigate the mental health impact of an information campaign designed to influence low-income farmers' attitudes and behaviors toward sustainability. This investigation addresses gaps in the existing literature on the effectiveness of information campaigns for pro-environmental behavior, which typically ignores the psychological interference caused by the poor mental health of exposed subjects. Using data from an experimental study of 780 low-income farmers in rural Nigeria with multiple mental health proxies, we investigate whether the psychological state of exposed farmers interferes with treatment. We find evidence of a counteracting effect, such that treated farmers with poor mental health prior to treatment are less likely to report pro-environmental attitudes and actions, in contrast to farmers with better mental health. These findings challenge the assumption that sustainability information drives behavioral change and calls for integrated interventions that address psychological well-being and environmental awareness.

1. Introduction

Promoting the adoption of sustainable behaviour through the enforcement of regulations, financial incentives, and informational outreach on citizens' duties is an essential component of public policy for environmental protection (United Nations Environment Programme - UNEP, 2017). Policymakers contend with the scale of benefits and costs of any public policy tool engaged to promote citizens' sustainability behaviors. Educating the public about responsible behaviour that has a real impact on sustainability could be a cost-effective strategy, especially for developing countries with limited economic resources to combat this existential threat. As evidence demonstrates, education and information campaigns are pertinent, low-cost strategies with a significant impact on influencing citizen behaviour (Pichert & Katsikopoulos, 2008; UNEP, 2017). This tool aims to alter an individual's evaluation of sustainable practices through motivated reasoning and mental appeal (Chong & Druckman, 2007). Consequently, mobilizing resources to disseminate pertinent sustainability information and motivating citizens to take pro-environmental action remains a core priority for developing country governments and interest groups.

Communication of sustainability information to the public for environmental awareness may not always be effective for a variety of reasons. First, such information may conflict with individuals' persistent normative practices, and the lack of consideration of local contexts and dynamics in the design of sustainability information may reduce its effectiveness (Scannell & Gifford, 2013; Hine et al., 2016; Metcalf et al., 2018; Byerly et al., 2019). Second, the effectiveness of sustainability information may depend on mental gaps caused by a variety of factors, such as attention and memory span, conflicting priors, or relevant aspects of a problem not being foremost in the recipient's mind (Haaland et al., 2021; Handel & Schwartzstein, 2018). As a result, the mental state of the information-receiving individuals determines how they perceive the information, as the information structure, presentation, or framing influences individuals to consciously develop a particular mental conceptualization or reorient their thinking about the subject at hand (Chong & Druckman, 2007).

This study supports this viewpoint by contending that the effectiveness of an information intervention for sustainability action is contingent on the mental state of the exposed individuals. Thus, the subsequent pro-environmental behaviour of individuals who are exposed to sustainability information depends on their mental health. It is probable that the information presented to respondents, particularly that which depicts

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how the respondent's current actions impact the environment, could contribute to the psychological distress of survey respondents. The extent of such distress has remained elusive in recent empirical studies, and the extent to which such prospective distress influences the treatment effects of intervention has not received a considerable amount of attention in the literature.[1] Consequently, the extent to which such distress influences the post-information treatment outcomes of respondents depends on their pre-existing mental health conditions. This condition influences individuals' reasoning and subjects their decisions to a specific experiential hyper-emotion, which is fundamental to the collective capacity to make decisions and shape worldviews (Gangemi et al., 2019; WHO, 2022).

Recent studies on cognitive decision-making and risk perception provide a theoretical explanation for why mental health conditions could interfere with responses to specific treatment information. That is, individuals' choices, which entail the evaluation and cognitive processing of the information and attendant risks (Corradi et al., 2013), are shaped by their mental health condition because it subjects choices and reasoning to a particular experiential hyper-emotion (Shilyansky et al., 2016; Gangemi et al., 2019; Dalton et al., 2020; May & Wisco, 2020; Romero-Rivas & Rodriguez-Cuadrado, 2021; Terraneo et al., 2021).

The experimental design of this research included implementing an information campaign through a survey to improve farmers' understanding of the impact of agricultural burning practices on environmental pollution, which impacts farm yield, income, and health. The experiment involved a random assignment of 780 sampled farmers into three treatments. The exposure included documented sustainability information on the influence of agricultural burning on farmers' health and biodiversity losses, farmers' income, and a combined effect on income, health, and biodiversity losses; typifying social, economic, and combined treatments.

We find consistent evidence of improvements in pro-environmental attitudes and behaviors for exposed farmers, in contrast to unexposed farmers, similar to the findings in previous research focusing on an information campaign to increase respondents' pro-environmental behavior (Carlsson et al., 2021; Ferraro et al., 2011; Nielsen et al., 2016). We evaluate the validity of the argument that the effect of the information depends on the farmers' current mental health status. We examine this issue leveraging two measures of mental health: the Kessler Psychological Distress Scale (K-10) and the Centre for Epidemiologic Studies Depression Scale (CES-D), both of which consist of 10 questions. These two techniques of assessing mental health are distinct: The Diagnostic and Statistical Manual of Mental Disorders, a reliable indicator of mental disorders, correlates with the K-10 (Kessler et al., 2003). Andresen et al. (1994) found that the CES-D accurately assesses depression symptomatology in community and population-based epidemiological studies and effectively screens for significant depression symptoms among adults. By interacting these variables with the treatment indicator, we find that the overall effectiveness of information exposure in inducing pro-environmental attitudes and behaviors among exposed farmers depends on their mental health status at the time they were exposed to such information on sustainability.

Our investigation offers two distinct contributions. This study provides a novel and frequently disregarded argument for the inclusion of farmers' mental health conditions in pro-environmental information campaigns aimed at promoting sustainable behaviors. Prior research considers information provision as a means to influence citizens' sustainability actions (Carlsson et al., 2021; Ferraro et al., 2011; Nielsen et al., 2016), arguing that individuals have limited information capacity and are influenced by exposure to relevant information that modifies their cognitive understanding of the topic. However, studies in this field have ignored the psychological interference from the poor mental health state of exposed individuals, which defines how they evaluate relevant information on sustainability and their long-term judgments/decisions (Gangemi et al., 2019; WHO, 2022). This issue is crucial in countries that are characterized by persistently low state capacity to address mental health crises among citizens (Adhvaryu et al., 2019). Second, this study complements a growing body of literature in environmental economics that reiterates incomplete analyses of pro-environmental interventions by ignoring other critical factors that define pro-environmental sentiments and focusing instead on material incentives, rule-making, and information provision (Cinner, 2018; Bujold et al., 2020). The findings of this study provide policymakers in developing countries with a low-cost, simple-to-implement strategy for enhancing their sustainability campaign. As a precursor to a sustainability campaign, addressing psychological distress can enhance its effectiveness in influencing citizens' pro-environmental attitudes and behaviors.

2. Information access, mental health, and farming behavior

There are multiple channels through which the farmers' mental health condition influences the manner in which information treatment informs agricultural practice. Primarily, the effectiveness of pro-environmental information exposure is contingent upon adequate mental awareness, comprehension, and psychological appreciation of the information. However, the gaps from short attention and memory span, conflicting priors, and pertinent features of a problem not being at the forefront of one's mind could be the dominant mental state that influences the effectiveness of the information (Haaland et al., 2021; Handel & Schwartzstein, 2018). In this research, we examine mental friction resulting from the psychological state of the individuals and the information provided. In other words, the influence of the information provided on the farmer's adoption of sustainable farming practices is contingent on the farmer's state of mind. Therefore, this suggests that providing pertinent information to farmers for effective behavioral change is not a solitary factor in determining an individual's post-treatment decisions.

