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ETHIOPIA	Water and Land Resources Institute (WLRI)
FINLAND	Finnish Environment Institute (SIKE)
ITALY	Centro Internazionale di Alti Studi Agronomici Mediterranei di Bari (CIHEAM-Bari)
ITALY	Italian Research Council (CNR-IPSP)
KENYA	Kenya Agricultural & Livestock Research Organization (KALRO)
SUDAN	Water Research Centre (WRC)
THE NETHERLANDS	International Soil Reference Center (ISRIC)
UGANDA	Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)

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Abstract (for dissemination)	The inception report highlights the socio-economic and environmental context of the study areas in Kenya, Ethiopia, Sudan and Egypt, including challenges and opportunities. Key findings include: (i) limited to moderate access to clean water, and sanitation; (ii) low yields for key crop commodities; (iii) high poverty levels and reliance on subsistence farming;; (iv) climate change impacts on agricultural productivity; (v) limited diversification of crops and income sources; (vi) flooding and moderate erosion; (vii) surface water pollution; and (viii) moderate access to extension services and training. The following key actions are recommended to improve the targeting of the project interventions to enhance impact and foster sustainable livelihoods: (i) Implement Best Management Practices (BMPs) especially the WUA to address water shortages, low yields, soil erosion, surface water pollution, and climate change impacts; (ii) Promote agroforestry and conservation agriculture practices to enhance soil health and reduce erosion; (iii) In partnership with the WUAs, facilitate access to fuel efficient pumping technologies available on the market to reduce the fuel costs, (iii) Strengthen the capacity of the water user associations to manage water resources and mitigate flood risks; (iv) Enhance extension services and training for farmers on BMPs and GAPs; (v) Foster partnerships among value chain actors to improve market access and income diversification; (vi) Promote diversification to build resilience against climate change and household shocks; (vii) Address social and cultural barriers to adoption of BMPs and GAPs; (viii) Monitor and evaluate the impact of BMPs on environmental sustainability and livelihoods; (ix) Support policy and regulatory frameworks that align with BMPs and GAPs to ensure synergy and complementary for enhanced impact of the interventions promoted by the WATDEV project in the study area; (x) Encourage private sector investment in agricultural development and value addition; and (xi) Foster community engagement and participation in project implementation and decision-making.
Keywords	Best Management Practices (BMPs), Data collection, Baseline Assessment, GAPs

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Acronyms and Abbreviations

AICS	Italian Agency for Development Cooperation
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa, Uganda
AU-EU	Africa-Europe
CIHEAM	Centre International de Hautes Etudes Agronomiques Méditerranéennes, Italy
CNR-	Consiglio Nazionale delle Ricerche, Italy
DG DEVCO	The Commission's Directorate-General for International Cooperation and Development
EARI	Ethiopian Institute of Agricultural Research, Ethiopia
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
HRC	Hydraulics Research Center- Ministry of Water and Irrigation- Gezira, Sudan.
HU	Heliopolis University, Egypt
ISRIC	International Soil Reference Center, The Netherland
IWUA	Irrigation Water Users Association
KALRO	Kenya Agricultural & Livestock Research Organization, Kenya
KU	Khartoum University, Sudan
NRC	National Research Council, Sudan
R&I	Research and Innovation
WRC	Water Research Centre, Sudan
SACCO	Savings Credit and Cooperative Organizations
STI	Science, Technology and Innovation
SYKE	Finnish Environment Institute, Finland
WATDEV	Climate Smart WATer Management and Sustainable DEVelopment for Food and Agriculture in North and East Africa
WLRC	Water and Land Resources Center, Ethiopia

Executive Summary

The baseline assessments were carried out in four countries (Kenya, Ethiopia, Sudan and Egypt). The assessments aimed to: (i) collect baseline data for selected key feasibility indicators against which the performance of the BMPs will be assessed at the end of the project using simulations; (ii) understand the challenges to implementation of the BMPs; (iii) identify gaps and opportunities to improve the implementation of the BMPs; and (iii) generate recommendations that would help project partners in the target countries to improve implementation of the WATDEV project.

Based on the baseline assessments conducted the following conclusions are made: (i) limited to moderate access to clean water, sanitation, and education in the study areas, (ii) low crop yields, (iii) limited crop diversification with high reliance on a few staple cereals, (iii) high levels of poverty, low-income, food insecurity and lack of technologies among smallholder farmers, with strong social networks and community ties; (iv) moderate to high erosion in the upper catchment areas resulting into sedimentation and siltation in Ethiopia, (v) more men than women participating in agricultural production activities in Egypt, (vi) a favorable environment for BMP implementation across all the countries; (vii) environmental challenges, including groundwater pollution due to agricultural activities and industrial discharges in Egypt.

The following strategic actions for improving performance of the BMPs are recommended: (i) deploy and scale BMPs for enhancing crop yields and soil fertility to increase crop productivity and overall soil health, (ii) promote agroforestry and conservation agriculture practices in the upper catchment areas to enhance soil health and reduce soil run off, (iii) strengthen the capacity of the water user associations to manage water resources and mitigate flood risks, (iv) provide training and capacity building for farmers on BMPs and Good Agricultural Practices (GAPs); (v) conduct regular monitoring and evaluation to assess the effectiveness of the BMPs and identify areas for improvement; (vi) implement Best Management Practices (BMPs) especially the WUA to address water shortages; (vii) engage with the government in a dialogue and come up with practical solutions to support desilting the reservoir; (viii) enhance extension services and training for farmers on BMPs and Good Agricultural Practices (GAPs); (ix) foster partnerships among value chain actors to improve market access and income diversification for the high value chains identified and being promoted amongst the farmers; (x) encourage other NGOs and the government to invest in sustainable soil and water management in the upper catchment areas; and (xi) promote access and use of energy efficient machinery and renewable energy to reduce fuel costs and environmental pollution. This will raise profit margins of the farmers and attract more farmers to invest in small-holder irrigation and other BMPs.

1. Introduction

1.1 Background

Climate change is affecting agricultural productivity and water resources in Eastern and Northern Africa. There is evidence indicating increased water scarcity and competition for limited resources, presenting significant challenges to smallholder farmers in areas affected by climate change. This challenge is further aggravated by intensification in agricultural production which often promotes unsustainable agricultural production practices leading to soil degradation, water pollution and loss of biodiversity. The Climate Smart WATer Management and Sustainable DEVelopment for Food and Agriculture in East Africa (WATDEV) aims to the enhance sustainability of agricultural water management and resilience of agro ecosystems to climate change in Eastern Africa and Egypt. The project aims to contribute towards addressing these challenges in the target countries, majorly through: (i) supporting the promotion of climate smart agricultural practices/best management practices; (ii) increasing resilience of agro-ecosystems to climate change; (iii) enhancing agricultural water management; and (iv) improving agricultural productivity and food security. The consortium involved in the implementation of the WATDEV project comprises of Agenzia Italiana per la Cooperazione e lo Sviluppo (AICS) which is the executing agency, while CIHEAM-BARI is the leading scientific institution, working closely with the Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the Kenya Agricultural and Livestock Research Organization (KALRO), Water, Land Resources Centre – Ethiopia (WLRC), Water Research Centre (WRC), Sudan and Heliopolis University (HU), Egypt.

The overarching objective of the project is to enhance sustainability of agricultural water management and resilience of agro ecosystems to climate change in Eastern Africa and Egypt. The specific objectives of the project include: **(1)** National Ministries and Research Institutions improve their knowledge and management of water in agriculture; and **(2)** Farmers and local actors, cooperatives and Water User Associations implement innovative/sustainable solutions and skills on water management. The project has four (4) key results namely: (i) Best fitting BMPs and Innovations selected by 4 countries **(R1)**; (ii) Enhanced implementation of BMPs/innovations in study areas **(R2)**; (iii) BMPs /Innovations upscale and out-scale scenarios performed **(R3)**; (iv) A water planning/management toolbox available for Researchers and Institutions **(R4)**; and (v) Strengthened knowledge and capacity building and established regional “Water Knowledge” Hub **(R5).**

Under R2, the project carried out feasibility studies in the target countries which included among other things- prioritization of the objectives for selection or application of best management practices; development of a set of indicators to measure the achievement of the prioritized objectives; collection of feedback from stakeholders (farmers, researchers, extension agents, local policy makers, community leaders, students and members of the communities; and collection of baseline data for selected list of feasibility indicators. The baseline assessments were undertaken prior to implementation of the BMPs and other interventions to collect baseline data for a set of feasibility indicators that were selected by the stakeholders in the target countries of Egypt, Sudan, Ethiopia, and Kenya. It’s important to note that the baseline assessments are critical for understanding the current situation, identifying areas of improvement for project implementation, and laying a strong foundation for monitoring and evaluating project progress and impact; thereby informing decision-making.

1.2 Purpose, Context and Scope of this Deliverable

The overall objective of the inception report is to provide a detailed understanding of the current conditions and challenges in study areas. Through documenting the existing state of the selected indicators, such as agricultural water management, land productivity, and environmental pressures, the report offers essential insights that inform the project's strategies and interventions. This initial/baseline data is crucial for tailoring the WATDEV project's activities to address specific local

needs, ensuring that efforts to enhance sustainability and resilience are grounded in accurate and context-specific information.

The specific objectives of the inception report are to:

1) Establish the status of the selected indicators in the target countries (Egypt, Sudan, Ethiopia and Kenya).

2) Identify gaps/challenges as well as opportunities for improving the implementation of the WATDEV project in the target areas.

3) Collect feedback, perceptions, and information on the feasibility of collecting data and measuring performance against the key selected indicators.

4) Develop and share with partners a set of recommendations for improving sustainability/efficiency/productivity of selected BMPs.

