# Irrigation Strategy for Georgia

# 2017-2025

საქართველოს მელიორაცია

GEORGIAN AMELIORATION

**Ministry of Agriculture of Georgia**

**LTD "Georgian Amelioration"**

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WATER PARTNERSHIP PROGRAM

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## List of Acronyms

| | |
|---|---|
| APMA | Agricultural Projects Management Agency (MoA) |
| AMMAR | Agriculture Modernization, Market Access and Resilience (IFAD-funded) |
| DASM | Department of Amelioration System Management |
| DPMMD | Donors Projects Management and Monitoring Division |
| EBRD | European Bank for Reconstruction and Development |
| ERP | Enterprise Resource Planning system |
| EU | European Union |
| FAO | Food and Agriculture Organization of the United Nations |
| G4G | Governing for Growth (USAID Project) |
| GA | Georgian Amelioration, Ltd |
| GCM | Global Circulation Model |
| GDP | Gross domestic product |
| GILMD | Georgia Irrigation and Land Market Development Project (WB) |
| GNERC | Georgian National Energy and Water Supply Regulatory Commission |
| GoG | Government of Georgia |
| IDCDP | Irrigation and Drainage Community Development Project (WB) |
| IFAD | International Fund for Agricultural Development |
| IWRM | Integrated Water Resource Management |
| LL | Local level |
| LTD | Limited (company) |
| MENRP | Ministry of Environment and Natural Resource Protection |
| MoA | Ministry of Agriculture |
| MoF | Ministry of Finance |
| MDF | Municipal Development Fund |
| MRDI | Ministry of Regional Development and Infrastructure |
| NEA | National Environmental Agency |
| NEO | New Economic Opportunities project |
| O&M | Operation and Maintenance |
| ORIO | Facility for Infrastructure Development, Netherlands Enterprise Agency |
| PMU | Project Management Unit |
| UASCG | United Amelioration Systems Company of Georgia |
| USAID | United States Agency for International Development |
| VAT | Value added tax |
| WB | World Bank |
| WPP | Water Partnership Program (WB) |
| WUO | Water User Organization |

# Executive Summary

This strategy is intended to guide irrigation development and management in Georgia for the coming ten years[1]. It encompasses both the rehabilitation of decayed irrigation infrastructure and the development of a modern data-based professional and participatory irrigation management capacity.

Five **strategic questions** frame the important choices made in the strategy.

1. What are the appropriate criteria, standards, and procedures for selecting rehabilitation investment projects?
2. How should the main system (off-farm) manager be organized – for-profit company, not-for-profit company, or government agency; should this organization be national or regional in scope; how can the management agency be organized to work more effectively and efficiently; and what kinds of capacity building assistance are need for this?
3. What organizational form should local-level water distribution take – direct service by the national irrigation service provider, informal groups of farmers, a formal farmer-based organization, a private company, a concession-holder, a company agent, or some other form; should there be only one permitted alternative for local level (LL) management, or a menu of several options for farmers to choose from?
4. How should irrigation system O&M be financed – from government funds, farmers' payments, or a combination; if a combination, what is the appropriate division of responsibility for funding, and how should subsidies be structured and provided?
5. Who oversees the quality and cost of irrigation services delivered, both by the main system manager and by the LL organization; how can cost-effective regulation be accomplished?

These questions are considered throughout the strategy and addressed directly in the "Strategy Components" section. Summaries of each section in the Strategy are presented below.

## *Agriculture*

Georgian agricultural output plunged following the break-up of the Soviet Union, and while it now provides just under 10% of GDP, it is the source of livelihood for fully half of the Georgian population. Current production is dominated by cereal grains, though the country's excellent soils and climatic conditions can support greatly-expanded horticultural crop production. Rehabilitating irrigation systems is a key to this transition, along with output market development, extension services, and adoption of on-farm drip irrigation technology. Farmers with improved irrigation service can afford to pay more for irrigation than they do now, but there are distinct limits on that ability to pay due to small farm sizes together with yield and marketing constraints.

[1] International and local experts started working on the Irrigation Strategy for Georgia in 2016 and it includes 10 years period from 2016 to 2025. Taking into consideration that the strategy is approved in 2017, the title of this strategy is 2017-2025. The strategy also includes activities commenced in 2016.

## *Water Resources*

Georgia is generously endowed with water resources, though availability varies greatly from season to season. The six operating irrigation reservoirs have the ability to store less than 4 percent of the annual flow of east Georgian rivers, and while mountain snowpack storage adds to this capacity, this natural storage capacity will erode as the climate continues to warm. The country is currently without a formal system of water resource allocation, though amendments in the water law currently pending approval will establish a water permitting system in 2018. In addition to its surface water resources, Georgia has abundant groundwater which, though little used at present, could be tapped for irrigation – particularly for drip irrigation systems. The analysis of both surface water and groundwater hydrology is severely handicapped by the virtual collapse of national hydrologic data collection and analysis systems.

## *Irrigation*

Actual irrigated area in Georgia, which was as much as 400,000 hectares during the Soviet period, had dwindled to one-tenth of that by 2015. Rehabilitation investment is expected to restore irrigable area to 200,000 hectares by 2025. If fully utilized, this will increase water demands from the current level of around 150 MCM to around 900 MCM per year, a value still well within the annual supply of water available in Eastern Georgia. However, a lack of storage and a progressive loss of snowpack storage may cause shortages later in growing seasons when demand is high and river flows are at their minimums.

Following the abrogation of the Amelioration Law in 2010, Georgia lacks a legal framework for irrigation. The repeal of this law also eliminated the legal basis for local level water management organizations in the country. Consequently, GA now attempts to operate irrigation delivery systems from the headworks to the farm. However the challenge of interacting directly with 50,000 farmers is an overwhelming one that will only grow more severe as irrigated area expands. Deteriorated facilities in many systems limit water management options to basic on/off control and some crude adjustment of operating levels in canals.

Irrigation management has operated under a variety of organizational forms since 1990. Main system management, handled by a ministry during the Soviet period, was first downgraded to a government department responsibility following independence, and then privatized into four so-called LTDs – under-resourced and inexperienced government-owned corporations that subsequently failed. The four LTDs were then merged into a single state-owned company which today operates all public irrigation facilities in the country.

At the local level, large state and collective farms which operated local level irrigation facilities during the Soviet period were replaced with a succession of different local level organizations in the ensuing 20 years. The last and most promising of these, the Amelioration Associations, were established in the early 00s but disbanded in an ideologically-driven push to privatize public services later in that decade.

By the end of 2012, new leadership in both the Ministry of Agriculture and GA launched a corporate reform effort which is on-going. That reform effort aims to re-make GA into a financially viable main system service provider with local level organizations as its clients. Accomplishments to date include a regional decentralization and new enterprise management software to support data-based management decision-making, along with

ongoing efforts to establish a computerized asset inventory, explore a variety of new contracting modes with local level farmer-based entities, and develop a radically new tariff system. Current operating income, excluding government subsidies, constitutes just 13% of expenditures. The ultimate success of these reforms will depend on the successful reform of the tariff system, cost control, efficient system operations, and establishment of viable local level management entities.

## *Reform Strategy*

### Rehabilitation and Modernization

Georgia will have 200,000 hectares of irrigable farmland by 2025. This represents an increase of around 112,000 hectares over 2015 levels. Most of the increase will result from rehabilitation of existing gravity irrigation schemes, supplemented by private development of pumped surface water and groundwater. The considerable unexploited potential of groundwater will be studied and measures devised to enhance private groundwater development for irrigation, particularly in conjunction with drip irrigation technology, which is expected to expand to cover as much as 10% of irrigated area by 2025.

Georgian Amelioration will establish a professional unit to evaluate and prioritize more than 100 potential projects on hydrologic, economic, and financial grounds, creating a high quality list of pre-qualified of projects for potential financing. The estimated $361 million required for this work will come from funds allocated by GoG and from international assistance agencies.

Rehabilitation projects will include modernization investments to allow improved system management and more effective and efficient service delivery. Major investments in this category will target improved water measurement systems and control structures, along with upgraded management information systems and staff development.

Farmers will be consulted extensively at each stage of project design and implementation to insure compatibility with local needs and practices. A new unit will be established to mobilize farmers and facilitate consultation and dialogue. Local level rehabilitation design will be carried out in close cooperation with local farmers, with Water User Organization (WUO) development proceeding in tandem with the rehabilitation process.

Georgian Amelioration will strengthen its *Asset Management Unit* and will take a more proactive stance in monitoring and assuring the quality of rehabilitation implementation.

### Main System Management

Georgian Amelioration will continue to operate as a single private corporation over the medium term, taking advantage of the financial discipline and results-orientation which typically characterize such entities. However as long it is publiclly-owned, GA will aim to operate at a financial break-even point, covering all O&M, administrative, and depreciation costs, with return on capital (profit) set to zero. Interest on private capital could be included in the rate structure, with the approval of the regulator, if this possibility were to emerge in the future. GA will retain its present decentralized structure, with the

regional divisions operating under the umbrella of a single unified national corporation to minimize overhead costs.

To create a governance structure more appropriate to a corporation, the Ministry of Agriculture will establish a broadly-constituted supervisory board for GA, which includes a variety of accomplished professionals from both governmental and non-governmental sectors.

GA will assume the role of bulk water supplier to local level organizations, which will distribute water and operate local facilities supplying individual farms. To facilitate this this process, a newly-formed WUO Support Unit will take the initiative in forming and supporting local level organizations which will provide service to individual users. Once these local level organizations are established, GA will enter into contracts with them for bulk water supply.

In operating and maintaining the main system facilities under its purview, including dams, major canals, diversion structures, and major off-take structures, GA will transform its operations by introducing modern data-based management practices for water delivery, facilities maintenance, and financial and administrative management.

For the near-term future, GA will supply most of its own maintenance and repair services directly using in-house resources. Over time, it will experiment with outsourcing selected services to the private sector, and evaluate results in terms of quality of work, responsiveness, and costs as compared with in-house provision.

## Local Level Management

The primary local level organization responsible for managing water delivery to individual farms will be a farmer-governed Water User Organization (WUO). Development and passage of a new WUO law will be necessary to enable this. Retail water delivery may also be undertaken by large commercial farmers who contract with GA for bulk water supply or by municipalities who have organized to provide local irrigation water delivery services. To facilitate this two-part irrigation management structure, GA will, in consultation with local farmers, subdivide all irrigation systems under its purview into smaller contiguous units on the basis of rational hydraulic boundaries. These units will typically be on the order of 1,000 hectares each, though they may be larger or smaller depending on local conditions.

Water User Organizations will be established by a majority affirmative vote of landowners within the boundaries of a designated local level management unit, resulting in the creation of irrigation service organizations in which participation of all eligible landowners is required. The WUO will then receive a right to use the local level irrigation facilities within the unit through a contract with GA and have exclusive authority to purchase bulk water supplies, distribute those supplies inside the local unit, and to collect irrigation tariffs from the farmers served. Bulk water will be supplied by GA under a contract with the WUO or other local management entity. The WUO may choose to hire its own staff to operate the local system or to contract with a private firm to operate and maintain its facilities.

The WUO will then contract with individual farmers for irrigation service in exchange for payment of service fees, which will be set by the WUO Board of Directors based on its costs of operation. It will also be responsible for maintaining local level facilities to

standards called for in its contract with GA and for paying GA for the bulk water supply received.

If landowners reject the idea of a WUO in referendum voting, GA will have the option of either providing irrigation services within the local unit directly to individual farmers, or of awarding a concession to a private firm who would operate tertiary facilities and collect fees from farmers served. It is expected, however, that all contracting with small farmers would be undertaken through collective contracts with WUOs within 5 to 7 years.

A WUO Support Unit will be created following Strategy approval which will develop procedures for establishing WUOs and provide training and support to the WUO governing board, manager, and staff for a period of 5 to 10 years.

## Irrigation Tariffs

Irrigation water is a commercial input to irrigated agriculture, as are fertilizer and plowing. At the same time, the provision of irrigation service is typically regarded by national governments as a powerful tool for rural economic development, with numerous positive linkages to other parts of the rural economy and hence is a candidate for public funding as well.

An independent regulator will establish a bulk water tariff for each system or group of systems operated by GA. Tariffs will be set to cover reasonable system-specific main system operating and maintenance and depreciation costs.

The bulk water tariff will consist of two parts – one fixed and one variable. The fixed portion will be based on the area of agricultural land within the local unit boundaries, as specified in the operating license awarded to GA by the regulator. The variable portion of the tariff will be based on the volume of water delivered to each local water retailer, whether a WUO, a municipality, or a corporate farm, at rates specified in the contract.

WUOs will set and collect their own retail water tariffs, taking into account the bulk water tariff specified in the water contract with GA. As an interim measure, GA may continue to provide both bulk and retail irrigation service to individual farmers in some systems as they do at present, especially in un-rehabilitated systems. In such cases, the regulator will establish separate bulk and retail tariffs to be combined when billing farmers.

The GoG will support its economic development objectives of expanding agricultural output and increasing rural incomes by providing the capital for initial system rehabilitation. Additional support to particular groups of farmers to cover higher irrigation tariffs during a transitional period could be provided by the GoG through the MoA if desired.

## Regulation

Georgian Amelioration is a monopoly for-profit service provider. As such there is a need for independent oversight to review the costs which GA proposes to pass on to its clients in the form of tariffs and also to monitor and insure the quality of service it provides to WUOs.

Quality of service can be regulated through contract provisions in agreements between GA and local level management entities such as WUOs, which include penalties for

failure to deliver agree-upon irrigation services. The designated regulator would provide external adjudication for resolving disputes between GA and its clients.

A third regulatory need, that of ensuring adequate maintenance of infrastructure assigned to a WUO for use, can be accomplished through provisions in service contracts, coupled with periodic joint inspections.

# 1. Introduction

Effective irrigation and drainage services are vital components of a vibrant Georgian agriculture. In the 1980s, nearly half a million hectares of Georgian farmland was equipped for irrigation. Today irrigation-ready area has shrunk to less than a fifth of that, and the actually irrigated area in 2015 was only 43,000 hectares. Alongside that shrinkage, agricultural production and productivity have fallen dramatically. Between 2000 and 2010, production of annual crops declined by 44%, while output of perennial crops fell 10%. With a handful of exceptions, yields for major crops are well below those of neighboring countries. Maize yields, for example, are 2.5 tons/ha in Georgia and 6.7 tons/ha in Armenia, while potato yields are 11.5 tons/ha in Georgia, and more than 30 tons/ha in Turkey.

To restore Georgia's position as an important exporter of high-value agriculture products, as it was during the Soviet period, it is critical that irrigation be re-established on a wide swath of the country's agricultural land. This does not mean to a return to the pre-1990 pattern of irrigation, for a part of the extensive area irrigated previously is almost certainly not economically viable in today's market economy. However a significant expansion is essential, and the extent of viable irrigation clearly lies somewhere between the current marginal level and the high water mark of 30 years ago. Moreover, the productivity of the land that is irrigated is tragically low by regional and international standards, and improving the quality of irrigation service is another key to raising agricultural productivity in Georgia.

The **objectives** of this strategy are:

- To describe the complex environment in which irrigation system rehabilitation, operation, and maintenance will take place over the next ten years
- To indicate the directions that Georgia intends to take in managing its water resources, rehabilitating and modernizing its irrigation systems, and organizing, managing and funding irrigation services for farmers

The **context** of irrigation and drainage has many dimensions, including hydrologic, agricultural, financial, economic, policy, legal, organizational and social ones. Important features of each these dimensions are outlined in the strategy to define the framework in which strategic choices are made.

The **timeframe** adopted for the strategy is the ten-year period between 2016 and 2025. This duration is long enough to secure results from the directions chosen while still lying within a reasonable planning horizon.

Five **strategic questions** define important choices made in the strategy. These questions guide both the strategic directions chosen and the structure of the strategy itself.

1. What are the appropriate criteria, standards, and procedures for selecting rehabilitation investment projects?
2. How should the main system (off-farm) manager be organized – for-profit company, not-for-profit company, or government agency; should this organization be national or regional in scope; how can the management agency be organized to work more effectively and efficiently; and what kinds of capacity building assistance are need for this?

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The remainder of the strategy is organized as follows. Section 2 provides a vision for the sector in 2025 and lays out the broader policies and principles that guide the strategy. The next two sections provide background for the strategy, describing the agricultural and water resource contexts of irrigation respectively. Section 5 then addresses irrigation, discussing its historical context, current extent, legal framework, water management practices and organizational structure. The section also estimates future water demand generated by an expanding irrigation sector. Section 6 describes Georgian Amelioration, the company presently responsible for irrigation and drainage service provision in the country. Chapter 7 is the heart of the strategy, in which strategic choices and directions are outlined. Finally, Chapter 8 discusses needed reforms and responsibilities for action and lays the groundwork for preparation of an action plan to guide capacity development in the sector.

# 2. Principles and Approach

## *2025 Vision of Irrigation and Drainage*

*In 2025, up to 200 thousand hectares of farmland will be adequately irrigated by gravity irrigation systems. A stable water supply will be available to serve this area. Another 100 thousand hectares will be effectively drained. Irrigation services will be effectively and efficiently provided by a combination of a national level main system manager and local level organizations[2] which contract for bulk water and distribute it to individual farmers. Main systems will employ modern water measurement and control technology. Both main system and local level facilities will be sustainably maintained. Farmers will bear an agreed-upon share of the costs of irrigation and drainage service provision and pay their assigned share of these costs promptly.*

## *Guiding Principles for Irrigation and Drainage Development*

The following principles guiding the preparation of an irrigation strategy have been extracted from the current national development strategy and the new national agricultural strategy. These two broader strategies are discussed more fully in subsequent sections.

- An overarching emphasis on improving the production environment for **higher-value crops** and **higher-value-added products**
- The critical need to **extend and improve the quality of irrigation and drainage services** in the country, focusing on rehabilitation and modernization of existing schemes
- The importance of facilitating and promoting investments by farmers in **drip irrigation technology** for higher value crops and higher output quality
- The facilitation of environmentally and **financially sustainable irrigated agricultural systems**
- The importance of **modernizing management systems**, including modern data collection and use for irrigation and drainage service delivery
- The importance of establishing **self-governing local level institutions** to manage retail water distribution and local facilities maintenance

### The National Policy Context

Integration into the European Union is the cornerstone of Georgia's foreign and internal policy. According to the national development strategy, *Georgia 2020,* the Government of Georgia posits a democratic development course and firmly supports universal European values. Effective implementation of the recently signed Association Agreement between EU and Georgia is seen as critical, as it is a precondition for political association and gradual economic integration with the EU. The government's current priority in this regard is to implement economic policies which ensure the sustainable development of the country,

[2] It is noted here that local level organizations may hire other public or private organizations to provide their members with local level services.

based on the principles of economic freedom and respect for and protection of property rights. At the same time, the state will act as a guarantor of justice in economic processes.

The development strategy recognizes three primary principles.

- Ensuring fast and efficient economic growth driven by development of the real (production) sector of the economy
- Inclusive economic growth
- Rational use of natural resources, ensuring environmental safety and sustainability and avoiding natural disasters

Fundamental principles posited as underlying socio-economic development are democratic development, rule of law, efficient administration, respect for human rights and basic freedoms. Economic development is to be driven by a free private sector operating under an optimal, efficient and transparent government. The government's role includes establishing conditions in which the private sector will be free to make its own decisions and in which the supremacy of property rights is guaranteed. Free market relations are to be combined with optimal state regulation. Based on the principles of optimal and efficient governance, the state's involvement in entrepreneurial activities will be minimal, and it will not seek to compete with the private sector; its participation in economic activities will be limited to sectors where the private sector remains weak and inefficient (*Georgia 2020*).

## Agricultural Sector Policy

*Georgia 2020* places a high priority on increasing the export potential of the country's agricultural products. Among other steps, this includes improving the country's irrigation and drainage systems. The *2015-2020 Agricultural Strategy*, developed by the Ministry of Agriculture, outlines proposed actions under this goal.

> *Improving irrigation and drainage systems leads to better water use, creation/development of efficient systems (including drip irrigation, sprinkler irrigation, etc.) and farmers' increased access to these systems; besides, as a result of the above-mentioned improvement, farmers will be supplied with modern technologies in order to increase their productivity and make optimal use of available resources.*

The national economic strategy accords special recognition to increasing production of higher-value crops and higher-value-added agricultural products, particularly for export. The *Agricultural Strategy* elaborates these objectives, asserting that, "given the particularities of the Georgian climate, construction, operation and management of irrigation and drainage infrastructure is vital for efficient and intensive agricultural production". It lays out the following as priorities for irrigation and drainage.

> *Preference will be given to rehabilitation and modernization schemes in order to increase their technical conditions and to improve their efficient technological and organizational capacities. Measures to be undertaken are the following: construction and rehabilitation of water reservoirs for irrigation purposes; rehabilitation of irrigation infrastructure and specific headworks; rehabilitation of drainage infrastructure and primary channels; undertaking of detailed studies of modern technologies and management approaches for efficient water use; improvement of hydrometric service.*

*These measures are also aimed to support rehabilitation of drip and sprinkler irrigation systems; fair and optimal allocation of water resources and improvement of tariff system; ensuring involvement of water-user groups in the rehabilitation and maintenance of internal systems; promotion of farmer organizations and institutional arrangements; establishment of demonstration plots arranged up to international standards and demonstrating advantages of ventilation techniques and combined usage of integrated pest management and agro technical measures; improvement of geo information system databases and relevant software application; improvement of billing system; development of cadaster of ameliorated areas.*

The *Agricultural Strategy* asserts that critical to the sector becoming viable and sustainable is "to commercialize and transform LTD Georgian United Amelioration Systems Company (now GA) into a profitable organization".

*Georgia 2020* lists several other development policy priorities relevant to an irrigation and drainage strategy. These include (a) improving public administration, (b) extensive employment of modern information and communication technology, and (c) a taxation system that provides appropriate incentives to facilitate sustainable development.

Taken together, these policy statements frame the context for the development, modernization, and improved management of the irrigation and drainage sector.

## *Strategy Development Process*

This strategy was developed through a collaborative process involving the Ministry of Agriculture and Georgia Amelioration[3] (GA), with support from the World Bank-funded Georgia Irrigation and Land Market Development Project (GILMD) and the World Bank's Water Partnership Program (WPP). Initiation of strategy development coincided with changes in leadership in both the Ministry and GA ("the Company") which resulted in a determination to undertake a comprehensive reform of the Company. As a part of the reform process, the Company began to prepare a new corporate strategy to guide changes to its structure and business practices. Sector strategy development thus took place on two parallel but closely interlinked tracks with similar timelines but somewhat different processes.

The broader I&D strategy was supported by a series of studies carried out by a team of local and international specialists assessing current situations and practices in the areas of legal structures, water resources, main system O&M practices, local level water management, and the economics of irrigated agriculture. These studies supported the development of reform options based on international experience and best practices combined with sound assessments of local conditions and capabilities.

Professionals working on both efforts collaborated closely and extensively throughout, sharing and discussing information and ideas freely.

[3] Formerly the United Amelioration Services Company of Georgia (UASCG).

# 3. Agricultural Sector

Georgian agricultural output plunged following the break-up of the Soviet Union, and now provides just under 10% of GDP while supporting half of the Georgian population. Current production is dominated by cereal grains, though great potential exists to expand horticultural crop production. Rehabilitating irrigation systems and reforming their management is a key to this transition, along with adoption of on-farm drip irrigation technology.

## *Sector Contributions to GDP and Employment*

During the Soviet era, Georgia exported substantial quantities of high value agricultural products. Following the breakup of the Soviet Union, however, agricultural production plunged. In the 1990s, the state farms and collectives which dominated Soviet agricultural production were disbanded and Georgian agriculture came to be characterized by small scale subsistence farming. This shift was accompanied by massive deterioration of irrigation infrastructure, electricity supply networks, and farm machinery services.

