PROJECT APPRAISAL DOCUMENT (Report No: PAD4959)

ANNEXES 2-5

FOR THE

GEORGIA RESILIENT AGRICULTURE, IRRIGATION, AND LAND PROJECT (P175629)

ANNEX 2: Detailed Project Description

COUNTRY: Georgia
Georgia Resilient Agriculture Irrigation and Land Project

1. **The project development objectives are to (1) improve irrigation and drainage services and agricultural production in project areas; (2) strengthen national irrigation and land management institutional capacity; and (3) to provide immediate and effective response in case of an Eligible Crisis or Emergency.**

2. **Irrigation infrastructure investments target the Alazani and Mtkvari (Kura) River basins, in which irrigations systems are facing varying degrees of seasonal water stress in Eastern Georgia.** Seasonal water stress is measured by calculating the seasonal aridity index. It is the ratio between mean precipitation (P) and reference evapotranspiration (ETref) over the period March-October. It measures the degree of dryness of the climate at a given location, a high aridity index (AI) indicates higher rainfall and lower seasonal water stress. A low AI, conversely, indicates high seasonal water stress and a higher need for irrigation application and supply to grow crops. Schemes in the Kakheti region (see Zemo Alazani in Figure 10) show a relatively low seasonal water stress (and therefore high values for Aridity Index (AI) (Figure 11). This is mainly due to the relatively high rainfall received in this region in May and June which falls within the main cropping season. However, other schemes that are part of the GRAIL short-list, such as Tashiskari, Tiriponi, Zeda Arkhi, and the Narekvavi irrigation system are showing medium to high levels of seasonal water stress (Figure 10). This corresponds with the screening of climate trends in Eastern Georgia, which show a reduction in precipitation. Glacial run-off is projected to decrease by 40 percent compared to 2010 levels by 2100, which will severely affect Georgia's energy, agriculture, and ecosystems. Droughts are expected to put further pressure on water availability (Vidal, et. al., 2022). Thus, irrigators in the Eastern part of Georgia in the Mtkvari (Kura) and Alazani basins face water scarcity, particularly during the summer months from June to August. This lack of water often leads to disputes and conflicts in communities, especially among irrigators. Improved reliability of water supply in these areas may help diffuse social tensions and stabilize agricultural incomes in the face of climate change, while improving soil fertility and carbon sequestration potential. Therefore, one of the main interventions of the project will be to improve water availability and reliability of irrigation water for irrigators in the respective command areas, where the project will improve the functioning of specific irrigation systems.

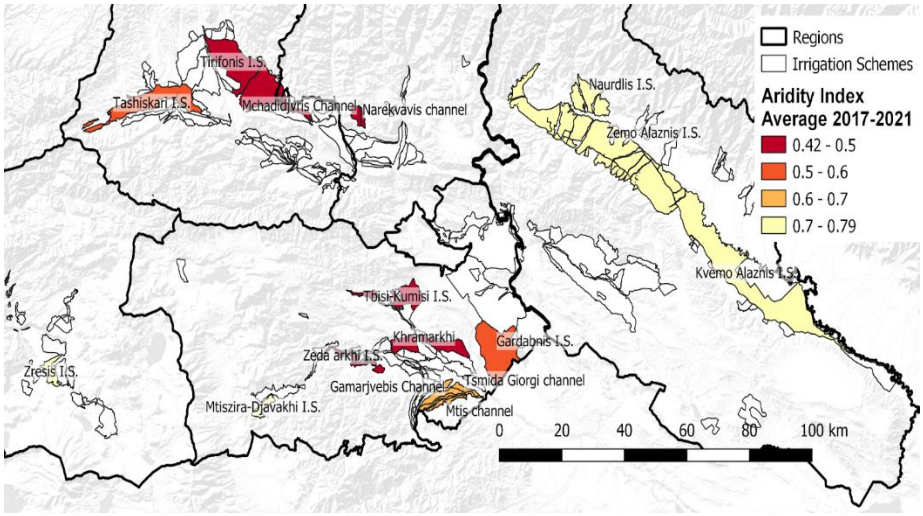

Figure 10. Seasonal Water Stress: Seasonal Aridity Index (AI) = ratio between mean precipitation (P) and reference evapotranspiration (ETref) over the period March-October. Average 2017-2021 per IS selected for benchmarking (ISs are labeled on the map).

3. **Geographical focus**. The short-listed irrigation and drainage schemes are in the following target regions, municipalities, and river basins of Eastern Georgia:

Short-listed Schemes	Region	Municipality	Basin
Tashiskari	Shida Kartli	Borjomi & Khashuri	Mtkvari
Tiriponi	Shida Kartli	Gori	Mtkvari
Zeda Arkhi	Kvemo Kartli	Bolnisi	Mtkvari
Zemo Alazani (sum of all secondaries)	Kakheti	Telavi & Akhmeta	Alazani
Narekvavi irrigation scheme	Mtskheta-Mtianeti	Dusheti & Mtskheta	Mtkvari
Shavgele Drainage	Samegrelo	Lanchkhuti & Zugdidi	

4. **Eastern Region**. The project will support rehabilitation and modernization (where applicable) in a selection of five irrigation systems located in the Shida Kartli, Kvemo Kartli, Kakheti, and Mtshketa-Mtianeti regions. Shida Kartli has a mean annual rainfall of 778 mm, Kvemo Kartli of 681 mm, Kakheti 728 mm, and Mtshketa-Mtianeti 780 mm. The short-listed schmes have average rainfalls of the following values: Tashiskari, 709 mm; Tiriponi, 616 mm; Zeda Arkhi 623 mm; Zemo Alazani 733 mm; Narekvavis irrigation scheme 651 mm. As per the climate analysis conducted, all of these regions will suffer from GWS due to reduced rainfall for maintaining soil moisture to support crop production (Section E). As of the current climate, parts of Shida Kartli, Kvemo Kartli and Kakheti are already suffering GWS (Figure 10). These areas for intervention also have some of the highest poverty rates in all of Georgia and a large majority of farms have land plots that are less than 1 Ha in size. In all the targeted shortlisted schemes, there is evidence of water shortage. Water shortage is an indicator that measures the adequacy and presence of water (irrigation and rainfall) during the growing season. Seasonal relative Evapotranspiration (ET) (RET=ETa/ETp) for the main crop in each scheme is used to quantify water shortage. ETp value is derived from high-performing fields in each scheme for each crop. All schemes are then evaluated based on the percentage of the area that has RET of less than 0.75. Areas with RET below 0.75 are those considered suffering from water shortage. Figure 11 provides the scores for water shortages impacting all short-listed schemes. The Narekvavi irrigation scheme is the scheme with worst score in terms of water shortage, given that on average nearly 34 percent of the cropped area has a RET of less than 0.75, followed by Zemo Alazani (Figure 11).

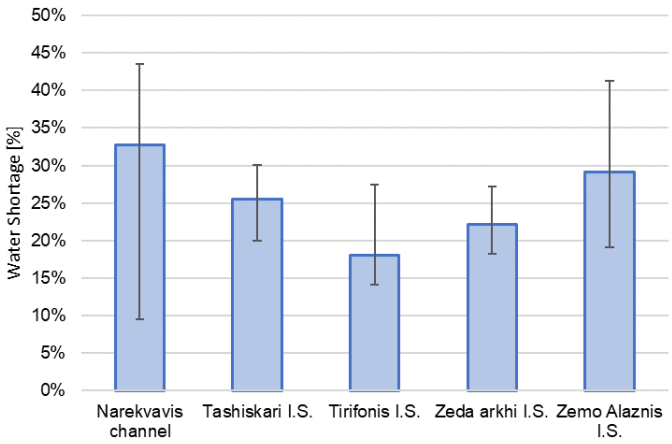

Figure 11. Water Shortage: Percentage of the cropped area in GRAIL short-listed schemes facing a Relative ET (ET/ETp) less than 0.75 (average 2017-2021).

5. **Western Region**. The Samegrelo region has a mean annual rainfall of 1342 mm and the Shavgele drainage scheme, mean annual rainfall of 1689 mm.

6. **Farming systems**. Almost 80 percent of agriculture holdings in Georgia operate less than one hectare of agricultural land. Only 5.6 percent of agricultural holdings (36,138) have two hectares or more of agricultural land, and 1.3 percent (8,577) have five hectares or more.[1] For many farms the combination of small farm size and low farm productivity means that agricultural incomes are not sufficient to survive on farm earnings alone. Wages and income transfers are the major sources of rural household income. On average, rural households derive only 8 percent of their income from farm sales and 16 percent from own production.[2] However, although no recent government statistics are available, it has been observed (including through the remote sensing analysis mentioned above) that farms are increasingly cultivating high value crops in response to commercial incentives to supply national and international value chains. According to MEPA, total production of primary agricultural products and processed products is showing an increasing trend (32.5 percent growth between 2018 and 2021). The total export value of agri-food products amounted to US$1,142 million in 2021, an increase of 18.2 percent compared to 2018. The negative trade balance amounted to US$207.6 million, a reduction of 46 percent compared to 2018.

7. **There is substantial variation among regions in cropping patterns in the project areas, mainly due to climatic and soil conditions**. Perennial cropping in the form of orchards is prominent in Kakheti, Shida Kartli, and Samegrelo, covering respectively 14 percent, 21 percent and 38 percent of national total area under orchard. Grape production is concentrated in Kakheti but is also found in other regions. Annual crops, notably grains (maize, wheat, barley), vegetables and potatoes are prominent in Kakheti, Kvemo Kartli, Shida Kartli, and Samegrelo, covering respectively 34 percent, 12 percent, 11 percent and 12percent of national total land area under annual crops. Agriculture production in Mtskheta-Mtianeti is small compared to other regions and focuses mainly on vegetables and other annual crops, and fruit orchards.[3] A recent analysis by the World Bank (May 2022), based on remote sensing data, suggested that area under perennial crops, mostly orchards, had doubled since 2017. The fertile soils of the country (specifically cinnamonic soil - Hromic Cambisols in the Kvemo Kartli and Shida Kartli regions; Alluvial soil – Fluvisols in the west coast and northern Kakheti region; Grey cinnamonic soil - Calcic Kastanozems in Shida Kartli region; and Yellow podzolic soil – Stagnic Acrisols in the west coast) provide favorable conditions for land cultivation, as well as animal husbandry.[4]

8. **Agricultural transformation can be driven by the adoption of efficient technologies (such as irrigation), appropriate regulatory systems over water and land, and access to markets and finance amongst others (Raian and others 2016).** Indeed, recent developments in land registration have paved the way for land registration to be implemented nationwide and land markets to develop as a result. Previous analytical work carried out by the World Bank noted that financial inclusion and credit for agriculture in Georgia compares favorably with other ECA countries. Specifically lending to primary agriculture production and agribusinesses has grown in significance. The development of irrigation infrastructure will allow the adoption of modern technologies to produce high value crops, including perennial crops that require reliable water supply, capital investment for irrigation equipment and, and land tenure security. On average, 95 percent of landowners in the short-listed irrigation schemes have less than one hectare of land. The project would provide the necessary conditions for farm improvement among landowners and support them to invest in the production of high value agriculture.

[1] GeoStat 2014, the latest available agriculture census data.
[2] World Bank 2020. *Georgia – Maximizing Finance for Inclusive Development of Agri-food Value Chains - Synthesis Report*
[3] GeoStat 2014, the latest available agriculture census data.
[4] FAOStat. 2019. Georgia: Land, Input and Sustainability Data.

9. **Market opportunities**. Various studies have highlighted agricultural value chains that have growth potential, including export potential in the EU, Gulf states, and the US. Among them are stone fruits (peaches, nectarines, plums, and cherries), berries (raspberries, blackberries, blueberries), apples (especially in Shida Kartli), and vegetables (tomatoes, cucumbers, eggplants, and peppers). The demand for fresh, dried, and frozen fruits is growing worldwide and Georgian products can compete in some markets. Common challenges are the relatively small volume of production, quality issues, underdeveloped post-harvest storage and aggregation capacity, limited cold chain logistics capacity, and obtaining food safety and market standard certification. This highlights the importance of an integrated approach that supports producers and operators along the chain.

10. **Gender.** The role of women in irrigation and agriculture in Georgia is complex, they are involved in irrigated production and fee payment, and in maintenance and conflict resolution, but they are less interested in being involved irrigation water scheduling and handling physical works. A recent rapid assessment conducted by the ongoing GILMDP found that in selected irrigation schemes in Eastern Georgia women are actively involved in agricultural activities, however, their engagement is smaller and less visible in comparison to the engagement of men. However, the assessment also demonstrated that regardless of participating in agricultural activities, women are less involved in the decision-making process regarding agricultural activities such as: what crops to grow, when to start works, when to harvest yield, etc. Results of focus group discussions with farmers in irrigations schemes in Eastern Georgia confirmed that women share agricultural labor activities with men. If the family does not have an adult male member, naturally, the woman is a decision-maker, while if there is an adult male member, female respondents report that decisions are often made jointly. Women work on the field too, while some of them only take care of the residential land parcel the assessment found that women are also involved in on farm water management, and some are using drip irrigation on their fields to grow strawberries and raspberries. However, when it comes to distribution of irrigation water, there are frequent conflicts among farmers as the respondents reported during the discussions. Farmers mentioned that it is often required to stay on their land parcel at night, visit the neighbor village which are considered inappropriate for women. Moreover, the study demonstrated that even in cases when the family does not have an adult male member, women rarely take care of irrigation water distribution matters, as male neighbors help them. In terms of interacting with Georgian Amelioration, women are involved in activities such as signing a contract with GA, paying the irrigation fee, and informing GA of problems. Women expressed readiness to unite with other farmers to ensure the maintenance of the irrigation system. This is a traditional practice within these communities.

