Feed the Future Innovation Lab for Small Scale Irrigation

4th SMALL SCALE IRRIGATION DIALOGUE:

Sustainability of cocoa systems: Exploring segmentation, water management and small scale irrigation suitability

By Abena Ofosu and Thai Thi Minh

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Introduction

Through the Feed the Future Innovation Laboratory for Small Scale Irrigation (ILSSI), the Small Scale Irrigation (SSI) 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 4th meeting was held on October 19th 2021 and organized by the International Water Management Institute (IWMI) and International Institute of Tropical Agriculture (IITA) with support from the Feed the Future Innovation Lab for Small Scale Irrigation (ILSSI) through Texas A&M University (TAMU). It is the first in a series of small scale irrigation multi-stakeholder dialogues (MSDs) that will focus on the cocoa sector. The overall goal of the cocoa-targeted MSDs is to contribute to the sustainability of the cocoa system through a market approach to improved water management and irrigation of cocoa. The first of this series is exploring cocoa producer market segmentation, agricultural water management, and small scale irrigation suitability for cocoa production (Annex 1). The aim of this meeting was to:

- Share information and reflect on the need and potential for water resource management in the sustainability of different cocoa systems; and
- Initiate engagement and networking between key players in a market systems approach to a climate resilient cocoa sector: actors in cocoa production, cocoa marketing, irrigation equipment companies, water management and climate research, and cocoa business and investment.

A total of 40 participants joined the meeting, including 6 virtually (Annex 2); 51 people registered (Figure 1a) out of 78 invited. The highest attendance was from research organizations (45%) (Figure 1b). Attendees from cocoa sector actors and irrigation technology and equipment supply chain formed the 2nd highest groups participating (20% each), indicating high interest in irrigation development in the cocoa sector. Private sector participants accounted for 10% of the attendance. The lowest attendance was recorded from government institutions (5%) mainly from the cocoa sector; their attendance was classified as part of cocoa sector actors.

Dr. Olufunke Cofie, Country Representative, IWMI Ghana gave the opening, followed by welcome messages by Dr. Richard Asare, Country Representative, IITA Ghana and Dr. Nicole Lefore, Director, ILSSI. Dr. Cofie mentioned that the dialogue had come at an opportune time because globally, people are exploring options for adapting to climate change and climate variability. Cocoa provides a livelihood for about 1 million households in Ghana, a major contributor to the Ghanaian economy, and water is a key resource for adaptation. IWMI is excited to be part of these dialogues because of the opportunity to contribute to the development agenda of Ghana. In welcoming participants, Dr. Asare indicated that the dialogue series offers

IWMI and IITA the opportunity to increase their research collaboration to include the cocoa sector. It will also strengthen the existing collaboration between IITA and COCOBOD. Dr. Lefore indicated that USAID encourages response to and support for farmer needs, and stakeholders have identified an emerging need to introduce and manage irrigation in the cocoa sector. With climate change, the need to adapt has become even more important, especially for smallholder farmers. The dialogues are therefore one of the innovative ways to explore the scaling of irrigation to smallholders.

