Finance curriculum for SPIS

Student Manual – a practical guide to the financial aspects of solar-powered irrigation systems

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Contact:
Ing. Prof. Eric Antwi Ofosu (University of Energy & Natural Resources, UENR): info@uenr.edu.gh
Dr. Sylvester Ayambila (University of Development Studies, UDS): info@uds.edu.gh
Ing. Rev. Dr. Seth Theodore Kwasi Dzokoto (Ho Technical University, HTU): info@htu.edu.gh

Authors: Judith de Bruijne (Practica Foundation): judith.debruijne@practica.org
Eric Awine Ayamga (MDF West Africa): eay@mdf.nl

With contributions from:
The Brew-Hammond Energy Centre
GIZ SPIS toolbox
Stephen Yaw Ntiamoah, CA, CIPFA (UENR)
Emmanuel Asare, CA (UENR)
Patrick Kwame Basuah, CA (UENR)
Richard Twum Barimah, CA, CIPFA (Affil.) (UENR)
Muftawu Iddrisu (UDS)
Dr Sylvester Ayambila (UDS)
Frank Awutey (UDS)
Cosmas Alhassan Lukeman (UDS)
Issifu Adam (Ecobank, Tamale)
Fuseini Nashiru (ADB, Tamale)
Selorm Akorli (HTU)
Joan Dagadu (HTU)
Moses Kpordzo (HTU)
Patience Dzantor Ayitey (HTU)

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PRACTICA Foundation promotes affordable technologies for water supply, irrigation and renewable energy in low- and middle-income countries, and is based in the Netherlands. MDF West Africa provides management training, advisory and evaluation services in the development sector from its head office in Accra, Ghana.

Photo 1: First batch of trained finance professionals at UDS, Tamale

CONTENTS

PREFACE

This financial manual is a practical guide for financial related aspects of small-scale solar irrigation. It provides a theoretical base on the most relevant concepts and space to practice these concepts with help of calculations and case studies. It aims to be a practical guide for:

- **Credit officers** that wish to gain insights how to assess a loan application for a solar irrigation system;
- **Project development professionals from finance institutions** that like to obtain knowledge on the associated risks and finance mechanisms for solar irrigation systems;
- **Finance trainers** that want a short guide that can be used during training as reference material for students.

Learning outcomes

After completing this module, trainees will be able to:

1. Demonstrate basic understanding of what solar irrigation is, what type of SPIS systems exist and what their associated technical risks are.
2. Apply a comprehensive risk framework for finance decisions on SPIS projects.
3. Apply basic financial tools for analysing finance or investment decisions on SPIS projects.
4. Demonstrate understanding of financing delivery mechanisms for SPIS projects.
5. Demonstrate understanding of SPIS credit risks and gendered aspect of it.
6. Apply the 5Cs of credit risk appraisal and bankability metrics for pre-screening respective SPIS clients

Reading guide

There are four chapters in this manual. Chapter one is an introduction and deals with the basics of SPIS and why it is important for the financial sector to understand the technical aspects and risks of SPIS. Chapter two deals with all types of risks associated with SPIS Projects. Chapter three presents tools for financial analysis and finance delivery mechanisms of SPIS projects. Chapter four is focused on the 5Cs of Credit Risks appraisal in the context of SPIS Projects as well as the Scope Insight assessment tool for pre-screening SPIS clients.

Further reading

For those who wish more in-depth information on solar irrigation in general we suggest using the online toolbox on Solar Powered Irrigation Systems (SPIS) developed by GIZ.
This can be found on:
https://energypedia.info/wiki/Toolbox_on_SPIS

CHAPTER 1 | THE BASICS OF SPIS

1.1 Introduction

Financial institutions play a key role in promoting access to modern energy services for productive use in emerging and developing economies. For SPIS, access to sustainable energy services can translate into increased yield and income for male and female farmers[1].

In Ghana, the financial sector has been financing energy projects in the same manner as they do for any other investment. The same interest rates and loan requirements are applied for energy projects, however, financial institutions providing funding to SPIS projects may need to restructure their approach. Energy lending for SPIS needs to consider a very different set of factors and approaches, such as the technical risks associated with SPIS design, landownership, environmental issues, longer payback times than fossil fuel alternatives. This needs to be translated in the ability of credit officers to design a tailored-made financial products and facilities for SPIS lending.

This financial training manual starts with an understanding of what SPIS are, how they look like and what technical components have certain financial risks.

1.2 Learning Objectives

After the completion of this chapter, participants should be able:

- To explain what SPIS are and how they differ from other irrigation alternatives
- To explain and draw the most important components of an SPIS
- To explain a number of specific technical and design-related risks of SPIS

Photo 2 A solar-powered irrigation demo site at UENR, Sunyani

[1] With every reference to farmers in this manual, both male and female farmers are meant.

1.3 What are solar-powered irrigation systems?

Solar irrigation uses solar energy from the sun to pump water from a source to bring it to the plants (to irrigate). The pump is powered by solar panels, has conveyance lines to bring water to an agricultural plot and application tubes, drips or sprayers to bring water to the plants. The total set-up is called a solar-powered irrigation system (SPIS).

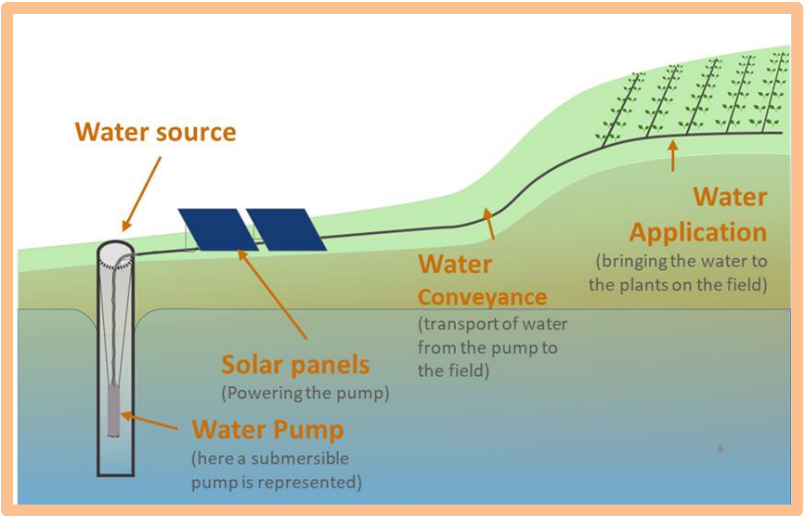

Figure 1: Components of a solar powered irrigation system

1.4 How do SPIS differ from manual or fuel-powered irrigation?

Solar pumps are an alternative to manual pumps (like treadle pumps or rope pumps) and fuel pumps for farmers. But there are differences. The most important ones to consider from a technical perspective are:

- Energy from the sun is free! So, running costs are much lower than for fuel pumps. However, solar pumps are often more expensive to buy.
- Submersible solar pumps allow access to water deeper than 7-8m, therefore they can be used in conditions where it is not possible to use manual or normal fuel pumps.
- Solar pumps can be more complex in their maintenance than manual or fuel pumps, due to the fact that they are relatively new on the market. It is quite common that spare parts of solar pumps are more difficult to source. Expertise from an electrician/ solar technician is required for more complex repairs.
- Solar pumps provide a relatively low flow over the course of the day. This flow varies depending on the intensity of the sun. The more sun the higher the flow. In comparison, fuel powered pumps provide a high & stable flow during a short amount of time.

Most important, thus to remember from a financial perspective is that solar pumps require a comparatively high initial capital investment and generally less frequent but more complex maintenance requirements. In case of credit provision, this means longer repayment periods or/and significantly higher repayment rates. For one single borrower this type of repayment scheme can be challenging. In a cooperative model with several users, repayment schedules could be shorter and more flexible.

1.5 What type of SPIS exists?

Commonly, SPIS in Africa are stand-alone systems, meaning that the energy generated is directly used to pump water, and not taken from an electricity grid.

Sizes of SPIS vary. Stand-alone systems are often small-scale or medium-sized systems. To indicate the size of an SPIS the following parameters are often used:

1) Photo Voltaic (PV) capacity of the system in kilo Watt (kW);
2) Number of acres or hectares being irrigated by the system.

Photo 3: A small PV stand-alone system for less than 2 ha

Systems with a capacity up to 4 kW and irrigates less than 2 ha are considered small-scale. Those that have a capacity up to 40 kW and irrigates between 2 – 10 ha are considered medium-sized. Large scale systems irrigate more than 10 ha.

Photo 4: On grid large-sized PV-systems for large commercial farms (and other electricity supply)

1.6 What are the main components of SPIS?

Depending on the type of SPIS installation, the main components of a stand-alone system are:

1. **The water source**, either surface or groundwater
2. Solar Photo Voltaic **(PV) array/ panels**
3. **Pump**
4. **Water piping/transport system**
5. **Application system**, like conveyance lines, tubes, drips, sprayers and fittings
6. In some cases, **batteries or water reservoir tanks** are used for either electrical energy storage or hydraulic energy storage, respectively
7. **Control and protective devices**, like solar inverters; charge controllers for batteries; float, sun or pressure switches; water sensors and electrical safety devices.

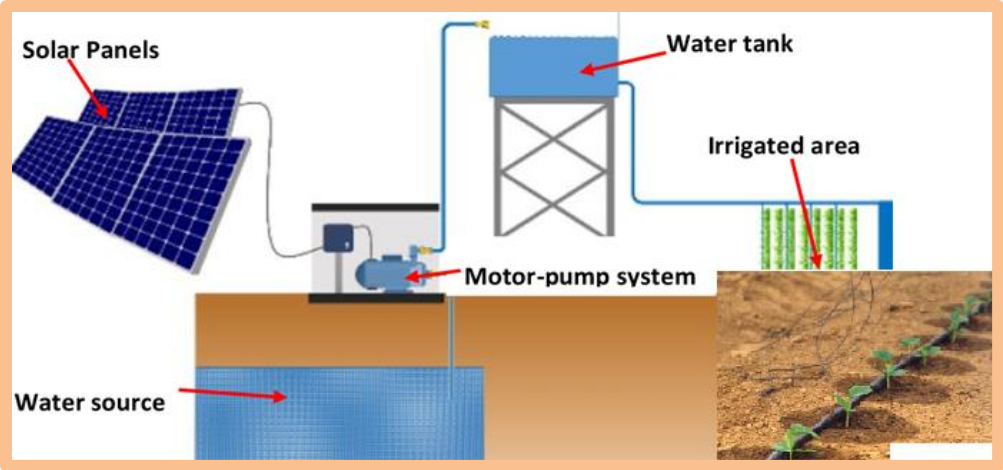

Figure 2: Components of a solar irrigation system, including a water tank

1.7 Which SPIS components matter when considering investment?

When considering any investment in SPIS it essential to consider different types of risks, which will be extensively discussed in the next chapter. As a starter, its important to careful select SPIS components to mitigate technical risks. Financial institutions thus especially **need to check the chosen design set-up** by the project developer or farmer (association) on its technical feasibility.

The most important elements that should be critically checked are:

1. **Water source:** Irrigation water can be pumped from surface water (lake, pond, river) or from groundwater (open well, tubewell). The availability of water determines to a great extent the financial viability of an SPIS: a common design failure is that the (safe) yield of a water source is lower than the design capacity of the SPIS. This will result in a low output.

How do I test the safe yield of a water source?

In case surface water is used, the source should be able to supply enough water especially in the peak irrigation season (dry season). This needs to be verified before designing the SPIS, for example questioning community members, particulary those who are fetching water, on the availability of water through the year. When using an existing groundwater source, the amount of water that can be safely pumped need to be determined by conducting a yield test.

The yield test will show the static groundwater level (in meters or feet) - the depth of the groundwater from the surface when no water is extracted from the well. More important is the dynamic groundwater level at a given safe pumping rate (liters per second or m3 per hour). This is the depth where the groundwater level stabilizes when pumping water from the well.

2. **Cultivation objective, water requirements and SPIS investment**: the financial viability of an SPIS is not only determined by the potential (safe) yield of a water source. It is also determined by its demand and market potential. How much water do the crops actually require and what will be the returns? The water source and pump selected might match well with a low-water demanding, stable crop (like millet or sorghum), but the market value might be low. This implies that it will take many seasons before the farmer sees any return on investment. The cultivation of cash crops, like vegetables, could thus be considered. They might demand more water and therefore perhaps a more expensive SPIS set-up, but if their margins are high, a good return on investment could be secured. In other cases food security might be more important than market returns. One needs to consider that the crop preferences of women and men differ. Enabling enough nutritrious and diverse meals for a family might be prefered by a woman over cash crop cultivation for the market. In the end, there should be a good balance between the cultivation objective, the water requirements and the investment required in the SPIS.

3. **Total water requirement**: the water source might provide enough (safe) yield for irrigating the selected, high-margin crop(s), but what is the intended use of the solar pump by the project developer or farmer (association)? Another risk for the financial sustainability of an SPIS is that other water uses are ignored in the planning phase and more water will be withdrawn once installed. Next to irrigation, pumped water could also be used for domestic purposes, watering animals or fish farming. Often the water preferences of women are overlooked: it is not uncommon that men highlight the need for irrigation while women prefer a system that considers domestic water needs too. Seasonal fluctuations could also be overlooked. In the dry season, when surface water resources are dry, the farmer might decide to pump more groundwater for its family, domestic uses and animals.
   This might result in less water left for the crops and poor quality yields. In the selection of the water source and

Photo 5: Other water needs next to irrigation are often overlooked

designing the SPIS, all water uses through the year should thus be considered. The SPIS should be designed to deliver the peak water requirement, and the productive uses of the SPIS should result in enough returns on investment.

4. **Size of the pump**: a common type of design failure is the selection of a pump that provides under- or overcapacity compared to the field size and type of crop to be irrigated. In case the pump is over- or under-dimensioned, too little or too much irrigation will result in less yields, thus less income, with the chance that an SPIS loan cannot be paid back. Even if good yields are obtained by installing a large pump, unnecessary costs can be made when the pump is not used to its full capacity. Since larger capacity solar pumps have higher investment costs.