11. **To address these integrated complexities, the project invests in water, agriculture, and land simultaneously, operates at multiple, nested scales, and all interventions are guided by the vision to advance climate change adaptation and mitigation in the irrigated agriculture sector in Georgia.** This vision is informed by (a) relevant higher-level national strategies and action plans of the Government of Georgia, (b) grounded in remote sensing based and global climate change analysis conducted by the project team, and (c) global principles for climate resilient and low-carbon water sector interventions adopted and championed by the World Bank. These include the productive use of water in agriculture and energy efficiency measures, and measures to increase adaptive capacity for rural populations in Georgia exposed to climatic shocks through improved water, agriculture, and land management services. These principles are integrated in the infrastructure investments supported by the project, but also in the institutional strengthening activities aimed at equipping water and agriculture sector institutions with the knowledge and tools required to confront and manage the impacts of climate change on agricultural development in Georgia.

PROJECT COMPONENTS

COMPONENT 1: RESILIENT IRRIGATED AGRICULTURE (US$120 million)

SUB-COMPONENT 1.1: Irrigation & drainage infrastructure rehabilitation and modernization (US$85 million)

12. **The five irrigation schemes, 1) Tashiskari and 2) Tiriponi in Shida Kartli region, 3) Zeda Arkhi in Kvemo Kartli region, 4) Zemo Alazani in Kakheti region, and 5) Narekvavi in Mtskheta-Mtianeti region, and a drainage scheme 6) Shavgele Massif in Samegrelo region cover an area of 26,887 ha are managed by "Georgia Amelioration" State Company.** The project finances rehabilitation and modernization of I&D systems at main, secondary, and tertiary canals and drains levels, covering provision of a pontoon with submerged pump for sediments removal from the Narekvavi reservoir, rehabilitation, and modernization of four headworks, four main canals of about 136 km, and network. The total number of structures on main and secondary canals as well as length of secondary and tertiary network will be identified during the preparation of engineering designs. The existing system was designed and built for large and monocrop production areas of former kolkhozes and sovkhozes, while the modernized system shall consider the actual land distribution and potential cropping pattern. The following structures will be rehabilitated and/or modernized across the five irrigation schemes: galleries; inverted syphons; secondary and tertiary network (pipeline or lined); water control/distribution; outlets; mudflows; flood protection; flow and/or volumetric measurement structures, bridges, and other required ancillary structures. Works for drainage system include reshaping of the main drain, network, rehabilitation/construction of required ancillary regulating and outlet structures.

13. **The sub-component will restore mainly previously irrigated and drained areas, and not build new schemes**. While a large part of the rehabilitation will involve reconstruction of original systems, the preliminary and detailed design studies will systematically examine the opportunities to modernize water control and delivery structures, including automation of headworks or introduction of Supervisory Control and Data Acquisition (SCADA) to monitor and control water distribution in some of the larger canal systems. Wherever the adjacent topography allows for conversion of secondary and tertiary networks to pressurized systems, it will be considered for application of modern irrigation techniques (drip, sprinkler, etc.). Under this sub-component, the project finances development of required engineering designs and design review, construction supervision and site specific environmental and social assessment and plans for the investments.

14. **The project finances modernization based on the World Bank's Resilient Water Infrastructure Design Brief to ensure that each structure is rehabilitated or modernized to minimize service disruptions in the face of climate and other disasters**. In this context, the capital investment provided under the sub-component will help to improve conveyance efficiency and water delivery to farmers. At the farm level, the project will promote climate-smart irrigation utilization through improved on-farm water management and introduction of modern irrigation techniques. A summary description of the schemes and expected improved efficiency are provided in Tables 8 and 9 below.

Table 8. Civil works for improvement of irrigation and drainage service delivery

Irrigation/Drainage Scheme	Average 3 years irrigated/drained area (ha)	Area considered under the project (ha)	Main canal/drain length (km)	Headworks to be rehabilitated (no)	Main canal capacity (m3/s)	Main canal to be rehabilitated	Cost estimation (USD Million)	Unit cost (USD/Ha)		Network rehabilitation[5]
Tashiskari	1,530	12,615	63.8	1	12.0	YES	27.59	2,187		Full rehabilitation and modernization.
Tiriponi	5,560	5,210	50.0	0	12.0	NO	9.03	1,733		Full rehabilitation and modernization.
Zeda Arkhi	1,250	1,490	33.9	1	2.0	YES	2.98	2,000		Full rehabilitation and modernization.
Zemo Alazani, Phase I	1,230	6,110	78.0	1	20.0	Only some 30 km in phase I.	23.43	3,835		Full rehabilitation and modernization.
Narekvavi	320	655	8.5	1	1.0	YES	2.10	3,206		Full rehabilitation and modernization.
Shavgele Massif	0	807	69.68	0	6.0	YES	1.25	1,549		Full rehabilitation and modernization.
Total			**26,887**					**66.38**	**2,469**	

Table 9. Source of water and expected improved efficiency

Irrigation/Drainage Scheme	Source of Water	Average Discharge (cub. m/s)	Average Volume (million cub. m)	Average Irrigation use (million cub. m)	2050 Climate Change Scenario	Comment
Tashiskari	Mtvkari (Kura) River	86.2[6]	2,718.40	153.50	Reduced flo	As a result of
Tiriponi	Didi Liakhvi River	33.8	1065.92	86.65		
Zeda Arkhi	Mashavera River, supplied with additional water from 4 upstream off stream reservoirs	5.23	164.93	29.84		

[5] This includes secondary and tertiary network down to farm gates. Secondary canals need to be rehabilitated and modernized, wherever feasible convert to pipelines for pressurized irrigation. Tertiary network is mainly unshaped earth ditches without engineering structures and need to be fully redesigned and built based on actual land distribution, current and potential cropping pattern.

[6] This considers diversion of 9.50 m^3/s of water flow from the Kura (Mtkvari) river, on the territory of Turkey, into the River Tchorokhi.

	(Iakubolo, Pantiani, Mtisdiri and Khorkhori).					
Zemo Alazani, Phase I	Alazani River	17.2	542.42	197.38		
Narekvavi	Narekvavi River (on stream Narekvavi reservoir	0.54	17.03	3.51		

15. **Development of Detailed Engineering Design, Construction and Supervision of works.** Development of detailed engineering designs and supervision of works will be conducted by consulting firms (Consultant). Implementation of works will be carried out by Contractors. Procurement of consulting services and works be based on method and thresholds described in the procurement section.

16. **The estimated sub-component cost (US$85 million) includes about 88 percent for works implementation.** The remaining 12 percent of the total allocation will be used for consultancy services for the development of engineering designs, additional other surveys as required, supervision of works, as well as some contingency built in for potential cost escalations during project implementation. These include up to 7 percent for development of designs, up to 3 percent for supervision of works and some 1 percent for environmental and social assessments and surveys.

17. **Procurement of consulting services and development of engineering designs and bidding documents for works implementation will take 2-3 years**. Thus, the budget requirements in the first two years would be limited and estimated at 10 percent of total allocated funds. The main indicative budget allocations would be in the third, fourth, and fifth years. It is estimated that some 20 percent of total funds would be disbursed in the third year, about 30 percent in the fourth year and about 30 percent in the fifth year. The remaining 10 percent would be expected to be disbursed during the sixth year.

18. **The sub-component will also finance the preparation of a national Irrigation Master Plan that would be guided by:** a) the provision of a reliable water supply to existing or potential irrigation schemes, including under water scarcity scenarios, b) technical feasibility of the investments, c) the economic and financial justification (including by considering "value chain catchment areas" where the context is particularly conducive to value chain development), c) environmental sustainability, including at a wider basin-scale, d) social inclusivity, and e) the adaptation to climate change in water stressed areas of Georgia, including drought-prone and flood risk areas. The exercise will require a sound analysis of the agricultural dynamics and potential (crops, marketing, etc.), which form a key driver for successful investments. The terms of reference for this plan will include an examination of any potential riparian issues as per paragraph 7(b) of the OP7.5 Policy.

SUB-COMPONENT 1.2: Irrigated agriculture and value chain development (US$20 million)

19. **Approach:** This sub-component will finance interventions that focus on increasing agricultural productivity and provide support that will enhance access to markets for farmers in project areas through better integration into value chains. Targeted farm-level agriculture advisory, training, and grant support aims to ensure that farmers in project areas where irrigation systems will be upgraded can intensify their production and/or switch to more profitable crops, increase overall crop productivity, and better access markets. Binding constraints that will be addressed under this sub-component include limited technical knowledge, low awareness, and uptake of modern technologies among farmers and processors, and lack of capital for investments among farmers and small and medium size agribusinesses. Farm-level support will include business and market advisory, knowledge transfer through field demonstrations of CSA technologies, including farm-level irrigation equipment, and technical and business training. Training and advisory support would be available to all

farmers within the irrigation schemes. Matching grants will be available for selected farmers for capital investment in technologies for high value crop production (perennial planting materials, irrigation equipment, post-harvest equipment). Targeted support to private agribusiness operators will be provided to increase post-farm value addition and logistics capacity that would absorb increased farm production, using a combination of advisory services and grants. The approach has been informed by lessons learned from similar ongoing and past agriculture support programs, which suggest an integrated, flexible, and demand-led set of activities, with an emphasis on knowledge transfer.

20. **Investment in modernization and commercialization of newly irrigated farm fields has multiple benefits**. Without interventions, as has been proven with past investments that focus only on infrastructure rehabilitation, many farmers will not have the technical capacity, knowledge, and the financial means to upgrade their production and make productive and efficient use of the available water. The activities that promote and facilitate the adoption of modern agriculture technologies would result in increased efficiency of water use, and significantly increased agricultural productivity and resilience. The activities will include the creation of relevant coordination and information value chain platforms that brings together producers and buyers/processors, which will facilitate market access and result in enhanced value addition and logistics capacity, and improved value chain integration. The enhancement of production capacity of agribusiness will generate employment, including job opportunities for women.

21. **Matching grants:** As a general principle, matching grants will be used as an instrument to promote and demonstrate new technologies that contribute to climate mitigation and adaptation, to increased productivity and value addition, and to improved efficiency and management of irrigation infrastructure and water resources. Grants will be used to co-finance farm and firm-level investments in technologies that generate or contribute to public-good benefits, rather than consumables such as seasonal farm inputs. Where complementary financing is needed, matching grants will leverage private capital from the commercial banking sector, thus enhancing their participation in the agriculture and agribusiness sectors. Co-financing opportunities will be identified based on a demand-led consultation and coordination process among value chain actors, supported by the project.

22. **Value chain approach:** Activities under this subcomponent will be demand-driven, responding to constraints faced by farmers and value chain actors, and to the economic opportunities that would generate farmer income growth and value addition post farm gate at the time of implementation. The selection of crops, on-farm irrigation technologies, and post-harvest equipment and technologies that will be promoted and supported by the project will be based on a demand-led consultation and coordination process among value chain actors that will commence once the irrigation schemes have been selected. Commercial banks will also be engaged in this process, and the project will provide business and financial advisory services to identify opportunities for value chain-based project interventions at the farm and agribusiness level.

23. **This sub-component will involve MEPA's Rural Development Agency (RDA) for the administration of matching grants.** RDA has extensive experience in agriculture support program implementation and grant administration. Building on existing programs (such as the Plant the Future program), the project provides an opportunity to expand the range of agriculture programs, supporting not only perennial crop production but also high value annual crop production, and integrating training and farm advisory as well as value chain coordination. Institutional support will be provided to enhance RDA's capacity to design and implement agriculture support programs that incorporate training and enhance the capacity of the ICC network to deliver relevant farm advisory.

24. **Beneficiaries and target areas:** The primary targeted beneficiaries are the 36,377 landowners and farmers in irrigation schemes that will be rehabilitated under the GRAIL project and who can expect water service delivery to commence during the third year of the project. In addition, during the first and second year, some 1,000

farmers in irrigation schemes (in Gori and Sagarejo municipalities) that were rehabilitated under the GILMDP (ongoing, closing in 2023) would be targeted. The GILMDP did not provide farm-level support and there is an opportunity for the GRAIL project to include selected irrigated areas under the GILMDP and target a limited number of farmers for early/frontloaded interventions during the first two years of the project. This will not only benefit farmers in newly rehabilitated irrigation GILMDP areas, but it will also prepare the rollout of project support in rehabilitated irrigation schemes under the GRAIL project.

