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Assessment of the coping strategies of cassava and maize farmers toward oil spillage in Akwa Ibom and Rivers States, Nigeria

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Abstract

The study assessed the coping strategies of cassava and maize farmers toward oil spillage in Akwa Ibom and Rivers States, Nigeria. The study specifically described the socioeconomic characteristics of the respondents, coping strategies adopted, and attitudes towards the coping strategies. A structured questionnaire was used to collect primary data from 360 respondents in the study area. The data obtained were analyzed using descriptive statistics and mean scores from a Likert rating scale. The results revealed that the mean ages of the respondents were 49 and 45 years (65.00% and 63.89%) in oil-spilled and non-oil-spilled communities, respectively, with the majority being male (58.81% and 66.11%). The results showed that the coping strategies most adopted by farmers were mixed cropping (85.56%), backyard farming (84.44%), and off-farm businesses (73.33%). The respondents' attitudes toward the coping strategies showed that farmers preferred mixed cropping because of its benefits (mean score = 4.24) and believed that adopting mixed cropping increases the output of many arable crops per season (mean score = 4.17). However, there was a negative response toward the installation of greenhouse farming (mean score = 2.26). The study, therefore, recommends that education and training on new coping strategies, such as greenhouse farming and sack crop production, should be encouraged, particularly by oil-producing companies as part of their Corporate Social Responsibility (CSR).

Keywords: Coping Strategies; Cassava; Environmental Pollution; Farmers; Maize; Oil Spillage

1. Introduction

Oil spills are the most common technological and human-induced hazards in Nigeria, with both short- and long-term cumulative detrimental effects on the affected population (Albert, Amaratunga, and Haigh, 2017). According to Albert et al. (2017), this has placed the region among the top five most severely impacted environments in the world due to petroleum pollution. The environment, arable lands, water resources, and livelihood sources of Nigeria's immediate oil-producing communities have all been affected by these disasters (Albert et al., 2017).

Oil spillage and gas flaring, the most frequently mentioned forms of pollution resulting from oil exploration and exploitation in the Niger Delta, have had severe consequences for the region. These environmental hazards have significantly impacted the living conditions of the people who depend entirely on their surroundings for sustenance, including fishing, agriculture, access to potable water, and recreational activities such as swimming and clean air. The agricultural sector, which once provided a sustainable livelihood, has been particularly affected, leading to degraded farmland, polluted waterways, and declining productivity (Adati, 2012).

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Iheke et al. (2019) reported that despite the agricultural sector being the primary livelihood source for many, it has received little attention. As a result of oil exploration, agricultural production has deteriorated over time. In addition to the sector's poor performance, the continuous occurrence of oil spills—especially in Akwa Ibom and Rivers States—has further contributed to declining agricultural productivity. Despite ongoing oil exploration, farmers in these areas continue to cultivate land near oil fields to feed their families and generate income. The oil sector has systematically replaced agricultural revenue, which was once the mainstay of Nigeria's economy. However, in communities where oil is abundant, agriculture is no longer as productive as it once was, and host communities continue to suffer from extreme poverty and social hardship.

The Niger Delta region has been severely affected by oil spills and gas flaring, the most frequently cited forms of pollution caused by oil exploration and exploitation. These environmental disasters have negatively impacted the livelihoods of those who depend entirely on natural resources, including fishing, farming, access to potable water, and clean land and waterways (Adati, 2012). Every stage of oil exploration and production impacts the environment—from seismic analysis during exploration to crude oil transportation and refining. Additionally, both onshore and offshore operations have caused environmental degradation, affecting entire ecosystems, communities, organizations, and even nations. The major sources of pollution include oil spills, gas flaring, drilling activities, and transportation. More significantly, due to weak regulations that only penalize companies for ongoing oil spills and gas flaring, these environmental effects may persist indefinitely (Udok and Akpan, 2017).

Nigeria is the world's sixth-largest oil producer and Africa's largest, owing to the vast oil and gas reserves in the Niger Delta (Adekola et al., 2017). Approximately 606 oil fields 360 onshore and 246 offshore, are used for oil extraction (Sam et al., 2016; Ijiomah, 2018; Umar et al., 2021). Nigeria's oil reserves are predominantly located in the Niger Delta, where large-scale oil exploration takes place.