The contribution of the agricultural sector to GDP has fallen significantly over the last decade and a half, from 22% in 2000 to about 8.4% in 2010. Recent government investments in agriculture have halted the long-term decline, and sector contribution was over 9.0% in 2014. Agriculture sector contributions to GDP are shown in Table 3.1, along with comparable figures for neighboring countries. Over the next 10 years, it is anticipated that the share of the agricultural sector will fall gradually to around 7% by 2025 as the manufacturing and service sectors continue to expand at a more rapid rate. Despite its reduced share of the national economy, the agricultural sector is expected to grow by about 4% per annum, yielding an overall economic growth rate of between 5.5% and 6.0% per annum.

**Table 3.1. Contribution of agricultural sector as share of GDP**

| Country | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Georgia | 21.9% | 16.7% | 8.4% | 9.4% |
| Armenia | 25.5% | 20.9% | 19.2% | 21.9% |
| Azerbaijan | 17.1% | 9.9% | 5.2% | 5.7% |
| Russia | 6.4% | 5.0% | 3.9% | 3.9% |

Source: World Development Indicators, World Bank, May 2015.

With regard to employment, agriculture remains a very important sector, with over 50% of the population engaged in agriculture activities, primarily as self-employed semi-subsistence farmers. There are also a number of larger commercial farms as well as an agri-business sector providing rural employment. It is estimated that agriculture accounts for 75% of rural employment and 45% of rural income in Georgia, counting these forward and backward linkages. The proportion of the population employed in the agricultural sector is shown in Table 3.2, and it can be seen that the proportion is considerably higher in Georgia in comparison to neighboring countries of Armenia and Azerbaijan.

**Table 3.2. Contribution of agricultural sector as share of employment**

| Country | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Georgia | 53.0% | 54.0% | 52.0% | 50.0% |
| Armenia | 45.0% | 46.0% | 39.0% | 38.0% |
| Azerbaijan | 41.0% | 39.0% | 38.0% | 37.0% |
| Russia | 15.0% | 10.0% | 10.0% | 9.0% |

Source: World Development Indicators, World Bank, May 2015.

The structure of the rural economy and demographic characteristics indicate that this dependence on agriculture is likely to continue into the medium-term future. Consequently, one of the greatest challenges facing Georgia is the long-term development of the agriculture sector to improve productivity, increase farm incomes, and reduce rural poverty.

## Poverty reduction

At the national level, the percentage of the population below the poverty line was estimated at 35.6% in 2010 (based on a poverty line of US$ 2 per day) with the vast majority of poor households living in rural areas. The lack of productive infrastructure (particularly irrigation), weak rural institutions, poor marketing systems and limited off-farm opportunities have resulted in declining agricultural productivity, low farm incomes and high rates of rural poverty. This situation is also exacerbated by the high proportion of very small farms and widespread land fragmentation.

Despite steady national economic growth, the proportion of the population living below the poverty line only fell from 38.9% in 2000 to 35.8% in 2010. This was primarily due to declining agricultural production, exacerbated by the Russian conflict in 2008. Driven by increased agricultural investment, including irrigation rehabilitation investments, poverty rates have now started to fall – from 35.8% in 2010 to around 30.0% in 2013. Continuing development of the agricultural sector should help to significantly reduce rural poverty in the future.

## Land tenure

Georgia does not have a separate Land Code. Instead land ownership, like the ownership of other types of assets, is addressed in the Civil Code. Provisions on land registration are contained in the Law on Public Registry,

The approach to land and agrarian reforms pursued during the 1990s, namely the distribution of state and collective farm land and non-land assets among former farm members, has led to a high degree of land fragmentation, with small plot sizes raising significant challenges for the creation of an economically-viable irrigated agriculture. The need for land consolidation, both for creating a profitable agriculture sector and for efficient irrigation, is clear. The Georgia Agricultural Strategy notes the problem posed by this fragmentation and calls for land consolidation and the establishment of functioning land markets. It also proposes a number of steps to achieve this[4].

There is at present no explicit legal basis for formal land consolidation, and even if there were, experience shows that land consolidation is an expensive and time consuming process. Informal land consolidation can be expected to take place over time as the owners of agricultural land plots sell and others buy. However this process is complicated by the

[4] *Strategy for Agricultural Development in Georgia: 2015-2020*. 2015. Ministry of Agriculture (p21).

relatively low level of land registration, which is required to formalize such transfers. In some countries specific legislation on the leasing of agricultural land has provided an effective middle way for those who wish to exit farming but who are reluctant to sell their land. Such legislation sets out a standard lease form, eliminating the need to negotiate each lease separately, with common provisions on their duration and rental increases. No such legislation exists in Georgia, meaning that leases on agricultural land are regulated by the general provisions of the civil code. In other words such leases are possible but must, in each case, be separately negotiated and drafted.

A further result of the low level of land registration is that it can be difficult to identify who owns particular parcels of agricultural land, particularly in cases where it is unused. In turn assessment and collection of irrigation and drainage tariffs is hindered, and this too has significant implications for the economic viability of irrigation schemes.

## *Crop Production: Recent Performance and Future Trends*

### Crop areas

Cereals (i.e. maize, wheat and barley) are the main annual crops grown in Georgia, with an average of 184,100 ha being cultivated annually between 2010 and 2014 (see Table 3.3). Maize is the principal annual crop, with 44% of the annual crop area, followed by wheat (17%). Potatoes and vegetables are also important annual crops accounting for 8% and 7% of the annual crop area respectively. Other crops grown include beans, sunflower, melons and grasses. Between 2000 and 2010, the overall area of annual crops declined by about 40% (or 193,520 ha).

With greater investment in the agricultural sector, it is anticipated that the areas of annual crops will steadily increase over the next 10 years, reaching around 327,000 ha by 2025, an increase of about 21%. It is expected that future cropping patterns would remain broadly similar to present ones, though there may be a relatively larger increase in the proportions of potatoes and vegetables.

The average area of perennial crops between 2010 and 2014 was estimated at 127,160 ha (Table 3.3), of which vineyard grapes were the most important (41% of perennial crop area). Other perennial crops included apple/pear (14%), hazelnut/walnut (15%), citrus fruits (13%) and stone fruits (5%). Between 2000 and 2010, the overall area of perennial crops fell by 34,255 ha (20%). The areas of apple, pear, and tea experienced the most marked declines, but there were only relatively small drops in the areas of grapes and stone fruit. In contrast, there were increases in the areas of citrus fruit (by 28%) and hazelnut/walnut (by 52%).

With improved agricultural infrastructure and support services, the area of perennial crops is projected to expand by 26,000 ha (20%) to reach 153,100 ha by 2025. With the exception of tea, it is expected that the crop areas will increase in similar proportions, so the perennial cropping patterns will remain broadly unchanged.

**Table 3.3. Annual and perennial crop areas (ha/annum)**

| Crop | 2000-04 | 2005-09 | 2010-14 | 2015-19 | 2020-25 |
|---|---|---|---|---|---|
| **Annual Crop** | | | | | |
| Wheat | 107,223 | 58,860 | 46,475 | 51,123 | 56,235 |
| Barley | 37,586 | 29,472 | 19,250 | 21,175 | 23,293 |

| | | | | | |
|---|---|---|---|---|---|
| Maize | 188,031 | 139,825 | 118,375 | 130,213 | 143,234 |
| Sunflower | 6,107 | 5,297 | 4,935 | 5,429 | 5,972 |
| Beans | 11,003 | 6,909 | 6,625 | 7,288 | 8,016 |
| Potato | 36,101 | 25,139 | 23,125 | 25,438 | 27,981 |
| Melons | 7,694 | 4,651 | 2,725 | 2,998 | 3,297 |
| Vegetables | 35,660 | 26,180 | 19,775 | 21,753 | 23,928 |
| Grasses/other crops | 34,352 | 29,633 | 28,954 | 31,850 | 35,035 |
| sub-total | 463,758 | 325,965 | 270,239 | 297,263 | 326,990 |
| **Perennial Crop** | | | | | |
| Vineyard grapes | 55,334 | 48,520 | 51,775 | 56,953 | 62,648 |
| Apples | 29,954 | 19,863 | 15,700 | 17,270 | 18,997 |
| Pears | 4,086 | 2,880 | 2,400 | 2,640 | 2,904 |
| Stone fruit | 8,550 | 8,947 | 6,625 | 7,287 | 8,016 |
| Citrus fruit | 13,200 | 15,000 | 16,875 | 18,563 | 20,419 |
| Hazelnut/walnut | 12,436 | 16,300 | 18,975 | 20,873 | 22,960 |
| Tea | 23,180 | 9,597 | 3,250 | 3,250 | 3,250 |
| Other crops | 14,674 | 12,111 | 11,560 | 12,683 | 13,919 |
| sub-total | 161,414 | 133,218 | 127,159 | 139,518 | 153,112 |
| Total Crop Area (ha) | 625,172 | 459,183 | 397,399 | 436,781 | 480,102 |

Note: Crop area refer to harvested area, not sown or planted areas.
Sources: FAOSTAT, Crop Production, 2015. Consultants' estimates for 2015 to 2020 projections.

## Crop yields and production

It is evident from Table 3.4 that yields of annual crops are generally very low, with maize and wheat currently achieving only 2.2 ton/ha and 1.7 ton/ha respectively. The productivity of horticultural crops is also quite low at 11.5 tons (potatoes) and 7.6 ton/ha (vegetables). Between 2000 and 2010, there were small declines in the yields of wheat, barley, sunflower and vegetables. This was offset somewhat by modest increases in the productivity of maize, beans, potatoes and melons.

The yields of perennial crops are also relatively poor. Vineyard grape yields are currently estimated 3.1 ton/ha, while the average yields of apples, citrus fruit and hazelnut/walnut are 3.7 ton/ha, 4.2 ton/ha and 2.0 ton/ha respectively. Yields of perennial crops did not change significantly between 2000 and 2010. With improved availability of irrigation water, as well as the adoption of improved cropping practices, yields of annual and perennial crops are projected to gradually increase. By 2025, it is anticipated that overall yield levels will be about 20% higher. Where drip irrigation technologies are employed, yield increases should be significantly larger.

**Table 3.4. Annual and perennial crop yields: actual and projected (tons/ha)**

| Crop | 2000-04 | 2005-09 | 2010-14 | 2015-19 | 2020-25 |
|---|---|---|---|---|---|
| **Annual Crops** | | | | | |
| Wheat | 1.84 | 1.53 | 1.66 | 1.82 | 2.00 |
| Barley | 1.53 | 1.37 | 1.47 | 1.62 | 1.78 |
| Maize | 1.97 | 2.22 | 2.16 | 2.37 | 2.61 |
| Sunflower | 0.61 | 0.53 | 0.49 | 0.54 | 0.60 |
| Beans | 0.69 | 1.77 | 1.33 | 1.47 | 1.61 |
| Potato | 10.96 | 9.84 | 11.47 | 12.61 | 13.88 |
| Melons | 13.77 | 14.75 | 17.33 | 19.06 | 20.97 |

| | | | | | |
|---|---|---|---|---|---|
| Vegetables | 9.94 | 6.76 | 7.60 | 8.36 | 9.19 |
| **Perennial Crops** | | | | | |
| Vineyard grapes | 3.00 | 3.62 | 3.09 | 3.40 | 3.74 |
| Apple | 2.54 | 3.57 | 3.66 | 4.03 | 4.43 |
| Pear | 6.88 | 7.35 | 6.78 | 7.46 | 8.21 |
| Stone fruit | 5.26 | 4.85 | 5.11 | 5.63 | 6.19 |
| Citrus fruit | 4.22 | 4.41 | 4.15 | 4.56 | 5.02 |
| Hazelnut/walnut | 1.99 | 1.78 | 1.98 | 2.08 | 2.19 |
| Tea | 1.00 | 1.00 | 0.94 | 0.99 | 1.04 |

Sources: FAOSTAT, Crop Production, 2015; consultants' estimates for 2015 to 2020 projections.

Average crop yields in Georgia are compared to those in Armenia, Azerbaijan, Turkey and Ukraine in Table 3.5. With the exception of melons, hazelnut/walnut, and stone fruit, yields in the other four countries greatly exceed those obtained by farmers in Georgia.

**Table 3.5. Average crop yields in Georgia and regional neighbors, 2013 (tons/ha)**

| Crop | Georgia | Armenia | Azerbaijan | Turkey | Ukraine |
|---|---|---|---|---|---|
| **Annual Crop** | | | | | |
| Wheat | 1.8 | 3.1 | 2.7 | 2.8 | 3.4 |
| Barley | 1.3 | 2.9 | 2.4 | 2.3 | 2.9 |
| Maize | 2.5 | 6.7 | 5.4 | 7.4 | 6.4 |
| Sunflower | 0.6 | n/a | 1.9 | 2.4 | 2.2 |
| Beans | 1.3 | 2.6 | 2.4 | 2.3 | 1.4 |
| Potatoes | 11.5 | 21.5 | 15.2 | 31.6 | 16.0 |
| Melons | 17.5 | n/a | n/a | 16.9 | 7.3 |
| Vegetables | 8.2 | 30.5 | 18.6 | 16.4 | 8.9 |
| **Perennial Crop** | | | | | |
| Vineyard grape | 3.5 | 15.0 | 11.7 | 8.6 | 8.5 |
| Apple | 3.8 | 11.5 | 9.4 | 18.0 | 11.7 |
| Pear | 6.3 | 8.9 | 8.7 | 13.4 | 12.7 |
| Stone fruit | 5.2 | 4.3 | 5.8 | 5.1 | 4.4 |
| Citrus fruit | 4.1 | n/a | 4.1 | 15.5 | n/a |
| Hazelnut/Walnut | 2.3 | n/a | n/a | 1.3 | 1.0 |
| Tea | 0.9 | n/a | n/a | 2.8 | n/a |

Source: FAOSTAT, Crop Production, 2015

With respect to total crop production, the output of annual crops declined by 44% from 1.49 million tons in 2000 to 0.83 million tons in 2010 with maize and wheat production decreasing by 31% and 61% respectively. There were also marked drops in the production of potatoes and vegetables (see Figure 3.1). Furthermore, there was an overall decrease in the production of perennial crops which fell by about 10% from 0.42 million tons in 2000 to 0.38 million tons in 2010. The production of vineyard grapes declined slightly, but there were notable falls in the production of apples, pears, stone fruits and tea. This was offset somewhat by an increase in the production of citrus fruits and hazelnuts.

In response to increasing market demand (both domestic and export), future projections of annual and perennial crop production indicate that a total of 1.22 million tons of annual crops and 0.55 million tons of perennial crops could be produced by 2025. This would represent an increase of 46% for annual crops and 45% for perennial crops.

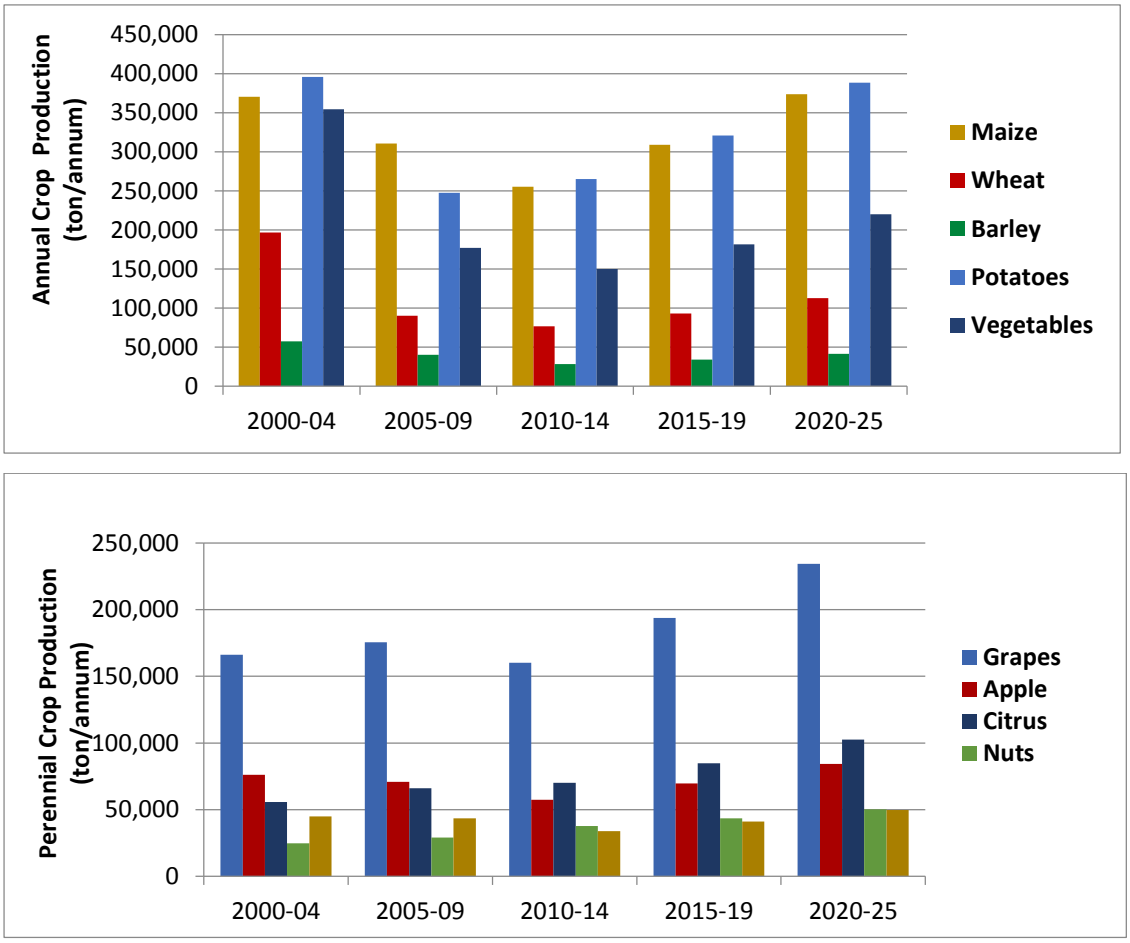



**Figure 3.1. Annual and perennial crop production: actual and projected**

## Irrigated crop production[5]

Extensive development of irrigation infrastructure was undertaken during the Soviet period, which resulted in a total irrigated area of 386,000 ha by the end of the 1980s. During 1980s, the major crops cultivated under full or partial irrigation were vineyard grapes, fruit orchards, potatoes, vegetables, wheat, maize, sunflower, fodder crops and pasture. In 1986, average irrigated crop yields were estimated at 3.0 tons/ha for winter wheat, 3.3 tons/ha for maize, 4.8 tons/ha for grapes, 5.0 tons/ha for fruits, and 12.0 tons/ha for potatoes.

In the 1990s, the loss of the tradition exports markets in the former Soviet Union, together with the deterioration of irrigation infrastructure, resulted in a significant reduction in irrigated area. By 2000, it was estimated that only about 160,000 ha were being irrigated – less than half of the total in the 1980s. Deterioration of the irrigation systems continued for another ten years, and by 2010, only about 24,000 ha were being irrigated.

[5] Post independence there are virtually no figures available distinguishing irrigated and non-irrigated production and yields. This is a significant handicap to any kind of analysis that looks at the impacts of irrigation on agriculture.

In order to reverse the dramatic decline in crop production (see Figure 3.1), there is an urgent need to rapidly expand irrigated area by rehabilitating irrigation infrastructure and improving the management, operation and maintenance of working irrigation systems. Irrigation is critical for productive agriculture, particularly in the central and eastern regions of Georgia, and the provision of a reliable and timely supply of irrigation water will facilitate a number of things, including the following.

- A significant increase in the yields of major crops, particularly maize, beans, oilseeds, vegetables, fruits and vineyard grapes which currently depend on rainfall
- An expansion in the areas under both annual and perennial crops
- A shift in the cropping patterns towards high-value horticultural crops
- An increase in net farm incomes, an expansion of employment opportunities, and a reduction in rural poverty
- Greater agricultural sector contributions to national GDP and economic growth
- An increase in agricultural exports (e.g. fruit, nuts, vegetables and wine), a decrease in agricultural imports (e.g. wheat, pulses and oil crops), and reduction in the agricultural trade deficit

As a result of rehabilitation works undertaken by MoA and GA between 2012 and 2015, the irrigation infrastructure is expanding once again and the actual irrigated area increased to 43,000 hectares in 2015. Rehabilitation is projected to continue over the next 5 to 10 years and beyond with area equipped for irrigation rising to around 130,000 hectares by 2020 and around 200,000 ha by 2025.

## *Profitability of Agriculture*

### Returns from crop production

Crop budgets were prepared for eight crops; namely wheat, maize, beans, potatoes, vegetables, grasses, fruit orchards, and vineyards; under both rainfed and irrigated conditions. Given the significant contrast between marginal/small farms (< 3 ha) and medium/large farms (> 3 ha), with respect to both labor and machinery requirements as well as productivity, crop budgets were prepared for both types of farms.

In the analysis, it was assumed that increases in crop yields of between 35% and 50% would arise from the supply of irrigation water following rehabilitation of irrigation infrastructure and the adoption of improved agronomic practices (e.g. balanced fertilizer application, improved weed control and better pest management). Increases in the gross value of production, as well as higher input, labor and machinery costs, were taken into account in the crop budget analysis.

Based on the rainfed and irrigated crop budgets, crop gross margins were derived for both marginal/small and medium/large farms (Table 3.6). It is readily apparent that under both rainfed and irrigated conditions the net returns per hectare from vegetables, potatoes, orchard and vineyard crops are substantially higher than the net returns from wheat, maize, beans and grasses. However, the higher returns from horticultural crops are moderated by the risks associated with very large seasonal price fluctuations. This risk is exacerbated by the dearth of post-harvest processing industries for most crops, wine grapes excepted.

It is also evident that the gross margins for irrigated crops are notably higher than the gross margins of rainfed crops, so the increases in gross crop returns more than offset the higher production costs for both types of farms.

**Table 3.6. Gross margins for rainfed and irrigated crops (GEL/ha)**

| Crop | Medium/Large Farm | | Marginal/Small Farm | |
|---|---|---|---|---|
| | Rainfed | Irrigated | Rainfed | Irrigated |
| **Annual Crop** | | | | |
| Wheat | 357 | 623 | 451 | 738 |
| Maize | 521 | 785 | 594 | 921 |
| Haricot Bean | 858 | 1,337 | 811 | 1,239 |
| Potato | 2,507 | 5,336 | 3,248 | 5,402 |
| Vegetables | 4,138 | 6,967 | 3,683 | 5,460 |
| Grasses | 548 | 872 | 318 | 649 |
| **Perennial Crop** | | | | |
| Orchard crops | 3,605 | 5,134 | 3,936 | 5,216 |
| Vineyard grapes | 2,201 | 3,803 | 2,494 | 3,481 |

Source: Consultants' estimates based on crop budget analysis.

## Net farm income and farmers' ability to pay

In the absence of detailed information on cropping patterns for different farm sizes, a generalized cropping pattern for Eastern Georgia was used in the analysis for both farm types. Reliable data on irrigated cropping patterns was likewise unavailable, so estimates of the likely changes in the present rainfed cropping patterns were used to derive cropping patterns under irrigated conditions (Table 3.7). With information on crop gross margins and cropping patterns, a farm budget analysis was then undertaken to determine average net farm incomes under rainfed and irrigated conditions for both a marginal/small subsistence farm (0.8 ha) and a medium/large commercial farm (6 ha)[6].

**Table 3.7. Cropping patterns in eastern Georgia**

| Crop | % of Cultivated Area | |
|---|---|---|
| | Rainfed | Irrigated |
| **Annual Crop** | | |
| Wheat | 33.3% | 28.3% |
| Maize | 19.4% | 20.4% |
| Haricot Bean | 6.8% | 10.3% |
| Potato | 4.4% | 5.3% |
| Vegetables | 9.9% | 11.9% |
| Grasses | 4.3% | 2.0% |
| **Perennial Crop** | | |
| Orchard crops | 10.6% | 10.6% |
| Vineyard grapes | 11.2% | 11.2% |
| | 100.0% | 100.0% |

Source: Consultants' estimates based on crop areas in Eastern Georgia

[6] These preliminary estimates need to be updated on the basis of more detailed field information on cropping patterns and yields. In their present form, they are indicative but are not definitive.

