

Promoting Climate Adaptation by Upscaling Solar Irrigation
Technology Options for Smallholder Farmers in Ghana through
Innovative Financing Mechanisms, a Conducive Policy
Framework for Technology Regulation and Tailored Training

Modules
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**Draft National Policy Framework for Solar-Powered Irrigation
Systems**



Prepared for:

Climate Technology Centre and Network (CTCN)
c/o United Nations Office at Nairobi (UNON)
P. O. Box 67578
Nairobi, Kenya 00200

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Promoting Climate Adaptation by Upscaling Appropriate Solar Irrigation Technology Options for Smallholder Farmers in Ghana through Innovative Funding Mechanisms, a Conductive Policy Framework for Technology Regulation and Tailored Training Modules

Draft National Policy Framework for Solar-Powered Irrigation Systems

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List of Abbreviation

CSIR	Council for Scientific and Industrial Research
EPA	Environmental Protection Agency
FLI	Farmer-Led Irrigation
GDP	Gross Domestic Product
GIDA	Ghana Irrigation Development Authority
GIRSIL	Ghana Incentive-Based Risk Sharing System for Agricultural Lending
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Development Agency)
GSA	Ghana Standards Authority
IWRM	Integrated Water Resources Management
KNUST	Kwame Nkrumah University of Science and Technology
KUSUM	Kisan Urja Suraksha evam Utthaan Mahabhiyan (India's solar irrigation scheme)
L.I.	Legislative Instrument
MoFA	Ministry of Food and Agriculture
NDC	Nationally Determined Contribution
NIP	National Irrigation Policy
PPP	Public-Private Partnership
PV	Photovoltaic
RE	Renewable Energy

SDGs	Sustainable Development Goals
SNV	Stichting Nederlandse Vrijwilligers (Netherlands Development Organisation)
SPIS	Solar-Powered Irrigation Systems
TA	Technical Assistance
UENR	University of Energy and Natural Resources
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WASH	Water, Sanitation, and Hygiene
WRC	Water Resources Commission

Executive Summary

Ghana's agricultural sector, a cornerstone of the national economy, faces significant challenges; an estimate of 3% of farmlands are currently irrigated, due in part to financial barriers and the high energy costs associated with traditional pumped irrigation systems, hampering agricultural productivity and sustainability. To address these challenges, the adoption of Solar-Powered Irrigation Systems (SPIS) presents a promising solution. SPIS harnesses renewable energy to provide a reliable and cost-effective water supply for farming activities, offering a sustainable alternative to traditional pumped irrigation systems.

This report proposes a comprehensive policy framework aimed at promoting the adoption and scaling of SPIS in Ghana. The framework is designed to increase the adoption of SPIS, reduce associated energy costs related to irrigation, and promote sustainable farming practices by addressing key gaps in policy, fostering stakeholder collaboration, and establishing clear standards for implementation.

Key Findings:

Existing Policy Landscape: While Ghana has made significant progress in developing policies specific to irrigation, these existing policies require further alignment and enhancement. In particular, the current National Irrigation Policy is to be reviewed and it is expected that it should better integrate SPIS and address the specific needs of smallholder farmers. *The report provides key recommendations and strategies that will be crucial in guiding this policy review to ensure a more effective and cohesive approach.*

- **Innovative Financing Mechanisms:** The report identifies three viable business models (Shared Ownership, Operator Ownership, and Community Ownership) that can lower financial barriers for smallholder farmers. Funding should be directed to support these models, ensuring their scalability and success. Demonstration farms will also play a critical role in validating these models and proving their effectiveness in real-world conditions.
- **Policy Framework and Recommendations:** The report outlines strategic recommendations for enhancing the policy environment to support SPIS adoption. These include the review and expansion of the existing National Irrigation Policy, to incorporate

specific provisions for SPIS, addressing regulatory gaps, and promoting innovation through supportive legal and financial frameworks.

- **Capacity Building and Training:** The successful implementation of SPIS depends on targeted training programs that equip farmers, technicians, and local officials with the skills needed to operate and maintain these systems. Additionally, partnerships with academic institutions and research bodies will drive innovation and the development of context-specific SPIS technologies.
- **Strategic Implementation:** The integration of results from ongoing projects, such as Ghana's Nationally Determined Contribution (NDC) Action Plan, into this policy framework is crucial to avoid duplication of efforts and maximize the impact of investments. A coordinated, multi-stakeholder approach involving government agencies, private sector partners, and international organizations is essential for the successful adoption and scaling of SPIS.

Promoting climate adaptation in Ghana through the upscaling of SPIS for smallholder farmers requires a multifaceted approach. By leveraging innovative financing mechanisms, establishing a conducive policy framework, and providing tailored training, Ghana can empower its farmers to adopt advanced technologies, improve their livelihoods, and contribute to the nation's agricultural sustainability. The review and enhancement of the existing National Irrigation Policy, guided by the recommendations in this report, will be pivotal in achieving these goals. The successful implementation of SPIS will enhance agricultural productivity, build resilience against climate change, and position Ghana as a leader in sustainable farming practices in the region.

1. Introduction

It is concerning to note that only 3% of Ghana's farmlands are irrigated¹. This presents a significant challenge to the nation's agricultural sector, which is integral to the economy, providing livelihoods for a large portion of the population and contributing substantially to the national GDP. Furthermore, the few pumped irrigation systems that do exist face high energy costs, which further limits their full benefits. To address these issues, the implementation of innovative and sustainable solutions, such as Solar-Powered Irrigation Systems (SPIS), is essential. SPIS utilizes renewable energy to provide a reliable and cost-effective water supply for agricultural activities.