In situations where decisions are based on heuristics or motivated logical reasoning, there are numerous reasons why the mental health conditions of respondents' matter. First, because mental considerations are engaged in evaluating options, regardless of whether they are heuristics or motivated reasoning, the mental state of respondents can effectively influence their opinions. According to Shilyansky et al. (2016), mental health conditions are associated with deficits in higher-order cognitive functions and information processing. Because a person's mental health condition shapes the reasoning strategy and subjects individuals decisions to a particular experiential hyper-emotion (Gangemi et al., 2019), which is fundamental to the collective capacity to make decisions and shape world views (WHO, 2022). Therefore, poor mental health alters individuals' cognitive reasoning by decreasing their dedication to the information provided or increasing their focus on other non-related information.

Second, poor mental health conditions alter an individual's perception of risks and rewards and distort their perception of social issues (Dalton et al., 2020; Romero-Rivas & Rodriguez-Cuadrado, 2021; Terraneo et al., 2021). In accordance with our experiment, the more psychologically distressed a person is, the more likely they are to opt for a less uncertain course of action, such as ceasing bush-burning without an obvious alternative. In decision-making actions involving risks, uncertainties, and ambiguities, such that choices relate to certain gains/losses and risky or ambiguous chances of gaining/losing something, the mental health condition of participants influences their decisions to minimize losses (Dalton et al., 2020; May & Wisco, 2020).

[1] See Bauman and Geher (2002) and Eyal et al. (2018) about how the inconsideration of the psychological state of the respondents and their feelings, ex-ante to an experiment, introduces errors and imprecise or biased assessments of the amount of beneficence of the research.

3. Sampling procedure, experimental design, and descriptive statistics

3.1. Sampling procedure

Participants in this research are smallholder farmers in the rural areas of the following five Nigerian states: Ekiti, Cross River, Ebonyi, Kwara, and Taraba. The majority of these states have a large number of farmers[2] who rely on rain-fed irrigation, as well as a substantial number of agricultural laborers who prepare their farmland for planting by weeding or field-flaming. The visitation of these States was organized into administrative zones (Local Government, LG, the third administration level) and enumeration areas (EA) in accordance with the protocol established by the Nigerian National Bureau of Statistics (NBS) to recruit a representative sample of individual farmers.[3] We utilized a multistage stratified sampling strategy to ascertain the proportion of EAs in rural LGAs in the selected states and the number of EAs visited in each state. Thus, more EAs are visited in states with a greater proportion of rural EAs, and vice versa. The starting location is then chosen at random from a census of locations in the respective EA, primarily a central and public location, such as a religious structure, market, town square, or the residence of the local ruler.

We followed the same procedure to ascertain the number of farmers visited from different directions of the randomly selected central location. We determined sample sizes based on the prospective EA population in each state. Then, we distribute an equal number of respondents to each EA across states. This approach has the flexibility to obtain more diverse perspectives, depending on the size of EAs in each state. In order to obtain a representative sample of farmers, we chose an initial criterion, such as being a smallholder farmer whose primary economic activities are in the agricultural sector and who possesses less than 5 ha of farmland. In addition, the respondent from the farmland must be the principal decision maker for farmland activities, the farmland must rely heavily on rainfed irrigation, and the respondent must be at least 18 years old. We conducted the interviews on the farmland (or household), with one person per farmland or household. In total, 780 farmers were chosen as the research sample.

The survey was conducted between March and May of 2022, coinciding with high and low bush-burning activity in the sample locations. These periods are primarily the planting season when farmers prepare their fields for planting prior to the rainy season (International Cryosphere Climate Initiative, 2020).

3.2. Experimental design

We elicit environmental sustainability attitudes and preferences from farmers after exposing them to information about the repercussions of a common practice among rural farmers – agricultural burning. The structure of the experiment is as follows: we randomly assign recruited farmers to three treatments that provide localized information about how agricultural burning affects farmers' health and biodiversity losses, farmers' income, and a combined effect on income, health, and biodiversity losses. For the sake of clarification, we will refer to these as social, economic, and combined treatments.

We randomly divided 780 farmers into two groups: those exposed to the information treatment and the control group (i.e., 390 in each group). Based on the information presented, the sample size for the Treatment group was further divided into three equal halves (130 for the "social," "economic," and "combined" groups). Recognizing the low levels of education and dearth of (or limited) climate change knowledge of our participants, we hired a professional to translate the information into vernacular and local languages. To enhance farmers' comprehension of the information, we also used a visual representation,[4],[5]. The respondents, those in the control and treatment groups, were given the following information in the form of a newspaper article with the foregoing statement,

> *A newspaper excerpt by a reputable non-government organization (NGO) says that bush burning or field flaming is a regular practice in the farming cycle.*

The reference to a newspaper excerpt and a reputable NGO was necessary for information acceptability and to mimic the reality of the information, as 75.7 % of rural residents in Nigeria receive their news from this medium, and approximately two-thirds of Nigerians trust information from this source (Afrobarometer, 2020; Edelman Trust Barometer, 2021). In addition, we attributed the information to an NGO because other options, such as government spokespeople or academics, posed the risk of eliciting a politicized because of the special interests of these groups. We pre-registered this experiment (see https://osf.io/7uwgj). We piloted all the approaches before field deployment.

To minimize inflaming participants' emotions, the treatment avoids using highly emotive language, such as emphasizing the existential threat of climate change - a phrase frequently used in climate change campaigns. Farmers designated to the "social" information group were exposed to information about the effect of agricultural burning on other social externalities. They were informed, after the preceding statement, that:

> *The carbon emitted from bush burning activities is stored in the atmosphere for a long period and causes extreme climate events that affect human health (through respiratory and cardiovascular disease), food insecurity (through weather variability), biodiversity loss (including loss of species of mammals, amphibians, birds, marine fish, and reptiles), and bush fire that spreads can affect the wellbeing of neighboring communities or farmlands.*

Those assigned to the treatment describing the "economic" consequence of agricultural burning were exposed to the following information following the preceding statement:

> *The heat from bush fire destroys the organic matter for soil fertility, and carbon emitted from bush burning is stored in the atmosphere for a long period, causing extreme climate events. These two issues from bush burning will eventually cause a decline in farm yield, an increase in pest and disease outbreak that destroys crops and farm productivity, and the potential to affect household agricultural income adversely.*

Those farmers assigned to the "combined" treatment were exposed to information about the "social" and "economic" consequences of bush-burning practices. Specifically, following the preceding statement, they were exposed to the following information,

[2] See National Bureau of Statistics bulletin for agricultural sector production.

[3] That is, from all the enumeration areas (EA) in Local Government that is classified as rural in the NBS protocol, we randomly select the required number of EAs to be visited for the survey. We selected 4 EAs in Ekiti State, 13 in Ebonyi, 9 in Cross River, 7 in Kwara, and 9 in Taraba.

[4] Whether a pictorial description of the information is more effective in this context than the traditional textual description remains a relevant empirical question outside the scope of this study.

[5] The information was translated into the local languages of farmers in the sample areas, primarily Broken English (Pidgin English), Yoruba, and Hausa, and infographics were used to describe the entire message in order to guarantee farmers' absolute comprehension of the information on the survey instruments. The essence of these additional translations is that the respondents considered in this study are predominantly low-education farmers and that these diverse modes of information dissemination will reduce attrition due to enhanced comprehension of the session's information. The pilot survey indicates that farmers exposed to textual and visual information are approximately twice as likely to comprehend the information compared to those exposed to only textual information (specific estimates are accessible upon request).

Carbon emission from bush-burning activities are stored in the atmosphere for an extended period and causes extreme events that adversely affect respiration, causing cardiovascular disease, food insecurity, and biodiversity loss. Bush fire can also affect the well-being of neighboring communities or farmlands. The heat from the fire destroys the organic matter for soil fertility, and carbon emitted from bush burning is stored in the atmosphere for an extended period, causing weather variability. The eventual effect is decreased farm yields and increased pests and disease that destroys crops and farm productivity, potentially affecting agricultural income adversely.