**Table 3.8. Net farm income and farmers' ability to pay**

| Farm Type | Net Farm Income (GEL per farm) | | |
|---|---|---|---|
| | Rainfed | Irrigated | Increment |
| **Before irrigation service fees** | | | |
| Marginal/Small Farm (0.8 ha) | 1,190 | 1,890 | 700 |
| Medium/Large Farm (6 ha) | 7,923 | 14,643 | 6,720 |

Source: Consultants' estimates based on farm budget analysis.

The results of this preliminary farm budget analysis are presented in Table 3.8. It is evident that there are likely to be significant increases in average net farm incomes (GEL 700 for marginal/small farms and GEL 6,720 for medium/large farms) before irrigation service fees are deducted.

To assess farmers' ability to pay for irrigation service fees (ISF), it was assumed that farmers will have the capacity to pay ISF up to 50% of the incremental net farm income gained from the supply of irrigation water. Under this "rule of thumb" (which provides an adequate incentive to purchase irrigation water and takes account of the risks associated with crop production), it is estimated that, on average, marginal/small farmers will be able to pay an ISF of up to GEL 440 per ha and medium/large farmers will be able to meet an ISF of up to GEL 560 per ha.

Note that for very small farms, however, even though net income may increase significantly with irrigation, the farm still may not produce sufficient income to support the farming household because of its small area. This needs to be taken into account in setting tariff and financial assistance levels.

The ability to pay ISF is very sensitive to the types of cropping pattern adopted by farmers. For example, if it is assumed that only wheat is grown, the ISF that farmers' are able to pay falls to GEL 144 per hectare for marginal/small farmers and GEL 132 per hectare for medium/large farmers. In contrast, if only vegetables are produced, the ability to pay ISF increases to around GEL 880 per hectare for marginal/small farmers and GEL 1,420 per hectare for medium/large farmers. Similarly, if only orchard crops are grown, an ISF of GEL 640 per hectare (marginal/small farms) and GEL 760 (medium/large farms) could be met, while vineyard grapes could pay an ISF of up to GEL 490 per hectare (marginal/small farms) and GEL 800 per hectare (medium/large farms). This analysis indicates that, on average, farmers will have the capacity to meet an ISF of up to around GEL 500 per hectare, but this will be highly dependent on the types of crop produced.

Working from Table 3.8, it is evident that incremental net farm income per hectare on larger farms, computed at GEL1,120/ha, is higher than on small farms at GEL 875/ha. Over the next 10 years, a gradual expansion in working farm sizes is expected, as smaller plots are leased or sold to others to create larger operational holdings. Improvements in the land registration system and the development of simple standardized leasing procedures would facilitate this consolidation, which is essential over the longer run to raise agricultural productivity.

# 4. Water Resources

Georgia is generously endowed with water resources, however the six operating irrigation reservoirs can store less than 4 percent of the annual flow of east Georgian rivers. Mountain snowpack storage provides additional storage capacity, but this will erode as the climate continues to warm. Georgia also has abundant groundwater, though it is presently little used for irrigation. The national water data collection and analysis system has virtually collapse, rendering analysis of both surface water and groundwater problematic. There is currently no water permitting system in the country, though a new water law will re-establish one in 2018.

## *Overview*

The Food and Agriculture Organization of the UN (FAO) reports a total renewable water resource per capita for Georgia of 14,589 cubic meters for 2014. This exceeds my many times the commonly-employed international standard for water scarcity of 1,000 cubic meters per capita. An overview of Georgian water resources is shown in

**Table 4.1. Summary of the water resources of Georgia**

| **Water Resources of the Republic of Georgia** |
|---|
| **Number of rivers:** 26,060 |
| **Total length:** 58,987 km. |
| **Major rivers of West Georgia to the Black Sea :** Psou (53km), Bzipi (110km), Kodori (84 km), Enguri (213 km), Khobi (150km), Rioni (327 km), Kvirila (140 km), Dzirula (83 km), Tskhenistskali (176 km), Tekhuri (10 km), Abasha (66km), Supsa( 108 km), Natanebi (61 km), Chorokhi (438 km), and Acharistskali (90km) |
| **Major rivers of East Georgia to the Caspian Sea:** Mtkvari (1,364km), Paravani (74 km), Potskhovi (64 km), Kvabliani (55 km), Didi Liakhvi (98 km), Patara Liakhvi (63 km), Ksani (84 km), Aragvi (66 km), Algeti (108 km), Ktsia-Khrami (201 km), Mashavera (84 km), Debeda (176 km), Iori (320 km), Alazani (351 km), Ilto (43 km), Stori (38 km), Lopota (33 km), Kabali (48 km), and Matsimi (39 km). |
| **West Georgia rivers annual average flow:** 49.7 $km^3$ (76%) |
| **East Georgia rivers annual average flow:** 15.7 $km^3$ (24%). |
| **Number of lakes:** 850 with total volume of 0.720 $km^3$ including 43 man-made, 9 of which are for hydropower generation and 34 for irrigation. Only 6 of the irrigation reservoirs are currently operational. The largest operational irrigation reservoirs are Sioni (315 M $m^3$), Tbilisi (155 M $m^3$), Algeti (60 M $m^3$), and Jandari (25 M $m^3$). Six of irrigation reservoirs are in-stream, while the other reservoirs are filled using supply channels or pump stations. The latter are, for the most part, inoperable. |

The country is divided into two surface water drainage basins, with the eastern portion draining to the Caspian Sea and the west draining to the Black Sea. Major rivers include the Mtkavari (Kura) in the east with major tributaries including the Alazani and Iori, and the Rioni in the west. The climate in the east is semi-arid, receiving 600 to 800 mm of rainfall a year. The west is more sub-tropical with over a 1,000 mm of rainfall a year. Hence irrigation is a common requirement in the East, while artificial drainage is often required in the West. Major historical irrigated areas are shown in Annex 1.

## *Legal Framework*

Draft legislation, the *Law on Water Resources Management,* currently being prepared by the Ministry of Environment and Natural Resources Protection (MENRP), is intended to give effect to the principles of integrated water resources management and to Georgia's obligations with regard to the EU-Georgia Association Agreement[7] (the Association Agreement) which was signed on 24 June 2014.[8]

As the EU does not have specific legislation on the amelioration sector, it follows that the Association Agreement can have little direct impact on the development of this *Strategy*. On the other hand, there is a potential indirect impact through EU environmental legislation, including the *Water Framework Directive*, the *Flood Risk Management Directive* and the *Nitrates Directive*. However an analysis of the relevant provisions of the agreement suggests that the obligations are not particularly onerous in that Georgia is not required to fully align its laws with these instruments.

In general terms, the draft *Water Law*[9] confers primary responsibility for water resources management, encompassing both ground and surface water, upon MENRP and its river basin units. Water resource management is to take place on the basis of River Basin Districts, with each district having its own River Basin Management Coordinating Council.

In terms of planning, the draft *Water Law* envisages the development of a national water resources strategy, with management plans being prepared for each River Basin District. The main focus of these plans is on achieving water quality/ecological objectives, in line with the EU's *Water Framework Directive.*

As described in the draft law, separate plans are to be prepared for water allocation and water quality. Unfortunately this approach contradicts the basic principles of Integrated Water Resource Management (IWRM) and if carried out would limit the effectiveness of the law in promoting rational management of the nation's water resources. The quantity of water flowing in a river has a direct impact on water quality through its ability to dilute contaminants. Likewise, water quality influences the uses to which water withdrawn from the river can be put. The essence of competent basin planning, is that water quality and water abstraction be dealt with together. The current approach of developing separate plans needs to be reconsidered and modified.

The draft *Water Law* distinguishes between "general" and "special" water uses. General water uses of small quantities of water do not require a permit whereas special uses, typically involving larger quantities of water, do. The draft *Water Law* does not set out a clear system of priorities for water use other than specifying that the use of water for drinking and household use has the highest priority. Permits for special water use are to be issued by River Basin District offices of MENRP for periods of five years, save that permits for centralized water supply are granted for 25 years, while those for the hydropower and irrigation systems are to be issued for ten years. In general terms, the five-year permit seems too short to encourage investment. In international practice, "ordinary" permits

[7] The Association Agreement between the European Union and the European Atomic Energy Community and their Member States, of the one part, and Georgia, of the other part (OJ L 261 30.8.2014, p 4).

[8] The provisional application of the agreement started as of 1 September 2014 pending the completion of the ratification procedure (by the European Parliament and each of the EU Member States).

[9] The discussion that follows is based on the latest available translated version of the draft Water Law (1 August 2015) and is therefore subject to the caveat that the final adopted version may be different.

typically last for 10-12 years. Moreover ten years does not seem sufficient for investments in new hydropower or irrigation infrastructure. A potential weakness of the draft Water Law is that the legal basis for the issue of permits derives also from a separate item of legislation, namely the *Law on Permits and Licences* of 2005.

There are no other specific references to irrigation water in the draft Water Law, apart from a reference in 6(4) where the "'implementation of the state policy in the field of irrigation and drainage" is included among the competences of the Ministry of Agriculture (along with drinking water monitoring and the identification of nitrate-sensitive zones and good agricultural practices) as well as a reference in article 32 to measures to prevent pollution as a result of irrigation. Preparation of a separate law governing the amelioration sector is under consideration.

Responsibility for achieving the environmental objectives established through river basin planning lies with MENRP, with its subsidiary NEA being responsible for monitoring water quality through the "State Water Resources Monitoring System" foreseen in article 34.

Finally it is to be noted that the draft Water Law envisages the establishment of a system for charging for the use of water resources, although the law itself provides little detail as to how the level of these charges and the means of applying and enforcing them are to be determined. Such fees, if applied to GA, will need to be taken into account in the irrigation tariff-setting process.

Implementation of certain provisions of the new law are to be delayed for from 3 to 7 years. Dates scheduled for implementation include the following.

- Water permitting: January 2018
- Wastewater discharge fees: January 2019
- Water resource use fees: January 2021
- River basin management plans: January 2022

It is expected that the draft law will enter into force in 2017.

## *Surface Water*

### Reservoirs

Reservoirs constructed for irrigation water supply and managed by GA are shown in Table 4.2. Note that while the majority of reservoirs are not currently in use, the ones that are in use comprise 71% of total live storage capacity. Important unutilized potential is represented by the 180 M m3 Dailis Mtis reservoir, works were suspended in 1989 just before the break-up of the Soviet Union and whose planned irrigation system was never constructed. Narekvavis, a 6.8 M $m^3$ reservoir with a design irrigation capacity of 1,600 hectares, was damaged in an earthquake, drained, and subsequently repaired. It is expected to be refilled in 2017. The total design irrigated area served by all of these reservoirs is around 1.200 hectares.

## Table 4.2. Irrigation reservoirs managed by Georgian Amelioration

| # | Name of reservoir | Location (municipality) | Source of fill (river-canal) | Irrigation schemes | Capacity (M m³) | | Design irrigated area (ha) | Commissionied |
|---|---|---|---|---|---|---|---|---|
| | | | | | Total | Active | | |
| **RESERVOIRS MANAGED BY GEORGIAN AMELIORATION** | | | | | | | | |
| 1 | Sioni | Tianeti | Iori | Zemo & Kvemo Samgori | 325.00 | 315.00 | 68,400 | 1964 |
| 2 | Tbilisi | Tbilisi | Iori-Aragvi (zemo Samgori- | Zemo Samgori lower | 308.00 | 155.00 | 22,500 | 1954 |
| 3 | Algeti | Tetrickaro | Algeti | Tbisi-Kumisi, Marneuli | 65.00 | 60.00 | 14,500 | 1983 |
| 4 | Dilis Mtis | Dedoplisckaro | Iori | NA | 180.00 | 140.00 | | 1988 |
| 5 | Jandaris (lake) | Gardabani | Mtkvari (gardabnis canal) | NA | 54.28 | 25.03 | 8,000 | 1867 |
| 6 | Narekvavis | Dusheti | Narekvavi | Saguramo-Mukhrani | 6.80 | 5.60 | 1,600 | 1977 |
| 7 | Iakublos | Dmanisi | Dmanisi | Dmanisi-Gantiadi | 11.00 | 10.80 | 5,000 | 1980 |
| 8 | Pantianis | Dmanisi | Naziglichi | Mashaveras systems | 5.30 | 5.20 | 1,000 | 1963 |
| 9 | Nadarbazevis (lake) | Gori | Didi liakhvi (Tiriponi canal) | Tiriponi | 7.20 | 6.20 | 30,600 | 1966 |
| 10 | Asuretis | Tetrickaro | Asureti | NA | 0.91 | 0.91 | | 1974 |
| 11 | Borbalos | Tetrickaro | Algeti (Tb-kumisi canal) | Tbisi-Kumisi | 0.10 | 0.06 | 300 | |
| 12 | Marabdis | Tetrickaro | Algeti (Tb-kumisi canal) | Tbisi-Kumisi | 1.50 | 1.20 | 400 | |
| 13 | Kushisxevis | Dedoplisckaro | Iori | Ivrispira farmland | 5.00 | 4.00 | 2,020 | 1977 |
| 14 | Kranchiskhevis | Dedoplisckaro | Iori | Ivrispira farmland | 1.92 | 1.25 | 490 | 1984 |
| 15 | Trialas | Adigeni | Shavckala | farmland | 0.30 | 0.30 | 150 | 1977 |
| 16 | Zresis (lake) | Akhalkalaki | Murdiakheti | Murdiakheti canal | 4.00 | 3.20 | 1,600 | 1976 |
| **RESERVOIRS MANAGED BY OTHERS** | | | | | | | | |
| 17 | Telatcklis | Dedoplisckaro | Iori | | 1.30 | 1.20 | | 1978 |
| 18 | Mcarecklis | Dedoplisckaro | Iori | | 1.50 | 1.30 | | 1976 |
| 19 | Zilicha | Dedoplisckaro | Alazani | | 4.50 | 4.00 | | 1986 |
| 20 | Kudigora “Ilias lake” | Kvareli | Duruji | | 3.60 | 3.00 | 950 | 1971 |
| 21 | Chalis “Kvarlistba” | Kvareli | Chagurgula | | 1.50 | 1.00 | 850 | 1966 |
| 22 | Akhalsoplis | Kvareli | Avanikhevi | | 1.40 | 1.00 | | 1984 |
| 23 | Kusckaros | Kvareli | Kusckaro | | 0.60 | 0.40 | | 1985 |
| 24 | Devisckis | Sagarejo | Iori | | 3.70 | 3.20 | | |
| 25 | Vakis | Signagi | Iori | | 1.29 | 1.05 | | 1978 |
| 26 | Cheremis | Gurjaani | Pataraveti | | 1.20 | 1.06 | | 1981 |
| 27 | Ckisis chis (lake | Adigeni | Zazalo | | 1.53 | 1.45 | | 1966 |
| 28 | Mtisdziris | Dmanisi | Mamutli | | 3.07 | 2.95 | | 1983 |
| 29 | Khorkhoras | Dmanisi | Khevebi | | 0.40 | 0.35 | | |
| 30 | Lipi | Tetrickaro | Aslaniscka li | | 1.77 | 1.53 | | 1988 |
| 31 | Kukhis | Khoni | Kukhisckali | | 1.90 | 1.85 | | |
| 32 | Kumisis Lake | Gardabani | Algeti (Tbisi-Kumisi canal) | | 11.00 | 7.67 | | |
| 33 | Zonkaris | Ckhinvali | Patara Liakhvi | Vanatis canal | 40.30 | 39.00 | 21,000 | 1981 |
| 34 | Khetaguris | Ckhinvali | Didi liakhvi (Kekhvi canal) | | 0.50 | 0.50 | | 1967 |
| | **Total capacity (M m³)** | | | | **1,057.37** | **806.26** | | |
| | **Total capacity of reservoirs managed by GA (M m³)** | | | | **976.31** | **733.75** | | |
| | **Total capacity of GA reservoirs currently in service (M m³)** | | | | **768.58** | **571.03** | | |
| | **Current GA operational reservoir capacity relative to total capacity** | | | | **73%** | **71%** | | |

Note: Reservoirs highlighted are currently operational and managed by Georgian Amelioration

In Eastern Georgia, the majority of river flow occurs in response to snow melt, with high flows occurring in April and May and low flow periods in July and August. The irrigation period for most crops is between May and September, and hence peak water demands coincide with these low flow periods. Thus while the overall picture of water availability in the country is good, serious constraints are likely to emerge late in the growing season as ongoing rehabilitation continues to increase the area under irrigation, leading to increased water demand during those minimum flow months. Reductions in mountain snow storage and earlier melting in response to the changing global climate will exacerbate pressure on available water resources.

Existing east Georgian reservoirs have the capacity to store only around 4 percent of the annual flow of its rivers, By contrast, the Colorado River Basin in the United States, also a snow-fed river system, has storage capacity for about four times the annual flow of the river. As the rehabilitation program proceeds, it will be necessary to address the need for additional storage on important east Georgian rivers. The Alazani River is a case in point, where a proposed new reservoir would stabilize water supplies for two large irrigation schemes in the Alazani valley and help to offset negative changes in precipitation and snow melt patterns driven by the changing climate.

## Environmental flows

There are no pre-set rules in Georgia for the maintenance of environmental flows in rivers. Environmental and sanitary flows are taken to be 10% of annual average river flow. This value is based on a practice inherited from the Soviet era. At this time, the general concept of environmental flows is under review by MENRP.

## Cross-border considerations

The Republic of Georgia shares rivers with Russia, Turkey, Azerbaijan, and Armenia. According to the European Water Initiative, Georgia is not a signatory to major strategic documents that regulate and protect transboundary rivers and lakes[10]. Of the five countries, only Azerbaijan and Russia have joined and ratified the UNECE *Convention on the Protection and Use of Transboundary Waters and Lakes*. Current bilateral treaties and agreements between Georgia and its riparian neighbors include the following[11].

- A treaty between the Soviet Union (now Russia) and Turkey in 1927 regulating the Araks, Korokh (Chorokhi) and Kura Rivers
- An agreement between Turkey and Georgia on the environmental protection of the Chorokhi/Korokh River
- A protocol between Turkey and Georgia on studying the environmental impact of hydropower development on the Chorokhi/Korokh River
- A MOU with Azerbaijan on monitoring water quantity and quality in the Kura River
- An agreement with Azerbaijan on conservation and regulation of transboundary ecosystems

[10] European Water Initiative, 2011, "National Political Dialogue on Integrated Management of Water Resources in Georgia". http://www.euwi.net/files/euwi/715_tmpphpnnb3k9.doc accessed 7 May 2015.

[11] The continuing validity of these agreements is subject to confirmation.

- An agreement between Azerbaijan and Georgia providing that Jandaris reservoir receives from Georgia annually 70 M $m^3$ of water (average 2.22 $m^3$/sec)
- An agreement between Georgia and Armenian that states that both parties "will make efforts for establishment of connections between national systems on environmental monitoring and corresponding databases"

In addition, the recent signing of an association agreement between Georgia and the EU will lead gradually to harmonization of Georgian rules and practices with respect to water resource management and those of the EU.

## *Groundwater*[12]

Groundwater is extensive and comprises an important but grossly underutilized resource for irrigation. Groundwater is widely available and, although it usually requires pumping, it is clean and generally suitable for use in modern pressurized irrigation systems without filtration.

During the 1970s and 1980s, the Department of Amelioration System Management (DASM) drilled some 816 large-diameter wells throughout the country principally to supply factories and municipalities, though there were minor irrigation uses. These wells were generally 20 to 30 cm in diameter and up to 300 meters deep. Most tapped confined aquifers and were either artesian or sub-artesian, meaning that they were either free-flowing or that the water rose in the well casing to within 50 to 100 meters of the surface. Discharges varied from 10 to 100 liters/second. Tables 2 and 3 show the regional distribution, average depth, and average yield of a sample of these wells, based on data from the DASM groundwater service. Well flows in three regions – the Alazani River basin, Mukhrani in the center, and Abasha in West Georgia are often artesian.

In addition to these deeper confined aquifers, shallow water table aquifers exist in some regions adjacent to streams and rivers. Both types of aquifers constitute resources which can be considered for irrigation use under certain conditions.

[12] Mark Svendsen. 2005. Developing and Managing Water for Agriculture in Georgia. Report to the Agricultural Policy Advisory Unit (APAU) of the AgVantage Project, supported by USAID.

**Table 4.3. West Georgia well profiles**

| Region | District | Number of wells | Avg. Depth [meters] | Avg. Capacity [ltrs/sec] | Potential irrigated area/well [ha] |
|---|---|---|---|---|---|
| Imereti | Samtredia | 8 | 50 | 16.1 | 16 |
| Samegrelo | Abasha | 17 | 164 | 16.5 | 16 |
| Samegrelo | Senaki | 5 | 158 | 15.5 | 15 |
| Samegrelo | Khobi | 9 | 152 | 14.9 | 14 |
| Samegrelo | Zugdidi | 8 | 90 | 13.8 | 13 |
| Guria | Lanchkhuti | 16 | 196 | 21.5 | 21 |
| Samegrelo | Tsalenjikha | 2 | 50 | 40.0 | 39 |
| Adjara | Khobuleti | 3 | 140 | 25.9 | 25 |
| Adjara | Khelvachauri | 5 | 54 | 27.2 | 26 |
| Imereti | Tskhaltubo | 14 | 50 | 38.1 | 37 |
| Imereti | Terjola | 1 | 50 | 12.0 | 12 |

Note: Potential irrigated area calculation assumes four 100mm waterings per 90 day season and 50% utilization.

**Table 4.4. East Georgia well profiles**

| Region | District | Number of wells | Depth [meters] | Avg. Depth [meters] | Avg. Capacity [ltrs/sec] | Potential irrigated area/well [ha] |
|---|---|---|---|---|---|---|
| Khartli | Khashuri | 1 | 40 | 40 | 10 | 10 |
| Khartli | Khareli | 1 | 40 | 40 | 30 | 29 |
| Khartli | Gori | 60 | 4650 | 78 | 34 | 33 |
| Khartli | Mtskheta | 25 | 2850 | 114 | 24 | 23 |
| Khartli | Marneuli | 4 | 200 | 50 | 11 | 10 |
| Khartli | Gardabani | 3 | 150 | 50 | 14 | 14 |
| Khakheti | Sagarejo | 24 | 2915 | 121 | 21 | 20 |
| Khakheti | Gurjaani | 16 | 2320 | 145 | 21 | 21 |
| Khakheti | Signagi | 14 | 1650 | 118 | 24 | 23 |
| Khakheti | Akhmeta | 9 | 1000 | 111 | 10 | 10 |
| Khakheti | Telavi | 25 | 4140 | 166 | 31 | 31 |
| Khakheti | Lagodekhi | 25 | 4450 | 178 | 25 | 25 |
| Khakheti | Dedoplistskharo | 4 | 900 | 225 | 13 | 13 |

Note: Potential irrigated area calculation assumes four 100mm waterings per 90 day season and 50% utilization.

Thus each well of this type has the rough potential to irrigate about 10 to 25 hectares in West Georgia and 15 to 30 hectares in East Georgia using traditional application methods under this conservative set of assumptions. If the wells are coupled with drip irrigation equipment, the area served would be at least double those shown. Alternatively, using drip equipment, a smaller 100 mm well could be drilled, with a correspondingly lower flow rate and cost to irrigate a similar area.

## *Inter-sectoral competition for water*

There are several areas of concern related to potential conflicts over water use. One is the development of additional hydropower plants (HPPs) on Georgian rivers. In addition to 29

operational projects, there are over 40 additional plants being planned with estimated installed capacities of 5 to 175 megawatts. Conflicts with HPPs occur during the irrigation season when large-scale power production is taking place, often for export; rivers are at low flow; and irrigation demands are high. This problem is particularly acute when water used for power production is diverted outside the basin and hence unavailable for downstream irrigation. In some cases small HPPs located in irrigation canals also divert water away from the main irrigation channel.