Ghana's Medium-Term Development Policy Framework (2022-2025), along with their National Irrigation Policy and Ghana's Strategy on Irrigation, demonstrates a commitment to addressing these issues, but there is a need for an enhanced focus on renewable energy utilization.

It is against this background that project with the following title is being executed: *“Promoting Climate Adaptation by Upscaling Appropriate Solar Irrigation Technology Options for Smallholder Farmers in Ghana through Innovative Funding Mechanisms, a Conductive Policy Framework for Technology Regulation and Tailored Training Modules”*. The project is a UN CTCN (Climate Technology Centre and Network) project. CARES Ghana, in association with INTEGRATION energy & environment (the Consultant) were awarded a contract to provide Technical Assistance (TA) for the project.

Output 3 of the project, require the development of National framework on Solar Powered Irrigation technology, to drive the setting of standards and certification that will support the deployment of a local market.

This report proposes a comprehensive policy framework for the adoption and promotion of Solar-Powered Irrigation Systems (SPIS) in Ghana. The framework is designed to enhance agricultural productivity, lower energy costs, and promote sustainable farming practices. In Output 2 of the project, business models for SPIS were developed with active participation from key stakeholders,

¹<https://www.gipc.gov.gh/wp-content/uploads/2023/03/Ghanas-Agriculture-Sector-Report-1.pdf> (The agricultural land area covers approximately 13.6m hectares representing about 57% of the country's total land area, out of which, a total of 6.8m hectares, representing about 50%, is under cultivation and 222,978 hectares is under irrigation.)

including government agencies, private sector entities, and farming communities. These business models form the critical foundation for the policy strategies that were subsequently developed.

The subsequent sections provide a comprehensive overview of existing policies related to SPIS, analyze their impact on SPIS adoption and development in Ghana, and outline detailed strategies for enhancing the policy environment to support SPIS adoption. Finally, we identify short-term and long-term objectives to support the policy review process and implementation.

2. Background

2.1. Context and Historical Background

Solar-Powered Irrigation Systems present a promising solution for addressing the challenges in food production in Ghana. By utilizing abundant solar energy, SPIS can provide a reliable and sustainable water supply for irrigation, reducing dependence on costly traditional energy sources and improving agricultural productivity. Historically, efforts to modernize Ghana's farming practices through irrigation systems have been fragmented and often limited by financial and technical constraints. The introduction of SPIS marks a significant shift towards more integrated and sustainable agricultural practices.

2.2. Current Policy Environment

The policy landscape in Ghana has evolved to support the adoption of renewable energy technologies, including SPIS. The Medium-Term Development Policy Framework, 2022-2025, serves as the overarching policy instrument guiding these efforts. It emphasizes the modernization of agricultural production systems and the development of supportive legal and regulatory frameworks for irrigation facilities.

In addition to this primary policy, the National Irrigation Policy and the Strategy on Irrigation provide specific directives for improving irrigation infrastructure. These policies highlight the need to expand access to irrigation for marginalized groups, such as women and persons with disabilities, and promote the use of renewable energy sources like solar and wind power.

2.3. Stakeholders Involved

The successful implementation of SPIS in Ghana requires the active involvement and collaboration of a diverse group of stakeholders. Key players include Government Agencies, Private Sector Companies, Research Institutions and Universities, NGOs, and Farmer Based Organizations.

While the existing framework for implementing Solar-Powered Irrigation Systems (SPIS) in Ghana has been effective, the current challenges and opportunities demand the involvement of a more diverse group of stakeholders. This expanded collaboration is crucial to ensure that all sustainability-related issues are comprehensively addressed.

A forthcoming section in this document will offer specific recommendations for consideration, aimed at enhancing the collaborative efforts and ensuring that the diverse group of stakeholders is effectively engaged in the implementation of Solar-Powered Irrigation Systems (SPIS) in Ghana

3. Policy and Institutional Review

3.1. Current Energy Policies Affecting Irrigation

Ghana has developed a comprehensive suite of policies addressing irrigation and the utilization of renewable energy in agriculture, reflecting a growing recognition of these areas as pivotal for sustainable development. The primary guiding document is the *Medium-Term Development Policy Framework (2022-2025)*, which outlines broad objectives aimed at modernizing and enhancing agricultural production systems through strategic interventions, including the adoption of advanced irrigation practices.

The Medium-Term Development Framework addresses some of the challenges and strategic responses required to optimize irrigation facilities, including:

- **Inadequate Access to Irrigation Facilities by Women and Persons with Disabilities:** Strategies include extending access to national irrigation development initiatives and mobilizing investments to expand and rehabilitate essential infrastructure such as formal schemes, dams, and dugouts.

- **High Cost of Energy for Irrigation:** This critical issue is tackled through promoting the use of solar and wind energy, expanding irrigated agriculture, and fostering solar-powered Farmer-Led Irrigation (FLI) practices.

The *Energy Policy of 2021* and the Ghana National Energy Transition Plan further bolster these efforts by supporting the productive use of renewable energy in irrigation, crop drying, and processing. These documents outline provisions to enhance access to solar irrigation, ensuring year-round farming that can significantly boost agricultural productivity.