25. **Gender.** Under sub-component 1.2, the project will carry out demonstration activities targeted to the land plots of female farmers on a priority basis and promote matching grant mechanisms that target the needs of female landowners in terms of agricultural inputs, trainings, machinery, and equipment. The proposed matching grants programs may also set aside funds for women-led projects and conduct outreach to make sure these funds are used.

Activities and activity costs are detailed below:

26. **Activity 1: Farm and agribusiness modernization and commercialization in project areas (US$17 Million).** A menu of farm modernization and commercialization packages will be offered to farmers in pre-identified irrigation systems who are or will be receiving improved water delivery services. The purpose is to ensure that farmers are equipped with knowledge and technology to modernize their irrigated farm once irrigation service delivery commences. Packages will include provision of value chain specific technical and business advisory, and training (including through demonstration plots/farms) to clusters of farmers. A first round of advisory services will be provided to assist farmers in identifying the most suitable crop/cropping mix, plant varieties, technologies, agronomic practices, market considerations, including compliance to food safety and market standards, and other factors that will underpin the viability of the specific farm enterprise. The project will facilitate value chain-specific coordination meetings involving agribusiness companies with the aim to create platforms for future dialogue. For selected farmers a matching grant for financing on-farm investments (irrigation equipment, planting materials, post-harvest equipment) will be available. Based on specific conditions and crop suitability in different irrigation systems, the following packages of technical advisory, training, and matching grants will be offered:

a. **Orchard development package (stone fruits, berries, nuts),** including advisory, training, possible matching grant for on-farm irrigation, certified planting material, on-farm storage, packing, possibly anti hail and frost protection equipment.

b. **Vegetable development package (tomatoes, cucumber, eggplant, greens),** including advisory, training, possible matching grant for on-farm irrigation, greenhouses and polytunnels, on-farm cold storage, packing equipment. Advisory and training for improved **forage production** for livestock farmers will also be offered.

c. **Nurseries improvement package:** advisory, training, possible matching grant for **the development or improvement of commercial nurseries that produce disease-free and certified saplings, seedlings, and other planting materials of commercial varieties.**

d. **Value chain business package:** advisory and possible matching grant to support agribusiness firms in investing in processing equipment, packing equipment, enabling them to increase their processing capacity, increase efficiency, reduce losses, reduce energy consumption, and develop new products.

27. **Farmers can apply for a matching grant under the project – packages a), b) and c) above – to finance on-farm investment requirements.** Some US$12m will be allocated to matching grants to farmers and agribusinesses under the project. The average landholding within the shortlisted irrigation schemes is less than

one hectare, suggesting the presence of many relatively small farms. As information on land size variability is currently insufficient to design detailed packages, details will be finalized once the beneficiary survey has been completed and the demand for grants in each value chain category can be estimated. Taking into account past demand for matching grants as well as the capacity for grant administration at RDA, the project would provide grants to approximately 2,500 farmers. The project will provide matching grants of around 40-60% of the total investment plan value, depending on local conditions, nature of investments, and selected crops. A flexible approach will be adopted, and grant values will be determined based on detailed information about farmers' needed investments at the time of implementation, which will also determine eligibility and selection criteria. As a first activity, before the grant application process commences, consultation and coordination events with agribusinesses and other relevant value chain actors, including banks, will be facilitated by the project, which will assist farmers in selecting viable investments applying for a matching commercial loan if needed.

28. **Grant applications will be launched starting Year 2, and grant approval will be timed to coincide with the completion of infrastructure works in all selected GRAIL schemes from Year 3 onwards**. Selection of grant recipients will be based on economic and sustainability related criteria, and gender and other equity considerations. RDA will be appointed by the PIU as grant administrator, given their extensive experience with grant administration. A committee comprised of selected PIU, MEPA and RDA staff will manage the selection process. The demand for grants will become clear once the final selection of irrigation schemes has been made, a beneficiary survey completed, and when engagement with farming communities can commence to raise their awareness about the grants, how to apply for them, as well as communication around the benefits of the grants for farmers.

29. **The project will provide training and technical advisory services using experienced NGOs**. Training and demonstration of climate-smart agriculture techniques and practices will be conducted using existing and new demonstration plots, including those of beneficiary farmers. Training and demonstration will be key in the transfer of knowledge on modern irrigation technology and techniques, conservation farming practices, advanced crop husbandry and management practices, and compliance with food and food safety standards. The project will also involve and support the existing farm extension service, operated by the Information Consultation Centers (ICCs) at the municipal level. As part of the Hydrological and Agricultural Informatics Program (HAIP) that will be established and supported under the project (under Sub-component 1.3), data and information relevant to farmers will be used to generate farm extension/advisory messages for dissemination which would assist farmers in making medium- to long-term decisions related to crop suitability based on water availability, soil and climatic conditions, as well as short term operational crop management decisions based on localized weather and water conditions. To this effect, technical support will be provided to the ICCs that cover the project areas as part of an effort to develop a new model for delivering farm extension services, including the promotion of a public-private digital farm extension platform, and a possible use of private sector advisory service providers. The development of digital e-commerce platforms for input and output marketing, storage, logistics, and other value chain functions will also be facilitated through technical advisory.

30. **The project will support a program of larger matching grants, under package d) above, to food chain businesses and farmer groups for value chain development**. Investment proposals will be prepared by individual companies, informed by value chain-specific coordination events facilitated by the project, involving producers, cooperatives, input suppliers, and commercial banks. Grants would finance equipment, fixed assets, and other investments that would enhance the firm's capacity for value addition. There would be a requirement for grantees to work with small and medium scale suppliers. The project will provide technical advisory services by national and international experts to support investments made by agribusiness companies, including technical advisory on advanced processing, packaging and other technologies that will stimulate the generation of new ideas and the adoption of new processing, packaging, and marketing technologies, enabling innovation and new

product development. Compliance to food safety standards in export markets is expected to be an important objective, requiring expertise and equipment. Advisory services may also be provided to support the preparation of bankable business plans.

31. **Two key areas for agribusiness investment are foreseen:** a) processing and packing equipment that would enable firms to increase their production capacity, reduce losses, reduce energy consumption, and develop new products for new markets based on different and innovative processing techniques such as freezing, drying, presentation, and packaging; b) cold storage facilities, packhouses, of which there is currently a shortage, and that would allow firms to expand and become more efficient. The number of beneficiaries under this grant scheme is estimated at 25-35 firms. The maximum grant amount would be the equivalent of US$150,000 per firm and should not represent more than 40% of the total investment plan value. There will be an expectation that commercial borrowing and own resources will provide the balance for the investment. The PIU will manage the above activities and engage RDA as the administrator of the matching grants and co-implementer of grant-related activities.

32. **Activity 2: RDA capacity building support (US$3 Million).** The Rural Development Agency operates various agriculture support programs at the national level, including support for developing perennial tree crop orchards, an interest subsidy program, an agriculture insurance program, and others. Programs focus on providing grant financing and interest subsidies, and RDA's administrative systems appear to be well developed. The national agriculture extension system operates through the network of ICCs at the municipal level and falls under RDA.

33. **RDA's active involvement in the implementation of agriculture support activities under GRAIL will provide an opportunity to enhance its capacity and existing programs as follows:** First, RDA programs currently focus on grant financing only and do not incorporate advisory services or training. Under the GRAIL project, support to on-farm modernization and value chain development will require commercial and technical expertise which will be provided before and after investment decisions are made. The project will also introduce an M&E function that could be adapted to suit RDA programs. Thus, the project can provide technical assistance to enhance and adjust core RDA programs, and ensure that these are tailored to local conditions, needs, and opportunities, for example supporting the development of high value annual crop production, or expanding investments in logistics and cold chain development. The project would support the upgrading to RDA's administrative systems to be able to receive and administer EU funding, accreditation for which is ongoing.

34. **Second, The ICC network's capacity to disseminate agronomic and market-related knowledge and introduce farmers to new technologies is limited.** The project would provide an opportunity to explore alternative service delivery models for farm advisory services, and will finance a pilot of outsourcing advisory services to experienced NGOs (using performance-based contracts) and agricultural service centers in project areas. Capacity building and technical support will be provided to the ICCs that cover the project areas to develop a new model, including a digital platform for delivering farm extension services, using data generated by the HAIP program and incorporating other data sources and data providers, and digital solutions. Based on the results of these pilot activities, a new extension model could be scaled up over time, financed by government budget and supported by existing development partners in this area (such as the EU and FAO). An important part of knowledge transfer are the farm demonstration plots, which will be supported in project areas to demonstrate e.g. modern micro irrigation technology, soil management practices, crop husbandry techniques such as pruning, and other CSA and productivity enhancing practices. Support to farmer field learning through demonstration plots will be done in coordination with the EU and FAO who have been supporting the development of a demonstration plot network.

35. **Third, given that the topic of agriculture logistics has been identified by MEPA management as a key and fundamental bottleneck to value chain development at the national level, the GRAIL project will finance one or more viability assessments of potential logistics hubs for agri-food products that would improve product aggregation, storage, and consolidation of products for local and export markets.** The viability assessments would identify and catalyze public and private investment opportunities and would inform ongoing discussions around the establishment of a large-scale integrated logistics center near Tbilisi (in which agro-logistics would feature prominently).

36. **The project will thus provide an opportunity to enhance the quality of RDA programs, including the delivery of extension services and contribute to an important dialogue on agro-logistics.** The activities are summarized as follows:

a. **Institutional support to enhance RDA program design and implementation capacity:** Areas of focus include technical design of agriculture sector support programs, including the use of advisory and training in combination with matching grants, digitalization of key data and service delivery, upgrading of administrative systems, and development of M&E capacity.

b. **Technical support to ICCs in project areas**, to develop alternative farm advisory service delivery modalities using third party service providers, and to introduce of digital farm advisory services. Technical support will be provided to ICC staff to develop capacity in using HAIP data and formulating messages to the farming community, using a digital platform. Technical support will also be provided to develop and facilitate e-commerce platforms for agribusinesses and farmers.

c. **Viability studies for the identification of priority investments in agri-logistics infrastructure,** that would increase efficiency of product aggregation at the rural level and enhance efficiency of logistics facilities for consolidation at a more central level.

37. **Collaboration with IFC:** Activities under a planned IFC Advisory Services program to promote CSA and sustainable agri-finance in Georgia may complement GRAIL project activities. Leveraging IFC's global experience, including in Georgia, areas of focus would include the development of innovative financing mechanisms such as crop and warehouse receipts, including regulatory support and capacity building among government and banks, and the promotion and financing of CSA technologies among farmers and value chain actors. This would potentially support on-farm investments in the project areas and will contribute to the de-risking of agriculture lending by commercial banks. IFC also has substantial technical expertise to share on food safety compliance in agriculture value chains that aspire to access EU markets.

SUB-COMPONENT 1.3 Improved performance of irrigation service delivery (US$15 million)

38. **This sub-component finances activities that aim to achieve operational sustainability through reform of the institutional environment and capacitation for effective operations, maintenance, and management (OMM) and providing innovative data and information tools and services required for evidence-based decision-making in water and irrigation management for improved productivity and resilience of irrigation in Georgia**. The project will enable GA to take a significant step forward to achieving financial sustainability through the establishment of a performance-based and service-oriented culture at the central and service center levels. The sub-component supports TA, training of GA personnel and farmers, software purchases setup, and incentives (offered as matching grants for adopting irrigation technologies and accessing decision support applications for climate data) (for the uptake of agricultural water management and WUO-centered operational establishment) and setting up a new Hydrological and Agricultural Informatics Program (HAIP) within MEPA to provide user-oriented data services. Activities include an organizational audit, review and reform of the irrigation service fee

structure, development of digital systems for improved asset management, and the initiation of new operational arrangements at scheme level, supported with incentives.

39. **The activities collectively enable farmers to adapt to climate variabilities by reducing their risks through access to more secure irrigation water services and through better water management practices on farms**. Additionally, these activities will strengthen the institutional capacity of GA as well as other agencies within MEPA to manage and monitor irrigation service delivery and plan and respond to climate risks. The five activities proposed under this sub-component strive for water productivity improvements by complementing the modernized infrastructure investments in Component 1 with reformed and fit-for-purpose scheme governance arrangements and capacitation investments. These combine to achieve direct benefits at the field scale in form of more secure irrigation and drainage services building farmers' resilience to climate shocks and contribute to social and economic gains through multiplier-effects.

