

IRRIGATION AND DRAINAGE STRATEGY OF UKRAINE

FINAL DRAFT PROPOSAL

Prepared jointly by an expert team from the World Bank, the Food and Agriculture Organization of the United Nations, and the Institute for Water Problems and Land Reclamation of the Ukrainian Academy of Agrarian Science, in collaboration with the Coordination Committee established under the Cabinet of Ministers



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Foreword

Ukraine's irrigation sector is facing a period of unprecedented challenge. After years of disinvestment in irrigation, drainage and associated hydraulic infrastructure, the need for investment into infrastructure rehabilitation, modernization and management is becoming ever more pressing. Much of the public irrigation and drainage infrastructure was designed and constructed during Soviet times, when irrigated agricultural production was centrally planned, water resources plentiful and the cost of electricity for pumping not an issue. The situation has changed radically and systems are not properly adapted to the needs of the irrigated agricultural sector in Ukraine today.

In 2015, the government approved the Single and Comprehensive Strategy for Agriculture and Rural Development in Ukraine 2015-2020, which provides a strategic framework for the development of the agricultural sector as a whole, addressing crop production, land tenure and land management, access to credit, taxation, agricultural research and education, state support mechanisms, food safety, environment and other related issues. However, the Strategy does not sufficiently address the role of irrigation and drainage in Ukraine.

In July 2015, the Minister of Agrarian Policy and Food established a Coordinating Committee with five working groups tasked to develop an Irrigation & Drainage Strategy for Ukraine and thereby fill the strategic gap in the Agriculture and Rural Development Strategy. The Committee has over 40 members and is chaired by the Deputy Minister of Agrarian Policy and Food. Members of the Committee include representatives of other ministries, parliament, the State Agency for Water Resources, the Academy of Agrarian Science, private agri-businesses and farmers' associations. Members of the Committee also include a team of national and international experts from the World Bank.

This approach was considered instrumental for the successful continuation of the overall strategy formulation process. The drafting of the strategy for renewal and development of irrigation and drainage systems in Ukraine was developed and approved by resolution of the Cabinet of Ministers of Ukraine No. 50 dated January 27, 2016 "On setting-up the coordination council on issues of operational rehabilitation and development of irrigation systems".

Numerous stakeholders participated in the strategy development process, including Members of Parliament, representatives of the Ministry of Agrarian Policy and Food, the Ministry of Ecology and Natural Resources, the Ministry of Regional Development, Construction and Housing, the State Agency for Water Resources, the Ukrainian Centre for Hydrometeorology, the Zaporizhzhya, Mykolayiv, Odessa and Kherson Oblast Administrations and the Water Resources Administrations of these oblasts, scientists from the Academy of Agrarian Science, agricultural producers, representatives of local government authorities, public representatives, members of Parliament and experts of the World Bank, FAO and US Agency for International Development (USAID).

Work on the strategy was led by the Coordination Committee, with intermediate results reviewed at its meetings. A first milestone was reached in January 2017, when the Coordinating Committee approved a set of 15 "Principles for Development of the Strategy for Land Amelioration in Ukraine" to guide the formulation of a more comprehensive strategic document. This first full version of the Strategy was developed by the editing group established by the Coordination Committee in January 2017, consisting of the World Bank and

FAO team and experts of the Institute of Water Problems and Land Reclamation of the Ukrainian Academy of Agrarian Science. It is based on the conclusions of the Working Group from work conducted over the period from March 2015 till May 2017, and constitutes a draft proposal for a comprehensive strategy for irrigation and drainage in Ukraine.

On September 21, 2017, the draft proposal for the Strategy was submitted to the Coordinating Committee and subsequently approved in principle, subject to consideration of discussions that arose during the meeting. Once finalized, the document will be formally submitted to the Council of Ministers for adoption. While this strategy sets a medium-term target for irrigation modernisation, rehabilitation and expansion to result in effective irrigation on 810,000 ha, the possibility for further expansion on up to 1.5 million ha of irrigated land was discussed, where future analysis shows it to be practical and economic. In addition, drainage targets would be set following detailed review, considering both the 3 million ha that are currently drained and the possibility of expanding this on up to 1 million additional hectares. Moreover, the meeting discussed the possibility of forming a 'water service entity' in Phase I as an intermediary form for infrastructure management.

