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Occupational Stress and Associated Factors among Sugarcane Farmers in Sa Kaeo Province, Thailand

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Abstract

Sugarcane farming is physically demanding and exposes farmers to multiple stressors, increasing their risk of mental health problems. This study aimed to examine stress levels and identify the factors related to stress among sugarcane farmers in Sa Kaeo Province, Thailand. A cross-sectional study was conducted among 276 registered sugarcane growers in Sa Kaeo Province for at least one year using a multi-stage sampling method. Data were gathered through questionnaires between February and April 2025. Data were analyzed using descriptive statistics and multiple logistic regression analysis. The results indicated that most participants experienced high stress (49.3%), followed by moderate stress (25.0%) and severe stress (22.5%). Factors significantly associated with high stress among sugarcane farmers included experienced changes in climate variability, which showed the strongest association, followed by experiencing sugarcane product prices lower than last year, having moderate social support, incurring costs for cultivation of more than 10,000 Baht, lacking access to agricultural water sources, sleeping less than six hours, and sleeping six to seven hours ($p < 0.05$). These findings highlight the need for targeted interventions such as improved mental health services, agricultural subsidies, and reliable water access. Compared with previous Thai studies on farmer stress, this research provides new evidence by focusing on sugarcane farmers in Sa Kaeo Province, thereby contributing to more context-specific strategies for supporting farmer well-being.

Keywords**:** *occupational stress; agricultural workers; risk factors; cross-sectional studies; Thailand*

1. Introduction

Sugarcane cultivation plays a significant role in Thailand's agricultural economy and sugar manufacturing industry, making the country one of the world's leading sugar exporters (Suchato et al., 2021). As a major cash crop, sugarcane generates income for farmers across central, northeastern, and eastern regions (Som-ard et al., 2024), contributing substantially to both household and national income (Dinesh Babu et al., 2022; Pipitpukdee et al., 2020). In Sa Kaeo Province, sugarcane farming is central to the regional economy, supporting farmers and the sugar industry (Office of Agricultural Economics, 2024). However, this economic importance is accompanied by significant occupational and environmental risks. Farmers are exposed to hazardous working conditions, particularly the burning of sugarcane fields, which releases harmful fine particulate matter (PM2.5) that adversely affects their health (Chengane et al., 2021; Kiatkitroj et al., 2022).

Beyond physical hazards, sugarcane farmers frequently encounter psychosocial stressors. Stress

has been linked to depression, anxiety, and burnout, with detrimental effects on both quality of life and productivity (Tantipanjaporn et al., 2025). Prior literature identifies multiple determinants of stress, including economic uncertainty, fluctuating global sugarcane prices, climate change, droughts, floods, and unseasonal rainfall, all of which disrupt yields and reduce incomes (Bazo-Alvarez et al., 2022; Leite et al., 2018; Ong-Artborirak et al., 2022). These challenges often translate into debt burdens and financial strain, thereby amplifying stress among farmers. Moreover, sugarcane farming is labor-intensive, requiring long working hours that contribute to fatigue, poor sleep, and heightened stress (Bangkadanara et al., 2023).

Stress not only exacerbates mental health conditions such as depression and anxiety (Rudolphi et al., 2024) but also contributes to physical health problems, including hypertension, headaches, and digestive issues linked to poor nutrition and sleep deprivation (Hagen et al., 2021). Stress further impairs concentration and decision-making, potentially reducing the efficiency of agricultural practices (Riethmuller et al., 2024). From a public health perspective, understanding farmer stress is critical, as it directly affects the sustainability of agricultural livelihoods and food security.

Sa Kaeo Province represents a particularly important context for studying farmer stress. It has extensive sugarcane cultivation areas supported by fertile soil and irrigation systems, with over 11,205 farmers managing 243,213 rai of farmland, equivalent to about 10% of provincial agricultural land (Office of Agricultural Economics, 2024). Most farmers are small- to medium-scale growers, primarily aged 40–60 years. Despite the province's significance, research on sugarcane farmers' stress in Sa Kaeo remains scarce (Bangkadanara et al., 2023; Ong-Artborirak et al., 2022; Tantipanjaporn et al., 2025). Existing studies often fail to address sugarcane-specific stressors or lack a contextual analysis of local challenges such as climate variability and the unique border economy (Kiatkitroj et al., 2022; Pintakham et al., 2019). Investigating the stress experienced by sugarcane farmers in Sa Kaeo is therefore essential to filling this knowledge gap. This study aims to examine the factors associated with stress among sugarcane farmers in Sa Kaeo Province, Thailand. The findings can inform targeted interventions, guide agricultural and mental health policy, and contribute to sustainable farming practices. Strengthening the physical and mental health of sugarcane farmers is a vital public health priority to support their livelihoods and ensure long-term agricultural resilience.

2. Objectives

This research aimed to: 1) assess the stress levels among sugarcane farmers in Sa Kaeo Province, Thailand, and 2) examine the associations between personal factors, health-related factors, economic factors, and social/environmental factors and stress among sugarcane farmers in Sa Kaeo Province, Thailand.

3. Materials and Methods

3.1 Study Design and Conceptual Framework

This study utilized a cross-sectional design and reported its findings under the STROBE Statement. The conceptual framework was based on a review of the Stress Process Model by Pearlin et al. (1990), which explains that stress results from exposure to stressors, including economic pressures, health problems, or social challenges. When individuals lack sufficient resources to cope with these issues, stress may arise. Additionally, the study applied the Determinants of Health theory by Dahlgren & Whitehead (1991), which describes how various factors, both personal and environmental, influence an individual's health and well-being. These factors were classified into four categories: personal, health-related, economic, and social/environmental. The study hypothesized that these categories were significantly associated with stress levels among sugarcane farmers in Sa Kaeo Province, Thailand.