The scope of the D2.3.1 deliverable covers the events that relate to: (i) prioritization of sustainability objectives; (ii) development of feasibility indicators; (iii) participatory selection of the final list of indicators, and (iv) baseline data collection. The deliverable therefore covers the outcomes of the feasibility studies in Kenya, Ethiopia, Sudan and Egypt expected to assess the performance and practicability of applying the selected BMPs in the study areas

1.3 Structure and Content of the Deliverable

Deliverable D2.3.1 Consolidated Inception Report for the baseline assessments in Kenya, Ethiopia, Sudan and Egypt

The structure for the D2.3.1 report is as follows: (i) executive summary, (ii) introduction (purpose, context and scope of the deliverable; and structure, content of the deliverable), (iii) context (baseline assessments), (iv) approach and methodology, (v) baseline findings; (vi) conclusions and recommendations; (v) references; and (vi) annexes (individual country reports). The deliverable provides content generated from baseline assessments carried out in Kenya, Ethiopia, Sudan and Egypt.

2. Context

2.1 Baseline Assessments

(a) Organization of the baselines

A total of four (4) baseline assessments were implemented, one in each country (Ethiopia, Sudan, Egypt and Kenya) and were facilitated by (i) ASARECA; (ii) the local partners in the countries (KALRO, WLRC, WRC and HU), and (iii) CIHEAM-BARI. These assessments were expected to deliver the following deliverables:

- Four (4) inception reports summarizing the outcomes of baseline assessments in each of the target countries
- D2.3.1 - One (1) consolidated final inception report on baseline assessments in target countries (ASARECA).

(b) Project Impacts

Activities under D2.3.1 will contribute to the delivery of the following early and long-term outcomes:

1) Increased understanding of the current situation with regards to the key feasibility indicators.
2) Improved decision making and targeting of project interventions
3) Improved implementation of the project activities contributing to sustainability, efficiency and productivity of selected BMPs in the long term.

2.2 Study Areas

The baseline assessments were implemented in the project sites to gather baseline data for selected indicators.

In Egypt the assessments were undertaken in Belbies, Sharqia Governorate, while in Sudan, the study was carried out in Gezira scheme.

The assessments in Ethiopia were undertaken in Koga Irrigation scheme, in Bahir Dar, Amhara region.

Similarly, the baseline assessments in Kenya were carried out in Tana Irrigation Scheme in the Lower Tana River County.

The maps showing the exact locations of the study areas in Egypt, Sudan, Ethiopia and Kenya are shown in the individual inception reports for each of the countries (Annex 1, 2, 3 and 4).

2.3 Stakeholders

The baseline assessments were carried out targeting mainly local partners, researchers, extension agents, smallholder farmers and other relevant stakeholders that are involved in the implementation of project activities.

This group of stakeholders was deemed highly knowledgeable in issues pertaining to the project.

3. Methodology

3.1 Approach

A phased approach was adopted for implementation of the baseline assessment leading to the development of the inception report. The baselines were implemented in four (4) inter-related phases: (i) prioritization of the objectives during the local awareness meetings held in Kenya (Zuri Hotel- Tana River County), Egypt (Sekem Farm), Ethiopia (Maerawi, Bahir Dar, Amhara Region – Ethiopia); and Sudan (Hydraulic Research Center- Wad Medani) (Phase 1); (ii) selection of the final list of indicators for the study areas (Phase 2), (iii) baseline data collection (Phase 3), and (iv) development of the baseline/inception report (Phase 4).

Phase 1: Prioritization of the Sustainability Objectives

Prioritization of sustainability objectives was undertaken during the local awareness meetings that were held in Ethiopia (1 July 2023), Kenya (18 July 2023); Egypt (29-30 July 2023) and Sudan (17 June 2023). The key outcome of this exercise was a list of sustainability objectives participatorily ranked and prioritized by the stakeholders (Table 1).

Phase 2: Participatory Selection of Final List of Indicators

Using prioritized objectives, the Technical Working Group (TWG) was able to define a list of indicators for the socio-economic and environmental dimensions for sustainability management of natural resources in the study areas. The list of prioritized objectives and the associated indicators are shown in Table 1, below. Using a participatory approach, stakeholders (researchers from the National Agricultural Research Systems (NARS), farmers, extension workers, landowners and irrigation technocrats from the irrigation schemes, opinion leaders, local politicians) were given the opportunity to select indicators that are applicable to their study areas from the original list of indicators defined by the TWG. This exercise was done during the Local Follow up meetings which were held in Ethiopia (Unison Hotel- Bahir Dar from April 19-20, 2024), Kenya (Azuri Hotel- Lower Tana County from 8-9 April 2024), Sudan (Hydraulic Research Center- Wad Medani- June 2024), and Egypt (Sekem Farm- Sharqia Governorate from 4-5 March 2024). The key outcome of this exercise was a list of feasibility indicators that are applicable to Koga Irrigation Scheme area (Tables 2, 3 & 4). The policy indicator on level of endorsement was categorized as follows: No support (0%-24%); (ii) Limited support (25%-49%); (iii) Intermediate support (50%-74%); and (iv) Fully supported (75%-100%).

Phase 3: Baseline Data Collection

During this phase, most data was collected from secondary sources through literature (including review of journal articles/papers, review of project documents for similar projects, review of existing datasets such as FAOSTAT and ILO), and online searches. The process entailed a comprehensive desk review, where relevant documents, reports, and academic papers were systematically examined to gather existing information on the selected indicators. An online search was conducted to identify additional resources and current studies relevant to the project's focus. Key Informant Interviews (KIIs) were conducted with a limited number of stakeholders who are highly knowledgeable in the socio-economic and environmental conditions of the study areas as well as the WATDEV project in general.

Phase 4: Development of the Baseline Report

Using information collected from the desk review and KIIs, the inception/baseline report was developed.

3.2 Data Collection and Analysis

Both qualitative and quantitative data was collected using various data collection methodologies. Secondary data was collected through review of literature from various sources, while primary data was collected through KIIs.

Qualitative data collected was cleaned, synthesized and subjected to content and thematic analysis. Qualitative data was subjected to descriptive analysis to generate means, frequencies, and ranges. Results obtained were then presented in the form of Tables, Graphs and Quad charts for visualization.

Table 1 - List of Prioritized Objectives (by Sustainability Dimension) and Indicators Selected in Kenya

Dimension/Sub-dimension		Objectives	Theme	Indicators
Socioeconomic	Socio-cultural	1. To create job opportunities for locals.	1.1 Social co-benefits	▪ No. of people employed by value chain, by gender (specify NUTS level, period)
	Policy	4. Supported by the Government.	4.1 Enabling conditions	▪ Level of endorsement or support by the local governments (Likert scale) ▪ No. of plans or projects or programs supporting implementation of the practice
		6. It is compliant with national legislation and regulations	6.1 Policy Feasibility	▪ No. of national, regional, or local policies and regulations that are aligned with the BMP activities ▪ Value (in US$) of government's contribution to implementation of the BMPs in the target communities
	Governance	7. Organizations that support learning about BMPs	7.1 Enabling conditions	▪ No. of farmers accessing agricultural extension services from extension agencies (…Number of extension contacts) ▪ No. of organizations providing agricultural extension services to farmers ▪ Number of farmers trained on BMP GAPs or practices
		8. To improve cooperation among all value chain actors.	8.1 Enabling conditions	▪ No. of value chain linkages established. ▪ No. of agreements among value-chain actors/yr
		9. To improve collaboration between institutions and value chain actors	9.1 Enabling conditions	▪ No. of collaborative projects or initiatives in the target area (jointly established between local actors and institutions)
	Economy	11. To increase crop production.	11.1 Diversification of the production	▪ Crop yield (total production (Kg)/Total land area (ha) ▪ Proportion of new crop enterprises
		12. To increase farmer's income.	12.1 Economic co-benefits	▪ Total household Net farm income (GFI- Total production costs & expenses) ▪ % Increase in net farm income
Environmental	Ground water	15. Ensure suitable groundwater access.	15.1 Access to resource(s)	▪ No. of community members with access to water rights or secure water resource allocations
	Soil	16. To prevent soil erosion (To keep the soil from washing away).	16.1 Risk reduction potential	▪ Area affected by soil erosion (%, Km2): Proportion of the area affected by soil erosion (%)
		17. Maintain soil health.	17.1 Soil health	▪ Soil Organic Carbon (t ha-1)
	Crop	19. To make crops productive.	19.1 Crop productivity	▪ Production yield of crop per unit of cultivated area (t ha-1)

Dimension/Sub-dimension		Objectives	Theme	Indicators
	Surface water	24. To keep the water flow safe.	24.1 Risk reduction potential	▪ Annual floods frequency (exceeding a certain threshold) ▪ Proportion of land prone to flood risks (%)
	Atmosphere	27. To ensure a healthier environment for the community.	27.1 Risk reduction potential	▪ Air Quality Index (AQI)

Table 2 - List of Prioritized Objectives (by Sustainability Dimension) and Indicators Selected in Ethiopia

Dimension/Sub-dimension		Objectives	Theme	Indicators
Socioeconomic	**Socio-cultural**	1. To create job opportunities for locals.	1.1 Social co-benefits	▪ No. of people employed by value chain, by gender (specify NUTS level, period)
	Policy	4. Legislations/Regulations are easy to understand	4.1 Policy feasibility	▪ No. of plans or strategies supporting BMP implementation
	Governance	7. To improve collaboration between institutions and value chain actors	7.1 Enabling conditions	▪ No. of collaborative projects or initiatives in the target area (jointly established between local actors and institutions)
	Economy	11. To increase crop production.	11.1 Diversification of the production	▪ Crop yield (total production (Kg)/Total land area (ha) ▪ Proportion of new crop enterprises
		12. To increase farmer's income.	12.1 Economic co-benefits	▪ Total household Net farm income (GFI- Total production costs & expenses) ▪ % Increase in net farm income
Environmental	**Ground water**	15. Ensure suitable groundwater access.	15.1 Access to resource(s)	▪ Intensity of water use by agriculture: Amount of irrigation water (mc) used per unit of cropped land (ha) ▪ No. of community members with access to water rights or secure water resource allocations
	Soil	16. To prevent soil erosion	16.1 Risk reduction potential	▪ Proportion of the area affected by soil erosion (%)- (dropped due to lack of data) ▪ Average soil loss (t ha-1yr-1)
	Crop	19. To make crops productive.	19.1 Crop productivity	▪ Production yield of crop per unit of cultivated area (t ha-1)