The "economic" and "social" information was nearly identical in length, emphasizing the primary implication of engaging in agricultural burning, and were designed with the attention span of farmers in mind. The difference between multiple vignettes lies in the framing of the effects of bush/field burning. The survey instrument included factual information regarding the social impact of carbon emissions from agricultural burning for the "social" treatment group. Such consequences include how carbon from bushfires is deposited in the atmosphere, leading to pollution and other extreme climate events with repercussions for health and biodiversity sustainability. The "economic" treatment had a similar vignette, but it emphasized the need to reduce bush burning because the heat destroys soil organic matter and the carbon from the fire causes extreme climate events, and pest and disease outbreaks, leading to a decrease in agricultural yields. Bushfires and black carbon emissions from bush burning have been linked to health issues (Balasooriya et al., 2022), biodiversity loss (Driscoll & Armenteras, 2021), pest and disease outbreaks (Cohen et al., 2020), and a decline in farm yield (Cline, 2008). The final treatment incorporated both the "social" and "economic" effects of this agricultural practice.

3.3. Follow-up focused group discussions

We conducted a follow-up focus group with a subsample of farmers in the treatment group to gain insight into how the treatment influences their perceptions of environmental sustainability and agricultural burning practices. Overall, we conducted five gender-representative focus groups with 30 farmers, selected based on their availability and accessibility after treatment. Since gender representation was a priority, the total number of participants in these sessions included an equal number of male and female farmers.

3.4. Mental health

We determined the farmer's mental health using the Kessler Psychological Distress Scale or K10, which consists of 10 questions. Although the K10 scale was devised by Ron Kessler and Dan Mroczek in 1992 as a measure of anxiety-depression spectrum mental distress (Kessler et al., 2003), it has been used to assess mental health conditions in recent research, such as Adhvaryu et al. (2019). This measure is correlated with other credible indicators of mental disorders, such as the Diagnostic and Statistical Manual of Mental Disorders (Kessler et al., 2003). As a result, we favor this method as the primary method for measuring the mental health of farmers.

We collected this information before the treatment, consisting of 10 questions about negative emotional experiences by the farmer during the past 30 days. Farmers are required to respond to the 10 questions ranging from "none of the time" to "all of the time." They were specifically asked the following questions:

3.4.1. K10 questionnaire (Past 30 Days)

Question Number	Question	Response Options (Likert Scale)
1	How often did you feel tired out for no good reason?	None of the time (1) → All of the time (5)
2	How often did you feel nervous?	None of the time (1) → All of the time (5)
3	How often did you feel so nervous that nothing could calm you down?	None of the time (1) → All of the time (5)
4	How often did you feel hopeless?	None of the time (1) → All of the time (5)
5	How often did you feel restless or fidgety?	None of the time (1) → All of the time (5)
6	How often did you feel so restless you could not sit still?	None of the time (1) → All of the time (5)
7	How often did you feel depressed?	None of the time (1) → All of the time (5)
8	How often did you feel that everything was an effort?	None of the time (1) → All of the time (5)
9	How often did you feel so sad that nothing could cheer you up?	None of the time (1) → All of the time (5)
10	How often did you feel worthless?	None of the time (1) → All of the time (5)

In addition to the K10 questionnaire, the Centre for Epidemiologic Studies Depression Scale (CES-D) template was used to ask farmers additional questions about their mental state. The 10-item CES-D is a commonly used self-report measure of depression symptomatology in community and population-based epidemiologic studies. There are multiple versions of this brief questionnaire, but we prefer the Andresen version due to its high reliability and excellent sensitivity and specificity for screening for major depression in older adults (Andresen et al., 1994). We considered this measure for comparison with the K10 mental health measure, and it has a reduced recall period - the past week or seven days. We asked farmers to rate the frequency with which they experienced the following emotions during the previous week:

3.4.2. CES-D questionnaire (Past 7 Days)

Question Number	Question	Response Options (Likert Scale)
1	I was bothered by things that usually don't bother me.	Rarely or none of the time (0) → All of the time (3)
2	I had trouble keeping my mind on what I was doing.	Rarely or none of the time (0) → All of the time (3)
3	I felt depressed.	Rarely or none of the time (0) → All of the time (3)
4	I felt that everything I did was an effort.	Rarely or none of the time (0) → All of the time (3)
5	I felt hopeful about the future. (Reverse-scored)	Rarely or none of the time (3) → All of the time (0)
6	I felt fearful.	Rarely or none of the time (0) → All of the time (3)
7	My sleep was restless.	Rarely or none of the time (0) → All of the time (3)
8	I was happy. (Reverse-scored)	Rarely or none of the time (3) → All of the time (0)
9	I felt lonely.	Rarely or none of the time (0) → All of the time (3)
10	I could not "get going."	Rarely or none of the time (0) → All of the time (3)

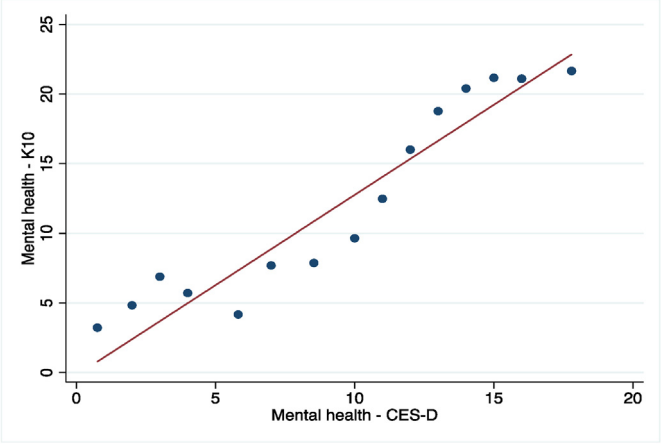

Fig. 1. Correlation between the K10 and CES-D measure of farmers' mental health.

Step 3: Assign Scores to Responses

The farmers were expected to respond to these statements[6] by noting whether they had these feelings "rarely or none of the time - less than 1 day", "some or a little of the time – 1 to 2 days", "occasionally or a moderate amount of time – 3 to 4 days", and "all of the time – 5 to 7 days." We sum the responses for each of the two mental health indicators, such that farmers with higher scores indicate that they experienced negative emotions the majority of the time within the past thirty days or within the past week.

These two measures are significantly and positively correlated (see Fig. 1), and each can be regarded as an independent indicator of the mental health condition of farmers.

3.5. Outcome variables

To measure sustainable farming practices, we consider the following attitudinal and behavioral measures.[7] We measured the farmers' attitudes towards bush burning by eliciting their views about bush burning, based on whether they agreed with the sentence,

"It is acceptable for a farmer to burn weeds from their farmland or flame their field to prepare for the planting season quickly."

This variable, "bush burning is acceptable," is a binary indicator if farmers respond that they agree or strongly agree with the statement. A different attitudinal variable, "bush burning likelihood," is a self-reported evaluation of farmers' likelihood of engaging in bush burning in the next planting season. The response to this statement ranges from 0 (no likelihood) to 10 (highest likelihood).

We considered three behavioral variables, including a binary indicator reflecting the farmer's willingness to sign a pledge to reduce or avoid bush burning in the next farming season "pledge," the farmer's affirmative response to sign-up to join a localized activist group that champions the reduction in bush burning in the respective community "localized activist," and a contingent valuation measure intended to elicit monetary value from respondents about the amount they are willing and ready to pay for each service by the local government to collect and dispose of weeds from farmland "service pay." The latter indicator was asked in the following form, "*which of the amounts listed below best describes your maximum willingness to pay for a service through a direct charge by the local government coming to your farmland to collect and dispose of weeds from farmland to reduce bush burning/field flaming?* The response to this question ranges from 0 US$ (i.e., 0 Naira) to 2US$ and above (i.e., 831.7 Naira and above), with a successive increase of 0.2 US$ (or 83.17 Naira).[8] These variables are relevant indicators of an individual's commitment to promoting environmental sustainability, as shown in Lokhorst et al. (2013).