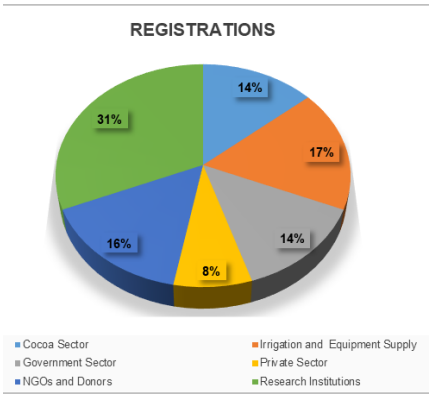

Figure 1a: Different groups of registrants

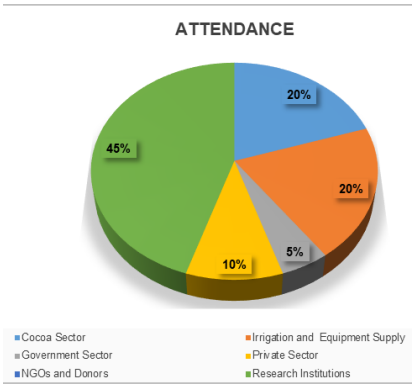

Figure 1b: Different groups of attendees

The first presentation was by Dr. Richard Asare, highlighting factors that must be considered when segmenting cocoa farmers based on understanding the diversity of farmers within a community. This was followed by a presentation by Dr. Fati Aziz from Texas A&M University, focusing on water resource availability and water requirements in cocoa production. The third presentation by Mr. Emmanuel Baffoe-Bonnie of ECOM Trading, focused on irrigation constraints for cocoa production from the producer and market perspectives. The fourth presentation by Mr. Ignatius Punpuni from Ghana Cocoa Board (COCOBOD), Cocoa Health and Extension Division (CHED), on behalf of Mr. Faruk Nyame of COCOBOD, CHED, described COCOBOD's cocoa irrigation pilots and initial results. The final presentation by Mr. Joseph Mensah of PEG Ghana provided initial observations about water use on cocoa farms based on the company's solar water pump clients. Breakout group discussions then focused on water management for different cocoa systems, notably: (a) *How can water management be affordable and accessible for the different segments?* (b) *Who would need to invest, and in what, to increase access to water management equipment and practices to support sustainability of cocoa production in Ghana?* Efforts were made to have multiple sectors represented and engaged in each group to enrich the discussion.

Highlights from segmentation for cocoa systems in Ghana

Different segments for cocoa systems in Ghana: Determining factors important to consider in segmenting cocoa farmers

Cocoa is the backbone of the West African economy, including the economy of Ghana. The effects of climate change have however made it necessary for Ghana to change the way the crop is managed to ensure sustainability. Studies by IITA have shown that some parts of Ghana may no longer be suitable for cocoa production due to the effects of climate change. In this study by IITA on cocoa system segmentation, three zones were identified based on the effects of climate change on cocoa production (Figure 2). ***Cope zone*** includes parts of the Western, Bono, Ahafo and Ashanti Regions where little effort is required to grow cocoa sustainably. The cope zone is best suited for cocoa due to its forest cover since cocoa is a forest crop. With a focus on Good Agricultural Practices (GAPs) and no-regret solutions, climate smart cocoa (CSC) may be scaled up in the cope zone. A major drawback however is that expansion of cocoa farming in the cope zone may be at expense of forest cover within the region. Focus should therefore be on intensifying output from existing

cocoa farms instead of rapid expansion at the expense of forest cover. **Adjust zone** is found in parts of the Eastern and Ashanti Regions. Cocoa thrives well in this zone but requires more effort in terms of agronomic practices to survive, compared to the cope zone. **Transform zone** is found mainly in parts of the Central, Ashanti, Bono and Ahafo Regions, especially around the Sunyani, Offinso and Techiman areas. This zone shows the least potential for CSC cultivation in Ghana. Cocoa can be grown in this zone but requires more effort and investment, compared to the cope and adjust zones. Where cocoa yields are not significant, farmers in the transform zone are advised to move to the production of other crops or off-farm activities. Sustainable production of cocoa requires consideration and adoption of climate-smart practices based on the different zones.

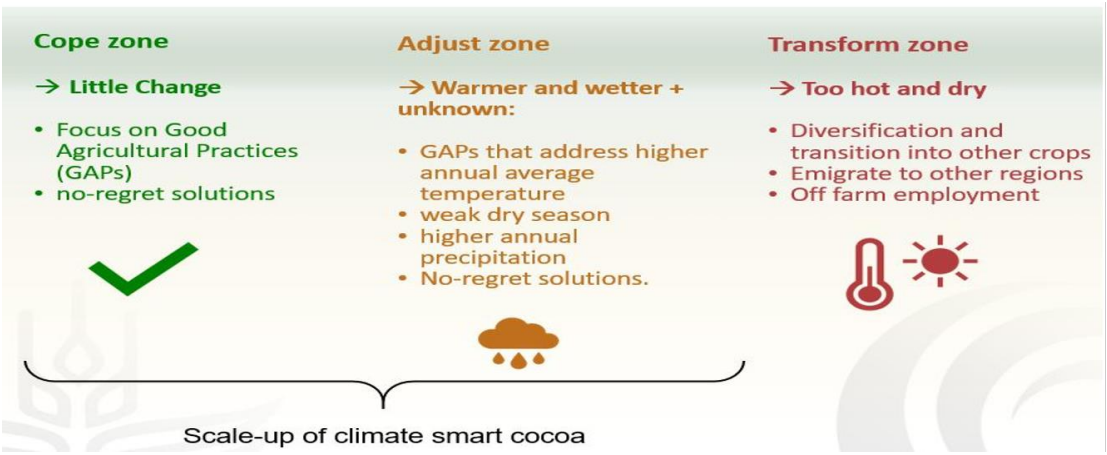

Figure 2: Climate impact zones for cocoa in Ghana[1]

For any practice to be considered as climate smart, it must address four areas: timing, spacing, moisture management and stepwise process.