3.2 Participant and Sample Size

The population consisted of 11,205 registered sugarcane farmers in Sa Kaeo Province in 2023 (Office of Agricultural Economics, 2024). The samples comprised 276 sugarcane farmers aged between 20 and 65 years who were registered as sugarcane growers in Sa Kaeo Province. Data were collected from February to April 2025. The sample size was calculated using the Cochran equation (Cochran, 1997), as the precise population size was unavailable. The total number of sugarcane farmers in Sa Kaeo Province could not be accurately determined due to outdated records and the presence of unregistered farmers, particularly smallholders. The confidence level for this study was 95.0% ($Z = 1.96$). The proportion of stress among farmers was 0.1821 (Suwannaphant et al., 2022), with an allowable margin of error (d) of 0.05. Based on these parameters, the initial sample size was calculated to be 229 individuals. To mitigate potential

data collection errors, the sample size was increased by 20%, leading to a final total of 276 sugarcane farmers.

3.3 Sampling Technique

A two-step multi-stage sampling method was used to select participants. First, purposive sampling was applied to select three of the nine districts with the largest sugarcane cultivation areas: Mueang Sa Kaeo, Watthana Nakhon, and Aranyaprathet Districts. Second, simple random sampling was conducted by drawing lots without replacement from the list of registered sugarcane farmers provided by the Office of Agricultural Economics (Office of Agricultural Economics, 2024). A total of 92 farmers were selected from each district, and participants meeting the inclusion criteria were enrolled until a total sample size of 276 was achieved. Although the initial selection of districts was purposive, potential sampling bias was minimized by using simple random sampling within each district to select participants from the list of registered sugarcane farmers. Additionally, farmers were drawn from all major sugarcane cultivation areas in Sa Kaeo Province, enhancing the representativeness of the sample and reducing the likelihood of selection bias.

3.4 Inclusion and Exclusion Criteria

The inclusion criteria for the study required participants to be sugarcane farmers aged 20-65 years, registered as growers in Sa Kaeo province with at least one year of experience. Eligible participants voluntarily agreed to take part, signed a consent form, and completed the assessment using a questionnaire. Additionally, the exclusion criteria included individuals who had a medical condition that severely affects psychological or emotional responses, such as severe depression or schizophrenia, which may interfere with the ability to complete the questionnaire. Participants who were unable to complete the questionnaire independently or provide complete information due to cognitive, auditory, or literacy problems, and those who had migrated or changed occupations within the past six months were excluded.

3.5 Research Instruments

The research instruments were developed by the researcher following a review of relevant theories and literature to ensure thorough content coverage and alignment with the research objectives (Bazo-Alvarez et al., 2022; Kiatkitroj et al., 2022; Mehdi et al., 2024; Ong-Artborirak et al., 2022). The instrument was divided into five sections, outlined as follows.

Part 1: Personal and health factors questionnaire. The items included both open-ended and closed-ended questions and comprised seven items: age, gender, education level, marital status, duration of farming experience, health conditions, and sleep patterns.

Part 2: Economic factors questionnaire. The inquiries consisted of both open-ended and closed-ended questions, encompassing six items: monthly income, household debt, sugarcane production costs, access to financial resources, stability of occupation, and sugarcane product prices.

Part 3: Social and environmental factors questionnaire. The survey featured a mixture of both open-ended and closed-ended questions, consisting of five items including climate variability, pests and crop diseases in sugarcane fields, access to agricultural water sources, presence of farmer networks, and support from the government.

Part 4: Social support questionnaire. This section was adapted from Ratana (2009) and includes 21 items rated on a 5-point scale: "Most true," "Very true," "Moderately true," "Slightly true," and "Least true," corresponding to scores of 5, 4, 3, 2, and 1, respectively. The results were divided into three categories following Best's criteria (Best, 1977): mean scores ranging from 1.00 to 2.33 signified low social support, scores from 2.34 to 3.67 indicated moderate social support, and scores from 3.68 to 5.00 represented high social support.

Part 5: Suanprung Stress Test-20 (SPST-20). This section utilized the standard stress assessment tool created by the Department of Mental Health (Mahattanirunkul et al., 2017). The tool was intended to gauge individual stress levels and has proven effective within the general population, especially among those of working age. It comprises 20 items rated on a 5-point Likert scale: no stress, slight stress, moderate stress, high stress, and extreme stress, assigned scores of 1, 2, 3, 4, and 5, respectively. The interpretation of total scores is as follows (Mahattanirunkul et al., 2017): a score of 0 – 23 signifies low stress, 24 – 41 indicates moderate stress, 42 – 61 represents high stress, and 62 or more signifies severe stress.

The validity of the instrument was assessed by three experts: an environmental health professional, a public health specialist, and a health behavior expert, utilizing the Index of Item-Objective Congruence (IOC), which yielded values between 0.80 and 0.96.

The reliability was examined through a pilot study with 30 sugarcane farmers from the same provinces as the research sample, who were not included in the study's sample. The analysis for reliability showed that the Cronbach's Alpha Coefficient was 0.95 for the social support questionnaire and 0.92 for the Suanprung stress test-20. Face validity was determined by gathering structured feedback from both experts and target participants to confirm that the instrument accurately measured the intended constructs. Recommendations from the expert panel and participants resulted in the rephrasing of specific items for improved clarity, alignment with the study goals, and increased simplicity.