Photo 6: Studying the solar irrigation pump is vital

Over-dimensioning the design of the SPIS can also result in taking more groundwater (or surface water) than is justifiable. It can have inversible environmental effects and might result in legal penalties from environmental authorities towards SPIS owners or investors. It is thus vital that the yield test is first checked, before an SPIS is being designed.

5. **Solar array size and quality**: another common design failure is that a set of solar panels has been selected which does not correspond well with the capacity of the pump. Again this can result in a situation in which insufficient water is pumped to guarantee the crop water requirements. The yields and its market value will be disappointing and there is chance an SPIS loan cannot be paid back. Installing too much solar panels or installing them at wrong location/direction (with too little sunlight catch) can also be a waste of money.

   Finally, the market of solar panels is growing. The price and quality of products differ strongly. Selecting the right balance between longelivity, warranty options and price for a solar panel is vital.

***Note**: Of course, also for other SPIS components careful quality selection is required, especially for pumps and irrigation kits.*

6. **Choice for buffering energy with a battery or water**: One of the downsides of SPIS is that when there is no or little sunlight they do not operate. A common way of solving this problem is buffering the generated energy at peak sunlight moments and use this energy when there is no or little sunlight. The most logical option might seem a battery to do so, since that is common for many PV systems. However, in the case of irrigation it is also possible to store the water which pumped at peak sunlight hours. Storing the water in a reservoir is often much cheaper option in terms of life cycle costs, since reservoirs have a longer life time and are more easy to repair than batteries. Other advantages for a farmer is that reservoirs can be used to mix soluble fertilizers and when a reservoir is placed on an elevated spot, it can provide pressure for a gravity-flow or drip irrigation system. The pressure will garantuee the water reaches the corners of the field and irrigates all crops efficiently. In addition to the advantages, water storage should be an integral part of appraisal with farmers such that water storage also benefits women and facilitate domestic use, especially if the water source or storage is close to homestead.

Photo 7: A water reservoir tank on an elevated platform

Photo 8: Control devices of a solar-powered irrigation system in protective box that can be locked

7. **Safety aspects are overlooked**: SPIS components are pricy, especially solar panels can be sensitive to theft or vandalism. Have measures to safeguard the installation been incorporated, for examples fencing and locking it, or ensure it is taken out of the field after use and kept secured in a barn. Furthermore, they are sensitive to electrical safety risks, like voltage spikes, connecting strings getting loose or weather related damages. Have electrical circuit breakers and fuses been considered in the design?

1.8 PRACTICAL WORK

Collect a number of pictures of SPIS you can find on the internet or any other resource. Even better, try to visit a SPIS in real life.

1. Analyse the components they are made of. Can you list them?
2. Do you see any potential technical risks of the set up? If yes, which ones?
3. What type of critical (technical) questions would you formulate if a project investor or group of farmers would approach you for a loan request?

CHAPTER 2 | RISK ANALYSIS FOR SPIS

2.1 Introduction

The previous chapter already started to discuss associated risks of SPIS design and its technical components. For financial institutions, it is vital to consider these risks while making investments, since it will increase the likeliness of a successful project and getting interest as a return. It enables financial institutions to pro-actively anticipate losses from undesirable outcomes.

Since risks will be unavoidable, it is essential that financial institutions identify manners to mitigate or transfer risks in such a way they become acceptable. This enables them to plan and take necessary measures of risk mitigation, rather than reacting to losses when they have already occurred. This chapter helps to understand which risks SPIS have and what type of risk mitigation measures could be considered.

***Note**: Many risk categories for finance institutions will be discussed in this chapter. For the risks directly relating to SPIS clients and their socio-cultural conditions, it is important to take a gendered approach. This implies analysing the obstacles of both men and women to access finance and looking at positive ways of mitigating this risk, making it attractive for finance institutions to invest. Since the majority of farmers in Ghana are women, it would be loss to not consider them in any investment portfolio.*

2.2 Learning Objectives

At the end of this chapter, participants should be able to achieve the following objectives:

- Demonstrate how to assess various general risks associated to SPIS projects.
- Demonstrate how to define risk mitigation measures associated to SPIS projects.
- Demonstrate how to link a financial value to risks, so that a financial institution can compensate for putting risk mitigation measures in place.
- List potential opportunities of SPIS projects.
- Explain how to advise the credit department of a financial Institution on their risk's mitigation strategy.

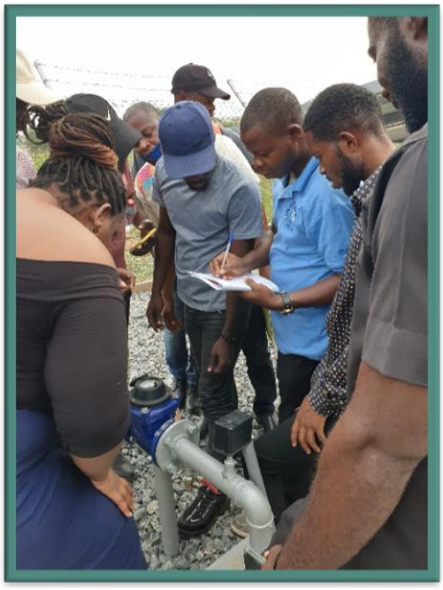

Photo 9: Risk analysis of SPIS should be a joint effort

2.3 Some basic risk definitions

Risks in its literal sense, is explained as the possibility of loss or injury. It is defined as something that creates or suggests a hazard. In the context of this course, risks are explained as the likelihood of an investment into an SPIS going bad.

The following are terminologies used in risk management:

- **Risk**: The possibility of an undesirable outcome or the absence of a desired outcome disrupting cash-flows expected from the SPIS project.
- **Risk Event**: The undesirable outcome.
- **Risk Driver**: The causal factor that results in the risk
- **Risk Indicator**: The relevant measure, which when measured, quantifies the level of the risk.
- **Risk Owner**: The person responsible for managing a particular risk in a financial institution
- **Exposure**: A condition or set of circumstances in which a risk event could result in loss.
- **Frequency**: The probability or likelihood of the risk event occurring or number of times a risk event is likely to result in a loss.
- **Severity or Impact**: The degree of damage that may result from an exposure.
- **Risk Assessment**: Analysing the Impact X Probability of a Risk Event, and scoring the risks with numbers and categories them in Low, Medium, High and Extreme risks.
- **Risk Management**: The activity of proactively identifying and controlling undesired project outcomes.
- **Risk Management Framework**: A guide for financial institution managers that helps them design an integrated and comprehensive risk management system. This enables them to focus on the most important risks in an effective and efficient manner.

2.4 Comprehensive risk management framework

A comprehensive risk management framework considers all types of risks. In the previous chapter, **design related risks** of SPIS were already highlighted, but there are many more risks relevant to SPIS projects. SPIS projects have a number of risks which are quite common for every (technological) project (see Table 1).

Establishing a comprehensive risk management control structure in a financial institution is a necessary pre-requisite to effectively managing risks related to an SPIS and offers the following benefits:

- **It provides an early warning system for potential problems** before they become larger and take a big toll on the organization's time and resources.
- **Enables the financial institution to use capital more efficiently** by allocating resources to those areas that present acceptable risk levels and returns.
- **Enables it to be more successful in developing an portfolio** by taking into account all the areas in which it may be exposed and managing the inherent risks.
- **Concentrate on viable projects as against faulty ones.**

Table 1: Relevant risk types or categories

1. Design risk
2. Completion risk
3. Technological risk
4. Supply risk
5. Economic risk
6. Foreign exchange risk
7. Credit risk
8. Environmental risk
9. Force majeure risk
10. Political risk
11.Socio-Cultural risk

It is therefore expected that financial institutions that are pursuing SPIS financing will put in place a risk management framework as a way of risk mitigation.

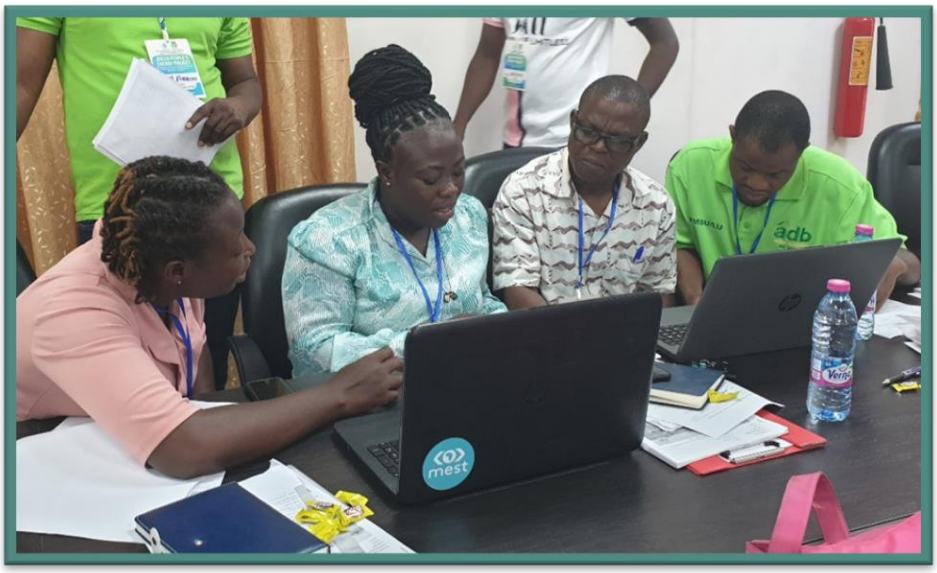

Photo 10: Discussing the risks of an SPIS project in a gender balanced and diverse team of expertise is vital

How a comprehensive risk management framework for an SPIS project looks like is demonstrated below.

***Note**: The risk ranking is a general indication for SPIS project: the actual risk ranking is always context specific.*

	1. **Design risk**	2. Completion risk	3. Technology risk
Risk description	The risk that the technical set-up of the SPIS does not generate the best potential revenues, due to poor analysis of market potential and selection of target crop(s), lack of understanding of weather conditions and water requirements, and/or improper selection water source, pump, solar panels, safety equipment and/or other components of the SPIS.	The risk that an SPIS project started might not be completed despite the lender having made the funding available	This is the risk that the SPIS equipment financed is of poor quality and or does not last as long as expected. The equipment may also not perform as expected or have a shorter shelf life/lifespan.
Risk driver	Poor technical assistance	Project costs higher than originally expected Projects are long-term and take long to be operational	Poor technical assistance; Poor product (lacking performance guarantees)
Risk indicator	Poor revenues / incomplete project	Incomplete project	Product failure
Risk owner	In charge of credit in the financial institution	In charge of credit in the financial institution	In charge of credit in financial institution
Impact	Loss of earnings High portfolio at risk (PAR)	Loss of earnings High PAR	Loss of earnings High PAR Loss of image (reputation risk)
Mitigation	The financial institution should do proper screening of the proposed SPIS set-up and its business case in terms of market potential versus selection of crop(s), water source and SPIS equipment.	The financial institution should consider transferring this risk to a third party, which can manage the risk. This can be in the form of insurance or a guarantee.	The financial institution should consider partnering with credible energy equipment suppliers whose products are certified by the relevant authorities and work with standard components that have easy substitution. They should also work with certified service providers, for instance, qualified solar technicians.
Ranking	High	Low / Medium	Medium / High

	4. Supply risk	5. Economic risk	6. Foreign exchange risk	7. Credit risk
Risk description	This is the risk that the raw materials or parts needed for repairs or to implement a project are not readily available when needed.	This is the risk that once the project has been completed or installed, demand for the energy/SPIS intervention drops to levels inadequate to sustain the project, which may not pay off the costs related to setting up the energy/SPIS solution	This is the risk an institution is exposed to when it borrows money in a different currency than the local currency. It is thus exposed to currency fluctuations.	A credit risk is the risk that a borrower may default on the repayment of a loan facility.
Risk driver	Failure to conduct due diligence on the reliability of the suppliers.	Failure of the financial institution to conduct a good feasibility study on the demand of the solution	Loss of value by the local currency	loan costs higher than originally expected cash flows may take a long-term to generate to make repayments Seasonality of the crops and the effects of post-harvest loses on farmer's revenue
Risk indicator	Incomplete project	Failure or low-uptake of the energy/irrigation solution	Higher than expected loan repayment amounts	Incomplete project
Risk owner	In charge of credit in financial institution	In charge of credit in financial institution	Management of financial institution	In charge of credit in the financial institution
Impact	Loss of earnings High PAR	Loss of earnings High PAR	Loss of earnings Erosion of capital Liquidity problems	Loss of interest income and principal amounts Increase interest expenses without corresponding income High PAR
Mitigation	The financial institution should first conduct a thorough due diligence so as to ensure the availability of all the required parts and resources. It should engage expert advice from qualified energy professionals.	The financial institution should ensure that it conducts a proper feasibility study and thorough due diligence. Also, it can consider transferring the risk to a third party in the form of full or partial guarantees.	The institution may consider hedging the loan so as to shield itself from the losses. The management needs to properly analyse loan terms and conditions before borrowing funds for SPIS investments.	The institution can control this risk by conducting proper assessment of loan clients and envisaged output markets; segmenting the loan clients into the categories and needs group they belong and conducting proper due diligence for these loan clients.
Ranking	Medium / High	Low	High	High / Medium

	8.Environmental risk	9. Force majeure risk	10. Political risk	11. Socio-cultural risk
Risk description	This is the risk associated with the physical environment that can impact negatively on an SPIS project implementation.	The risk that any entrusted loan cannot be recovered on time or in full (or both) as a result of the occurrence of any unforeseeable, unavoidable or insurmountable circumstance, for example a natural disaster or a political coup.	The risk associated with change in government which will result in halting of SPIS project. This maybe as a result of change in new government focus. It is also associated with Politically Exposed Persons (PEP's)	The risk associated with the social-cultural practices and gender related issues, which affect the land ownership system and water access.
Risk driver	Failure to request for an environment assessment certificate/report.	Failure to diversify the loan portfolio over many sectors and regions.	Change in government or when the client is affiliate to political parties	Failure to identify the rightful land ownership (including water sources), especially in communities where women do not own lands or where men own lands in trust for women. Gender bias towards ownership of land and water in some communities Not consulting all females and males on existing uses of water sources.
Risk indicator	Delay in approval of project implementation by government agencies	Defaulting loan repayments	Blockage of project implementation by government agencies	Defaulting loan repayments
Risk owner	In charge of credit/ management	Credit Department	Credit Department	Credit Department
Impact	Loss of earnings High portfolio at risk Delay in implementation of the project	Loss of earnings High portfolio at risk	Loss of capital Delay/abandonment of project High PAR	Loss of earnings High PAR
Mitigation	The institution can control this risk by ensuring that before financing medium to large energy projects, the borrower has all the necessary documentation on environmental assessment from the relevant government agencies.	The financial institution should transfer this risk to third party in the form of a political risk insurance cover or a partial guarantee. Additionally, it should be very careful when financing projects whose implementation periods cut across two electoral periods and should consider funding long-term projects in tranches.	This form of risk can be controlled by not dealing with PEP's.	Intensive education on gender equality and women's land and water rights. Adequate consultations with women and men on land and water source use, access and ownership. Adequate documentation on land ownership and water rights.
Ranking	Medium / Low	Low	High	Medium

2.5 Risk mitigation measures for SPIS

In the table below presents the types of risks, examples and their mitigation measures in SPIS.