The Renewable Energy Act 2020,1045, amends the earlier Act from 2011 to further foster the development of renewable energy sources in Ghana. This amendment was aimed at creating a more competitive market for renewable energy, which is particularly relevant for sectors like agriculture that can benefit from technologies such as solar-powered irrigation systems. One key provision of the Act, the **Net-Metering Scheme** allows consumers who generate their own electricity from renewable sources to feed surplus power back into the grid, which can make solar irrigation more attractive to Operator owner-ship model(to be discussed later).

Furthermore, The Renewable Energy (RE) Master Plan includes provisions for the use of solar energy for irrigation purposes, aiming to improve agricultural productivity and ensure sustainable water management. The intention is to deploy 46,150 Solar-Powered Irrigation Systems (SPIS)with a total PV capacity of 48.8MW systems across the country by 2030.

The Renewable Energy (RE) Master Plan for Ghana is a strategic document developed as part of the government's commitment to increasing the share of renewable energy in the national energy mix. The plan, established with the support of various international bodies provides a detailed roadmap to achieve substantial renewable energy targets by the year 2030.

In view of the recent policy direction in the energy sector, aimed at promoting more sustainable mechanisms, it has become evident that the existing policies in the water sector are somewhat lagging behind. This misalignment poses significant challenges to the full realization of Ghana's potential for integrating renewable energy technologies, particularly solar power, into its irrigation practices. The disparity is evident in the following policies and regulations:

3.2. Water/Irrigation Policies

3.3. National Irrigation Policy and Strategies, 2011

The National Irrigation Policy (NIP) of Ghana aims to promote and facilitate the development of sustainable irrigation across the country to ensure increased agricultural productivity and food security. The policy seeks to address the challenges of erratic rainfall and the growing need for water management in agriculture. Key aspects of the policy include:

- **Infrastructure Development:** The policy emphasizes the development and maintenance of irrigation infrastructure to support both small-scale and large-scale farming operations.
- **Capacity Building:** Enhancing the technical and managerial capacity of farmers and irrigation scheme managers is a priority to ensure efficient water use and crop management.
- **Private Sector Involvement:** Encouraging private sector investment and participation in irrigation development to leverage resources and expertise.
- **Water Resources Management:** Ensuring sustainable water resource management practices that balance agricultural needs with ecological and other uses.

A study of Ghana's National Irrigation Policy reveals some shortcomings that impact its efficacy, particularly due to the absence of provisions for integrating Renewable Energy to support irrigation and the lack of specific strategies to address the challenges faced by smallholder farmers.

Water Resources Commission Act 522, 1996

The Water Resources Commission Act 522 of 1996 was established in Ghana to provide a comprehensive legal framework for the regulation and management of the country's water resources. The act was designed to ensure the sustainable development of water resources for various uses, including domestic, agricultural, industrial, and environmental purposes. Key provisions of the Act include:

Establishment of the Water Resources Commission: The act establishes the Water Resources Commission (WRC) as the primary body responsible for the management of water resources in Ghana.

Management and Use of Water Resources: It provides guidelines for the sustainable and equitable use of water resources, including the allocation of water rights and permits for water use.

Protection and Conservation: The act emphasizes the protection and conservation of water resources, promoting measures to prevent pollution and to manage water bodies effectively.

Coordination of Development Plans: It mandates the coordination of all development plans within river basins, ensuring that water resource management is integrated into national development planning processes.

Despite its comprehensive scope, the Water Resources Commission Act 522 has faced challenges, particularly in relation to its effectiveness in managing water resources for irrigation. Some of the weaknesses identified in research papers include:

- **Lack of Specific Provisions for Irrigation:** The act does not explicitly address the unique challenges and needs of irrigation water management.²

Water Users Association (WUA) Regulation

The Water Users Association (WUA) Regulation, L.I.2230, established under the Water Resources Commission Act in Ghana, aims to formalize the management of irrigation and drainage systems through structured community involvement. The regulation provides a legal framework for the creation and operation of Water Users Associations, which are community-based organizations responsible for the management of local water resources, particularly in irrigation schemes. These associations are designed to:

Manage Water Resources: WUAs are given the responsibility to manage water resources within a specified area, ensuring efficient and equitable distribution.

Maintenance and Operation: They oversee the maintenance and operation of irrigation infrastructure, handling everything from water delivery systems to drainage and flood control.

Financial Management: WUAs are tasked with collecting fees for water usage and managing these funds to sustain the irrigation systems.

Conflict Resolution: They play a role in resolving conflicts among users over water use.

² Owusu, K., & Waylen, P. (2013). "Trends in spatio-temporal variability in annual rainfall in Ghana (1951-2000).

Promote Sustainable Practices: Encourages the adoption of sustainable agricultural practices among its members.

Despite the intentions behind the establishment of WUAs, research has highlighted some weaknesses in how these regulations function in practice, particularly concerning irrigation management:

- **Limited Technical and Financial Capacity:** Many WUAs struggle with insufficient technical and financial resources to effectively manage irrigation systems. This limitation hampers their ability to maintain infrastructure or expand services.³
- **Governance and Participation Issues:** Research has indicated that there can be significant challenges in governance within WUAs, including issues related to transparency, accountability, and equitable participation. Often, the management of these associations can become dominated by more powerful local interests, which can lead to inequitable water distribution.⁴
- **Policy and Regulatory Framework Gaps:** The lack of detailed guidelines and the broader policy support for integrating modern irrigation technologies, such as solar-powered systems, into their operations is a shortcoming.⁵

National Water Policy⁶

On July 8, 2024, the Minister for Sanitation and Water Resources of Ghana, Hon. Lydia Seyram Alhassan, unveiled the revised National Water Policy (NWP) for 2024 in Accra. One of the provisions of this policy seeks to promote and encourage the use of efficient irrigation techniques and technologies and reduce transmission losses of water in irrigation systems.

