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Impact of Climate-Smart Agricultural Education on Youth Livelihood in Bayelsa Riverine Communities

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Abstract
This study evaluated the impact of climate-smart agricultural education on youth livelihoods across riverine communities in Bayelsa State. Guided by three research questions and three null hypotheses, the author adopted a mixed-method design integrating a cross-sectional descriptive survey with a quasi-experimental field trial. The target population consisted of active farming youths within Ekeremor and Southern Ijaw Local Government Areas. From this frame, the Taro Yamane formula determined a descriptive survey sample of 195 youths, while a nested cohort of 60 youths was purposively selected and split evenly into experimental and control groups (n=30 each) for experimental tracking. Data collection relied on the verified Youth Climate-Smart Agriculture and Livelihood Questionnaire and the objective Climate-Smart Agriculture Competency Assessment Test. Descriptive questions were analyzed using mean and standard deviation, whereas the null hypotheses were tested via Analysis of Covariance (ANCOVA) at a 0.05 level of significance. The empirical findings demonstrated that targeted education in flood-resilient crop production, advanced fish farming, and aquaponics significantly boosted practical vocational competencies, prompting the rejection of all three null hypotheses. The study concluded that institutionalized climate-smart agricultural training enhances economic resilience and promotes livelihood diversification in ecological flood zones, recommending that relevant state agencies provide financial tools, specialized equipment, and demonstration hubs for trained cohorts

Keywords: *Climate-smart agricultural education, youth livelihood, riverine communities*

Introduction

Climate change is increasingly recognised as a major global challenge with profound implications for agriculture, food security, rural livelihoods, and sustainable development. It refers to persistent changes in climatic conditions, including temperature, rainfall, atmospheric characteristics, and other elements of the climate system over long periods. Contemporary climate change is substantially influenced by human activities such as fossil-fuel combustion, land-use changes, and other sources of greenhouse-gas emissions (Intergovernmental Panel on Climate Change [IPCC], 2023). Its effects are manifested through increasing temperatures, changing rainfall regimes, drought, flooding, sea-level rise, coastal erosion, and variations in the frequency and intensity of extreme weather events. These changes affect ecological systems, economic activities, food production, human wellbeing, and the livelihood security of communities. The consequences are particularly severe for vulnerable populations whose economic survival depends on agriculture and other natural-resource-based activities. Recurrent flooding, irregular rainfall, increasing temperatures, and environmental degradation can damage farms and other productive assets, reduce income, and limit households' capacity to maintain sustainable livelihoods.

Agriculture is highly sensitive to climate change because production outcomes depend heavily on favourable climatic and environmental conditions. Changes in temperature, rainfall, soil moisture, water availability, flooding, pests, and diseases can influence the productivity of crops, livestock, fisheries, and aquaculture. At the same time, agriculture contributes to climate change through greenhouse-gas emissions generated by livestock, land-use changes, fertiliser application, energy use, and other production activities. This dual relationship makes the transformation of agricultural systems essential to addressing climate-related challenges. The FAO (2021) consequently advocates agricultural systems that can increase productivity and incomes, enhance resilience and adaptive capacity, and contribute to greenhouse-gas mitigation where feasible. This orientation has strengthened the adoption of climate-smart agriculture as a framework for achieving food security while responding to climate risks and environmental sustainability concerns.

Climate-smart agriculture encompasses agricultural strategies designed to improve productivity and income while enabling farming systems and agricultural communities to cope with climate-related risks. The FAO (2021) defines it as an integrated approach that seeks to sustainably increase productivity and incomes, strengthen resilience and adaptive capacity to climate change, and reduce or remove greenhouse-gas emissions where possible. It is not limited to one agricultural technology or practice; rather, it incorporates context-specific interventions such as improved crop varieties, soil and water conservation, agroforestry, integrated farming, resilient livestock production, sustainable fisheries and aquaculture, improved farm management, and climate-information services. The successful application of these practices depends not only on the availability of appropriate technologies but also on the capacity of individuals to understand climate risks and apply suitable responses. Thus, education is fundamental to climate-smart agriculture because it develops the knowledge, technical skills, adaptive attitudes, and problem-solving competencies required for the adoption and effective use of climate-resilient agricultural practices. Translating climate smart agriculture into actionable agricultural capacity requires structured educational channels designed to build risk awareness and sustainable farming competencies. Nwosu and Ebi (2023) emphasize that climate-smart agricultural education serves as a key instructional mechanism that equips students with skills in crop and livestock preservation, efficient irrigation, conservation agriculture, and environmental risk mitigation. This educational approach turns passive learning into active resilience, helping youth maintain economic independence within fragile ecosystems. UNESCO's (2023) global assertion that targeted environmental education is a core prerequisite for meaningful climate action. When applied to agrarian communities, this training teaches young people to assess incoming weather threats, handle natural resources responsibly, and configure innovative defenses against shifting production cycles. Embedding these smart concepts into educational programs gives young farmers the tools to restructure their enterprises, diversify their income bases, and control environmental factors rather than being controlled by them.