3.6. Descriptive statistics, balance test, and estimation

We collected important sociodemographic, household and farmland decision-making, and other farmland information to access the success of the randomization. We also elicited information about the farmer's previous engagement in bush-burning activities. Table 1 reports the balance checks for the observable variables. It presents the mean and standard deviation for the treatment and the control groups and between each combination of the treatment groups. We also report the p-value for the test that the difference in means between these groups is zero and the normalized differences between each group. The farmer's individual and farm-level variables are well-balanced across the treatment and control groups and the different treatment arms. The p-value for each variable's difference in means is never statistically significant. The p-value of the F-statistic of joint significance is never significant. Normalized differences in means are below the rule of thumb of 0.25, as suggested by Imbens & Rubin (2015).

The preferred estimation for the data gathered from the farmers is the linear probability model for the binary outcome variables "bush burning is acceptable," "pledge," and "localized activist," and OLS regressions for the continuous variables "bush burning likelihood" and "service pay." The regression estimation is of the following form:

$$Y_i = \alpha + \beta T_i + \vartheta M_i + \delta T \times M_i + \varepsilon_i \quad (1)$$

Where Y_i is the outcome variable of interest for individual farmer *i*. *Ti* is a vector of dummies for the farmer being assigned to each of the treatment arms – "social" (T1), "economic" (T2), and "combined" (T3) – relative to the control group. M_i is the mental health condition of the farmers, elicited before the experiment was conducted. δ is the variable of interest, showing the effect of the treatment conditioned on farmers' mental health.

Following the success of the randomization as shown in Table 1, we do not see the need to adjust for the observable characteristics of farmers and their farmlands. Although not reported, the main results do not change with or without the inclusion of these variables. The robust standard error is represented as ε_i in equation (1). Finally, in subsequent analysis, we report q-values correcting for false discovery rate within each pre-specified family using the Benjamini–Hochberg procedure (Benjamini & Hochberg, 1995).

4. Results and discussion

4.1. Estimates of treatment effect

Fig. 2 suggests that treated farmers are more likely to report better sustainability attitudes and behavior. As shown in Fig. 2a, farmers who were exposed to any treatment were less likely to concur that bush burning is an acceptable agricultural practice. This decrease is approximately 13, 12, and 15 percentage points for the "social," "economic," and

[6] For statements 5 and 8, the responses were scored in reverse order. For example, "all of the time – 5 to 7 days" signify improved mental health, and "rarely or none of the time - less than 1 day" imply a decline in mental health.

[7] The questions to capture these variables were presented to the respondents immediately after the respective treatment information.

[8] We considered a maximum limit of 2 US$, as this is above the poverty line of Nigeria at 1US$ a day (World Bank, 2020) and the rural farmers considered in this study are mostly poor. 73 % of smallholder households in Nigeria are below this poverty line and about 71 % barely have money for food and clothes or do not have enough money for any (Anderson et al., 2017).

Table 1
Descriptive and balance test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	C	T1	T2	T3	T1 vs. C	T2 vs. C	T3 vs. C	T1 vs. T2	T1 vs. T3	T2 vs. T3
Mental health – K10	11.906	11.285	11.231	11.349	−0.005	0.001	−0.000	−0.010	−0.005	0.003 (0.007)
	(8.192)	(7.818)	(7.673)	(7.867)	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	[0.015]
					[0.008]	[0.009]	[0.007]	[-0.006]	[0.008]	
Mental health – CES-D	9.220	8.771	9.215	9.000	−0.003	0.009	0.001 (0.008)	−0.014	−0.007	0.009 (0.012)
	(4.996)	(4.976)	(4.488)	(4.819)	(0.008)	(0.008)	[0.044]	(0.011)	(0.012)	[-0.046]
					[0.090]	[0.001]		[0.093]	[0.047]	
Education level	2.893	2.979	3.015	3.013	0.007	−0.002	0.005 (0.018)	0.020	−0.002	−0.015
	(1.375)	(1.402)	(1.545)	(1.409)	(0.018)	(0.018)	[-0.087]	(0.028)	(0.026)	(0.027)
					[-0.062]	[-0.084]		[0.024]	[0.024]	[-0.000]
Gender	0.612	0.604	0.723	0.671	−0.018	0.069	0.049 (0.045)	−0.113	−0.085	0.030 (0.072)
	(0.488)	(0.491)	(0.449)	(0.471)	(0.045)	(0.045)	[-0.125]	(0.072)	(0.066)	[-0.112]
					[0.015]	[-0.238]		[0.253]	[0.139]	
Age	44.576	45.034	43.200	42.622	0.001	−0.002	−0.001	0.004	0.001	−0.003
	(14.219)	(14.041)	(15.266)	(14.190)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
					[-0.032]	[0.093]	[0.138]	[-0.125]	[-0.170]	[-0.039]
Decides over earning	0.564	0.653	0.581	0.559	0.033	−0.119	0.056 (0.074)	0.185*	−0.049	−0.212**
	(0.497)	(0.478)	(0.495)	(0.498)	(0.075)	(0.074)	[0.009]	(0.105)	(0.117)	(0.195)
					[-0.182]	[-0.035]		[-0.146]	[-0.191]	[-0.044]
Residence years	31.030	29.382	31.154	30.832	−0.002	0.001	0.001 (0.002)	−0.003	−0.003	0.001 (0.003)
	(16.965)	(18.469)	(16.052)	(15.614)	(0.002)	(0.002)	[0.012]	(0.002)	(0.002)	[-0.020]
					[0.093]	[-0.007]		[0.102]	[0.084]	
Total household asset	3.835	3.917	4.031	4.056	−0.004	−0.003	0.007 (0.010)	0.001	−0.014	−0.006
	(2.932)	(3.128)	(3.199)	(3.133)	(0.010)	(0.009)	[-0.073]	(0.013)	(0.013)	(0.014)
					[-0.027]	[-0.064]		[0.036]	[0.044]	[0.008]
Engaged in rainfed agriculture	0.972	0.944	0.969	0.972	−0.157	0.007	−0.006	−0.155	−0.093	0.018 (0.189)
	(0.164)	(0.230)	(0.173)	(0.165)	(0.119)	(0.120)	(0.133)	(0.138)	(0.150)	[0.016]
					[0.140]	[0.019]	[0.003]	[0.122]	[0.137]	
Own agric. land	0.777	0.826	0.785	0.762	0.074	−0.002	−0.065	0.065	0.135	0.107 (0.100)
	(0.417)	(0.380)	(0.413)	(0.427)	(0.066)	(0.065)	(0.065)	(0.095)	(0.096)	[-0.053]
					[-0.124]	[-0.019]	[0.035]	[-0.105]	[-0.158]	
Farming experience (years)	22.719	22.750	21.785	20.839	0.000	−0.001	−0.002	0.001	0.003	0.002 (0.004)
	(13.707)	(14.159)	(14.017)	(12.274)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	[-0.072]
					[-0.002]	[0.067]	[0.144]	[-0.069]	[-0.144]	
Total farm asset	3.253	3.278	3.377	3.230	−0.008	0.015	−0.014	−0.026	0.005	0.027 (0.034)
	(1.091)	(1.007)	(1.241)	(1.173)	(0.023)	(0.023)	(0.024)	(0.035)	(0.034)	[-0.121]
					[-0.023]	[-0.106]	[0.020]	[0.087]	[-0.043]	
Workers in past harvest	1.814	1.874	1.858	1.836	0.002	0.077	−0.051	−0.118	0.078	0.162 (0.122)
	(0.559)	(0.843)	(0.572)	(0.570)	(0.080)	(0.081)	(0.078)	(0.116)	(0.110)	[-0.039]
					[-0.085]	[-0.078]	[-0.039]	[-0.022]	[-0.053]	
Workers in past planting	1.789	1.838	1.798	1.824	0.028	−0.068	0.092 (0.084)	0.154	−0.080	−0.214
	(0.540)	(0.762)	(0.546)	(0.513)	(0.089)	(0.087)	[-0.067]	(0.130)	(0.126)	(0.134)
					[-0.073]	[-0.015]		[-0.060]	[-0.020]	[0.051]
Number of crops planted	4.711	4.576	4.469	4.462	−0.014	−0.020	−0.025*	0.005	0.008	0.001 (0.023)
	(1.622)	(1.632)	(1.666)	(1.686)	(0.015)	(0.015)	(0.015)	(0.022)	(0.020)	[-0.005]
					[0.083]	[0.147]	[0.151]	[-0.064]	[-0.069]	
Engaged in bush burning	0.730	0.701	0.738	0.699	−0.083	−0.016	−0.084	−0.062	−0.004	0.054 (0.082)
	(0.445)	(0.459)	(0.441)	(0.460)	(0.056)	(0.056)	(0.055)	(0.076)	(0.076)	[-0.087]
					[0.063]	[-0.019]	[0.068]	[0.082]	[-0.004]	
Decision over planting	0.583	0.674	0.643	0.531	0.087	−0.015	−0.074	0.050	0.164	0.122 (0.160)
	(0.494)	(0.471)	(0.481)	(0.500)	(0.110)	(0.120)	(0.121)	(0.169)	(0.153)	[-0.228]
					[-0.188]	[-0.124]	[0.103]	[-0.063]	[-0.292]	
Decision over harvest	0.565	0.646	0.638	0.521	−0.035	0.160	−0.014	−0.179	0.030	0.162 (0.167)
	(0.496)	(0.480)	(0.482)	(0.501)	(0.124)	(0.131)	(0.131)	(0.171)	(0.160)	[-0.239]
					[-0.165]	[-0.150]	[0.088]	[-0.015]	[-0.254]	