Dimension/Sub-dimension		Objectives	Theme	Indicators
	Surface water	24. To keep the water flow safe.	24.1 Risk reduction potential	▪ Annual floods frequency (exceeding a certain threshold) (dropped due to lack of data) ▪ Proportion of land prone to flood risks (%) (dropped due to lack of data)
	Atmosphere	27. To ensure a healthier environment for the community.	27.1 Risk reduction potential	▪ Air Quality Index (AQI) (prefer indicator measuring climate variability)

Table 3- List of Prioritized Objectives (by Sustainability Dimension) and Indicators Selected in Egypt

Dimension/Sub-dimension		Objectives	Theme	Indicators
Socioeconomic	**Socio-cultural**	1. To create job opportunities for locals.	1.1 Social co-benefits	▪ No. of people employed by value chain, by gender (specify NUTS level, period)
	Policy	4. Supported by the Government.	4.1 Enabling conditions	▪ Level of endorsement or support by the local governments (Likert scale) ▪ No. of plans or projects or programs supporting implementation of the practice
	Governance	7. Organizations that support learning about BMPs	7.1 Enabling conditions	▪ No. of farmers accessing agricultural extension services from extension agencies (…Number of extension contacts) ▪ No. of organizations providing agricultural extension services to farmers ▪ Number of farmers trained on BMP GAPs or practices
	Economy	12. To increase farmer's income.	12.1 Economic co-benefits	▪ Total household Net farm income (GFI- Total production costs & expenses) ▪ % Increase in net farm income
Environmental	**Ground water**	14. Enhance water quality.	14.1 Water quality	▪ Level of water quality (standard methods) ▪ Level of biological contamination (E. coli, IBA…)
	Soil	17. Maintain soil health.	17.1 Soil health	▪ Soil Organic Carbon (t ha-1)
	Crop	20. To make crops healthier.	20.1 Crop healthy	▪ Amount of fertilizers/pesticides per unit of crop (Residue level in the product). ▪ Nutrient (N, P) use efficiency (Kg product/kg N, P)
	Surface water	24. To keep the water flow safe.	24.1 Risk reduction potential	▪ Annual floods frequency (exceeding a certain threshold) ▪ Proportion of land prone to flood risks (%)

Dimension/Sub-dimension		Objectives	Theme	Indicators
	Atmosphere	27. To ensure a healthier environment for the community.	27.1 Risk reduction potential	▪ Air Quality Index (AQI)

Table 4- List of Prioritized Objectives (by Sustainability Dimension) and Indicators Selected in Sudan

Dimension/Sub-dimension		Objectives	Theme	Indicators
Socioeconomic	**Socio-cultural**	1. To create job opportunities for locals.	1.1 Social co-benefits	▪ No. of people employed by value chain, by gender (specify NUTS level, period)
	Policy	4. Supported by the Government.	4.1 Enabling conditions	▪ Level of endorsement or support by the local governments (Likert scale) ▪ No. of plans or projects or programs supporting implementation of the practice
	Governance	8. Improve cooperation among value chain actors	8.1 Enabling conditions	▪ No. of value chain linkages established ▪ No. of agreements among value chain actors/yr
		9. Improve collaboration between institutions and value chain actors	9.1 Enabling conditions	▪ No. of collaborative projects or initiatives in the target area (jointly established between local actors and institutions)
	Economy	10. To make farm costs manageable	10.1 Micro-Economic viability	▪ Crop Yields (Tons/Ha) ▪ Price- cost ratio (compares selling price to cost of production) ▪ Benefit-cost ratio of production ▪ Percentage increase in net farm income
Environmental	**Soil**	18. To help crops grow better	18.1 Soil fertility	▪ Soil fertility (SOM, N, P2O5, K2O) ▪ Farmers' perception on soil fertility (Likert scale)- additional
	Crop	19. To make crops productive	19.1 Crop productivity	▪ Production yield of crop per unit of cultivated area (t ha-1)
	Surface water	24. To keep the water flow safe.	24.1 Risk reduction potential	▪ Annual floods frequency (exceeding a certain threshold) ▪ Proportion of land prone to flood risks (%)
	Atmosphere	27. To ensure a healthier environment for the community.	27.1 Risk reduction potential	▪ Air Quality Index (AQI)

4. Findings of the Baseline Assessments

4.1 Socio-Economic Dimension

Findings from the baseline assessments show that the study areas are largely occupied by small-holder farmers whose major source of livelihood is crop farming, livestock rearing and other off-farm activities. The socio-economic dimension of the study areas in the four (4) target countries (Egypt, Sudan, Ethiopia and Kenya) is rural settings with high levels of poverty and food insecurity. Access to education, health care, clean water and sanitation and electricity and other urban amenities are highly limited especially in Sudan, Ethiopia and Kenya. Across the target countries, the four (4) study areas face the challenge of climate change which is negatively impacting on agricultural productivity and livelihoods.

The socioeconomic context of the study area in Egypt (Belbies) is characterised by agricultural production with most farmers engaging in production of wheat, rice vegetables, fodder (alfalfa), and citrus fruits. Despite the existence of a strong agricultural industry, the poverty levels in this area remain above average highlighting the need to scale up sustainable agricultural practices to benefit more community members for wider impact. The study area in Sudan (Tyba Agricultural Block) located in the Gezira Scheme is largely a rural area with limited access to urban amenities. Most farmers in the area are smallholder farmers with limited landholdings and resources. The area experiences high levels of poverty and food insecurity, particularly among smallholder farmers. The local people heavily rely on crop production for food and income security and grow mainly soybeans, cotton, wheat, and sorghum.

Similarly, the Koga scheme in Ethiopia is largely occupied by small-holder farmers whose major source of livelihood is crop farming, livestock rearing, and off-farm activities. The major crops produced are maize, wheat, barley, teff, and vegetables. The farmers also practice livestock rearing where various types of livestock are kept including cattle, sheep, goats, and poultry. The socio-economic context of the Lower Tana River area is characterized by various challenges and opportunities. The local economy of the study area is largely dependent on agriculture production with rice, maize and sugarcane grown as the major crops. The livestock sector consists of cattle, goats and sheep. There are conflicts over resources (water, pastures etc.), land, and ethnicity related disputes. The area suffers from high poverty levels, with many relying on subsistence farming.

4.1.1 Socio-cultural Aspects

(a) Social Co-benefits

Under Social co-benefits, the stakeholders in the four countries prioritized “creating job opportunities for locals” as the main objective for adoption and application of the BMPs. The indicator selected by the stakeholders to measure the achievement of this objective was “number of people employed by value chain (disaggregated by country and gender). Findings from the surveys show that more men than women are employed in the agricultural sector and participating in specific value chains across the four (4) countries (Table 5). These findings suggest the need to: (i) address social and cultural barriers that hinder women’s participation in agricultural related activities; (ii) encourage participation of women and other vulnerable groups such as the youth in agricultural activities as a means of fostering inclusive sustainable rural development; and (iii) promote access to productive resources (land, inputs, agricultural micro-credit) for agricultural production.

Table 5 - Number of People Employed in Value Chain (disaggregated by country and gender)

#	Country	Value Chain	Total No.	Males	Females	Remark
1	Egypt	All	603,900	428,800	175,100	Data is for all value chains
2	Ethiopia	Avocado	1,200	950	250	
3	Sudan	Soybeans	14,000	8,000	6,000	
4	Kenya	Rice	352	247	105	
		Maize	234	200	34	

Survey Data (2024).

(b) Social Inclusion

Across all the target countries (Egypt, Sudan, Ethiopia and Kenya), findings show that participation in agricultural programs was not backed by a strong policy or strategy for Gender Equality and Social Inclusion (GESI). To address this challenge, the implementation of WATDEV project is taking seriously the issues of inclusivity to ensure that all community members (youth, women, men, disabled and minority groups) of the study areas are targeted to ensure inclusive participation in the implementation of the BMPs.

4.1.2 Policy

The key objectives prioritized by stakeholders under the policy sub-dimension were: (i) support from government, and (ii) compliance with national regulations. The respective indicators for the two (2) objectives selected by the stakeholders in Egypt, Sudan, Ethiopia and Kenya were as shown in Table 6.

Table 6 - List of Prioritized Objectives and respective Indicators Under Policy Sub dimension

Prioritized Objective	Selected Indicators
(a). Support from government	▪ *Level of endorsement or support from local government* ▪ *No. of plans or projects or programs supporting implementation of the practice*
(b). Compliance with the national regulations	▪ *Number of national, regional, or local policies and regulations that are aligned with the BMP activities* ▪ *Value (in US$) of government's contribution to the implementation of the BMPs in the target communities*

(a) Support from Government

(i) Level of endorsement or support from government

The results from the baseline assessments show that the enabling policy environment for implementation of the BMPs across the four (4) countries is generally high. Based on stakeholder perceptions, the level of endorsement or support by the governments was estimated as high in Egypt (75%); Ethiopia (80%) and Kenya (87%).

The perceived level of support from government in Sudan was intermediate, estimated at 62% (Survey data, 2024) (Figure 1).