Another current conflict is between irrigation and drinking water supplies. Even though about 60% of drinking water in Georgia comes from groundwater, Tbilisi, as well as districts including Bolnisi, Dmanisi, Marneuli and Tsalka, depend on surface water for their potable supply. Tbilisi obtains a large portion of its potable water from the Tbilisi Reservoir (Sea) which receives approximately 45 MCM/year from the Iori River and 40 MCM/year from the Aragvi River. About 85% is withdrawn for potable water and the remaining 15% used for irrigation[13]. Projected water demand for irrigation from the Iori River by the end of scheme renovation could be as high as 53 MCM. Required environmental flows and reductions in river discharge due to the changing climate will further tighten the supply/demand picture. During droughts priority goes to drinking water, and farmers downstream may receive less water. A similar situation occurs for the districts of Bolnisi, Dmanisi, Marneuli and Tsalka which withdraw potable water from the Kharma River. This river also supplies local irrigation systems and its flow results mainly in response to snow melt, leaving limited water in the river during late summer months for both irrigation and potable supplies.

Another area of concern relates to possible conflicts among different irrigation schemes along the same river. The Tedzami River is one example, on which nine irrigation canals are operational. The river has high flows in spring and very limited water flow in summer and autumn. Renovation of schemes within this watershed could increase monthly irrigation demand to as much as 3 MCM during the months of July and August when average monthly flows are on the order of 2.5 to 3.5 MCM. Given the tenuous balance between supply and demand during these months, periodic water shortages are likely.

## *Water quality considerations*

A number of studies on water quality have been carried out. The National Environmental Agency is responsible for water quality monitoring of surface waters. Before the 1990s, monitoring was carried out at 91 points. Currently, samples are collected at 41 sites on 22 rivers and 4 lakes on a monthly basis and monitored for 31 parameters. In general, water quality is quite good and does not present a salinity hazard to crops under irrigation. However, studies indicate that urban runoff, point source industrial wastewater discharges, and non-point source agriculture runoff are potential threats to water quality. Site-specific studies are needed to verify and quantify threats in affected areas.

## *Climate change*

Numerous studies have been carried out on the implication of climate change for Georgia. Each of these studies indicates that temperatures will continue to rise, however, there is considerable

[13] USAID, 2015, Water Sector Initial Assessment Report Governing For Growth (G4G) In Georgia Contract Number: AID-114-C-14-00007, 28 January 2015.

variation in estimated precipitation and runoff patterns throughout the country. These variations are largely due to the particular scenario chosen and the Global Circulation Model (GCM) used. In general, for mountain-fed rivers, it is anticipated that as temperature rises, snow melt will come faster, decreasing the amount of water available in rivers during the latter part of the irrigation period when it is needed most. In Eastern Georgia, average annual flow rates in rivers are anticipated to decrease by 12 to 14% over the next 25 years.

# 5. Irrigation

Actually irrigated area in Georgia in 2014 dwindled to one-tenth of the 400,000 hectares irrigated during the Soviet period. Rehabilitation investment is expected to restore irrigation capacity to 200,000 hectares by 2025, increasing water demand from the current level of around 150 MCM to around 900 MCM per year if this capacity is fully utilized. Limited storage may cause shortages in the latter parts of the growing season when demand is high and river flows are at their minimums.

Georgia currently lacks a legal framework for irrigation. GA attempts to operate irrigation delivery systems from the headworks to the farm, however the challenge of interacting directly with 50,000 farmers is nearly overwhelming. In many systems, deteriorated system facilities limit water management options to basic on/off control and some crude adjustment of operating levels in canals.

## *Historical extent*

Almost all existing Georgian irrigation schemes were constructed between 1950 and 1970 and were generally designed to serve large state and collective farms. Designs were done by scientific-research institutes based on historic surface water availability, geology, hydrogeology, soil cover, and climatic factors, together with estimated water demands by the crops specified in the five-year plans prepared by the Soviet Ministry of Agriculture.

Major investments made during this period resulted in about 500,000 ha being equipped for irrigation[14]. In the early 1980s, 72 percent (357,000 ha) of this area was gravity-fed, while the remaining 28 percent (143,000 ha) was designed to be served by pumps (FAO, 2008). Schemes comprised engineered systems with head works, weirs, siphons, tunnels, pump stations, and concrete-lined primary canals, as well as non-engineered systems having either partially-lined or unlined canals. Most schemes were located in the more arid eastern part of the country.

During the 1990s, civil strife, war, vandalism and theft, as well as a drastic reduction in financial support and problems associated with land reform, the transition to a market economy, and the loss of markets contributed to a huge reduction in irrigated area (see Figure 5.1). During a severe drought in 2000, only about 160,000 ha were irrigated. As of 2015, approximately 43,000 hectares in Eastern Georgia were irrigated, with the majority of these systems located in Kvemo Kartli (Figure 5.2).

[14] Note that being equipped for irrigation is not the same as actually being irrigated. Actual area irrigated figures are lower. Also note that during the Soviet period, figures were often inflated.

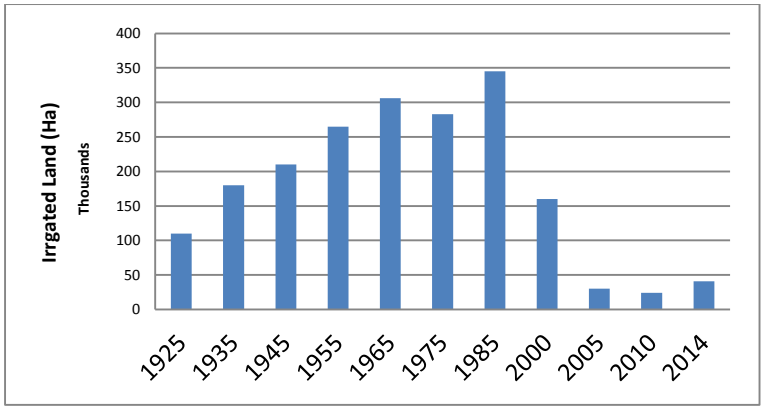



**Figure 5.1. Irrigated area in eastern Georgia**

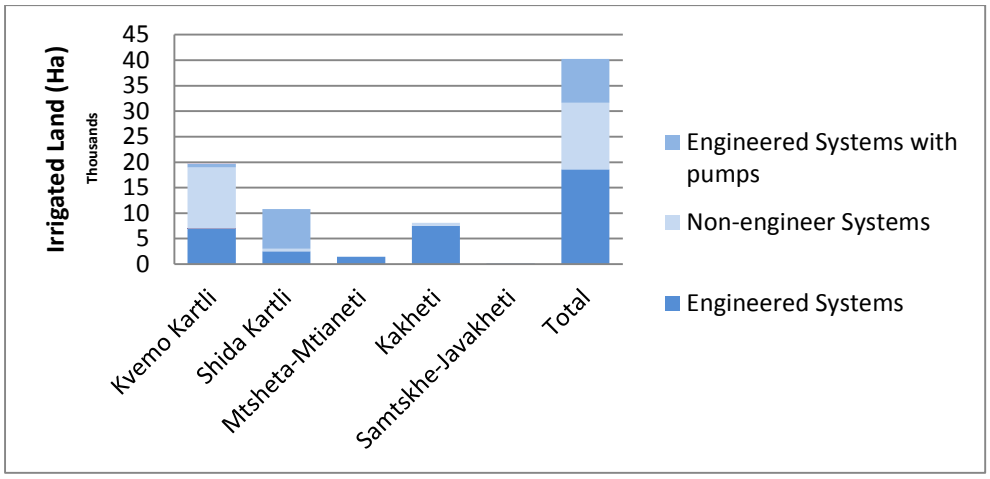



**Figure 5.2. Actual irrigated area, 2014, by district and type of scheme**

## *Future irrigation water demand*

Future irrigation water demand depends fundamentally on the water requirements of the crops grown. Crop water requirements also vary from region to region and with climatic factors such as evapotranspiration and precipitation. In addition water requirements depend on the efficiency with which irrigation water is delivered at the main system, local, and on-farm levels. Little data on this last critical factor is available. However, one study has found that loses in primary, secondary, and tertiary canals comprise around 50% of incoming flow (Jacobs UK, 2007).

A small but growing number of farmers are installing drip irrigation systems in orchards and vineyards and on fields of fruits and vegetables. As these scattered drip installations demonstrate their benefits of increased yields and improved product quality to surrounding farmers, the area under drip will grow. There are at least three vendors for drip equipment operating in the country as present, and systems manufactured in China, Turkey, and Israel are available.

MoA is implementing a program called “Plant the Future” (GEL 15 M for 2015-2017) which is financing the creation of new perennial orchards and nursery gardens. Up to 70 percent of sapling and 50 percent of drip system costs are being provided by the Ministry. The program envisages the creation of 1,000 to 1,200 ha of new perennial orchards, most or all of which would be drip irrigated.

A preliminary estimate of the expansion in use of drip irrigation technology is presented in Table 5.1, suggesting that drip irrigation coverage will reach around 10% of total irrigated area by 2025. Initially, it expected that most of the systems purchased will be the less expensive Chinese ones. However with time, and as experience is gained, purchases are expected to shift to higher quality systems from Turkey and Israel.

**Table 5.1. Estimated extent of drip irrigation, 2015-25**

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total irrigated area** | 41,357 | 41,357 | 41,357 | 66,300 | 90,000 | 120,000 | 150,000 | 170,000 | 185,000 | 195,000 | 200,000 |
| **Drip irrigated area** | 2,700 | 3,800 | 4,300 | 5,300 | 6,300 | 7,800 | 9,300 | 11,300 | 13,800 | 16,800 | 20,300 |
| **Share** | 7% | 9% | 10% | 8% | 7% | 7% | 6% | 7% | 7% | 9% | 10% |

This expansion in drip-irrigated area will have important implications for irrigation system managers. The first will be a reduction in the use of water on drip-irrigated farms. This should make more water available for use elsewhere in the system or in other systems sharing the same water source.

The second will be a need for more or less continuous flow in the ditches serving the farm. While drip irrigation needs smaller amounts of water overall, it requires that water be available for application on a daily basis. It cannot tolerate long periods between water supply events and may necessitate the construction of small farm ponds for local storage where canal water supplies are intermittent. Rural electrification is also critical for the spread of modern pressurized water application methods. Costs of solar powered pumping have been falling rapidly as well, and represent an opportunity for farmers, even those in areas without electricity, to install these systems.

Third, there may be a demand for improved water quality, since filtration costs borne by the farmer are directly related to the amount of sediment suspended in the water supplied. The expansion of modern irrigation methods and its implications for the main and local-level system management need to be taken into account when designing for rehabilitation and modernization.

Using the widely-accepted FAO CropWat program, expected crop water requirements for Eastern Georgia were forecasted through the 2025 and are presented in Figure 5.3. Calculations are based on field losses of 30% and initial system losses of 50%, which would fall to 35% for conventional irrigation and to 25% with drip irrigation following rehabilitation. As shown in this graph, irrigation scheme water requirements decrease slightly between 2015 and 2017 mainly because of an anticipated reduction in system losses due to canal system improvements.

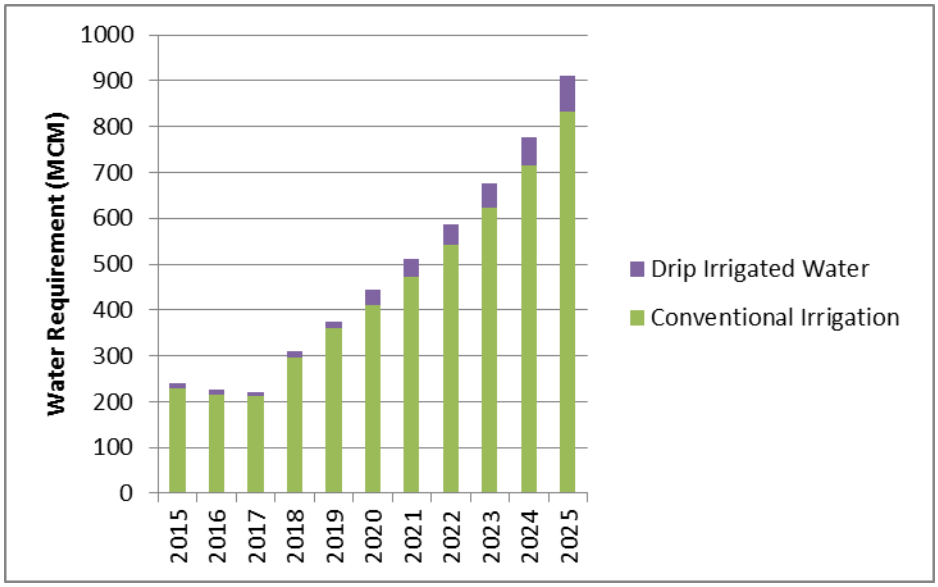



**Figure 5.3. Irrigation water requirements through the year 2025**

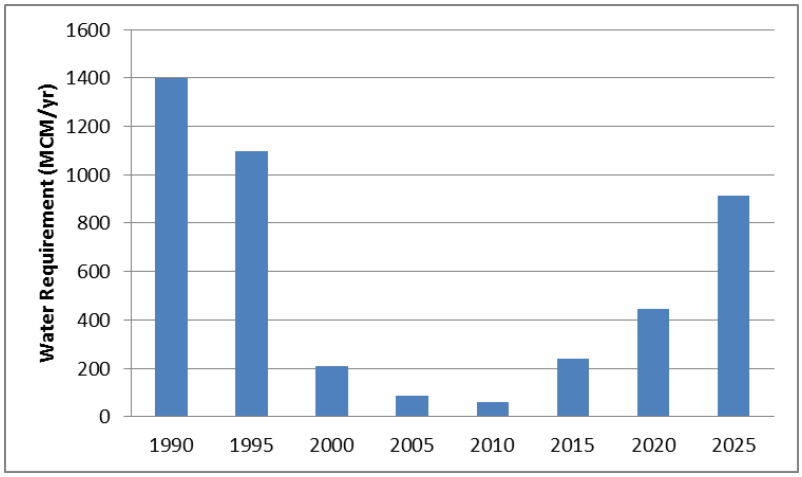
Table 5.2 shows the estimated water demand through the year 2025 broken out by different regions.

**Table 5.2. Existing and projected irrigation water requirements**

| | Kakheti | Shida Kartli | Kvemo Kartli | Mtskheta-Mtianeti | Samtskhe-Javakheti | Total |
|---|---|---|---|---|---|---|
| **2015** | | | | | | |
| Area (ha) | 8078 | 11379 | 20261 | 1502 | 137 | **41357** |
| Crop Water Requirement (MCM/yr) | 27.93 | 23.91 | 64.05 | 4.12 | 0.39 | **120.4** |
| Gravity and pump Water Requirement (MCM/yr) | 53.1 | 45.4 | 121.7 | 7.8 | 0.7 | **228.8** |
| Drip Irrigated Water Requirement (MCM/yr) | 2.5 | 2.2 | 5.8 | 0.4 | 0.04 | **10.9** |
| Total Water Requirement (MCM/yr) | **55.6** | **47.6** | **127.5** | **8.2** | **0.8** | **239.7** |
| **2020** | | | | | | |
| Area (ha) | 28721 | 26444 | 35113 | 4138 | 5584 | **100000** |
| Crop Water Requirement (MCM/yr) | 99.3 | 55.6 | 111.0 | 11.3 | 15.7 | **293.0** |
| Gravity and pump Water Requirement (MCM/yr) | 139.0 | 77.8 | 155.4 | 15.9 | 22.0 | **410.2** |
| Drip Irrigated Water Requirement (MCM/yr) | 11.9 | 6.7 | 13.3 | 1.4 | 1.9 | **35.2** |
| Total Water Requirement (MCM/yr) | **150.9** | **84.5** | **168.7** | **17.2** | **23.9** | **445.3** |
| **2025** | | | | | | |
| Area (ha) | 57442 | 52889 | 70225 | 8276 | 11168 | **200000** |
| Crop Water Requirement (MCM/yr) | 201.6 | 114.1 | 225.0 | 25.7 | 34.5 | **600.9** |
| Gravity and pump Water Requirement (MCM/yr) | 279.2 | 158.0 | 311.5 | 35.6 | 47.8 | **832.1** |
| Drip Irrigated Water Requirement (MCM/yr) | 26.9 | 15.2 | 30.0 | 3.4 | 4.6 | **80.1** |
| Total Water Requirement (MCM/yr) | **306.0** | **173.2** | **341.6** | **39.0** | **52.4** | **912.2** |

Historic and projected irrigation water requirements for all of Eastern Georgia are rolled up in Figure 5.4.

**Figure 5.4. Historic and projected irrigation water usage through 2025**




Note that the total projected water demand in 2025 is still substantially lower than 1990 use, implying that water availability is not constraining. However a number of factors could invalidate this assumption. First, while overall water availability may be adequate, supply in a particular river might not be able to accommodate a planned rehabilitation. Secondly, water availability during months with the highest water stress could be constraining. Finally, as average temperatures rise and carbon-driven climate change affects precipitation patterns, particularly mountain snowpack storage of winter precipitation, flows may differ significantly from long-term historical averages. These factors make it essential that planned rehabilitation projects be screened for water adequacy before proceeding.

Approximately, 50 rivers supply water for irrigation throughout the country. With the completion of proposed irrigation scheme rehabilitations in Eastern Georgia, water for irrigation scheme will be mainly distributed among rivers in the Mktavari, Iori, Khrami, Aragvi, Algeti and Alazani watersheds (Figure 5.5).

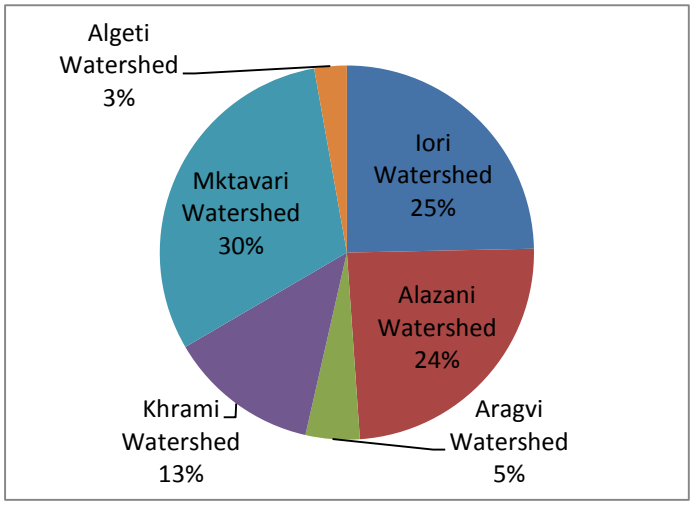



**Figure 5.5. Post-rehabilitation shares of irrigation water requirement, by watershed**

At present little or no monitoring of actual river discharges is undertaken by the hydromet service of NEA. Moreover data from the hydromet service is available only for sale and at prohibitively high prices. As a result, reliance is generally placed on Soviet-era data which is 20 and more years old. This is clearly an inadequate basis for planning current water resource

development and rehabilitation, and a concerted effort to restore and upgrade the national river discharge monitoring system and to rationalize its accessibility is urgently required.

## *Legal framework for irrigation*

### Duties and practices

The abrogation on 17 December 2010 of the *Law on Amelioration of Georgia* (the *Amelioration Law*), means that Georgia currently has no legislation in place governing the amelioration sector. It follows that a number of important issues contained in the *Amelioration Law* (such as the financing of the sector; the setting of tariffs for irrigation and drainage services; the competences of state bodies with regard to the sector; the establishment and functioning of farmer-managed "Amelioration Associations"; the use of water, amelioration infrastructure, and related land; the preparation of a cadastre of reclaimed land; and the certification, inventorying and monitoring of amelioration infrastructure) are no longer explicitly addressed in Georgian legislation.

Instead, the sector is subject only to laws of general application. For example the current *Water Law of 1997*, as amended, contains a number of references to irrigation and the use of water for agriculture purposes. Article 53 recognises the use of water for agriculture purposes as a type of "special water use" and sets out a number of general conditions for such uses. However the existing law contains no provisions of any kind relating to the permitting of water abstractions from surface waters or ground water, or for payment for the use of water resources. Although provisions for water permitting existed earlier, these provisions were removed from the law in March 2013 by parliamentary action.

### Amelioration infrastructure

The use and ownership of amelioration infrastructure is presently addressed only within the overall framework of land legislation. The current situation is that the former main system, or "inter-farm", networks, built in Soviet times with public money and operated by the Ministry of Amelioration and Water Economy of Georgian SSR, and then after independence by the Department of Amelioration and Water Economy and its successors, are now owned by GA. The situation is complicated, however, by the lack of a complete inventory, though such an inventory is now underway.

As regards the former "intra-farm" or "on-farm" (local level) networks, the situation is less clear. Following the abolition of the Amelioration Associations (AAs) in 2010, these networks were notionally transferred to the balance of the Ministry of Economy (MoE). However the legal basis for this is not entirely clear. In the case of the on-farm systems of the former *sovkhoz* (state farms) these, like the *sovkhoz* themselves, were in state ownership and thus could logically remain in state ownership during the land reform period. In the case of on-farm systems built by the former *kolkhoz* (collective farms), however, these and other kolkhoz assets were never in state ownership but rather in the collective ownership of their members. It is therefore not entirely clear how they can have ended up in state ownership. Leaving aside the legal theory, more complicated still would be any attempt to try and track down the precise legal status of individual on-farm systems. According to the National Agency for Public Registry, a number of such systems are registered as being under state ownership (variously as owned by municipalities, GA and MoE.

Until 2016, there was a troublesome issue of property tax liability associated with irrigation infrastructure ownership. In 2016, however, parliament wrote a permanent exemption for irrigation infrastructure into the tax code, similar to the exemption held by the electricity sector for its infrastructure.

## *Water Management*

### The management challenge

Three fundamental challenges confront the provision of irrigation service. These are (1) to operate facilities and deliver water to irrigators, (2) to maintain facilities in good working order, and (3) to generate sufficient income to support the first two sets of activities.

Large surface irrigation systems the world over have a dendritic structure that begins with large facilities – dams, diversion structures, large canals – and branches into an ever finer network of channels delivering water to individual farms and fields. Typically the management structure of these systems also consists of three parts that corresponds to the different levels of the system. The first part is the major infrastructure, the main system, which requires specialized technical skills and equipment to operate and maintain. The third and final part is comprised of the facilities that are truly on-farm and under the control of individual cultivators[15]. The second part, the middle or local level system, is more complicated and assumes a variety of forms.

In earlier decades the world over, large irrigation systems developed by a national agency were typically controlled by the state irrigation agency from top to bottom, at least on paper. In practice, it was often informal community-based groups or institutions that mediated the delivery of water between the state agency and individual farmers. Local institutions were better placed to understand farmers' needs and personal relationships, and were more effective and less expensive than an extension of the state bureaucracy in managing water down to the farm level. As systems matured, these local organizations often became more formalized and acquired a legal personality, able to sign contracts, hold bank accounts, and so on. The nature of these intermediate institutions is the pivotal factor in designing a system of management institutions for irrigation, in that the extent and mode of operation of the main system manager depends to a very large extent on the form, size, and mode of operation of the local level management organization.

### Main system water management

The Ministry of Agriculture has delegated responsibility for irrigation and drainage system management to Georgian Amelioration. Presently the great preponderance of main system infrastructure is badly deteriorated, and the volume of deferred maintenance is overwhelming[16]. Moreover, some deficiencies resulting from the lack of ongoing maintenance simply cannot be fixed through routine maintenance actions. Hence there is a need for systematic rehabilitation of most main system infrastructure to return it to a sound operating condition. This will provide a basis for a solid program of routine preventative maintenance in the future.