***Note**: The overview is an example of potential risks and the risk ranking is a rough indication. Risk assessment and developing mitigation measures should always be done on a case-to-case basis.*

Types of Risks	Examples of Risk Occurring	Examples of Mitigation Measure	**Ranking** (before mitigation is in place)
Design risk	A financial institution can be exposed to a design risk if it does not assess the plan and SPIS design of the loan trustee.	The financial institution should do proper screening of the proposed SPIS set-up and its business case in terms of market potential versus selection of crop(s), water source and SPIS equipment.	High
Completion risk	A financial institution can easily be exposed to completion risk if it funds a SPIS project on a short-term basis while the project completion takes longer than anticipated.	The financial institution should consider not disbursing all funds before completion. One can also transfer this risk to a third party, which can manage the risk. This can be in the form of insurance or a guarantee.	Medium Low
Technological risk	Some SPIS components such as solar panels are sensitive and their installation is quite technical in nature. There is a risk that a financial institution considering financing the purchase of solar panels may partner with rogue suppliers and expose the institution to losses from customers' non-repayment due to poor quality products.	The financial institution should consider partnering with credible energy equipment suppliers whose products are certified by the relevant authorities and work with standard components that have easy substitution. They should also work with certified service providers, for instance, qualified solar technicians, and in case of new suppliers, allow them to build up credit trustworthiness gradually	Medium High
Supply risk	An institution may expose itself to supply risk if it finances an SPIS where components are sourced from abroad and are not readily available.	The financial institution should first conduct a thorough due diligence so as to ensure the availability of all the required parts and resources. It should engage expert advice from qualified energy professionals.	Medium High
Economic risk	For instance, if an institution finances solar stand-alone project and then the government extends the grid to such an area, then individuals may opt to connect to the national grid, making the local solution unsustainable.	The financial institution should ensure that it conducts thorough due diligence. Also, it can consider transferring the risk to a third party in the form of full or partial guarantees. The financial instutition should also check governmental plans, policies and legislation.	Low

Foreign exchange risk	This risk occurs due to financing projects in currencies other than the local currency.	The institution may consider hedging the loan so as to shield itself from the losses. The management needs to properly analyse loan terms and conditions before borrowing funds.	High
Credit Risk	This risk occurs when for example, bad loan facilities are given to clients. Bad loans increase the non-performing loan (NPL) portfolios of financial institutions, which can lead to regulatory risk issues with the Central Bank.	The institution can control this risk by conducting proper assessment of loan clients; segmenting the loan clients into the categories and needs group they belong and conducting proper due diligence for these loan clients.	High Medium
Force Majeure (e.g. Political unrest, civil war, natural disaster)	An influential person/group in an area may decide to interfere with the management of a financed energy development project. This in turn will expose the institution to losses.	The financial institution could seek to transfer this risk to third party in the form of a partial guarantee. Insurances may not cover damage to due force majeure. Additionally, it should be very careful when financing projects whose implementation periods cut across two electoral periods and should consider funding long-term projects in tranches.	Low
Environmental risk	This could come from a regulatory body such as Environmental Protection Agency (EPA), which may stop the implementation of a project on the basis that it negatively affects the environment. For example, when the SPIS might consume too much groundwater and conflict with other objective of the EPA, like nature conservation.	The institution can control this risk by ensuring that before financing medium to large energy projects, the borrower has all the necessary documentation on environmental assessment from the relevant government agencies.	Low Medium
Political risk	This risk could occur as a result of change in government which will then shift the attention on the previous government's policies. The risk can also occur when a politically exposed person (PEP) is directory involved in the project.	This form of risk can be controlled by not dealing with PEP's.	Medium
Socio-Cultural Risk	The risk associated with the social-cultural practices and gender related issues, which affect the land ownership system and water access.	The institution can control this risk by checking whether documentation on land ownership is adequate, and by forming diverse groups of smallholder male and female farmers, consulting them on land and water resource access, educating them on gender equality and women's land & water rights and coach them in getting accessing to finance products.	Low

TEMPLATE FOR A COMPREHENSIVE RISK ASSESSMENT

The template below is a tool which supports financial institutions to develop a risk assessment of an SPIS project. The following steps should be taken:

1. Define the risk category / type with help of the 11 main categories defined in Table 1.
2. Define the effect of the risk if it would materialise: how large would its impact be?
3. Define the likelihood that the risk materialises: how realistic is that this hazard/defaulting would take place?
4. Calculate the risk level by multiplying the ranking given to Effect with the ranking given to Likelihood
5. Define possible mitigation measures or remedies in case the risk materializes.
6. Re-calculate the risk level. With what number would the Effect and/or the Likelihood be reduced if this mitigation measure is put in place? E.g. If you construct a fence around a SPIS, the likelihood of theft decreases substantially.
7. Calculate the required expenditures of putting the mitigation measure in place. For example: what would be the additional costs of the fence? What would be the premium/fee of an insurance against completion risk? If there is a significant risk level remaining after the mitigation measure is in place, it is recommended to put an additional financial value in place for de-risking the portfolio.

Ref / ID	**Risk category / type**	**Risk severity / effect**	**Risk likelihood**	**Effect *Likelihood = risk level**	**Mitigations / Remedies / Anticipated actions**	**Corrected risk level** (so after mitigation is in place)	**Financial value attached to risk**
		- Low impact (1) - Medium impact (2) - High impact (3) - Very high impact (4)	- Improbable (1) - Possible (2) - Probable (3) - Very probable (4)	- Low (acceptable: 0-4) -Medium (tolerable: 5-8) - High (undesirable: 9-12) - Extreme (intolerable: 13-16)			

2.6 Opportunities of SPIS

So far, we mainly discussed the associated risks of SPIS. However, the investment in a SPIS can also be a great opportunity. A SPIS is likely to be a feasible option in a region if:

- Physical conditions are fit. The weather conditions are optimum with sufficient daily sunlight. Water is available and managed adequately so as to prevent groundwater depletion in the long run.
- Energy provision for farming is a constraint (availability or cost of fuel, reliability of grid connection);
- An intensification of agricultural production is envisaged;
- Producers are market-oriented and not working on subsistence level;
- There is sufficient density of producers in the area and markets to sell the products. Producers are at least medium-sized or organized in smallholder groups;
- Subsidized refinancing options for financial operators are available;
- Grant schemes or subsidies are available to borrowers (farmers or solar dealership companies);
- Producers aim at specialized markets using environmentally friendly technology (focusing on CO2 reduction and/or ecological production, which could give scope for premium pricing);
- Technology distributors and system integrators are available in the region.

Photo 11: Analysing potential opportunities of SPIS in a gender balanced team is important

The **MARKET module of GIZ's SPIS toolbox** (see Annex 4 for a reference) also provides an elaborate tool to assess whether the conditions for SPIS introduction are positive or negative in a specific region.

2.8 CASE STUDY / PRACTICAL WORK

In Ghana, the effects of climate change are evident especially during the dry and rainy seasons. Erratic rainfall patterns and distributions have been occurring across the country. The rainfall during the rainy seasons has been very short with very long dry periods in the northern savannah zone. Farmers especially smallholder farmers along the black and white Volta corridors yearn for support to continue all-year-round farming. They have asked for Solar Powered Irrigation systems (SPIS) to be provided, but this comes at a cost and a risk.

Development Partners and the Government of Ghana have underscored the importance of providing convenient affordable SPIS Products for smallholder farmers to enable them carry out all year-round farming and to address the issue of food security and food prices fluctuations across the country. The Government has asked the private sector, including Banks and other development partners, to assist in achieving this agenda. Consequently, the Green People's Energy Project has decided to work with public and private partners to achieve the development vision of the country. Solar Energy Companies are showing greater interest to access these new SPIS products for their clients.

A private Bank, known as Energy Bank Ltd, has decided to introduce a new product termed "the SPIS product for smallholder farmers in Ghana". The product focusses on providing suitable credits for smallholder farmers to finance their irrigation systems along the White and Volta Corridors.

As the Credit Officer of the bank, you are invited by the Bank's Product Manager to assess the general risks components of this product and advice on how these risks can be mitigated in order to scale up the facility to the smallholder farmers. Use the **Comprehensive Risk Assessment Template** to answer the questions below.

Questions

1. Explain General Risks in the context of SPIS.
2. What are the risk components/types to consider in your assessment? Put them in the template and explain them in brief with practical examples.
3. Give a tentative risk level assessment, scoring the different mentioned risks in categories the Low, Medium, High, Extreme, using the formula Risk Level = Effect * Likelihood
4. Brainstorm on possible mitigation measures / remedies for the identified risks.
5. To which extent are your formulated mitigation measures realistic? Can certain risks really be transferred to smallholder farmers or should they be tackled differently?
6. Indicate the corrected risk level based on the mitigation measures you have identified. So, lowering the risk level based on the situation that the mitigation measures are put in place.
7. Assess the financial value that should be added to de-risk/hedge the risk.
8. List a few potential opportunities for this envisioned SPIS project.
9. What advice will you give to the Bank Credit Manager and the team based on your assessment of the risks and opportunities?
10. What advice would you give to an association representing smallholder farmers in the Volta Corridors?

CHAPTER 3 | FINANCIAL ANALYSIS AND DELIVERY MECHANISMS FOR SPIS

3.1 Introduction

In the previous chapter, you learned to analyse risk and to develop mitigation measures. One might think: "Let's invest! If the mitigation measures are in place, we are safe." As a financial expert, you are probably still cautious. Since a low final risk assessment does not automatically imply a high return on investment over time. Like with many projects, SPIS investments will not result in gains on the day of investment, but need to materialise over time. And time = money!

It is thus essential to factor in time. This is because:

- **Money may lose its purchasing power over time**, so-called inflation. The lender must be compensated for the declining spending/purchasing power of money. If the lender receives no compensation, he/she will be worse off when the loan is repaid than at the time of lending the money;
- **The receipt of money is preferred sooner rather than later**, since money can be used to earn more money. The earlier the money is received, the greater the potential for re-investment and increasing wealth. Thus, if money is back paid later, it is reasonable to expect that one gets relatively more compensation in return (thus higher interest rates).

Also, there is the undeniable fact that, the risk of money not being paid back, also called credit risk. This uncertainty requires a premium as a hedge against the risk, hence the return must be proportionate with the risk being undertaken.

In this chapter, we will learn how to conduct a financial analysis of SPIS projects, meaning how to factor in time against monetary values. It will also discuss suitable SPIS finance delivery mechanisms.

3.2 Learning Objectives

At the end of this chapter, participants should be able to achieve the following objectives:

- Explain why we use selected methods and tools in Project Financing decisions, like Simple Back Period, Net Present Value (NPV) and Internal Rate of Returns (IRR).
- Apply different tools for the financial analysis of SPIS Projects, like the GIZ SPIS toolbox Farm Analysis tool and Payback tool, which are based on principles as Payback, NPV and IRR.
- Demonstrate how to make an analysis and an informed decision using the selected tools with help of given practical examples.
- Explain a number of debt finance examples and models in the context of SPIS.
- Explain a number of other financial mechanisms and approaches used to deliver SPIS products/projects to clients, and their pros and cons, including gender-related concerns.

- Give advice to the management of a financial institution on suitable financial products, considering a specific client group and the potential gender constraints of this group.

3.3 General methods in financial analysis

Net Present Value, **Internal Rate of Return** and **Payback time** are the main methods used in capital budgeting. Their calculation systematics are used to make investment decisions, including those on SPIS Projects. The methods enable companies, in this case banks, to determine whether a new investment into SPIS projects is worthwhile. On the other hand, the tools enable smallholder farmers or solar companies to know whether it is useful to embark on a SPIS Project for expansion and/or all year-round farming. This is because, the results of the analysis of these tools will show whether to proceed with the project or not (from a financial point of view).

Explanation on Payback, NPV and IRR

Below the concepts are explained as a refresher. In case you have no prior experience with these terms, we recommend you to practice with help of the exercises in Annex 1.

Simple payback: The simple payback period is the length of time required to recover the cost of an investment out of the annual savings. The payback period is an important determinant of whether to undertake the project or not.

Typically, longer payback periods are not desirable. The simple payback period ignores the time value of money, unlike other methods of capital budgeting, such as net present value, internal rate of return, or discounted cash flow.