Ashraf et al. (2013) define coping strategies as self-directed, temporary, and location-specific actions and adjustments aimed at managing particular hazards. Coping refers to dealing effectively with a difficult situation, while strategies are the means or methods of addressing it. Coping strategies are helpful actions that farmers employ to survive when unexpected events, such as floods, droughts, or oil spills, threaten their livelihoods. These strategies involve actions and activities within existing structures and systems, as well as the adoption of various approaches to reduce economic, environmental, and social vulnerabilities. In other words, coping strategies—also referred to as survival strategies—are measures taken by individuals to manage exposure to shocks. For farmers, these strategies serve as adaptive mechanisms to address challenges either on-farm or off-farm. Implementing effective coping strategies can help mitigate the negative effects of oil spillage and enhance resilience in affected communities.

In Nigeria, cassava (*Manihot esculenta*) is a crop used for both residential and industrial purposes. As a staple food, it provides a significant portion of the population's daily calorie intake. In southern Nigeria, cassava is the most widely cultivated crop, particularly by smallholder farmers. Due to its drought tolerance and ability to thrive in marginal soil conditions, it plays a crucial role in ensuring food security in rural economies. The International Institute of Tropical Agriculture (IITA, 2017) has classified cassava as one of the crops with the highest potential for environmental adaptation. This is because cassava can survive under a wide range of edaphic and climatic conditions and can grow even in areas considered unsuitable for other crops. It also thrives in low-fertility soils and regions with irregular rainfall, competing favorably in terms of yield with crops such as maize, cocoyam, okra, and vegetables.

Maize (*Zea mays*) is one of the most significant food crops and a key cereal in Nigeria. Its genetic adaptability allows it to grow across various ecological zones, from the dry Sudan savanna to the humid, evergreen forest zones. As a result, maize has become the most widely cultivated crop in the country, gradually replacing traditional cereals such as millet and sorghum. In 2018, Nigeria produced approximately 10.2 million tons of maize from 4.8 million hectares, making it the highest maize producer in Africa (Food and Agriculture Organization, FAO, 2018).

The value of intercropping as a tropical agricultural practice has long been recognized by peasant farmers. Small-scale farmers frequently use intercropping to enhance crop yields, increase diversity, and improve production stability. Intercropping involves planting crops with different productivity levels, growth habits, and phenological traits together on the same plot of land. Research has shown that intercropping increases total returns per unit of land, enabling farmers to maximize financial gains. In Nigeria, cassava and maize are the two major crops used in intercropping systems. Since cassava is a long-duration crop and maize is a short-season crop, intercropping them has been perceived as both productive and compatible (Adeniyan et al., 2014).

Iheke et al. (2019) reported that oil spills have led to poor crop yields and declining land productivity. These environmental hazards have significantly lowered the standard of living for farmers in affected areas. Many have been

forced to abandon their farmlands in search of alternative means of livelihood. Indigenous people in oil-rich communities lament the degradation of their once-thriving agricultural lands, which sustained their forefathers but have now become polluted and unfit for farming. As a result, the challenges faced by the Niger Delta people—including neglect, marginalization, deprivation, poverty, unemployment, and underdevelopment—remain pressing issues.

ThankGod (2014) concluded that crude oil pollution has severely reduced crop output, posing a serious threat to agricultural production. The frequent occurrence of oil spills in the Niger Delta has further degraded soil fertility, destroyed soil microorganisms, and decreased agricultural productivity among farmers in oil-producing communities. Ahmadu and Egbodion (2013) highlighted the negative effects of oil spills on cassava production, including yellowing and wilting of leaves, burnt appearances on stems and leaves, stunted growth, tuber rot, and reduced cassava quality and quantity. Similarly, Odiyi et al. (2020) observed several negative impacts of oil spills on maize production, such as reduced chlorophyll content in leaves, growth retardation, defoliation, chlorosis, wilting, necrosis, tissue damage, low yields, and plant death. These adverse effects have led to untold hardship, income loss, and food insecurity among farmers.

The people of Akwa Ibom and Rivers States are predominantly smallholder farmers, with cassava and maize as their major staple crops. However, farming in these states has become increasingly difficult due to persistent oil spills, which have significantly reduced crop yields. Given the challenges faced by farmers in oil-producing communities, it is crucial to explore alternative ways to mitigate the effects of oil spills. Implementing effective coping strategies could provide much-needed relief and support for affected farmers. While most studies focus primarily on the negative effects of oil spills, there is limited research on measures that safeguard agricultural productivity and farmers' livelihoods. Therefore, it is essential to assess the coping strategies employed by cassava and maize farmers in response to oil spills in Akwa Ibom and Rivers States of Nigeria.