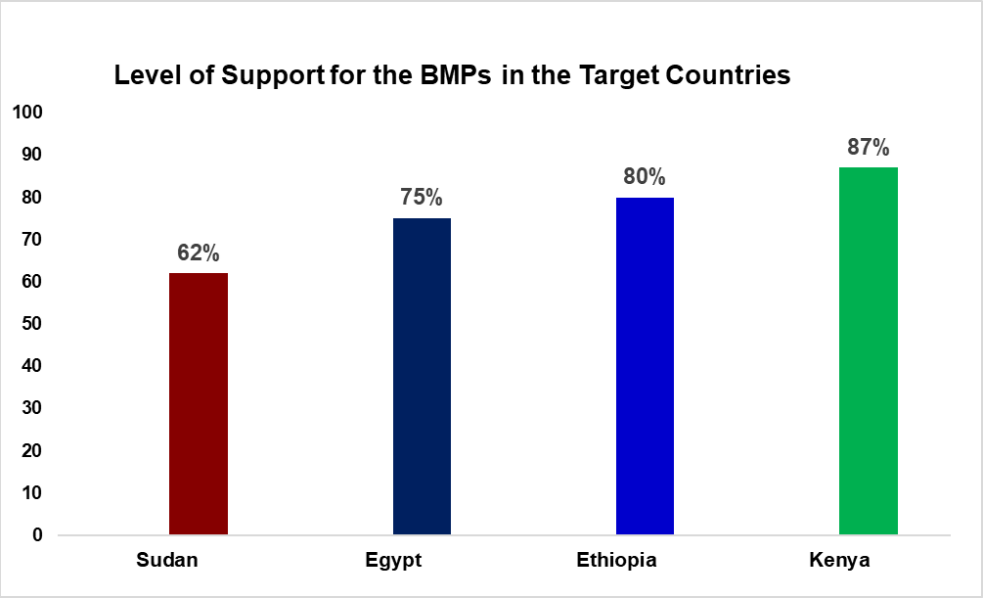

Figure 1 - Level of endorsement or support from governments on BMP implementation

These findings show that there is a strong enabling policy environment to support the implementation of the BMPs in the target countries. The results show that BMPs selected for promotion are aligned to the policies, programs, projects, plans, strategies and interventions that are supported by the national, regional and local governments in the study areas.

These findings suggest that there is a supportive policy environment for adoption of the BMPs in all the target countries.

(j) Number of plans or projects or programs supporting implementation of the practice

Findings from the survey indicate that the implementation of the BMPs is supported by various programs, projects, plans and strategies. Findings from the survey show that the implementation of BMP activities are supported by at least 32 policies operating at national, regional and local level across the four (4) countries (Survey data, 2024). These include Programs (11), Projects and initiatives (9), Plans (4), and Strategies (8) (Figure 2). Across the four countries, the highest number of policies were reported in Kenya (10), followed by Ethiopia (9), Egypt (7) and Sudan (6).

Kenya and Ethiopia had the highest number of Programs and Strategies that support BMP implementation. These findings show that there is a higher potential for scaling of the BMPs in Ethiopia, Kenya and Egypt. However, the enabling policy environment in Sudan, may be affected by the current wave of insecurity that is sweeping across the country. This is affecting the implementation of the BMPs and scaling within and outside the project areas.

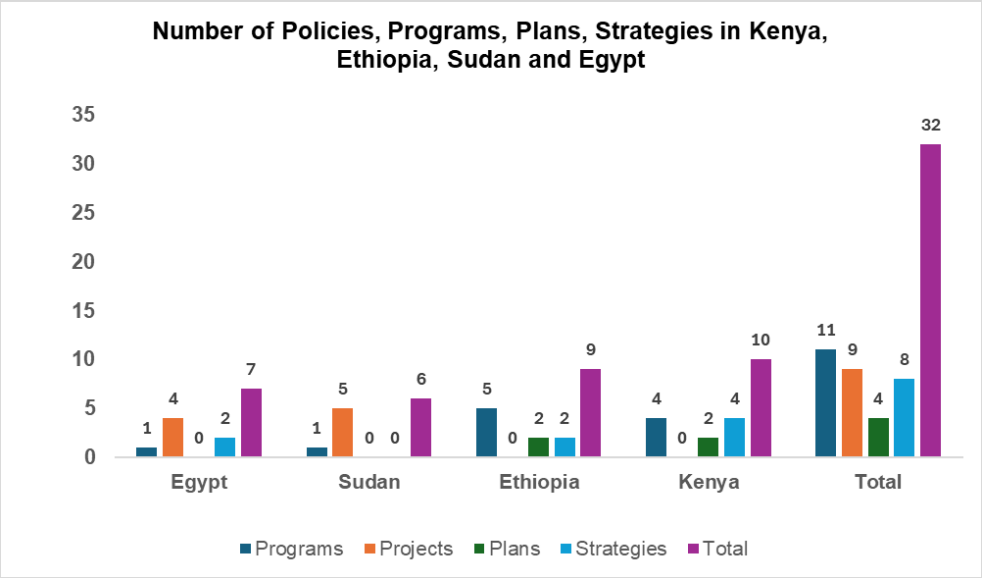

Figure 2 - Number of policies, programs, plans and strategies supporting implementation of the BMPs in Kenya, Ethiopia, Sudan and Egypt.

(b) Compliance with the National Regulations

(i) Number of national, regional, or local policies and regulations that are aligned with the BMP activities

This indicator was selected by the stakeholders in Kenya. Findings from the baseline assessment show that the implementation of the BMP activities complies with at least 10 national regional and local policies in the country (Survey data, 2024).

These findings further suggest that: (i) there is a high potential for scaling the BMPs in the study area and other regions, leveraging on government support and resources; and (ii) enhanced impact of the WATDEV project activities through alignment with government policies and priorities.

(ii) Value (in US$) of government's contribution to the implementation of the BMPs in the target communities

Like the case above, this indicator also applies to one (1) country (Kenya). Findings from the assessment show that the amount of funds committed by the Kenyan government to support the implementation of the BMPs in the Tana River is estimated at 257,000 US$ (Survey Data, 2024). These funds have been channeled through the Tana River County Integrated Development Plan (CIDP) (2023-2027).

The support has been majorly directed towards strengthening the extension system (farmers field days), agroforestry nurseries, capacity building – training of farmers. This investment underscores the government's commitment to enhancing agricultural sustainability and productivity, which is expected to significantly benefit local farmers and improve overall community resilience.

These results further show that government's investments will be instrumental (as project implementation progresses) in terms of creating multiplier effects on project outcomes and impacts leading to significant social, economic and environmental benefits for the project area.

4.1.3 Governance

Under this socio-economic sub dimension, three objectives were prioritized by the countries.

These include: (i) organizations that support learning about BMPs (Kenya and Egypt), (ii) improve cooperation among all value chain actors (Kenya and Sudan), and (iii) improve collaboration among value chain actors (Kenya, Ethiopia and Sudan).

(a) Organizations that Support Learning about BMPs

To support the achievement of this objective, three (3) indicators were selected by stakeholders in Kenya and Egypt. These indicators include: (i) number of organizations providing agricultural extension services to farmers; (ii) number of farmers accessing agricultural extension services from extension agencies; and (iii) number of farmers trained on BMP GAPs or practices.

(i) Number of Organizations Providing Agricultural Extension Services to Farmers

Results from the baseline study show that there are over 20 organizations that are providing agricultural extension services to farmers in Kenya and Egypt (Table 7).

Across the two (2) countries, the organizations offer training services, dissemination of information on best practices, market access, input supply and access to credit facilities.

The details of the extension services provided are well elaborated in the individual inception reports (Annex 1 and Annex 2).

Table 7 - List of Organizations that provide Extension Services in the Study Areas

Kenya		Egypt	
Organization	**Scale/scope/level**	**Organization**	**Scale/scope/level**
1. Ministry of Agriculture and Livestock Development	National	1. Sekem Farms	International
2. National Irrigation Authority	National	2. Heliopolis University	National
3. Kenya Agricultural and Livestock Research Organization	National	3. Zagzig University	National
4. ICRAF	International (CGIAR)	4. MARL (Government)	National
5. FAO	International (UN Agency)	5. ASFS (Government)	National
6. GIZ	International NGO	6. CAAEE (Government)	National
7. CYMMIT	International (CGIAR)	7. FAO	International (UN Agency)
8. TANA River Farmers Association	Local (CBO)	8. ICARDA	International (CGIAR)
9. Lower Tana River Water Users Association	Local (CBO)	9. GIZ	International NGO
10. Seed Companies (EASEED)	National	10. Sharqia Directorate of Agriculture (SDA).	Regional
11. Fertilizer Companies	National	11. Central Administration for Agricultural Directorates Affairs (CAADA)	National
12. Irrigation Equipment and Machinery Suppliers	National	12. Community Based Organizations	Local

In Kenya, 6 organizations are actively providing extension services to the farmers (Survey Data, 2024). These include: (i) County Government of Tana River – Department of Agriculture; (ii) National Irrigation Authority; (iii) Water Resource Users Association; (iv) KALRO; (v) Private Sector (Banks and Small Scale Mirco Credit Institutions); and (vi) Development Partners (CBOs, ICRAF, CIMMYT). On the other hand, SEKEM Farms, Heliopolis University, Zagzig University, Water Users Association, Community Based Organizations (CBOs), International agencies (FAO, CGIAR- ICARDA, GIZ) and Government Agencies (MARL, ASFS, CAAEE) are among the organizations that are currently providing extension services to farmers in Egypt.

(ii) Number of Farmers Accessing Agricultural Extension Services from Extension Agencies

Available data shows that a total of 750,000 farmers need agricultural extension services in Egypt and yet those currently receiving the services are still few (EARC, 2024). This suggests the need to put in place robust and strategic interventions to increase access to extension services by potential beneficiaries. Evidence collected during the baseline assessments shows that approximately 26,000 farmers in Kenya (Tana River County Annual Development Plan 2024/2025), and 225,000 farmers in Egypt (EARC, 2024) have access to extension services translating to extension coverage of about 48.6% and 30% respectively.

These results reveal a significant effort to support local farmers with extension contacts estimated at 1 to 3 per year in Kenya. Provision of agricultural extension services in Egypt is majorly through two (2) channels: (i) national campaigns funded by the Academy of Scientific Research and Field irrigation development projects and supported by the various government agencies such as the Central Administration for Agricultural Extension and the Environment (CAAEE), the Agricultural Services and Follow-up Sector (ASFS), the Central Administration for Agricultural Directorates Affairs (CAADA), and Sharqia Directorate of Agriculture (SDA); and (ii) implementation of agricultural research projects funded by international agencies such as FAO, GIZ, and ICARDA.