This capacity-building is essential because the youth generation represents the foundational human capital required for rural economic transformation. Broadly defined, youth livelihood encompasses the specific assets, capabilities, and economic strategies that young people deploy to secure food, generate revenue, and sustain their households. Adeyanju et al. (2023) clarify that in vulnerable, agriculture-dependent regions, youth livelihoods are defined by the range of productive ventures, technical skill sets, and economic strategies that young people use to preserve their financial well-being. Although shifting climate realities threaten traditional, natural resource-dependent occupations, access to specialized vocational knowledge allows youth to exploit emerging agribusiness markets and pivot away from climate-compromised income streams. As highlighted by the FAO (2021), combining climate-smart principles with youth talent boosts local farm productivity and builds a resilient agricultural workforce capable of translating education into sustainable self-employment. The structural value of this educational model becomes clear when applied to riverine communities, where daily survival is tied to rivers, swamps, creeks, and wetland resources. In these water-dominant environments, the physical landscape dictates the patterns of community habitation and economic life, leaving residents exposed to recurrent flooding, severe coastal erosion, and salinity intrusion. The World Bank (2021) underscores the vulnerability of the Niger Delta, identifying it as an area facing intense climate risks that jeopardize infrastructure, biological ecosystems, and community survival. In this fragile delta context, climate-smart agricultural education acts as a vital tool for economic adaptation. By mastering flood-resilient crop production, floating cage aquaculture, and innovative aquaponics, young people can actively insulate their work from environmental shocks. This training goes beyond teaching technical skills; it alters the long-term socioeconomic prospects of riverine youth by enhancing their entrepreneurial capacity, increasing their income margins, and securing their livelihoods against a changing climate.

Statement of the Problem

The escalating crisis of climate change has systematically undermined agricultural production and livelihood security in the riverine communities of Bayelsa State, where local economic activities are inextricably tied to fragile aquatic ecosystems. Perennial flooding, severe coastal erosion, saltwater intrusion, and highly erratic rainfall regimes continually threaten crop production, wild fisheries, and aquaculture setups. Because traditional agrarian practices depend heavily on dryland conditions, they have become entirely ineffective in this perennially waterlogged environment. This ecological shift traps rural youth in a cycle of declining productivity, volatile incomes, structural unemployment, and acute livelihood insecurity.

Despite these clear environmental challenges, a profound institutional gap persists between existing agricultural instruction and the survival needs of riverine youth. Most regional agricultural programs remain tied to rigid, textbook-oriented instructional methods rather than imparting functional competencies suited for flooded soils and fluctuating water columns. Consequently, young people lack targeted exposure to practical climate-smart frameworks specifically flood-resilient crop production, floating cage fish farming, and soil-less aquaponics. Deprived of these specialized competencies, local youths are unable to apply resource-conservation methods, utilize real-time climate info, or diversify their revenue streams. This skill deficit directly limits their capacity to transition into modern agribusiness self-employment, build resilient livelihoods, or defend local food security against escalating environmental shocks. Therefore, this study investigates the impact of climate-smart agricultural education on youth livelihoods in the riverine communities of Bayelsa State.

Aims and Objectives

The major aim of this study is to examine the impact of climate-smart agricultural education on youth livelihood in Bayelsa riverine communities. The objectives are to:

1. Determine the impact of flood-resilient crop production education on the livelihood of youths in Bayelsa riverine communities;
2. Examine the impact of fish farming education on the livelihood youths in Bayelsa riverine communities;
3. Assess the impact of aquaponics education on the livelihood of youths in Bayelsa riverine communities.