40. **Activity 1: Comprehensive investment program to improve Georgian amelioration functions (US$5 million).** The activity will finance TA to undertake comprehensive institutional reform assessments and support intensive subsequent capacitation activities for GA staff. The support includes: i) TA for an in-depth organizational audit of the GA internal structure at the national, regional, and local levels. The audit process would assess and redefine structural organizational arrangements with a focus on the optimization of functions centered around a service-oriented and performance-based work culture. The TA contract will extend over a period of three years with an intensive first 18 months followed by an 18-month handholding and exit phase; ii) a separate follow-on TA for internal capability development of GA and service-center personnel will be supported, to ensure staff competency for the re-defined roles identified in the organizational audit. Related purchases will include essential instruments and equipment for effective organizational functioning at all levels (including computers, field instruments, transport, water measurement instruments) as well as an Asset Management System comprising a GIS based MIS system (which will be linked to tariff calculations, administration and payment notifications, monitoring of operations, management, and maintenance (OMM) in selected service centers); iii) The activity will also finance TA to aid GA to establish an internal public relations and marketing team, including the development of a communications strategy. Related financing will include provision for sensitization campaigns targeting farmers and GA personnel regarding their re-defined activities; iv) A key knowledge element of study tours for GA staff and WUOs members will also be supported. This will include local and international tours to successful similar sites of practice with innovative solutions and technology adoption; and v) finally TA and goods for Field Level Leadership (FLL) interventions will be supported. FLL implementation in GRAIL will cover selected staff of GA, with a focus on the operational units at head-office and the service centers who are linked to the five schemes in GRAIL. Initial implementation will be completed in the first two years of GRAIL and will include training of FLL master trainers and roll-out of FLL workshops led by the master trainers.

41. **Activity 2: Review and redefinition of the irrigation and drainage tariff (US$1 million).** This activity will support TA to undertake the consultation process, legal and financial study (affordability and willingness to pay) and technical review of the proposed tariff methodology and structure which will be finalized by GNERC at the end of 2023, related to the irrigation tariff. The regulatory restructuring of the tariff will be informed by the options in the irrigation strategy, including a binary tariff. Volumetric tariffs are envisaged for the bulk water supplied by the Service Centers to the WUOs, while area-based tariffs are envisaged within the WUO area of operation (e.g., for the Irrigation Service Fee or fee charged to WUO members by a WUO) (Figure 12). The current irrigation tariff approximately covers only 20 percent of actual OMM costs excluding the capex required for rehabilitation or modernization, and as per the targets set in the Green DPO, the objective is to improve the tariff to achieve at least 100% cost recovery of OMM costs for GA, including provision of cross-subsidization of irrigation OMM costs from tariff fees from other water user clients of GA, including hydropower, fish farms, and industrial water users by 2025. The project plan is drive progressive reforms through success in practice at local

level within the selected GRAIL schemes, thereby providing a sound basis for subsequent scaling nationally. The plan is enabled by: the 2019 WUO law; practical experience from the proposed WUO pilot that will be underway in 2023; investments in operational control and volumetric measurement infrastructure under sub-component 1.1; and increased farm profitability that is supported by Sub-component 1.2. Progress is premised on: a) first, ensuring higher service delivery levels through functional infrastructure and operational capacitation within Service Centers and WUOs, including the establishment of explicit performance-based service contracts, b) second, a targeted communication campaign for farmers in the GRAIL project scheme areas about the costs related to OMM as well as information and awareness raising for farmers on the rationale for improved service delivery and the broader national process of tariff reform that is underway, and to clearly communicate to farmers how this will translate into economic gains for their production. This activity will also finance stakeholder group consultations sessions at different locations in Georgia and related media and awareness outputs to support wider understanding of the tariff reform initiative, and c) third, step-wise tariff increases for irrigation clients of GA will be phased in over 3 years with progressive tariff subsidies provided for under Activity 4, starting in scheme areas, where construction works are more than 90% completed, to be able to coincide irrigation services improvements, improved water supply, and tariff increases consecutively. In Activity 2, a standalone technical assistance consultancy will be mobilized to conduct an 'ability to pay' survey for all project beneficiaries, which will be identified for different farmer types to ensure financial realism from the farmers' perspective. Varied tariffs for different types of agricultural, commercial, industrial, and other users are also anticipated.

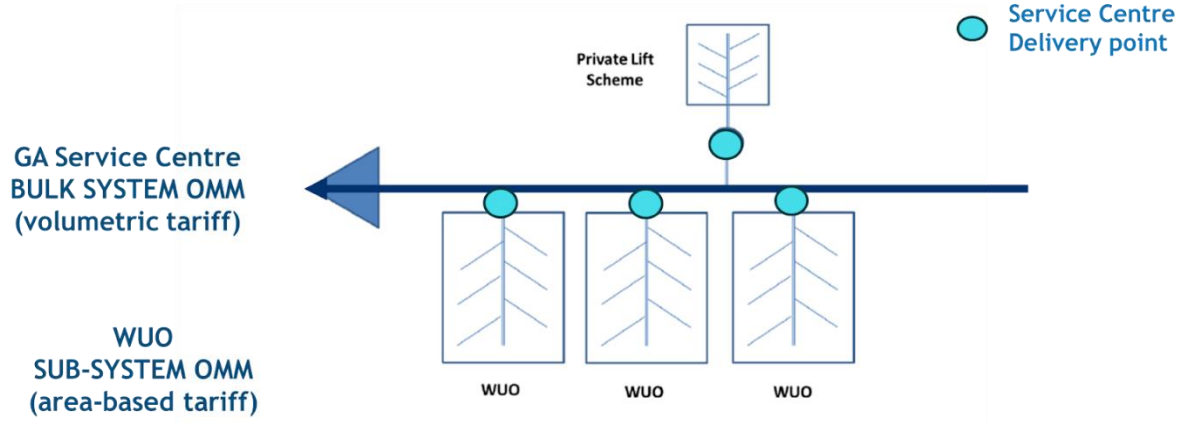

Figure 12: Proposed Division of Operations, Management and Maintenance (OMM) Functional Responsibilities and Tariff Type (as per Georgia Irrigation Strategy, 2017)

42. **Activity 3: Support to farmers and GA in water and irrigation management to reduce adverse impacts of climate change on their crop production and livelihoods (US$1 million).** This activity will focus on developing tools and action plans that are required by farmers for coping with climate variability as well as probable future impacts of climate change. These impacts include the increased degree of heat stress, increased inter-annual and inter-seasonal variability of precipitation, more frequent drought incidents, and increased water stress in Eastern Georgia. The level of farming sophistication and scale varies widely on the GRAIL schemes from large corporate style export fruit and vegetable farms, to a more peasant farming style on smaller farms, often with less than 1 Ha farm plots. While all farmers need to maximize returns from limited water supplies and manage climate change risks, different technical and knowledge interventions are needed for different types of farmers to improve irrigation agronomy field practices and soil-water availability. The activity will finance TA and goods for a series of Farmer Field Schools (FFS) that will be tailored to the varied needs of the different farmer groups in the selected GRAIL irrigation scheme areas. Learning topics will focus on improved soil-water management (including low-cost and robust wetting front detectors and soil-water sensors), irrigation agronomy (cultivar

selection, timing of planting, weeding etc.), irrigation application technologies, and use of Decision Support Systems via mobile applications to provide farmers with data from the HAIP on climate and weather-related aspects. Knowledge gaps and learning needs will be identified by qualified FFS Master Trainers (one international and one Georgian national) working with GA staff, academics, and Georgian sectoral specialists. Farmer Field Schools will be rolled out over a minimum of two production seasons for every farmer involved. The program will include details of matching grant and farmer co-payment amounts and modalities to enable widespread uptake of low-cost soil-water management instruments and more selectively due to their much higher cost per hectare, micro-irrigation technologies, as well as changes in irrigation methods away from flood irrigation towards more water efficient irrigation methods.

43. **Activity 4: Establishment of I&D service delivery organizations (US$2 million):** The activity will finance TA services and goods for WUO organizational establishment and capability development of leadership and membership, functionally tied to GA service center personnel who are responsible for the five participating GRAIL irrigation schemes. It is anticipated that between 10 and 15 WUOs, ranging in size between 700 ha and 1200 ha will need to be established, equipped, capacitated, and supported financially through the first three years of operation. The TA scope of work would include a baseline survey and WUO case study assessment building from the experiences of the WUO pilot under the existing ILMDP, and the establishment of a WUO development program. The activity will support the formation of Farmer Initiative Groups targeting both male and female water users in the project areas, in the first year of the project, to enable farmers to come together regularly to discuss design and construction works as well as provide feedback to project staff on water management, irrigation practices, and their experiences with GA services in their respective schemes. The activity will further finance the implementation costs of the WUO development program covering workshop venues and media outreach and awareness trainings over a 3-year period. Finally, the activity will also provide critical financial support for incentives at the WUO level, covering initial operational costs during the establishment and transition period. These incentives will drive uptake of the new irrigation tariffs by eliminating initial financial risks for farmers by phasing in operational costs in a phase-wise manner both for WUO membership as well as for increased irrigation tariff fees to GA. The incentives supported by the project would include subsidies for irrigation service fees (for new WUOs) for 3 years on a phased-out basis linked to steadily improving service delivery levels; support for all WUO operational infrastructure and equipment (e.g., computers, equipment, transport, measurement devices etc.); professional training, and continued professional development of (including experiential cross visits) for personnel and WUO board members comprising representative farmers; farm-level irrigation knowledge including improved water management, irrigation practices, and climate advisories linked to Activity 3. This may also include study tours for selected groups of farmers and GA officials to visit mature WUOs in relevant countries.

44. **Activity 3 will aim to raise awareness in the communities about women's knowledge and integrate them into critical roles in the management of water resources.** The project will seek to build on the importance and benefit of women's voice and decision-making in local irrigation management organizations, such as WUOs. Trainings will be specifically targeted to women to build their confidence and encourage active involvement in the work of WUOs. Trainings could cover water scheduling, operation and maintenance of irrigation on-farm infrastructure/equipment, calculation of irrigation service fees as well as leadership, negotiations, and communication skills to increase technical and leadership skills of female farmers as well as build on the natural skills of conflict resolution that seem to be prominent among Georgian female water users. The project will a) consult women on their needs and preferences during irrigation infrastructure design within the context of the Farmer Initiative Groups, b) raise awareness among all public officials and water users on the importance of incorporating women's preferences in irrigation infrastructure design, c) include in the infrastructure design water systems that are often more valued by women because they support both domestic and irrigation uses (e.g., on-farm irrigation technologies), d) train female farmers on operating, maintaining, and repairing their own

irrigation technologies/equipment, and e) formalizing and recognizing the WUO as an institution so that it is mandated to promote gender and inclusion, among others. Efforts to support WUOs development may also include adding gender-affirmative measures in by-laws such as quotas for women in leadership positions, specific training (communication skills, technical skills) to help women have their concerns heard in male-dominated spaces, gender sensitive training in all training sessions for example to explain the benefits of having balanced representation. Existing organizations such as the Association of Women Farmers of Kakheti could be partners for these aspects.

45. **Activity 5: Establishment of a new Hydrological and Agricultural Informatics Program (HAIP) (US$6 million).** Insufficient information is hampering the ability of Georgia to properly deliver irrigation services, manage water and environmental resources, and support agricultural growth. Hydrological and Agricultural Informatics Program (HAIP) will help MEPA build the foundation needed for filling this information gap through the application of new tools for integrated monitoring of water, agriculture, and land. This integrated approach will help Georgia leapfrog into a modern water and agricultural management system where decisions across the scales are informed by continuous, reliable, and openly accessible data.

46. **The project will support the establishment of a new "HAIP Center" with dedicated focal points in NEA, GA and LMA**. The project will build on existing in-situ monitoring of hydrological, groundwater, soil moisture, river flow, and other types of land management activities of NEA, GA, LMA and will complement their ground monitoring network in the GRAIL selected schemes. These agencies will collect and share the ground-based information and send it to the HAI Center where the collected ground data will be processed and complimented with remote sensing data, into a series of data products and tools to allow the users including the agencies such as GA to make better management decisions (Figure 13).

47. **The HAIP Center will develop and maintain a state-of-the-art web-based based platform to visualize and share associated databases that will include the following data elements**: i) remote sensing; ii) canal flow monitoring; iii) groundwater monitoring; iv) water-environmental information, and v) agrometeorological monitoring. Services envisioned to be provided through the HAI Center in collaboration with relevant agencies include: i) crop monitoring and productivity reports; ii) irrigation service monitoring reports; iii) water balance reports; iv) flood monitoring and mapping; v) drought monitoring; and vi) weather, and climate information and forecasting services for farmers.

48. **The general institutional structure of HAIP is shown in Figure 13**. However, to finalize this structure, one of the first sub-activities during the project implementation phase will focus on developing a detailed roadmap for HAIP which will include stock taking, needs assessments, an overview of existing hydrological and agricultural ground monitoring network, types of improvement needed for the ground monitoring network, staffing needs, detailing services that HAIP will provide, and a consulted (and agreed) proposal on best institutional structure for HAIP. This will aim to surface stakeholder feedback to determine, which specific agency within MEPA is the best place to host the new HAIP Center, how the center would work with agency focal points to receive data, and most importantly how the center can meet the operational needs of the agencies to enhance water, agricultural, and land management within MEPA. For example, LMA can be a key agency in the future to host the HAIP center.

