SMALL SCALE IRRIGATION DIALOGUE SPACE:

Understanding the scalability of solar-powered irrigation in Ghana: market segmentation and mapping pump suitability

Submitted to:

The Feed the Future Innovation Laboratory for Small Scale Irrigation (ILSSI) and Africa Research in Sustainable Intensification for the Next Generation (Africa RISING)

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Introduction

Through the Feed the Future Innovation Laboratory for Small Scale Irrigation (ILSSI), the Small Scale Irrigation (SSI) Multi-stakeholder Dialogue Space was established in 2019 as a unique strategy to bring stakeholders together to encourage collective thinking across sectors and explore new opportunities and solutions to scaling SSI in Ghana. This meeting - the 3rd Multi Stakeholder Dialogue (MSD) - is organized by International Water Management Institute (IWMI) through ILSSI and Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) – two projects funded by the U.S. Agency for International Development (USAID). The meeting was the first one in a series of dialogues on market systems and value chain approaches to support farmer-led irrigation (FLI) development. It zoomed into the data-driven tools to open opportunities for growth, inform private sector's product development to improve customer retention and facilitate sustainability of solar-powered irrigation. The aim of this meeting was to:

- Explore the customization of solar suitability maps to geographical areas and pump characteristics,
- Share insights into market segment for potential clients of solar-powered irrigation pumps and how segmenting the market can support client acquisition, and
- Discuss ways to customize solar suitability maps and visualize market segmentation for solar-powered irrigation technologies in Ghana (Annex 1).

The meeting was held on May 4, 2021 at Mensvic Grand Hotel in East Legon, Accra in Ghana. A total of fifty-five invitations were sent via email to individuals representing government agencies and departments, development partners and donors, irrigation technology and equipment supply, private sector actors, research institutions and farmer organizations. A total number of forty-four people registered to attend the meeting (Figure 1a). Actual attendance was thirty-six (Annex 2) out of which six joined virtually through Zoom (Figure 1b). The highest attendance was from research organizations (28%). Government agencies and departments and irrigation technology and equipment supply formed the second highest groups of attendees (19% each). This shows a growing interest to drive investment into renewable energy-based irrigation technology among equipment suppliers and government agencies and departments. Development partners and donors and private sector participants each accounted for 14% of the attendance. The lowest attendance was recorded from farmer organizations (6%). This is because of the low number of farmer organizations invited to attend this event.

The meeting started with a welcome speech from Dr. Olufunke Cofie, Country Representative, IWMI Ghana. She pointed out that the MSDs have been organized since 2019 to discuss with participants how to encourage farmer-led irrigation (FLI) by addressing the challenges with FLI scaling. This is because evidence has shown that there is a high potential for expanding FLI activities in Ghana. The use of

motorized pumps is high among farmers, especially among those involved in cultivation of high value vegetables.