Note: The values in parenthesis are the standard deviation, while those in brackets are the p-value for the test that the difference in means between the groups is zero and the normalized differences between each group.

"combined" groups, respectively. Fig. 2b demonstrates a comparable pattern. Similar to farmers exposed to the "combined group," those exposed to "social" and "economic" information report being substantially less likely to engage in bush-burning during the next farming season, although the coefficient is not statistically significant. Fig. 2c and d depict positive effects for the outcome variables - farmers signing a pledge to reduce bush-burning activities or joining a localized activist group that promotes the reduction of bush-burning in the respective community. Statistically, the effects were not significant at the 1 and 5 percent levels. The results for the outcome variable "service pay" are depicted in Fig. 2e, which demonstrates a significant increase in the amount that farmers in the "economic" group are willing to pay for a service provided by the local government to prevent bush burning. Although farmers in the "social" and "combined" treatments are more inclined to pledge funds for this government service, the coefficients are not statistically significant at the traditional levels.

These initial results are validated through a robustness test that examines for overestimation of the treatment effect by assuming that farmers assigned to any of the information groups comprehended the information provided. We investigate this issue by estimating the intent-to-treat (ITT) using an instrumental variable (IV) analysis that relies on the treatment assignment as an exogenous shock on the degree to which each farmer comprehends the provided information. We determine the extent to which each farmer comprehends the information presented in each treatment by analyzing the results of a manipulation check, in which each farmer is asked to respond to an apparent question after

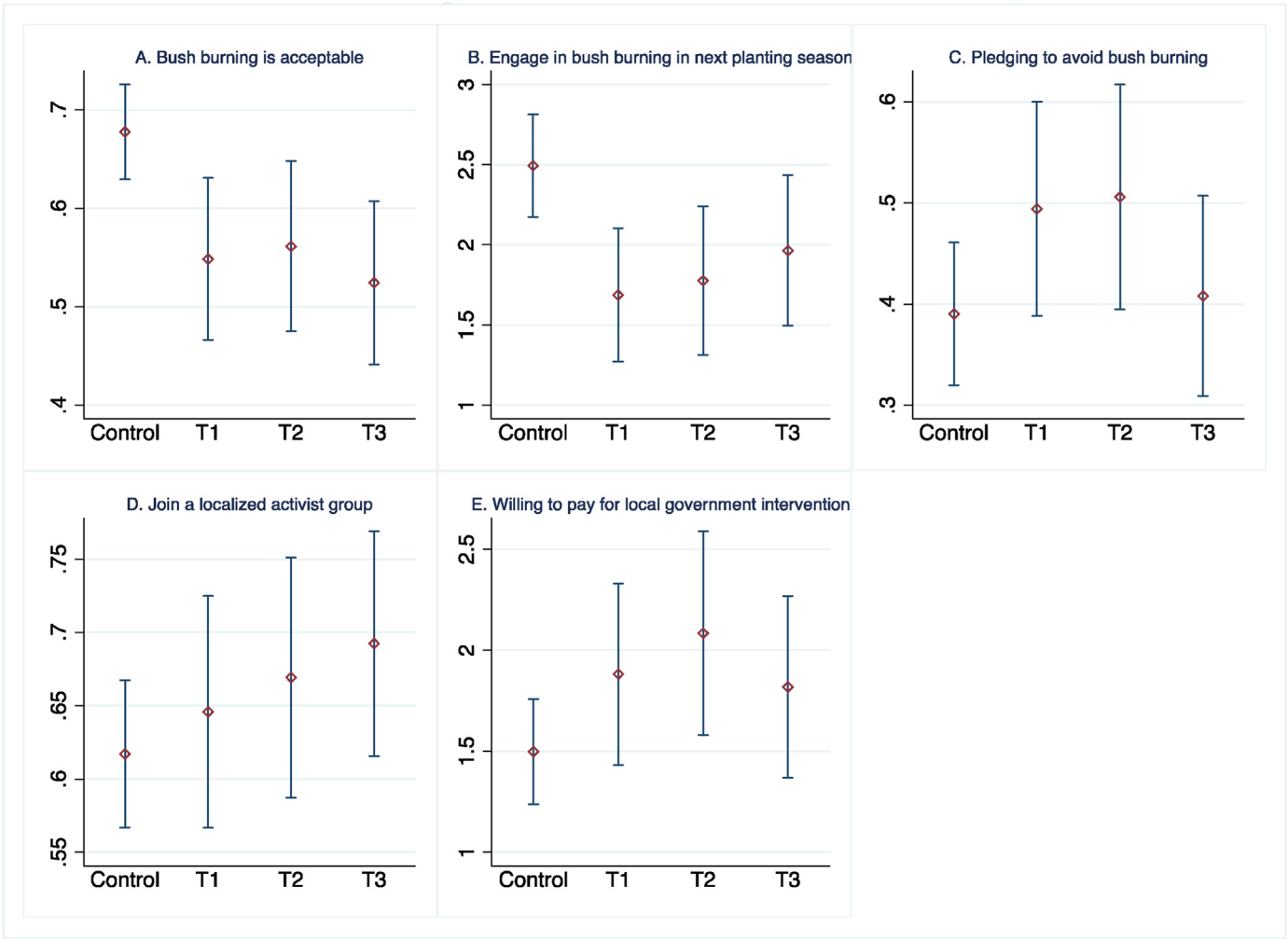

Fig. 2. Means and Confidence Intervals
Note: The results are the mean and respective confidence intervals for the outcomes for each of the experimental groups.

reading the treatment information. T1, T2, and T3 farmers were tasked with identifying all agricultural burning consequences from a catalog of all possible outcomes, as depicted in the information. In the options, we included both treatment-related and non-treatment-related responses. Therefore, we identify those farmers who correctly identify the responses as having paid close attention to the information provided in the treatment. The results of the first-stage regression, which were not reported,[9] indicate that the treatment assignment substantially affects the extent to which farmers comprehend the information provided to them. In Fig. 3, we present the IV regression estimates to demonstrate that farmers' responses are determined by their comprehension of the information presented in any of the treatments[10]. The results demonstrate that farmers' responses to the outcome variables are highly dependent on their comprehension of the information provided in the treatment. Correctly answering the manipulation checks presented immediately after any of the treatments is mostly significantly associated with an improvement in farmers' attitudes towards bush burning and alignment with behaviors that could enhance environmental sustainability. Contextually, the direction of the results aligns precisely with the earlier findings in Fig. 2, which only serves to illustrate the treatment's validity.