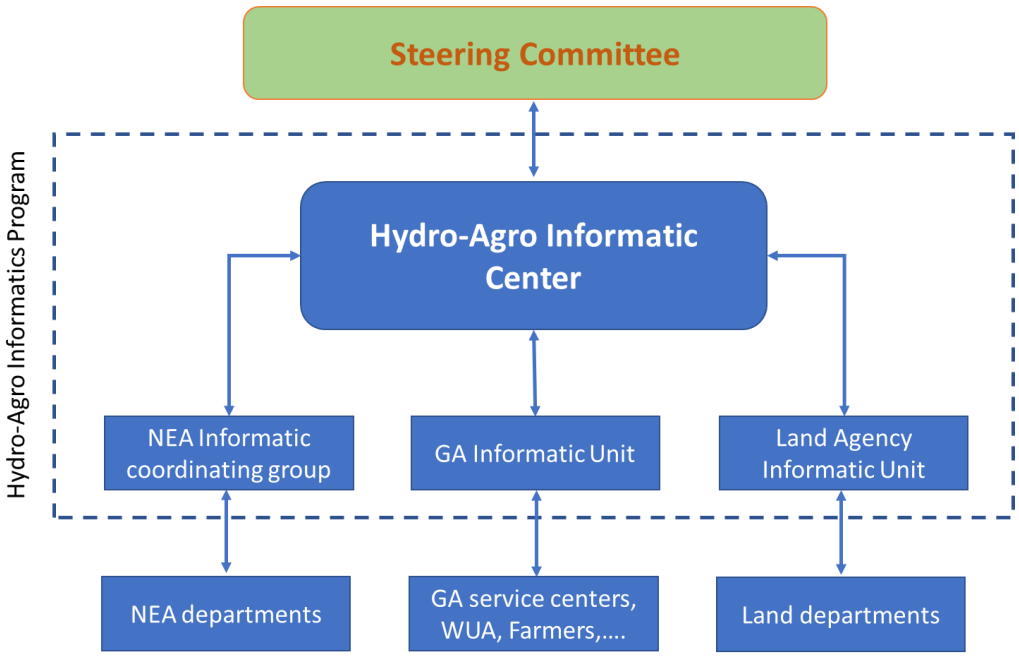

Figure 13. Schematic view of the Initially proposed institutional structure for HAIP (to be confirmed during the project implementation)

COMPONENT 2: Improved Land management capacity (US$24 million)

49. This component will finance activities aiming at strengthening national land administration and management systems and facilitation of access to and use of geospatial data. It is expected that described below activities of support to the preparation of the National Land Consolidation (NLC) and Sustainable Land Management (SLM) Strategies, operationalization of the Multi-purpose Agricultural Land Information System (MALIS), development of the NSDI and enhancement of the IPRS , in conjunction with introduction of market-based mass valuation and voluntary land consolidation methodologies and procedures for agricultural land and their piloting in the selected Project areas would contribute to the activation of agricultural land markets and would facilitate investments into the agri-businesses.

50. **SUBCOMPONENT 2.1 Strengthening of agricultural land management and monitoring (US$14 million).** This subcomponent would support creation of a solid foundation for improved land management, agricultural land markets development and hence land use efficiency with a particular focus on agricultural land through investments in development of policy and institutional reforms, capacity building of the key stakeholders, upgrading of their IT and other infrastructure and acquisition and processing of targeted spatial data for their operations. For that purpose, regulatory, institutional, and operational support would be provided to the LMA and NASP. The sub-component will finance the following activities:

- Activity 2.1.1 Operationalization of the MALIS including update of the land balance database and report
- Activity 2.1.2 Enhancement of the Farm Registry for Georgia
- Activity 2.1.3 Support in the preparation of the SLM and NLC strategies and their piloting in the GRAIL irrigation areas

- Activity 2.1.4 Design and piloting of the agricultural mass land valuation methodology and system

51. **Activity 2.1.1 MALIS operationalization including update of the land balance database and report (US$6 million).** This activity will finance IT infrastructures procurement and deployment, collection and processing of the data and pertaining technical assistance activities for modelling, standardization, and organization of the quality control with an aim to establish a MALIS within LMA. The MALIS should be also connected to the NAPR IPRS, and its implementation would be piloted in selected areas. The Component would additionally support redesign of methodologies of land balance and inventory and State agricultural land management activities leveraging good international practices and their implementation in selected areas, such as use of remote sensing technologies for creating and monitoring land use and land cover data and creation and monitoring of the soil quality database. The activity will also finance preparation and implementation of the trainings and capacity building for the staff of the LMA, NASP and other relevant stakeholders' potential partners and users of the MALIS.

52. **Activity 2.1.2 Enhancement of the Farm Registry for Georgia (US$2 million)**. This component will finance database design, standardization and update of the records pertaining to the Farms' records in Georgia. This database and the corresponding developed modules within MALIS would enable monitoring of land use, land cover, soil typology, agricultural production, and other relevant parameters. This farm registry would fit into the agenda of progressive alignment of the Georgian legislation and institutional framework with European Union (EU) with an aspiration of the future accession. It could be used as a Georgian version of a Land Parcel Identification System (LPIS)[7].

53. **Activity 2.1.3 Preparation of the SLM and NLC strategies and piloting of the NLC strategy in the GRAIL irrigation areas (US$3 million).** The activity will finance support in the preparation of the SLM strategy and NLC strategy and subsequent piloting of the NLC strategy in the irrigated areas of the project. A pilot area with a highly fragmented land tenure pattern and a strong demand for land consolidation will be selected at the initial stage of the project and after an extended awareness raising campaign. The expected total size of the pilot project is around 5,000 ha comprised of a total number of households of around 5,000. An average holding size is expected to be 1 - 2 hectares of non-constricted agricultural land, divided into 3-4 parcels with an average parcel size of around 0.5 ha. Based on the recent experiences in Armenia and in Turkey[8], and statistics on the spontaneous demands for land consolidation during Systematic Land Registration (SLR) activities in Georgia, where 11 percent of plots were required to be consolidated, it can be assumed that around 900 ha would be consolidated out of 5,000 ha. The land consolidation pilot project is expected to have several positive impacts at three different levels: farm, community, and macro-economic level, such as increased agricultural productivity, reduced transportation costs, development of the local economy, creation of local jobs, improvement of infrastructure, land market development, contribution to reduction of greenhouse gas emissions, etc. For example, experiences from similar pilots[9] show that agricultural land consolidation increases the average parcel size by 60-70 percent, the price by 10 percent and the productivity of the key crops by 15-25 percent. It is

[7] LPIS -A geographic information system in EU that allows competent national authorities to geo-locate, display and spatially integrate its constituent data, as referred to in Article 70 of Regulation (EU) No 1306/2013 and Article 5 of Regulation (EU) No 640/20143. It contains diverse spatial data sets from multiple sources which together form a record of all agricultural areas (reference parcels) in the relevant Member State and the maximum eligible areas under different EU aid schemes in Pillars 1 and 2 of the Common Agricultural Policy. LPISs comprise alphanumerical and graphic elements in all countries of the EU. LPIS activities undertaken by Member States to record changes to land over time, e.g. by drawing the correct parcel boundaries, determining the degree of eligibility of agricultural land, delineating ineligible areas, defining pro-rata categories for each reference parcel affected etc.

[8] FAO. 2015. "Pilot evaluation: Land Consolidation in Konya Region, Cumra District, villages Inli and Dinlendik(2010-2012) ". Final Report. FAO/Turkey Partnership Programme

[9] AGREX. 2011. "Impact Assessment of the Land Re-parceling Pilot Project in 6 Villages". Final Report.

additionally expected that the decrease in CO2 emissions per hectare would be around 0.046 tons/hectare/year[10].

54. **Activity 2.1.4 Design and piloting of the agricultural mass land valuation methodology and system (US$3 million).** The objective of this activity would be to design and develop a MALIS-based and LMA-administered prototype for mass valuation of agricultural land. The secondary aim will be to promote awareness on the importance of property value data in property taxation, state property management, state asset management and state audits, and for enhancing property and credit markets. The activity will also finance a property valuation infrastructure and requirements and gaps' analysis and develop a property price index and mass valuation application prototype making use of the data stored in MALIS database. The mass valuation methodology will focus on the agricultural land and adhere to the international valuation standards. The mass valuation prototype module within MALIS should provide approximate market values suitable for multiple uses such as recurrent property taxation, check and balances for property transfer tax monitoring, expropriation compensation, state land management, state asset valuation, state audits and more. On demand valuation approach, currently practiced in Georgia, does not produce accurate market values in real property market conditions, and could eventually need to be replaced by a new mass valuation function capable of producing approximate market values. The prototyped mass valuation prototype will allow LMA to test mass valuation as a potential future business line and demonstrate its capabilities for internal and external beneficiaries. This activity will also finance training and capacity building focused on valuation standards and practices for agricultural land.

55. **SUBCOMPONENT 2.2 Enhancement of the land administration service delivery and building digital governance infrastructure (US$10 million)**. This subcomponent would finance further enhancement of the NAPR (IPRS), and operationalization of the NSDI. The IPRS initiated under GILMDP, should be further enhanced to connect additional stakeholders, and develop new E-services, such as State leases management. The additional cadastral and registration data through National Systematic Land Registration Program implemented by the NAPR between 2022 and 2024 will also require review and update of the National Address Registry, which is known to be outdated by 70 percent, and eventually a change in the methodology of the Georgian address data management system. The NAPR started developing NSDI a few years ago. The process should be brought from piloting to a production level and progressively connect all the stakeholders: producers and users of spatial data (including cadastral, topographic, and geodetic data). The Component would also provide regulatory and operational support to optimize land and real estate markets monitoring.

56. **Activity 2.2.1 IPRS (Phase II) and E-services Enhancement (US$ 2 million).** The activity will finance a second phase of the NAPR IT System upgrade and will focus on redevelopment of the core cadastre and registration modules and a subsequent redevelopment and operationalization of the new E-Services to further improve NAPR-customers; experience and complete digitalization of the NAPR functions.

57. **Activity 2.2.1 Operationalization of the NSDI (US$8 million)**. This activity will finance design, development, inter-institutional capacity building and deployment of the Georgia NSDI. This would be a consistent next step in the implementation of the Integrated Geospatial Information Framework (IGIF)[11] which is a global good practice for NSDI design and implementation. NAPR started implementation of the IGIF with the support from the Norwegian State Mapping Agency by preparing a Baseline Assessment, Alignment to Governmental Policy drivers and Socio-economic Impact Analysis (SEIA) reports. The activity will focus on the

[10] Ramírez del Palacio, Óscar, Salvador Hernández-Navarro, Luis Fernando Sánchez-Sastre, Ignacio Alonso Fernández-Coppel, and Valentín Pando-Fernández. 2022. "Assessment of Land Consolidation Processes from an Environmental Approach: Considerations Related to the Type of Intervention and the Structure of Farms". Agronomy 12, no. 6: 1424.

[11] IGIF was endorsed in August 2018, by the United Nations Committee of Experts on Global Geospatial Information Management – UN GGIM.

implementation of the recommendations of the above-mentioned reports and besides design and development of the IT infrastructure will also implement 10 use cases out of 32 identified by the SEIA report.

58. According to the Baseline report: "one of the primary components of a data infrastructure is the location of a nation's assets, including land, natural resources, and the built environment to allow these assets to be managed more effectively in the context of development, planning and climate change mitigation[12]". Georgia SEIA established that investment into the NSDI would generate an NPV of US$30 million based on the benefits derived from the implementation of 15 percent of the identified use cases. Additional benefits include better land tenure security, effective decision-making, and public services' delivery. Nationwide security of tenure and accessibility of spatial reference data is one of prerequisites for a country's accession to the EU (alignment with requirements of the directive INSPIRE) and should provide a solid foundation to attract private investments into commercial agriculture.

COMPONENT 3. PROJECT MANAGEMENT (US$6 Million)

59. **This component would finance project management, including coordination and technical supervision of the implementation, financial management, procurement, monitoring and evaluation, and progress reporting, relating to Component 1 with a Project Implementation Unit (PIU) that falls under MEPA and a PIU for Component 2 that falls under NAPR, within MoJ**. These responsibilities include project management and coordination, procurement, and financial management, monitoring and evaluation, social and environmental standards management and oversight, communications, and outreach. This component will also finance oversight of detailed engineering designs, and construction of civil works (with the support of a Technical Assistance firm for quality assistance on studies and works[13], compliance with environmental and social management measures for the PIU). This will mostly include staff and operational costs as well as consultancy for the TA. MEPA would rely on the experienced PIU that currently manages Component 1 of GILMDP and was until recently responsible for an IFAD[14] funded agricultural project and MoJ would rely on the experienced PIU within NAPR that has successfully managed Component 2 of GILMDP.

COMPONENT 4. CONTINGENCY EMERGENCY RESPONSE (US$0 Million)

60. **This component establishes a disaster response contingency funding mechanism that could be triggered in the event of an eligible crisis or emergency, such as a natural disaster involving a formal declaration of a national or regional state of emergency, or a formal request from the Government of Georgia in the wake of a disaster, a health pandemic, or other types of disasters such as armed conflict**. A provisional zero amount component is included, which will allow for rapid reallocation of credit/loan proceeds from other components during an emergency under streamlined procurement and disbursement procedures. This component allows the Government to request the World Bank to recategorize and reallocate financing from other project components to cover emergency response and recovery costs. The CERC will be established and managed in accordance with the provisions of the World Bank Policy and World Bank Directive on Investment Project Financing. The CERC, if activated, will be able to finance eligible activities included in the positive list, stipulated in the Project Operations Manual (POM) (dedicated CERC annex). Emergencies could include pandemics, floods, droughts, landslides, and armed conflict. In that case, funds from other project components could be reallocated to this component to

[12] Georgia Baseline Assessment Report prepared with a support from the Norwegian State Mapping Agency in 2021

[13] The experience of GILMDP (poor quality of some studies and of some cost estimates) and that of many donor funded projects proves how critical this technical assistance can be. The benefits of using such TA in the PK Sindh Water Sector Improvement Project Phase (P084302, Pakistan) is one of the successful lesson learned mentioned in the draft ICR (September 2021).