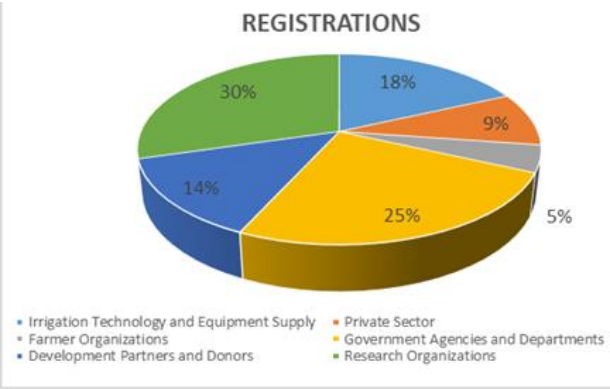

Figure 1a: Groups of registrants

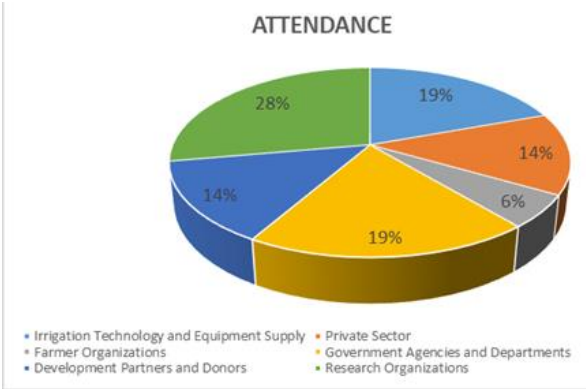

Figure 1b: Groups of attendees

The first presentation was by Dr. Mansoor Leh, Researcher - Spatial Hydrology and Hydro Informatics at IWMI. He explained how online tools may be used to guide decision makers on the best locations for investing in solar-powered pump infrastructure, considering the source of water and pump characteristics. This was followed by a presentation by Joseph Mensah from PEG Africa, highlighting the benefits PEG has derived from utilizing solar suitability maps customized by IWMI for their products and sales locations. It continued with plenary discussions on the need and potential of customizing solar suitability maps for business sustainability. The final presentation for the meeting was done by Osman Sahanoon Kulendi, Managing Director for Pumptech Ghana, highlighting the benefits of the PS2-100 solar-powered irrigation pump who explained various market segments that IWMI has helped to identify in the Upper East Region for Pumptech products. The breakout group discussions focused on the importance of understanding market segments, outcomes of a better understanding of these segments and innovative ways of market segmentation from the perspectives of gender inclusion, government and practitioners and private sector actors.

Highlights from customization of solar suitability maps

Solar suitability mapping tool for enhancing sustainability of solar-powered irrigation scaling

IWMI has developed an interactive solar suitability online mapping tool (http://sip.africa.iwmi.org/) that is used to assess land suitability for photovoltaic-based irrigation, using solar energy (Figure 2a). The tool helps users to identify suitable areas for solar-based irrigation depending on water sources and pump characteristics[1]. This solar suitability mapping framework was developed using a GIS-based Multi-Criteria Evaluation technique. The multi-criteria evaluation was implemented by combining spatial information from a number of geospatial drivers for solar based irrigation sourced from a variety of national and international databases. Data used include solar irradiation, slope, underground water levels and sustainability, water storage, proximity to rivers, proximity to small dams and inland valleys, soil characteristics, crop and land suitability, aquifer productivity, population, roads and travel time to markets. Slope gradient has a major effect on agricultural productivity where steeper gradients facilitate increased runoff and hence accelerated risk of soil erosion and slopes greater than 8% are not typically recommended for agriculture. In addition, a constraint layer is developed to differentiate areas that would be suitable for solar based irrigation from those that cannot be suitable under any condition. Protected zones, forested and urban areas and areas with extreme droughts identified as unsuitable for agricultural production are excluded. Weights are applied to available data to create data layers. Using the data layers and the water source within a particular region, the online tool may be used to determine how suitable a location is for solar-powered irrigation. The water source may be surface water, underground water at different depths or both surface and underground water (Figure 2b).

[1] This was first piloted in Ethiopia in 2018 and currently covers several countries in sub-Saharan Africa and beyond, including Ghana. The tool was developed with funding from GIZ and WLE.

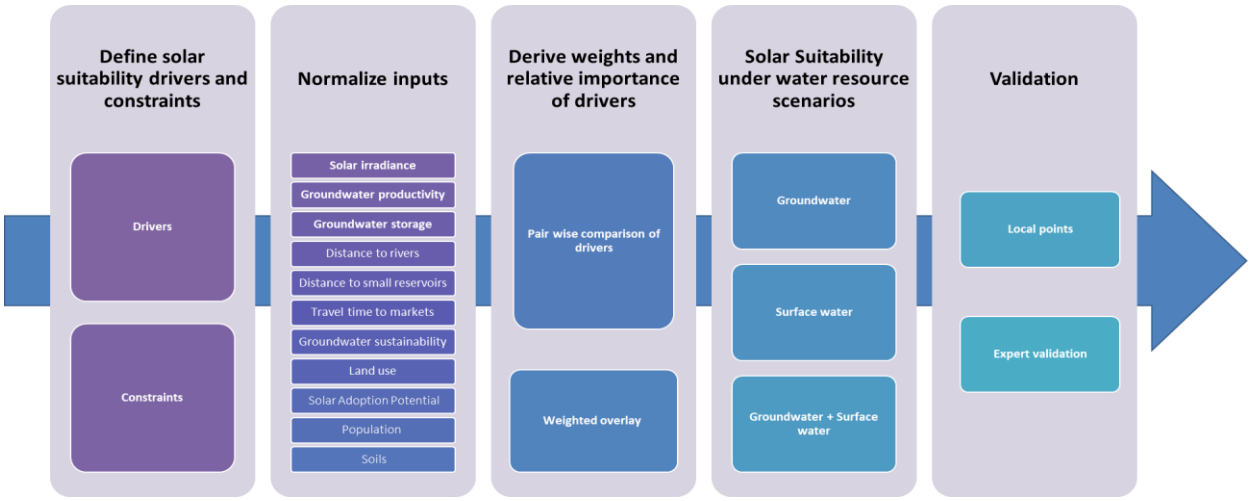

Figure 2a. Solar suitability mapping process[2]