(iii) Number of Farmers Trained on BMP GAPs or Practices

Results on number of farmers trained on application of GAPs and BMPs show that very few farmers have been trained on GAPs and BMPs in Egypt (14.6% of the targeted farmers) and Kenya (19.7% of the potential beneficiaries). Findings show that a total 10,000 farmers (19.7% of the population in Tana North sub-county) in Kenya have been trained in Best Management Practices (BMPs) and Good Agricultural Practices (GAPs) (Tana River County Annual Development Plan 2024/2025). Similarly, results from the baseline assessment in Egypt show that 5,849 farmers were trained by the Egyptian Biodynamic Association (EBDA) in collaboration with SEKEM Farm in 2022 (SEKEM Annual Report, 2023). A total of 40,000 farmers have been targeted to adopt these sustainable farming practices by 2025 (SEKEM Annual Report, 2023).

Overall, these findings suggest that there is an opportunity for the WATDEV project to scale up training services to its stakeholders not only in Kenya and Egypt but also in Ethiopia and Sudan to facilitate wider uptake and adoption of the BMPs. These trainings are critical in fostering more efficient farming practices, which are expected to boost crop yields, optimize resource use, and contribute to the overall sustainable agricultural development, economic and environmental well-being in the communities.

(b) Improve Cooperation among all Value Chain Actors

To support the achievement of this objective, two (2) indicators were selected by stakeholders in Kenya and Sudan. These indicators include: (i) number of value chain linkages established and (ii) number of agreements among value chain actors/yr. For both indicators, the findings show that there are no value chains linkages established yet at baseline in both countries. Similarly, there were no agreements among value-chain actors that had been signed. The baseline values were therefore taken as 0.

(c) Improve Collaboration between Institutions and Value Chain Actors

To support the achievement of this objective, one (1) indicator on “number of collaborative projects or initiatives in the target area (jointly established between local actors and institutions) was

selected by stakeholders in Kenya, Ethiopia and Sudan. Results show that there were no collaborative projects or initiatives jointly established between local actors and institutions in the target area. Consequently, the baseline values for these indicators have therefore been taken as 0.

4.1.4 Economy

Three (3) objectives were prioritized by the countries under this socio-economic sub-dimension. These include: (i) increase crop production (Kenya and Ethiopia), (ii) increase farmers' income (Kenya, Ethiopia and Egypt), and (iii) make farm costs manageable (Sudan).

(a) Increase Crop Production

Stakeholders in Kenya and Ethiopia selected two (2) indicators to track the achievement of this objective. These include: (i) crop yield (total production (kg)/total land area (ha), and (ii) proportion of new crop enterprises.

(i) Crop yield (Total production (Kg)/Total land area (ha)

Results from the baseline show that the yields for most commodities produced in the target areas are below or slightly above the national average in both Kenya and Ethiopia. According to the Tana River County Integrated Development Plan (2023-2027) (CIDP), the crop average yield per ha for various crops was 1.44 tons/ha (Maize); 1.35 tons/ha (Green gram); 2.70 tons/ha (Rice); 1.35 tons/ha (Cowpeas).
Findings from the baseline assessment show that the crop average yield per ha was as follows: 6.25 tons/ha (Avocado); 3.6 tons/ha (Wheat); 6 tons/ha (Maize); 1.66 tons/ha (Teff) and 2.6 tons/ha (Beans) (Survey, 2024).

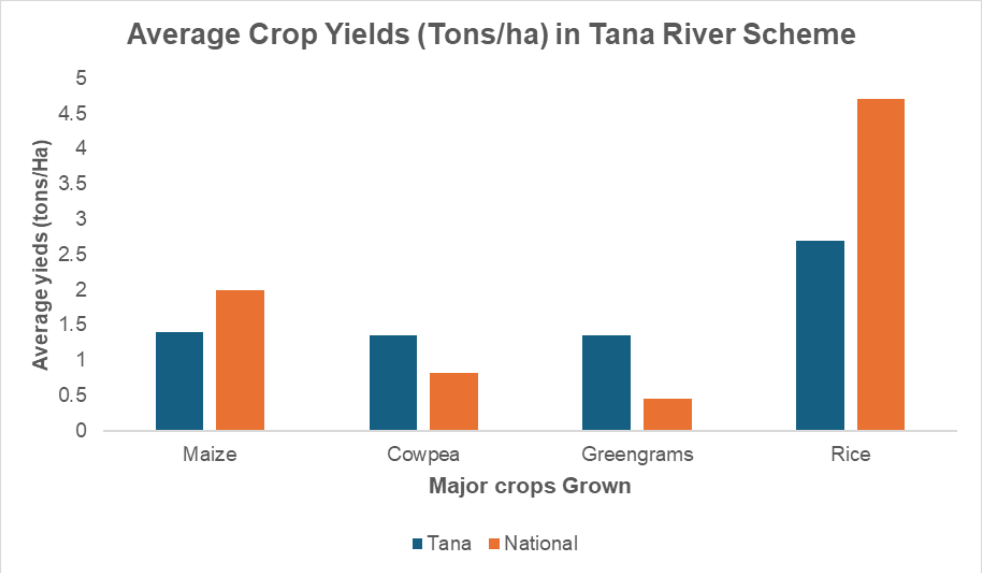

Figure 3 - Average crop yields in Tana Irrigation Scheme (Kenya) (2023/2024).

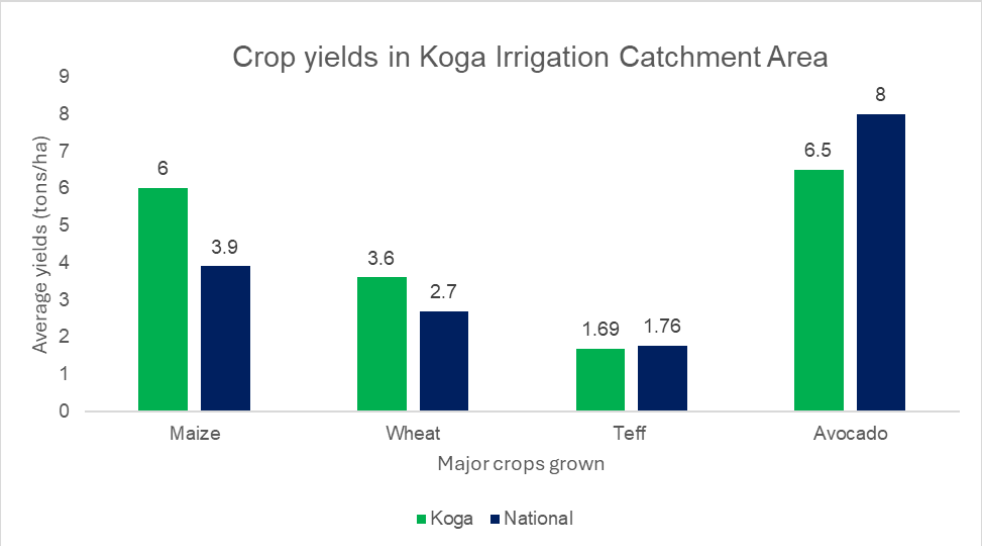

Figure 4 - Average crop yields in Koga Irrigation Scheme (Ethiopia) (2023/2024).

These findings provide useful information pertaining to the existing yield gaps with regards to production of key crops within the WATDEV project intervention areas in Ethiopia.

The results also suggest the need to ramp up efforts in deploying and scaling more yield enhancing technologies with the Koga Irrigation catchment to address the existing yield gaps. For example, more heat stress tolerant high yielding wheat varieties that can be produced under irrigation water management should be promoted within the irrigation scheme to increase wheat productivity and production and ensure self-sufficiency in the project area.

(ii) Proportion of New Crop Enterprises

The proportion of new crop enterprises was computed as: (Number of new crop enterprises introduced or taken on board/Total number of crop enterprises) x100. Results show that the proportion of new crop enterprises is zero (0) since there were no recent introductions of new crop enterprises. The results for Kenya suggest limited diversification of production in the study area with major crops of economic importance being rice and maize. In the case of Ethiopia, our data shows that the proportion of new crop enterprises is 44% with farmers engaged in 9 crop enterprises (maize, wheat, beans, teff, tomatoes, avocado, coffee, spices and rhamnus spp) of which 4 (avocado, coffee, spices and rhamnus spp) are recently introduced to the farmers of the Koga Irrigation Scheme.

These findings show that there is still a slow pace for diversification which leads to limited rural development and limited increase in food security. The findings also suggest that there is need to implement policies that support diversification of crop entrepreneurship in the local areas targeted by the project. There is need for deliberate efforts to promote new remunerative value chains in both Kenya and Ethiopia to enhance crop diversification. This is critical in building resilience against climate change, pests and diseases, and food and income insecurity. Crops diversification can also enhance opportunities for market access ensuring that farmers can access new markets for the new crop enterprises. This ultimately will contribute to enhanced household incomes and foster resilience to economic shocks.

(b) Increase Farmers' Income

Under this objective, stakeholders in Kenya, Ethiopia and Egypt selected two (2) indicators.

These include: (i) total household net farm income (GFI- Total production costs and expenses) and (ii) increase in net farm income.

(i) Total Household Net Farm Income (GFI- Total Production Costs and Expenses)

Based on the 2022, 2023 and 2024 data for Ethiopia, Egypt and Kenya respectively, the estimated annual household incomes were as follows: Ethiopia (US$2,869; Habtamu and Koyachew, 2022); Egypt (US$2583.4; Sekem Annual Report; 2023); and Kenya (US$ 1,688; Islamic Relief Baseline Report).

Annual household income for Kenya and Ethiopia for 2022 were estimated at US$846 (IFAD ISM Report, 2022); and US$4080 (Sekem Annual Report, 2023) (Figure 5).