2. Methodology

The study was conducted in the South-South geopolitical zone of Nigeria, specifically in the Niger Delta region. The study areas included Akwa Ibom and Rivers States, both of which are oil-producing states with a high prevalence of oil spills. A multi-stage random sampling technique was employed to select respondents for the study.

In the first stage, Akwa Ibom and Rivers States were purposively selected based on their frequent oil spill incidents and their major staple crops, cassava and maize. In the second stage, two agroecological zones were purposively selected from each state. In Akwa Ibom State, the selected zones were Eket Agricultural Zone (oil-spilled area) and Uyo Agricultural Zone (non-oil-spilled area). In Rivers State, the selected zones were Crop Zone 1 (Bori, an oil-spilled area) and Crop and Livestock Zone III (Omuma, a non-oil-spilled area). These four zones were categorized into two groups: oil-spilled communities and non-oil-spilled communities.

In the third stage, two extension blocks (Local Government Areas) were purposively selected from each zone. Within each extension block, two extension cells (communities) were randomly selected. In the fourth stage, a total of eight (8) extension blocks were randomly selected across both states. Within these blocks, 16 extension cells (communities) known for high levels of cassava and maize production, as well as the prevalence of oil spills, were selected. In the fifth and final stage, a random sampling technique was used to select 180 cassava and maize farmers from oil-spilled communities and another 180 from non-oil-spilled communities in both states, yielding a total sample size of 360 respondents.

A structured questionnaire was used to obtain primary data. The data were analyzed using descriptive statistical tools and mean scores derived from a five-point Likert scale. The Likert scale used in this study was specified as follows:

Strongly Agree	SA	5
Agree	AG	4
Undecided	UD	3
Disagree	DA	2
Strongly Disagree	SD	1

The mean response to each item was calculated using the following formula:

$$X = \frac{\sum fS}{N}$$

Ẋ= Mean response
∑= Summation
f= number of respondents choosing a particular scale point,
S = numerical value of the scale point
N = total number of respondents to the item.

The mean response to each item was interpreted using the concept of the real limit of numbers. The numerical value of the scale point (response modes) and their respective real limit are as follows:

Strongly Disagree	SD	= 1 point with real limit of 0.5 – 1.49
Disagree	DG	= 2 points with real limit of 1.50 – 2.49
Undecided	UD	= 3 points of real limit of 2.50 – 3.49
Agree	AG	= 4 points of real limit of 3.50 – 4.49
Strongly Agree	SA	= 5 points of real limit of 4.50 – 5.49

- **Decision Rule:** The values are summed to get 15 and divided by the number of values, 5, to get three as the mean. Items with a mean value of 3.0 and above will be accepted as AGREED, but items with a mean score of less than 3.0 will be regarded as DISAGREED.

3. Results and discussion

3.1. Socio-economic Characteristics of the Respondents.

The socio-economic characteristics of cassava and maize farmers in oil-spilled and non-oil-spilled communities in Akwa Ibom and Rivers States were described using frequencies and percentages as presented in Table 1. The socio-economic characteristics of cassava and maize farmers in oil-spilled and non-oil-spilled communities of Akwa Ibom and Rivers States reveal key demographic and agricultural patterns. The majority of farmers (65.00% and 63.89%) fall within the 41–60 age range, with mean ages of 49 and 45 years in oil-spilled and non-oil-spilled communities, respectively. Younger individuals are less engaged in farming, often seeking alternative livelihoods. According to Opuofoni *et al*. (2022), age is a major factor in production. Males dominate agricultural activities (58.89% and 66.11%), influenced by land tenure systems favouring men. The involvement of both sexes in the cultivation of cassava and maize could be because these crops are major food crops and also substantial sources of income. The result agrees with the study of Onoh *et al*. (2015), who reported that most of the respondents (54%) were males. This is consistent with the gender role pattern of people where fathers play dual roles of home and farm family heads. The findings of the study disagree with the study conducted by Arigor *et al*. (2021), who reported that a greater percentage (58.33% and 41.67%) of the respondents were female and male, respectively.