- **Timing**: Farm practices such as land preparation and irrigation must be carried out at specific seasons and time intervals to ensure maximum benefit to farmers. The specific time to carry out farm activities is however becoming increasingly difficult to determine due to climate variability.
- **Spacing:** Cocoa tree spacing influences performance of farm activities and yield. Cocoa must ideally be spaced using the line-and-peg approach to ensure adequate spacing between trees. This also includes the cultivation of shade trees within cocoa farms.
- **Moisture management:** Adequate water for cocoa trees depends on their growth stage, climatic conditions and water requirements for agronomic practices, such as fertilizer application.
- **Stepwise approach:** Incremental investments are needed for climate smart cocoa production and increased yields. (Figure 3). The stepwise approach includes all GAP practices needed throughout the life cycle of the cocoa plant. The farmer's ability to invest and the stage of growth of the cocoa trees determines which practices needed to be adopted at each step.

Notably, *water is needed across all the stages* of implementing the stepwise process. Erratic rainfall patterns, competing uses of water and illegal mining activities in water bodies have led to insufficient availability of water for cocoa production. Irrigation in the cocoa sector has therefore become increasingly important. Farmers must however be empowered to adopt the stepwise process since each level requires financial and

[1] Dr. Richard Asare, "Different segments for cocoa systems in Ghana: Determining factors and important variables to consider in segmenting cocoa farmers", the fourth meeting of Small Scale Irrigation Dialogue Space on 'Sustainability of cocoa systems: Exploring segmentation, water management and small scale irrigation suitability?', 19th October 2021

time investment from the farmer. To understand the type of support that cocoa farmers require for this adoption, there was the need to segment cocoa farmers in Ghana.

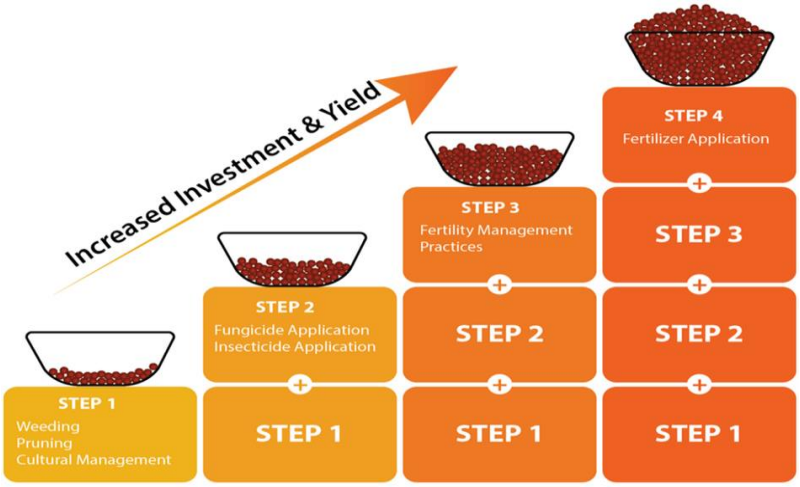

Figure 3: The step-wise process

Segmentation of cocoa farmers was done by the IITA team based on socio-economic characteristics and ability to invest in GAPs and CSC (resource endowment). The resource endowment of the farmer refers to the financial ability to undertake the agronomic practices required at each step. IITA interviewed 270 farmers, on age, educational level, market orientation, household size, available labour (household labour, labour hired in and labour hired out), total land size, size of land for cocoa farming, cocoa productivity, cocoa income, total livestock units and total annual income. Analysis identified three typologies: ***least efficient***, ***most efficient*** and ***most resourceful*** (Figure 4). The least efficient cluster has the lowest output from cocoa production mainly due to farmers spending less time on farm activities. The most efficient cluster consists mainly of younger farmers keen to try new technology and farming methods for improved production. The most resourceful cluster consists mainly of older farmers with aging cocoa trees but with extensive knowledge in cocoa cultivation.