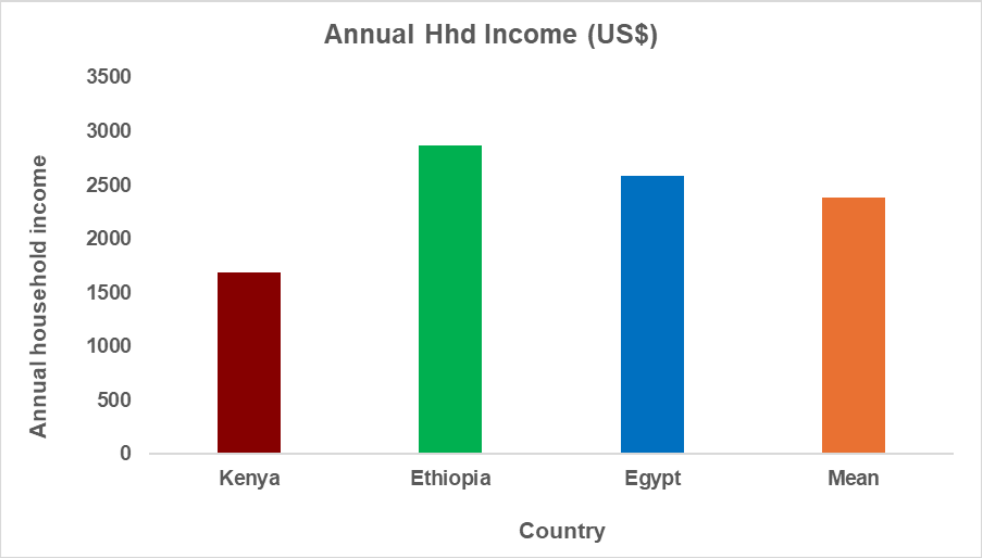

Figure 5 - Annual household incomes in Kenya, Ethiopia and Egypt (Survey Data, 2024).

Further analysis of the data collected showed that households participating in irrigation water management practices (irrigation households) earned more household incomes (US$ 2,869) compared to households (US$ 1,048) that entirely depended on rainfed agricultural production, and the difference was highly significant ($P \leq 0.000$, t value= 17.06) (Habtamu and Koyachew, 2022).

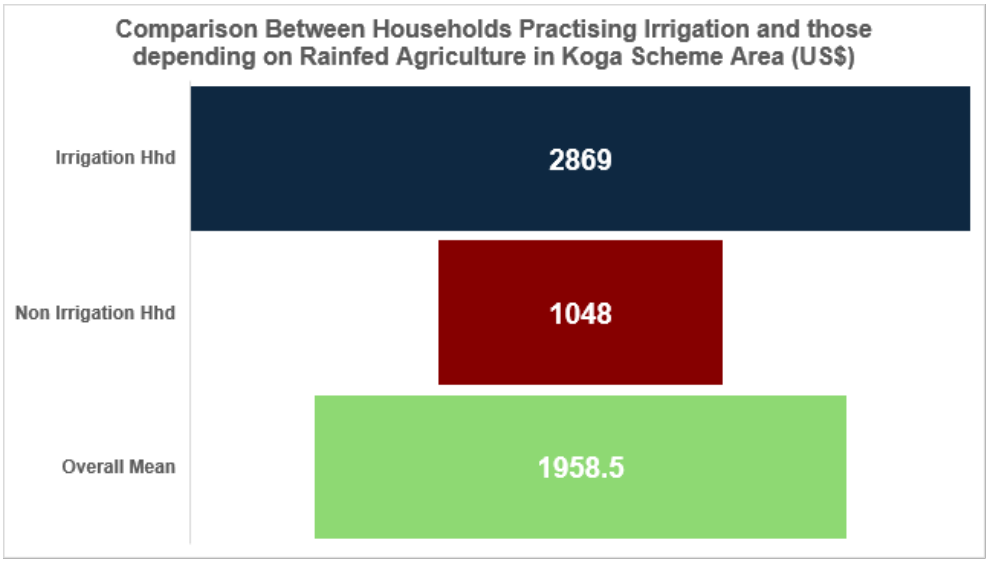

Figure 6 - Comparison between Annual household incomes for irrigating and non-irrigating farmers in Ethiopia (Habtamu and Koyachew, 2022).

These above findings show that households within the study areas in both Ethiopia and Egypt are more economically empowered than their cohorts in Kenya. These findings are consistent with the observation that most of the households in the Tana scheme area suffer from have higher levels of economic poverty due to several reasons including: (i) low farm gate prices for most of the commodities that the households are producing; (ii) high costs of production; (iii) limited access to lucrative markets, (iv) lack of diversification to high value commodities, and (iv) limited agro-processing.

These findings suggest that there is potential to enhance income levels and overall economic well-being in the study areas, especially in Kenya through implementation of the BMPs. On the other hand, the findings could also imply that there is potential for increased investments in BMPs application, increased access to credit and markets contributing to enhanced adoption of the BMPs among households with higher incomes.

(ii) Percentage Increase in Net Farm Income

Across the three countries (Kenya, Ethiopia and Egypt) percentage increase in net farm income will be determined based on the data collected from in the subsequent years as the implementation of the BMPs progresses. Hence at baseline the percentage increase in net farm income has been taken as zero (0).

(c) Make Farm Costs Manageable

This objective was prioritized by stakeholders in Sudan who selected four (4) indicators to track the performance on the achievement of the objective. These include: (i) crop yields (tons/ha), (ii) percentage increase in net farm income, and (iii) price- cost ratio (compares selling price to cost of production).

(i) Crop Yields (Tons/Ha)

This indicator addressed the objective of increasing crop production. The optimum crop yields for Soybean crop were calculated as 2.14 tons/ha or 0.9 tons/feddan (Survey data, 2024).

The yields are within the range for the national average for on-farm yields (1.5-2.5 tons/ha) but lower than on-station yields (3.0-4.0 tons/ha) (Survey data, 2024). These findings show that there is an immense opportunity for improving soybean yields in the study area through application of the BMPs.

Besides using improved seed, the other avenue for improving crop yields will be through modelling. Modeling indicators for crop yield within the study area will involve a multifaceted approach aimed at increasing overall agricultural productivity. Additionally, modeling will also facilitate the identification of factors influencing productivity, ranging from soil quality and water availability to pest management practices, thereby enabling informed decision-making to sustainably enhance crop production within the study area and the Gezira scheme.

(ii) Benefit-Cost Ratio of Production, and Selling Price-Cost Ratio

To compute the price-cost ratio, data for the Soybean value chain was collected for the following parameters: (i) yield (kg/feddan); and (ii) cost of production (US$/kg). The on-farm yields were estimated at 900 kg/feddan; while cost of production was determined as 790 US$/feddan (0.87 US$/kg). The selling price for Soybeans was calculated as 0.62 US$/kg. The selling price to cost of production ratio was then computed as: 1.00/1.40 (Survey data, 2024). If the unit value of the selling price is $\geq$ 1; the implication is that farmers are currently operating at a loss.

It's anticipated that application of the BMPs (improved seed and efficient water utilization) will help to address this problem and improve the production of the target commodities.

(iii) Percentage Increase in Net Farm Income

This indicator will be computed once the BMPs have been introduced/applied in the study area.

The current situation is a 40% loss. Modeling indicators to increase farmers' income within the Gezira study area will be done by assessing the potential impact of best management practices (BMPs) yet to be introduced, with a focus on improving net farm income.

Through modeling the expected percentage increase in net farm income stakeholders can forecast economic gains and prioritize interventions that maximize profitability for farmers.

When introduced, the BMPs will increase production through increasing crop (soyabean) productivity, decreasing cost of production, and enhancing crop quality thus reversing the current trend (of 40% loss) to register better profits.

4.2 Environmental Dimension

4.2.1 Ground Water

Under this sub-dimension, two (2) objectives were prioritized by 3 countries. These include: (i) ensure suitable access to ground water (Kenya and Ethiopia) and (ii) enhance water quality (Egypt).

(a) Ensure Suitable Access to Groundwater

Stakeholders in Kenya and Ethiopia selected two (2) indicators to track the achievement of this objective. These include: (i) number of community members with access to water rights or secure water resource allocations (Kenya and Ethiopia) and (ii) intensity of water use by agriculture or amount of irrigation water (mc) used per unit of cropped land (ha) (Ethiopia).

(i) Number of Community Members with Access to Water Rights or Secure Water Resource Allocations

Results from the baseline show that a total of 29,754 community members have access to water rights or secure groundwater allocations (Tana River County Integrated Development Plan: 2023-2027 (CIDP) and the Islamic Relief Kenya Baseline Report 2024).

No data was available for this indicator in Ethiopia.

(ii) Intensity of Water use by Agriculture or Amount of Irrigation Water (mc) Used per Unit of Cropped land (Ha)

No data.

(a) Ensure Water Quality

This objective was prioritized by the stakeholders in Egypt. The corresponding indicators selected were: (i) level of water quality (standard methods), and (ii) level of biological contamination (E. coli, IBA…).

(i) Level of Water Quality (Standard Methods)

There is a concern regarding quality of groundwater in Sharqia (Egypt) attributed to high levels of nitrates that have been detected in the groundwater, primarily due to the excessive use of nitrogen-based fertilizers in agriculture.

The intrusion of saline water into freshwater aquifers, especially in the northern coastal and delta areas is also affecting the quality of ground water. This can be exacerbated by over-extraction of groundwater, which lowers the water table and allows saltwater to leak into the groundwater sources.

Level of water salinity (standard methods) was adopted as a proxy indicator for tracking the level of water quality in the study area. Findings from the baseline assessment indicate that groundwater salinity in Sharqia ranges from fresh to slightly saline. It ranges from 1,000 ppm in the south of the

governorate to more than 10,000 ppm in the north (Figure. 4). The chemical analysis (RIGW, 2021) for some monitoring wells showed that TDS ranges between 883 and 7,705 mg/l in the west of Ismailia Canal.

Through field investigation made by Heliopolis team in Sharkia governorate, the average of TDS in the east is 1483 mg/l and the average pH value is 7.67 (HUSD, 2024).