It is evident from the preceding analysis that the current water and irrigation policies do not prioritize Solar-Powered Irrigation Systems (SPIS). Despite the growing recognition of the importance of water management and the potential of sustainable irrigation technologies, the

³ Source: Owusu, K., & Waylen, P. (2013). Trends in spatio-temporal variability in annual rainfall in Ghana (1960–2000). *Weather*, 68(4), 115-120.

⁴ Source: Barry, B., Obuobie, E., Andreini, M., Andah, W., & Pluquet, M. (2005). Comprehensive assessment of water management in agriculture comparative study of river basin development and management. IWMI.

⁵ Source: Donkor, E., & Mwangi, W. (2014). Water governance and collective action in the Atankwidi Catchment of the White Volta Basin, Ghana. *International Journal of Water Resources Development*, 30(4), 751-767.

⁶ Source: https://www.ircwash.org/sites/default/files/ghana_national_water_policy_updated_version_2024.pdf

existing policies remain somewhat outdated, lacking the necessary provisions to fully integrate these innovations. By neglecting to include solar-powered irrigation within the water management /irrigation policies, the opportunity to leverage clean energy to improve agricultural productivity and address the challenges faced by smallholder farmers is missed, leaving a significant gap in the country's approach to modernizing its agricultural sector.

3.4. Standards for Solar Systems

Ghana has made considerable progress in developing standards for photovoltaic (PV) systems, solar batteries, and related components. These standards include:

- GS 1341-1:2022: Specifications for Solar Photovoltaic Water Pumping Systems - Part 1: Centrifugal Pumps.
- The Renewable Energy (Standards and Labelling) (Solar Panels) Regulations 2022 (LI 2449).
- The Renewable Energy (Standards and Labelling) (Renewable Energy Batteries) Regulations 2022 (LI 2452).
- Electrical Wiring Regulations, 2011 (L.I. 2008).
- GSA Standards on Cables.
- GS IEC TS 62446-3:2020 - Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance

As confirmed by the Energy Commission (EC) and the Ghana Standards Authority (GSA), these existing standards are sufficient to support the growth of a dynamic industry and market for solar-powered irrigation systems. However, the GSA highlights the need to equip laboratories at the GSA with the necessary testing equipment to ensure the effective enforcement of these standards. The enforcement of these standards will provide quality assurance, promote innovation and adaptation and ensure policy Integration.

Another focus area suggested by stakeholders is to explore the option of developing specific standards for designing irrigation systems for small-holder farms that will optimize the use of solar irrigation technology.

3.5 Review of Institutional Arrangements and Partnerships Supporting SPIS

The successful implementation and scaling of SPIS depend on the active involvement and coordination of various stakeholders. The following section provides an overview of the key institutional arrangements and partnerships that play a critical role in supporting SPIS initiatives across the country.

Governmental Agencies.

Ministry of Food and Agriculture (MoFA): MoFA plays a central role in agricultural policy formulation and implementation. The Ministry coordinates with other agencies and has department dedicated to support mechanized farming.

Ghana Irrigation Development Authority (GIDA): GIDA is responsible for developing and managing irrigation projects in Ghana. GIDA works on the design and execution of irrigation schemes, focusing on both technical aspects and farmer training.

International Partnerships and Funding Agencies

World Bank, African Development Bank and KfW: These international financial institutions provide funding and technical assistance for projects that integrate renewable energy solutions into agriculture. Support includes funding for establishment and expansion of irrigation infrastructure.

Development Partners

The United Nations Development Programme (UNDP), GiZ, SNV, USAID, and other bilateral agencies partner with the Ghanaian government to support projects in agriculture, sustainable energy development, and Water, Sanitation, and Hygiene (WASH) programs. These collaborations focus on improving agricultural productivity, promoting renewable energy sources, and enhancing access to clean water and sanitation facilities.

For example, GIZ has been instrumental in promoting renewable energy applications in agriculture through projects like the Green People's Energy. This initiative aims to promote solar irrigation on selected farms, enhancing agricultural productivity and sustainability.

Private Sector Collaboration

Companies specializing in solar technology and irrigation systems play a crucial role in supplying equipment and expertise.

Public-Private Partnerships (PPPs): PPPs can facilitate the implementation of SPIS by leveraging private sector efficiencies and public sector resources. These partnerships might include setting up demonstration farms that use SPIS, serving as models for scalability and replication across different regions of Ghana.

Example of Effective PPP: A notable example of a successful PPP is the collaboration between the Ghana Irrigation Development Authority (GIDA) and China Geo-Engineering Corporation. This partnership focused on integrating solar power solutions into an existing irrigation site, demonstrating the potential for scaling up renewable energy in agriculture. The project involved the installation of solar panels to power water pumps, significantly reducing the energy costs associated with running the irrigation systems and demonstrating a sustainable model that could be replicated across other sites in Ghana. This initiative not only showcased the benefits of integrating solar energy into irrigation but also highlighted how government agencies can effectively partner with international firms to leverage technological expertise and financial resources for sustainable agricultural development.