Simple payback ignores all savings beyond the payback years, thus potentially penalizing projects that may have a longer service life in favour of those that offer high initial savings relative to the installation cost. The simple payback period is simply computed as:

$$\text{Simple Payback} = \frac{\text{Investment Cost}}{\text{Annaul Savings from Energy Reduction}}$$

Net Present Value: Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. Net present value (NPV) takes into account the time value of money. This refers to the view that money is worth more now than in the future, due to factors such as the cost of capital, uncertainty, etc.

The analysis converts future cash flow values to present values, which facilitates like-for-like comparison of projects. By comparing an original investment to the income and/or expenses that it generates over the investment lifetime, you can calculate whether the entire cash flow results in an increase in wealth, or a positive net present value.

$$\text{Present value} = \frac{\text{Future value}}{(1+r)^n}$$

Where

r = rate of return or discounted rate

n = number of periods

Decision rule: To determine net present value (NPV) convert all expenses and income over the life of a project to a present value using the appropriate table and discount rate (r). Sum the present values over the period, including the initial investment and determine whether the net present value is positive or negative. Net present value is an example of a discounted cash flow (DCF) method. In general only SPIS projects with positive NPV should be pursued.
If NPV is positive (+): accept the project
If NPV is negative (-): reject the project

Internal rate of return: The internal rate of return (IRR) is a metric used in financial analysis to estimate the profitability of potential investments. IRR is a discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis. The annual return makes the NPV equal to zero.

$$0 = CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + \frac{CF_3}{(1+IRR)^3} + \ldots + \frac{CF_n}{(1+IRR)^n}$$

Or

$$0 = NPV = \sum_{n=0}^{N} \frac{CF_n}{(1+IRR)^n}$$

Where:
CF_0 = Initial Investment / Outlay
$CF_1, CF_2, CF_3 \ldots CF_n$ = Cash flows
n = Each Period
N = Holding Period
NPV = Net Present Value
IRR = Internal Rate of Return

3.4 Specific tools for SPIS financial analysis

Financing solar-powered irrigation can be an opportunity for financial institutions seeking to diversify their loan portfolio and expanding their range of financial products. The **INVEST module of GIZ's SPIS Toolbox** (see its reference in Annex 4) provides specific tools to conduct comprehensive financial analysis on whether SPIS investment is financially viable.

The INVEST module focuses on the product features for SPIS loans, considering direct financing by financial institution to a small and medium-scale agricultural end borrower. The tool provides guidance to financial service providers who are already financing or planning to finance SPIS. It thus addresses two groups:

1. Stakeholders at management level who decide upon credit policies of a financial institution.
2. Loan/credit officers who assess single loan/credit applications for financing SPIS.

It has integrated main concepts as payback period and net present value to understand whether the farm profitability is sufficient to justify the SPIS loan investment and to compare it with other energy provision alternatives.

For the specific individual loan assessment process on loan operations level, three main steps have been elaborated:

1. the determination of the financing volume and calculation of the profitability of the investment;
2. the assessment of credit risk and collateral of the potential borrower;
3. determination of the cash flow and the repayment plan for the single potential borrower, along with loan conditions.

Financial service providers, potential borrowers and technology providers can make use of two tools to support their investment decision in SPIS. More details are provided below:

The INVEST-Farm Analysis Tool

The **INVEST – Farm Analysis Tool**, contained in GIZ's SPIS Toolbox, allows for conducting an assessment on farm profitability. It provides entry sheets for adding various farm expenses and incomes and automatically calculates the farm profit margin. It also highlights which fixed and variable costs are most prominent and where savings could have a significant impact. The tool generates a Farm Income Statement, which can be presented to a lending institution. The analysis of the smallholder farm productivity and profitability aims to serve as baseline information to help segment the potential clients to access credit support from financial institutions offering SPIS products.

The tool is useful for:

- Determining the current level of profitability (pre-investment base line)
- Determining the anticipated profitability of the investment (post investment projection)

Even when the profitability of the farming enterprise is confirmed, this does not automatically imply that an investment into an SPIS is the most sensible choice. This is especially true if other pumping technologies are readily available on the market. A Diesel or Grid-connected electric pump might be more feasible where water pumping is only required for a limited time per year. Therefore, the GIZ's SPIS Toolbox also offers the INVEST – Payback Tool.

The INVEST – Payback Tool

The **INVEST – Payback Tool** considers and compares solar powered irrigation system (SPIS) with other pumping technologies. Basic data is collected from technology suppliers and the payback period against the farm profit and the different technologies is automatically calculated.

The tool is useful for:

- Assessing pre-investment and post-investment profitability;
- Determining most financially viable pumping technology option.

DATA REQUIREMENTS for both Tools

- Current farm expenditure and income;
- Projected farm income and expenditure;
- Capital costs (Capex) for different pumping technologies;
- Operating expenses (Opex) for different pumping technologies
- Interest rates from lending institutions
- Inflation and fuel increase rates

3.5 Financing Delivery Approaches for SPIS

The risk assessment and financial analysis can form a suitable basis to decide what type of finance product could be offered by the financial institution to a client with a SPIS project proposition. Each delivery method has its pros and cons.

Financing delivery mechanisms for SPIS can be categorised in three main forms, which are:

1. Debt financing
2. Grants/Subsidies linked with finance
3. Hybrid and other lending mechanisms

More lending mechanisms, like equity finance, exist, but will not be discussed, since they have little relevance for SPIS.

3.5.1 Debt Financing

Debt financing is a mechanism in which a financial institution provides capital for the installation of a SPIS project, and then earns an interest out of this arrangement. Debt financing options include corporate or project loans under recourse or limited recourse structures, leasing arrangements, and full or limited guarantees. Financiers using this model specify minimum cash flow generation projections, debt coverage, leverage and other financial ratios for projects to qualify for loans. In some cases, credit support can be structured into a transaction by obtaining additional collateral, cash flow, or parent company or third party guarantees for a loan. Options under this model include: loans converted to some amount of equity ownership with a view to increasing the lender's rate of return.

EXAMPLES OF DEBT FINANCING:

- ***Conventional Loans:*** In this case, the financial institution provides SPIS loans in the normal way it finances other business loans, that is without any concessions or improved terms.
- ***Financing provided hand in hand with technical assistance:*** In this business delivery mechanism, financial institutions partner with solar irrigation installers and then offers a comprehensive loan product.
- ***Leasing Financing***: This asset finance mechanism can be used to finance the sale of SPIS equipment and service.
- ***Vendor Financing***: In this delivery method, financial institutions provide a vendor with capital to enable them to finance the purchase of large quantities of SPIS products.
- ***Micro-credit***: The micro-credit delivery mechanism is where financial institutions provide farmers with access to capital and consumptive irrigation credit.

MODELS USED IN DEBT FINANCING

The models used in debt financing include:

- The Consumer Credit Model
- Dealer Credit Model
- The Energy Service Company Model (ESCO)

The Consumer Credit Model

For the consumer credit model, two financial players are involved: **commercial financiers and local financiers** who advance credit to end users to purchase goods from energy enterprises. In this model, commercial financiers are those institutions that lend money to local financial institutions which in their turn lend to end-users (farmers). End-users eventually purchase SPIS products from a supplier company.

Dealer Credit Model

In this model, financial institutions provide credit as commercial financiers to dealers. The dealer then sells SPIS products to the end-user (farmer) who then pays in cash or credit as determined by the SPIS installer/suppliers or dealer. Granting of credit by the dealer to the end user does not involve the financial institution.

Energy Service Company Model (ESCO)

An ***energy service company*** is defined as a business that develops, installs and arranges financing for energy projects and maintains costs of energy facilities over a defined period. In most cases, ESCOs act as project developers for a wide range of tasks as well as working to mitigate technical and performance risks associated with the project. This project financing model operates both at a macro level where governments could be key players and also, at a micro level involving end users, especially where the latter pay for the energy service that is provided to them by an ESCO.

The example of SolarNow's Finance Delivery Mechanism in Uganda

SolarNow sells high quality European standards solar energy solutions in Uganda and Kenya for diverse clients. The Company offers solutions to residential, commercial & industrial customers with warranty, installation and a 2 years' service to their clients. Clients can opt to pay the products in monthly instalments. The focus of SolarNow is particularly on solutions that generate income or reduce energy costs. The company believes that solar energy is a clean, affordable and reliable alternative for traditional energy access.

SolarNow introduced a debt-financing scheme in 2011 for rural households. The reason for SolarNow introducing the credit facility in 2011, was that there was no other effective alternative for rural households to access the SPIS. It was extremely difficult to get loans from the Bank for solar equipment, especially pumps. However, in the last 2 years (2020-2021), the company has seen a dramatic shift in financing mechanisms for SPIS as more and more banks are becoming active in the provision of agricultural loans, solar loans and green investment loans. Currently, banks are gaining momentum to finance agriculture because incentives are coming up i.e. technical assistance programs for Banks where they receive support in diverse forms including subsidy programs to invest in agriculture products and services.

Models/Delivery Mechanisms that exist in the Ugandan SPIS include the following:
(1) Debt Financing used by suppliers: e.g. 50% down payments and 50% upon delivery;
(2) Subsidy programs (Provided on the invoice; subsidy quotation amount is reduced for the client on the purchase invoice OR a discount amount is given to the client for instalment payments)
(3) Partnership with Banks;
(4) Internal Incentives for the loan officers to promote SPIS facilities.

In their attempts to deliver SPIS for clients across the country of Uganda, SolarNow Uganda recommended the following actions and protocols to be examined and observed for effective efficient delivery of SPIS.

- It is good for banks to work with recommended suppliers doing quality jobs that guarantee the right technical solutions to the farmer
- If the SPIS sizing is done correctly, it reduces product related risks.
- Banks may need to carry out a pre-qualification of solar/irrigation supplier companies to partner with them.
- Involving irrigation experts that will interpret technical information for credit decision-making should be an integral part of the SPIS financing system.
- Irrigation experts that provide effective training to credit officers on the SPIS technical components are helpful. It enables them to perform well on the credit appraisal system.
- Two most important criteria in credit assessment of SPIS: i.e., technical solutions that fits the farmer and the farming model- i.e., whether Horticulture or mixed farming system or any other viable farming system.
- Client segmentation or value proposition should be an integral part of the technical part of assessing the SPIS products for the smallholder farmer.

Feasible loan product for farmers could be 30-50% upfront payment, remaining balance paid back within 6 months (equivalent to 1 crop circle inclusive of harvest and selling)

3.5.2 Grants/Subsidies Linked Financing

In this financing model, the financial institution or SPIS delivery partner institution receives subsidies or grants and then passes on these funds together with technical assistance to the end-users.

Photo 12: Solar-powered irrigation system constructed with subsidy from the Green people's energy program in Ghana

An example of this kind of arrangement in Ghana are the rural electrification programs being usually subsidized by government and other donors. An example of a subsidy linked financing for SPIS is being championed by the GIZ Green People's Energy Project.

The example of GIZ Green People Energy's Finance Delivery Mechanism

The GIZ Green People's Energy Project aims at improving access to modern energy services and promoting alternative sustainable technologies using renewable energy and energy efficiency. A key component of the project is to facilitate investments of farmers, companies, NGOs, cooperatives, women groups and other key stakeholders in rural areas into solar powered irrigation system with the help of technical support and incentives on a results-based financing (RBF) scheme.

Under the RBF scheme, GIZ Green People's Energy Project will provide the following support and incentives:

- Technical evaluations of SPIS designs before the approval of offers.
- Technical evaluation and commissioning after the evaluation of SPIS.
- An incentive of 40% of the customer price of the entire SPIS.
- In case the customer is a female farmer or women's groups, the incentive will be 50% of the customer price for the entire SPIS.
- The threshold of the incentive is 3000 euros for each customer
- These arrangements are granted to selected solar pump companies who supply the system to their customers (In the Annex one can find the contact details of 5 companies in Ghana supplying SPIS systems under GIZ's subsidy scheme)

3.5.3 Other Lending Mechanisms

This section provides a number of other lending mechanisms, which could be interesting to consider for managers of financial institutions.

RESTRICTED ACCOUNTS

Restricted accounts are those that are restricted to specific purposes and administered by an agency or financial institution, usually under an agreement. A financial institution can set up restricted accounts targeting clients interested in purchasing a specific energy product such as SPIS project.

REVOLVING LOAN FUND

The revolving fund is structured to become a self-sustaining source of funding after the fund's initial capitalization. A revolving fund is a loan fund that is replenished by borrowers as they repay their debt. They are designed to be self-sustaining, where from time to time, new loans continue to be made to borrowers. The initial seed capital for revolving funds can be sourced from grants, government subsidies or retained earnings. In order to benefit from such opportunities, financial institutions can write proposals for setting up a revolving fund for energy project lending.

INVESTMENT FUND

This fund can be close-ended, open-ended, capitalized with equity, or leveraged with equity and debt. Its main purpose is to obtain an acceptable return for its investors/owners, although multiple developmental objectives may often be achieved. Financial institutions can tap investment funds to start SPIS energy portfolios.

GUARANTEE FUND

This is a commitment by a third party to cover the obligations of other parties in the event of partial or complete non-repayment. Energy stakeholders are working with financial institutions through loan guarantees as part of efforts by stakeholders to increase access to energy projects. See also chapter 2 on risk mitigation strategies.

HYBRID: This is a mechanism in credit delivery that borrows from more than one of the mechanisms described in section 3.5.1 and 3.5.2. This mechanism is especially relevant for large-sized SPIS schemes with associated high investments. Examples of this could be: (1) long term financing combined with bond financing from an investment bank or (2) long-term debt combined with equity.