Most farmers are married (73.89%), contributing to household labour availability, while household sizes range from 1 to 10 members, with an average of six, highlighting reliance on family labour. Education levels vary, with 42.78% and 38.33% attaining secondary education, while a smaller proportion remains without formal education, influencing access to agricultural information and innovation. Agriculture remains the predominant occupation (81.67% and 75.00%), with farmers possessing an average of 14–15 years of experience. However, farm sizes remain limited (1.5 ha and 1.8 ha), constrained by land tenure systems, urbanization, and oil spills. Despite their experience, farmers still operate on small, fragmented plots with manual labour, impacting productivity. These findings agree with the study of Ighoro *et al*. (2018), who reported that agriculture is commonly practiced by married people to make ends meet and cater for their families. Fadipe *et al*. (2019) reported that a greater proportion of farmers in Southeast Nigeria were peasant farmers, on average cultivating less than 2.0 hectares of land. The result of this study also agreed with Mgbakor (2017), who stated that cassava and maize are commonly cultivated by smallholder farmers with low resources. It further reported that there is limited access to land by farmers, which was a result of high rent paid on hired land and the problem of land tenure system (land fragmentation), which are prevalent in the study area.

Table 1 Socioeconomic Characteristics of the Respondents for Both States n=360

Variables	**Oil Spilled = 180**		**Non-Spilled = 180**		**Pooled**	
	Frequency	**Mean**	**Frequency**	**Mean**	**Frequency**	**Mean**
Age						
20 – 40	44 (24.44)	49 yrs.	57 (31.67)	45 yrs.	101 (28.06)	47 yrs
41 – 60	117 (65.00)		115 (63.89)		232 (64.44)	
61 and above	19 (10.56)		08 (4.44)		27 (7.50)	
Subtotal	180 (100)		180 (100)		360 (100)	
Sex						
Male	106 (58.89)		119 (66.11)		225 (62.50)	
Female	74 (41.11)		61 (33.89)		135 (37.50)	
Subtotal	180 (100)		180 (100)		360 (100)	
Marital Status						
Married	133 (73.89)		133 (73.89)		266 (73.89)	
Single	15 (8.33)		17 (9.44)		32 (8.89)	
Divorced	13 (7.22)		09 (5.00)		22 (6.11)	
Widow	19 (10.56)		21 (11.67)		40 (11.11)	
Subtotal	180 (100)		180 (100)		360 (100)	
Household Size						
1-5	90 (50.00)		64 (35.56)		154 (42.78)	
6-10	87 (48.33)	6 members	108 (60.00)	6 members	11 (3.06)	6 members
11-15	03 (1.67)		08 (4.44)		195 (54.17)	
Subtotal	180 (100)		180 (100)		360 (100)	
Educ. Background						
No formal education	21 (11.67)		31 (17.22)		52 (14.44)	
Primary education	45 (25.00)	8 years	52 (28.89)	7 years	97 (26.94)	
Secondary education	77(42.78)		69 (38.33)		146 (40.56)	
Tertiary education	37 (20.56)		28 (15.56)		65 (18.06)	
Subtotal	180 (100)		180 (100)		360 (100)	
Major Occupation						
Farming	147 (81.67)		135 (75.00)		282 (78.33)	
Artisanship	02 (1.11)		09 (5.00)		11 (3.06)	
Trading	09 (5.00)		09 (5.00)		18 (5.00)	
Civil Service	06 (3.33)		19 (10.56)		35 (9.72)	
Public Service	16 (8.89)		08 (4.44)		14 (3.89)	
Subtotal	180 (100)		180 (100)		360 (100)	
Farming Exp.						
1- 15	111 (61.67)		118 (65.56)		229 (63.61)	
16 – 30	59 (32.78)	15 yrs.	59 (32.78)	14 yrs.	118 (32.78)	15 yrs.
31 – 45	10 (5.56)		03 (1.67)		13 (3.61)	
Subtotal	180 (100)		180 (100)		360 (100)	
Farm Size (Cassava)						
Below 1.0	14 (7.78)	1.5 ha	13 (7.22)	1.8 ha	27 (7.50)	
1.0-2.0	146 (81.11)		102 (56.67)		248 (68.89)	1.6 ha
2.1-3.0	17 (9.44)		52 (28.89)		69 (19.17)	

Above 3.0	03 (1.67)		13 (7.22)		16 (4.44)	
Subtotal	180 (100)		180 (100)		360 (100)	
Farm Size (Maize)						
Below 1.0	14 (7.78)	1.5 ha	12 (6.67)	1.8 ha	26 (7.22)	
1.0-2.0	147 (81.67)		103 (57.22)		250 (69.44)	1.6 ha
2.1-3.0	16 (8.89)		52 (28.89)		68 (18.89)	
Above 3.0	03 (1.67)		13 (7.22)		16 (4.44)	
Subtotal	180 (100)		180 (100)		360 (100)	

Source: Computed from Field Survey, 2023.