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[15] Unfortunately, the term "on-farm" is often used to refer to facilities that were within the boundaries of the former state and collective farms, an inappropriate usage in a de-collectivized world. Such facilities are herein termed "local level" facilities, while the term "on-farm" is reserved for facilities that are literally within the boundaries of a single farm and under the control of a single cultivator.

[16] Deficiencies are detailed in Annexes 2 and 3 of the Final Report of the GILMD MOM Advisor.

Deteriorated main system infrastructure also limits the options available for system operation to basic on/off control and crude adjustment of flow rates in larger canals. In addition the virtual absence of water measurement devices makes data-based management impossible, and the paucity of cross-regulators in major canals make precise deliveries to lateral canals difficult or impossible in any case. This results in canal operators diverting large volumes of water into canal systems and allowing unused tailwater to flow unused into drains to return to the river draining the basin. This is workable in the short-term because water in the source rivers is relatively abundant and most systems do not presently serve their full design command areas. However, as schemes are rehabilitated and full design areas are brought under irrigation command once again, more refined management practices will be essential if commanded areas are to be served with an adequate and reliable water supply.

## Local level water management[17]

Although GA presently attempts to provide irrigation service all the way from diversion structure to individual farm, this approach will not be workable or cost effective as irrigated area expands. Hence some form of locally-based organization will be needed to provide the interface between GA and individual farmers.

### Legal framework

The abrogation of the Amelioration Law eliminated the provisions providing the legal framework for establishing local water user organizations with legal personality (the ability to hold assets, open bank accounts, and take/defend legal proceedings among others). The only legal forms that could theoretically be used at present for farmer-based management of local level systems are agricultural cooperatives and some types of legal entities defined in the Law on Commerce. None of these forms are really suitable for the creation of farmer-managed local level institutions. Civil associations can be established on the basis of the Civil Code (there is no specific legislation for NGOs) but these are not considered to be suitable for undertaking any form of economic activity.

As regards the creation of arrangements without creating legal entities, the option of partnerships is problematic due to the issue of joint and several liability – the issue of holding the members of the informal group accountable for tariff payment. However, the provision of discounted water rates for such groups could help to offset this problem. The conclusion of group contracts between GA and a group of farmers is theoretically possible under the Civil Code and may work for relatively small groups of farmers who know and trust each other. However should disputes arise, some mechanism for resolving them would be needed.

Currently GA contracts with individuals for service, but the current draft of the contract is rather one-sided in favour of the Company, placing few obligations on it with respect to the quality of service it undertakes to provide. Where GA does continue to provide service directly to individual farmers, a simpler and more balanced contract needs to be developed in the interests of fairness and acceptability to farmers.

[17] The definition of "local level" is somewhat flexible, as canal levels and sizes and command areas vary from place to place. In general, a local level management unit would be served by a secondary canal or a set of tertiary canals and cover around 1,000 hectares. Its boundaries would be hydraulically-defined, with inflows to the unit being received at one or several well-defined points.

If legal entities are to be established for delivering water at the local level and maintaining local level systems, as appears necessary, no existing forms provide a reasonable legal basis for such entities. New legislation is required to provide such a legal basis and to define the powers, responsibilities, and governance arrangements for such entities.

### Management practices

Current local level water delivery involves scheduling based on demand from the farmer, relayed to a ditch-level "regulator" working for GA and then aggregated upward. Farmers judge crop water needs visually, and often try to delay irrigation to avoid having to pay irrigation service fees, relying instead on rainfall, until an extended drought makes irrigation unavoidable. In practice, there are often informal arrangements among farmers sharing a ditch for sharing irrigation turns among themselves. Generally, little maintenance is carried out at this level. At times, farmers may undertake ditch cleaning themselves, or they may request assistance for a particular repair or cleaning from GA.

## Farm-level water management

In-field irrigation practices are generally poor, employing low technology furrow and flood application methods, with poorly-formed furrows, uneven slopes and uncontrolled flow rates. Field crops are irrigated by furrow and tree crops by borders between the tree lines. Intercropping is often practiced between the tree lines, especially when the orchard plantings are young.

Some sprinkler irrigation systems are in place in Kakheti, drawing water from canals, and, in at least one case in Kvemo Kartli, from groundwater. Their use is not widespread however, as capital costs are high and small holdings do not lend themselves to large machines such as center pivots.

Drip irrigation is used for horticultural crops on a relatively small area at present, but is growing in popularity. Most farmers recognize its advantages in reducing water use, and, more importantly for them, raising yields and improving product quality. In the future, main system and local level water delivery schedules and practices will have to take the needs of drip-irrigating farmers for continuous access to water into account.

# *Irrigation-related organizations*

## Ministry of Agriculture

MOA plans and implements state policy in the agricultural sector, including the amelioration subsector, and, through its Department of Melioration and Land Management, oversees Georgian Amelioration Ltd on behalf of the Ministry of Economy, which holds 100% of the shares of GA. MOA is headed by a minister, assisted by five deputy ministers. GA is reviewed in the next chapter of the strategy.

### Melioration and Land Management Department

The MoA department most directly related to irrigation is the Melioration and Land Management Department. This department was originally established as the Melioration Department and later expanded to become the Department of Melioration and Land Management. This department is responsible for developing policy related to irrigation and agricultural land and monitoring its

implementation. It is also responsible for gathering and processing data related to its mandate, and is involved in budget development and rehabilitation project planning.

This department has been or is currently instrumental in a number of actions, including the following.

- Merging the four LTD irrigation companies and bringing them under MOA management.
- Seeking funding for the sector from the state budget and from foreign donors
- Commissioning G4G to undertake a study of irrigation tariffs
- Serving on rehabilitation project tender commissions

### The Department of Food and Agriculture

This Department develops programmes for the development of different fields and determines the priorities for the development of the agricultural sector.

### Agricultural Projects Management Agency

This agency provides vouchers to farmers for tractor hire, seeds, fertilizer and other inputs on a prepaid debit card. This mechanism could potentially be used for providing irrigation subsidies to farmers as well.

### Policy and Analysis Department

This department carries out policy research, analyzes investments, identifies and analyzes sector problems, and develops agricultural development policies, strategies and action plans. It is currently in a capacity-building phase.

### Donors Projects Management and Monitoring Division

The Donors Projects Management and Monitoring Division (DPMMD) serves as the Project Management Unit (PMU) for internationally-funded agricultural projects, including GILMD and the new IFAD Agriculture Modernization, Market Access and Resilience (AMMAR) project. It reports directly to the Minister of Agriculture.

## Other water-related organizations

### Ministry of Economy

The MoE holds the stock in GA on behalf of the Government of Georgia. Oversight responsibility for GA is delegated to the MoA.

### Ministry of Finance

The Ministry of Finance (MoF) develops annual budgets in conjunction with concerned ministries and provides funds to other government ministries, including the MoA.

### Ministry of Environment and Natural Resource Protection

This ministry (MENRP) is the parent ministry of the National Environmental Agency (NEA) and is responsible, through the NEA, for monitoring and protecting the quality of Georgian waters.

Under pending legislation, the MENRP will be responsible, for water resource allocation from January 2018 and collection of water resource fees, with effect from 2021.

### Department of Hydrometeorology

This department, a unit of the NEA, is responsible for collecting data on river discharges and meteorological conditions throughout the country. It is an extremely important potential source of data for the analysis of water resource availability during the rehabilitation screening process, but at present collects little real data on river discharges (see Section 5).

### Ministry of Regional Development and Infrastructure

This ministry (MRDI) houses the Municipal Development Fund (MDF) which manages development projects for a variety of different sectors. In the past it has managed the USAID-financed rehabilitation of the Saltvisi-Tirifoni Irrigation Scheme and may be taped to manage future irrigation rehabilitation projects.

### National Agency for Public Registry

The Public Registry maintains a national registry of land ownership. At present only a small fraction of the land within the boundaries of irrigation systems is registered. Completion of the land registration process is important to GA to facilitate development of contracts for irrigation water and for assessing and collecting irrigation tariffs. The Registry is housed in the Ministry of Justice.

### Georgia National Energy and Water Supply Regulatory Commission

This commission reviews and approves tariffs charged by electricity supply and municipal water supply companies. It is widely regarding as having authority over irrigation tariffs as well, but there appears to be no basis in law for this perception. In practice, the commission approved an initial set of irrigation rates in 2011, but has not acted since with respect to the irrigation tariff.

# 6. Georgian Amelioration

Irrigation management has operated under a variety of organizational forms since 1990. Main system management was privatized into four so-called LTDs in the mid-2000s – under-resourced and inexperienced government-owned corporations that subsequently failed. The LTDs were subsequently merged into a single state-owned company, GA, which today operates all public irrigation facilities in the country.

At the local level, large state and collective farms which distributed water during the Soviet period were replaced with a succession of different local level organizations in the ensuing 20 years. The last and most promising of these, the Amelioration Associations, were established in the early 00s but disbanded in an ideologically-driven push to privatize public services later in that decade.

In late 2012, a new Government selected amelioration as one of its top priorities and then launched reforms which are on-going. Current operating income, excluding government subsidies, constitutes just 13% of expenditures, and the ultimate success of the reforms will depend on the successful reform of the tariff system, cost control and higher operational efficiency, and establishment of viable local level management entities.

## *Background*

The structure of irrigation and drainage management has evolved considerably since the Soviet period. Important changes are summarized in Table 6.1.

**Table 6.1. Evolution of the organizational structure of the I&D sector**

| Level | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1991 | 2005 | | | | 2007 | 2010 | 2012 | 2015 |
| **Main System** | MAWE | DAWE | DASM | | | | 4 LTDs | | UASCG | GA |
| **Local System** | SF/CFs | DAWE | ASCs | → | VCs | → | AAs | → 4 LTDs | UASCG | GA |

Notes:
AA = Amelioration Association (WUA)
ASC = Amelioration Service Cooperative
DASM = Department of Amelioration and Scheme Management (MoA)
DAWE = Department of Amelioration and Water Economy (MoA)
GA = Georgian Amelioration
LTD = one of 4 state-owned limited liability companies established to manage irrigation and drainage
MAWE = Ministry of Amelioration and Water Economy
SF/CF = state farm/collective farm
UASCG = United Amelioration Service Company of Georgia
VC = Village Council

At the end of the Soviet period, a Ministry of Amelioration and Water Economy (MAWE) operated main systems and delivered water to large state and collective farms which distributed water internally. With independence, the MAWE was transformed into a department under the MoA (DAWE) with responsibility for both main system management and, following the dissolution of the state and collective farms and the redistribution of land to individual landholders, local level water distribution as well.

The DAWE was retitled the Department of Amelioration Schemes Management (DASM) in 2005 and then abolished in 2006. In that year, four regional limited liability companies were established to replace it and provide main system management services in their respective regions. The idea of autonomous self-financing regional companies proved unworkable, and the four were merged in 2012 into the United Amelioration Services Company of Georgia (UASCG).

Despite the nominal assumption of responsibility for top to bottom system management by MAWE and its successors, in practice a wide gap in the irrigation water management set-up emerged between irrigation main systems and individual farms with the dismantling of state and collective farms after 1991. To fill that gap, a series of local level organizations were introduced and subsequently abandoned. Initially the government established around 200 Amelioration Service Cooperatives (ASCs) over a command area of some 200,000 ha. The ASCs were made responsible for MOM within the boundaries of the old state and collective farms and were supplied with water under contracts with DAWE. However most ASCs failed to function as there was little support and no training given to these new entities. Membership charges were high, there was little participation and transparency, and service delivery was poor. As a result, few farmers agreed to join the enterprises.

As ASCs failed, the government transferred local level management responsibility to Village Councils (VCs). However the VCs had neither the expertise nor the financial resources to manage and maintain the systems.

Subsequently, beginning around 2001, the government began establishing a set of Amelioration Associations (AAs) across the area formerly managed by the ASCs. A total of 259 AAs were registered to manage on-farm irrigation on 237,000 hectares. The World Bank-supported Irrigation and Drainage Community Development Project[18] (IDCDP), rehabilitated irrigation systems serving an area of 16,573 ha, while assisting the 22 AAs located within these schemes.

In 2006, a new government abolished DASM and, at the same time, withdrew support for the continuing development of the AAs. Initially, the newly-appointed Minister of Agriculture instructed the IDCDP project to close down all AA activities. However, following objections from the World Bank, the project was allowed to continue working with 46 of the 206 existing AAs, while support to all other AAs was halted. At the same time, the AA support team was cut from 16 persons to 7 and the remaining staff were given the additional task of supervising on-farm construction works. This made it virtually impossible for the AA Support Unit to perform its original role of AA institutional development, support and capacity building[19].

Although the fallout from the government's abrupt policy shift was primarily responsible for the collapse of the AA program, a number of other factors also contributed.

- The small size of the AAs – the average size of irrigation AAs was around 700 ha and some were less than 300 ha – and many were thus unable to achieve the economies of scale needed to operate cost effectively
- The generally poor condition of water delivery infrastructure and the inexperience of the new main system operators (the LTDs)
- A predominant public policy focus on expanding irrigated area without corresponding emphasis on effective operation and maintenance of the rehabilitated schemes
- A sharp increase in the irrigation tariff, implemented before irrigation infrastructure was improved and without consulting farmers through the AAs

[18] This US$ 43.7 M project operated from 2001 to 2009 and supported both infrastructure rehabilitation and capacity development for local level water management.

[19] Sam H. Johnson III, June 2014. Challenges and Opportunities for Irrigation Management Transfer in Southern Ukraine, IMT in Georgia

- Excessive debt and an inability to collect irrigation tariffs owed to it
- The general antipathy on the part of the government to the concept of participatory irrigation and drainage management, the project's fundamental underlying principle
- The *de facto* acceptance by the World Bank of the evisceration of the AA component of the IDCDP
- The limitations inherent in the five short articles inserted into the existing Amelioration Law to provide a legal basis for the AAs
- Low levels of irrigation utilization in commanded areas, resulting in inefficient local level system operation

The remaining AAs were formally dissolved in 2010 and the enabling law, *On Land Amelioration* was repealed on 17 December 2010.

## *Legal basis*

The United Amelioration Systems Company of Georgia (Georgian Amelioration) was formed in 2012 by merging four regional Amelioration Services Companies (the four LTDs) which had been created six years earlier but proved to be ineffective and unviable. At the same time, responsibility for management of the company, then known as UASCG, was shifted from the Ministry of Economy to the Ministry of Agriculture. Georgian Amelioration (GA) is a limited liability company established pursuant to the *Law on Entrepreneurs of 1994* as amended. Its shares are 100% state-owned and held by the National Agency for State Property Management, a division of the Ministry of the Economy. It reports to the Minister of Agriculture. It owns all main system irrigation-related infrastructure and provides irrigation and drainage services to contracting farmers within the command areas of its systems.

Subject only to the fact that it is publicly-owned and to a number of particularities described below, GA is essentially free to operate like any other limited liability company in seeking to make a commercial return on its assets, with no specific regulatory constraints on its operations.

Indeed the only formal constraints on the activities of GA are those contained in the "scope" clause of its charter[20], as follows.

> *a) plan the activities and define the development prospects of [GA] in the service area (the design command area of irrigation schemes in one or several municipalities) taking into account the water users' demands regarding water use and amelioration services*
>
> *b) provide amelioration services (water supply, excess water drainage) to physical and legal persons through the amelioration infrastructure*
>
> *c) carry out the activities on the amelioration schemes as required by the established procedures*
>
> *d) provide training and improvement of the qualification for the staff member; ensure their participation in conferences, seminars and other events*
>
> *e) contract with legal and physical persons; carry out activities, provide water supply and excess water drainage services*

[20] Charter of GA, dated 2 October 2015.

Thus, as is typically of the charters of private companies, GA is entitled to engage in a broad range of activities, within the field of water supply and amelioration services, with the overall legal objective of making a profit.

Although GA is clearly set up as a commercial company, its governance structure is similar to that of a government department. In accordance with Article 5 of its charter, the governing bodies of the Company are (a) the general meeting of the partners (shareholders) and (b) the Director General who is appointed by the Ministry of Agriculture under authority delegated to it by the Ministry of Economy. There is neither a formal board of directors nor a supervisory board[21].

The particularities of GA mentioned above are as follows. First, GA is not able to charge for drainage services, even though it owns the drainage networks and is responsible for pumping costs, because there is no legal basis for enforcing the payment of drainage charges.

Second, GA has not considered itself free to set its own tariffs for irrigation water supply. Instead it has deferred to the Georgian National Energy and Water Supply Regulatory Commission[22] to establish these rates. The legal basis for this belief is questionable, however, in that setting tariffs for irrigation and drainage services is not within the formal mandate of that body. In practice, the commission has simply maintained the tariffs previously set by the MoA and there has been no change in tariffs since the establishment of GA in 2012.

## *Ongoing Reforms*

In late 2012, new Government of Georgia selected amelioration as one of its top priorities and leadership in both the Ministry of Agriculture and GA launched corporate reforms efforts which are on-going. Key features of the reforms include the following.

- Regional decentralization and empowerment
- Explication of all roles and functions within the Company
- Introduction of a new financial management system, the Enterprise Resource Planning system (ERP), consolidating information on many aspects of company operations
- Contracting with Deloitte for a study to design a new tariff policy for the Company
- Launching of an comprehensive asset inventory and valuation exercise
- Limited experimentation with different modes of contracting for retail water delivery

## *Costs and Funding for Operations and Maintenance*

Over the past three years, as GA has expanded irrigated and drained area and embarked on an extensive restructuring process, its operating costs have risen by 71% (Table 6.2) and currently total around GEL 530/ha[23]. At the same time income from irrigation has risen by just 7.5%. Much of this cost increase can be attributed to the costs of reform and of raising the level of professionalism of Company operations. In order for this investment to pay off, the Company

[21] GA does have an internal 'executive council' but this is made up of the General Director, executive directors and the head of the technical board. It is an operational body rather than a governance mechanism.

[22] Established on the basis of the *Law on National Regulatory Organs/Agencies* of 13 September 2002

[23] Assuming a service area of 68,000 ha (43,000 ha of irrigated land and 25,000 ha of drained land).

must expand its service areas dramatically for both irrigation and drainage so as to spread fixed costs and take steps to include all farms within the commanded areas in the revenue stream.

**Table 6.2. GA operating income and costs**

| Thousand GEL | 2012 | 2013 | 2014 | Share | Change |
|---|---|---|---|---|---|
| **Total operating income** | **4,235** | **3,947** | **4,244** | | **7.5%** |
| Income from irrigation | | 2,330 | 2,485 | | 6.7% |
| Other operating income | | 1,617 | 1,759 | | 8.8% |
| **Total operating costs** | **-21,210** | **-30,943** | **-36,244** | **100.0%** | **70.9%** |
| Electrical energy | -1,485 | -688 | -1,471 | 4.1% | 113.8% |
| O&M (less wages) | -1,820 | -6,711 | -7,472 | 20.6% | 310.5% |
| Wages | -2,458 | -6,592 | -8,915 | 24.6% | 262.7% |
| Other overheads | -858 | -735 | -1116 | 3.1% | 30.1% |
| Land and property tax | -105 | -371 | -335 | 0.9% | 219.0% |
| Depreciation | -14,484 | -15,846 | -16,935 | 46.7% | 16.9% |
| **Operating loss** | **-16,975** | **-26,996** | **-32,000** | | **88.5%** |
| Total non-operating activities | 530 | 13,901 | 17,586 | | |
| Subsidy | | 11,600 | 14,000 | | |
| Other non-operating | 186 | 2,254 | 3,285 | | |
| Non-operating income | | | | | |
| Financial expenditures | 344 | 47 | 301 | | |
| Profit tax | | | | | |
| **Net loss** | **-16,445** | **-13,095** | **-14,414** | | |

Source: Georgian Amelioration

As seen in Table 6.2, there has been a sharp increase (311%) in O&M expenditures, reflecting the huge backlog of deferred maintenance the company has begun to address. The wage bill has also grown dramatically (263%) as the staff professionalizes and expands. Together these two categories account for nearly half of total expenditures.

If operating costs and revenues are extrapolated linearly – the expansion of irrigation to an area of 200,000 ha and drainage to 100,000 ha as planned – operating costs would more than quadruple, from GEL 36.24 million to GEL 159.90 million. Operating income would also rise from GEL 4.24 million to GEL 19.74 million as the irrigated area expands, but a corresponding increase in government subsidies would also be required to ensure that GA remains financially viable.

However, such a linear trend in both costs and revenue is unlikely. First administrative costs in the GA headquarters unit will expand, but at a much slower rate than the irrigated and drained area. Second, irrigation contracts are currently scattered throughout irrigation commands, like seeds in a watermelon. GA will have to take measures to expand contracted area to cover newly-rehabilitated irrigation commands completely to have any hope of achieving parity between operating revenues and costs. Third, an increase in irrigation tariffs is to be forthcoming in the near future. Fourth, drained land currently produces little revenue, and new methods must be developed to recover costs of drainage provision.

GA is subject to the same tax regime as are other commercial companies. It pays a value added tax (VAT) and will be required to pay profit tax if and when it makes a profit. GA is no longer subject to property tax on its assets.

With respect to income, operating revenues remained virtually flat between 2012 and 2014. In 2014 irrigation fees comprised just 11% of total income, and their contribution was dwarfed by the subsidy category. Drainage services generated no income at all from the 25,000 hectares served in 2014 because of the Company's legal inability to enforce payment for this service. Irrigation fees remain at the flat level of GEL 75/ha, where they have been for a number of years. Contracted area comprises just 52% of the area actually receiving irrigation water and only an estimated 60% of the amounts due from farmers are actually collected. Hence there is ample scope for increasing revenue efficiency.

The current tariff arrangements are clearly sub-optimal, not only as regards the level of the tariff, but also in that it is structured as a per-hectare payment on the basis of voluntary annual contracts with water users. More than 50,000 irrigation contracts were concluded in 2015, covering irrigation on 43,000 hectares. In the absence of any sector legislation, however, GA has no legal basis to impose any kind of tariff on anyone who does not concluded a contract with it or to apply an area-based charge on anyone with whom it does not have a contract. GA can impose sanctions for water "despoilment". The intention is to move towards a subscription model with a multi-part fee, but this will require legislative change.

## *Irrigation Tariffs*

Irrigation water is a private good, a commercial input to irrigated agriculture as are fertilizer and plowing, which should be paid for by its users. At the same time, the provision of irrigation service is typically regarded by national governments as a powerful tool for stimulating rural economic development, with numerous positive linkages to other parts of the rural economy. This provides a strong justification for public funding for irrigation service provision as well.

To accommodate both of these perspectives, Georgian Amelioration must provide high quality irrigation service to as wide an area as possible while keeping its facilities in good working condition through regular maintenance. It must also sustain itself financially by generating sufficient operating revenue to cover its costs, whether from service users or from public sources.

The way in which funds are mobilized to support main system and local level water delivery and system maintenance is arguably the most important single factor determining the success or failure of the new institutional architecture for irrigation. The tariff and subsidy structure needs to meet the varying objectives of a variety of stakeholders.

- Georgian Amelioration is interested in ensuring an adequate and reliable revenue stream for itself
- Farmers are interested in receiving high quality irrigation service, but also with minimizing their costs
- MoA is interested in boosting agricultural output and achieving significant agriculturally-based economic growth, while protecting rural family livelihoods
- MoF is concerned with both economic growth and with required outlays from the treasury
- Politicians are interested in measures which increase the satisfaction of rural voters and hence their own popularity

For any system adopted, costs of system O&M should be differentiated on a regional or system-by-system basis and tariffs set accordingly. Revenue generated within a particular system

should be earmarked for that system, both in the interests of fairness and to encourage payment by irrigators who see themselves as paying for "their" system. Possible tariff models should be evaluated in terms of their net yield[24], since different tariff models may have dramatically different costs associated with recordkeeping, collection, and enforcement.