The example of FuturePump and its distributors wish for PAYGO

FuturePump is a producer and marketing company of solar irrigation pumps. It works with various distributors, examples are: SolarNow Uganda, Vitalite Zambia, Solar Works Mozambique & Malawi, WIS in Mozambique, Sunculture Kenya and Bios Solar. FuturePump tested a financial product themselves, but withdraw from it when they experienced it required lots of follow-up. They started a collaboration with an equity bank and large supplier of water equipment. They thought they could scale their solar pumps easily by involving a large bank and a large supplier throughout Africa. However, they encountered the bureaucracy and risk-avoidance attitude of big organisations making it difficult to come to agreements. The bank demanded very harsh conditions for prospective farmers, so in the end only high class farmers were reached. The supplier had the role to bridge this gap by providing explanation to SACCOs (cooperative saving groups) on the characteristics of the product and its associated loan. However, the supplier had more products to offer and was not only selling solar pumps to the SACCOs. In the end, it took FuturePump lots of efforts to set up this collaboration, but with little result: only a 10th of their sales could be contributed to this initiative. Nowadays they just provide solar irrigation pumps to distributors. Many distributors nowadays want a PAYGO solution on the solar pump Futurepump provides. Let us study PAYGO.

PAYGO – a revolutionary access product?

An upcoming finance mechanism for solar irrigation pumps is Pay-as-you-go, abbreviated as PAYGO. It is inspired by companies providing solar-home systems. The consumer leases the product and only pays at the moment of use. In case of solar-home systems, people only pay when they use the solar light. The payment is incremental: the more hours they put on the lights, the more they pay. The same mechanism is applied to solar irrigation pumps, but than on a volumetric basis: the more water the farmer uses, the more he/she pays. The pumps with PAYGO solutions work through digital platforms and mobile payment solutions, examples are PaygOps, MobiSource and Illuminator. For switching on appliances key codes can be applied. Also experiments exist with infra-red remote control. The distributor is in this case not only responsible for supplying the pump, but also installing and keeping it operational and doing necessary maintenance. If the pump does not operate, the farmer does not have to pay. It also doesn't have to worry about maintenance, since the solar dealership company will need to fix it. It is a great incentive for solar dealer companies to provide high quality pumps, so they can gain long term income from the pumps and have little maintenance costs.

The downside of the PAYGO solution is that it can be tricky for vulnerable and/or illiterate farmers. When starting the use of the pump, the amounts of payments seem little and a farmer might not understand the financial consequences of the product yet. However, over time they will add up and payments will fluctuate with seasonality. At hot times, when they farmer might need to pump large volumes, he/she might not be able to pay. The farmer will just be switched off and might lose all investments in his/her crop at once. This is not beneficial for the solar dealership company either: it won't gain anymore income from the pump and might need to send somebody to de-install it and place it somewhere else. Because of social acceptance issues and the cost of a water metering device, in practice PAYGO arrangements are often not volume based, but using regular instalments until the agree total price has been paid. The same principle is also referred to as Rent to Own.

3.6 Finance deployment tool

As explained in section 3.4, the INVEST module of the of GIZ's SPIS Toolbox (see its reference in Annex 4) focuses on financial institutions and their SPIS investment decision. Once an institution can segment a potential group of clients (eg. female block farmers along the Volta Lake), they will design a Finance deliver mechanism and product.

Of course, there needs to be a match between the means, preferences and capacity of the client and the conditions of the finance product. For example, the client might not have a bank account, but could be part of socially tight community and a rural cooperative. In this case, the finance institution may decide to set up a finance delivery mechanism for the rural cooperative, which

NOTE: GENDER BIAS IN THE DELIVERY OF FINANCE PRODUCTS

Gender inequality is a major issue of concern in all countries of the world. The energy divide is gendered in countries like Ghana. Women are experiencing energy poverty differently and more severely. In Annex 3 | Gender and energy terminology, you can find more information on gender and energy terms.

Women's limited options for activities / networking outside household

Women are often associated with household activities. To a large extent they are responsible for household and community energy provision. Thus, without access to modern energy services, women and girls spend most of their day performing basic subsistence tasks such as collecting biomass fuels which are time-consuming and physically draining tasks. This limits their ability from accessing decent wage employment, educational opportunities and livelihood enhancing options, as well as limit their options for social and political interaction outside the household.

Women's limited access to resources

Generally, women have less resources than men. Socio-cultural restrictions on women's land ownership mean that many women do not have access to productive land to farm. Often they are also constrained in accessing loan products, for example because they have no bank accounts. A lack of financial capital and access to land and technologies means women cannot easily diversify their livelihoods.

Women's limited access to financing information

Information on various financing options, delivery mechanisms and associated risks and mitigation measures on obtaining and operating SPIS helps to increase uptake of the technology. Barriers to information dissemination (for example having no mobile phone) hinder women's ability to access financing opportunities and also hamper them from being informed on financial viability, savings or returns on investing in SPIS for their farms.

In chapter 4, you can find more in depth information on women's barriers accessing finance and what financial institutions can do to bridge that gap.

the farmer then can access even without a bank account. Specialised products for female farmers could also be considered. See the note below, why this is important.

For this purpose of exploring these conditions for potential borrowers, the GIZ's SPIS toolbox provides the FINANCE – deployment tool.

Finance – Deployment Tool

This tool helps farmers to decide which type of Finance product fits their circumstances. The tool could also be a starting point for finance institutions for the design of a new finance mechanism/product, if they know the circumstances of their targeted new client group.

The tool distinguishes 8 categories:

1. Bank Loan
2. Rural bank/Development bank loan
3. Loan from Micro Financial Institutions (MFIs)
4. Value chain loan
5. Leasing / Repurchase agreement
6. Cooperatives
7. Informal Saving Groups
8. Pay-Per-Use business model

3.7 CASE STUDY/ PRACTICAL WORK:

The case of Hajia Safia farms in Karaga, northern Ghana

[*This assignment can be executed with the GIZ SPIS Toolbox – INVEST-Farm analysis Tool, INVEST-Payback Tool and the FINANCE-Deployment Tool. See Annex 1 for the solutions of the exercises*]

Hajia Safia owns a four acre land 2 acres which she inherited from her late husband and 2 acres which she purchased with her savings. Hajia uses part of the land for cultivating pepper and okra and the remaining for livestock rearing (poultry and goats). For her business, Hajia Safia owns the following assets:

ITEM	SIZE/NO	VALUE/COST	EST. LIFE
Land	3 acres	3,000.00	
Tricycle	1	17,500.00	10
Motor Bike	1	7,500.00	10

The farm produce is processed into dry pepper and okro for sale in the local markey and she estimates the following revenue from the farm:

ITEM	EST. OUTPUT (BAGS)	EST. PRICE/BAG
Pepper	13	GHS550.00
Okra	17	GHS370.00

On average, Hajia gets GHS515.00 from the sale of livestock monthly and also receives GHS900.00 annually from the sale of manure (animal droppings) to local farmers. The tricycle is used to convey items in the Karaga area and especially on various village market days and generates revenue of GHS250.00 weekly.

She spends GHS100.00 a week on feed for the animals and GHS550.00 on preparation and ploughing of the land annually.

She has engaged one person who uses the tricycle and is paid GHS300.00 a month. During peak farming periods, Hajia relies on daily farm hands known as "By Day" at GHS15 per person per day. She engages an average of 4 persons for 5 days weekly for a period of 4 months. 10 litres of fuel is used weekly and the cost per litre is GHS12.00.

She has 3 children, 2 of who are in secondary schools in Tamale and Kumasi and she spends an amount of GHS2,000.00 on their education yearly.

She spends GHS5,000.00 annually trying to complete a mansion she inherited from her late husband. The facility is expected to be completed in 7 years at the current level of development. When completed, the house is expected to fetch her about GHS2,500.00 yearly since rent does not fetch much in the Karaga area. She also contributes GHS100.00 weekly to a local women's "susu group".

1. Determine the following (*optionally the INVEST – Farm Analysis Tool could be used*):
    a. the farm's gross income?
    b. Hajia's gross income?
    c. the total fixed cost of Hajia Safia.
    d. the components of variable costs of Hajia Safia?
    e. the gross profit of Hajia Safia?
    f. the farm's net profit?

PROPOSAL FOR INSTALLATION OF SOLAR POWERED IRRIGATION SYSTEM

Hajia Safia has heard of the Solar Irrigation Package under the GIZ Grean People's Energy and feels that she will be able to boost her earnings by investing in a solar irrigation system for all-year round farming. She has approached you with the following estimates prepared for her by Pump Tech, a company specialized in solar installation.

ITEM	EST. COST (GHS)	EST. LIFESPAN	RESIDUAL VALUE
Solar panels	150,000.00	15	15,000.00
Control unit	35,000.00	10	Nil
Motor pump	75,000.00	10	5,000.00
Wires/tubes	10,000.00	10	Nil
Water storage	25,000.00	10	1,000.00
Irrigation system	50,000.00	10	2,000.00
Installation cost	15,000.00		
Maintenance cost	3,000.00 per annum.		

Hajia will be able to undertake all year round farming and will particularly cultivate tomato which is in high demand in the dry season.

She has approached you as banker to provide funding under the GIZ Green People's Energy Project and has provided the following additional information:

Tomato production is estimated at 2,350 kg and estimated to be sold at GHS 35.00 per kg.

Additional Labour cost of GHS 1,050.00 per month is estimated for 6 additional months to handle the irrigation project.

Additional cost of land preparation is estimated at GHS 950.00

She will continue with her current ventures and therefore the current cash flows are expected to continue in addition to cash flows from the solar project.

2. As a Banker, please determine the following (*optionally with the INVEST- Farm analysis Tool*):
    a. The additional fixed cost from the irrigation project.
    b. The additional variable cost of the irrigation project.
    c. The additional gross revenue from the irrigation project.
    d. Hajia's projected total revenue, projected total fixed costs, projected total variable costs, projected gross profit and project net profit for the proposed all-year round operations.
3. Given that the cost of funds is 16%, please calculate the following for the proposed irrigation project (*optionally, the INVEST – Payback Tool could be used*):
    a. Pay Back Period
    b. Net Present Value
    c. Internal Rate of Return
4. Please advise Hajia on the amount of loan suitable for the proposed project and additional measures (if any) she needs to put in place to improve her operations.
5. Hajia does not have a bank account. Taking the FINANCE- Deployment tool, what type of Finance delivery product would you recommend her?

3.8 PRACTICAL WORK

Finance delivery mechanisms

Throughout this chapter, you can find 3 examples of Finance delivery mechanisms: (1) Solar Now's debt finance options, (2) GIZ Green People's Energy subsidy program and (3) Futurepump suppliers' PAYGO solution.

1. Develop a Strengths, Weaknesses, Opportunities and Threats (SWOT) or Availability, Suitability, Acceptability and Supportability (ASAS) analysis of the 3 examples separately. How do they compare?
2. If you had to advice the management of your bank, what type of finance delivery mechanism would you propose for an SPIS facility to smallholder farmers?

CHAPTER 4 | CREDIT RISK APPRAISAL & DUE DILIGENCE

4.1 Introduction

To build upon our case study in the previous chapters. By now, a proper risk assessment and financial analysis has been made of the SPIS project, and the respective financial institution has selected a suitable finance debt delivery mechanism and model. It now aims to start a SPIS facility. Why bother any further? Why not straight away ask the customer or association that proposed the SPIS project, market the credit possibility and try to get as many smallholder farmers and solar power companies as possible on board? Or to just ask the solar company to market the SPIS equipment to farmers and install as much as possible?

Next to considering general project risks and overall profitability and return on investment, it is essential to screen the organisation that will be responsible for the actual SPIS implementation. For example: Is the solar energy supplying company really credit worthy, reliable and experienced enough? Do the involved smallholder farmers and solar power companies have a history of paying back loans timely, do they have access to the necessary resources to successfully apply SPIS? A Due Diligence Process and Credit risk appraisal is thus vital.

However, vulnerable groups, like smallholder female farmers with limited access to land, often face challenges to access finance, since banks easily consider them as not being credit worthy or smallholder farmers do not know how the screening and loan request process work, so ignore the possibility. This hampers their growth and resilience.

SCOPEInsight and the Center for Financial Inclusion (CFI), in partnership with the Alliance for a Green Revolution in Africa (AGRA) have tried to bridge this gap by introducing a special assessment tool with bankability metrics. These Bankability metrics are useful to augment the existing information gap in financing SPIS projects in Ghana. In this chapter you will learn to apply this tool.

4.2 Learning Objectives

At the end of this chapter, participants should be able to achieve the following objectives:

- Explain why vulnerable groups, especially women, have challenges to access finance and how this gap could be bridged by financial institutions
- Explain the ScopeInsight Assessment Bankability Metrics in the context of SPIS
- Explain the 5Cs of Credit Risks appraisal in the context of SPIS
- Demonstrate how to analyse practical cases and scenarios using the 5Cs of credit Risks Appraisal in the Context of SPIS

- Demonstrate how to use the ScopeInsight Assessment Bankability Metrics to pre-screen and shortlist applicants for Due diligence
- Demonstrate how to advise SPIS Smallholder farmers on how to de-risk and apply for an SPIS facility.

4.3 Women access to finance for SPIS

Financial inclusion means that women, men and their businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance –delivered in a responsible and sustainable way. This section highlights why especially women have challenges to access finance and what the role of financial institutions could be to bridge that gap.

4.3.1 Barriers and Challenges to women's access to finance SPIS

Some of the barriers to women's financial inclusion include the following:

Photo 13: Female trainees in SPIS finance

1. **Lack of collateral to secure loan** - In many cultures, it is men who traditionally own land and other assets. The gender disparities in asset ownership reflect a mix of social, cultural and legal barriers to women's participation in the financial system. This immediately excludes women from accessing loans towards the purchase of SPIS.
2. **Lack of access to accounts & digital payment** - Research has shown that fewer women have access to bank accounts and mobile phones compared to men. Documentation requirements for account openings, like an official means of identification, hinder women from opening accounts. The few women who have a savings account use it to a limited extent. Moreover, fewer women make or receive digital payments since only a limited number of women own mobile phones.
3. **Inability of banks to reach women farmers** – financial institutions are frequently unable to reach vulnerable farmers with their financial products and services. Marketing messages of banking products and services are often gender blind and do not target women as beneficiaries. Moreover, the fact that many women do not own bank accounts or mobile phones means that they cannot receive digital communication from banks.
4. **Difficulty in understanding women's energy needs and priorities** – women prefer energy solutions which meet both their productive needs as well as their household and social

needs. SPIS solutions which also make water available for household use or/and provide additional energy for charging phones or lanterns are preferable to SPIS solutions which focus only on crops. In addition, men and women may have different access to farming tools and inputs. This may affect their choice of crops and the techniques of cultivation (including choice of irrigation system). Women and men may also value different traits for the same crop (e.g., women often value taste and cooking characteristics for home-consumed crops, versus yield or cost advantage for marketed crops). All these needs and priorities should inform the design of financial products targeting women farmers.