Research Questions

The following research questions guided the study:

1. What is the impact of flood-resilient crop production education on the livelihood of youths in Bayelsa riverine communities?
2. What is the impact of fish farming education on the livelihood of youths in Bayelsa riverine communities?
3. What is the impact of aquaponics education on the livelihood of youths in Bayelsa riverine communities?

Hypotheses

The following null hypotheses were tested:

H_{01}: Flood-resilient crop production education has no significant effect on the livelihood of youths in Bayelsa riverine communities.

H_{02}: Fish farming education has no significant effect on the livelihood of youths in Bayelsa riverine communities.

H_{03}: Aquaponics education has no significant effect on the livelihood of youths in Bayelsa riverine communities.

Methodology

A mixed-method research design combining a cross-sectional descriptive survey and a quasi-experimental design was adopted for this study. This design framework was considered ideal as it allowed the researcher to gather data on the baseline awareness, attitudes, and livelihood profiles of rural youths via a survey, while simultaneously determining the direct effect of an instructional intervention on their practical agricultural skills using a pre-test, post-test, non-equivalent control group format without altering intact social structures. The target population encompassed active farming youths within the Ekeremor and Southern Ijaw Local Government Areas of Bayelsa State. The Taro Yamane (1967) formula was applied to establish a representative sample of 195 farming youths for the survey component. Concurrently, a purposive sampling technique isolated a subset of 60 farming youths for the quasi-experimental phase, distributing them evenly into an experimental treatment group (n=30) and a control baseline group (n=30) across the selected communities. Data collection was facilitated through two primary researcher-designed instruments: Youth Climate-Smart Agriculture and Livelihood Questionnaire (YCSALQ) and the Climate-Smart Agriculture Competency Assessment Test (CSACAT). The questionnaire featured two primary segments, where Section A captured demographic profiles and Section B evaluated the impacts of flood-resilient crop production, fish farming, and aquaponics modules. Items were structured on a four-point Likert scale ranging from Strongly Agree (4) to Strongly Disagree (1), while the assessment test provided an objective measure of functional skills. Face and content validity were established by a panel of multidisciplinary experts in Agricultural Extension, Agronomy, Aquaculture, and Measurement and Evaluation from Niger Delta University. A pilot study involving 30 non-sampled farming youths was conducted to establish internal consistency, yielding a Cronbach's Alpha coefficient of 0.84 for the survey and a reliable Kuder-Richardson score for the practical test. Mean and standard deviation scores addressed the research questions. A criterion mean threshold of 2.50 dictated the decision-making process, where scores at or above 2.50 signified agree and scores below 2.50 indicated disagree. For the experimental datasets, the null hypotheses were tested using Analysis of Covariance (ANCOVA) at a 0.05 level of significance to control for pre-test variances.

Results

Analysis of Research Questions

Research Question 1: What is the impact of flood-resilient crop production education on the livelihood of youths in Bayelsa riverine communities?

Table 1: Mean and standard deviation on the impact of flood-resilient crop production education on the livelihood of youths in Bayelsa Riverine communities

S/N	Impact of flood-resilient crop production education on the livelihood of youths	$\bar{X}$	SD	Remark
1	Training on submergence-tolerant crop varieties helps youths avoid seasonal crop losses.	2.84	0.64	Agree
2	Learning early-maturing planting cycles increases annual farm income.	2.92	0.58	Agree
3	Skills in setting up raised-bed nurseries protect young plants during early flood onset.	2.76	0.71	Agree
4	Knowledge of post-flood soil remediation techniques accelerates immediate replanting and recovery.	3.01	0.52	Agree
5	Education on floating agricultural bed systems provides continuous food supply and revenue during peak floods.	2.95	0.61	Agree
	Grand Mean	**2.90**	**0.61**	**Agree**

The data presented in Table 1 indicate that all five items recorded mean scores above the 2.50 criterion mean. The item mean scores ranged from 2.76 to 3.01, showing that the respondents consistently agree with the statements on the livelihood benefits of flood-resilient crop production education. The grand mean of 2.90, with a standard deviation of 0.61, further indicates an overall positive response. Therefore, the findings establish that farming youths agree that flood-resilient crop production education positively impacts their livelihoods.

Research Question 2: What is the impact of fish farming education on the livelihood of youths in Bayelsa riverine communities?