4. Policy Recommendations

In response to the evolving needs of Ghana's agricultural sector, there is a planned review of the current National Irrigation Policy. Because of this forthcoming policy review, there will not be a need for a new policy specifically for SPIS, rather the National Irrigation Policy should be reviewed to incorporate the policy recommendations in this report. It is expected that the scope of this review will be broadened to capture sustainability and economic concerns. The revised policy will also require detailed solar irrigation strategies under existing frameworks, ensuring that specific targets, funding allocations, and technical guidelines are well-articulated and aligned with national sustainability goals.

It is essential to recognize that promoting Solar-Powered Irrigation Systems (SPIS) in Ghana requires upcoming irrigation policies to account for the varying scales of farm sizes within the sector. The financial challenges are particularly acute for smallholder farmers, making it imperative that policies and incentives are tailored to address these differences. By ensuring that

support measures are size-specific, SPIS can be more effectively promoted across all farm sizes, enabling broader adoption and maximizing the impact on agricultural productivity.

The new National Water Policy presents a lot of interesting dimensions that are highly relevant to any impending reforms to the irrigation policy. For example, it seeks to align with the Sustainable Development Goals (SDGs) and has incorporated principles of sustainable water management, equitable access, and the promotion of integrated water resources management (IWRM). Additionally, it emphasizes the importance of climate resilience, conservation of water bodies, and the need for stakeholder participation at all levels of water governance, which can significantly inform and enhance the development of a more robust and inclusive irrigation policy

On the 1st of August 27, 2024, a comprehensive workshop was convened with key stakeholders to deliberate on the draft policy recommendations and strategies that had been formulated as part of our ongoing initiative. This workshop served as a crucial platform for open dialogue, where diverse perspectives and insights were shared. The feedback received was invaluable, reflecting the collective expertise and concerns of the participants. As a result of this rich exchange, several initial policy recommendations and strategies were re-evaluated and refined to better align with the needs and expectations of all stakeholders involved. This collaborative approach underscores our commitment to developing well-rounded and effective policies that are both inclusive and sustainable.

The following section of this report will outline the key policy recommendations and strategies derived from the policy analysis and stakeholder feedback

4.1 Key Inputs for Policy Review

Broader Vision and Mission: The revised policy will expand its vision to not only enhance irrigation efficiency but also to harness solar energy as a primary driver for powering irrigation. This dual focus aims to position Ghana as a leader in sustainable and energy-efficient agriculture.

Following a workshop held on 1st August 2024, the participants proposed the following vision statement for consideration in the new irrigation policy as follows:

"To make Ghana's agriculture productive and resilient by increasing irrigated land from 3% to xx% and cutting energy costs by 50% with solar power over the next xx years."

And the mission statement proposed after the discussions was:

“To facilitate the integration of solar-powered irrigation technology in Ghana 's agricultural sector by promoting research, capacity building, and collaboration among stakeholders, thereby driving economic development and environmental stewardship.”

Energy Cost Reduction: A major objective of the new policy should include strategies for reducing the energy costs associated with irrigation. This will involve promoting the use of solar power, which not only lowers operational costs but also reduces the carbon footprint of farming operations.

Key Policy Statements to Consider:

- **Commitment to Renewable Energy Integration:** The policy commits to the integration of renewable energy technologies, particularly solar power, into the national irrigation infrastructure to enhance sustainability and energy efficiency in agriculture.
- **Support for Innovation and Technology Adoption:** The policy encourages the adoption of innovative technologies and practices that improve water and energy efficiency. This includes strong support for ongoing research and development in Solar-Powered Irrigation Systems (SPIS) technologies and practices to ensure continuous improvement and adaptation.
- **Funding and Incentives for Solar Irrigation:** The policy establishes specific funding opportunities and incentives for farmers and businesses adopting solar-powered irrigation systems. This includes state-provided concessionary loans, tax reliefs for SPIS-related equipment, and access to grants or low-interest loans through donor partnerships. The policy recognizes the government’s commitment, as reflected in the GH¢8 billion (\$500 million)⁷ plan, to support farmers affected by climate-related challenges, ensuring these interventions are sustained and expanded.

On 27th August, the Daily Graphic published a news item stating that the government has outlined an estimated GH¢8 billion (\$500 million) plan on various interventions, primarily to support farmers affected by dry weather to ensure food security in the country. This indicates that the government is already addressing the challenges faced by the agricultural sector due to climate change. To ensure the sustainability and long-term impact of these interventions, it is essential to capture

⁷ On 27th August, the Daily Graphic published a news item that The government has outlined an estimated GH¢8 billion (\$500 million) plan on various interventions, mainly to support farmers affected by dry weather to ensure food security in the country.

them within a comprehensive policy framework. By doing so, the policy will not only formalize these efforts but also ensure that funding and support mechanisms are consistently available, thereby encouraging widespread adoption of solar-powered irrigation systems and enhancing the resilience of Ghana's agriculture sector to climate variability.