3.6 Data Collection Process

The researcher sought permission and support from the heads of Subdistrict Health Promoting Hospitals in each district within the study area to collect data from sugarcane farmers. Upon obtaining approval, the researcher conveyed the aims and specifics of the study to the personnel of the Subdistrict Health Promoting Hospitals. Before data collection, the researcher trained ten research assistants to help in the data gathering process. A data collection manual was provided, and the researcher explained and demonstrated the data collection procedures in the field to ensure the research assistants fully understood how to use the tools correctly according to the research protocol. Data collection was conducted with the cooperation of Village Health Volunteers (VHVs) in each area. Verbal consent was first obtained from the sugarcane farmers, followed by written informed consent. The researcher then proceeded with data collection through questionnaires, which took approximately 45 minutes per participant.

3.7 Statistical Analysis

Data analysis was conducted using IBM SPSS version 29.0.1 (IBM Corp.), with the significance threshold set at 0.05. Descriptive statistics, including frequency, percentage, mean, and standard deviation (SD), were applied to characterize the sample. The Kolmogorov-Smirnov test assessed the normality of continuous variables, indicating that all continuous variables exhibited a normal distribution ($p > 0.05$). Multiple logistic regression (MLR) was employed to investigate the factors associated with elevated stress levels among sugarcane farmers. The use of MLR was appropriate given several key assumptions. The dependent variable, stress level, was dichotomized into two categories low-to-moderate stress and high-to-severe stress to satisfy the binary outcome requirement of logistic regression. This categorization preserves meaningful differences in stress levels while enabling robust statistical analysis. Second, the observations were independent, as each respondent represented a unique individual with no repeated measures. Third, multicollinearity among factor variables was assessed using the Variance Inflation Factor (VIF), with all VIF values below 2, indicating no significant multicollinearity. Variables were selected using the Enter selection method. The findings include the Crude Odds Ratio (COR) obtained from binary logistic regression (BLR) and the Adjusted Odds Ratio (AOR) derived from multiple logistic regression (MLR), along with the 95.0% Confidence Interval (CI).

3.8 Ethical Statements

The research protocol was approved by the Institutional Review Board (IRB) of Valaya Alongkorn Rajabhat University under Royal Patronage, with REC No: 0077/2024 and COA No: 0007/2025, and certification was issued on January 27, 2025. The authors affirmed that informed consent was acquired from all participants, who were required to provide this consent before taking part in the study. The research was conducted under the Declaration of Helsinki.

4. Results

4.1 Personal and Health Factors among Sugarcane Farmers

The analysis of personal and health factors indicated that the sample consisted of 58.0% males, with 65.6% aged 50 years and above, and an average age of 52.0 years (SD = 8.5). The majority of the samples were married (81.5%), had graduated from primary school (54.7%), and had experience as sugarcane growers for one to five years (38.4%), followed by six to ten years (32.6%). Additionally, most of them had health conditions (65.2%), including hypertension (36.6%), diabetes (21.7%), and hyperlipidemia (17.0%). Among participants, 55.4% reported sleeping six to seven hours per night.

4.2 Economic Factors among Sugarcane Farmers

Most of the samples had a monthly income of 10,000 Baht or less (62.7%), had household debt (70.3%), and had sugarcane production costs of 10,000 Baht or less per month (56.9%). Additionally, the majority of participants accessed financial

resources (67.4%). Among the participants, 59.1% of sugarcane farmers felt very stable in their occupation, and 40.2% of them experienced sugarcane product prices similar to last year.

4.3 Social and Environmental Factors among Sugarcane Farmers

Sugarcane farmers experienced climate variability (55.1%), including drought (51.8%) and storms (2.9%), and faced pests and crop diseases in sugarcane fields (46.0%), including insects (33.7%) and aphids (10.5%). Additionally, the majority of the samples had accessed agricultural water sources (59.4%) and engaged in a farmer network (53.3%), including knowledge exchange (35.9%) and training or seminars (13.8%). Furthermore, the sugarcane farmers received government support, including funding (17.4%), training to enhance knowledge and skills (8.3%), and allocation of water and land resources (7.6%). Among them, 58.3% had high social support, followed by moderate social support (40.2%).

4.4 Level of Stress among Sugarcane Farmers Assessed using SPST-20

Stress experienced by sugarcane farmers was evaluated using the SPST-20 and classified into four levels. The results showed that the majority of participants had high stress (49.3%), followed by moderate stress (25.0%), severe stress (22.5%), and low stress (3.3%), with an average stress score of 51.0 (SD = 15.2) (Table 1).

Table 1 Stress levels among sugarcane farmers assessed using SPST-20 (n = 276)

Level of Stress	Number	Percentage
Low (0 – 23 scores)	9	3.3
Moderate (21 – 41 scores)	69	25.0
High (42 – 61 scores)	136	49.3
Severe (≥62 scores)	62	22.5
Mean ± SD, 51.0 ± 15.2 scores, Min–Max = 20–91 scores		

4.5 Factors Associated with Stress among Sugarcane Farmers in Sa Kaeo Province, Thailand

Table 2 shows that factors significantly associated with high stress among sugarcane farmers included sleeping less than 6 hours, sleeping six to seven hours, incurring sugarcane cultivation costs of more than 10,000 Baht per month, facing sugarcane product prices lower than last year, experiencing changes in climate variability, not accessing agricultural water sources, and having moderate social support. The study found that sugarcane farmers who slept less than six hours were likely to have high stress at 1.92 times greater than those who slept eight hours or more (AOR = 1.92, 95% CI = 1.18–4.21, p = 0.022). Moreover, sugarcane farmers who slept for six to seven hours of sleep experienced stress levels that were 1.17 times higher compared to those who slept for eight hours or more (AOR = 1.17, 95% CI = 1.10–3.31, p = 0.030). Additionally, sugarcane farmers with cultivation expenses exceeding 10,000 Baht each month were found to experience significantly higher stress levels, with a likelihood 2.97 times greater than those whose costs were 10,000 Baht or lower (AOR = 2.97, 95% CI = 1.38–6.37, p = 0.005).