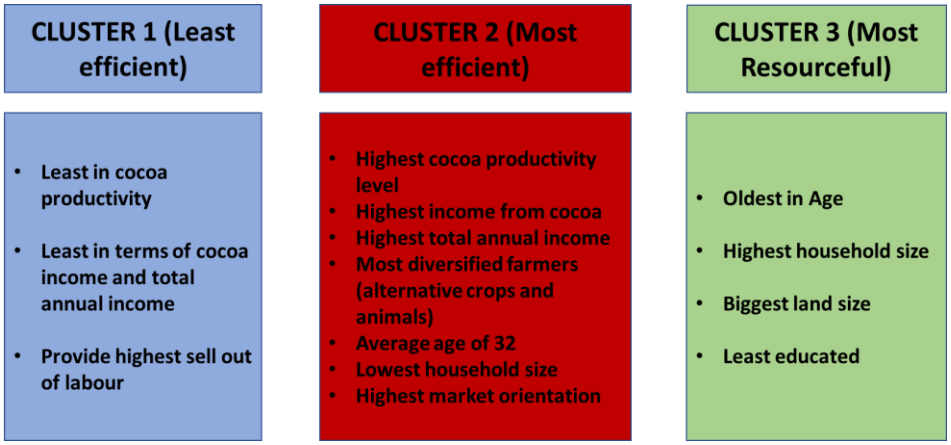

Figure 4: Cocoa farmer segments

Segmenting cocoa farmers has multiple benefits. ***First***, it guides extension delivery; extension agents are able to deliver tailor-made solutions to farmers based on their needs if the market is segmented. ***Second***, it guides farmers to invest in climate smart cocoa cultivation; farmers are able to plan for each step of being climate smart based on their current level within the process and their resource endowments.

Exploring water management for different cocoa systems in Ghana

Water resource availability and water required for cocoa production

Ghana's water resources are mainly groundwater and surface water, with impoundments or reservoirs. In terms of surface water, Ghana is drained by three main water systems: the Volta River System (70%); South Western River System (22%) and the Coastal River (8%)[2]. Studies show that approximately 9% of Ghana is suitable for surface irrigation under the baseline period (1990-2010), mainly in the southwestern area. Boreholes have an average potential yield of 2.5l/s while aquifer productivity is between 0.20l/s and 62.83l/s[3],[4].

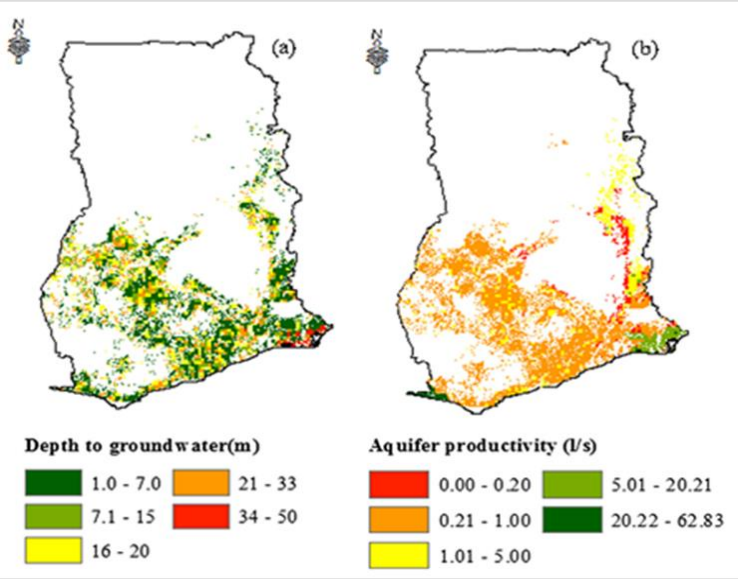

Figure 5:[5] (a) Depth of groundwater (m) and (b) Aquifer productivity (l/s) over the potential suitable land (suitability greater than 80%)[3,4].

Crops lose water from the soil surface by evaporation and from the crops themselves by transpiration in a process termed evapotranspiration (ET). Estimation of crop evapotranspiration (ETC) is key to determining crop water requirements (amount of water required to compensate the evapotranspiration loss from a cropped field). Accurate assessment of ETC provides useful information for irrigation of crops. The amount of water that cocoa loses through evapotranspiration was calculated under this study, including additional water losses (e.g. application and land preparation). Data sets used for the analysis were maximum and minimum temperature from climate stations located in the six cocoa growing regions in Ghana (Figure 6), obtained from the Ghana Meteorological Agency. Additional data sets for the same locations, included solar radiation, relative humidity, sunshine hours and wind speed (obtained from Climate-Data.org). [See presentation for full methodology.]

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[2] Ministry of Water Resources, Works and Housing, Ghana. (2007). Ghana national water policy.

[3] MacDonald, A.M., Bonsor, H.C., Dochartaigh, B. E. O. and Taylor, R. G. (2012). Quantitative maps of groundwater resources in Africa. Environ. Res. Lett. 7, 024009. 7pp.