Tariffs should consist of two components – one fixed and one variable[25]. These components have different incentive effects on both irrigators and on GA which must be carefully assessed. Charging all agricultural land owners within the boundaries of an improved irrigation system a fixed "availability fee" will encourage them to contract for water and practice irrigated agriculture rather than continuing to grow rainfed crops or devoting their land to pasture or other low value uses. For this incentive to be effective though, an effective billing, collection and enforcement mechanism must be in place.

The relative size of the fixed component matters. A large fixed component in the tariff methodology, coupled with an effective collection mechanism, will diminish the incentive that GA has to provide high quality service to the maximum possible number of irrigators, since its revenue stream would not depend heavily on its water delivery performance. A small fixed component, on the other hand, reduces the assured revenue stream available to GA to cover its fixed costs in drought years, and reduces the incentive that farmers may feel to contract for irrigation services.

The variable portion of the tariff, the portion tied to the volume of water actually delivered, encourages clients, e.g. WUOs, to restrict the amount of water which they order from GA and to make efficient use of that water within their own service areas. This, in turn, allows GA to maximize the total service area it can supply through its WUO clients with a limited supply of water. Measured deliveries, coupled with a volumetric fee, also provides clients with a way of holding GA accountable for making the bulk water deliveries specified in their contract, and withholding payment in the event that deliveries are not made.

A high overall tariff level can have the effect of encouraging consolidation of working land holdings by inducing very small farmers to lease or sell their land to others. However the impacts of this on rural livelihoods, particularly in the absence of alternative employment opportunities, needs to be carefully assessed.

WUOs must be self-financing, while paying a bulk water delivery fee to GA. GA, in turn, should be able to finance its operations from irrigation and drainage revenues. However, if ability-to-pay limitations restrict the amounts that can be charged to some categories of farmers, then some system of direct public subsidies may be necessary.

[24] The income generated after subtracting the costs of billing and collection.

[25] Although there is a theoretical relationship between fixed costs and the level of the fixed portion of the tariff, the incentive effects of different ratios of fixed and variable tariff components can modify that relationship and lead to a fixed tariff component that is either larger or smaller than the fixed portion of operating expenses.

# 7. Strategy Components

## *Rehabilitating and Modernizing Irrigation Systems*

### Summary

Georgia will equip 200,000 hectares of land for irrigation by 2025, an increase of around 112,000 hectares over 2015 levels. Most of the increase will result from rehabilitation of existing gravity irrigation schemes. The considerable unexploited potential of groundwater will be studied and measures devised to enhance private groundwater development for irrigation, particularly in conjunction with drip irrigation technology, which is expected to expand to cover as much as 10% of irrigated area by 2025.

Georgian Amelioration will evaluate and prioritize more than 100 potential projects on hydrologic, economic, and financial, grounds, creating a high-quality list of pre-qualified of projects for potential financing. The estimated $361 million required for the rehabilitation work will come from funds allocated by GoG and from international assistance agencies. Modernization investments to allow improved system management will target improved water measurement systems and control structures, along with upgraded management information systems.

A new unit will be established to mobilize farmers and facilitate consultation and dialogue. Local level rehabilitation design will be carried out in close cooperation with farmers, with WUO development proceeding in tandem with the rehabilitation process.

### Irrigation expansion

#### Public investment

National development policy calls for public irrigation development to be restricted to restoring irrigation on previously-irrigated land. This is appropriate given the sunk costs embedded in existing infrastructure and the past experience of local farmers in previously irrigated areas with irrigated agriculture. An irrigated area of 278,000 hectares was under gravity canal command prior to independence. However, since it is highly unlikely that all of the Soviet-era gravity systems will prove viable following an initial screening, a target of 200,000 hectares of functional irrigation command by 2025 is established, comprising 88,000 hectares already partially rehabilitated by GA and 112,000 hectares of additional land to be brought back into production by comprehensive rehabilitation and modernization.

Because economic feasibility was not considered in designing systems during the Soviet era, systems often mixed gravity and pumped command area indiscriminately. Virtually all of the pump-supplied areas are now out of service. Pump-supplied commands are usually much more costly to operate than gravity-supplied areas because of the energy charges incurred, and this can place huge financial burdens on both the managing agency and on irrigators. It is thus appropriate to focus publically-financed irrigation development and re-development on gravity irrigation systems.

## Private investment

At the same time, pump-supplied water can be controlled more precisely and is available whenever it is needed by the crop, without waiting for a scheduled delivery by a public canal irrigation system. Hence with careful management, pumped irrigation supplies can be a valuable cost-effective input to higher-value agriculture, if the costs of water supply can be met by benefitting farmers. There are two possible scenarios for expanding privately-financed lift irrigation drawing water from public system main and secondary canals.

- First, large individual farmers who wish to abstract water with their own pumps from a major canal to be rehabilitated could be included in the rehabilitation design by undertaking a contract for service with GA and posting a deposit covering the first year's water charge in advance of rehabilitation.
- Second, groups of farmers wanting GA to provide a pumped water supply could organize and enter into a contract with GA under which they undertake to (a) register their land, (b) repay a share of capital costs incurred, and (c) pay the full cost of operation and maintenance of the pump station and water delivery network. Such schemes would generally produce horticultural crops and in such cases group members would be required to install drip irrigation equipment.

Another promising opportunity for private investment in lift irrigation rests on the abundant high-quality groundwater resources present across significant parts of the country. Shallow groundwater development may be appropriate even for smaller landholdings, while development of deeper groundwater resources may only be appropriate for larger farmers or groups of farmers Although public development of these resources is not appropriate, groundwater lends itself readily to private development and exploitation. Given the very limited extent of current private exploitation however, judicious public support may be required to jump-start the expansion of groundwater irrigation in the country.

Public programs promoting and facilitating groundwater resource development for irrigation could include the following.

- Low-cost credit for well installation
- Support to encourage small local contractors to invest in well drilling equipment
- Harnessing of agricultural cooperatives for collective well development
- Credit and cost-sharing support for drip irrigation equipment purchase and installation

Drip irrigation technology is a natural complement to groundwater development because clean groundwater is available 24 hours a day, 7 days a week, and is available on-site and under pressure. As a result, drip systems, which require relatively continuous delivery of clean pressurized water, can often be connected directly to irrigation wells to deliver water to crops.

While external support may be necessary initially to spark private development in this sub-sector, once a critical mass of knowledge, private drilling contractors, and product markets is established, this potentially lucrative sub-sector should become self-sustaining. A special study will be commissioned to explore the potential for groundwater development, particularly in conjunction with drip irrigation of higher-value crops. The study will explore groundwater availability, costs of well installation in different regions, drilling contractor capacity and recommend steps to encourage private groundwater development for irrigation.

## Screening potential investments

Because of the massive deterioration of irrigation infrastructure over the past 25 years, facilities on virtually all of the area to be added will require rehabilitation. However, in the absence of feasibility studies, the economic viability and sustainability of particular schemes is uncertain. A prioritization process is needed to weed out those schemes which would clearly not be sustainable and to allocate scarce rehabilitation financing efficiently[26].

A structured screening and prioritization process has been developed for this purpose. Potential schemes are first screened for compliance with three primary criteria.

- Sufficient availability of water
- No significant risk of technical failure (seismic, cross-border water supply)
- Demonstrated interest by farmers in practicing irrigated agriculture

Schemes failing to satisfy any one of these criteria are eliminated from consideration. Those satisfying all three criteria are then subject to two additional tests which ask if they are (1) economically viable and (2) financially sustainable. A two-stage screening process is used because the economic and financial tests are more data-intensive, and hence more costly to carry out, than are the first-stage criteria. The economic and financial tests are thus applied only to schemes without obvious water supply problems, and where there is demonstrated farmer interest in irrigated agriculture.

Schemes that make it through this screening process by satisfying all five criteria are then ranked using a weighted combination of three factors to prioritize them for investment. The three factors and their respective weights are the following.

- Farmer interest (15%)
- Economic viability (50%)
- Poverty impact (35%)

The complete prioritization methodology is included in Annex 2.

More than 100 schemes are included in the list of those available for rehabilitation, and a systematic screening process will require that a unit be established at GA. This unit will require skills in hydrology, economic analysis, and technical risk assessment. The screening process should also have access to historical data on river flows through an agreement with the NEA's Department of Hydrometeorology. This screening unit would be most active for the first several years of the rehabilitation program, with the workload declining later.

## Rehabilitation funding requirements

Costs of the proposed rehabilitation program derived from the cost estimates prepared for three large schemes being rehabilitated under the World Bank-supported GILMD project are shown in Table 7.1.

[26]GoG funds can be used to rehabilitate any scheme the Government chooses, based on political or any other grounds, assuming intra-government agreement on the decision is reached. International lenders will generally insist on more objective technical, economic, and financial criteria for project acceptance.

**Table 7.1. Estimated rehabilitation costs for three World Bank-funded schemes, GILMD**

| Scheme | Area (ha) | Main Canal ($/ha) | Secondary and Tertiary Canals ($/ha) | Total ($/ha) |
|---|---|---|---|---|
| Zeda Ru | 2,304 | $ 1,253 | $ 239 | $ 1,493 |
| Kvemo Samgori Right Bank | 9,500 | $ 440 | $ 1,217 | $ 1,656 |
| Tbisi-Kumisi | 8,300 | $ 804 | $ 2,411 | $ 3,215 |
| **Total** | **20,104** | **$ 683** | **$ 1,598** | **$ 2,281** |

The weighted average cost of main canal rehabilitation across all three schemes is US$ 683/hectare. Secondary and tertiary level rehabilitation costs for these three projects are estimated at $1,598/hectare. System modernization costs to introduce a modern management information system and to improve water control are estimated at $300/hectare, bringing the average total system rehabilitation and modernization cost to $2,581/hectare in 2015 dollars. Using these 2015 values, rehabilitating irrigation systems serving 112,000 hectares of agricultural land over 10 years will cost an estimated $361 million[27] (Table 7.2).

**Table 7.2. Estimated rehabilitation investment requirements (million US$), 2016-2025**

| | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** | **Total** |
| **Area rehabilitated (ha)** | 5,000 | 5,000 | 8,000 | 10,000 | 12,000 | 15,000 | 18,000 | 15,000 | 14,000 | 10,000 | 112,000 |
| **Unit cost ($/ha)** | 2,581 | 2,607 | 2,659 | 2,712 | 3,255 | 3,320 | 3,386 | 3,454 | 3,523 | 3,593 | |
| **Funding requirement (M$)** | 12.9 | 13.0 | 21.3 | 27.1 | 39.1 | 49.8 | 60.9 | 51.8 | 49.3 | 35.9 | 361.2 |

Note: Assumes 2% annual inflation and 20% increase in per hectare costs after 2020 when less expensive schemes have been completed.

Funding for this investment program is expected to come from annual allocations from the State budget, supplemented by international multi-lateral and bi-lateral lending. A small amount of additional funding might come from private borrowing by GA to fund certain private local level development, as discussed in a previous section.

Direct government funding for irrigation system rehabilitation ramped up sharply in 2012. Levels for the past three years are shown in Table 7.3 and averaged around US$ 20 M per year.

**Table 7.3. Georgia state budget funding for irrigation system rehabilitation, 2012-2015**

| | million GEL | million US$ |
|---|---|---|
| **2013** | 48.6 | 21.1 |
| **2014** | 36.0 | 15.7 |
| **2015** | 52.5 | 22.8 |

Note: conversion at GEL 2.3 / US$

In addition to GoG funding, two major irrigation rehabilitation projects are currently underway. The World-Bank-funded GILMD project has programmed $42.1 M in rehabilitation financing over the period 2014-2019, and the Dutch government is supporting the design and rehabilitation of Zemo Samgori scheme under the ORIO project with cost sharing support of € 15.5 M (US$ 17.2 M).

Assured financial support available over the ten-year period might thus total around $259 M. Assuming that follow-on projects at the same funding levels will replace the two externally-

[27] There will be additional costs incurred to bring partially-rehabilitated areas up to full rehabilitation/modernization status.

funded projects as they complete, the total available funding over the period would rise to around $319 M. Thus a gap of around $42 M would need to be filled to cover the full 112,000 hectare target. In addition, the 88,000 hectares already partially rehabilitated by GA require additional funding to complete rehabilitation and modernization of these systems.

On the other hand, it is possible that the area covered by projects successfully passing through the screening process will be less than 112,000 hectares, in which case financing requirements will be lower. The Government of Georgia will secure resources to fully fund the comprehensive rehabilitation and modernization of qualifying projects up to a total service area of 200,000 hectares.

## System modernization

As indicated above, along with basic rehabilitation, investments in system modernization are urgently required. A basic component of scheme modernization will be the installation of water measurement structures and devices, along with data collection and transmission systems to provide current information on water flows throughout all rehabilitated schemes. Some of this data-collection would be automated, though cost considerations may prevent full deployment of automated data collection systems, and manual reading and transmission may be necessary in many cases.

In addition, modern information processing and decision-support systems at the scheme and regional levels are necessary to make use of the information collected and to achieve effective management control over the system. The type of information to be collected and the decision-support systems established will depend on the system management procedures selected. Additional water control structures are also needed in many locations. These include cross-regulators and long-crested weirs to stabilize canal water elevations. Successful introduction of new technology and management procedures will require extensive staff training in the new technology and procedures.

A second aspect of system modernization relates to the growing spread of drip irrigation technology at the farm level. Although the area under drip is relatively small at present, it is expanding and its clear advantages, particularly for fruit and vegetable production, should lead to accelerating growth in coverage. The need for a constant supply of water for this technology means that the drip irrigating farmer needs access to a canal that is always flowing, or that individual farmers, or groups of farmers, will need to construct their own farm ponds to buffer intermittent supplies from the canal system. The anticipated growth of drip technology in systems to be rehabilitated or modernized needs to be taken into account in modernization planning. A source of credit for farmers to purchase drip equipment and to construct farm ponds is critical in facilitating this expansion. The new AMMAR project is also a logical source of funding for these innovations and MoA and GA should explore this topic with them.

In addition, there appears to be sufficient head in some canals for farmers to operate drip or sprinkler equipment without the use of mechanical pumps. To take advantage of this excess head, additional siphon turnouts could be installed with flexible hoses running down slope for the farmer to attach to drip or sprinkler systems, or pressurized laterals constructed running downslope. These opportunities need to be discussed with irrigators during the design process and included in the design where feasible. A separate note on modernization will be prepared to guide investments in modernization once the general strategy has been reviewed and approved.

## User consultation and dialogue

The ultimate purpose of any irrigation system is to create viable and profitable local agriculture. Hence farmers are a critical component of the irrigation system and are important stakeholders in the rehabilitation process. Consultation and dialogue with farmers is required at three separate stages of rehabilitation – selection, design, and construction.

### Selection

At the project screening and selection stage, a qualifying criterion for farmer interest is mentioned above and described in Annex 2 for schemes with an active irrigated area prior to rehabilitation. For schemes which are not currently functioning, a series of public meetings should be organized by GA mobilizers to acquaint farmers with the possible rehabilitation of the scheme which would serve them and to gage local interest in using irrigation services. Signatures on a petition could be collected to measure the level of interest present. Another possible metric could be the percentage of farmers who have registered their land titles with the Public Registry. One aspect of these public meetings should be encouragement for local landowners to register their land, which is important for subsequent system management.

### Design

At the design stage of the rehabilitation project, communication and active dialogue with farmers is important to (a) acquaint them with the basic features of the main system design being proposed, and (b) to gain their advice on such local level infrastructure features as tertiary channel alignments, turnout locations, locations of canal road crossings, and operational requirements, i.e. continuous versus rotational delivery. For this purpose, GA mobilizers should organize a series of local-level meetings throughout the service area of proposed rehabilitation projects in which plans would presented and the issues outlined above discussed. A representative of the engineering design firm should be present at these meetings, along with farmers and the GA mobilizer.

At each of these meetings, which together should cover the entire command, farmers could elect a representative to a system-wide farmer committee. This committee would serve as a communication link between farmers and GA during the design and construction process and beyond.

For the first three schemes to be rehabilitated with World Bank funding[28], designs were completed in advance of the project's commencement and included only main canal rehabilitation. They also did not include comprehensive modernization elements. For these projects, secondary canal and local level system design will come at a later date and modernization elements will be retrofitted into the projects. Local level system design for these schemes should include the farmer consultation process outlined above.

For other schemes now being considered, and for additional schemes to be rehabilitated under GILMD, the all three components – main system, local level system and modernization elements – should be designed together to achieve an efficient and integrated design[29]. These projects should involve farmer consultation from the outset.

[28] GILMD Project

[29] However main and local level distribution systems do not necessarily have to be constructed simultaneously.

### Construction

During the construction phase, the farmer committee formed during the design stage meetings should be actively involved and meet regularly with staff of the GA who are charged with monitoring construction quality. In these meetings farmer representatives will be updated on construction progress, and can provide feedback to GA on observed problems with construction. This will keep farmers engaged in the process and provide GA with a valuable source of information regarding the activities of the construction contractor.

### Monitoring and supervision

Construction quality, particularly when carried out by smaller local contractors, has been observed to be poor or extremely poor. GA will be the party responsible for managing these schemes once rehabilitation is completed, and GA thus needs the capacity to monitor design and construction quality of the schemes it will manage, even where another agency is the contracting and supervisory authority. Poorly designed and built schemes, once turned over to GA to manage, will leave the Company with higher than expected maintenance and repair bills and more difficult and expensive operation.

Periodic meetings with farmer representatives during construction would also provide useful information on contractor activities. GA then needs to take a more aggressive stance in accepting, or refusing to accept, completed systems, depending on their construction quality and expected MOM costs.

### Needed reforms

- GA to establish an investment screening capability that would be responsible for preliminary hydrologic, economic, and financial analyses of proposed rehabilitation projects.
- MoA to secure free or affordable access to river discharge data from the Hydromet Service to make hydrologic screening possible.
- MoA to initiate a study of the potential for agricultural groundwater with the support of GoG and try to introduce programs which facilitate and support groundwater development and drip irrigation installation along with small reservoir development to serve drip systems.
- GA to strengthen its capacity to take a more aggressive stance in monitoring the quality of rehabilitation construction performed on irrigation systems that it will be required to operate and maintain.
- GA to prepare a plan to guide the design of modernization investments in water measurement and control and develop main system operational plans for systems to be rehabilitated.

## *Main System Management*

### Summary

Georgian Amelioration will continue to operate as a unified state-owned corporation over the medium term, taking advantage of the financial discipline and results-orientation which typically characterize such entities. However while public subsidies are flowing to it, GA will aim to operate at a financial break-even point, rather than

attempting to return a fictitious profit to the Government. The Ministry of Agriculture will establish a broadly-constituted supervisory board for GA which includes a variety of accomplished professionals from both governmental and non-governmental sectors.

GA will assume the role of bulk water supplier to local level organizations which will distribute water and operate local facilities supplying individual farms. The Ministry will instigate a program to organize and support local level water use organizations which will provide service to individual users and enter into contracts with GA for bulk water supply.

The regulatory authority will provide GA with exclusive licenses to provide irrigation and/or drainage services in designated areas. In operating and maintaining the main system facilities under its purview, GA will transform its operations by introducing modern data-based management practices for water delivery, facilities maintenance, and financial and administrative management. Over the near-term future, GA will continue to provide most of its own maintenance and repair services using in-house resources. Over time, it may outsource selected services to the private sector if costs and quality of work prove acceptable after trials.

## Organizational structure

Main system management organizations the world over take one of two general forms. The first and simplest is a government department – a part of a line ministry. This is the simplest form since it simply replicates the structure of the parent ministry. It enjoys access to the national budget for funding, follows standard government and civil service rules and regulations, and turns over the national treasury any tariff revenue it collects. Unfortunately, this form of organization is generally a poor manager – ineffective and inefficient – for a wide variety of reasons. It lacks any accountability to its clients, is often subject to political pressures for hiring, leading to overstaffing with under-qualified personnel, and has little incentive to perform at a high level.

The second model typically used is that of an agency or authority. Such an organization is generally semi-autonomous, governed by a board of directors, and reliant to some degree on the revenue it generates from its operations. It is sometimes termed a “quasi-public” agency, in that it has characteristics of both public and private organizations. It has the ability to develop its own budgets and work programs, subject to board approval, and is able to hire and fire staff and set salary levels according to its own rules and procedures. It is not charged with earning a profit, though it is usually expected to be financially self-reliant, even though public subsidies may be a part of its income stream.

Georgia has chosen a third way. Its main system manager is organized as a publically-owned company under the 1994 Law on Entrepreneurs. The company, Georgian Amelioration, is intended to earn a profit, and, more importantly, it is expected to employ modern business management practices to achieve efficient and effective operation.

There are no known examples of successful commercial main system irrigation (or drainage) companies elsewhere in the world – commercial in the sense that they seek to generate profits for their investors. A fundamental reason for this is that, in contrast with services such as domestic water supply and electricity service, irrigated agriculture typically lacks the income-generating potential to support full cost recovery for irrigation service. Other fundamental constraints on a for-profit model are the scale of infrastructure investments needed and the

typically low direct return on those investments. An added challenge is that while water, like seeds and fertilizer, is a private production inputs, it also has a public-service character, and it is usually difficult to exclude potential users who fail to contract or pay for services from obtaining those services. These risks are greatly increased in the case of Georgia, with its dilapidated infrastructure, the small size of the market for agricultural products, the large number of small farms and scattered plots, the absence of a functioning land market and, above all, the fact that irrigation is supplemental to rainfall in most places.

In addition, the corporate form of organization lacks several features of public or semi-public organizations. These include the right of eminent domain, the right to compel inclusion in a service district, and certain abilities to compel payment and sanction non-payers.

On the other hand, most irrigation agencies in low and middle-income countries around the world, whatever their form, fall far short of the standards of efficiency and effectiveness that characterize well-run private companies in those same countries. The current corporate status of GA carries with it the healthy potential to instill financial discipline, install modern management practices within the company, and create an organizational culture focused on effective and efficient service delivery. This is an extremely difficult transition for irrigation agencies to make, and the potential of the corporate form to facilitate this transition offsets many of its liabilities. Some strengths and weaknesses of the three organizational forms are shown in Table 7.4.

**Table 7.4. Organizational features**

| Organization | Eminent Domain | Taxation Powers | Flexibility | Results Orientation |
|---|---|---|---|---|
| **Department** | yes | yes | low | low |
| **Authority** | yes | yes | moderate | moderate |
| **Company** | no | no | high | high |

Over the medium term, GA should continue to operate as a corporate entity, taking advantage of the potential for heightened flexibility and efficiency of operation. However, given the strong likelihood of a continuing reliance on public subsidies, any effort to raise investment funds in private capital markets should be deferred until such time as GA is able to support its operations without subsidies. At the same time, the goal of earning a profit on the provision of irrigation and drainage services should be modified to one of deficit-free operation, taking into account appropriate financial transfers from the government.

The governance of GA currently consists of a direct line of accountability to the Ministry of Agriculture. By contrast, standard corporate governance would typically be provided by a board of directors having a more diverse composition. The current governance arrangement will be revised, with a view to bringing in alternative viewpoints and a wider range of expertise. This would strengthen governance by incorporating in it an expanded set of skills and experience, while making it more robust and less subject to short-term political influence. As a first step, a GA supervisory board will be established, comprised of experienced professionals from both governmental and non-governmental sectors. Board members will meet two to four time annually to consider and decide on important policy issues facing GA.

One significant difficulty with the corporate model is that a private service provider lacks the ability to compel potential customers to employ its services. But GA, and by extension WUOs, can never become financially viable unless they have the ability to charge all farmers within a

rehabilitated service area at least a portion of the total irrigation tariff due from each hectare of irrigable land. In issuing an operating license to GA, the independent regulatory authority will mandate GA to provide services to all land within particular boundaries. A similar authority, provided to WUOs through their enabling legislation, would give them the authority to charge a portion of the established irrigation tariff to all landowners within system boundaries as an inducement to use the irrigation service made available by rehabilitation investments.