- Surface water
- Ground water
- Surface & Ground water

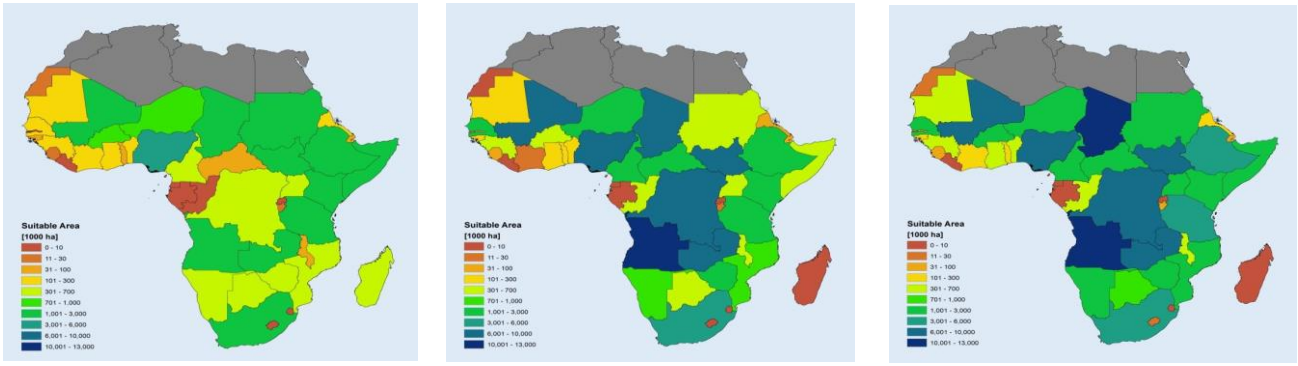

Figure 2b. Solar suitability maps for surface water, underground water or both

Customizing the solar suitability map for PEG Africa's solar powered irrigation

The customized solar suitability maps for PEG Ghana guide the field team in identifying potential opportunity areas for selling solar technology (Figure 3a). The maps have made it easier for PEG to identify water resources within a particular geographical area so that the most suitable pumps may be recommended for potential clients within that geographical area in terms of water resource type and depth suitability. PEG has also used the information to suggest new product lines that may be piloted in particular geographical zones (Figure 3b). Marketing initiatives and interactions with other actors within the irrigation supply chain have also been guided by the maps. This has helped PEG to establish a sales agent network within the high potential geographical areas. Partnerships have been formed with agro-input dealers and other actors to stock PEG products, lowering the transportation cost per unit for the end users. New business opportunities have opened for PEG especially in the Ashanti, Bono, Bono East and Ahafo Regions. Sales have also been recorded in the Eastern, Volta and Central Regions in this regard.

PEG has recognized the impact that the solar suitability maps have had on its business development drive. In this regard, PEG recommends that IWMI develops solar suitability maps at a more granular level, going beyond the current district-level information. PEG recommends a mobile app that can help PEG staff to identify water resources within each district. The current practice is for the technical team to contact local MoFA offices or extension agents to help identify water resources within each district.

[2] Dr. Mansoor Leh's presentation on 'Solar suitability mapping: An online tool for business sustainability', the third meeting of Small Scale Irrigation Dialogue Space on 'Understanding the scalability of solar powered irrigation in Ghana: market segmentation and mapping pump suitability?', 4th May 2021

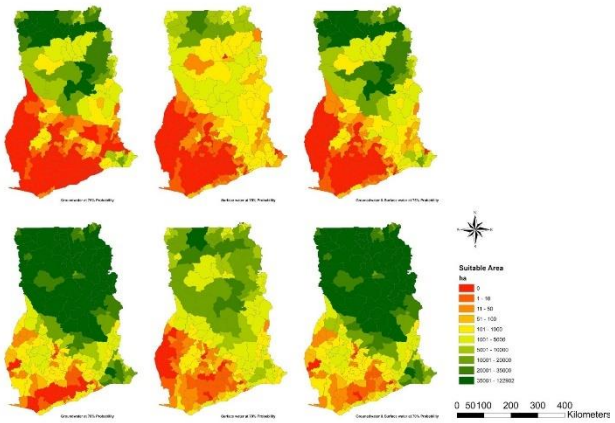

Figure 3a. Opportunity identification[3]

Figure 3a. Solar suitability utilization

Needs and potential to customize the solar suitability map for business sustainability

The plenary group discussion highlighted the needs and potential to customize the solar suitability map for business sustainability. There is a growing interest around Africa for solar suitability maps. This is evident in countries such as Nigeria, Togo and Mozambique. Also, generating more granular information within the maps is possible, if the right data sets are available. Accessibility to data is therefore important for both IWMI and the user of the solar suitability tool. It was mentioned that IWMI should explore the possibility of accessing more granular data from the Ghana Geological Service.