[4] Worqlul, A.W., Dile, Y.T., Jeong, J., Adimassu, Z., Lefore, N, Gerik, T., Raghavan, S. and Neville, C. (2019). Effect of climate change on land suitability for surface irrigation and irrigation potential of the shallow groundwater in Ghana. Computers and Electronics in Agriculture; 157:110–125. ISSN 0168-1699, https://doi.org/10.1016/j.compag.2018.12.040.

[5] Dr. Fati Aziz's presentation on Water Resources Availability and Water Required for Cocoa Production in Ghana, the fourth meeting of Small Scale Irrigation Dialogue Space on 'Sustainability of cocoa systems: Exploring segmentation, water management and small scale irrigation suitability?', 19th October 2021

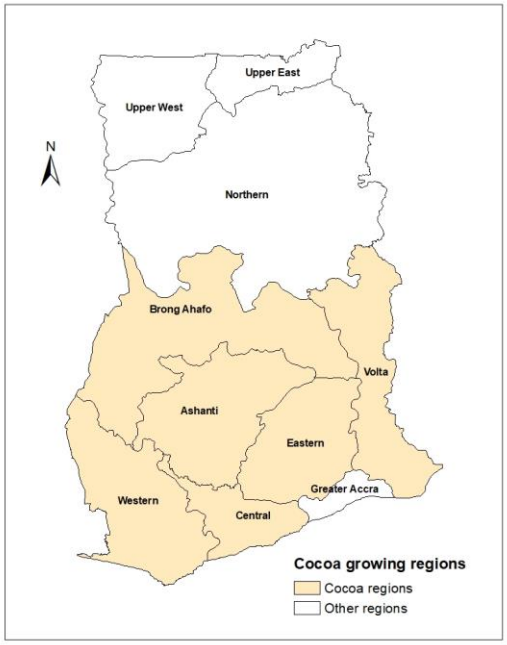

Figure 6: Cocoa growing regions of Ghana

The monthly CWR for cocoa production in Ghana varies between 130 mm/month and 235 mm/month. A Crop Water Deficit Analysis shows insufficient rainfall for much of the cocoa areas in Ghana, meaning that cocoa requires supplemental irrigation. Ghana's ground water and surface water resources are both suitable for supplemental irrigation. The study focused on the total quantity of water available. Quality of water and water requirement per variety were not assessed in the study – this offers opportunity for the further studies.

Irrigation constraints for cocoa production: Producer and market perspectives

ECOM is a leading global commodity merchant and sustainable supply chain management company,[6] including the purchase of cocoa, coffee, cashew and cotton. In Ghana, the company focuses mainly on cocoa and cashew, working with over one hundred and 150,000 farmers. ECOM promotes irrigation among its farmers because sustainability is at the core of its business model. Irrigating cocoa reduces risks associated with erratic rainfall and has proved beneficial to farmers who have implemented it.: accelerating the time for commercial production of new cocoa trees from five years to about three years, and increasing yields and income. Other advantages include a reduction in water stress; provision of doses of nutrition needed for healthy plant growth and revegetation of disturbed soils in dry areas, especially from December to February.

Despite the recognized benefits, irrigation is not widely adopted among cocoa farmers in Ghana. Constraints include lack of viable cost-effective irrigation options. Unlike the grains and cereals sub-sector, cocoa does not enjoy public or private investments in commercial irrigation schemes. Farmers therefore lack the opportunity to tap into existing commercial irrigation schemes. An ECOM study shows that only 43 of 800,000 cocoa farmers access irrigation, which are the special initiatives by the COCOBOD (CHED division) and not on a commercial basis. Further, high illiteracy serves as a barrier for adoption of irrigation technology, as most cocoa farmers do not understand the need to irrigate or have the technical know-how to operate irrigation equipment. High initial cost of setting up an irrigation system together with poor land tenure systems also hinder irrigated cocoa production. Access to lands close to water sources is a challenge with 80% of lands in

[6] Emmanuel Baffoe-Bonnie's presentation on Irrigation Constraints for Cocoa Production: Producer and Market Perspective, the fourth meeting of Small Scale Irrigation Dialogue Space on 'Sustainability of cocoa systems: Exploring segmentation, water management and small scale irrigation suitability?', 19th October 2021

cocoa regions held by chiefs and families. This is further aggravated by the poor access to financial services. Farmers often cannot afford the cost of irrigation equipment and accessories alone and a borehole is costly particular as farms are far from major roads and in forest areas. Weak function of farmer groups and cooperatives also hinder farmer bargaining power. Existing farmer groups often do not cooperate to find group solutions for irrigation or to lobby government for attention. Finally, planting configuration of cocoa trees serves as a barrier. Most cocoa trees are not planted in lines, as recommended by extension services, which makes setting up an irrigation system in a cocoa farm complex. Despite the constraints, ECOM continues to advocate for irrigation among its farmers by engaging other stakeholders in the industry.