The earlier attempt to establish multiple independent autonomous regional corporations to provide irrigation services failed for a variety of reasons. In general, there would appear to be no advantage to creating independent regional entities. Such an approach would inevitably raise overhead costs without a corresponding increase in income or improvement in service quality. Any advantages which might result from individualized cost accounting for systems or regions can be achieved more easily and cheaply through a suitably designed cost accounting system implemented by a nation-wide agency.

## Main system O&M

Choice of main system management practices depends critically on a number of factors, including type and condition of system infrastructure, system water measurement and control capacity, staff capabilities, the Relative Water Supply available to the system, and, perhaps most importantly, the type and scale of the local level organization which will distribute water to farmers. The size of the local level organizations, in turn, determines where the hand-over point for operational responsibility will be and helps to define the extent of the main system manager's responsibilities and its staffing requirements. Only when these factors are specified can a detailed main system operating regime be developed.

GA has already restructured its field operations to devolve major decision-making authority to four regional offices and to align management responsibility with system boundaries. Field operations within regions are managed by approximately 20 Service Centers, each of whose area of responsibility corresponds to a single large system or a cluster of smaller ones. Each Service Center, in turn, has a staff of 15 or 20 persons. This is a sound organizational foundation on which to build system management.

Centralized equipment pools are presently located in each region, supplementing the equipment based in each larger system. Equipment from the regional pools is dispatched to individual systems upon request. In the future there may be scope for outsourcing certain types of maintenance to private sector contractors. However, the capabilities of local contractors is currently limited and response times are often too long to deal with emergency situations. Moreover a recent donation of 300 pieces of new Chinese vehicles and equipment, worth around $11M, make the cost of carrying out routine maintenance and repairs in-house quite low. Over the medium-term, GA will continue to provide most maintenance and repair services itself, while monitoring costs and testing the capabilities of local contractors to provide such services in the future.

In future, GA may experiment with contracting out management of main canal and secondary canals providing service to WUOs to private firms. This would be done in the event that it lowered total costs of service provision and would be subject to regulatory approval.

In the future, main system management must become far more data-based than it is at present. Water measurement points currently are few and far between in all GA systems and deliveries are based on estimates rather than measured flows. In some systems, main canals are simply

allowed to flow with little effort at regulation and control. Major elements of system modernization investments will be water measurement; data collection, transmission, and processing; and decision support. Likewise, routine maintenance will be based on a geo-referenced asset database currently being developed using asset management software and practices. A third area in which modern information technology will improve organizational and delivery performance is in administrative data management, including such things as company personnel records and financial accounts, irrigated land ownership records, irrigation and drainage service contracts, and fee payment records. Upgrading data-based management capacity will require water measurement devices, data transmission systems, computers, software, communications technology, and extensive staff training.

Such technology cannot simply be grafted on to existing administrative and operational routines. Processes need to be redesigned with new technology in mind, eliminating paper forms and records in many instances. In many countries the potential of mobile internet and SMS communications to farmers' cell phones is being exploited and this should be considered also for communicating irrigation schedules and other information to farmers.

A company-wide data network is needed, allowing exchange of data both within individual units and Service Centers and among Service Centers, Regional Offices, and Company headquarters. This information system should also have a public portal to provide open access to selected information, such as reservoir levels and storage volumes, current system releases, and planned canal maintenance schedules.

### Needed reforms

- MoA to establish a diversified supervisory board for GA which includes both government and non-government members.
- GA to install modern systems of data-based management in all rehabilitated irrigation schemes and build staff capacity to employ them

## *Local Level Management*

### Summary

The primary local level organization responsible for managing water delivery to individual farms will be a farmer-governed Water User Organization (WUO). Development and passage of a new WUO law will be undertaken to facilitate this. To permit this two-part irrigation management structure, GA will subdivide all irrigation systems under its purview into smaller contiguous units on the basis of rational hydraulic boundaries. These units, which would normally be 1,000 ha or greater to achieve economies of scale, will then comprise local level management units. Smaller units may be created where necessary.

Water User Organizations will be established by a majority affirmative vote of farmers within the boundaries of a designated local level management unit. The WUO will then have exclusive authority to distribute purchased bulk water supplies inside the local unit and to collect irrigation tariffs from the farmers served. Bulk water will be supplied by GA under a contract with the WUO. The WUO may choose to hire its own staff to operate the local system or to contract with a private firm to provide O&M services within its boundaries.

If farmers reject the idea of a WUO in referendum voting, GA will have the option of either providing irrigation services within the local unit directly to individual farmers, or of awarding a concession to a private firm who would operate tertiary facilities and collect retail fees from farmers served. It is expected that will cease all direct service to small irrigators within 5 to 7 years.

MoA will establish a WUO Support Unit, either within GA or elsewhere, which will develop procedures for organizing WUOs and provide training and support to WUO governing boards, managers, and staff for a period of at least 5 years beyond the date of establishment.

### Water user organizations: formal and informal

Even in the absence of a formal local level irrigation management organization, most irrigation systems rely on informal local organizational arrangements to distribute water and (sometimes) clean ditches. Such arrangements may rely on leadership from a local village head or respected person in the community who will typically organize water-sharing arrangements, organize ditch-cleaning work parties, and resolve disputes among irrigators. In such situations, where irrigation fees are charged, individual farmers will typically be responsible individually for payments to the supplying irrigation agency.

A variation on this informal mechanism involves a local "agent" who contracts with the main system manager for irrigation service and then distributes water to individual farmers sharing a canal. The agent would also collect service fees from farmers and make payments to the irrigation agency, perhaps retaining a prearranged portion for his efforts. This arrangement has been used in China and was experimented with briefly by GA in Kvemo Samgori before abandoning it by hiring the local agent for its own staff.

Another type of informal arrangement would involve a joint contract between a small group of farmers sharing a canal and the main system manager. Under a joint contract, the famers would undertake to distribute water among themselves and be jointly responsible for payment of a discounted service fee. The tariff discount for a joint contract would need to be sufficiently large, relative to individual contracts, to cover occasional defaults by group members and still result in lower per hectare costs to the members. Presumably, defaulting members would be excluded by the group from future contracts.

At this point in the small-to-large continuum of local level management arrangements a significant break occurs. In the foregoing discussion, arrangements being considered are small and informal. When larger groups and more formal arrangements are considered, it becomes necessary to establish a formal organization with a legal personality, the ability to handle and account for money, and governance arrangements which make the organization accountable to its clients. This, in turn, requires a law enabling and defining such an organization. This organization will have a minimum size requirement for cost effective operation. This is because of the "lumpy" costs involved in setting up an office and hiring even a minimal staff. In Georgia, this might be on the order of one thousand hectares. A significant benefit of a large local level organization is that its existence would allow application of volumetric water pricing for measured deliveries to the organization. Given the small size of individual holdings this is not economically feasible to do when the GA client is an individual farmer.

At present, GA contracts with individual farmers whose average holding size is generally one hectare or less. This results in a huge number of contracts and places an extensive and

expensive burden on Company operations. Although the Company employs Regulators in many areas to arrange contracts, deliver water to farmers, and monitor use, it is likely that farmers handle a good deal of the local water management, as well as most of the ditch cleaning that is actually performed, themselves. However such arrangements are *ad hoc* and spotty in coverage and do not necessarily lead to the levels of service that will support high-value agriculture or result in maintenance of local level infrastructure that will keep canals and control structures in their post-rehabilitation condition.

Hence, while there are some informal arrangements at the local level that can be effective in reducing the number of contracts the main system manager must manage, to move beyond franchising or small group contracting arrangement, a more formal organizational structure must be established at the local level. This requires both a legal basis and a specialized professional unit which can help develop and support these new organizations.

In some countries, existing legislation has been utilized to form WUOs in lieu of a law written specifically for them. This has been the case in Turkey, where an existing law allowing the formation of unions of local governments was employed for the past 25 years to create a viable set of WUOs across almost all of the irrigated area in the country. However this is the exception rather than the rule, and generally a law tailored specifically for WUOs is a more effective vehicle for this[30].

In Georgia, the only existing legal vehicle which might be employed for the purpose of formal local level management of water appears to be the Cooperatives Law. However cooperatives have numerous liabilities relative to irrigation service provision that render them unfit for this purpose, including the following.

- The fundamental purpose of coops is to make a profit from an agriculture-related enterprise, while the purpose of a local level irrigation agency is not-for-profit service provision to all farmers within a specified area
- Coops are typically formed on the basis of community boundaries rather than hydraulic ones, which renders them unusable as irrigation service providers
- Coops are generally very small, involving only a few members, far too small to constitute a viable WUO
- Coops are limited by law in their ability to provide services to non-members
- Membership in coops is voluntary, with no ability to compel membership or payment for services provided to non-members

In moving beyond relatively informal small-scale local level organizational modes then, it appears necessary to develop a new class of local irrigation organizations with a new legal basis in the form of a dedicated WUO law. Features of different local level organizational forms are shown in Table 7.5.

**Table 7.5. Local level organizational forms**

[30] Turkey has just passed a new law specifically enabling, defining, and regulating WUOs to replace the older one.

| Organization | No of members | Service Area Boundaries | Legal personality | Purpose |
|---|---|---|---|---|
| Village leader | 5 - 100 | village | no | service |
| Local agent | 5 - 50 | social/hydraulic | no | service/profit |
| Informal group | 3 - 10 | social/hydraulic | no | service |
| Ag cooperative | 5 - 50 | social | yes | profit/service |
| WUO | 250 - 1,000+ | hydraulic | yes | service |
| Franchise | 250 - 1,000+ | hydraulic | yes | profit |

## Water User Organizations in Georgia

A previous attempt to establish water user organizations (Amelioration Associations, AAs) in Georgia in the early 2000's failed, primarily because of the withdrawal of government support mid-way through the establishment process. Currently the role that they were intended to fill – the interface between the main system and individual users – remains vacant, and system performance suffers as a result. As discussed above, no viable alternative to specialized formally-registered WUOs appears to be available to occupy this niche.

Circumstances today differ significantly from those of the early 2000's and there are strong reasons to believe that a successful program of WUO organization can be mounted and sustained.

- Ten years has elapsed since a withdrawal of government support triggered the collapse of the AAs, and the unpleasant memories of collectivized agriculture dating from the Soviet period have now faded more than 25 years into the past
- The importance of scale is now recognized, and the average size of new WUOs would be larger than those established earlier
- There is now more than 20 years of experience with establishing and supporting viable WUOs in other countries in the region to draw on in designing and implementing a WUO development program for Georgia
- The Ministry, the Company, and GoG recognize the need for local level water management organizations and are prepared to support and sustain them over the longer term
- GA is undergoing comprehensive reform, characterized by fresh thinking and an orientation toward practical results, and, during this period of flux, WUOs can be more easily integrated into new operating regimes
- An extensive infrastructure rehabilitation program is underway which can provide new WUOs with updated functional local level distribution systems
- Financial support for WUO establishment and capacity building is currently available through internationally-funded projects

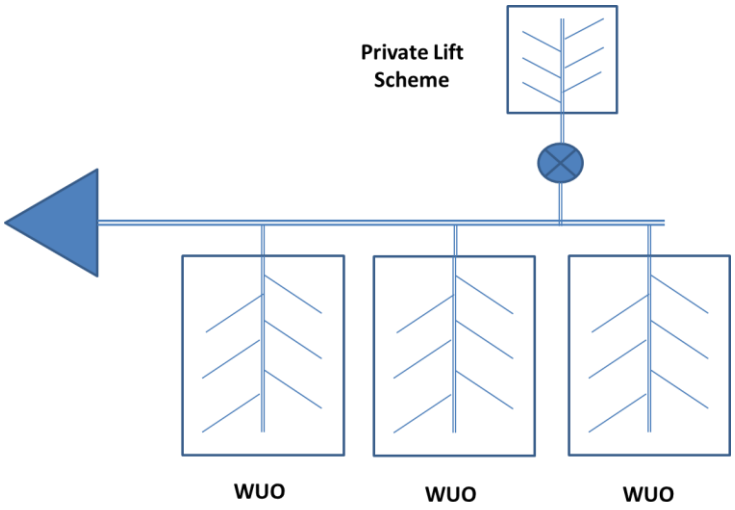
Although the detailed organizational form of the WUOs to be introduced must still be worked out, international experience shows that a number of important features will characterize any design adopted.

- WUOs are legal entitles with specific powers and authorities
- WUOs are accountable to the farmers who use their services through a representative assembly

- WUOs operate in a financially self-reliant mode, covering their own operating costs plus contractual payments to their bulk water supplier (GA) with its service fee income
- WUOs would be single-purposed (water delivery), with any financial surpluses retained by the WUO

The relationship between GA operations and WUO operations is shown schematically in Figure 7.1. The figure illustrates three gravity-supplied WUOs and one special pump-irrigated unit operated by a single corporate farm under contract with GA.

**Figure 7.1 Schematic system layout under two-party management**




An irrigated area of 200,000 hectares would require that around 200 WUOs be established to achieve complete coverage. However, some WUOs would be smaller, particularly where schemes are smaller than 1,000 hectares, while in large schemes they could cover more than 1,000 ha to achieve greater economies of scale. As experience is gained, adjacent schemes may cooperate to share specialized staff and equipment and eventually merge to reduce costs. In adjacent smaller schemes, staff can also be shared to reduce operating costs where full-time effort is not required. Hence the actual number of WUOs will be somewhat variable, and may change over time.

WUOs would contract with GA for bulk water supplies. These contracts would also assign tertiary facilities under GA's control to WUOs to employ in service delivery, while requiring certain standards of operability to be sustained through adequate maintenance. Over the longer term, permanent transfers of local level facility ownership to WUOs can be considered.

WUO development would proceed together with system rehabilitation in a coordinated sequence. Initial actions to secure WUO input to system design would lay the foundations for further cooperation, and culminate in the formation of a WUO to assume local level management responsibilities. A group of specially-trained community liaison specialists would be responsible for the organizing work.

A prerequisite for initiating work to organize WUOs is the announcement of a new higher irrigation tariff scheme. This would allow WUO organizers to point to lower costs for irrigation service provided through a WUO relative to service provided directly by GA. It is essential that

forming a WUO be seen by farmers as a way of reducing their costs rather than a step causing them to pay higher fees than they otherwise would.

There would seem to be no compelling reason to organize farmers for operating drainage facilities. Drainage requires little or no operational activity, and maintenance can most efficiently be carried out by a regional authority such as GA. Funding for drainage maintenance would come from a tax attached to drained land and turned over to GA.

## Recent GA experience with local level management

In 2014, GA began experimenting with local level water management in a 340 ha area served by two small secondary canals on the right bank of the Kvemo Samgori Irrigation System. A respected local farmer was selected initially to represent the larger group of farmers in dealings with GA and to arrange water deliveries to them. He was subsequently employed by the Company as a "Regulator" and his duties expanded to include the following.

- Compiling a list of all farmers in his command area
- Soliciting water contracts from all farmers within his area and signing them on behalf of the Company
- Collecting water requests from farmers and transmitting them to the system manager
- Distributing water
- Monitoring water use to control unauthorized use by non-contracting farmers

The Regulator does not perform maintenance on the system, nor does he collect irrigation service fees from farmers. Contracting farmers deposit their payments directly into a local GA bank account. Farmers observed taking water without a contract are fined by GA. However, larger farmers often find it cheaper to pay the fines levied than to contract for water and pay the irrigation fee. This revenue is lost to the Company, as fines go to the State budget and not to GA.

This model worked satisfactorily and the Company subsequently hired a total of 12 Regulators in Kvemo Samgori and expanded the program to cover the entire scheme. It is also applying this arrangement in other systems. Drawbacks of the model include (a) the lack of a mechanism for performing local level canal cleaning and maintenance, (b) the large number of contracts it generates, since it relies on contracts with individual farmers rather than with larger groupings of farmers, (c) Incomplete coverage of the commanded area of the irrigation system, since contracts are voluntary, and (d) high costs.

Another model GA is experimenting with involves an agreement with a group of upland farmers in the Gurjaani municipality in Kakheti. Crops grown are vineyard grapes and peaches. There are medium-sized farms with areas between 5 and 8 hectares and also larger companies with 100 or more hectares of vineyard grapes. The concept is that GA will rehabilitate a pump station on a GA main canal, and construct a pressure pipeline and main delivery system to a commanded area of 720 hectares located above the canal. Water will be pumped periodically into a set of 12 reservoirs within the area to be served and irrigators will pump from these reservoirs with their own pumps into their own drip systems. Farmers have agreed to pay 25% of the investment cost of the pumping station, pipeline and reservoirs and to cover the energy cost of operating the system once completed. Seasonal energy costs are estimated at GEL 200 to 300/ha and farmers would pay this in addition to the standard irrigation tariff, presently GEL

75/ha. Farmers would purchase their own in-field drip systems and would also commit to registering their land with the national registry. Farmers are currently buying water from tanker trucks at a cost of 800 to 1,000 GEL per hectare, so the savings to them under this arrangement would be considerable.

This is an example of the type of water wholesaling arrangement the Company hopes to establish across its entire service area. In this particular case, medium to large-scale producers of two high-value products – wine for export and premium peaches for the local market – have both the willingness and the ability to pay the full operational costs of a local-level lift irrigation system and to share in the capital cost of system construction. In the Company's vision of its future operations, either WUOs or units of this type would be established all across GA's gravity systems, purchasing bulk water from GA and distributing it to individual farmers.

There is no necessity to standardize on a single type of local level water management entity, since contracts linking main and local level systems can be tailored to the type of client contracting for service. In fact encouraging several different types of local level water management entities would generate valuable experience regarding the strengths and weaknesses of different models.

## Local level O&M

The operational tasks undertaken by a WUO depend, to some extent, on its size. In general, a WUO covering 1,000 hectares would be expected to contract with GA for a bulk water supply, measure and record bulk deliveries, arrange delivery schedules with individual farmers, operate gates and turnout structures to implement the schedules, and conduct routine maintenance, such as weed clearance and periodic desilting, and special maintenance and repairs as required. A standard set of operating procedures will be developed by the WUO Support Unit which can be customized for individual WUOs as they gain experience.

Supporting tasks carried out by the WUO would include executing service agreements with individual farmers, billing water users, collecting service fees, and enforcing payment, in addition to standard administrative tasks such as personnel management, and financial accounting.

## Needed reforms

- GoG to adopt a new WUO Law, or a new WUO section of a broader Amelioration Law, defining WUOs, enabling their establishment and guiding their formation and operation
- GA, with regulatory endorsement, to announce a new system of irrigation tariffs presenting significantly lower rates for WUO-provided service.
- MoA to instigate establishment of a WU Support Unit (WUSU) to form and support WUOs across all irrigation systems in the country
- GA to assume ownership of, or controlling authority over, all public irrigation facilities of all types and sizes in the country, enabling it to assign use rights for local level facilities to WUOs and to monitor the condition of this infrastructure after delegation

# *Irrigation Tariffs*

## Summary

Irrigation water is both a commercial input to irrigated agriculture and a powerful tool for stimulating rural economic development. As such, its provision is a potential candidate for public funding as well as being a privately purchased input for agricultural production.

The independent regulator will estimate a proposed bulk water tariff for different group of systems operated by GA. Tariffs will be set to cover reasonable system-specific long-term main system operating and maintenance costs plus depreciation, while insuring sustainable lowest-cost service to irrigators.

The bulk water tariff will consist of two parts – one fixed and one variable. The fixed portion will be based on the area of agricultural land within the boundaries of the local water retailer. The variable portion will be based on the measured volume of water delivered to each local water retailer, whether a WUO, a municipality, a corporate farm, or other local level operator, at rates specified in the contract between the retailer and GA.

WUOs will set and collect their own retail water tariffs, taking into account the bulk water tariff specified in the contract. Retail tariffs will be based on long-term O&M costs, including bulk water costs, and collected directly from irrigators by the local level service provider (WUO).

The GoG will support its economic development objectives – expanding agricultural output and increasing rural incomes – by providing the capital for initial system rehabilitation. The government may provide direct subsidies to help cover the cost of the irrigation tariff to certain groups of individual farmers, based on their ability to pay.

## Tariff Structure and Subsidies

### Tariff structure

#### Bulk water supply

The independent regulator will establish a bulk water tariff for each group of systems operated by GA. Tariffs will be set to cover main system O&M costs, including reasonable costs of central administration and coordination, as well as estimated depreciation (replacement) costs. System maintenance will carried out to include incremental repair and replacement of deteriorated system assets on an as-needed basis in order to deliver a constant high level of service. This contrasts with the outdated *rehabilitate-decay-rehabilitate* model in which system assets are allowed to degrade and fail between periodic rehabilitations.

In the absence of competition, proposed bulk water tariffs will be reviewed and approved by an external regulator to insure lowest-cost sustainable service to irrigators. A small regulatory fee would be included in the bulk water tariff, payable directly to the regulator, to cover the costs of regulation.

The bulk water tariff will consist of two parts – one fixed and one variable. The fixed portion will be based on the area of agricultural land within the boundaries of the local water retailer, as specified in the operating license awarded to GA by the regulator. The variable portion of

the tariff will be based on the measured volume of water delivered to each local water retailer at volumetric rates specified in the contract.

Bulk water tariff formulas may include a term for return on asset base, but as long as GA is publically-owned, this term will be set to zero. If GA raises private capital, it may include the financing costs of that capital in its rate structure, as authorized by the regulator. In the event that ownership shares in GA are sold to private sector entities, a return on equity equivalent to the share of private ownership can be authorized by the regulator.

**Retail service delivery**

WUOs will set their own retail water tariffs, taking into account the bulk water tariff specified in the contract with GA. Retail tariffs will be based on long-term O&M costs, including bulk water costs and may include both fixed and variable components. The retail tariff would be collected from individual water users by the WUO, based on a suitable proxy for volume of water used, or by another charging system chosen by the WUO.

As an interim measure, GA may continue to provide both bulk and retail irrigation service to individual farmers in certain systems as it does at present, particularly in systems which have not been fully rehabilitated and modernized. In such cases, GA would propose separate bulk and retail tariffs to the independent regulator for approval and combine the two when billing farmers served directly.

The ability to provide direct service will sunset after 5 to 7 years, at which time, all service to small individual irrigators must be delivered through a WUO or similar local level retailer.

## Financial Assistance

The GoG will support its economic development objectives of expanding agricultural output and increasing rural incomes by providing capital for initial system rehabilitation, drawn either from its own resources or from donor financing. Beyond this initial restoration of irrigation system functionality, additional financial assistance may be needed, either to promote government objectives of poverty alleviation and accelerated rural growth, or because farmers' ability to pay, even with the increased farm income resulting from the provision of irrigation service, is not sufficient to support the full cost of service provision.

In the event that the full costs of irrigation still exceed the ability of some classes of irrigators to pay, the GoG may target particular classes of irrigators with financial assistance that can be used by them to pay tariffs reflecting the full cost of sustainable irrigation service. This could be done by adding the amount of the desired subsidy to the prepaid debit cards that farmers currently receive for other agricultural inputs from the MoA's Agricultural Projects Management Agency (APMA). This approach has the advantage of targeting only those farmers who are in need of subsidies as a result, for example, of small farm size or the low value of the crops they produce. It has the disadvantage of reinforcing the *status quo* with respect to choice of low-value subsistence crops and is administratively cumbersome and prone to bias. It also requires accurate information on land holding sizes and farm incomes, which is not generally available at present.

The recent direct input subsidy scheme for fertilizer and other inputs, operated by the Ministry of Agriculture, expired at the end of 2016. If this mechanism for providing selective subsidies for irrigation tariffs is adopted by the GoG, the APMA scheme will be extended accordingly.

In order to assess financial assistance needs and to facilitate assessment of the impacts and performance of irrigation development programs in general, MoA will introduce changes in its data gathering programs separating statistics on irrigated and rainfed production.