[14] IFAD (International Fund for Agricultural Development).

facilitate rapid financing of a positive list of goods and services related to Components 1 and 2 that would still be relevant to the achievement of the PDO.

PROJECT COST AND FINANCING

61. **The total project cost is US$150 Million.** Site-specific designs will follow World Bank Water Global Practice guidelines on Resilient Water Infrastructure Design[15], which will be developed once schemes are finalized. A breakdown of costs per component is presented in Table 10 below.

Table 10. Summary of Project Costs, Financing allocations and responsible entity.

Project Components	Cost (US$, million)	IBRD Loan Financing (US$, million)	IBRD Loan % of Total	Government of Georgia Co-Financing (US$, million)	Government of Georgia Co-Financing % of Total	Responsible implementing agency (and entity within the agency)
Component 1: Resilient Irrigated Agriculture	119.8	59.8	50	60	50	MEPA
Sub-component 1.1: Irrigation & drainage infrastructure rehabilitation and modernization	84.8	42.3	50	42.5	50	MEPA
Sub-component 1.2: Irrigated agriculture and value chain development	20	10	50	10	50	MEPA
Sub-component 1.3: Improved performance of irrigation service delivery	15	7.5	50	7.5	50	MEPA
Component 2: Improved land management capacity	24	12	50	12	50	MEPA & NAPR
Sub-component 2.1. Strengthening of agricultural land management and monitoring	14	7	50	7	50	MEPA
Sub-component 2.2. Enhancement of land administration service delivery and building digital governance infrastructures	10	5	50	5	50	NAPR
Component 3: Project Management	6	3	50	3	50	MEPA & NAPR
Component 4: Contingent Emergency Response Component	0	0	0	0	0	Ministry of Finance
Total	**149.8**	**74.8**	**50%**	**75**	**50%**	

[15] Resilient Water Infrastructure Design Brief (English). Washington, D.C.: World Bank Group.

ANNEX 3: : Economic and Financial Analysis

COUNTRY: Georgia
Georgia Resilient Agriculture Irrigation and Land Project

1. **Ex-ante cost-benefit analysis was conducted to determine the project feasibility**. It included both financ analysis carried out using actual market prices inclusive of taxes, subsidies, and other distortions, as well economic analysis, developed using economic prices adjusted in some instances to correct for taxes, subsidi and other distortions known to be present in the Georgian economy. The results of the financial analysis sh the returns to project supported activities from the perspective of the private sector, while the results of t economic analysis show the social returns, which will be of interest to the public sector.

2. **Economic and Financial indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Co Ratio (B/C) and payback period were estimated to evaluate the level of return on investment for the ent project, components, sub-components, and activities**. The analysis was conducted taking into consideration t following general investment parameters, which was considered as a base scenario: i) evaluation period: 30 yea ii) cost of capital: 9.4 percent[16], iii) social discount rate: 6 percent. Sensitivity analysis was conducted to determi the robustness of the results under a range of possible changes in key variables: prices, production costs a yields. Likewise, the EFA indicators were estimated for different scenarios: evaluation periods, costs of capi and social discount rates.

3. **The results of the economic analysis show positive returns on the overall investment, components, su components, and activities considering the project's environmental benefits (reflected in the valuation of t GHG emissions reduction)**. In economic terms, the Net Present Value (ENPV), Internal Rate of Return (EIR Benefit/Cost Ratio (B/C) and the payback period were estimated at USD 158.5 million, 12.33 percent, 1.63 a 10.81 years , respectively. In financial terms, the Net Present Value, Internal Rate of Return (FIRR), Benefit/Co ratio (B/C) and the payback period were estimated at USD 52.5, 11.95 percent, 1.31 and 11.66 years, respective

4. **The sensitivity analysis shows the robustness of the analysis**. The economic returns of the overall project and components would remain positive even if environmental benefits were not included in the cash flow. The retur would remain positive in case the variables such as prices and yields to be reduced hypothetically at 10 perce The scenario analysis shows that the project would have positive returns on investment in economic ter despite the increase in the interest rate and reduction of evaluation periods until 15 years.

5. **Expected benefits and cost are described in the paragraphs below**:

6. **The ex-ante cost-benefit analysis measures incremental costs and benefits comparing a "without" proje scenario and a "with" project scenario to determine the project's effects on the direct beneficiaries**. T potential costs and benefits attributable to the project were identified considering the activities that will implemented during the life of the project as well as developments expected to occur in the future years, reflected in the project results chain.

7. **The benefit streams estimated in this analysis are the incremental value of production realized by beneficiari**

[16] Source: National Bank Of Georgia https://nbg.gov.ge/en/page/georgian-lari-yield-curve As of November 1, 2022

and increase of land value because of adopting irrigation technologies, good agricultural practices, and improvement of water and land management. The main expected incremental costs and benefits for each type of activity, organized by the Project components, are summarized in Table 11.

Table 11. Summary of costs and benefits used in economic analysis

Subprojects/activities	Expected incremental benefits and costs
Component 1. Resilient Irrigated Agriculture[17]	
Sub-component 1.1 Irrigation & drainage infrastructure rehabilitation and modernization	
Irrigation scheme - Tashiskari	Main focus: Increase in vegetable production (medium and long term) in improved and new irrigated lands. Indicative cropping pattern: Forage (alfalfa), cereals (maize, wheat), tuber (potato), vegetable (tomato), fruit (apple) and nut (walnut). Benefits: Increased revenues due to increased yields because of the improvement of irrigation infrastructure. Costs: Increase in maintenance costs of the on-farm irrigation equipment and irrigation tariff.
Irrigation scheme - Tiriponi	Main focus: Increase in fruit production (medium and long term) in improved irrigated lands. Indicative cropping pattern: Forage (alfalfa), cereals (maize, wheat), tuber (potato), vegetable (tomato), fruit (apple, grapes) and nut (walnut). Benefits: Increased revenues due to increased yields because of the improvement of irrigation infrastructure. Costs: Increase in maintenance costs of on-farm irrigation equipment and irrigation tariff.
Irrigation scheme - Zeda Arkhi	Main focus: Increase in vegetable production (medium and long term) in new irrigated lands Indicative cropping pattern: Forage (alfalfa), cereals (maize, wheat), tuber (potato), vegetable (tomato), fruit (apple) and nut (walnut). Benefits: Increased revenues due to increased yields because of the construction of irrigation infrastructure. Costs: Increase in maintenance costs of on-farm irrigation equipment and irrigation tariff.
Irrigation scheme - Zemo Alazani	Main focus: Increase in fruit production (medium and long term) in improved and new irrigated lands. Indicative cropping pattern: Forage (alfalfa), cereals (maize, wheat), tuber (potato), vegetable (tomato), fruit (apple, grapes) and nut (walnut). Benefits: Increased revenues due to increased yields because of the improvement and/or construction of irrigation infrastructure. Costs: Increase in maintenance costs of the on-farm irrigation equipment and irrigation tariff.
Irrigation scheme - Narekvavi	Main focus: Increase in fruit production (medium and long term) in improved irrigated lands. Indicative cropping pattern: Forage (alfalfa), cereals (maize, wheat), tuber (potato), vegetable (tomato), fruit (apple, grapes) and nut (walnut).

[17] For the purposes of the EFA, the drainage scheme economic benefits and costs were excluded due to data limitations. This will be updated in future iterations of the EFA.

	Benefits: Increased revenues due to increased yields because of the improvement of irrigation infrastructure. Costs: Increase in maintenance costs of the on-farm irrigation equipment infrastructure and irrigation tariff.
Drainage scheme – Shavlege-massif	Main focus: reduced production losses for floodings, salinization, etc. Indicative cropping pattern: Forage (alfalfa), cereals (maize, wheat), tuber (potato), vegetable (tomato), fruit (apple) and nut (walnut). Benefits: Increased revenues due to reduced production losses because of the rehabilitation of the drainage system. Costs: Increase in maintenance costs of on-farm irrigation and drainage equipment.
Sub-component 1.2 Irrigated agriculture and value chain development	
Livestock feed development package	Main focus: Improve livestock value chain. Indicative animal production: Dairy production (cattle), meat (lamb) Benefits: - Increased revenues due to improved animal productivity for the increased availability of forage. - Improved quality of products which are derived from animals because of the application of good livestock practices for commercialization. Costs: Increase in commercialization costs.
Fruit development package	Main focus: Improve fruit value chain. Indicative cropping pattern: Apples, grapes, and nuts. Benefits: Increased revenues due to improved application of good agricultural post-harvest practices for commercialization process. Costs: Increase in commercialization costs.
Vegetable development package	Main focus: Improve vegetable value chain. Indicative cropping pattern: Potato and tomato. Benefits: Increased revenues due to improved application of good agricultural post-harvest practices for commercialization process. Costs: Increase in commercialization costs.
Sub-component 1.3 Improved performance of irrigation service delivery	
Main objective: Improved irrigation water efficiency by reducing production losses due to poor irrigation water management and poor service delivery. Indicative cropping pattern: Forage (alfalfa), cereals (maize, wheat), tuber (potato), vegetable (tomato), fruit (apple, grapes) and nut (walnut). Benefits: Reduced production losses and improved product quality due to efficient irrigation water management and enhanced service delivery. Costs: Increased irrigation tariff and maintenance of digital management tools/platforms of the irrigation service delivery.	
Component 2. Improved land management capacity	
Sub-component 2.1 Improved agricultural land management and monitoring	
Main objective: Land consolidation for improving agricultural production. Benefits: Increase in market prices of land due to land consolidation for agricultural activities y decrease in fixed costCosts: Increased costs due to potential mechanization of agricultural activities (farm size)	

Sub-component 2.2 Enhancement of land administration, service delivery and building digital governance infrastructures
Main objective: Improvement of the agricultural land administration and NSDI. Benefits: i) reduction in transaction costii) reduced cost in the cadastral system (enhanced efficiencies in the application of geospatial tools in the cadastral procedures), (iv) improved geospatial data sharing and reduced costs to the collection and maintenance of geospatial information; (v) added value of cadastral, orthophotos and base maps to vineyard cadaster database creation, management and operation; (vi) improved emergency service response times; and vii) time saving by accessing online services Costs: Maintenance of the digital management tools/digital infrastructure including NSDI

8. **For all the benefit streams, the timing of costs and benefits was adjusted to reflect the activity implementation period, expected adoption rates and distribution through time of the benefits**. Moreover, the benefits related to the GHG emission reduction were considered in the economic analysis applying the nominal shadow prices of carbon recommended by the World Bank.

9. **Several additional benefit streams were not considered, including:** i) future productivity gains that may be realized by indirect beneficiaries and other agricultural value chain actors thanks to the greater availability of information and knowledge; ii) environmental benefits (soil erosion and degradation) due to the application of activities oriented to the improvement of land and water management; and iii) benefits related to institutional strengthening. While it is difficult to quantify and evaluate, these additional benefit streams could be significant, and for that reason, the results of the analysis can be considered conservative.

10. **Data sources**. The analysis relied on information from the following sources: i) household farm survey applied to potential beneficiaries in the project intervention area; ii) information on other similar projects in Georgia, iii) reports and specialized articles; iv) project documents, and v) other secondary sources. Data were collected on yields, production volume, prices, production costs, cropping pattern, land prices, and other variables. The data collected were supplemented with specific assumptions to develop the calculation model in excel. The direct investment costs and project operation cost were included in the aggregated and disaggregated cash flows.

11. **Analytical approach**. The ex-ante cost-benefit analysis was designed to estimate standard measures of project worth including Net Present Value (NPV) at private and social prices over a 30-year period, Financial and Economic Internal Rates of Return (EIRR and FIRR), Benefit/Cost ratio, payback period, and incremental benefits per beneficiary in terms of present value. These indicators were estimated: (i) for the overall project, (ii) by project components, (iii) by sub-components, (iv) by activities (irrigation scheme rehabilitation, development packages, etc). Sensitivity and scenario analysis were carried out to explore the potential impacts of possible changes in key variables such as yields, prices, production costs, social discount rate and evaluation period on the project return.

12. **Key assumptions**. All cash flows were estimated using nominal prices. The exchange rate for converting from Lari (GEL) to US dollars was determined considering the annual average value that prevailed between January 2020 to October 2022[18]. In the baseline scenarios, the cost of capital was set at 9.4 percent[19] and the social discount rate at 6 percent[20], and the evaluation period was 30 years. The economic analysis was based on the use of social prices whose values had been estimated for different inputs and outputs by previous analysis related to this

[18] https://www.investing.com/currencies/usd-gel-historical-data

[19] Georgia 10-year treasury bonds. Source: National Bank Of Georgia https://nbg.gov.ge/en/page/georgian-lari-yield-curve As of November 1, 2022

[20] Recommended value by the World Bank.