Cocoa irrigation pilots: Focus and initial results

Given the crop water requirement of cocoa (Table 1), (COCOBOD) recognizes the importance of irrigation to ensure all-year production and increased productivity. Flower abortions due to moisture stress is also reduced and survival rate of seedlings on irrigated farms is significantly higher than non-irrigated farms. COCOBOD set up irrigation systems on cocoa farms to test the suitability of various irrigation systems for cocoa production. Currently, drip irrigation and the mist/spray tube systems are being piloted in Western North, Western South, Ashanti, Brong Ahafo, Eastern, Volta and Central Regions. Pilots were done in cocoa research stations, seed production centres run by the Seed Production Division of COCOBOD and on farmers' fields. COCOBOD pre-financed the irrigation systems; the farmer is expected to pay later.

Table 1. Cocoa tree's water requirement

Cocoa tree's age	Average water requirement (litres/day)
1st year of production	10
2nd to 3rd years of production	15
3rd to 20th year of production	30

Some challenges were recorded in the pilot. There was poor access to groundwater. Drilling boreholes was abandoned due to no or low water yields. The pilot re-focused on surface water, mainly rivers. There was also poor access to solar energy for irrigation across seasons, so the project has refocused on grid energy. The reasons for low energy from solar system have not been investigated. Finally, pests and diseases affected cocoa yields. Some regions especially in the Western North Region had Cocoa Swollen Shoot Virus Disease (CSSVD) infestations, resulting in the cutting down and replanting of infested trees. While 200 farmer fields were in the pilot, positive results were recorded in 134 farms, including increased yield from an average of 18 to 41 bags per hectare, and up to 84 bags (5,376 Kg) per ha; the average yield on pilot farms was 2,624 Kg per ha (2.6 tons per ha). Plans are in place to scale irrigation to other cocoa farms. An additional nine Seed Production Division farms have been selected for irrigation on 110 ha. Nine major river bodies in the Brong Ahafo, Ashanti and Central Cocoa Regions have also been earmarked as sources of water for the scaling up of the Irrigation Project to cover 3,972.49 ha of cocoa farms within a period of four years. Moreover, nine companies have visited the sites of the selected farms for the irrigation and conducted quality tests, and measured volumes of water required for the project.

Solar water pump use by cocoa farmers: Initial observations

PEG Africa/Ghana offers installment financing (asset-based finance) for clean, reliable and affordable solar energy. PEG's portfolio includes submersible and surface solar water pumps/borehole packages for crop and livestock farmers and households in off-grid communities.[7] Negative and positive initial are observed in visits to three irrigated cocoa farms. Farmers experience erratic rainfall patterns and dry spells and seek solutions.

[7] Joseph Mensah's presentation on "Solar Water Pump Use by cocoa farmers: Initial observations", the fourth meeting of Small Scale Irrigation Dialogue Space on 'Sustainability of cocoa systems: Exploring segmentation, water management and small scale irrigation suitability?', 19th October 2021

Farmers also have limited access to water sources for irrigation. Surface water may not be readily available and access to groundwater also has constraints. Drill rigs often have challenges reaching farm locations to set up boreholes because cocoa farms are often in forest areas.

Positive observations however outweigh the negative. PEG's financing model enables credit access; PEG's credit facility can overcome constraints to traditional finance for rural families that are largely unbanked and have little credit history. Further, there is evidence of improved plant growth with irrigation. Irrigated cocoa showed evidence of enhanced flowering, fruiting and pod growth. With a solar pump, the farmer saves time that would have been used to fetch water for watering crops or other activities such as fertilizer application and spraying for disease. This time can be used for other farm activities or off-farm activities. Finally, pumps are used for multiple purposes, including domestic use, irrigating other crops, and keeping livestock. Pumps provide farmers and neighbours with clean water that can enhance general wellbeing.