Challenges to the solar suitability map customization for business sustainability are, however, numerous. ***Business-related challenges*** show that solar-powered irrigation pumps are very demand-specific and expensive for farmers to afford. PEG's distributed pumps, for example, have a wide range of pumps up to 5.5hp and the company currently has few customers in the northern region because many of the farmers cannot afford PEG pumps even on a pay-as-you-go basis. Moreover, matching the solar-powered irrigation pump, irrigation system (e.g. drip, sprinkler and spray tube) and the water requirements for a variety of crops requires big and consistent data to integrate into the mapping tool. ***Contextual conditions*** such as flood and drought can destruct permanent solar infrastructure, especially in the Upper East Region. Some farms and irrigation infrastructures have also experienced destruction from animals including cattle and elephants. Herders from neighbouring countries sometimes pose challenges by destroying farms with their animals and making farmers insecure including further concerns over instances of murder and rape. In case of underground water extraction, both pump sellers and farmers often overlook borehole/aquifer characteristics. ***Clients*** often have inadequate access to information on affordability for solar-powered irrigation pumps, security of solar panels, unsuitability of crops they grow and the type of irrigation method they practice. Women clients face challenges of limited access to gender-sensitive solar technology, irrigable land and the maximum depth of underground water that PEG solar-powered pumps can reach. In PEG's current business, only about 1% of PEG's clients are women and these women acquired the solar technology through their husbands.

Participants suggested that large scale farmers should also be targeted because they have the financial ability to purchase solar technology to provide service or share with smallholder farmers they employ to work within the commercial farms. Commercial farms may also offer assistance to the smallholder farmers or act as a collateral during repayment under the pay-as-you-go model. Solar distributors should advocate for products that cannot be re-used once they have been removed from particular units. Farmer-to-farmer recommendation approach could be used to promote sales. Working towards women farmers' access to solar technology can be achieved with gender-sensitive credit scorecards and inclusive business models.

[3] Joseph Mensah's presentation on "PEG Africa: Customizing the Solar Suitability Map for Solar Powered Irrigation", the third meeting of Small Scale Irrigation Dialogue Space on 'Understanding the scalability of solar powered irrigation in Ghana: market segmentation and mapping pump suitability?', 4th May 2021

Market segments for Pumptech's supply of solar-powered irrigation pumps

PS2 solar-powered irrigation pumps and pay-as-you-own financing

Pumptech is a water infrastructure company established in Ghana for the last 13 years. Pumptech has installed over 2,000 solar-powered pumping systems for community water supply, irrigation and for responsible leisure. The abundance of sunlight in Ghana provides an opportunity for using renewable energy products like Lorentz solar-powered pumps for cropping, human consumption and animals. With the technological advances, solar-powered pumps now have the ability to pump as much water as grid pumps and may even exceed the capacity of grid pumps. Current solar-powered pumps have the capacity to provide water as low as 5 cubic metres a day and as high as 800 cubic metres an hour. Solar-powered pumps may be classified according to how they lift water (submersible or surface pumps) or how they deliver water (mechanical or centrifugal).

Lorentz pumps[4] have special features that make them ideal for irrigation purposes. The pumps are adaptive and have features that allow the user to communicate with the pump. They serve the purpose of varied methods of irrigation including sprinklers, drip and centre pivot unlike previous solar technology. They can be regulated to give differential pressures, constant pressures and a number of variations in the flow to serve the needs of the farmer. Communication with Lorentz pumps may be from a distance using an app or from close range using android Bluetooth technology. This helps to reduce downtime for the pump. Pumptech carries a wide range of pumps as part of its portfolio from 100 watts to 500 kilowatts and offers a complete solution when it comes to pumps. No third-party components are integrated into the systems. The farmer is guaranteed harmony in the functioning of the pump. Pumptech also employs a sizing tool to help decide the best pump for a farmer's needs.

The smallest pump within the Pumptech range is the *PS2-100* which has been labelled as "the farmer's friend" because of its portability. All components and panels fit into one box, making it easy to carry and transport using motorbikes, bicycles or other means of transportation. The *PS2-100* pump has three models of pump heads that may be fitted depending on the water source and the daily water requirements of the farm. Pump heads are suitable for a variety of water depths, ranging from 10 metres to 100 metres. The advantage of such a system to the farmer is that a change in water source may not require a change in the pump used. The controller of the *PS2-100* pump is 100% water resistant, making it very durable, even within water. It is also plug-and-play and does not require any form of wiring, therefore making it easy for self-installation. This puts the farmer in charge, eliminating the need for frequent visits of solar technology experts.