- **Development of SPIS-Specific Financial Products:** The policy mandates financial institutions to develop specialized products tailored to the unique needs of SPIS projects. These products should reflect the higher upfront costs and long-term savings associated with SPIS, offering flexible terms that align with the lifecycle and return on investment of such projects.
- **Adjustment of Evaluation Metrics:** The policy requires agri-finance institutions to adopt alternative key performance indicators (KPIs) that account for the long-term environmental benefits, water savings, and sustainability impacts of SPIS. These metrics should focus on factors such as water-use efficiency, reduction in fossil fuel dependency, and improved resilience to climate variability.
- **Expansion of Insurance Coverage for SPIS Systems:** The policy includes provisions to amend existing insurance policies to extend coverage for SPIS systems, protecting them against theft and damages. It also advocates for credit insurance to safeguard financial institutions offering loans for SPIS, ensuring coverage in case of farmer default due to market or other external factors.
- **Capacity Building and Training:** The policy emphasizes the importance of building the capacity of local farmers and irrigation managers through targeted training programs focused on the operation and maintenance of SPIS. This approach aims to ensure the sustainability and efficiency of SPIS across the agricultural sector.
- **Regulatory Support and Standards Development:** The policy supports the development and implementation of standards and regulatory guidelines specific to solar irrigation systems. This ensures the safety, efficiency, and compatibility of SPIS technologies across different platforms and components.
- **Stakeholder Engagement and Partnerships:** The policy promotes active participation and collaboration among government entities, private sector companies, academic institutions, and local communities. This collaborative approach is vital for the successful implementation and scaling of SPIS technologies, ensuring widespread adoption and sustainability.

The review and expansion of the irrigation policy to include these elements will not only enhance the effectiveness of irrigation practices across Ghana but also align them with global trends towards sustainable agricultural practices. By incorporating solar irrigation and energy cost reduction into the policy framework, Ghana can achieve significant advancements in agricultural productivity, sustainability, and resilience against climate challenges.

4.2 Strategies for Enhancing the Policy Environment to Support SPIS Adoption in Ghana

In this section, we will outline strategic recommendations designed to enhance the policy environment and facilitate the broader adoption of SPIS. These recommendations aim to address identified gaps in the current policy framework and optimize the integration of renewable energy technologies into Ghana's agricultural landscape. By addressing these strategic needs through a comprehensive, multi-stakeholder approach, we can leverage SPIS to significantly improve agricultural productivity, water management, and sustainable energy use in the sector. The following strategies are crafted to ensure effective implementation, foster robust partnerships, and create a supportive ecosystem for SPIS across various regions of Ghana.

In Phase I of the TA, a financial model was developed to identify the most viable financial metrics, resulting in the identification of three business models: Shared Ownership, Operator Ownership, and Community Ownership. These models are specifically designed to target smallholder farmers and have the potential to significantly reduce the financial barriers that currently prevent them from accessing this technology. To ensure their successful implementation and scalability, funding should be directed towards supporting these models. Furthermore, the development of policy strategies will require a well-aligned application of these models across several key aspects to maximize their effectiveness and sustainability.

1. Involvement of New Government Agencies

Incorporate the Ministry of Energy and the Energy Commission more actively in the planning and execution of SPIS projects. Their involvement can ensure that energy policies are aligned with agricultural development strategies. This can be done through establishment of a dedicated inter-

ministerial committee involving the Ministry of Food and Agriculture, Ministry of Energy, and the Ministry of Environment, Science, Technology, and Innovation and the Ministry of Local Government and Rural Development. This committee should focus on creating cohesive policies that integrate SPIS into both agricultural and renewable energy frameworks.

To further operationalize this arrangement, a task force within the Ministry of Energy should be established that specifically addresses the use of renewable energy in agriculture, ensuring that policies and projects like SPIS are prioritized.

The institutional arrangements and partnerships in Ghana provide a solid foundation for supporting SPIS. However, to bridge the gaps identified, it is essential to broaden the existing multi-stakeholder approach. This approach should involve collaboration among government agencies, private sector companies, research institutions, NGOs, and farmer organizations. By working together, these stakeholders can align their efforts, optimize resource utilization, and maximize the impact of SPIS.

This coordinated strategy would not only promote SPIS but also support market development and create sustainable business models necessary for its widespread adoption. Establishing such a comprehensive and collaborative framework will be crucial for the successful implementation of SPIS in Ghana and could serve as a model for other nations with similar conditions.

2. Strengthening Existing Bodies

Strengthen the role of the Ghana Irrigation Development Authority (GIDA) by providing it with the resources and mandate to specifically focus on renewable energy-powered irrigation systems.

3. Public-Private Partnerships (PPPs)

Encourage PPPs by providing incentives for private firms specializing in renewable energy and irrigation to invest in SPIS projects. Incentives could include tax breaks, expedited permitting processes, and matching grants.

Investors looking to implement the Operator Model should establish a partnership with the GIDA. This collaboration will ensure that the investor's approach aligns with national standards and best practices. GIDA's involvement can facilitate access to market intelligence, existing infrastructure, technical expertise, and a standardized approach to the deployment and management of SPIS projects.

Such an arrangement will ease the involvement of development partners in implementing demonstration projects, providing essential technical support to GIDA in developing the necessary standards for SPIS implementation. By establishing a standardized approach through these collaborative efforts, GIDA can ensure consistency, quality, and sustainability in SPIS projects across the country.

As a first step, GIDA should prepare and submit detailed proposals aimed at attracting funding from development partners. These proposals should focus on creating opportunities for significant private sector participation, ensuring that the expertise and resources of private investors are effectively harnessed to support the standardization process. This strategic move will not only accelerate the development of SPIS standards but also strengthen the overall framework for private sector involvement in Ghana's irrigation sector.