Moreover, the sugarcane farmers who received sugarcane product prices lower than last year were likely to have high stress at 3.63 times greater than those who faced higher prices than last year (AOR = 3.63, 95% CI = 1.07–12.30, p = 0.038). In addition, sugarcane farmers who experienced changes in climate variability were likely to have high stress at 4.02 times greater than those who did not experience climate variability (AOR = 4.02, 95% CI = 1.63–9.93, p = 0.003). Additionally, sugarcane farmers who lacked access agricultural water sources were likely to have high stress at 2.83 times greater than those who accessed agricultural water sources (AOR = 2.83, 95% CI = 1.21–6.58, p = 0.016). Ultimately, sugarcane farmers with moderate social support tended to experience stress levels that were 3.56 times higher than those with high social support (AOR = 3.56, 95% CI = 1.62–7.81, p = 0.002).

Table 2 Personal, health, economic, social, and environmental factors associated with high stress among sugarcane farmers using binary and multiple logistic regression (n = 276)

Variables	Binary logistic regressions (BLR)			Multiple logistic regression (MLR)		
	COR	95% CI	*p*-value	AOR	95% CI	*p*-value
Age (years)						
20 – 49	1.02	0.58 – 1.76	0.966	1.65	0.74 – 3.69	0.220
50 or above	1.00			1.00		
Gender						
Male	1.00			1.00		
Female	1.26	0.75 – 2.14	0.384	1.39	0.69 – 2.81	0.361
Marital status						
Married	1.00			1.00		
Single/ Widowed/Divorced	1.54	0.75 – 3.19	0.242	1.44	0.58 – 3.61	0.433
Education level						
Primary school	1.23	0.44 – 1.30	0.307	1.53	0.28 – 1.26	0.175
Secondary school	1.44	0.46 – 4.56	0.534	2.27	0.45 – 11.46	0.322
Diploma degree or higher	1.00			1.00		
Duration of sugarcane field						
1-5	1.76	0.95 – 3.29	0.075	1.08	0.32 – 2.25	0.738
6–10	2.36	1.20 – 4.65	0.013	1.69	0.69 – 4.13	0.252
>10	1.00			1.00		
Health conditions						
Yes	1.35	0.79 – 2.32	0.278	1.07	0.52 – 2.18	0.859
No	1.00			1.00		
Sleep patterns (hours)						
<6	4.35	1.08 – 5.14	0.032	1.92	1.18 – 4.21	0.022*
6–7	3.34	1.83 – 6.12	0.044	1.17	1.10 – 3.31	0.030*
8 and above	1.00			1.00		
Monthly income (baht)						
≤10,000	1.07	0.62 – 1.84	0.805	1.31	0.60 – 2.83	0.501
> 10,000	1.00			1.00		
Household debt						
No	1.00			1.00		
Yes	1.11	0.62 – 1.97	0.731	1.14	0.52 – 2.51	0.747
Sugarcane production costs						
≤10,000 baht/month	1.00			1.00		
>10,000 baht/month	2.66	1.50 – 4.72	<0.001	2.97	1.38 – 6.37	0.005*
Access to financial resources						
No	1.74	0.94 – 3.14	0.068	1.50	0.65 – 3.43	0.341
Yes	1.00			1.00		
Stability of occupation						
Very stable	1.00			1.00		
Moderately stable	1.83	0.78 – 4.29	0.166	1.14	0.36 – 3.61	0.817
Unstable	1.02	0.42 – 2.48	0.968	1.90	0.60 – 6.07	0.279
Sugarcane product prices						
Higher than last year	1.00			1.00		
Same as last year	2.68	1.49 – 4.85	0.001	1.42	0.59 – 3.39	0.432
Lower than last year	7.77	3.22 – 18.69	<0.001	3.63	1.07 – 12.3	0.038*
Climate variability						
No change	1.00			1.00		
Changed	4.22	2.30 – 7.73	<0.001	4.02	1.63 – 9.93	0.003*
Pests and crop diseases						
No problems encountered	1.00			1.00		
Problems encountered	2.60	1.51 – 4.46	<0.001	1.21	0.50 – 2.90	0.684

Table 2 Cont.