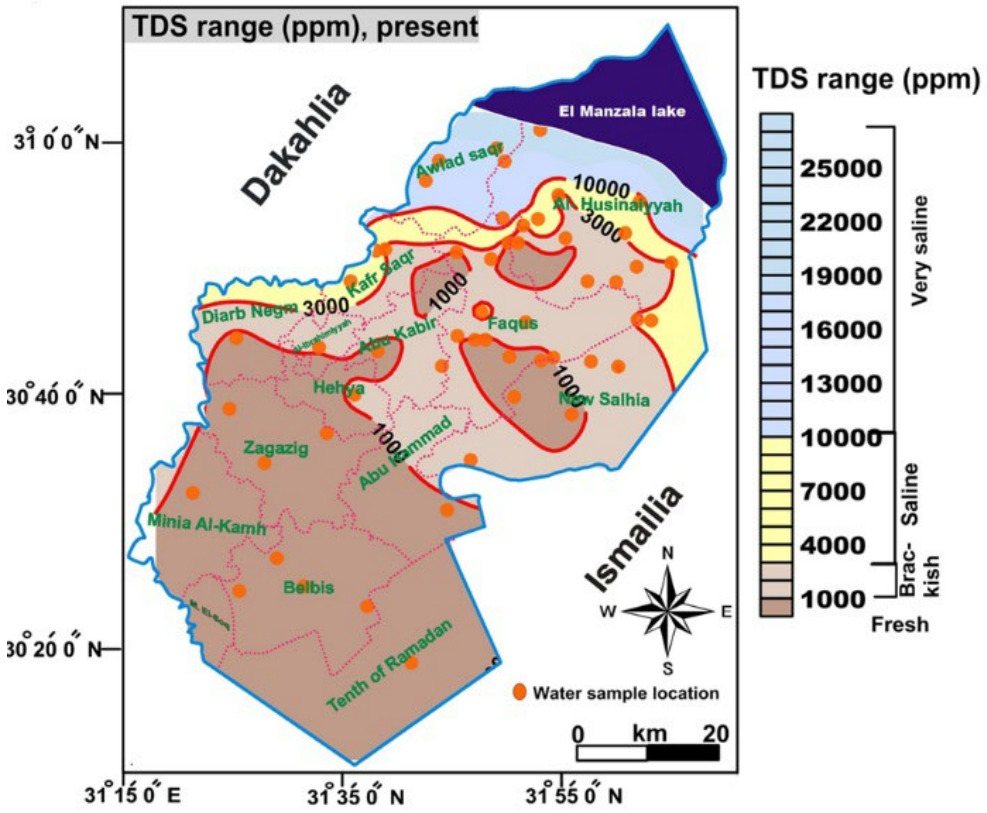

Figure 7 - Groundwater Salinity in Sharqia, Egypt (Attwa et Al., 2016).

(ii) Level of Biological Contamination

The data on the biological contaminants of groundwater in the study area are rare.

According to El-Aassar et Al. (2023), data for the groundwater samples taken from the shallow aquifer in Sharqia show that the mean Chemical Oxygen Demand (COD) is 33.04 mg/l, the Biochemical Oxygen Demand (BOD) values were less than 5.0 mg/l, and the average Total Organic Carbon (TOC) is 140 mg/l as shown in Figure 8. While according to RIGW (2021), the average TOC is 24.32 mg/l.

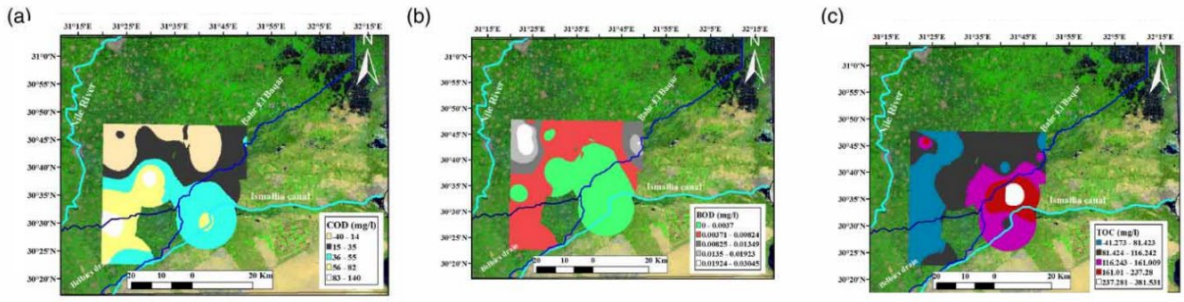

Figure 8 - Groundwater COD, BOD and TOC distribution (El-Aassar et al., 2023).

4.2.2 Soil

Under this sub-dimension, three (3) objectives were prioritized by 4 countries. These include: (i) prevent soil erosion (Kenya and Ethiopia), (ii) maintain soil health (Kenya and Egypt), and (iii) help crops grow better (Sudan).

(a) Prevent Soil Erosion/Keep Soil from Washing Away

Two (2) indicators were selected to track the achievement of this objective. These include: (i) area affected by soil erosion (%, km^2) or proportion of the area affected by soil erosion (%) (Kenya), and (ii) average soil loss ($tha^{-1}yr^{-1}$) (Ethiopia).

(i) Proportion of Area affected by soil erosion

No data.

(ii) Average soil loss

Results from baseline assessment in Ethiopia show that at least 8000 Km^2 (25.8%) of the total sub basin area of 31,000Km^2 is affected by soil erosion. Average soil loss ($tha^{-1}yr^{-1}$) due to soil erosion in the Tana River County ranges from 2-5 tons/ha per year driven largely by agricultural practices. However, no data was available due to lack of datasets for this indicator.

These findings highlight the need to urgently implement sustainable agricultural practices to curb the rate of soil loss.

(b) Maintain Soil Health

One indicator on “soil organic carbon” was selected by stakeholders in Kenya and Egypt to track the achievement of this objective. Data collected from the baseline only shows that SOC in the Tana River County ranges from 11-18 T/ha. For the case of Egypt, the baseline assessment indicates that the SOC in the topsoil is 23.58 T/ha and 32.2T/ha in the sub soil.

(c) Help Crops Grow Better

Under this objective, 2 indicators were selected by stakeholders in Sudan. These include: (i) soil fertility (SOM, N, P_2O_5, K_2O) and (ii) farmers’ perception on soil fertility. No data was available for both indicators.

4.2.3 Crop

Under this sub-dimension, two (2) objectives were prioritized by 3 countries. These include: (i) make crops healthier (Kenya, Egypt and Ethiopia) and (ii) make crops productive (Sudan).

(a) Make Crops Healthier

Under this objective, the following indicators were selected by the stakeholders: (i) production yield of crop per unit of cultivated area ($t\ ha^{-1}$) (Kenya and Ethiopia), (ii) amount of fertilizer/pesticides per unit of crop (residue level in the product) (Egypt), (iii) nutrient use efficiency (Kg product/Kg N, P) (Egypt).

(i) Production Yield of Crop Per Unit of Cultivated Area (T/ha)

Data already provided in Section 4.1.4(c).

(ii) Amount of fertilizer/pesticides per unit of crop (Residue level in the product)

No data

(iii) Nutrient Use Efficiency (Kg product/Kg N, P).

No data

(b) Make Crops Productive

Under this objective, only one (1) indicator on production yield of crop per unit of cultivated area (t ha^{-1}) was selected by stakeholders in Sudan. Stakeholders prioritized this objective based on understanding the BMP positively affects the total crop yield. Hence the indicator selected for this objective is "crop yield". Findings from the survey indicate that average crop yield for Soybeans in the study area is 2.14 tons/ha (Survey data, 2024). This is consistent with the national average yields which range from 1.5-2.5 tons/ha (Ibrahim, 2018), while on-station yields range from 2.4-2.7 tons/ha (Ibrahim, 2012).

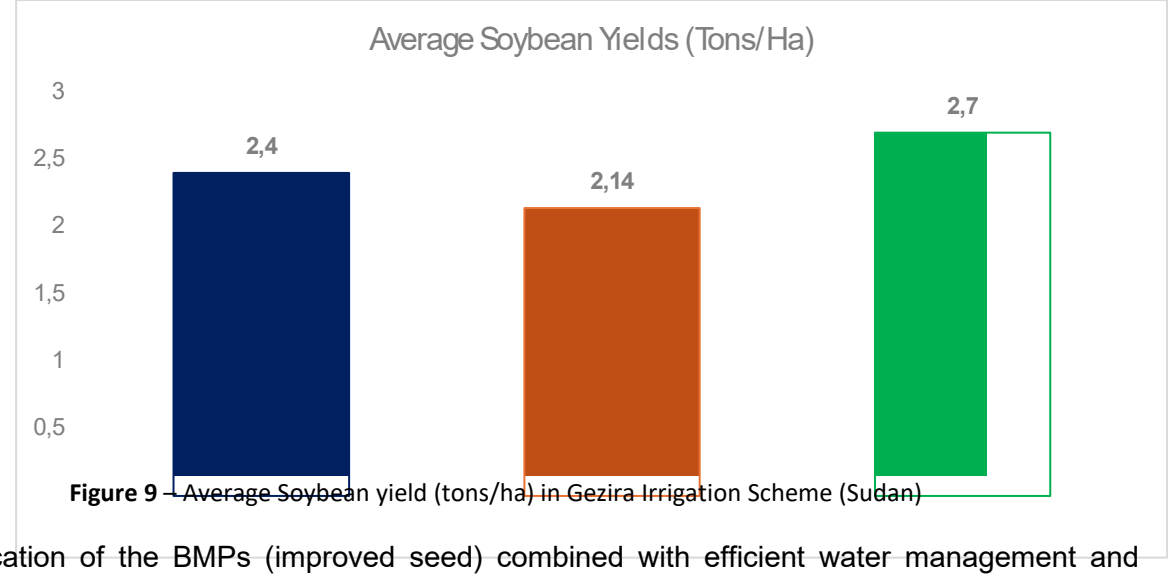

Figure 9 – Average Soybean yield (tons/ha) in Gezira Irrigation Scheme (Sudan)

With application of the BMPs (improved seed) combined with efficient water management and improved extension services provided by the farmers' cooperative union (Tyba Farmers' Cooperative Union) the current crop yields in the study area will be increased above the national average to the level of on-station yields.

4.2.4 Surface Water

Under this sub-dimension one (1) objective was prioritized by the 4 countries (Kenya, Ethiopia, Sudan and Egypt)- i.e. "to keep surface water flow safe". The two indicators selected by the countries were: (i) annual floods frequency (exceeding a certain threshold), and (ii) proportion of land prone to flood risks (%).