The pay-as-you-own[5] financing model from Pumptech is a flexible credit system that allows farmers to use solar-powered irrigation pumps while paying in installments to acquire it. It is customized to the needs of each farmer and involves the payment of an initial deposit and regular subsequent payments as agreed with Pumptech. The payment may be weekly, monthly, quarterly or scheduled around the farmer's harvest times. The initial deposit is equated to an amount of water which is programmed into the chip of the pump. The pump automatically stops working once that amount of water has been used by the farmer unless he/she makes payment as per the agreed installment pay schedule. The pump becomes the property of the farmer after all installments have been paid.

Market segments for PS2 pumps bundled with pay-as-you-own financing in the Upper East Region

Since 2020, Pumptech has partnered with IWMI to segment the market for the various products in the Upper East Region. Pumptech has been able to segment its market for a range of PS2 solar-powered irrigation pumps within the Upper East Region. The segmentation was done based on land and water

[4] Osman Sahanoon Kulendi's presentation on "Market segment for PS2 solar-powered irrigation pump in the Upper East Region", the third meeting of Small Scale Irrigation Dialogue Space on 'Understanding the scalability of solar powered irrigation in Ghana: Market segmentation and mapping pump suitability?', 4th May 2021

[5] Pay-as-you-own is also an effectively asset-based financing or PAYGO

access, irrigation and production arrangement, financial capital and potential and farmer preferences (Table 1).

Table 1. Different market segments for Pumptech's distributed solar-powered irrigation pumps

Characteristics	Resource-rich farmers	Mobile farmers	Resource-limited individual farmers	Farmer Groups
Land and water access	- Owning relatively large land area - Being able to control water sources	- No ownership to irrigated land area - Access mainly to surface water	- Permanent access to cultivated land - Access mainly to underground water	- Individual ownership to cultivated land with possible access to common land - Access mainly to underground water
Arrangement of irrigation and production	- Advanced irrigation system managed by individual farmers	- Individual and/or informal group management - Flexible	- Individual/group management - Potential to expand production	- Individual and/or collective management of irrigation
Financial capital and potential	- Financial potential to invest into solar-power pump for irrigation as an individual	- Relatively high potential to invest into solar-power pump - An individual or group investment	- Very limited financial capital, especially female farmers - Relatively high potential to invest into solar-powered pump	- Limited financial capacity to invest - Potential to collectively invest into relatively high capacity of solar-powered pump
Pump product preferences	- High capacity of solar-power pump accompanying with payment schedule	- Low capacity and moveable solar - Solar-power pump with or without payment schedule	- Low/medium capacity of solar-powered pump for irrigation and/or multiple uses	- Medium/high capacity of solar-powered pump for irrigation and/or multiple uses when collective financial management and mobilization are organized

The ***resource-rich farmers*** understand the economic reasons why they farm. They can afford their own land, water source and mechanism for pumping water. They have the financial muscle to buy pumps even without credit. The ***mobile farmers*** do not own the land they cultivate during the dry season. They move from their residential area to irrigate fields close to publicly funded irrigation schemes where they can access cultivated land and surface water sources. Motor pumps are commonly used despite the high running costs. Their farming is seasonal, and they move from place to place, making it unattractive for them to invest in permanent solar-powered pump infrastructure. ***Resource-limited individual farmers*** have access to land within their communities and the natural resources around them, but they don't understand farming as a business. They usually farm for survival or because they grew up seeing their fathers farm. As a result, they have the potential but cannot make upfront payment for the pumps. They are often limited by access to water and capital. The pay-as-you-own option is possible for some resource-limited farmers. The ***farmer groups*** have to pool their strengths together to purchase shared solar infrastructure, especially when bundling with the pay-as-you-own option.

Challenges encountered by Pumptech include the perception that solar technology is expensive. This is because of a direct comparison between the initial cost of grid or motor pumps and solar-powered pumps. The value of the solar-powered irrigation pump is best seen in the life span of the pump, which is often much longer than the grid pumps. Solar devices can be controlled in terms of the power they produce, unlike grid pumps that are prone to damage from power fluctuations. Theft of solar panels and pumps may sometimes occur, especially in communities close to the country's borders. Structures for holding solar panels are fixed in such a way that the panels will be damaged if anyone attempts to remove them. This is to minimize theft of solar infrastructure.