Variables	Binary logistic regressions (BLR)		Multiple logistic regression (MLR)			
	COR	95% CI	COR	AOR	95% CI	*p*-value
Access to agricultural water sources						
No	2.67	1.56 – 4.56	<0.001	2.83	1.21 – 6.58	0.016*
Yes	1.00			1.00		
Presence of farmer networks						
No	1.03	0.61 – 1.75	0.903	1.06	0.45 – 2.51	0.888
Yes	1.00			1.00		
Support from government						
No received	1.32	0.77 – 2.24	0.312	1.63	0.68 – 3.87	0.271
Received	1.00			1.00		
Social support						
Low	1.69	0.17 – 16.6	0.653	5.59	0.422 – 74.0	0.192
Moderate	2.73	1.51 – 4.91	<0.001	3.56	1.62 – 7.81	0.002*
High	1.00			1.00		

Note: 1.00 = Reference group; COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval; BLR, binary logistic regression; MLR, multiple logistic regression *Significant level $p < 0.05$

5. Discussion

This study investigated the stress levels among sugarcane farmers in Sa Kaeo Province using the SPST-20. The results demonstrated that the majority of respondents had high stress (49.3%), followed by moderate stress (25.0%), and severe stress (22.5%). In contrast, Suwannaphant et al. (2022) reported a lower prevalence, with 18.2% of sugarcane farmers experiencing heightened stress, suggesting that stress levels may differ depending on geographic, economic, and contextual factors. Similarly, Bangkadanara et al. (2023) found that 40.3% of agriculturists in general experienced high stress, which is slightly lower than our finding, possibly due to differences in the types of crops grown and associated workloads. One explanation for the stronger association of stress in Sa Kaeo may be the challenging nature of sugarcane farming, which is labor-intensive and subject to volatile external conditions such as market fluctuations and weather instability. In this region, farmers encounter additional burdens from unpredictable climate changes and limited access to irrigation water, which exacerbate stress compared with farmers in areas with more stable environmental resources. Moreover, the economic pressures faced by sugarcane farmers such as high cultivation costs coupled with declining or unstable market prices intensify financial strain (Elliott et al., 2022; Noomnual et al., 2024). This combination of environmental, financial, and social challenges may explain why stress levels among sugarcane farmers in Sa Kaeo are relatively high when compared with other groups of farmers in prior studies.

Insufficient sleep was associated with high stress among sugarcane farmers. This finding was consistent with a previous study that indicated sleep deprivation can affect occupational stress symptoms among farm and ranch operators (Chengane et al., 2021). Sleep is crucial for the body to heal and to sustain peak cognitive performance. Prolonged lack of sleep can lead to increased cortisol levels, the hormone associated with stress, which may further result in heightened feelings of anxiety, irritability, and emotional instability. For sugarcane farmers, who engage in physically demanding and time-consuming work, the need for adequate rest becomes even more critical. Lack of sufficient sleep may not only reduce their ability to cope with the daily challenges of farming but may also increase their vulnerability to stressors related to work demands, financial pressures, and environmental conditions (Olowogbon et al., 2019).

Costs for sugarcane cultivation were associated with high stress among sugarcane farmers. The findings were similar to those of Bangkadanaran et al. (2023), which indicated that the lack of agricultural investment and inadequate availability of agricultural funding were associated with high stress levels among Thai farmers. Similarly, prior research found that higher financial costs for cultivation were associated with higher stress among farmers (Riethmuller et al., 2024). This result highlights the significant economic pressures farmers face in Sa Kaeo Province, where financial constraints and high production costs are major sources of stress. High cultivation costs can contribute to a sense of financial insecurity, as farmers

are required to invest substantial amounts in seeds, fertilizers, labor, and other inputs, often without guaranteed returns (Younker & Radunovich et al, 2022). This financial strain can lead to anxiety and worry, exacerbating stress levels and potentially affecting the overall mental well-being of farmers.

Sugarcane product prices were associated with high stress among sugarcane farmers. This discovery corresponds with research conducted by Hagen et al. (2021), which showed that prices of sugarcane products can influence increased perceived stress levels. The association between lower sugarcane prices and increased stress may be attributed to the dependency of farmers on a stable income from sugarcane sales. For many farmers, sugarcane is their primary source of income, and any reduction in prices can directly affect their ability to meet personal and family needs (Garrett-Wright et al., 2023). Farmers may feel a sense of loss or inadequacy when prices fall, which can exacerbate existing financial pressures and contribute to emotional distress. Additionally, the volatility in sugarcane prices can lead to a sense of unpredictability in the farming business (Saju et al., 2024). When prices are unstable, farmers may struggle to plan for the future or make necessary investments in their operations.

Climate variability was associated with high stress among sugarcane farmers. The result aligned with the previous research, which showed that variations in climate change were linked to stress concerning the health of farmworkers (El Khayat et al., 2022). Similarly, earlier research indicated that climate change impacts can affect mental health among farmers (Daghagh Yazd et al., 2019). The uncertainty about future weather patterns exacerbates stress, as farmers may be unable to plan adequately for the upcoming season or make informed decisions about planting, irrigation, and harvest (Clayton et al., 2021). The impact of climate variability on stress is not just related to the direct effects on crop production but also to the broader sense of insecurity and loss of control that farmers feel when their environment becomes unpredictable (Yeleliere et al., 2023). Farmers who are unable to predict or adapt to changing climate conditions may experience anxiety and worry about their ability to sustain their farming operations and provide for their families.

Not accessing agricultural water sources was associated with high stress among sugarcane farmers. This finding aligns with the former research, which revealed that not accessing agricultural water can cause higher stress among farmers in the agricultural community (King et al., 2023). Sugarcane farming, being a water-intensive crop, relies heavily on a consistent and adequate water supply. When farmers lack access to water sources, they face increased uncertainty regarding their ability to maintain healthy crops, especially during dry periods or droughts (Ingrao et al., 2023). The stress associated with water scarcity is compounded by the potential for reduced yields, which can result in financial losses and threaten the livelihoods of farmers. In such conditions, farmers may experience heightened anxiety about the survival of their crops and their ability to meet both personal and economic demands (Brennan et al., 2021). Water scarcity not only impacts crop growth but also restricts farmers' ability to manage their fields effectively, creating a cycle of stress related to agricultural sustainability.