Exploring water management for different cocoa systems

During the group discussions, participants provided suggestions on how water management can be made affordable and accessible for the different cocoa farmer segments. Tailor-made irrigation supply and business models should be made available for the various market segments. Both the private and public sectors should jointly ensure that irrigation systems meet the needs of farmers. The irrigation supply chain actors and market must move away from the one-size-fits-all approach to selling irrigation equipment. Irrigation equipment suppliers should collaborate with funders to create access. Partnerships with funders like the World Bank and USAID can help to improve access to water management equipment for farmers. Further, tax waivers should be implemented efficiently to benefit cocoa farmers to reduce cost of water management equipment. Further, financial access should be improved to make credit facilities available for both low and middle income farmers. Financing modalities should take into account harvest seasons, low interest rates and be easily accessible to farmers in terms of proximity. Farmer-based organizations should also be encouraged to promote group acquisition and management of facilities. Farmers who may not be able to afford equipment individually may have the chance to do so within a farmer group. Finally, awareness creation of the options available for cocoa irrigation should be intensified. This will ensure that farmers know the water management options, financing options and the benefits of effective water management in cocoa farming.

All stakeholders in the cocoa value chain are expected to invest in different ways to increase access to water management equipment and practices to support sustainability of cocoa production in Ghana. The Government of Ghana is expected to invest in several ways such as designing a cocoa-specific water management policy, funding research into cocoa irrigation, carrying out irrigation awareness campaigns and constructing feeder roads to improve access to coca farms. Government agencies must also collaborate to reduce inefficiencies and improve synergy for cocoa irrigation. These include the Ministry of Local Government, Environmental Protection Agency, Ghana Standards Board and the Customs Division of the Ghana Revenue Service.

Farmers need to invest in farm cultivation and GAPs. Growing cocoa using the line-and-peg method may for instance facilitate the deployment of water management technology. Formation of farmer cooperatives may also help to reduce irrigation costs per unit due to pooled financing for water management equipment. These cooperatives may be facilitated by agricultural extension agents (AEAs), COCOBOD, Department of Cooperatives and the Ministry of Food and Agriculture (MoFA).

The private sector needs to invest in several ways. These include technical support for farmers in the form of agronomic practices, financial assistance in acquiring technology such as pre-financing, soft loans, improved financial access, and agro-financing and provision of suitable irrigation technology. Collaboration with COCOBOD should also be explored for awareness creation private sector actors include equipment supply companies; off takers and financial institutions.

COCOBOD needs to facilitate adoption of irrigation among cocoa farmers by pre-financing initial investments towards acquisition. Participants believe that COCOBOD stands a better chance of retrieving pre-financing funds since deductions may be made directly from farmers after exporting beans. COCOBOD may collaborate with private sector and other institutions to manage the pre-financing options with cocoa farmers.

Local and international NGOs and development partners need to invest in relevant research and implementation of projects. Organizations such as the World Bank, USAID and other impact investors must implement programs that will assist farmers to acquire relevant technology.

Researchers have to invest in finding suitable technologies for irrigating cocoa. Institutions such as IWMI, Water Research Institute and the Water Resource Commission (WRC) must work towards finding sustainable irrigation solutions for cocoa. Local researchers should also be brought in to collaborate with international consultants engaged by institutions such as the World Bank to further study water availability within cocoa growing zones.

Summary and conclusion

Some key messages were drawn from participants' discussions and feedback sessions. Awareness creation on the need for irrigation and options available for cocoa irrigation is essential for scaling irrigation in the sector. Cocoa has traditionally been grown under rain-fed conditions for over a hundred years in Ghana. Irrigation in the sector is therefore uncommon. Farmers must be educated on the need for irrigation that has emerged with climate variability. Awareness must also be created on options for irrigating cocoa. The pilot project from Ghana Cocoa Board, Cocoa Health and Extension Division may be used as a start. The multi-stakeholder approach to awareness creation will be most effective. Synergy within the cocoa value chain must be tapped to promote irrigation. A combined effort by government, private sector, research institutions and other stakeholders can drive the needed adoption in the sector. The 'silo' approach to tackling irrigation within the sector may not be sustainable in the long term. Finally, multi stakeholder dialogues are key for sustained adoption of irrigation in the cocoa sector. Regular dialogues will continue to offer stakeholders opportunities to collaborate and understand innovations in the scaling irrigation within the cocoa sector.

Annex 1: The Meeting Agenda

Venue: Mensvic Hotel, East Legon

Time: 8.30 – 13.30 on 19th October 2021

Objectives:

- Share information and reflect on the need and potential for water resource management in the sustainability of different cocoa systems; and
- Initiate engagement and networking between key players in a market systems approach to a climate resilient cocoa sector: actors in cocoa production, cocoa marketing, irrigation equipment companies, water management and climate research, and cocoa business and investment, who are key players in a market systems approach.