4.4.2 Reaching women farmers with finance

Integrating gender sensitive approaches to SPIS dissemination and finance delivery mechanisms increases adoption rate, improves food and nutrition security, enhances livelihoods and contributes to women empowerment. The following section highlights manners in which finance institutions could bridge the access gap of women to SPIS finance:

1. **Alternative ways of credit-check:** Financial institutions could start to think outside the box and use other methods to credit-check an individual, such as issuing loans based on cash flow, savings group history, mobile money transaction history or a track record of farm performance.
2. **Build skills and savings capacity of women:** Credit officers could work with women clients on ways to collectively save money and develop their business skills. One such savings group is the village savings and loans association (VSLA). The Association meets regularly to save together and take small loans from those savings. Members of these savings group keep track of all deposits and withdrawals, which can be a vital record of a person's ability to save and repay a more formal loan.
3. **Enable women's access to social safety nets and networks**. Social safety nets enables vulnerable women and men cope adversities such as low harvest. Credit officers can target vulnerable female and male farmers who belong to VSLAs, cooperatives or other social groups. Cooperatives are able to pull their resources together, secure group loans or provide guarantee for members to secure individual loans to purchase SPIS. Alternatively, they can work with agriculture extension officers to encourage the women to form such groups and build their capacity to improve their farming enterprises. The women who excel in expanding their farms and repaying the loans should be recognized and enabled to access formal financial services. Further promotion of this success could encourage others, including young girls, to join.
4. **Design financial products with incentives**. High upfront cost of SPIS are a barrier to both women and men. Financing options such as subsidies, grants, VSLA loans options and loans at competitive interests could be used to increase customer interest and

ability of acquiring solar technologies. Networking with governmental and development partners could be instrumental in making this happen.

5. **Design financial products and services with women as beneficiaries**. Credit officers could analyse women farmers' energy needs and priorities (including work burden of the selected solar technologies) and engage with SPIS providers on packages which take these needs into consideration. This includes designing a financial product in which the women will have control over the earnings from the irrigated production.
6. **Gender-sensitive marketing for financial products**. Marketing information on specialised financial products could be made gender-sensitive and address identified needs and priorities of women.
7. **Start with gender mainstreaming and policies within your institution**. Having an internal gender, finance and energy policy in place can create an enabling environment. It may result in concrete outcomes, such as more women employed at financial institutions and more programs and portfolios that address sustainable energy services for women.
8. **Contribute to awareness raising in the sector**. To effectively reach women with financial packages requires a supporting environment. Efforts to maintain gender in energy policies, programs and projects have contributed in raising awareness at all the level of decision making. Contributing to these initiatives as a financial institution will accelerate gender mainstreaming.
9. **Use women as role models and accelerators**. - When women enhance their access to energy, they are able to increase their incomes which in turn enhance their social status. In particular, women who are able to draw on their social circle of family, friends and community, can be great to increase the customer group of banks and solar technology distributors. While doing so women are becoming significant actors in creating and disseminating sustainable energy solutions. They can act as role models, so positive changes in attitude will emerge. Women will more and more be perceived as entrepreneurs instead of just household and community actors.

Photo 14: A woman as role model in SPIS finance training

10. **Provide training packages**. To enhance internal policies, awareness-raising in the sector and introducing women as role models, financial institutions could provide targeted training programs for both male and female employees. These trainings could be used to promote women's access to credit and loan facilities. It is recommended to also include prospective women credit officers in these trainings, which could also be women lead farmers who have demonstrated capabilities in good financial management and convincing other communities members in taking certain credit products.

Photo 15: It is vital to train both male and female credit officers in SPIS finance

4.4 ScopeInsight Assessment Tool

4.4.1 Introduction to ScopeInsight Assessment Tool

JUSTIFICATION FOR THE USE OF THE SCOPEINSIGHT ASSESSMENT TOOL

Currently in Ghana, many lenders do not have clear and standard lending requirements for agri-SMEs/ customers on creditworthiness. In recognition of the need to narrow this finance gap, the Center for Financial Inclusion (CFI) and SCOPEinsight, in partnership with the Alliance for a Green Revolution in Africa (AGRA), have developed a standardized set of bankability metrics that can serve as a common language between lenders and agri-SMEs/ customers. This resulted in the ScopeInsight Assessment Tool, which is based on conducted research with 90 lenders and industry experts, analysed datasets and conducted desk research.

The tool enables Credit Officers to gain a clear overview on the state of a customer (agri-SME business/smallholder farmer) of a SPIS loan facility. The tool is robust enough for the credit officer to make an informed decision on whether to continue with due diligence. This will reduce the amount of time and cost it takes to conduct a pre-screening and initial assessment.

In Ghana most lenders struggle with high cost of serving smallholder farmers which are often located in rural, hard-to-reach areas. In addition, the informal business practices and reporting

mechanisms of these businesses make it difficult to assess the creditworthiness. In order to overcome the common perception that the agricultural sector has a high investment risk, this tool was developed.
In addition, smallholder farmers can use the metrics to understand the expectations of lenders, so they can better prepare for financial assessments in the near future.

METRICS CLASSIFICATION

SCOPEInsight has organised the proposed general and bankability metrics according to lending requirements in the **pre-due diligence part** of the lending flow. They are split into two main categories for assessment, in accordance with the typical loan origination deal flow indicated below, namely **general metrics** and **bankability metrics**.

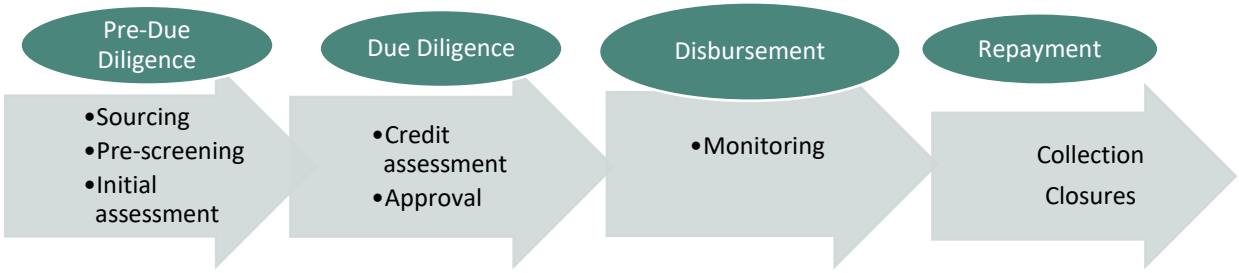

Figure 3: The Loan Deal Flow Processes

In this context, Credit Officers start a SPIS deal flow process with sourcing and pre-screening interested applicants. In this period, they reference general information on the smallholder farmer or a solar energy company, which will be included in the general metrics section.
Credit Officers then continue with the initial assessment step where bankability is assessed for the smallholder farmer or solar energy company. Together, the metrics during the pre-due diligence phase provide a holistic picture of a Smallholder Farmer/Solar Energy company's financial readiness, and a Credit Officer can make an informed decision as to whether to continue the loan deal flow and progress to due diligence.

The classification of the metrics includes the following:

4.4.2 GENERAL METRICS for PRE-DUE DILIGENCE:

During the sourcing step, Credit Officers mainly seek background information on the applicants to establish their long list of potential borrowers. They will request available documentation that will be referenced throughout the deal flow.
During the pre-screening, Credit Officers consider details of the finance request to create a short list for further assessment. The main sections under the general category are:

A1: Company/Customer information— farming/ organisation activity, farming/organisation type, farm/organisation registration and management, organization structure, etc.
A2: Contact information—Location of farm/company, address, and primary contact details
A3: Finance request—Loan amount requested, financing purpose, timeframe when financing is needed, and how it will be repaid
A4: Documents—Comprehensive list of financial and legal documents

Below is a table describing the **general metrics** that will be useful for credit officers to **pre-screen SPIS applicants**.

SECTION A1: Company/ Customer Information	
METRIC NAME	DESCRIPTION
Business ID / **Registration number**	Unique identifier provided by the relevant national company registration authority
Organization type (by legal ownership)	Ownership structure as registered with relevant national authority
Business description	The purpose of the company
Primary activities of business	Primary activities in the context of the relevant value chains
SECTION A2: Contact information	
METRIC NAME	DESCRIPTION
State or region	Address as registered with the relevant national company City registration authority
Phone Number	General contact information
Primary contact: Name: Information: Title: Email:	Contact information of primary point of contact
SECTION A3: Finance request	
Loan amount requested	Target value of SPIS loan and if this is flexible
Date loan is required	Target date to receive SPIS loan
Loan purpose	Relevant categories of loan purpose
Specifics of loan use	Specific activities or items to be financed by this loan
Length of loan	Target loan term in years
Repayment intentions of the loan	Specifics of how the loan will be repaid
SECTION A4: Documents	
METRIC NAME	DESCRIPTION
Registration	Documents, including constitutional and registration documents, created when the company/farm was established

Financial statement projections	Balance sheet and income statement for the first 12 months of the requested loan with quarterly projections beyond one year, if applicable.
Technical certificates if any	As may be required for the company to handle food, produce seed, trade solar equipment, etc.

4.4.3 BANKABILITY METRICS for DUE DILIGENCE:

During the initial assessment of a loan facility, lenders aim to determine the bankability of an organisation and decide whether to proceed with due diligence. The bankability metrics provide a clear and robust picture of a smallholder farmer/ solar energy company's activity, governance, and financial performance—the three areas of focus identified by lenders. The metrics are further classified by the 5Cs of credit—capital, condition, character, capacity, and collateral—they address.

Photo 16: Practicing the 5Cs approach by stimulating a credit appraisal of a SPIS project during a role play

Credit Risk Definition (see also chapter 2)

Credit risk is the possibility of a loss resulting from a borrower's failure to repay a loan or meet contractual obligations. Usually, this arises when the credit department of a bank does not conduct a proper credit risk appraisal for their clients or facilities. Consequently, the risk of defaulting is usually high when the appraisal does not take several factors into consideration.

Notable among these factors include the **5cs of credit risk appraisal system** explained below in the context of SPISs.

Character	Capacity	Conditions	Capital	Collateral

Tool for analysing credit risks for SPIS using SCOPEInsight's **5Cs of Credit Risks Analysis**

No	5Cs	Description
1C	**Character**	This element is about the (attractiveness, appearance) characteristics of the borrower. In this context, the smallholder farmer or a solar energy company. Under this section, the lenders of SPIS are concerned about if the smallholder farmer is **honest** and if he or she will make the greatest effort to repay back the facility. For the most part, it is not possible to evaluate the character of a farmer quantitatively but qualitative issues such as experience in managing an SPIS, Skills in managing a SPIS can be looked at. The Credit Officers should check the following questions in the context of an SPIS credit appraisal. 1. What is your experience in designing, selecting and using a SPIS? 2. Do you have skills in designing, selecting and using the SPIS? 3. Do your team members contribute experience in the field i.e., farming, marketing and records keeping? 4. Have you taken a facility before? Yes/No 5. How much was the facility? 6. What was your past repayment schedule like? 7. Were you able to pay on time? For Solar Energy Dealership companies, the following questions could be considered along some of the questions for the smallholder farmers: 8. What is your experience in dealing with small holder farmers/clients on your SPIS products? 9. What is your experience in dealing with female / male farmer groups who are individually marginalized? 10. How many female/male clients have accessed your SPIS facility before? 11. How do you assess the experience in designing, selecting and using a SPIS among your clients? 12. Do you actually assess the SPIS designs of your clients or provide technical support to clients in making proper SPIS designs? 13. When was the last time you took a new facility from the Bank? 14. What was your repayment like? 15. Were you given a moratorium for repayment?
2C	**Capacity**	Under capacity, the Credit Officers will assess the financial ability of the borrower to pay back the loan facility. Usually, this assessment is done based on the history of the business, the past performance and credit history. Profitability and cash flow are pivotal here to consider. In the context of the SPIS, it is important to not place emphasis on the credit history alone but to consider the viability of the project itself in generating cash flows to repay the facility. In this case, it is important to look at the capacity of the farmer in terms of production capacity, water availability and the size of the farmland. The following questions/statements will help credit officers obtain useful information to make a decision on a SPIS facility. 1. Do you have forecasted financial statements?