Social support was associated with high stress among sugarcane farmers. This study aligned with the research by Deegan & Dunne (2022), which found that social support was linked to increased stress levels among farmers. Participants who engaged in membership of a farming organization reported feeling protected against stress (Deegan & Dunne, 2022). Similarly, a previous study found that lower social support was associated with higher stress among farmers (Riethmuller et al., 2024). For farmers with moderate social support, it is possible that the support they receive may not be sufficient to effectively buffer them from the pressures of farming. In times of financial hardship, uncertainty, or environmental stressors, those with only moderate support might find it difficult to cope with the emotional or practical challenges they face (Proctor & Hopkins, 2023). Moderate support may reflect an imbalance in the availability of help, where the support is inconsistent, insufficient, or not well-targeted to address the specific needs of the farmers. This may lead to feelings of isolation or frustration, as farmers may feel that their emotional or material needs are not being fully met (Brennan et al., 2022). This finding underscores the importance of fostering strong, supportive communities for sugarcane farmers. Interventions aimed at enhancing social networks and encouraging mutual support among farmers may be crucial in reducing stress (Laoveeratam et al., 2025; Noiprasert et al., 2024).

This research has several limitations. First, a cross-sectional design was utilized, capturing stress levels and associated factors at a single point in time. Therefore, causal relationships between stress and the identified factors cannot be established, and

longitudinal studies are needed to explore the directionality and long-term impacts of stress on sugarcane farmers. Second, participants' self-reported data may introduce biases such as social desirability or recall bias. Farmers may have under- or overestimated their stress levels or experiences due to personal perceptions or privacy concerns. Third, the study was conducted in Sa Kaeo Province, a specific geographical area along the Thai-Cambodian border, which may limit generalizability. Stress factors and experiences might differ in other regions of Thailand or elsewhere due to variations in environmental, economic, and cultural contexts. Finally, although multiple factors associated with stress were examined, unmeasured variables such as personal coping mechanisms, prior mental health history, or specific farming practices may also influence stress levels among farmers.

These findings have several important policy and practice implications. First, healthcare providers should implement regular mental health screening among farmers, and mobile mental health services could be developed to enhance accessibility for those in remote or underserved rural areas. Second, targeted mental health promotion programs should be established, focusing on stress management, sleep hygiene, and coping strategies for economic instability and environmental uncertainty. Third, policymakers should prioritize sustainable agricultural policies by ensuring fair pricing mechanisms for sugarcane products and providing financial subsidies or assistance to farmers struggling with rising cultivation costs. Fourth, improving access to essential resources such as clean and reliable water supplies is critical for both physical health and psychological well-being. Finally, strengthening community-based social support systems within farming communities could play a pivotal role in fostering resilience, reducing isolation, and promoting overall well-being. These policy recommendations not only address local challenges but also align with global calls for greater investment in agricultural worker mental health, recognizing farmers as a high-risk occupational group facing interconnected economic, social, and environmental stressors.

Future research should consider using a longitudinal study design to better establish causal relationships between stress and associated factors among sugarcane farmers. Moreover, qualitative research examining the personal experiences and coping strategies of farmers could offer a more profound understanding of the root causes of stress. Importantly, this study contributes to the advancement of the Stress Process Model by contextualizing it within the farming sector. It highlights how structural stressors including economic pressures, unpredictable markets, and environmental challenges interact with psychosocial resources such as social support and coping strategies to influence mental health outcomes. Expanding the study to include farmers from different regions and agricultural sectors would not only enhance generalizability but would also further refine the theoretical application of the Stress Process Model, guiding the development of comprehensive interventions for agricultural workers nationwide.

6. Conclusion

This study reveals the significant stress factors impacting sugarcane farmers in Sa Kaeo Province, including insufficient sleep, high cultivation costs, fluctuating sugarcane prices, climate variability, limited access to water, and moderate social support. These factors contribute to the high stress levels experienced by farmers in the region. Targeted interventions that address these stressors and provide mental health support are essential for improving the well-being of sugarcane farmers. Further research should focus on the development and evaluation of such interventions to mitigate stress and promote mental health among farmers.

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9. Abbreviations

Abbreviation	Full Term
AOR	Adjusted Odds Ratio
BLR	Binary Logistic Regression
CI	Confidence Interval
COR	Crude Odds Ratio
IOC	Index of Item-Objective Congruence
MLR	Multiple logistic regression
PM	Particulate Matter
SPST	Suanprung Stress Test
SPSS	Statistical Package for the Social Sciences

Abbreviation	Full Term
SD	Standard Deviation
VHV	Village Health Volunteers
VIF	Variance Inflation Factor

8. CRediT Statement

Sootthikarn Mungkhunthod: Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Project Administration.

Phannathat Tanthanapanyakorn: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing.

Nonlapan Khantikulanon: Conceptualization, Methodology, Formal Analysis, Investigation, Resources, Data Curation.

Chaninan Praserttai: Conceptualization, Validation, Investigation, Resources, Supervision.

10. References

Bangkadanara, G., Arphorn, S., Tangtong, C., Maruo, S. J., Yogyorn, D., Thanachoksawang, C., & Ishimaru, T. (2023). Factors associated with stress levels among Thai farmers during the COVID-19 pandemic. *The Southeast Asian Journal of Tropical Medicine and Public Health*, *54*(3), 101-116.