4. Funding and Financial Incentives

Increase funding for SPIS through both governmental and international sources. Implement financial incentives such as subsidies or low-interest loans for farmers adopting SPIS technologies.

The Ghana Incentive-Based Risk Sharing System for Agricultural Lending (GIRSIL) can play a pivotal role in addressing the financial challenges associated with the adoption of Solar-Powered Irrigation Systems (SPIS). Introducing GIRSIL within the policy framework as a key financial support mechanism offers a strategic approach to mitigate the high initial costs and perceived risks by financiers in investing in SPIS technologies.

Further work is needed to establish demonstration farms where these models can be tested in real-world conditions. These demonstration farms will play a crucial role in validating the underlying assumptions of each model, refining their effectiveness, and proving their viability as a key approach to overcoming the challenges faced by smallholder farmers. By doing so, these models can be firmly established as sustainable solutions that empower smallholder farmers to adopt advanced technologies and improve their livelihoods.

5. Capacity Building and Training

Invest in extensive training programs for farmers, technicians, and local government officials. Focus on the maintenance and operation of SPIS, as well as the management of irrigation schemes using renewable energy.

As part of ongoing efforts under this Technical Assistance (TA), training modules will be developed in a subsequent phase to support the implementation of the business cases that were created during the previous phase of this assignment. These training sessions will build on the existing programs offered by the Sustainable Energy Services Center at UENR, where a demonstration farm, supported by SPIS, has been set up as a practical training site. Additionally, insights from SPIS projects implemented by GIZ, which also included training components, will be invaluable in shaping further support initiatives.

6. Research and Development

Promote R&D in SPIS technologies through partnerships with academic institutions and international research bodies. Focus on developing more efficient solar-powered pumps and drip irrigation systems suited to Ghana's agricultural conditions.

Notable examples of institutions that will be relevant in this space include the CSIR, Universities, and the Sustainable Centers based at University of Energy and Natural Resources (UENR), KNUST and Accra Technical Univeristy

7. Community Engagement and Awareness Campaigns

Conduct widespread community engagement and awareness campaigns to educate farmers and local communities about the benefits and operation of SPIS. Utilize local languages and culturally relevant communication methods.

The successful adoption and implementation of Solar-Powered Irrigation Systems (SPIS) in Ghana hinges not only on the availability of financial resources and technical expertise but also on the awareness and responsiveness of key stakeholders. To this end, there is a critical need to enhance awareness and capacity on two crucial fronts: Extension Officers and Agri-Finance Institutes.

Extension Officers

Extension officers across the country play a pivotal role in the dissemination of agricultural technologies and practices. However, to effectively support the roll-out of SPIS, it is essential that these officers:

- **Develop Specialized Knowledge:** Extension officers must be equipped with the knowledge and skills to understand SPIS technology, its benefits, and the unique challenges it presents. This includes training on the technical aspects of SPIS, such as system design, maintenance, and the environmental advantages it offers over traditional irrigation methods.
- **Provide Tailored Support:** Extension officers should be prepared to offer tailored advice and support to farmers interested in SPIS. This includes guidance on selecting appropriate systems, understanding the financial implications, and navigating any regulatory requirements. By building this capacity, agricultural offices can become a trusted resource for farmers considering the switch to SPIS.
- **Actively Promote SPIS:** These officers should also take a proactive role in promoting SPIS to farmers, particularly in regions prone to water scarcity or where traditional irrigation methods are less effective. This can be achieved through workshops, demonstration farms, and collaboration with local SPIS providers to showcase the benefits of these systems.

Agri-Finance Institutions

Agri-finance institutions are key enablers of SPIS adoption, but their current approach to evaluating and financing agricultural projects may not fully accommodate the unique characteristics of SPIS. Therefore, it is essential to **Raise Awareness Among Financial Stakeholders:** There is a need for targeted awareness programs aimed at financial institutions to help them understand the distinct value proposition of SPIS. These programs could involve workshops, seminars, or partnerships with SPIS experts who can provide insights into the technology's long-term financial and environmental benefits.

8. Land Tenure systems

The land tenure system has been identified as a significant challenge, particularly concerning the use of land by cooperatives, associations, or groups. The primary issues revolve around land ownership and the long-term use of land, especially after investments have been made to install irrigation infrastructure. This uncertainty has led to reluctance among smallholder farmers to invest heavily in the land, fearing that they may be dispossessed once the land becomes more valuable.

To address this concern, the new National Irrigation Policy should include provisions that work in collaboration with the Ministry of Local Government and Rural Development (MLGRD). The policy should aim to designate and secure land in various districts specifically for the purposes of Solar-Powered Irrigation Systems (SPIS). This approach will help intensify farming activities in different communities and provide farmers with the security they need to invest in their land confidently.

5. Regulatory and Legal Clarity for Innovative Business Models in the SPIS Sector

As the adoption of Solar-Powered Irrigation Systems (SPIS) gains momentum in Ghana, innovative and unconventional business models are emerging to address the diverse needs of communities and operators. These models, including community ownership, shared ownership, and operator ownership configurations, offer promising pathways for expanding access to sustainable irrigation solutions. However, the successful implementation and scalability of these models are heavily dependent on regulatory and legal clarity.