		2. What kind of crops do you intend to cultivate? 3. What is your current production capacity? 4. How will the SPIS credit facility augment your production capacity? 5. How many acres of irrigated land will you cultivate? 6. How much extra yield will you add under the SPIS project and how large is the extra market value you generate? 7. Who are your clients/buyers? For Solar Energy Dealership Companies, the following key question may be considered along some of the questions for the smallholder farmers. 8. What do you consider from your clients as the most significant factor when deciding to give out some SPIS Services (I) Financial Statements (ii) Credit Risk Mitigations/Smallholder farmer de-risking mechanisms (iii) Credit History (iv) Project projected cash flows
3C	**Condition**	Conditions under the credit risks appraisal system refers to the environment surrounding the loan facility as well as the personal opinion or policy statement of the Creditor. 1. What will be the water source for your SPIS? Underground or open sources? What is the yield of this source? 2. What are the other competing uses of the water source for women and men in the community? 3. What is the quality of those sources? Have they been tested and suitable for irrigation? 4. How long will the water last in the period of farming season for the SPIS Project? Is the water source available all year round or is it seasonal? 5. Can you demonstrate the actual design of your SPIS? Which SPIS components and equipment have you selected? 6. What have been your considerations in design & selection? 7. To which extent can you show that your selected water source, design of pump and solar panels match your water source capacity, size of plot and type of crop(s) you aim to cultivate? 8. To which extent have you considered safety issues, like theft, vandalism, and electrical safety? 9. To which extent have you considered environmental conditions, like bad weather events? 10. To which extent have you considered legal regulations, like environmental protection laws for water resources or waste management regulations for solar panels and batteries? For Solar Energy Dealership Companies, the following questions may be considered alongside some of the above questions

		11. What kind of female/male smallholder farmers/clients are you targeting? 12. Do you provide group lending to farmer groups in place of the collateral? 13. Do you provide design, installation and/or maintenance services for clients? 14. Do you provide training to your clients prior to installation? 15. How do you ensure the provided SPIS products do not fail? Do you or your third-party suppliers provide product quality guarantees? 16. Do you often record damages or theft cases from the SPIS from your clients? If yes, how often? 17. Do you check if your clients adhere to governmental laws and regulations around safety, environment and waste management?
4C	**Capital**	Under the capital, the creditor is interested in knowing the commitment level of the borrower to the facility. In this case, the term capital is equivalent to equity. Creditors are usually interested in the debt-to-equity ratio as it presents financial stability and commitment of the borrower. Usually, the acceptable level of debt-equity-ratio is 2:1. In the context of the SPIS Model, it is vital for credit officers to assess what the farmer has to aid to make the use of the SPIS effective. It is also important to look at land ownership rights and legal documents covering the farmland. Some statements/questions to consider include the following: 1. Have you invested your own money into the business? 2. Did you take personal risk to establish the business? 3. Do you own the land for the business/SPIS Project? 4. Do you own or have control of the water sources for the SPIS project? For Solar Energy Dealership Companies, the following questions may be considered alongside some of the above questions 5. What is your service fee arrangement like? (i) Pay before use of the SPIS (ii) Use the SPIS before payment / Pay-as-you-go (iii) Hybrid, for example paying in instalments 6. What is demonstrated effectiveness of your service fee model? What is the percentage of defaulters? 7. What are you mechanisms in place to deal with defaulters?
5C	**Collateral**	Under the collateral section, the creditor assesses the borrower's ability to repay the facility should the business fails. 1. Are you aware that if you do not have sufficient funds to repay the facility you need to sell your assets? 2. What type of property/ collateral do you have and where can it be located for verification?

		3. Can you provide additional security such as that can be used to repay the facility in case the business fails? 4. Do you belong to a farmer-based organization? 5. Would you like to join a group to qualify to access this loan facility? 6. How could this farmer group be diversified and organised effectively that the risk of defaulting is minimal? 7. How would you encourage group members to be committed to the SPIS facility in terms of repayments? For Solar Energy Dealership Companies, the following questions may be considered alongside some of the above questions 8. Do know of any other Solar Energy Dealership Companies? 9. Is there an association of Solar Energy Dealership Companies? 10. Do you belong to any Solar Energy Dealership association? 11. What kind of additional facility can you use to qualify for this facility?

The other details under the bankability metrics category for the pre-screening stage are:

B1: Business activity—The metrics in this section provide information on the organization size (number of employees), experience (years in operation), business activity (top commodities/products), links to markets (top clients), and level of indebtedness (financial disclosure).

B2: Governance and management capacity — despite the wide variety of information lenders seek on governance and management capacity, the selected metrics aim to provide ample information on the management team, their experience, dedication, and decision-making processes. While the metrics in the other two categories are mostly quantitative, the governance metrics are qualitative.

B3: Financials — the financial metrics selected include balance sheet and income statement indicators (e.g., revenue, cost of goods sold, assets, liabilities) to provide an overview of the financial capacity of the business. These metrics are complemented by financial ratios calculated based on the information provided in documents (e.g., projected financial statements) and indicate the state of the business in terms of liquidity, solvency, and level of indebtedness.

Below is a table describing the **bankability metrics** that will be useful for credit officers to **pre-screen** SPIS applicants. It should be noted however that requiring paperwork, income statements, registration documents and permits can easily lead to exclusion of farmers, and especially female farmers. Hence, the specific questions and accepted justifications, as well as the accepted level of risk, need to be adapted to the target group.

SECTION B1: Business activity		
METRIC NAME	**DESCRIPTION**	**AN INDICATOR OF (5CS)**
Year of foundation	Year the Organization/Farm/Company was founded	Condition
Number of employees (segregated by sex)	Number of all employees in the business, Condition including full-time, part-time, and temporary employees	Condition
Top three commodities/ products of the (by share of sales)	Top three commodities/products of the business by share of sales (value).	Condition
Current contracts specify pricing	Current contracts clearly define pricing for the products sold	Condition
SECTION B2: Governance		
Dedicated manager for each business function	Separate manager dedicated to each of: business function such as farm manager, finance manager	Character
Experience of the smallholder farmer / solar energy company	Number of years engaged in farming / solar energy	Character
Level of commitment of the smallholder farmer / solar energy company	The level of commitment of the business through indications to the business of other current professional occupations. Is the farmer fulltime or part-time? Is solar energy equipment a core or a side-business?	Character
SECTION B3: Financials		
Production capacity	Farm size, number of acres, production volumes Solar company's stock and trade volumes	Capacity
Disclosure of financial obligations	All outstanding debts, donations or grants and donations. For each, include provider, total amount, amount outstanding, security, purpose, start date, end date.	Capacity
Sales revenue	Value of the revenue from sales of the farmer's / company's products/services during the reporting period, for the past three years, if applicable. Strategy to deal with market price volatility.	Capacity
Cost of goods sold	Value of direct expenditures attributable to the production of the goods sold by the organization during the reporting period, for the past three years, if applicable	Capacity
Net income (Net profit)	Value of the organization's net profit, calculated as total income minus total expenses, taxes, and	Capacity

	cost of goods sold during the reporting period, for the past three years, if applicable.	

4.5 CASE STUDY / PRACTICAL WORK

Exercise on the 5cs of credit risks appraisal

Mr Alidu Adams is a smallholder farmer located in the Northern Region of Ghana. Alidu has 10 years of experience in farming soybean, maize, millet and rice in the Karaga District.
Mr Alidu approached Energy Bank to finance a SPIS Project for him. This in order to increase and sustain his production all-year-round. Mr Alidu has a vast land but the raining season is very short and highly un-predictable due to climate change.

Mr John Atanga is a Solar Energy Dealer. The name of his company is called North Sunlight Energy Company Ltd. North Sunlight Energy is specialised in the purchases of solar powered irrigation systems, installation, trading, lending and retailing to small holder farmers across Ghana at a fee.

Mr Alidu Adams has a working relationship with Mr John Atanga. A group of 10 smallholder farmers who are having difficulty accessing funds directly from the Bank to finance their SPIS, reached out to Mr Alidu Adams for advice on and support to access a solar energy dealership company. Mr Alidu Adams decided to recommend the smallholder farmers to North Sunlight Energy Company Ltd. As a result of this arrangement, North Sunlight Energy Company decided to get a SPIS facility from your Bank to purchase SPIS for on-warding transactions with his prospective clients, the small holder farmers located at the Karaga District in the Northern Region.

Questions

1. Explain the 5Cs of Credit Risks analysis in the context of SPIS
2. Alidu was pre-screened and shortlisted by your Bank for Due Diligence. As the Credit Officer, and using the 5Cs of credit risks analysis in the context of SPIS, advise the Credit Manager about Alidu's suitability or otherwise to access the SPIS facility of your Bank.
3. Is Alidu a high or low risk potential client? If Mr. Alidu was a female farmer would you give a different risk level to this client? Why?
4. If yes Mr Alidu is a high risk client, what advise will you give to Alidu to help him to de-risk his profile to access the SPIS Facility?
5. What advice will you give to the smallholder farmers in general to help them de-risk to enable them apply for your product? Try to give an answer for both a male and a female farmer.
6. North Sunlight Energy company has heard of your Bank's SPIS facility and decided to reach out to you for credit. Conduct a credit risk appraisal using the 5Cs for North Sunlight Company.
7. Is North Sunlight suitable for the credit facility?
8. What advise will you give to the credit manager?

When you can form a group of trainees, it is highly recommended to this practical assignment as a role play featuring Mr. Alidu, Mr. John Atanga and a representative of Energy Bank.

4.6 CASE STUDY / PRACTICAL WORK

Exercise on pre-screening data collection

Mrs Akousa Adjei is a smallholder farmer located in the Ashanti Region. Mrs Akosua is a maize farmer in Bosomtwe District. As a Credit Officer, you went to her field to screen whether she could be a potential SPIS client. You met Mrs Akosua and spoke to her about the SPIS facility. You need to obtain data to pre-screen Akosua among other clients.

In the context of a SPIS facility and using the ScopeInsight assessment bankability metrics, kindly collect information from the following categories as maybe applicable from Mrs Akosua Adjei for your Bank's pre-screening.

A1. Company Information A2. Contact Information
A3. Finance Request A4.Documents
B1. Bankability B2.Governance B3.Financials

This exercise is meant to do in pairs of two. One acts as a Credit Officer and one as Mrs Akousa Adjei. You can develop your own story and fictively describe a farm in Ashanti region.

4.7 PRACTICAL WORK

Reflection question on Women's access to finance

Answers the following questions and preferably discuss them with your male/female co-workers:

1. How are women represented in governance- and management structure of (my) financial institution?
2. Who are our customers (women/men/formal sector/informal sector)?
3. Which of our financial products/services do women/men use most? How frequently do women/men use these services?
4. Which of our financial products and services are targeted at women/men farmers?
5. Which of our financial products/services might be of value to women/men farmers?
6. What constraints are women/men farmers experiencing in accessing them?
7. How could we strengthen our internal policies to reach more women?

ANNEXES

Annex 1 | Practical exercises with calculations & solutions

Payback, Net Present Value (NPV), Internal Rate of Return (IRR)

For not yet familiar with the concepts of Payback time, NPV and IRR, this Annex provides a number of exercises to practice with these concepts and financial equations with the following exercises:

Exercise 1: Simple payback

Consider an investment of GHS 100, 000 into a solar powered irrigation system (SPIS). The SPIS is to replace an existing irrigation system powered by diesel generator with expected savings bills of GHS 40,000 per year. Find the simple payback period.

Exercise 2: Present net value

Determine the present value of expected saving of GHS 40,000 in five years' time at a discount rate of 15%.

Exercise 3: Present net value

An investment of GHS 100,000 has been made in a solar powered irrigation system, which is energy efficient with projected savings of GHS 40,000 per year for five years. Determine the net present value (NPV) of this investment for 5 years at a discount rate of 15%.

Exercise 4: Internal rate of return

A large SPIS project requires an investment of GHS 400,000. As a result of this investment, the following cash flows are likely to accrue in the next 5 years. Calculate the Internal Rate of Return.

Internal Rate of Return

Year	**Cash Flows (GHS)**
1	125,000
2	125,000
3	150,000
4	150,000
5	200,000

Exercise 5: Internal rate of return

Assuming North Solar company in Tamale is reviewing two projects. The company Management team needs to decide whether to move forward with one, both, or neither. Its cost of capital is 10%. The cash flow patterns for each project are as follows:

Project	A		B
	Year	Amount (GHS)	Amount (GHS)
	Initial Investment	5000	2000
	Year 1	1,700	400
	Year 2	1,900	700
	Year 3	1,600	500
	Year 4	1,500	400
	Year 5	700	300

The company must calculate the IRR for each project. Initial outlay (period = 0) will be negative.

Solution sheet – Payback, NPV, IRR Exercises 1-5

Exercise 1:

$$\text{Simple Payback} = \frac{\text{Investment Cost}}{\text{Annaul Savings}} = \frac{\text{GHS}100{,}000}{\text{GHS}\,40{,}000} = 2.5 \text{ years}$$

Exercise 2:

$$\text{Present value} = \frac{\text{Future value}}{(1+r)^n} = \frac{\text{GHS}40{,}000}{(1+0.15)^5} = \text{GHS}19{,}887$$

Exercise 3: Determine the present value of all cash flows

Using $\text{Present value} = \frac{\text{Future value}}{(1+r)^n}$ the following table is generated

Year = n	Cash Flow (GHS)	Present value (GHS)	Net present value (GHS)
0	-100,000	-100,000	-100,000
1	40,000	34,783	-65,217
2	40,000	30,246	-34,972
3	40,000	26,301	-8,671
4	40,000	22,870	14, 199
5	40,000	19,870	**34,086 Ans**

Note that the NPV only becomes positive after more than three years. A negative NPV project should not be undertaken (from a financial viability viewpoint).

Exercise 4:

The IRR of the value "k" will satisfy the following equation:

$$400{,}000 = \frac{125{,}000}{(1+k)^1} + \frac{125{,}000}{(1+k)^2} + \frac{150{,}000}{(1+k)^3} + \frac{150{,}000}{(1+k)^4} + \frac{200{,}000}{(1+k)^5}$$

From iteration method, we can estimate the IRR, which in this case lies between 23% and 24%

Exercise 5:

Solving for IRR is an iterative process using the following equation:

0 = Σ CFt ÷ (1 + IRR) t

where:
CF = net cash flow
IRR = internal rate of return
t = period (from 0 to last period)
-Or-

GHS 0 = (initial outlay * −1) + CF1 ÷ (1 + IRR)1 + CF2 ÷ (1 + IRR)2 + ... + CFX ÷ (1 + IRR)X

Using the above examples, the company can calculate IRR for each project as:

IRR Project A:
GHS 0 = (− 5,000) + 1,700 ÷ (1 + IRR)1 + 1,900 ÷ (1 + IRR)2 + GHS 1,600 ÷ (1 + IRR)3 + 1,500 ÷ (1 + IRR)4 + 700 ÷ (1 + IRR)5

⇨ IRR Project A = 16.61 %

IRR Project B:
GHS 0 = (−2,000) + 400 ÷ (1 + IRR)1 + 700 ÷ (1 + IRR)2 + 500 ÷ (1 + IRR)3 + 400 ÷ (1 + IRR)4 + 300 ÷ (1 + IRR)5

⇨ IRR Project B = 5.23 %

Given that the company's cost of capital is 10%, management should proceed with Project A and reject Project B because the internal rate of return on investment for project A is far better than the return on investment for project B.