Bazo-Alvarez, J. C., Bazalar-Palacios, J., Bazalar, J., & Flores, E. C. (2022). Mental health among the sugarcane industry farmers and non-farmers in Peru: A cross-sectional study on occupational health. *BMJ Open*, *12*(11), Article e064396. https://doi.org/10.1136/bmjopen-2022-064396

Best, J. W. (1977). *Research in education*. Prentice Hall Inc.

Brennan, M., Hennessy, T., Meredith, D., & Dillon, E. (2022). Weather, workload and money: Determining and evaluating sources of stress for farmers in Ireland. *Journal of Agromedicine*, *27*(2), 132-142. https://doi.org/10.1080/1059924X.2021.1988020

Chengane, S., Beseler, C. L., Duysen, E. G., & Rautiainen, R. H. (2021). Occupational stress among farm and ranch operators in the midwestern United States. *BMC Public Health*, *21*(1), Article 2076. https://doi.org/10.1186/s12889-021-12053-4

Clayton, S. (2021). Climate change and mental health. *Current Environmental Health Reports*, *8*(1), 1-6. https://doi.org/10.1007/s40572-020-00303-3

Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). John Wiley & Sons.

Daghagh Yazd, S., Wheeler, S. A., & Zuo, A. (2019). Key risk factors affecting farmers' mental health: A systematic review. *International Journal of Environmental Research and Public Health*, *16*(23), Article 4849. https://doi.org/10.3390/ijerph16234849

Dahlgren, G., & Whitehead, M. (1991). *Policies and strategies to promote social equity in health*. Institute for Futures Studies.

Deegan, A., & Dunne, S. (2022). An investigation into the relationship between social support, stress, and psychological well-being in farmers. *Journal of Community Psychology*, *50*(7), 3054-3069. https://doi.org/10.1002/jcop.22814

Dinesh Babu, K. S., Janakiraman, V., Palaniswamy, H., Kasirajan, L., Gomathi, R., & Ramkumar, T. R. (2022). A short review on sugarcane: Its domestication, molecular manipulations and future perspectives. *Genetic Resources and Crop Evolution*, *69*(8), 2623-2643. https://doi.org/10.1007/s10722-022-01430-6

Elliott, K. C., Lincoln, J. M., Flynn, M. A., Levin, J. L., Smidt, M., Dzugan, J., & Ramos, A. K. (2022). Working hours, sleep, and fatigue in the agriculture, forestry, and fishing sector: A scoping review. *American Journal of Industrial Medicine*, *65*(11), 898-912. https://doi.org/10.1002/ajim.23418

El Khayat, M., Halwani, D. A., Hneiny, L., Alameddine, I., Haidar, M. A., & Habib, R. R. (2022). Impacts of climate change and heat stress on farmworkers' health: A scoping review. *Frontiers in Public Health*, *10*, Article 782811. https://doi.org/10.3389/fpubh.2022.782811

Garrett-Wright, D., Malin, C., & Jones, M. S. (2023). Mental health in farming communities. *Journal of Psychosocial Nursing and Mental Health Services*, *61*(10), 39-43. https://doi.org/10.3928/02793695-20230424-02

Hagen, B. N., Sawatzky, A., Harper, S. L., O'sullivan, T. L., & Jones-Bitton, A. (2021). What impacts perceived stress among Canadian farmers? A mixed-methods analysis. *International Journal of Environmental Research and Public Health*, *18*(14), Article 7366. https://doi.org/10.3390/ijerph18147366

Ingrao, C., Strippoli, R., Lagioia, G., & Huisingh, D. (2023). Water scarcity in agriculture: An

overview of causes, impacts and approaches for reducing the risks. *Heliyon*, *9*(8), Article e18507. https://doi.org/10.1016/j.heliyon.2023.e18507

Kiatkitroj, K., Arphorn, S., Tangtong, C., Maruo, S. J., & Ishimaru, T. (2022). Risk factors associated with heat-related illness among sugarcane farmers in Thailand. *Industrial Health*, *60*(5), 447-458. https://doi.org/10.2486/indhealth.2021-0161

King, E., Lamont, K., Wendelboe-Nelson, C., Williams, C., Stark, C., van Woerden, H. C., & Maxwell, M. (2023). Engaging the agricultural community in the development of mental health interventions: A qualitative research study. *BMC Psychiatry*, *23*(1), Article 399. https://doi.org/10.1186/s12888-023-04806-9

Laoveeratam, S., Sugkraroek, P., & Norchai, P. (2025). The Effects of Mindfulness on Sleep Quality in Working adults with stress: A systematic review and meta-analysis of randomized controlled trials. *Journal of Current Science and Technology*, *15*(3), Article 128. https://doi.org/10.59796/jcst.V15N3.2025.128

Leite, M. R., Zanetta, D. M. T., Trevisan, I. B., Burdmann, E. D. A., & Santos, U. D. P. (2018). Sugarcane cutting work, risks, and health effects: A literature review. *Revista de Saude Publica*, *52*, Article 80.

Mahattanirunkul, S., Phumpaisarnchai, W., & Tapanya, P. (2017). The construction of the Suan Prung stress test for the Thai population. *Academic Psychiatry and Psychology Journal*, *13*(3), 1-20.