3.2. Coping Strategies Adopted by Cassava and Maize Farmers

The coping strategies adopted by cassava and maize farmers in oil-spilled communities to mitigate the negative effects of oil spillage are presented in Table 2 using frequencies and percentages. The results in Table 4 reveal that the majority (85.56%**)** of respondents adopted a mixed cropping system as a coping strategy to mitigate the unpredictable effects of oil spillage. The major crops cultivated in the study area included cassava, maize, yam, okra, fluted pumpkin, and cocoyam. The implication of this finding is that mixed cropping serves as a complementary strategy for farmers, allowing them to cultivate multiple crops on the same plot simultaneously, thereby reducing the risk of complete crop failure due to oil pollution.

Another widely adopted coping strategy among cassava and maize farmers was backyard farming, reported by 84.44% of respondents. This strategy involved cultivating a variety of crops and rearing different types of livestock within their residential compounds. The majority of respondents grew maize, cassava, and vegetables such as okra, pepper, fluted pumpkin, waterleaf, bitter leaf, and scent leaf. They also engaged in small-scale livestock rearing, including local poultry, goats, sheep, pigs, snails, and rabbits. The study further found that 73.33**%** of respondents engaged in off-farm businesses as an alternative income source. This suggests that many farmers in the study area sought additional livelihood opportunities such as petty trading, tailoring, running restaurants, riding motorcycles, hiring out labour, and engaging in other menial jobs for financial sustenance. Additionally, 73.33% of respondents reported using early-maturing and improved crop varieties as a coping strategy. This implies that farmers opted for crop varieties that could mature quickly, thereby minimizing the risk of yield losses due to prolonged exposure to oil pollution.

Moreover, the results indicate that 63.89% of respondents practiced mixed farming while 58.33**%** adopted intensive farming as coping strategies. However, fewer respondents adopted sack crop production (38.89%) and greenhouse farming (17.78**%**), suggesting that these strategies are less common, possibly due to limited resources or a lack of technical knowledge. The findings of this study are consistent with the research conducted by Demba et al. (2023)**,** which examined small-scale farmers' coping strategies in response to extreme weather events in Upper Guinea. Their study found that farming households adopted a range of coping approaches based on household characteristics and available economic opportunities. Similarly, Mango et al. (2017) reported that the adoption of individual agricultural technologies varied widely, with smallholder farmers often implementing a combination of strategies to maximize their benefits.

Table 2 Coping Strategies Adopted by Cassava and Maize Farmers for both States n = 180

Coping Strategies	**Frequency**	**Percentage**	**Ranking**
Mixed cropping	154	85.56	1st
Backyard farming	152	84.44	2nd
Off- farm Business	132	73.33	3rd
Improved varieties	132	73.33	3rd
Mixed farming	115	63.89	5th
Intensive farming	105	58.33	6th
Sack Crop Production	70	38.89	7th
Greenhouse farming	32	17.78	8th

Source: Computed from Field Survey, 2023

3.3. The Attitudes of Farmers toward the Coping Strategies

The attitudes of cassava and maize farmers toward coping strategies in oil-spilled communities are presented in Table 3 using the mean scores from a five-point Likert-type rating scale. The results indicate that the majority of respondents assigned the highest mean score (MS = 4.24) to the statement that they engage in mixed cropping because of its numerous benefits. This suggests a positive attitude toward mixed cropping as a coping strategy. Mixed cropping is a common agricultural practice in the South-South region of Nigeria, where multiple crops are grown together in the same plot. The implication is that farmers adopt this strategy to optimize productivity and enhance resilience against oil spillage. These findings align with the study by Mustapha et al. (2021), which reported that mixed cropping offers several benefits, including improved crop productivity and reduced pest and disease infestations.

Furthermore, respondents strongly agreed that mixed cropping preserves and improves soil quality, with a mean score of (MS = 3.68). They also strongly agreed that mixed cropping increases the output of multiple arable crops per season, with a mean score of (MS = 4.17). This implies that the majority of respondents have a positive attitude toward adopting mixed cropping as a coping strategy to mitigate the adverse effects of oil spills.