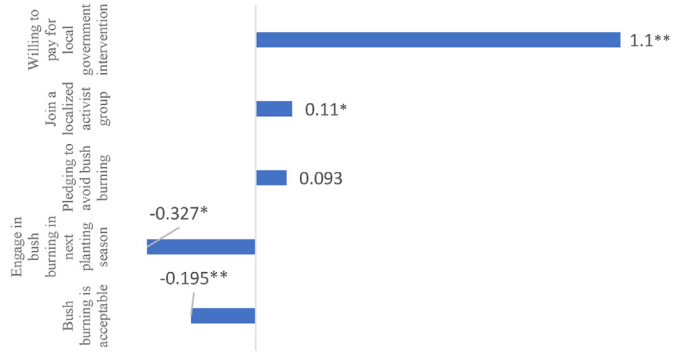

Fig. 3. Effect of Understanding the Information Provided on Farmers' Response
Note: The estimates presented in Fig. 3 are the second-stage regression coefficients, showing the effect of correct response to the questions asked to check farmers understanding of the information on the relevant outcome variables. The first-stage results are not presented for space, but they are available upon request. Other check to verify the strength of the instrument, such as the F-statistics, follow the rule of thumb of being above 10 for all the estimation. Significant values are * $p < 0.05$; **$p < 0.01$.

[9] The results are available upon request. Nonetheless, a snippet of the result is as follows: depending on the treatment assignment, farmers are 53 percentage points more likely to choose a correct answer to the manipulation check.

[10] We do not consider the individual treatment in this analysis since the farmers' specific assignment to any of the treatment arms is being used as an exogenous instrument.

Table 2
ATE when conditioned on farmers' mental health (K-10 measure).

	Bush burning is acceptable	Engage in bush burning in next planting season	Pledging to avoid bush burning	Join a localized activist group	Willing to pay for local government intervention
Mental health	0.014**	0.052**	−0.000	−0.013**	0.014
	(0.003)	(0.019)	(0.005)	(0.003)	(0.012)
	[0.000]	[0.005]	[0.948]	[0.000]	[0.418]
T1	−0.254**	−1.022*	0.130	0.004	0.955*
	(0.083)	(0.446)	(0.107)	(0.081)	(0.452)
	[0.002]	[0.041]	[0.222]	[0.960]	[0.039]
T1*Mental health	0.012*	0.016	−0.003	−0.001	−0.050
	(0.005)	(0.030)	(0.009)	(0.006)	(0.020)
	[0.041]	[0.649]	[0.739]	[0.801]	[0.094]
T2	−0.192*	−1.088*	0.216	0.058	1.017*
	(0.087)	(0.458)	(0.111)	(0.079)	(0.494)
	[0.022]	[0.037]	[0.053]	[0.499]	[0.036]
T2*Mental health	0.008	0.030	−0.010	−0.001	−0.038
	(0.006)	(0.032)	(0.009)	(0.006)	(0.031)
	[0.213]	[0.428]	[0.248]	[0.838]	[0.226]
T3	−0.206*	−0.959*	0.012	0.070	0.664
	(0.083)	(0.431)	(0.103)	(0.078)	(0.432)
	[0.011]	[0.050]	[0.906]	[0.390]	[0.152]
T3*Mental health	0.005	0.035	−0.003	−0.000	−0.030
	(0.006)	(0.033)	(0.008)	(0.006)	(0.029)
	[0.354]	[0.323]	[0.711]	[0.974]	[0.300]
Observation	780	780	780	780	780

Note: Standard errors are in parenthesis. *p < 0.05; **p < 0.01. Family-wise p-values, reported in brackets, adjusted for the number of treatment variables in each family and are estimated using 1000 bootstraps. The Table reports the estimates, the standard error from the regression analysis, and the family-wise p-value. The results presented show perfect alignment in the conventional inference and the p-values after adjusting for the three treatments in this family.

4.2. Treatment effect conditioned on farmers' mental health

The effects of the interaction between the farmer's treatment status and their mental health condition at the time of treatment assignment are presented in Table 2. The outcome demonstrates that the treatment impact is inconsistent across all farmers. We find a lower treatment effect for farmers with poor mental health conditions at the time of treatment assignment and vice versa, suggesting that the mental health condition of individuals influences their judgment and perception of social issues, altering the individual's perception of risks and rewards while distorting their judgment about issues (Romero-Rivas & Rodriguez-Cuadrado, 2021).

Table 2 reveals that treated farmers with poor mental health are 14 percentage points more likely to concur that bush burning is an acceptable agricultural practice. Similarly, they are more likely to report engaging in bush-burning practices during the upcoming agricultural season. This group of farmers is also less likely to commit to reducing bush burning, join a local activist group to advocate for reducing this practice, or contribute financially to a government initiative to reduce bush burning.

Table 2 estimates that farmers assigned to the "social" treatment group are 12 percentage points more likely to report that bush burning is permissible, along with a unit increase in poor mental health.[11] Therefore, with each unit increase in farmers' mental health condition (i.e., a decline in their mental well-being), farmers exposed to the "social" consequences of bush-burning are more likely to report that the practice is permissible. This suggests that the information they were exposed to had no effect on their perception of this practice. Similarly, a decline in farmers' mental health counteracts the effect of exposure to "social" information on the likelihood of engaging in bush burning during the next planting season, pledging not to engage in bush burning, and joining a local activist group to advocate for the reduction of bush burning. These effects are not statistically significant at the traditional levels of 1 and 5 %, but they indicate that the perceptions and behaviors of the sampled farmers are influenced by their current mental health conditions, despite their exposure to information designed to influence these broad outcomes.

We observe a comparable heterogeneous effect for "economic" information treatment. Table 2 demonstrates that farmers' mental health conditions also mitigate the effect of exposure to the "economic" consequences of bushfires on the various attitudes and behaviors. It goes without saying that none of the coefficients representing the interaction term between the mental health of producers and exposure to this treatment are significant. Nonetheless, the direction of the coefficients suggests that farmers with a decline in their mental well-being and who were exposed to the "economic" treatment are more likely to demonstrate negative attitudes towards sustainable farming practices, such as agreeing that bush burning is acceptable and intending to engage in bush burning in the upcoming farming seasons. Moreover, they are less likely to pledge to stop bush burning and to join a localized activist group, and they report less financial support for an innovative initiative by the government to help reduce bush burning practices.

Similar patterns are observed when examining the effect of treatment on farmers exposed to the "combined" information group due to their mental health conditions. In farmers with poor mental health, exposure to the "combined" treatment counteracts the treatment effect, as seen in the previous analysis. These results reveal a decline in the attitudes and behaviors of farmers with poor mental health, regardless of their treatment status.

4.3. Treatment effect conditioned on the farmer feeling depressed

To further investigate the significance of farmers' mental health in determining the treatment effect, we consider an alternative mental

Table 3
ATE when conditioned on CES-D's measure of mental health.