Project.

13. **EFA indicators were estimated for different scenarios**: i) 15 and 20 years of evaluation period, ii) 5 percent and 7 percent of social discount rates and iii) 7 percent and 12 percent of cost of capital. Additionally, possible changes in key variables such as yields, prices and production costs were evaluated considering variations at -20 percent, -10 percent, -5 percent, 5 percent, 10 percent, and 20 percent.

14. **Positive externalities generated by the project, such as technology spillovers and environmental and social benefits, were not included in the analysis due to the complexity of quantifying those externalities and the limited availability of information**. This information will be updated in future iterations of the EFA following the appraisal stage of the project.

15. **Overall results**. For the overall Project investment, the estimated values of standard measures of project worth are presented in Table 12.

Table 12. Ex post cost-benefit analysis – Summary of Results of the Financial Indicators (9.4% cost of capital)

Financial Net Present Value (FNPV) (USD million)	Financial Internal Rate of Return (FIRR) (percent)	Benefit/Cost Ratio	Payback period (years)	Incremental NPV per beneficiary (USD)	Incremental NPV per ha (USD)
52.8	11.95	1.31	11.66	1452	1965
Economic indicators (6% social discount rate)					
Economic Net Present Value (ENPV) (USD million)	Economic Internal Rate of Return (EIRR) (percent)	Benefit/Cost Ratio	Payback period (years)	Incremental NPV per beneficiary (USD)	Incremental NPV per ha (USD)
158.5	12.33	1.63	10.81	4357	5895

16. **The positive ENPV, FNPV, FIRR and EIRR show that the resources invested in the project would generate positive returns on investment, both financially and economically**. These values fall toward the ranges reported in global studies of returns to investment in irrigation and land.

17. **Sensitivity and scenario analysis**. Scenario analysis was carried out to determine the robustness of these results under a range of possible changes in key parameters. First, the analysis was run assuming project evaluation period of 30 years as a base scenario and considering the evaluation period to 20 and 15 years respectively. As shown in Table 13, reducing the evaluation period decreases the return on investment.

Table 13. Sensitivity analysis – Effects of a change in evaluation period

	15 years	20 years	30 years (base scenario)
Financial indicators (9.4% cost of capital)			
Financial NPV (USD Million)	(16.4	90.1	52.8
Financial IRR (%)	7.52	12.01	11.95
Benefit/Cost ratio	0.80	1.12	1.31
Payback period (years)	11.66	11.66	11.66
FNPV/beneficiary family (USD)	(450)	380	1452
FNPV/ha (USD)	(609)	515	1965
Economic Indicators (6% social discount rate)			
Economic NPV (USD Million)	32.0	90.1	158.5
Economic IRR (%)	9.04	12.09	12.33
Benefit/Cost ratio	1.31	1.60	1.63
Payback period (years)	10.6	10.6	10.6
ENPV/beneficiary family (USD)	880	2477	4357
ENPV/ha (USD)	1190	3351	5895

18. **Table 14 shows the EFA indicators in response to changes in the cost of capital and social discount rates**. Higher cost of capitals is associated with lower FNPV. By contrast, lower social discount rate of return would generate higher ENPV.

Table 14. Sensitivity analysis – Effects of a change in discount rates

Scenarios	NPV (USD million)
Financial indicators	
Base scenario – Cost of capital (9.4%)	52.8
High cost of capital – 12%	8.4
Low cost of capital – 7%	118.8
Economic Indicators	
Base scenario – Social discount rate (6%)	158.5
High discount rate – 8%	93.7
Low discount rate – 4%	254.3

19. **In addition, the ENPV and EIRR values in a scenario of low and high shadow price of carbon are shown in the table 15**. Further details on this are provided in Annex 4.

Table 15. Economic indicators in a scenario of low and high shadow price of carbon

Indicators	Low shadow price of carbon (base scenario)	High shadow price of carbon (optimistic scenario)
ENPV (USD million)	158.5	160.7
EIRR (%)	12.33	12.43

20. **Sensitivity analysis was also carried out to test the robustness of the results to changes in other key parameters**. Table 16 shows how the EIRRs change in response to progressive decreases and increases in the values of key parameters, including yields, prices, and production costs.

Table 16. Sensitivity analysis - Effects of changes in selected key parameters

Parameter	EIRR values (percent)						
	-20%	-10%	-5%	0%	5%	10%	20%
Yields	9.46%	11.36%	11.86%	12.33%	12.76%	13.16%	13.96%
Prices	10.96%	11.66%	12.06%	12.33%	12.66%	12.96%	13.26%
Production costs	12.37%	12.35%	12.34%	12.33%	12.32%	12.31%	12.30%

21. **The sensitivity analysis revealed that the EIRRs are somewhat sensitive to changes in prices and yields, but they are relatively insensitive to changes in production costs**.

22. **Results – Disaggregated**. To estimate the returns to different types of activity financed by the Project, the measures of project worth were calculated separately by project component, by sub-component and by activities.

23. **Returns by project component**. Returns to individual project components are shown in Table 17.

Table 17. Economic and financial indicators by project component

Financial indicators (9.4% cost of capital)				
	FNPV (USD million)	FIRR (%)	B/C	Payback period (year)
Component 1	50.1	13.01	1.37	10.54
Component 2	2.7	9.81	1.08	12.04
Economic indicators (6% social discount rate)				
	ENPV (USD million)	EIRR (%)	B/C	Payback period (year)
Component 1	125.5	13.41	1.51	10.12
Component 2	32.8	10.08	1.88	11.82

24. **The implementation of component 1 and component 2 would generate positive and attractive returns both economically and financially**. These results are in line with the positive returns estimated for the sub-components.

25. **Returns by sub-components**. To determine the relative profitability of different types of sub-components, the measures of project worth were calculated separately. Returns to different sub-components under the components 1 and 2 are shown in Tables 18 and Table 19.

Table 18. Economic and financial indicators by sub-component (Component 1)

Financial indicators (9.4% cost of capital)				
	NPV (USD million)	FIRR (%)	B/C	Payback period (year)
Sub-component 1.1	41.6	16.08	1.51	9.97
Sub-component 1.2	1.9	9.78	1.04	11.56
Sub-component 1.3	2.6	1049	1.61	11.21
Economic indicators (6% social discount rate)				

	NPV (USD million)	EIRR (%)	B/C	Payback period (year)
Sub-component 1.1	116.1	17.19	2.07	9.81
Sub-component 1.2	39.5	11.77	1.52	10.47
Sub-component 1.3	12.7	10.62	1.66	11.08

Table 19. Economic and financial indicators by sub-component (Component 2)

Financial indicators (9.4% cost of capital)				
	NPV (USD million)	**FIRR (%)**	**B/C**	**Payback period (year)**
Sub-component 2.1	1.3	9.60	1.04	12.06
Sub-component 2.2	1.2	10.44	1.13	12.60
Economic indicators (6% social discount rate)				
	NPV (USD million)	**EIRR (%)**	**B/C**	**Payback period (year)**
Sub-component 2.1	24.8	9.61	1.80	12.06
Sub-component 2.2	7.8	12.64	2.19	11.45

26. **To determine payoffs to investment in different sub-components, the measures of project worth were also calculated separately by activities**. The economic returns on investment were found to be positive for all the main activities. Attractive returns would be generated by investments in irrigation and drainage schemes and development packages financed under component 1 as shown in the following table (Table 20).

Table 20. Economic and financial indicators by commodity grouping/ value chain/land activity

Financial indicators (9.4% cost of capital)				
	NPV	**FIRR**	**B/C**	**Payback period**
Irrigation scheme - Tashiskari	8.7	16.27	1.26	11.31
Irrigation scheme - Tiriponi	4.5	12.09	1.71	12.42
Irrigation scheme - Zeda Arkhi	0.62	18.14	1.14	10.31
Irrigation scheme - Zemo Alazani	24.6	19.17	1.68	9.39
Irrigation scheme - Narekvavi	2.1	15.6	1.81	9.21
Drainage scheme – Shavlege massif	1.1	16.07	1.83	10.72
Livestock feed development package	1.0	9.94	1.32	10.00
Vegetable development package	1.1	10.27	1.08	12.53
Fruit development package	9.1	9.33	1.31	11.06
Water efficiency	2.6	10.41	1.33	11.10
Land consolidation	1.3	9.60	1.04	12.1
Land administration	0.6	11.32	1.13	13.93
NSDI	0.5	10.28	1.10	14.89
Economic indicators (6% social discount rate)				
	NPV	**EIRR**	**B/C**	**Payback period**
Irrigation scheme - Tashiskari	40.1	19.70	1.94	9.62
Irrigation scheme - Tiriponi	20.7	16.11	3.00	819.
Irrigation scheme - Zeda Arkhi	1.4	20.59	1.57	9.56
Irrigation scheme - Zemo Alazani	35.6	19.69	2.1	9.24

Irrigation scheme - Narekvavi	4.2	16.35	2.52	9.03
Drainage scheme – Shavlege massif	2.6	18.25	2.19	10.05
Livestock feed development package	10.9	10.30	2.08	10.00
Vegetable development package	14.7	12.91	1.78	10.84
Fruit development package	13.8	10.41	1.53	10.80
Water efficiency	12.6	10.61	1.68	11.00
Land consolidation	24.8	9.61	1.80	12.06
Land administration	3.5	13.45	1.60	12.92
NSDI	1.2	11.61	1.27	13.91

27. **Efficiency analysis – Summary and conclusions.** The results of the ex-ante cost-benefit analysis support the following general conclusions: the overall project investment would generate positive returns, in both financial and economic terms. The estimated FIRR exceeds the cost of capital, and the estimate EIRR exceeds the social discount rate considered for the cost-benefit analysis. All components and sub-components would generate positive returns on investment in economic and financial terms. All activities financed under components 1 and 2 would generate positive economic returns.

ANNEX 4: Greenhouse Gas Emissions Analysis

COUNTRY: Georgia
Georgia Resilient Agriculture Irrigation and Land Project

1. **Project activities are expected to contribute to an overall reduction in greenhouse gas emissions.** The project cumulative GHG emission savings adds up to an estimated 113,932 tCO2-eq over a 30-year period, with an annual average of 3,798 tCO2-eq/year.
2. **For the irrigation investments (sub-component 1.1), the greenhouse gas analysis based on the Ex-Ante Carbon-balance Tool (EX-ACT), estimates that the net carbon balance over a period of 30 years is 1688 tCO2-eq (approximately 56 tCO2-eq/year) (Table 21).** Some of the improved irrigation and new irrigation systems will be highly efficient using pressurization from topography, which does not require energy for pumping, and enables farmers to adopt sprinkler and drip irrigation for annual and orchards cultivation, respectively.
3. **The project involves a transition of 7428 hectares from annual croplands with tillage to perennial croplands without tillage (sub-component 1.2).** The transition is expected to mitigate 134,058 tCO2-eq over a 30-year period, with an annual average of 4,469 tCO2-eq/year (Table 21).
4. **The total GHG emission reduction benefits were estimated through project life considering the estimated shadow price of carbon that will evolve from year to year according to the World Bank Shadow Price of Carbon Guidance Note[21].** In addition to base case scenario (without carbon benefits), low band of carbon price (starting from US$41 and evolving over years) as well as higher band of carbon price (starting from US$82 and evolving over year) scenarios were introduced and the ERR and ENPV were calculated accordingly (see Table 15, Annex 3).

Table 21. Results from the EX-ACT analysis for sub-component 1.1 and 1.2.

Components of the project	**Gross fluxes**			**Share per GHG of the Balance**					**Result per year**	
	Without	**With**	**Balance**	**All GHG in tCO2eq**					**Without**	**With**
	All GHG in tCO2eq			**CO_2**		**ALL non AFOLU**	**N_2O**	**CH_4**		
Land use changes	**Positive = source/ negative = sink**			**Biomass**	**Soil**					
				CO2-Biomass	CO2-Soil		N2O	CH_4		
Deforestation	0	0	**0**	**0**	**0**		**0**	**0**	0	0
Afforestation	0	0	**0**	**0**	**0**		**0**	**0**	0	0
Other LUC	0	134,058	**134,058**	**116,298**	**17,703**		**57**	**0**	0	4,469
Agriculture										
Annual	166,220	166,220	**0**	**0**	**0**		**0**	**0**	5,541	5,541
Perennial	-146,889	-396,546	**-249,657**	**-231,506**	**-18,151**				-4,896	-13,218

[21] "Guidance Note on Shadow Price of Carbon in Economic Analysis," World Bank (2017), and "IFI approach to GHG accounting for renewable energy projects," World Bank (2015).