Table 2: Mean and standard deviation on the impact of fish farming education on the livelihood of youths in Bayelsa Riverine communities

S/N	Impact of fish farming education on the livelihood of youths	$\bar{X}$	SD	Remark
1	Practical skills in floating cage construction prevent fish escapes during peak floods.	3.15	0.44	Agree
2	Hands-on training in breeding catfish fingerlings equips youths with the technical skills to run profitable commercial hatcheries.	3.22	0.51	Agree
3	Knowledge of flood-season fingerling stocking rates improves commercial harvest margins.	2.98	0.60	Agree
4	Training on value-added fish processing and smoking extends shelf life during flood infrastructure disruptions.	3.08	0.55	Agree
5	Skills in water quality management during flood overflows minimize disease outbreaks and mortality rates.	3.11	0.49	Agree
	Grand Mean	**3.11**	**0.52**	**Agree**

The data presented in Table 2 show that all five items recorded mean scores above the 2.50 criterion mean. The individual item means ranged from 2.98 to 3.22, indicating a consistent agreement among the respondents regarding the livelihood benefits of fish farming education. The grand mean of 3.11, with a standard deviation of 0.52, further demonstrates a strong positive response. Therefore, the findings establish that farming youths agree that fish farming education has a strong positive impact on their livelihoods.

Research Question 3: What is the impact of aquaponics education on the livelihood of youths in Bayelsa riverine communities?

Table 3: Mean and standard deviation on the impact of education on the livelihood of youths in Bayelsa Riverine communities

S/N	Impact of aquaponics education on the livelihood of youths	$\bar{X}$	SD	Remark
1	Closed-loop soil-less farming provides a reliable food supply when land is flooded.	2.68	0.78	Agree
2	Training in building backyard vertical aquaponic systems creates secondary income streams for riverine households.	2.58	0.81	Agree
3	Re-circulating water techniques taught in training lower operational costs for youth setups.	2.64	0.72	Agree
4	Hands-on skills in integrating fish waste as organic nutrient solutions eliminate fertilizer expenses for vegetable production.	2.71	0.69	Agree
5	Practical education on managing solar-powered water pumps ensures system continuity during flood-related power grid failures.	2.61	0.74	Agree
	Grand Mean	**2.64**	**0.75**	**Agree**

The data presented in Table 3 show that all five items recorded mean scores above the 2.50 criterion mean. The individual item means ranged from 2.58 to 2.71, indicating consistent agreement among the respondents regarding the livelihood benefits of aquaponics education. The grand mean of 2.64, with a standard deviation of 0.75, further indicates an overall positive response. Therefore, the findings establish that farming youths agree that aquaponics education has a positive impact on their livelihoods.

Testing of Research Hypotheses

Hypothesis 1: Flood-resilient crop production education has no significant effect on the livelihood of youths in Bayelsa riverine communities.

Table 4: ANCOVA analysis of the effect of flood-resilient crop production education on youth livelihood competencies

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	F-value	p-value	Decision
Experimental	30	14.25	3.12	28.60	2.45	66.58	< 0.001	Rejected
Control	30	14.10	2.98	16.35	3.01			

The inferential results presented in Table 4 indicate that, after controlling for the pre-test scores, the experimental group recorded a higher post-test mean competency score of 28.60 compared with 16.35 for the control group. The ANCOVA result revealed a statistically significant difference between the experimental and control groups, with a p-value of less than 0.001, which is below the 0.05 level of significance. Consequently, the first null hypothesis (H_{01}) was rejected. This finding indicates that the flood-resilient crop production education intervention had a significant treatment effect on the livelihood competencies of the youths in the experimental group.

Hypothesis 2: Fish farming education has no significant effect on the livelihood of youths in Bayelsa riverine communities.

Table 5: ANCOVA analysis of the effect of fish farming education on youth livelihood competencies

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	F-value	p-value	Decision
Experimental	30	12.18	2.44	32.45	1.88	52.14	< 0.001	Rejected
Control	30	12.30	2.51	18.12	4.22			

The results presented in Table 5 indicate that the experimental and control groups had comparable pre-test aquaculture competency mean scores of 12.18 and 12.30, respectively, before the intervention. Following the fish farming education intervention, the experimental group recorded a higher post-test mean competency score of 32.45 compared with 18.12 for the control group. The ANCOVA result revealed a statistically significant difference between the experimental and control groups, with an F-value of 52.14 and a p-value of less than 0.001, which is below the 0.05 level of significance. Consequently, the second null hypothesis (H_{02}) was rejected. This finding indicates that the fish farming education intervention had a significant treatment effect on the livelihood competencies of the youths in the experimental group.