	Bush burning is acceptable	Engage in bush burning in next planting season	Pledging to avoid bush burning	Join a localized activist group	Willing to pay for local government intervention
Mental health	0.096**	1.407**	−0.037	−0.087*	−0.181
	(0.035)	(0.225)	(0.053)	(0.036)	(0.175)
	[0.005]	[0.000]	[0.477]	[0.021]	[0.281]
T1	−0.305*	−2.389**	0.127	0.116	0.122
	(0.155)	(0.822)	(0.188)	(0.147)	(0.650)
	[0.030]	[0.006]	[0.502]	[0.411]	[0.851]
T1*Mental health	0.088	0.719*	−0.015	−0.067	−0.250
	(0.068)	(0.360)	(0.088)	(0.067)	(0.294)
	[0.193]	[0.032]	[0.860]	[0.298]	[0.389]
T2	−0.473**	−3.432**	0.251	0.038	1.971
	(0.172)	(0.979)	(0.213)	(0.183)	(1.248)
	[0.003]	[0.000]	[0.219]	[0.813]	[0.116]
T2*Mental health	0.161*	1.273**	−0.067	−0.008	−0.638
	(0.075)	(0.439)	(0.098)	(0.082)	(0.531)
	[0.022]	[0.002]	[0.511]	[0.915]	[0.223]
T3	−0.433**	−2.090*	0.116	0.035	1.558
	(0.150)	(0.891)	(0.187)	(0.152)	(1.057)
	[0.001]	[0.027]	[0.530]	[0.824]	[0.149]
T3*Mental health	0.132*	0.728	−0.052	−0.051	−0.581
	(0.067)	(0.401)	(0.087)	(0.069)	(0.454)
	[0.050]	[0.088]	[0.510]	[0.456]	[0.199]
Observation	780	780	780	780	780

Note: Standard errors are in parenthesis. *p < 0.05; **p < 0.01. Family-wise p-values, reported in brackets, adjusted for the number of treatment variables in each family and are estimated using 1000 bootstraps. Other notes are the same as Table 2.

[11] Recall that the mental health condition of the farmer is measured using the K10 scale, ranging from 0 to 50, with higher values implying poorer mental health conditions.

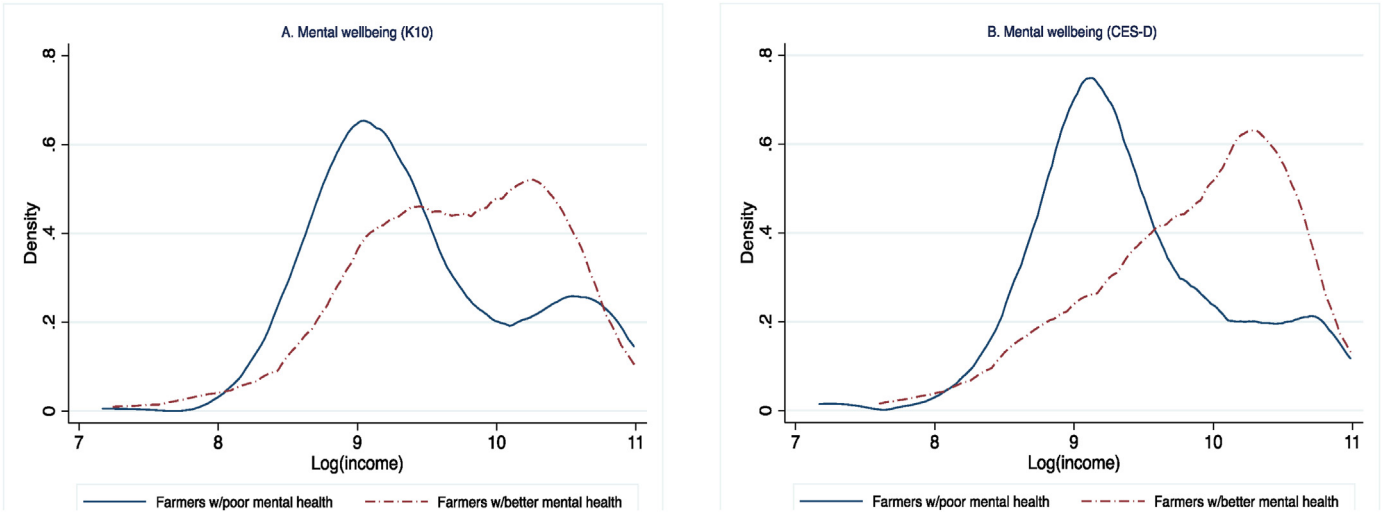

Fig. 4. Household Income by Farmers' Mental Health
Note: Household income is the logarithm value of the sum of household food and non-food expenditure in the past thirty days.

health measure. Mohebbi et al. (2018) found that the Centre for Epidemiologic Studies Depression Scale (CES-D) is useful for detecting clinical and subclinical depressive symptoms. Similar to the regression estimates presented in Table 2, this indicator is correlated with the treatment assignments. The results of this estimation are summarized in Table 3. This Table displays consistent results as Table 2, demonstrating that the extent to which a farmer reported depressive tendencies during periods ranging from 1 to 7 days counteracts the treatment effect.

For all outcome variables, the effect of the treatment when interacted with the indicator of farmer depression followed a different trajectory than the direct effect of the treatment. Farmers with a high proportion of depressive syndromes, for instance, report an increase of one unit in the likelihood that they will engage in bush burning during the next planting season after being exposed to "social" information. This effect is significant at the 5 % level. In addition, farmers with increased depressive tendencies who are exposed to "economic" information are 16 percentage points more likely to concur that burning of brush is acceptable. We also observe a comparable counteracting effect in farmers exposed to "combined" information. The likelihood that these farmers accept bush burning increases by 13 percentage points, and the likelihood that they will engage in this practice during the next planting season rises by one unit.

In conclusion, although the majority of coefficients were not statistically significant at the traditional 1 and 5 percent levels, the sign of the coefficients suggests that farmers exposed to any of the information who report an increase in CES-D depressive tendencies record a decline in the behavioral outcomes. These effects observed in Tables 2 and 3 are conceptually consistent with the literature indicating that an individual's psychological health influences their risk perception and, consequently, their issue-based judgment (Romero-Rivas and Rodriguez-Cuadrado, 2021). Suggesting that, in order to influence farmers' attitudes and behaviors towards sustainability practices, particularly through an education or information campaign, their mental health condition must be addressed from the outset.

4.4. *Why should farmers' mental health matter?*

We now turn our attention to the question of mechanisms. Why should the farmers' mental health condition matter in defining our treatment effect? Given that the information is a direct expression of the consequences of their farming practice, the logical reason may be that something within their psyche could counteract the information given to the farmers. As to what? The most likely explanation is that current economic and social deprivation may have influenced the decisions and risk-taking propensities of these farmers.[12] Therefore, informing these farmers to modify their current farming practices, despite the prevalence of economic and social burdens and the fact that farming is their primary source of income, may result in potential resistance. In other words, burdened farmers may be less likely to take the risk of abandoning this practice because their perception of environmental protection is influenced by the fact that they will incur an additional burden if they commit to sustainability actions. For instance, these farmers may have determined that altering their agricultural practices would exacerbate their current circumstances, which may have been the initial cause of their deteriorating mental health. This conclusion is plausible in a context where the average farmer is impoverished, with multiple social and economic deprivations that can contribute to the deterioration of their mental health.

This conclusion is further supported by Fig. 4, which depicts farmers' household income (logarithmic value of food and non-food consumption) in relation to their mental health score. We divide the farmers into two groups: those with a higher mental health score than the average sample farmer and those with a lower mental health score than the average sample farmer. For the purposes of this exercise, we categorize the first group as farmers with poor mental health and the second group as farmers with improved mental health. Fig. 5 demonstrates that farmers with "poor" mental health report lower domestic consumption than farmers with "better" mental health. This outlook is consistent regardless of the method used to assess farmers' mental health, which reinforces the claim that farmers who report deteriorating mental health conditions are also burdened by severe deprivation.