The market segmentation presentation brought up concerns on gender inclusion within the various market segments. Emphasis was on the number of women identified in the various market segments. The *PS2-100* pump, which is light weight (14kg pump head and 5kg panel) and easy to assemble, is a gender-friendly pump. The *PS2-100* is a full package that includes the pump, cables and solar panels, making it relatively affordable to women farmers or groups of farmers at a price of GHS 7,000. Pumptech also

acknowledges the need to reach more female clients. Poor access of women to productive resources such as land and water serves as a disincentive for them to invest in solar technology.

Reflecting market segmentation with different practical implications

Market segmentation is the process of dividing a target market into smaller, more defined categories. Each segment or group shares similar characteristics such as demographics, interests, needs, location or preferences amongst others[6]. There are several advantages for segmenting markets. These include improved campaign performance; better product development; improved business focus and informed business decisions. There are different types of market segmentations with different measures. The demographic segmentation considers details such as age, occupation, education, family size and income. Geography splits up markets based on location. Customer behaviour such as likes and dislikes when interacting with a product or service may also be used to split markets. Psychographic segmentation considers customer personalities and characteristics such as lifestyle, attitude and motivations. Market segmentation cannot and should not be generalized. It must be tailor-made, taking into account the particular needs of the actors such as gender inclusion, types of crops grown, water resources available and so on. Therefore, there is the need to identify the ***segmentation basis*** that will best fit solar-powered irrigation pumps. From this basis, the participants discussed market segmentation from gender inclusion, government/practitioners and private sector business implication.

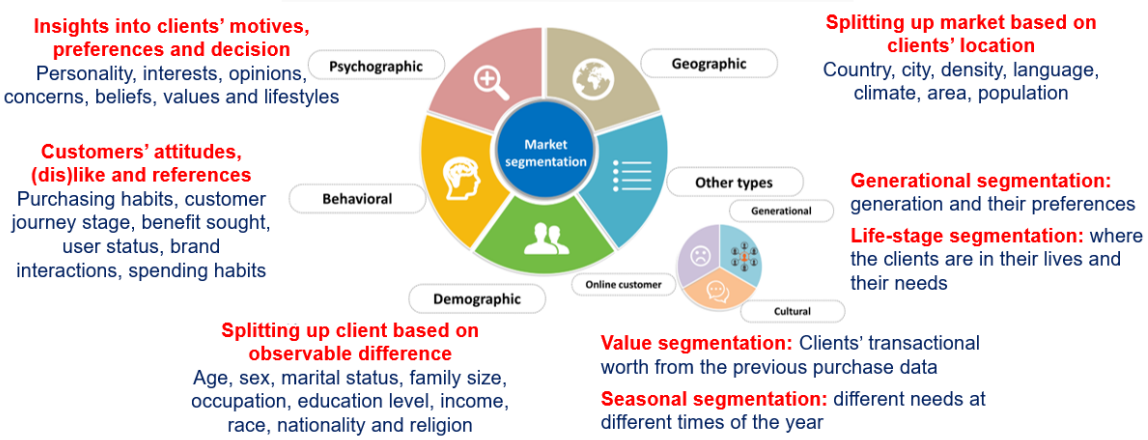

Figure 4. Bases for segmenting consumer markets

For ***government and practitioners,*** market segmentation helps to identify the needs of the various actors within the market to design and offer the right solutions to the right target groups. It also helps to allocate resources in a more appropriate way. Market segmentation also helps to enhance impact when target groups are better specified, their potential involvement is identified and innovative ideas/interventions are offered to meet their needs. For the ***private sector,*** market segmentation helps to identify the needs and interests of various groups within the target market such as women, youth and persons with disabilities. With better market segmentation, companies can save time, while reducing cost and effort, when attempting to reach new customers in target markets. In this way, market segmentation indirectly contributes to business growth in the agricultural sector.

For ***gender inclusion implication,*** market segmentation highlights various aspects. First, *gender-sensitive products* could be simple to assemble and lightweight to attract women. A well segmented market will recognize the need to design products that are within the income levels of its women targets as many women are at the bottom of the pyramid. Product design must also fit the time schedules of the intended women farmers as they may not have the opportunity to water their farms when sunlight is at its peak due to work and house chores. The solar-powered irrigation products that can still be used after peak

[6] IWMI's presentation on "Market segmentation: Introduction and discussion", the third meeting of Small Scale Irrigation Dialogue Space on 'Understanding the scalability of solar powered irrigation in Ghana: market segmentation and mapping pump suitability?', 4th May 2021

hours allow women farmers to participate in solar irrigated agriculture. Second, *pump capacity* needs to reflect women farmers' resource availability. Women generally have smaller farm sizes compared to men. Manufacturers can therefore make lower capacity pumps with lower prices that will meet the needs of women farmers and men farmers with small plot sizes. Some women's farms are far away from their homes, requiring a portable technology or a secured technology that will not be stolen if left on the farm. With this understanding, the manufacturer will invest in technology that addresses this need for both men and women.