Time	Activity	Remarks
08.30 – 09.00	Registration	
09.00 – 09.10	Welcome by IWMI, IITA and Texas A&M University	Olufunke Cofie, IWMI Richard Asare, IITA Nicole Lefore, TAMU
	Segmentation for cocoa systems in Ghana	
09.10 – 09.25	Different segments for cocoa systems in Ghana: Determining factors and important to consider in segmenting cocoa farmers	Richard Asare
09.25 – 09.50	Plenary discussion: - Why do we need to understand market segmentation? Whatare the outcomes of better understanding cocoa segmentation? - What could be innovative ways to conduct the segmentationfor cocoa production? What needs to be considered in the cocoa segmentation?	All participants
	Exploring water management for different cocoa systems in Ghana	
09.50 – 10.00	Water availability and water required for cocoaproduction	Fati Aziz, Texas A&M
10.00-10.15	Irrigation constraints for cocoa production: Producer and market perspectives	Emmanuel Baffoe-Bonnie
10.15-10.30	Cocoa irrigation pilots: Focuses and initial results	Faruk Nyame
10.30-10.40	Solar water pump use by cocoa farmers: Initial observations	Joseph Mensah, PEG
10.40-11.00	Coffee Break	
11.00-11.15	Introduction and instruction for the break out group discussion: Exploring water management for different cocoasystems	Thai Thi Minh
11.15 – 11.45	Breakout discussion question: - How can water management be affordable and accessible for the different segments? - Who would need to invest, and in what, to increase access to water management equipment and practices to support sustainability of cocoa production in Ghana?	All participants (3-4 groups)
11.45 – 12.15	Report Back: What key messages have come out from today's section? What are next steps toward market system approachto sustainable cocoa production and a resilient cocoa sector?	
12.15 – 12.30	Meeting closure: IITA & COCOBOD	
12.30 – 13.30	Lunch and networking	

Annex 2: List of participants

No	Name	Organization
In-person participation		
1	Ignatius Punpuni	Ghana Cocoa Board (COCOBOD)
2	Kwadwo Osei Danso	Ghana Cocoa Board (COCOBOD)
3	Kwame Owusu Ansah	Ghana Cocoa Board (COCOBOD)
4	Samuel Osei	Ghana Cocoa Board (COCOBOD)
5	Ernest Amoako	Ghana Cocoa Board (COCOBOD)
6	Daniel Kwabena Marfo	Ghana Cocoa Board (COCOBOD)
7	Emmanuel Baffoe-Bonnie	ECOM
8	Amol Parker	Aggrico
9	Latif Kulendi	Pumptech Ltd.
10	Israel Fugah	Pumptech Ltd.
11	Moses Tampoe	Pumptech Ltd.
12	Nana Fredua Mensah	PEG Africa
13	Joseph Mensah	PEG Africa
14	Ramla Keelson	PEG Africa
15	Kekeli Gbodji	PEG Africa
16	Awuni Erasmus Atiah	Namoo and Sons Ltd
17	Dr. Christopher Agyekumhene	Financial Access Consulting Services
18	Richard Hammond	Power Africa Off Grid
19	Billy Christel Yarro Zemtsa	Power Africa Off Grid
20	Bright Komla Atsyor,	Ghana Irrigation Development Authority (GIDA)
21	Francis Ennor	Ministry of Food and Agriculture (MOFA)
22	Dr. Michael Obour Opoku-Agyeman	Cocoa Research Institute Ghana
23	Sebastian Yanore	University of Ghana
24	Dr. Sylvester Ayambila	University of Development Studies (UDS)
25	Dr. Olufunke Cofie	IMWI
26	Dr. Thai Thi Minh	IMWI
27	Nana Ekua Awotwi	IMWI
28	Zinabu Mohammed	IMWI
29	Francis Npong	IMWI
30	Maxwell Twumasi	IMWI
31	Abena Ofosu	IMWI
32	Dr. Richard Asare	IITA
33	Dr. Nicole Lefore	Texas A&M
34	Dr. Fati Aziz	Texas A&M
Virtual participation		
35	Dr. Opoku	Ghana Cocoa Board (COCOBOD)
36	Beatrice Twum	KNUST
37	Michael Kpakpo-Sraha	IWMI
38	Emily Nguyen-Perperidis	CGIAR
39	Dr. Emmanuel Oboubie	CSIR
40	Prof. Isaac K. Tetteh	KNUST