5.1. Clarification of Ownership Structures

- The lack of clear guidelines on the possible ownership structures within the SPIS sector presents a significant barrier to investment. For example, India has implemented various guidelines and policies that support different ownership models for solar-powered irrigation systems (SPIS). The government's KUSUM scheme is particularly notable - farmers can receive a subsidy for installing their own SPIS.: Regulatory frameworks need to be updated to explicitly recognize and support various ownership models.

5.2. Legality of New Tariff Collection Mechanisms

Innovative tariff collection mechanisms are often integral to the financial viability of new SPIS business models. However, the absence of legal recognition for these upcoming mechanisms can pose a significant risk. For instance, community-based tariff collection systems or pay-as-you-go models may not fit neatly within existing regulatory frameworks designed for traditional utility services. To encourage investment, there must be:

- **Legal Endorsement of Tariff Models:** Explicit legal provisions that recognize and legitimize new tariff methodologies tailored to SPIS configurations. This includes guidelines on setting tariffs, collection processes, and consumer protections.
- **Flexible Regulatory Approaches:** The introduction of adaptive regulatory frameworks that can accommodate the diverse nature of tariff mechanisms in the SPIS sector, ensuring that these models are both legally compliant and economically viable.

5.3. Liability and Risk Management

The legal landscape surrounding liability and risk management in the SPIS sector needs to be clearly defined. Investors and operators are often hesitant to engage in new business models due to uncertainties regarding:

- **Liability Issues:** Clear regulations are needed to define the liability of different stakeholders in the event of system failures, accidents, or disputes. This includes delineating the responsibilities of system owners, operators, and users, and establishing protocols for resolving conflicts.
- **Risk Allocation:** Legal frameworks should address how risks associated with SPIS investments—such as financial, operational, and environmental risks—are allocated among stakeholders. This clarity is essential for investors to assess their risk exposure and for operators to plan for contingencies.

5.4. 4. Harmonization with Existing Regulatory Systems

One of the major hurdles for new businesses in the SPIS sector is the risk of falling outside existing regulatory systems, which can lead to legal complications and financial losses. To mitigate this risk, there needs to be:

- **Integration with Current Regulations:** Efforts should be made to harmonize new SPIS-specific regulations with existing agricultural, environmental, and energy laws. This ensures that innovative SPIS models do not face legal obstacles due to conflicts with older regulations.
- **Regulatory Support for Innovation:** Policymakers should consider creating a regulatory sandbox or pilot program that allows new SPIS business models to operate within a controlled environment. This would enable the testing and refinement of these models before they are fully integrated into the broader regulatory framework.

6. Implementation Strategies (this section will be expanded)

Work is currently underway on the development of an investment plan as part of the NDC Action Plan project. Significant progress has been made in laying a strong foundation for this investment, providing a solid starting point for future efforts. To maximize the effectiveness of this initiative and ensure efficient use of resources, it is essential to integrate the results from this ongoing work with this policy framework. This integrated approach will help achieve the best possible outcomes while avoiding duplication of efforts.

7. Conclusion

In the pursuit of enhancing agricultural productivity and sustainability in Ghana, the promotion of Solar-Powered Irrigation Systems (SPIS) presents a viable and impactful solution. Smallholder farmers, who constitute the majority of the agricultural workforce, face significant challenges, particularly in accessing reliable irrigation and managing the high costs associated with traditional energy sources. By upscaling SPIS through innovative financing mechanisms, establishing a conducive policy framework, and providing tailored training, Ghana can make substantial progress in climate adaptation and agricultural resilience.

Integrating Innovative Financing Mechanisms

The development and implementation of innovative financing models are crucial for overcoming the financial barriers that prevent smallholder farmers from adopting SPIS. The identification of

Shared Ownership, Operator Ownership, and Community Ownership models as viable business cases is a significant step forward. These models are designed to lower the entry barriers for smallholder farmers by spreading the financial burden, thereby making SPIS more accessible. It is essential that funding is directed to support these models, ensuring their successful implementation and scalability. Furthermore, the establishment of demonstration farms will be pivotal in testing and refining these models, validating their effectiveness, and proving their viability as sustainable solutions.

Establishing a Conducive Policy Framework

A robust and integrated policy framework is vital for the widespread adoption of SPIS in Ghana. The alignment of policies related to renewable energy, irrigation, and agricultural development is necessary to create an environment that supports the integration of solar technology into farming practices. The review and enhancement of existing policy, including the National Irrigation Policy should focus on specific provisions for SPIS, addressing gaps in regulation, and providing clear guidelines for implementation. By doing so, Ghana can foster a policy environment that encourages the adoption of SPIS, promotes innovation, and supports the integration of sustainable energy solutions into the agricultural sector.

Tailored Training and Capacity Building

Capacity building through targeted training programs is essential to ensure the successful adoption and operation of SPIS. Training modules tailored to the needs of smallholder farmers, technicians, and local government officials will equip them with the necessary skills to operate and maintain these systems effectively. Additionally, promoting research and development (R&D) in SPIS technologies, in partnership with academic institutions and research bodies, will drive innovation and the development of more efficient, context-specific solutions.

Strategic Implementation and Integration

The implementation strategies outlined in this report emphasize the need for a coordinated and multi-stakeholder approach. The integration of results from ongoing projects, such as the NDC Action Plan, into this policy framework is essential to avoid duplication of efforts and to maximize the impact of investments. By fostering collaboration between government agencies, private sector partners, and international organizations, Ghana can build a cohesive strategy that not only

promotes SPIS adoption but also contributes to the overall goals of climate adaptation and sustainable agricultural development.

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