Gender-sensitive market segmentation will benefit women farmers in various ways. It has both social and economic benefits. With access to appropriate technology, women's farm productivity will improve, contributing to food and nutrition security for the family. The women farmers will save time in doing farm activities with the right technology, thereby, having more time with their families and for other income generating activities that can improve the family's livelihood. Appropriate technology will also help in increasing their on-farm income. Additional income from farm activities may depend on the type of crops. Women have access to incomes from "female crops" such as tomatoes, onions and green leafy vegetables. They may not have access to income from crops such as maize, eggplant and chili which are often seen as "male crops" and so have a trade dominated by men. A woman growing such crops may have to use output for home consumption or sell through her spouse or other male relative. Total income from the improved cropping may therefore not come to the woman.

Market segmentation basis includes various factors. First, *land ownership and land tenure systems* are critical factors determining irrigation preference and investment. Different regions in Ghana have different land tenure systems that affect women farmers differently. Segmentation may be useful to look at freehold or leasehold access to land, especially for women. Some women also offer services like weeding, planting and protecting the land from animals and harvesting for men in exchange for irrigable land to farm. Such women may have multiple farms based on the service-for-land arrangement. Second, the *irrigation water source* could be surface, underground, both surface and underground water or harvested water. Needs may differ depending on the type of water source. For instance, someone using running water may need a pump that can withstand gravity compared to another farmer using still water from water harvested in a dam. The depth of the water source is also of importance in developing appropriate technology. Third, *structure of irrigation schemes* should look into different irrigation typologies. A formalized irrigation scheme has the potential to regulate irrigation and ensure participation of minorities like women and youth. Informal schemes may not be as inclusive because cultural bias may give preferential access to men over women and other interest groups. Small and large irrigation schemes may also have different dynamics that have to be factored into the segmentation.

Fourth, *access* to credit/finance, inputs, extension services and intelligent communication technologies (ICT) and market infrastructure should be considered. Identifying these accesses helps to know a farmer's ability to afford technology being offered as well as potential to capitalize their investment into irrigation products. The whole value chain should also be considered since the activities of one actor within the value chain affects the activities of other actors in the chain, thereby ensuring collaboration and connections among the chain actors. Fifth, *needs of special groups* should be part of segmentation to ensure inclusion of women, youth or other groups of interest such as female-headed households, male-headed households and persons with disabilities (vulnerability assessment). This is because a general classification of farmers may exclude some groups if they are not directly targeted by the segmentation. Finally, *climate change* and its impact differ from place to place. This may be extended to include rainfall patterns. Southern Ghana for instance has two rainfall seasons while northern Ghana has one rainfall season. Communications should also be intensified especially using radio because it reaches a wide audience.

Ways to segment the market include use of existing data from government agencies such as demographic data, focus group discussions, field surveys and analysis of past projects and interventions. Innovative ways to segment the market include the use of digital innovation and appropriate technology in terms of ease of use, considering educational levels of users. There is need to consider the resource-potential of the target market and the time or season to conduct market segmentation. For instance, if a face-to-face survey is to be conducted, it will not be appropriate to do it during the farming season as most respondents

will be away on their farms. Other factors to consider are the security within the target area and how accessible the location of the target market is. Accessibility, for instance, may inform the tool to use.

Reflection and conclusion

Participants reflected on solar suitability mapping and market segmentation for solar powered pumps for irrigation and highlighted some key messages. *First*, participants stressed the need for equality in irrigation equipment supply. Manufacturers, importers and distributors should make a conscious effort to supply and promote irrigation equipment that are gender-friendly in terms of weight, price, complexity and functionality. Efforts should also be made to include vulnerable populations including persons with disabilities. Market segmentation benefits both the equipment suppliers and the target market. The suppliers benefit from improved sales and cost savings from focusing marketing activities while the target market benefits from products that meet their particular needs. Market segmentation is still a developing area for MSD participants. It is also an area of high interest. This is demonstrated in the request from PEG to IWMI to conduct a market segmentation on their behalf, after the segmentation presentation from Pumptech.