Decision Rule: If IRR exceeds cost of capital, project is worthwhile, i.e., it is profitable to undertake

Solution sheet – Case study / practical 3.7

	HAJIA SAFIA FARMS, KARAGA - GHANA				
A	**EXISTING BUSINESS**				
1	**ASSETS**				**Depreciation**
	Land	4 acres	3,000.00		
	Tricycle	1	17,500.00	10	1,750.00
	Motor Bike	1	7,500.00	10	750.00
			28,000.00		**2,500.00**
2	**REVENUE**				
	Pepper	13	550.00		7,150.00
	Okro	17	370.00		6,290.00
	Livestock	12	515.00		6,180.00
	Sale of Manure	1			900.00
	Tricycle	52	250.00		13,000.00
					33,520.00
3	**EXPENDITURE**				
	Animal Feed	52	100.00		5,200.00
	Land Preperation	1	550.00		550.00
	Wages of Tricycle Rider	12	300.00		3,600.00
	Casual Farm Labour	320	15.00		4,800.00
	Fuel	520	12.00		6,240.00
	School Fees	1	2,000.00		2,000.00
	Building Project	1	5,000.00		5,000.00
	Susu	52	100.00		5,200.00
					32,590.00
	SOLUTION				
	Q1. a)		20,520.00		
	b)		33,520.00		
	c)		2,500.00	Depreciation	
	d) Components of Variable Cost	Annual Cost	Monthly		
	Animal Feed	5,200.00	433.33		
	Land Preperation	550.00	45.83		
	Wages of Tricycle Rider	3,600.00	300.00		
	Casual Farm Labour	4,800.00	400.00		
	Fuel	6,240.00	520.00		
		20,390.00	**1,699.17**		
	e) Hajia's Gross Profit		31,020.00	(33,520.00 - 2,500.00)	
	f) The farm's net profit		10,630.00	(31,020.00 -20,390.00)	

	HAJIA SAFIA FARMS, KARAGA - GHANA						
B	**PROPOSED IRRIGATION PRJECT**						
1	**ASSETS**		**Cost**	**Est. Lifespan**	**Solvage Value**	**Dep. Val**	
	Solar Panels		150,000.00	15	15,000.00	135,000.00	9,000.00
	Control Unit		35,000.00	10	-	35,000.00	3,500.00
	Motor pump		75,000.00	10	5,000.00	70,000.00	7,000.00
	Wires/Tubes		10,000.00	10	-	10,000.00	1,000.00
	Water storage		25,000.00	10	1,000.00	24,000.00	2,400.00
	Irrigation system		50,000.00	10	2,000.00	48,000.00	4,800.00
	Installation cost		15,000.00				-
	Maintenance cost (per annum)		3,000.00				-
	TOTAL ANNUAL DEPRECIATION		363,000.00				**27,700.00**
2	**OTHER EXPENSES**						
	Additional Labour Cost	6	1,050.00		6,300.00		
	Additional Cost of Land Preparation	1	950.00		950.00		
	Maintenance cost (per annum)				3,000.00		
					10,250.00		
3	**PROJECTED REVENUE FROM IRRIGATION PROJECT**						
	Sale of Tomato	2350	35.00		82,250.00		

	SOLUTION			
	Q2. a)		27,700.00	i. e total annual depreciation
	b)	10,250.00	854.17	(annual maintenance+Add Labour+add land Prep cost)
	c)		82,250.00	Additional gross revenue from irrigation project
	d) Projected total revenue		115,770.00	(GHS33,520.00+GHS82,250.00)
	Projected total fixed costs		30,200.00	(GHS27,700.00+GHS2,500.00)
	Projected total variable costs		33,640.00	(GHS10,250.00+20,390.00)
	Projected gross profit		85,570.00	(GHS115,770.00-GHS30,200.00)
	Projected net profit		51,930.00	(GHS85,570.00-GHS30,640.00)
	Q3. a) Pay Back Period of proposed irrigation project			5 years (GHS360,000.00/GHS72,000.00 per annum)
	b) Net Present Value (20 yrs is assumed)			(GHS360,000.00)+GHS72,000.00*r
	c) Internal Rate of Return			GHS360,000.00/GHS72,000.00r

Annex 2 | GIZ RBF Solar Companies in Ghana - Contact Information

Company		Location	Contact person	Contact number
1	Deng Ltd	Accra	Kenneth Cornelius	0244337443
2	Pumptech Ltd	Tamale	Osman Sahanoon Kulendi	0243259020
3	Foundries & Agric Machinery GH Ltd	Tema	Meshack Lartey	0557237157
4	Jahan Engineering	Kasoa	Abass Addy	020811742
5	Agaabi Plumbering Services	Accra	Gabriel Asare	0246477929

Annex 3 | Gender and energy terminology

Gender Terms/Concepts

Gender and sex: sex refers to the biological differences between male and female bodies. Gender refers to the socially-constructed attitudes, values, roles and responsibilities of women and men, in a given culture and location which are learned and which change over time.

Gender analysis: the critical examination of a problem or situation in order to identify differences in the gender roles. Activities, needs, rights/entitlements and available opportunities of women, men, girls and boys.

Gender approach: the design and implementation of policies and projects in such a way that they are more gender aware in their objectives, implementation and outcomes.

Gender audit: a tool to identify and analyse the factors that hinder efforts to mainstream gender in policy, used as part of a process in developing a more gender aware policy.

Gender awareness: the understanding that there are socially determined differences between women and men, based on learned behaviour, that affect one's ability to take decisions and action and to access and control resources.

Gender blindness: the failure to recognize the different roles, responsibilities, capabilities, needs and priorities of women and men.

Gender budgeting: the application of gender mainstreaming in the budgetary process.

Gender discrimination: giving differential treatment to individuals on the grounds of their gender in the distribution of income, access to resources and participation in decision-making.

Gendered division of labour: an overall societal pattern whereby women are allotted one set of gender roles and men another.

Gender equality: the condition in society when both men and women are attributed equal social value, equal rights and equal responsibilities, and have equal access to the means (resources, opportunities) to exercise them.

Gender equity: fairness and justice for women and men in the distribution of benefits and responsibilities.

Gender equitable energy outcomes: women and girls' lives improve relative to men's as a consequence of energy investments. Women have equal opportunity relative to men to participate as managers, employees or entrepreneurs in the processes of implementing these investments.

Gender gap: an observable and sometimes measurable gap between men and women in terms of a specific societal outcome.

Gender goal: the desired state to be achieved for women and men by a policy or project.

Gender indicators: measures of people's situation in society that can show gender differences and gaps and identify differences that can lead to stereotypes.

Gender inequality: inequality, on the basis of a person's gender, in access to and control over the various material and non-material resources and assets of a society and the benefits which accrue from these.

Gender mainstreaming: a strategy for ensuring that the concerns and experiences of women and men are an integral part of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic, and societal spheres.

Gender neutral: the assumption, enshrined in gender-neutral language and concepts, that women and men benefit equally from policies, programmes and projects with equal capacity and opportunity to respond to and to influence and control, the processes and outcomes.

Gender responsive: actions that reflect an understanding of the realities of women's and men's lives and address the issues, taking into consideration the implicit and explicit social norms.

Gender roles: sets of behaviour, activities, tasks and responsibilities assigned to men and women, differentiated according to the cultural norms and traditions of the society where they live which define the perception of what is to be male and female, and hence shape identity.

Gender sensitivity: the ability to recognize gender issues and the different perception and interests of women and men arising from their different social location and different gender roles.

Gender transformative approaches: interventions that create opportunities for individuals to actively challenge gender norms, that promote positions of social and political influence for women in communities and in social, political and economic spheres at all levels of society and that address gender-based power inequities.

Patriarchy: an ideology that promotes the male domination of ownership and control at all levels in society, and which maintains and operates the prevailing system of property rights and the gendered division of labour.

Practical needs: requirements that women and men perceive as immediate necessities, such as water, shelter and food, for their survival.

Strategic interests: women's strategic interests are those related to women changing their position in society, gaining more equality with men and empowerment in all its senses.

Quota system: a specified number or proportion of participation spaces so that various groups can share and participate in social, political and economic activities.

Sex-disaggregated data: separation of data by sex as the basis of gender analysis.

Women in Development (WID): an approach to development that focuses on women with the aim to improve the status of women.

Women's empowerment: a process by which women and girls gain power and control over their own lives through awareness-raising, building self-confidence, expansion of choices, increased access, and ownership and control over resources and actions, to transform the structures and institutions that reinforce and perpetuate gender discrimination and inequality.

Exercise - statements defining sex and gender

Which of the following statements relate to gender and which ones relate to sex?

1. Women give birth to babies, men don't.
2. Men carry babies on their shoulders, women carry babies on their back.
3. Girls are gentle, boys are tough.
4. Men produce stoves, women cook with stoves.
5. Men are susceptible to prostate cancer; women are susceptible to cervical cancer.
6. Men own lands and farms; women farm on family lands.

ANS. G=gender, S=sex. 1.S; 2.G; 3.G; 4.G; 5.S; 6.G

Energy Terms/Concepts

Access to energy services: the ability of an end user to utilize energy services (such as lighting, cooking, motive power, etc.) that require an energy appliance and suitable energy supply. Access to energy services does not necessarily imply control or decision-making.

Access to energy supply: the ability of an end user to utilize an energy supply that can be used for desired energy services. Energy access is taken to refer to both physical availability of supply and ability to use the supply. Access to energy supply and access to appliances are necessary for access to energy services.

Biomass fuel: any organic material of plant or animal origin such as wood, charcoal, agricultural residues and dung, used as a fuel.

Connection: a connection entails registration as a consumer to use an energy supply infrastructure. This can be electricity or piped gas, as well as bottled gas that needs to be collected at a delivery point.

Decentralized energy supply: energy supply generated at a point or near the point of use. Decentralized supply can be grid-connected or off-grid (individual or small distributed system), and can be in the form of electricity, heat, etc.

End-user: the consumer who requires energy services. End-users may be members of a household, they may be enterprises using energy for productive purposes, or they may be community institutions.

Energy: energy comes in different forms, including fossil fuels, biomass fuel, power electricity), and animate forms of energy, particularly human metabolic energy. Food energy is not included.

Energy efficiency: the ratio of output energy to input energy gives a measure of the conversion efficiency of a particular piece of equipment. The ratio varies and

can never by 100%. Engineering design aims to maximise the conversion efficiency which in turn influences the economics of use.

Energy poverty: an absence of sufficient choice in accessing adequate, affordable, reliable, clean, high-quality, safe and benign energy services to support economic and human development.

Energy results chain: the series of causal linkages from energy policy through energy interventions to their development outcomes. Energy supply and use of energy services are key elements of the energy results chain.

Energy sector reform: structural changes in the policies and institutions that govern any part – production, transmission or distribution – of the energy value chain, and any fuel within this value chain.

Energy services: the useful services that result from the use of energy; for example, illumination, refrigerated storage, transportation and appropriate heat for cooking. End-users usually express a need or desire for an energy service rather than a particular form of energy.

Energy supply: the physical availability of energy carriers to a location where there is demand. Energy supply is an insufficient indicator of access as it does not assume the ability to use the supply (for example the supply may not be affordable or appropriate for use).

Energy technology: the hardware, or end-use device that converts an energy carrier into a form of energy useful to the end-user, thus providing a desired energy service.

Fuels: a store of energy including solid and non-solid fuels, from fossil and renewable sources.

Grid: a system of synchronized power providers and consumers connected by transmission and distribution lines and operated by one or more control centres.

Grid-connected: a physical connection (grid or non-grid) to the electric power grid is in place (as opposed to off-grid). Grid connection may or may not include illegal physical connections.

Household connection: the connection (grid or non-grid) to an energy supply at household level (does not provide an indication of use, or possible differentiated use by members of the household. A household connection may be used for productive uses).

Modern energy: there is no universally agreed definition of 'modern energy'. Modern energy includes electricity, gas (egg. natural gas, LPG, producer gas) and liquid fuels for transport (e.g. Petrol, diesel and biofuels). This definition separates the issue of modernity from a number of issues of sustainability, such as those related to including fossil fuels (which not everyone would agree should be included), and to including biofuels if they complete with food crops.

Off-grid: electricity supply that is not connected to a central grid system.

Productive use of energy: use of energy for income generation (in formal/informal enterprise, home-based or in an enterprise location), including farm and non-farm income generation.

Reliability of energy supply: predictability of energy supply entails absence of unexpected outages.

Useful energy: the energy that goes into an energy service, rather than being lost in conversion or transport.

Annex 4 | List of resources

GIZ's TOOLBOX - MARKET, INVEST and FINANCE Tools on SPIS

https://energypedia.info/wiki/Toolbox_on_SPIS

https://www.youtube.com/watch?v=bJsftBWOpdo

List of References

Abu-Nowar, L. M. (2020). Economic and Financial Assessment of Solar-Powered Irrigation. *Journal of Agricultural Science*, *12*(4), 185. https://doi.org/10.5539/jas.v12n4p185

IRENA. (2016). Solar pumping for irrigation: Improving livelihoods and sustainability. *The International Renewable Energy Agency* (Issue June). https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Solar_Pumping_for_Irrigation_2016.pdf

PARM (2019). Gender in agricultural risk management: analytical framework and operational guidelines – (by Desiree Zwanck). Rome: PARM/IFAD. Available at: http://p4arm.org/document/gender-in-agricultural-risk-management/

Roger Boyd (2013), Energy and the Financial System: What Every Economist, Financial Analyst, and Investor Needs to Know, ISBN-13: 978-3319042

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