Degradation & Management										
Forest degradation	0	0	**0**	**0**	**0**		**0**	**0**	0	0
Peat extraction	0	0	**0**		**0**		**0**	**0**	0	0
Drainage organic soil	0	0	**0**		**0**		**0**	**0**	0	0
Rewetting organic soil	0	0	**0**		**0**		**0**	**0**	0	0
Fire organic soil	0	0	**0**	**0**			**0**	0	0	**0**
Inputs & Investments	0	1,668	**1,668**						0	56
Total	19,331	-94,601	**-113,932**	**-115,208**	**-448**		**57**		644	-3,153
Per ha	0.7	-3.6	**-4.3**	**-4.3**	**0**	**0**	**0**			
Per ha per year	0.0	-0.1	**-0.1**	**0**	**0**					

ANNEX 5: Safety of Dams

COUNTRY: Georgia
Georgia Resilient Agriculture Irrigation and Land Project

1. **The irrigation schemes of Narekaki and Zeda Arkhi draw water from existing upstream reservoirs and depend on their safe storage and operation**. The Narekvavi scheme is supplied by the Narekvavi dam and Zheda Arkhi scheme is supplied by 4 upstream reservoirs: Iakublo, Pantiani, Mtsdziri and Khorkhori in the Mashavera river basin (Table 22).

2. **Georgia has no law regulating dam safety at the national level**. Dams are operated by Georgian Ameiloration (GA) Ltd. following the "Technical Regulations - Rules for Technical Operation of Amelioration Systems, Chapter VI", approved by the Government of Georgia through the decree No. 409, dated December 31, 2013, that entered into force on January 1, 2014. GA performs visual periodic inspection and surveillance of the dams. Since June 2021 the "Dam Safety and Reservoir Monitoring Office" has been established in the company.

3. **By their height and volume, Narekvavi, Iakublo, Pantiani and Mtsdziri are classified as "large dams", while Khorkhori is a "small dam", according to the criteria defined in ESS4-Annex A Safety of Dams**. The dams are not instrumented. The GRAIL project will finance the removal of sediment in the Narekvavi reservoir to improve its storage and reduce the sediment entrainment in the irrigation canals. Despite no major dam rehabilitation works are in the scope of the GRAIL project, dam safety assessments for all associated dams to the irrigation schemes shall be done by at least one independent dam safety specialist. The specialist(s) will review and evaluate the dam's performance history, the risk downstream in case of dam failure or mis operation, the owners' operation, maintenance and emergency procedures and provide a written report of findings and recommendations for any remedial work and/or soft safety measures (installation of instrumentation, dam safety plans, etc.) necessary to upgrade the existing dams to an acceptable standard of safety. The dam safety requirements will apply to all large dams and to Khorkhori dam if its operation could cause safety risks.

Table 22. List of dams associated to the irrigation schemes to be rehabilitated

Reservoir	Scheme and irrigated area	Dam type	Total volume (mln m^3)	Live volume (mln m^3)	Dam height (m)	Dam length at the crest (m)
Narekvavi	Narekvavi (650/1600 ha)	earth dam	6.8	5.6	41	360
Iakublo	Zeda Arkhi (250 ha)	earth dam	11	10.8	14	1100
Pantiani	Zeda Arkhi (1000 ha)	earth dam	5.3	5.2	10	300
Mtisdziri	Zeda Arkhi (980 ha)	earth embankment	3.07	2.95	1.5-11	2700
Khorkhori	Zeda Arkhi (68 ha)	earth embankment	0.4	0.35	1.8	50

4. **A preliminary dam safety assessment study already exists, in the framework of the East Georgia Irrigation reservoir rehabilitation and construction Program (pre-feasibility study), financed by the previous project GILMDP[22] (Tractebel, October 2022)**. This study includes Pantiani, Mtisdziri and Khorkhori reservoirs. The dams are found to be in an acceptable condition at present and there is no actual safety concern for their use. The study lists additional investigations (such as topographic measurements and geological mapping), repair and maintenance works in the dam body and its appurtenances (spillways, diversion weirs, intake towers, outlet pipes, hydromechanical equipment, etc.). The dams are currently not instrumented and is recommended to install piezometers for pore water pressure monitoring.

5. **Based on the previous study and the dam safety assessment on the 5 dams associated with the GRAIL project, dam safety management instruments, including installation of dam monitoring and capacity building activities will be put in place as required and financing will be discussed in coordination with MEPA and GA**.

6. **The capacity of MEPA and GA to ensure safe operation of irrigation dams has benefitted from the experience gained under the ongoing project GILMD, including the installation of monitoring instruments and dedicated trainings and the preparation of Emergency Preparedness Plans (EPP) for two dams (Sioni and Algeti)**. More benefit is expected from the planned Project Failure Mode Analysis (PFMA) workshop recommended within the frame of GILMD Project by the World Bank. The workshop will help MEPA and GA, in charge of irrigation dam operation, to develop a systematic approach to dam safety for the whole dam portfolio. This experience can be replicated in GRAIL.

[22] "Preliminary Assessment Study of the East Georgia Irrigation Reservoirs Rehabilitation and Construction Program" D6- Final Report. Tractebel-Engie, October 2022

NAREKVAVI SCHEME

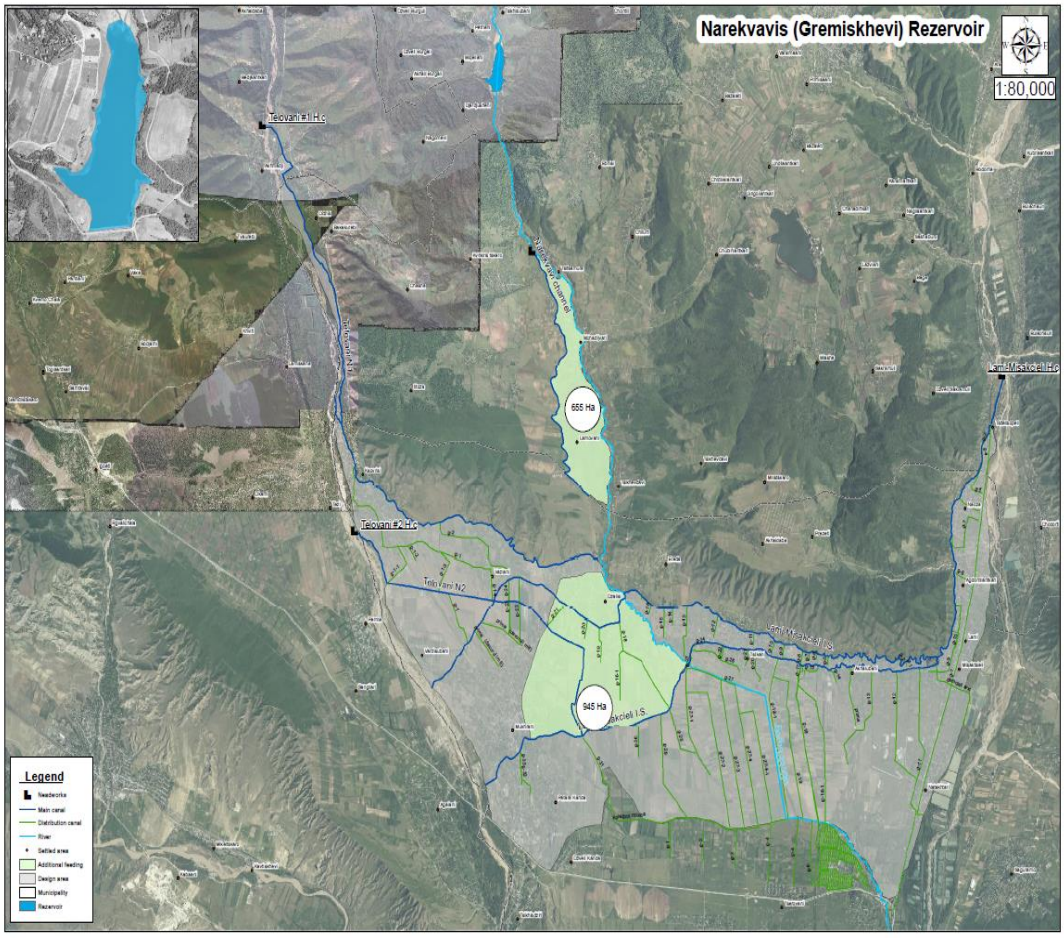

Figure 14. Location of the Narekvavi irrigation scheme

7. **Description of Narekvavi dam:** The Narekvavi dam is a 41m earthen dam with clay core. The reservoir has an emergency spillway on the right bank with a rectangular channel of 490m. (rehabilitated in 2015) and an operating spillway. After more than 40 years of operation, the sedimentation level reached the crest level of the irrigation outlet and caused heavy sediment entry into the waterways. To allow continued operation of the reservoir, the sediments will be dredged from a floating pontoon with a submerged pump. The reservoir is operational, and no visual deformation has been observed (Figure 14).

ZHEDA ARKHI SCHEME

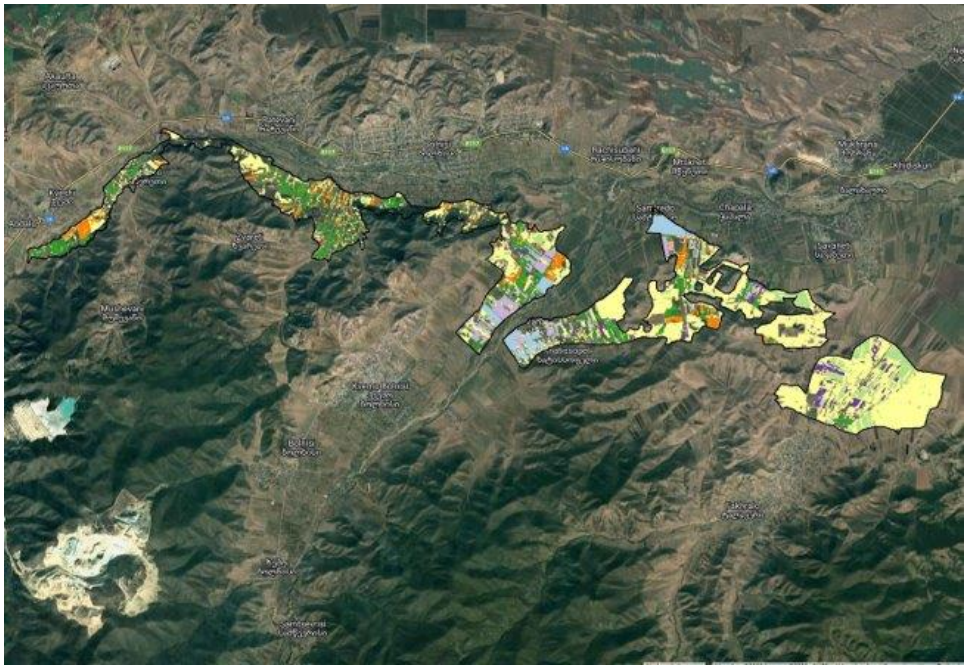

Figure 15. Location of the Zeda Arkhi irrigation scheme (Mashavera river basin)

8. **Description of the Lakublo dam:** The Iakublo is an earth dam of 14 m height that stores water from the river Nazigklicki. The technical conditions of the structures are adequate and operational. The rip-rap needs improvement and some minor sedimentation is observed in the reservoir (off-stream). Minor rehabilitation works were carried out in 2019, funded by IFAD. The second stage of maintenance works will be implemented in 2023, as informed by GA.

9. **Description of the Pantiani dam:** The Pantiani project was commissioned in 1956 and consists of a 10 m. height earth dam that encircles a natural depression and forms the Pantiani reservoir. The reservoir is filled with water from the river Nazigklicki via a diversion weir and concrete-lined canal. The irrigation is released from the reservoir via an outlet structure to an earthen canal into the Mashavera river. In the past, heavy leakages occurred after impoundment and a clay surface sealing was constructed at the right abutment. The reservoir is filled only 70-80 percent of the design volume (4.66 hm^3 can be impounded without leakages). The Tractebel report recommends to do a detailed topography and to perform geological studies to detect the infiltration path and recover the construction details of the surface seal constructed along the abutment. Also, to install dam instrumentation and rehabilitate the crest road, clay sealing, removal of vegetation and repairs in the intake, outlet and the associated diversion weirs and canal.

10. **Description of the Mtisdziri dam:** The Mtisdzriri reservoir is created by three earth embankments that range from 1.5 to 11 m. height closing an existing natural depression and stores water diverted from the river Mamutli. The irrigation water is released via an outlet structure onto a creek. 5-8 percent of its live volume is occupied by sediment, but this does not pose a problem as it is an off-stream reservoir. The project was commissioned in 1981. During full impoundment the reservoir creates wet areas downstream, though not critical for the dam stability this should be

further investigated. Also, riprap has to be replaced partially or substituted by a concrete slab protection in the mid-term.

11. **Description of the Khorkhori dam:** The Korkhori is a 1.8m height embankment dam that encloses the shoreline of a natural depression. It is fed by snowmelt and ravines that filled by water from the river Nazigklichi. The reservoir is currently not being operated (has no specific irrigation command area) but could provide an additional supply to the Zeda Arkhi irrigation scheme on the Mashavera River (Figure 15). The rip-rap upstream is deteriorated, but no deficiency susceptible to affecting its normal operation condition has been observed. The access road is very poor and not accessible during winter or in case of heavy rains**.**