Second, encouraging solar-powered irrigation adoption needs government subsidies, provision of financial services to fund purchases and public education on the long-term benefits of using renewable energy. Government was specifically urged to address the challenges to ensure financial accessibility. Also, although smallholder farmers need attention when it comes to adoption, attention should also be given to large scale farmers who have a high ability to adopt solar technology and introduce smallholder farmers to it through out-grower schemes.

Third, regular meetings of various stakeholders are needed to address several issues including renewable energy to find workable solutions to adoption. Key stakeholders, including regulators such as the Water Resources Commission, should be present in such meetings. One such meeting could explore the possibility of comparing the Pumptech pay-as-you-own model with the government initiated “One Village, One Dam˝ initiative to identify which model holds better opportunities for farmers. Suggestions for future MSD meetings include inviting more farmers to be part of the discussions as they are the end users and have the best ideas of what they need from equipment suppliers. Further, future MSD meetings should have end users of particular products share their experiences on usage, benefits and challenges. Finally, efforts should be made to include youth in future meetings to ensure that ideas are sought from people from all age brackets.

Annex 1. The meeting agenda

Venue: Mensvic Grand Hotel in East Legon, Accra in Ghana.

Time: 8.30 – 13.30 on 4th May 2021

Time	Activity	Remarks
08.30 – 09.00	Registration	
09.00 – 09.15	Welcome by IWMI and AfricaRISING	Olufunke Cofie
	Customization of solar suitability map	
09.15 – 09.30	Solar suitability mapping: An online tool for business sustainability	Mansoor Leh IWMI
09.30 – 09.45	Customizing the solar suitability map to solar-powered irrigation business	PEG Africa
09.45 – 10.15	Plenary discussion: Needs and potential to customizing the solar suitability map for business sustainability	All participants
	Market segmentation for solar-powered irrigation technologies	
10.15 – 10.30	Market segment for PS2 solar-powered irrigation pump in the Upper East Region	Pumptech Ghana
10.30 – 10.45	**Coffee Break**	
10.45 – 11.00	Introduction and instruction for the breakout group discussion: Investigating market segmentation	Thai Thi Minh
11.00 – 12.00	Breakout discussion: market segmentation for different implication **Questions:** 1. Why do we need to understand market segmentation? What are the outcomes of better understanding potential users and clients? 2. What could be innovative ways to conduct the market segmentation study? What needs to be considered in the studies?	All participants (3 groups)
12.00 – 12.15	**Reflection:** What key messages have come out from today's section?	
12.15 – 12.30	Meeting closure	Minh Thai
12.30 – 13.30	Lunch and networking	

Annex 2. List of participants

No	Name	Organization
In-person participation		
1	Joseph Mensah	PEG Africa
2	John Dotse	PEG Africa
3	Osman Sahanoon Kulendi	Pumptech Ltd.
4	Latif Kulendi	Pumptech Ltd.
5	D. Venu Babu	Aggrico Solar
6	Amol Parker	Aggrico Solar
7	Sunil Lalvani	Aggrico Solar
8	Isaac K.Mintah	Farm Radio Int
9	Richard Nunekpeku	Anyako Farms
10	Asamani Osae Ako	Ako Engineering (Grundfos Pumps)
11	Edmund Kyei Akoto-Danso	GASIP
12	Leticia Apam	GASIP
13	Emmanuel Amuzu	GASIP Farmer, Anloga
14	Ayanaba Moses	GASIP Farmer, Goog
15	Bright Komla Atsyor,	GIDA
16	Patience Gbediame	WAiD
17	Zimi Alhassan	MOFA
18	Francis Ennor	MOFA
19	Abdul-Basit S. Mohammed	Local Gov't East Mamprusi Municipal
20	Darlington Junior Apeadu	Akuapem South Municipal Assembly
21	Tabi Karikari	AfDB
22	Barnabas K. Apom	Ghana Netherlands Business & Culture Council
23	Kuukua Ghanney	IFDC
24	Stella Obanyi- Brobbey	IFDC
25	Maxwell Twumasi	IWMI
26	Henry Igbagdun	IWMI
27	Thai Thi Minh	IWMI
28	Abena Ofosu	IWMI
29	Zinabu Mohammed	IWMI
30	Peter Edzesi	IWMI
Virtual participation		
31	Amos Gyau	World Bank
32	Andrew Asaviansa	White Volta Basin Authority
33	Olufunke Cofie	IWMI
34	Everisto Mapedza	IWMI
35	Cecily Layzell	IWMI
36	Mansoor Leh	IWMI