Mehdi, F., Cao, Z., Zhang, S., Gan, Y., Cai, W., Peng, L., ... & Yang, B. (2024). Factors affecting the production of sugarcane yield and sucrose accumulation: Suggested potential biological solutions. *Frontiers in Plant Science*, *15*, Article 1374228. https://doi.org/10.3389/fpls.2024.1374228

Noiprasert, S., Buttagat, V., Sittiprapaporn, P., Sivaphongthongchai, A., & Hongsing, P. (2024). Effects of acupuncture on autonomic nervous system parameters and salivary cortisol level among mental stress university students: A pilot randomized controlled trial. *Journal of Current Science and Technology*, *14*(2), Article 25. https://doi.org/10.59796/jcst.V14N2.2024.25

Noomnual, S., Konthonbut, P., Kongtip, P., & Woskie, S. R. (2024). Mental health disorders among Thai farmers: Occupational and non-occupational stressors. *Human and Ecological Risk Assessment: An International Journal*, *30*(1-2), 180-200. https://doi.org/10.1080/10807039.2024.2310810

Office of Agricultural Economics. (2024). *Overview of agricultural areas and products in Sa Kaeo Province*. Retrieved from https://www.opsmoac.go.th/sakaeo-dwl-files-461991791905

Olowogbon, T. S., Yoder, A. M., Fakayode, S. B., & Falola, A. O. (2019). Agricultural stressors: Identification, causes and perceived effects among Nigerian crop farmers. *Journal of Agromedicine*, *24*(1), 46-55. https://doi.org/10.1080/1059924X.2018.1538915

Ong-Artborirak, P., Boonchieng, W., Juntarawijit, Y., & Juntarawijit, C. (2022). Potential effects on mental health status associated with occupational exposure to pesticides among thai farmers. *International Journal of Environmental Research and Public Health*, *19*(15), Article 9654. https://doi.org/10.3390/ijerph19159654

Pearlin, L. I., Mullan, J. T., Semple, S. J., & Skaff, M. M. (1990). Caregiving and the stress process: An overview of concepts and their measures. *The Gerontologist*, *30*(5), 583-594. https://doi.org/10.1093/geront/30.5.583

Pipitpukdee, S., Attavanich, W., & Bejranonda, S. (2020). Climate change impacts on sugarcane production in Thailand. *Atmosphere*, *11*(4), Article 408. https://doi.org/10.3390/atmos11040408

Pintakham, K., Jitkham, P., & Khamthiang, T. (2019). Stress and coping mechanisms of farmers in Ban Du Subdistrict, Mueang District, Chiang Rai Province. *Phetchabun Rajabhat University Journal*, *21*(1), 49-53.

Proctor, C., & Hopkins, N. (2023). Stressors and coping strategies in rural farmers: A qualitative study. *Journal of Agromedicine*, *28*(3), 415-424. https://doi.org/10.1080/1059924X.2023.2173691

Ratana, W. (2009). *Health care behavior and social support with the elderly's life quality of the aging club at Suratthani Central Hospital*. Srinakharinwirot University, Thailand.

Riethmuller, M. L., Newnham, E. A., Dzidic, P. L., & McEvoy, P. M. (2024). Farming, finance

and family: Factors associated with anxiety, depression and stress among Western Australian farmers. *Health Promotion International*, *39*(3), Article daae069. https://doi.org/10.1093/heapro/daae069

Rudolphi, J. M., Cuthbertson, C., Kaur, A., & Sarol, J. (2024). A comparison between farm-related stress, mental health, and social support between men and women farmers. *International Journal of Environmental Research and Public Health*, *21*(6), Article 684. https://doi.org/10.3390/ijerph21060684

Saju, S., Reddy, S. K., Bijjal, S., & Annapally, S. R. (2024). Farmer's mental health and well-being: Qualitative findings on protective factors. *Journal of Neurosciences in Rural Practice*, *15*(2), Article 307. https://doi.org/10.25259/JNRP_403_2023

Som-ard, J., Immitzer, M., Vuolo, F., & Atzberger, C. (2024). Sugarcane yield estimation in Thailand at multiple scales using the integration of UAV and sentinel-2 imagery. *Precision Agriculture*, *25*(3), 1581-1608. https://doi.org/10.1007/s11119-024-10124-1

Suchato, R., Patoomnakul, A., & Photchanaprasert, N. (2021). Alternative cropping adoption in Thailand: A case study of rice and sugarcane production. *Heliyon*, *7*(12), Article e08629. https://doi.org/10.1016/j.heliyon.2021.e08629

Suwannaphant, K., Wongsaming, P., Sangdang, R., Nguanjairak, P., Tannugoal, P., & Sangmueang, M. (2022). Factors associated with stress among sugarcane farmers in Kudpladuk Sub-District, Chuenchom District, Mahasarakham Province. *Thai Journal of Safety and Health*, *15*(1), 100-111.

Tantipanjaporn, T., Povey, A., Shiels, H. A., & van Tongeren, M. (2025). High levels of heat stress among sugarcane workers in Thailand. *Annals of Work Exposures and Health*, *69*(4), 401-414. https://doi.org/10.1093/annweh/wxaf002

Yeleliere, E., Antwi-Agyei, P., & Guodaar, L. (2023). Farmers response to climate variability and change in rainfed farming systems: Insight from lived experiences of farmers. *Heliyon*, *9*(9), Article e19656. https://doi.org/10.1016/j.heliyon.2023.e19656

Younker, T., & Radunovich, H. L. (2022). Farmer mental health interventions: A systematic review. *International Journal of Environmental Research and Public Health*, *19*(1), Article 244. https://doi.org/10.3390/ijerph19010244