Hypothesis 3: Aquaponics education has no significant effect on the livelihood of youths in Bayelsa riverine communities.

Table 6: ANCOVA analysis of the effect of aquaponics education on the livelihood of youths

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	F-value	p-value	Decision
Experimental	30	11.50	2.10	29.74	2.01	48.35	< 0.001	Rejected
Control	30	11.62	1.98	19.33	3.75			

The results presented in Table 6 indicate that the experimental and control groups had relatively similar pre-test livelihood competency mean scores of 11.50 and 11.62, respectively, before the intervention. Following the aquaponics education intervention, the experimental group recorded a higher post-test mean competency score of 29.74 compared with 19.33 for the control group. The ANCOVA result revealed a statistically significant difference between the experimental and control groups, with an F-value of 48.35 and a p-value of less than 0.001, which is below the 0.05 level of significance. Consequently, the third null hypothesis (H_{03}) was rejected. This finding indicates that the aquaponics education intervention had a significant treatment effect on the livelihood competencies of the youths in the experimental group.

Discussion of Findings

The findings in Table 1 indicate that education in flood-resilient crop production positively influences the livelihoods of youths in Bayelsa riverine communities. This implies that training in flood-tolerant crop varieties, short-duration cropping, raised-bed nursery establishment, post-flood soil restoration, and floating cultivation systems can improve youths' ability to sustain agricultural activities under flood conditions. These competencies can reduce production losses, support faster recovery after flooding, increase farm earnings, and sustain food production during periods of excessive flooding. The corresponding hypothesis tested in Table 4 further established that the flood-resilient crop production education intervention had a statistically significant treatment effect on the livelihood competencies of the youths. The higher post-test performance of the experimental group compared with the control group indicates that the observed improvement was associated with participation in the intervention. The ANCOVA result therefore demonstrates that practical instruction in flood-resilient crop production can improve youths' capacity to manage agricultural activities and sustain livelihood opportunities in flood-prone riverine environments. This finding agrees with the empirical study of Adekola et al. (2023), who examined the effects of flooding on the livelihood activities of smallholder crop farmers in Saki West Local Government Area of Oyo State, Nigeria. Their study revealed that flooding caused considerable crop losses, damage to agricultural infrastructure, and threats to household food security, while farmers adopted adaptive measures such as early planting, crop rotation, erosion-control practices, and the use of flood-resistant crop varieties. The consistency between their findings and the present study indicates that strengthening youths' knowledge and practical competencies in flood-adaptive crop production can enhance their ability to manage flood-related agricultural disruptions and sustain their livelihoods. The findings in Table 2 demonstrate that fish farming education exerts a substantial positive impact on the livelihoods of youth across the riverine communities of Bayelsa State. These descriptive insights indicate that acquiring functional expertise in floating cage construction, catfish fingerling propagation, stocking density optimization, post-harvest processing, fish smoking, and aquatic water quality management directly elevates youth aquaculture productivity and revenue margins. Correspondingly, the inferential analysis in Table 5 confirms that fish farming education yields a highly significant effect on youth livelihood parameters. This statistical outcome verifies that the educational intervention drove a measurable, objective improvement in the vocational competencies of the experimental group over the control cohort. Furthermore, the resulting Analysis of Covariance (ANCOVA), which isolated a statistically sound treatment effect, establishes that these performance gains are directly attributable to the specialized training program. This outcome proves that structured aquaculture education can operate as an effective, strategic mechanism for livelihood enhancement in the Niger Delta. This finding is supported by Oyedele et al. (2023), who investigated the impact of training and capacity development on aquaculture output among fish farmers in Odogbolu, Ogun State, Nigeria. Utilizing data from a sample of 121 aquaculturists and executing regression models, those researchers isolated statistically significant relationships linking formal educational exposure to enterprise profitability, feed quality to biomass performance, and fish sizing to commercial marketability. Consequently, this alignment implies that modern vocational initiatives in aquaculture must move beyond basic production mechanics to incorporate holistic, multi-dimensional modules in breeding techniques, water parameter management, strategic stocking, value-added processing, and marketing competencies to guarantee the long-term economic sustainability of youth-led fish enterprises.