The study also examined farmers' attitudes toward greenhouse farming as a coping strategy. The following mean scores were recorded for various attitudinal statements:

- Greenhouse farming protects crops from pests, diseases, extreme weather, and oil spillage (MS = 4.05).
- Greenhouse farming is limited to enclosed spaces and is mainly used for vegetable cultivation (MS = 3.39).
- Greenhouse farming does not require technical know-how for farmers (MS = 3.01).

However, respondents strongly disagreed with the statements that the cost of greenhouse farming installation is not expensive and that it does not protect crops from hazards, with a mean score of (MS = 2.26). Regarding backyard farming, respondents strongly agreed that it allows for the cultivation of vegetables, root and tuber crops, and livestock rearing, with a mean score of (MS = 3.89). However, some respondents strongly disagreed with the notion that backyard farming is capital-intensive, with a mean score of (MS = 2.98). Overall, the study found that there was a positive attitude toward the adoption of key coping strategies, particularly mixed cropping and backyard farming. These findings emphasize the importance of sustainable farming practices in improving food security at the rural farm level. Egwu (2015) highlights that while agricultural practices significantly impact national food security, many rural farmers exhibit poor attitudes toward adopting new agricultural technologies.

Table 3 Attitudes of Farmers toward the Coping Strategies n= 180

Farmers' Attitudinal Statements	SA	A	UD	D	SD	TSS	MS	Prop.	Decision
I engaged on cultivation of mixed cropping because of its many benefits.	74	89	5	11	1	764	4.24	84.89	Agree
The cultivation of mixed cropping does preserve and improve soil quality.	61	60	12	34	13	662	3.68	73.56	Agree
I adopted cultivation of mixed cropping because it increases output of many arable crops per season.	80	71	14	10	5	751	4.17	83.44	Agree
Greenhouse farming prevents crops from pests and diseases attack and also threat from oil spillage.	72	64	28	13	3	729	4.05	81.00	Agree
The greenhouse farming is not limited to as enclose space where vegetables are cultivated.	46	44	38	38	14	610	3.39	67.78	Agree
I think the cost of installation of greenhouse farm is not expensive and it does not protect crops from hazard.	26	21	3	55	75	408	2.26	53..22	Disagree
It does not require any technical know- how by farmers before adoption.	36	41	23	49	31	542	3.01	60.22	Agree
The adoption of backyard farming allows the cultivation of vegetables, root and tuber crops and animal rearing at the same plot.	71	65	12	18	14	701	3.89	77.89	Agree

I think backyard farming does not provides gainful self-employment as a relief because of its proximity.	40	10	3	63	64	439	2.43	83.11	Disagree
It always produces fresh food in terms of vegetable and meat for family consumption.	79	66	7	22	6	730	4.06	81.11	Agree
I understand backyard farming to be capital Intensive.	39	40	13	54	34	536	2.98	59.56	Disagree

SA = Strongly Agree, A = Agree, UD = Undecided, D = Disagree, SD = Strongly Disagree, TSS = Total Summation Sum, and MS = Mean Score.
Source: Computed from Field Survey, 2023.

4. Conclusion

The study assessed the coping strategies of cassava and maize farmers in response to oil spillage in Akwa Ibom and Rivers States, Nigeria. Oil spillage poses serious threats and challenges to agriculture, human health, and the ecosystem, particularly in oil-producing communities.

The magnitude of its effects has rendered agricultural farmlands unproductive, disrupted the livelihoods of rural dwellers, and negatively impacted their health. Given the persistent nature of oil spills, the adoption of coping strategies is both important and inevitable for affected farmers. The study identified five key coping strategies that farmers have adopted as mitigation measures against the negative effects of oil spillage: mixed cropping, backyard farming, off-farm businesses, use of improved crop varieties, and mixed farming.

Based on the findings of the study, the following recommendations are made:

- Farmer Education and Training: Farmers should be encouraged to participate in training programs on newly adopted coping strategies, such as greenhouse farming and sack crop production. These programs should include workshops, information sessions, and outreach activities to promote best practices in crop production.
- Preventing Oil Spillage: The Government and oil companies should work jointly to prevent oil spills from contaminating farmlands and causing environmental destruction.
- Pipeline Monitoring and Maintenance: There should be proper monitoring and evaluation of pipelines to protect the environment and ensure sustainable farming activities. This includes the timely replacement of worn-out facilities, such as pipelines and weak or leaking valves, which could lead to spillage.
- Community Awareness Campaigns: Oil companies and the government should increase environmental awareness campaigns to educate communities about the dangers of having pipelines close to their farmlands and the preventive measures they can take.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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