### Needed reforms

- External regulator to complete design of a proposed bulk supply tariff system
- MoA to refine its collection procedures for agricultural statistics to separate irrigated and rainfed cropping patterns, yields, and production levels.
- MoA to carry out studies of expected farm incomes and farmers ability to pay irrigation tariffs
- MoA to establish a mechanism for channeling any needed financial assistance to individual farmers, based on information provided by GA and its regulator

## *Regulation*

### Summary

Georgian Amelioration is a monopoly service provider which charges tariffs for its services. Because of its monopoly status, there is a need for independent oversight to review and approve the costs which GA proposes to pass on to its clients in the form of tariffs and also to monitor and ensure the quality of service it provides to them. GNERC will assume this task. Where WUOs exist, GNERC will establish a bulk water tariff for sale to the WUO. In the absence of a WUO and where, as a result, retail tariffs are levied by GA in addition to bulk water tariffs, both bulk and retail components of the tariff would be reviewed by the regulator.

Quality of service can be assured through provisions in contracts between GA and WUOs, which include penalties for failure to deliver agree-upon irrigation services. GNERC will resolve disputes arising between GA and its clients as necessary.

A third regulatory need, that of ensuring adequate maintenance of infrastructure assigned to a WUO for use, will be accomplished through contract provisions and periodic joint inspections.

### Discussion

Because GA is a monopoly service provider, and given its status as a private company, there is a need for an independent mechanism to regulate the costs it passes along to its clients and to resolve disputes between those clients and GA. That regulatory responsibility will be conferred on the Georgian National Energy and Water Supply Regulatory Commission (GNERC), which currently regulates electricity, natural gas, and domestic water providers. This experienced and capable body is headed by three commissioners, supported by a staff of 110. Its annual budget of around GEL 8 million is met from a regulatory assessment on the regulated entities, insuring its independence from the public budgeting process.

GNERC will perform four regulatory functions with respect to GA. These are (1) licensing, (2) tariff setting, (3) dispute resolution, and (4) quality of service regulation. In its tariff-setting role, it will review the financial submissions and tariff proposals of GA and then set an allowable tariffs

(or tariff ceilings) for the coming rate period. Given the existing tariff-setting expertise in GNERC, total regulatory costs should increase only modestly.

The introduction of the ERP accounting system into GA operations will ease one hurdle for effective regulation by producing detailed and cost-center-based information on GA's costs of operation. Such information has not been available in the past and is a vital input to a regulator's tariff review process. Building the required regulatory capacity will require specialize training for GNERC staff in the specifics of irrigation tariff setting and service delivery, which can be supported by external donors. The groundwork of analyzing GA accounts and assessing the reasonableness of costs could be contracted out to a private firm, if the competence of the firm was assured and if this were a less costly alternative to hiring additional GNERC regulatory staff, or if the issues were so complex that highly-specialized outside expertise was desirable.

At the local level, one major advantage of the WUO form of organization is that it is, to a large extent, self-regulating. Under a WUO approach, farmers determine the level of service they desire (and can afford) and then, through the internal governance structures of the WUO, establish a tariff level and monitor the delivery of services. If service is sub-standard, the elected governing board of the WUO can hold the hired WUO manager accountable and take corrective action, firing him/her if necessary. If the elected board fails to take action, WUO members can call an extraordinary meeting of the WUO general assembly and change the management board.

To supplement this basic self-regulation, it is necessary to provide a degree of external oversight of the WUO to insure that governance and management processes are fair, equitable, and transparent. The job of the external overseer is to ensure that each WUO properly maintains the necessary books, records and accounts and complies with relevant legislation in terms of its operation, for example, by holding periodic meetings of the management board and general assembly. This overseer is not entitled to second-guess the decisions lawfully made by the WUO organs or to seek to substitute its own judgment for that of the WUO. While the routine work of such an overseer is typically based on annual inspection of WUO accounts and the annual reports it files, provision is also typically made in legislation for physical inspection in the event that a malfeasance is identified or on the request of WUO members. It is expected that a new WUO Monitoring and Oversight Unit established by MoA would perform this function.

A final regulatory task is for the owner of the irrigation and drainage facilities to insure that facilities handed over to outside parties to utilize do not deteriorate significantly over time. Standards will be specified and provision for regular joint inspections will be included in the service contracts signed by GA and its clients.

## Needed reforms

- GoG to assign responsibility for regulating wholesale irrigation services to GNERC
- GNERC to augment existing capacity with expertise in irrigation contracting and tariff setting, supported with capacity building assistance from external partners as needed
- GA to develop a model service contract for local level service providers that includes irrigation service standards and physical standards and inspection procedures for infrastructure, for approval by the regulator

# 8. Implementation

## *Needed reforms*

In light of the foregoing discussion, a number of legal and administrative actions are needed to move forward in creating a vibrant and viable irrigated agriculture. These include the following, consolidated from the previous section.

### Irrigation Expansion

- GA to establish and train an Investment Screening Unit within its Design Bureau. This unit would be responsible for preliminary hydrologic, economic, and financial analyses of proposed rehabilitation projects.
- MoA to secure free or affordable access to river discharge data from the Hydromet Service to make hydrologic screening possible.
- MoA to initiate a study of the potential for agricultural groundwater development to be undertaken by MENRP and introduce programs which facilitate and support private groundwater development and drip irrigation installation along with small reservoir development to serve drip systems.
- GA to strengthen its capacity to take a more aggressive stance in monitoring the quality of rehabilitation construction performed on irrigation systems that it will be required to operate and maintain.
- GA to prepare guidelines for modernization investments in water measurement and control and develop main system operational plans for systems to be rehabilitated.

### Main System Management

- MoA to establish a diversified supervisory board for GA, which includes both government and non-government members.
- GA to install modern systems of data-based management in all rehabilitated irrigation schemes and build staff capacity to employ them.

### Local Level Management

- GoG to adopt a new national WUO Law, or a WUO section of a broader Amelioration Law, enabling WUO establishment and guiding their formation and operation.
- GA, with endorsement from the regulator, to announce a new system of irrigation tariffs, presenting significantly lower rates for WUO-provided service, relative to direct service from GA.
- MoA to instigate establishment of a WU Support Unit (WUSU) to form and support WUOs across all irrigation systems in the country.
- GA to assume ownership of, or controlling authority over, all public irrigation facilities of all types and sizes in the country, enabling it to assign use rights for local level facilities to WUOs and to monitor the condition of this infrastructure after delegation.

## Irrigation Tariffs

- External regulator to complete design of a proposed bulk supply tariff system.
- MoA to revise collection procedures for agricultural statistics, separating irrigated and rainfed areas, cropping patterns, yields and production.
- MoA to carry out studies of expected farm incomes and farmers ability to pay irrigation tariffs.
- MoA to establish a mechanism for channeling any needed financial assistance to individual farmers, based on information provided by GA and its regulator.

## Regulation

- GoG to assign responsibility for regulating wholesale irrigation services to GNERC
- GNERC to augment existing capacity with expertise in irrigation contracting and tariff setting, supported with capacity building assistance from external partners, as needed
- GA to develop a model service contract for local level service providers that includes irrigation service standards and physical standards and inspection procedures for infrastructure for approval by GNERC

## *Responsibilities for action*

Important actions required to implement the Strategy, with responsibilities for action shown in Table 8.1.

**Table 8.1. Action matrix**

| # | Task | Action | Actor | | | | |
|---|---|---|---|---|---|---|---|
| | | | GA | MoA | GNERC | GoG | Parliament |
| **Expansion** | | | | | | | |
| 1 | | Establish investment screening unit | X | | | | |
| 2 | | Secure access to Hydromet river flow data | | X | | X | |
| 3 | | Initiate groundwater study | | X | | | |
| 4 | | Strengthen construction oversight | X | | | | |
| 5 | | Prepare system modernization plan | X | | | | |
| **Main System Management** | | | | | | | |
| 6 | | Establish GA supervisory board | | X | | | |
| 7 | | Introduce data-based irrigation management systems | X | | | | |
| **Local Level Management** | | | | | | | |
| 8 | | Prepare and pass new WUO Law | X | X | | X | X |
| 9 | | Announce new tariff system | X | | X | | |
| 10 | | Initiate establishment of Water User Support Unit | X | X | | | |
| 11 | | Consolidate ownership of all public irrigation infracture on GA books | | | | X | |
| **Tariffs** | | | | | | | |
| 12 | | Design new tariff and regulation system | | | X | | |
| 13 | | Revise agricultural data collection to distinguish irrigated and rainfed production | | X | | | |
| 14 | | Assess farmers' ability-to-pay irrigation tariffs | | X | | | |
| 15 | | Develop mechanism for channeling financial assistance to farmers in need | X | X | | X | |
| **Regulation** | | | | | | | |
| 16 | | Assign responsibility for regulating wholesale irrigation services to GNERC | | | | X | X |
| 17 | | Augment GNERC capacity to regulate irrigation sector | | X | X | | |
| 18 | | Develop model service contract for WUOs that regulates facilities condition | X | X | X | | |

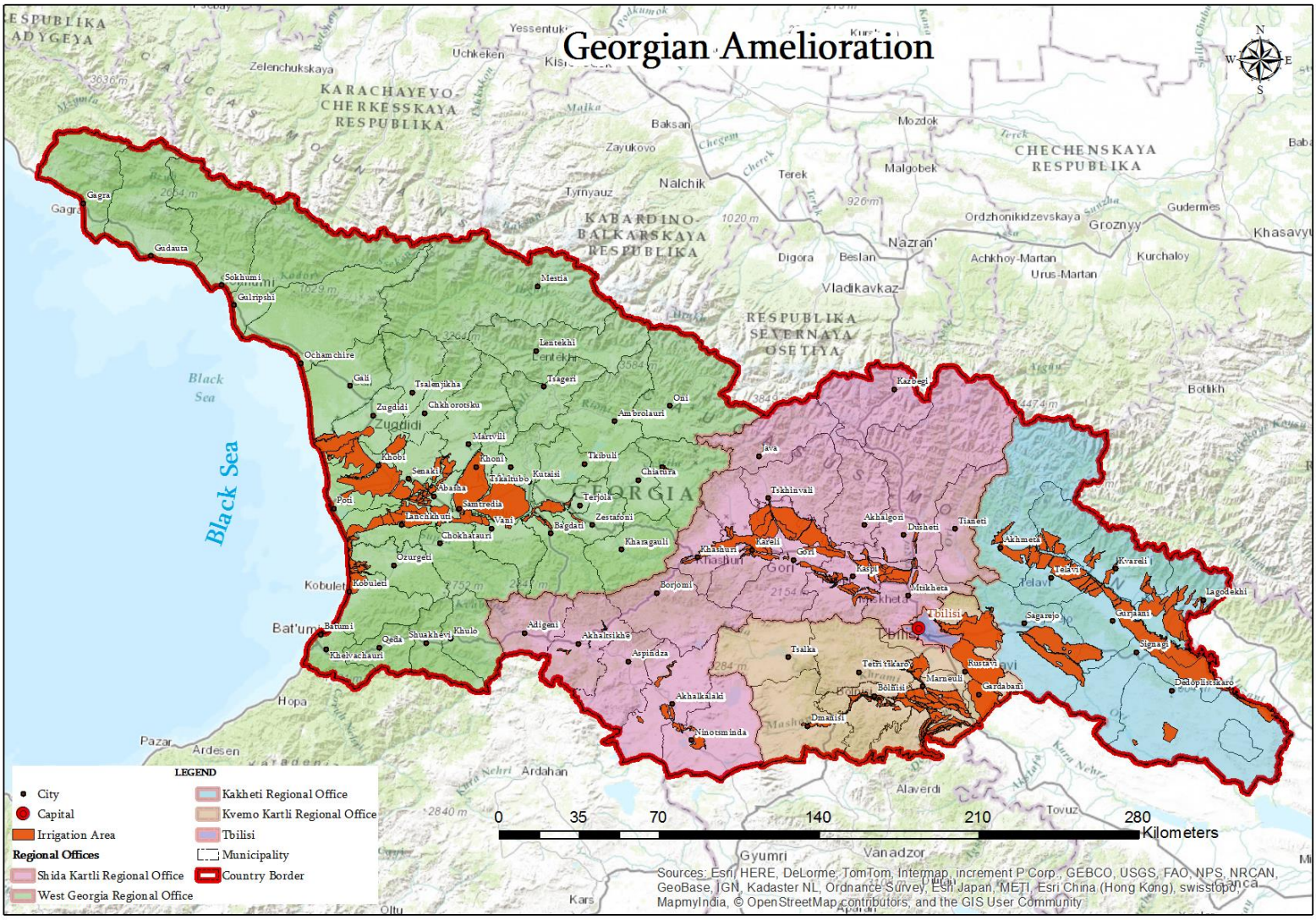
## *Next Step*

The next step in the reform process is to develop an action plan to guide the preparation of required legal instruments, plans and guidelines for system operations, and the capacity building needed to implement new procedures and practices effectively. Primary capacity building support will be directed to and through GA. General needs include the following.

- Assistance in drafting new Hydromelioration and WUO Laws for the country
- Computer equipment, training, and support for a new Water User Organization Support Unit
- Computer equipment, training, and support for the Rehabilitation Screening Unit within GA
- Development of a real-time data link with the Hydromet Service of the NEA
- Preparation of guidelines for system modernization
- Training in budget development and long range planning for all Service Center and Department heads and MoA
- Installation of modern flow measurement devices and data acquisition systems for key points in all large irrigation systems
- Training in data-based system operations for GA Service Center personnel
- Pilot automation of main system controls in selected systems
- Training in maintenance practices and asset management for GA Service Center personnel

Specific needs to flesh out the capacity building action plan will be identified by GA and MoA, with assistance from external consultants as required. Extensive support for WUO development will also be required.

# Annex 1. Irrigated areas and GA regional boundaries



# Annex 2. Rehabilitation Scheme Screening Methodology

**Summary**

**Eligibility Criteria [Pass or Fail]**

1. Sufficient availability of water
2. No significant risk of technical failure (seismic, cross-border water supply)
3. Existence of contracts with farmers or local level farmer organizations for water distribution (currently functioning schemes)

*Only schemes passing the above criteria would be evaluated for the following economic and financial criteria.*

4. Economically viable
5. Financially sustainable

**Prioritization of Eligible Schemes [Ranking]**

1. Share of farmers currently contracting for water and paying fees (weighting 15%)
2. Economic viability (weighting 50%)
3. Poverty impact (weighting 35%)

Notes

- Schemes would first be assessed in terms of the first three eligibility criteria. Those passing would be assessed in terms of criteria 4 and 5 . Those passing all five criteria would move on to the prioritization stage.
- A separate screening system will be needed for drainage schemes.

**Eligibility Criteria [Pass or Fail]**

**1. Sufficient availability of water ($RWS_s$ > 2.0; $RWS_m$ > 1.5)**

Definition

- RWS = volume of water available at source/aggregate crop water demand

- $RWS_s$ = RWS for entire growing season; $RWS_m$ = RWS for each month in the growing season
- Water availability based on measured historical discharge in river, including the effects of any upstream hydropower operations
- Water availability at the system intake is net of any downstream requirements for irrigation, municipal, environmental, and other uses
- Ministry/Company can adjust RWS target values as applied to all considered schemes if desired

Notes

- The Relative Water Supply (RWS) value for each scheme is computed by dividing the average historical water available for a period by the computed crop water requirement (PET) for an assumed post-rehabilitation cropping pattern for the same period. Software is readily available for this. The criteria would then be, for example, that RWS must be > 2.0 for the season and > say 1.5 for each month of the growing season.
- This approach would automatically aggregate and consider all losses in the system while bypassing the need to make explicit assumptions about individual technical efficiencies.
- A RWS of 2.0, for example, says that there is two times as much water available in the river at the point of diversion as would actually be taken up by crops in farmers' fields, with the extra water available to satisfy the various technical and management losses incurred and to provide a margin of safety.
- The monthly criterion is less stringent because it is assumed that more intensive management during limited critical periods would reduce lost and wasted water.
- Monthly supplies would be computed considering the typical hydropower release schedule from any upstream hydropower reservoirs. Any downstream water requirements (including trans-boundary requirements) would be subtracted from river discharge at the intake to yield net availability.

**2. No significant risk of technical failure**

Definition

- Technical failure means the collapse or breaching of a major structure such as main canal or dam. Significant risk means that a reasonable possibility exists of a technical failure that would be difficult or very expensive to mitigate. Examples might be structures which would be located on active seismic zones or on unstable soils or foundations.

Notes

- Risks would be evaluated through review of system design documents, reconnaissance visits, and discussions with local GA officers, resulting in “yes/no” determination.

**3. Contracts with local farmers [31]**

Definition

- GA has signed contracts with farmers in place for the current year covering at least 50% of the current irrigable area of the system, either as individuals or through some form of joint contracting.

Notes

- “Current irrigable area” is the area which has an adequate water supply and working distribution networks capable of delivering water throughout that area.

**4. Economic viability**

Definition

- Economic internal rate of return (EIRR) > 10 percent
- Net present value (NPV) > 0

Notes

- Economic viability based on EIRR and NPV.
- Need to develop a set of standard crop-specific values for productivity and net returns to facilitate economic screening.
- Sensitivity analysis should not reveal extreme single risks to achievement of economic viability.
- MOF / MOA have the option to define a lower minimum EIRR.
- GA are now not routinely excluding pumped schemes, arguing that they are viable in combination with drip irrigation where farmers are willing to invest in this. Their viability should be reflected in the economic analysis.

[31] In the event that the scheme is completely non-functional, another procedure based on meetings with an assembly of farmers would have to be developed to assess interest.

### 5. Financial Sustainability

Definition

- Increase in gross margin (GM) > 2 times estimated system-specific O&M cost

Notes

- Purpose is to insure that full O&M cost recovery would still leave an adequate share of the increase in GM to farmers as an operating incentive.
- Value of 2 in definition reflects an even split of the added value between the Company and the farmer; this can be adjusted upwards by GA/Ministry but should not be reduced below 2.
- Sustainability here is defined in terms of operation and maintenance expenses only. Investments sourced from funds which require capital cost recovery would require a modified cost definition.

## Prioritization of Eligible Schemes [Ranking]

### 1. Farmers contracting for water and paying ISF (weighting 15%)

Definition

- Percent of total active scheme service area operated by farmers contracting with the Company for water and paying irrigation service fee (ISF).

Notes

- Score is based on percent of area relative to the largest percentage found in a considered scheme and weighting for criterion 1.
- This criterion gives priority to schemes which are still, in part at least, functioning. It provides an index of how interested farmers are in irrigated agriculture and how willing they are to pay for irrigation service.
- This criterion may need to be relaxed or revised once the majority of functioning schemes have been rehabilitated and attention shifts to schemes which are completely non-functional.
- An example of application of this criterion is shown below.

**Farmer Commitment**

Weighting 15%

| Scheme | Area of farmers contracting and paying (ha/total irrigable ha) | Score | Weighted Score |
|---|---|---|---|
| **A** | 78% | 78 | 12 |
| **B** | 52% | 52 | 8 |
| **C** | 100% | 100 | 15 |
| **D** | 86% | 86 | 13 |
| **E** | 40% | 40 | 6 |
| **F** | 22% | 22 | 3 |

## 2. Economic Viability (weighting 50%)

Definition

- Part 1: Economic internal rate of return (weighting 25%) .
- Part 2: Net present value at 10% discount rate (weighting 25%)

Notes

- Score for part 1 is based on EIRR relative to highest EIRR and weighting for part 1 of criterion 2.
- Score for part 2 is based on NPV relative to highest NPV and weighting for part 2 of criterion 2.
- Total score is based on sum of weighted scores for part 1 and part 2 of the criterion.
- An example of application of this criterion is shown below.

**Economic Viability**

| Scheme | EIRR | Score | Weighted Score | NPV ($1000) | Score | Weighted score | Total weighted score |
|---|---|---|---|---|---|---|---|
| | | | 25% | | | 25% | 50% |
| A | 55% | 86 | 21 | 25,000 | 46 | 12 | 33 |
| B | 38% | 59 | 15 | 17,000 | 31 | 8 | 23 |
| C | 16% | 25 | 6 | 54,000 | 100 | 25 | 31 |
| D | 64% | 100 | 25 | 15,000 | 28 | 7 | 32 |
| E | 45% | 70 | 18 | 30,000 | 56 | 14 | 31 |
| F | 14% | 22 | 5 | 43,000 | 80 | 20 | 25 |

## 3. Poverty Impact (weighting 35%)

Definition

- Part 1: Number of farmer beneficiaries per 100 hectares (weighting 15%).
- Part 2: Rehabilitation cost per hectare (weighting 10%).

Notes

- Score is based on sum of weighted scores for part 1 and part 2 of the criterion.
- Using the number of beneficiaries is a good way to identify schemes with the most asset poor individuals in terms of land ownership. However, there are disadvantages to prioritizing the very smallest farmers who may have a lower willingness to pay. A further weakness in this indicator is that the quality of land is very different in different regions, compromising comparisons based on land holding size. A third disadvantage is that it

reflects distribution of direct agricultural benefits only and ignores positive impacts on agricultural employment and employment in input supply and output processing enterprises. Nevertheless, given its simplicity and its strong appeal to policy makers, it is retained here.

- Note that this criterion should apply to area owned per individual and not farm area, which may be different because of leasing-in and cooperative management.
- A criterion based on investment cost per hectare irrigated, irrespective of the EIRR calculation will tend to spread constrained project financing across a larger area and more beneficiaries. In addition, projects which are significantly more expensive are generally more complex and therefore riskier, with more assumptions to be made and more things to go wrong. This criteria would tend to work against projects requiring construction of new reservoirs, while not eliminating such projects categorically.
- An example of application of this criterion is shown below.

| Scheme | Number of farmers (#/ 100 ha) | Score | Weighted score | | Rehabilitation cost ($/ha) | Rehabilitation cost (ha/$1,000) | Score | Weighted score | Total weighted score |
|---|---|---|---|---|---|---|---|---|---|
| | Weight | | 15% | | | | | 20% | 35% |
| A | 98.00 | 100 | 15 | | $ 1,000 | 1.00 | 50 | 10 | 25 |
| B | 75.00 | 77 | 11 | | $ 850 | 1.18 | 59 | 12 | 23 |
| C | 96.00 | 98 | 15 | | $ 2,700 | 0.37 | 19 | 4 | 18 |
| D | 55.00 | 56 | 8 | | $ 500 | 2.00 | 100 | 20 | 28 |
| E | 18.00 | 18 | 3 | | $ 1,280 | 0.78 | 39 | 8 | 11 |
| F | 45.00 | 46 | 7 | | $ 2,150 | 0.47 | 23 | 5 | 12 |

## Combined evaluation and ranking

**Irrigation Scheme Selection**

| Scheme | Eligibility Criteria [1= Pass, 0= Fail] | | | | | Prioritization of Eligible Schemes [Ranking] | | | | Ranking |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1. Sufficient availability of water | 2. No significant risk of technical failure | 3. Existence of local level farmer-based organization for water distribution | 4. Economically viable | 5. Financially sustainable | 1. Farmer commitment weighted score (15%) | 2. Economic viability weighted score (50%) | 3. Poverty impact weighted score (35%) | Total weighted score | |
| A | 1 | 1 | 1 | 1 | 1 | 12 | 33 | 25 | 70 | 2 |
| B | 1 | 1 | 1 | 1 | 1 | 8 | 23 | 23 | 54 | 4 |
| C | 1 | 1 | 1 | 1 | 1 | 15 | 31 | 18 | 65 | 3 |
| D | 1 | 1 | 1 | 1 | 1 | 13 | 32 | 28 | 73 | 1 |
| E | 1 | 1 | 1 | 1 | 1 | 6 | 31 | 11 | 48 | 5 |
| F | 1 | 1 | 1 | 1 | 1 | 3 | 25 | 12 | 40 | 6 |
| G | 1 | 1 | 1 | 0 | NA | | | | | FAIL |
| H | 0 | 1 | 1 | NA | NA | | | | | FAIL |