The findings in Table 3 indicate that aquaponics education positively influences the livelihood of youths in Bayelsa riverine communities. This implies that knowledge and practical skills in closed-loop soilless production, vertical aquaponic systems, water recirculation, utilisation of fish waste as nutrients, and the operation of solar-powered water pumps can equip youths with alternative livelihood competencies appropriate for flood-prone environments. The result of the corresponding hypothesis in Table 6 further established that aquaponics education has a significant effect on youth livelihood. The significant improvement recorded by the experimental group following the intervention suggests that the observed change was associated with the training received. The ANCOVA result also confirmed a significant treatment effect, as the experimental group recorded a substantially higher post-test performance than the control group. This finding demonstrates that aquaponics education can provide a viable livelihood option for youths in Bayelsa riverine communities. The finding is supported by Amusan and Adeleke (2024), who investigated youth involvement in soilless agriculture in Ogun State, Nigeria. The study involved 122 youths and revealed that participation in soilless agriculture was relatively low, with inadequate information, insufficient finance, and lack of interest identified as major constraints. The researchers also established a significant relationship between educational level and involvement in soilless agriculture and recommended increased publicity and training by extension agents and research institutes to promote youth participation. This indicates that equipping youths with practical competencies in water recirculation, nutrient reuse, integrated fish and vegetable production, and alternative energy systems can assist them in addressing some of the land and water limitations associated with conventional agriculture in flood-prone riverine communities.

Conclusion

The conclusion drawn from this investigation is that climate-smart agricultural education serves as a powerful, transformative driver for youth livelihood advancement in Bayelsa's vulnerable riverine communities. The findings clearly show that transitioning from textbook-oriented lessons to practical, field-based training in flood-resilient agronomy, modern aquaculture, and soil-less aquaponics provides young people with the specialized skills needed to adapt their work to chronic flooding challenges. Armed with flood-resilient crop production education, rural youth can confidently implement adaptive planting cycles and utilize submergence-tolerant seeds to eliminate seasonal harvest failures and secure farm continuity. In the same vein, fish farming education updates the traditional skills of young aquaculturalists by introducing advanced modules in floating cage engineering, processing, and value-added smoking, which directly improves their output and revenue margins. Furthermore, aquaponics education offers an innovative, high-efficiency production model, allowing youth to run integrated fish and vegetable operations in waterlogged zones where traditional farmlands are completely unusable.

This further reinforced the quasi-experimental field results, which proved that all three educational tracks triggered significant, measurable improvements in youth vocational skills. The experimental groups demonstrated a substantial skill gain over their control peers during the post-test field assessments, proving that the capacity shift was directly caused by the educational intervention. Therefore, this study concludes that climate-smart agricultural education must move beyond basic academic curricula and be embraced as a central tool for rural wealth creation. By implementing these practical models, development frameworks can effectively help young people bypass land-use barriers, diversify their household income streams, and build sustainable agribusinesses capable of surviving environmental instability.

Recommendations

The following recommendations are made:

1. The Ministry of Agriculture and Natural Resources of Bayelsa State, in collaboration with agricultural extension agencies, should establish regular community-level training programs for riverine youths. These interventions must focus explicitly on the production of submergence-tolerant crop varieties, early-maturing planting cycles, post-flood soil remediation, and floating agricultural bed installations to systematically insulate local crop output from seasonal flood hazards.
2. The State Government, through interventionist agencies like the Niger Delta Development Commission (NDDC), should provide youths with technical resources and subsidized equipment for floating cage setup. Training modules must expand beyond baseline fish production to emphasize commercial breeding, water quality monitoring, stocking density optimization, and fish processing technologies to boost the commercial margins of youth-led aquaculture hubs.
3. Non-Governmental Organizations (NGOs) and agricultural research institutes should fund solar-powered vertical aquaponics pilot stations across riverine communities. Providing youths with practical skills in closed-loop water recirculation and automated fish-waste nutrient integration will enable continuous, land-independent food and revenue generation during the peak of severe flooding.
4. Tertiary institutions and technical vocational colleges within the South-South region should formally integrate climate-adaptive agribusiness courses into their curriculum streams. This academic alignment will ensure a consistent transfer of updated technological skills from research spaces directly to the agrarian youths facing real-world environmental shocks.
5. Financial institutions and agricultural cooperative societies should design accessible, low-interest micro-credit facilities specifically for youths who have completed vocational training. Securing initial capital ensures that trained youths can seamlessly procure flood-resilient seeds, fingerlings, water testing kits, and renewable energy equipment to transform their conceptual knowledge into viable, long-term commercial setups.

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