In addition, Fig. 5 tends to support the earlier assertion that the decline in farmers' mental health is due to their immediate socioeconomic circumstances. With an increase in the food security scores of a farmer's household, the farmer is more likely to report improved mental health. Due to these farmers' socioeconomic constraints, they are more likely to evaluate their post-experiment decisions based on the impact of their actions on their long-term circumstances. They may be concerned that reducing bush-burning practises will have a negative impact on their farm harvest and long-term household earnings, with additional negative repercussions for the socioeconomic circumstances that initially led to their mental health decline. This argument is consistent with the findings of other studies regarding the psychological or socio-contextual factors

[12] Research on risk-taking behavior has shown that life experiences are an important determinant of choices and risk-taking behavior (Ayton et al., 2020).

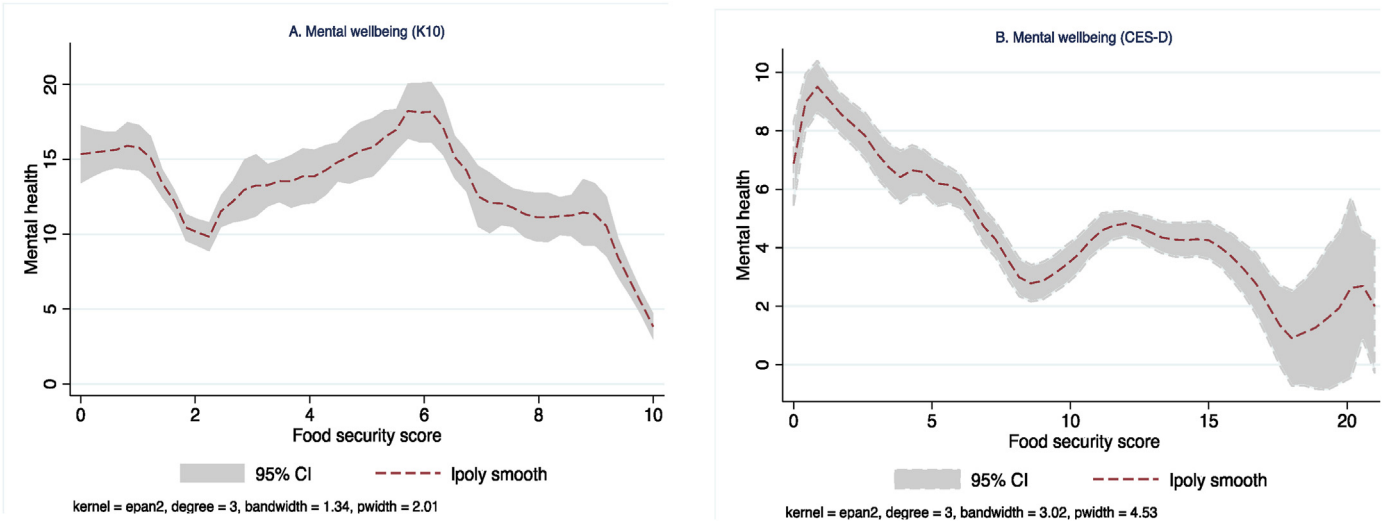

Fig. 5. Food Security and Mental Health

Note: The graph displays smoothed values of the kernel-weighted local polynomial regression of mental health conditions on food security indicator, with confidence bands. Food security score is the summation of affirmative response (i.e., yes) to any of the statements regarding whether the household or any member experienced any of the ten incidents in the past thirty days: (a). worried you would run out of food because of a lack of money or other resources; (b). unable to eat healthy and nutritious/preferred foods because of a lack of money or other resources; (c). ate only a few kinds of foods because of a lack of money or other resources; (d). had to skip a meal because there were not enough money or other resources to get food; (e). ate less than you thought you should because of a lack of money or other resources; (f). ran out of food because of a lack of money or other resources; (g). hungry but did not eat because there were not enough money or other resources for food; (h). went without eating for a whole day because of a lack of money or other resources; (i). restricted consumption in order for children to eat; and (j). borrowed food, or relied on help from a friend or relative.

that influence how individuals assess pro-environmental interventions (Gronhoj & Thogersen, 2012; Bujold et al., 2020; Corradi et al., 2013).

5. Conclusion

In this research, we estimate the effects of exposing farmers to the environmental repercussions of bush burning, a common agricultural practice with significant consequences. We also condition the effect of such exposure on the mental health of the farmer. We contend that the response of farmers is contingent on their mental health at the time of treatment. A systematically collected survey from five states in Nigeria demonstrates that exposing farmers to the consequences of bush-burning substantially explains their subsequent attitudes and behavior towards reducing this practice. Moreover, this relationship is contingent on the individual's mental health when treatment is administered. In accordance with this hypothesis, our results demonstrate a counteracting effect, such that farmers who report a decline in mental health are more likely to report that they are likely to engage in bush burning in the future and do not support efforts to reduce such practices.

Recent experimental studies aimed at influencing behavioral change to achieve sustainable development have demonstrated the efficacy of an information campaign, primed by relevant themes, to nudge participants towards enhancing their behavior (Chong & Druckman, 2007; Lofgren & Nordblom, 2020).[13] However, we contend that addressing the mental health of farmers from the outset is one effective way to improve the effectiveness of an environmental sustainability information campaign. Considering that studies have estimated the economic losses in low- and middle-income countries due to mental disorders (e.g., depression) to be US$55.5 million disability-adjusted life-year (Adhvaryu et al., 2019), which is less than one percent of the annual losses due to climate change, particularly in sub-Saharan countries by 2030 at $358 billion, policies to improve the mental wellbeing of farmers for adopting sustainability practices may be relatively more cost-effective.

Understanding mental health conditions at the time of a campaign designed to alter attitudes and behaviors toward sustainability is important for identifying persistent differences in outcomes. In addition to being primary determinants of an individual's utility, psychological traits have also been linked to adult decision-making (Heckman et al., 2006) and serve as a crucial mechanism for determining the effects of a life-related intervention. As Burgess et al. (1998) observe, designing interventions to influence pro-environmental behavior implicitly assumes a lack of information rather than other psychological factors. Bujold et al. (2020) link these psychological factors to the careful evaluation of affected individuals in response to a particular environmental intervention. We contribute to the literature by demonstrating that the effect of an information experiment designed to improve sustainability action persists based on the mental health condition of the targeted individuals.

Two mutually compatible interpretations of the farmers' mental health impact are offered by suggestive quantitative evidence and sentiments from focused group discussions with farmers during post-experiment periods. First, mental health conditions substantially explain farmers' attitudes and behaviors towards bush burning practices, which have been shown to significantly degrade the environment via carbon emissions and biodiversity losses. Second, the impact of an informational campaign depends in part on the affected farmer's mental health. In this case, previously assessed farmer attitudes and behaviors from an information experiment would be overestimated to the extent that they do not account for the farmers' mental health condition. This study supplements an increasing body of literature in environmental economics that provides an incomplete analysis of pro-environmental interventions by focusing solely on material incentives, rulemaking, and information provision (Cinner, 2018; Bujold et al., 2020). Consideration of the recipient's mental health enriches research on the efficacy of information interventions and should be increasingly incorporated into policies aimed at enhancing sustainability-oriented attitudes and behaviours.

[13] As Bruns et al. (2018) note, nudging is an effective instrument to alter people's decisions without significantly changing economic incentives or limiting options.

CRediT authorship contribution statement

Oluwabunmi Adejumo: Writing – review & editing, Project administration, Conceptualization. **Uchenna Efobi:** Writing – original draft, Methodology, Formal analysis, Data curation. **Obinna Ogwuike:** Supervision, Software.

Declaration of competing interest

The authors have no competing interest to declare.

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