This indicator was dropped for Ethiopia and Egypt since the study areas do not experience flooding. For Kenya and Sudan, there was no data.

4.2.5 Atmosphere

Under this sub-dimension one (1) objective was prioritized by the 4 countries (Kenya, Ethiopia, Sudan and Egypt)- i.e. "to ensure a healthier environment in the community". One (1) indicator was selected by all the four (4) countries- i.e. Air Quality Index (AQI) as a measure for achieving a healthier environment. Based on the AccuWeather data, the AQI in the study areas in the 4 countries is as follows: Egypt (55), Sudan (51), Kenya (18) and Ethiopia (37). The data shows the AQI in Kenya is excellent followed by Ethiopia. The AQI in Sudan and Egypt are moderate.

5. Conclusions and Recommendations

5.1 Conclusions

The baseline assessments were carried out in four countries (Kenya, Ethiopia, Sudan and Egypt).

The assessments aimed to: (i) collect baseline data for selected key feasibility indicators against which the performance of the BMPs will be assessed at the end of the project using simulations; (ii) understand the challenges to implementation of the BMPs; (iii) identify gaps and opportunities to improve the implementation of the BMPs; and (iii) generate recommendations that would help project partners in the target countries to improve implementation of the WATDEV project.

Based on the outcomes of the baseline assessments the following conclusions are made (by country):

5.1.1 Egypt

(a) Conclusions

1) *Employment*- Most of the population in Sharqia region is engaged in agriculture with more men than women participating in agricultural production.
2) There is government's commitment to sustainable agriculture through implementation of policies aligned with Egypt's Vision 2030. This indicates a favorable environment for BMP implementation.
3) *Environmental Sustainability*- The baseline assessment identified some environmental challenges, including groundwater pollution due to agricultural activities and industrial discharges.
4) There are also concerns of high air pollution ultimately affecting the health of people in the area. These concerns highlight the need to establish a robust environmental monitoring system to track environmental impacts. The findings also highlight the opportunities for intervention by the project address these challenges.
5) *Strong enabling policy environment*- There are various policies in place in the study areas that align very well with the implementation of the BMPs. The WATDEV project should explore further possibilities of engaging with government and stakeholders to facilitate the implementation of the BMPs within the existing and favorable policy and regulatory frameworks.
6) *Governance and Support*- There is strong governmental and organizational support for BMPs in Sharqia. Various government agencies and NGOs are actively involved in promoting sustainable agricultural practices and providing agricultural extension services to farmers. However, data gaps exist in key areas such as groundwater quality, soil fertility, and trends in fertilizer/pesticide levels in commodities, which need to be addressed to ensure the effectiveness of BMPs.

(b) Recommendations

1) *Enhanced Data Collection*- To better understand the environmental and socio-economic impacts of BMPs, it is crucial to fill the existing data gaps. This includes commissioning studies on groundwater quality, soil fertility, trends in fertilizer and pesticide levels in the commodities produced as well as gathering more detailed socio-economic data on farm income and employment by value chain.
2) *Strengthening BMP Implementation*- Given the supportive policy environment, efforts should focus on scaling up BMPs across the Sharqia region. This could involve: (i) increasing the number of farmers trained in application of BMPs and other sustainable

practices, (ii) expanding agricultural extension services, and (iii) ensuring continuous government and organizational support.

3) *Policy and regulatory frameworks*- Support policy and regulatory frameworks that align with BMPs and GAPs to ensure synergy and complementary for enhanced impact of the interventions promoted by the WATDEV project in the study area.
4) Promote use of energy efficient machinery and renewable energy to reduce fuel costs and environmental pollution. This will raise profit margins of the farmers and attract more farmers to invest in small-holder irrigation and other BMPs.
5) The WUAs should address challenges related to governance and efficient access to ground water sources: Farmers accessing ground water sources note the fuel costs for pumping water are high. To enhance access, the WUA should facilitate access to fuel efficient pumping technologies available on the market to reduce the fuel costs.
6) Engage with government authorities to provide incentives to private sector to invest in the BMPs.

5.1.2 Sudan

(a) Conclusions

1) *Socio-cultural context*- The socio-cultural context in the study area is characterized by high levels of poverty, low-income and lack of technologies among smallholder farmers, with strong social networks and community ties.
2) *Employment*-Most of the smallholder farmers are engaged in the soybean value chain.
3) *Policy Support*- Support from the local government is moderate channelled mainly through five (5) related plans or projects.
4) *Governance*- There are six (6) on-going collaborative projects between local actors and institutions. This is likely to improve the collaboration between the actors.
5) *Economy*- Current price-cost ratio indicates losses; crop yields are lower than on-station yields, with potential for improvement.
6) *Soils*- Challenges include low organic matter, salinization, and nutrient depletion; data on soil fertility needed.
7) *Crop yields*- Soybean yield is 2.14 tons/ha; BMPs expected to improve the current on farm yields.
8) *Water quality*- There are significant water quality issues with turbidity and sedimentation data suggesting high levels of turbidity and sediment concentration.

(b) Recommendations

1) *Promote climate smart and high yielding soybean varieties* to increase farm productivity. Stakeholders should promote improved seed for climate smart, high yielding, disease and pest resistant crop varieties for soybean value chain. Members of the Tyba Farmers' cooperative should work closely with the WATDEV Team and ARC scientists to promote identified and agreed soybean varieties.
2) *Water and irrigation management*- To enhance water quality and irrigation water management it's important to adopt/develop and deploy a hydraulic model.
3) *Strengthen community-based seed system.* Support farmer led seed multiplication to increase access to improved seed in Gezira Scheme Area.
4) *Efficient irrigation systems.* Explore options for implementing efficient irrigation systems to save water.

5) *Implement capacity building programs*. Training of smallholder farmers on various aspects and tailored towards enhancing application of the BMPs should be carried out in partnership with relevant stakeholders like ARC, MoWIR and Private Sector. Train farmers on seed production/multiplication, crop production and management practices.
6) *Implement effective BMP dissemination strategies*. Establish demo plots to show case best practices among the small-holder farmers
7) *Facilitate knowledge exchange and sharing among stakeholders especially small holder farmers*. Support farmer organizations to enhance collective action and knowledge sharing.
8) *Support development and implementation of BMP supportive policies*. Lobby, advocate and facilitate engagement/dialogue with policy makers from nationally mandated institutions (MoWIR, MoA) to review and update policies to support application of the BMPs (improved seed and water management practices)
9) *Strengthen partnerships.* Strengthen partnerships with on-going initiatives, projects and programs to improve collaboration and enhance impact and long-term sustainability.

5.1.3 Kenya

(a) Conclusions

1) Limited access to clean water, sanitation, and education in the study area as well as surrounding areas.
2) Low crop yields ranging from 1.35 t/ha (cowpeas and green grams), 1.44 t/ha (maize) to 2.7 t/ha (rice).
3) Limited crop diversification with high reliance on maize and rice.
4) High poverty levels and reliance on subsistence farming.
5) There are conflicts over resources and land
6) Climate change on impacts agricultural productivity.
7) Limited diversification of crops and income sources.
8) Moderate access to extension services and training programs to improve collaboration and enhance impact and long-term sustainability.

(b) Recommendations

1) Implement Best Management Practices (BMPs) especially the WUA to address water shortages, soil erosion, surface water pollution, and climate change impacts.
2) Promote agroforestry and conservation agriculture practices to enhance soil health and reduce erosion.
3) Support water user associations to manage water resources and mitigate flood risks.
4) Enhance extension services and training for farmers on BMPs and Good Agricultural Practices (GAPs).
5) Foster partnerships among value chain actors to improve market access and income diversification.
6) Address social and cultural barriers to adoption of BMPs and GAPs.
7) Monitor and evaluate the impact of BMPs on environmental sustainability and livelihoods.
8) Support policy and regulatory frameworks that align with BMPs and GAPs to ensure synergy and complementary for enhanced impact of the interventions promoted by the WATDEV project in the study area.
9) Encourage private sector investment in agricultural development and value addition.

10) Foster community engagement and participation in project implementation and decision-making.

5.1.4 Ethiopia

(a) Conclusions

1) Low crop yields ranging from 6 t/ha (maize), 6.25 t/ha (avocado) to 3.6t/ha (wheat).
2) Limited crop diversification (estimated at 0.44) with high reliance on wheat, maize and teff.
3) High poverty levels characterized by low use of high yield enhancing inputs/technologies as well as soil and water conservation technologies.
4) Conflicts over water resources; (vi) climate change impacts on agricultural productivity.
5) Moderate to high erosion in the upper catchment areas resulting into sedimentation and siltation of the Koga dam reservoir.
6) Moderate access to extension services and training.

(b) Recommendations

1) Deploy and scale BMPs for enhancing crop yields and soil fertility to increase crop productivity and overall soil health.
2) Promote agroforestry and conservation agriculture practices in the upper catchment areas to enhance soil health and reduce soil run off.
3) Strengthen the capacity of the water user associations to manage water resources and mitigate flood risks.
4) Provide training and capacity building for farmers on BMPs and Good Agricultural Practices (GAPs).
5) Conduct regular monitoring and evaluation to assess the effectiveness of the BMPs and identify areas for improvement.
6) Implement Best Management Practices (BMPs) especially the WUA to address water shortages.
7) Engage with the government in a dialogue and come up with practical solutions to support desilting the reservoir.
8) Enhance extension services and training for farmers on BMPs and Good Agricultural Practices (GAPs).
9) Foster partnerships among value chain actors to improve market access and income diversification for the high value chains identified and being promoted amongst the farmers.
10) Encourage other NGOs and the government to invest in sustainable soil and water management in the upper catchment areas.

6. References

Please refer to individual reports for reference lists.

7. Annexes

Annex 1 - Egypt Inception Report

Annex 2 - Sudan Inception Report

Annex 3 - Ethiopia Inception Report

Annex 4 - Kenya Inception Report

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