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List of acronyms

SAWR: State Agency for Water Resources

WUO: Water Users' Organisation

RIDO: Regional Irrigation & Drainage Organisation

Executive Summary

A. Background

A1. The importance of irrigation and drainage to Ukraine's agriculture

- S.1 Agriculture directly generates 10 % of GDP, 20 % of exports and 5 % of employment, with significant additional impact in input supply, processing and marketing. Irrigation covers 1 % of all agricultural land but is much more important for certain crops (e.g. 15 % of potatoes, almost all tomatoes & rice) and regions (e.g. 14 % Kherson oblast), contributing to the rural economy in these areas. Drainage covers around 10 % of agricultural land, mainly in the north and north-west, and makes a significant contribution to Ukraine's total production.
- S.2 The main objective of irrigation and drainage and their reform is economic: to make Ukraine richer, with the additional wealth benefitting the lives of people involved throughout the production chain.
- S.3 The main rationale for government involvement is that irrigation and drainage depend on large-scale public-good infrastructure that private individuals and companies cannot provide, and without which the agricultural sector cannot fulfil its potential. This strategy provides a roadmap for government to exercise this responsibility in the most effective way, complementing the overall sector vision set out in Ukraine's Strategy for Agriculture and Rural Development.

A2. Climate change and its implications

- S.4 Ukraine is becoming marginally wetter and markedly hotter, increasing rainfed yields in the north and irrigation requirements in the south. Thus irrigation will become increasingly important to crop farmers in the south of Ukraine; fortunately, climate-change models predict that there will be sufficient water to support this, even on an expanded irrigation area.

A3. Land reform

- S.5 The moratorium on land sales means that large farms depending on land leases, which hampers access to finance and discourages investment in irrigation and drainage.

A4. Strategy development

- S.6 The Government invited the World Bank and FAO to help draft this strategy with a Working Group of many stakeholders. All key elements were discussed and agreed by the Working Group in February 2017. This draft strategy has been prepared by the World Bank/FAO team and the Institute for Water Problems and Land Reclamation, for discussion and finalisation by the Working Group, then formal submission to the Council of Ministers for adoption.

B. Irrigation and drainage system

B1. Decline of the irrigation and drainage system

- S.7 Ukraine's irrigation and drainage system was developed for state-run farms under the Soviet Union. Economic and political transition after the collapse of the Soviet Union broke up these large structures and created an ownership and funding vacuum leading to widespread deterioration. By 2013 the irrigated area had reduced from 2.2 million to around 370,000 ha.

Drainage suffered a reduction in efficacy due to lack of regular maintenance, as well as a reduction in the area under two-way drainage (draining in winter, irrigating in summer).

- S.8 Transition also changed the relative prices of capital, labour, electricity and agricultural products, so some previously-irrigated areas may no longer be economic.

B2. Current institutional and funding arrangements

- S.9 The State Agency for Water Resources (SAWR) delivers the large majority of irrigation, pumping water to large centre-pivot sprinklers on fields of around one square kilometre. It also manages the main drainage systems and flood defences.
- S.10 SAWR reports to the Ministry of Ecology and Natural Resources, employs around 28,000 people, comprises over 250 legal entities, and has a budget of \$ 200 million, of which 80 % is for irrigation and drainage. User fees cover 45 % and the state 55 %. Most expenditure goes on staff costs and electricity, with little for maintenance. Whilst the irrigated area has fallen by more than 80 %, staff and other costs have not reduced by nearly so much, and it is widely recognised that costs must be reduced and efficiency increased.
- S.11 Given that most irrigation and drainage is managed by SAWR, and that most of SAWR's staff and budget are devoted to this task, reform of the irrigation and drainage sector will inevitably involve major reform of SAWR. This reform should also address other aspects of the water sector, including implementation the EU Water Framework Directive, and this strategy offers a comprehensive framework for reform.

B3. An example of irrigation in practice

- S.12 An example where irrigation still functions well is secondary canal R1 on the Kakhovska Main Canal. It is supplied from Kakhovska reservoir, like 80 % of Ukraine's current irrigated area, through Kakhovska main pump station and a secondary pump station.
- S.13 Secondary canal R1 is 27 km long and supplies 17 Pressure Pump Stations, each serving around 1,000 hectares of soya, maize, wheat and vegetables; 95 % of the area is managed by 30 large farmers, with 1-5 users per pump station. It could be covered by one Water Users' Organisation as a rational hydraulic unit, with a reasonable economy of scale, a manageable number of members, and no dominant farms.

B4. Investment opportunities in irrigation

- S.14 Investment can increase make the irrigation system more profitable through **modernisation** of systems that currently work, to make them work better; **rehabilitation** of systems that used to work but have fallen into disrepair; and **expansion** of irrigation onto new areas that were not previously irrigated.
- S.15 Priority should be given to areas where water is cheap, the basic infrastructure is in reasonably good condition, the benefits of irrigation are high, and the environmental and other social costs are low. This indicates six canals, which currently irrigate almost 300,000 hectares, 80 % of the total irrigated area:
- **Kakhovska** canal, supplied by Kakhovska main pump station and feeding **Sirogozska** and **Priazovska** canals;
 - **North Crimea Canal** gravity section, supplying **Chaplinsky** and **Krasnosnamenska** canals.
- S.16 Modernisation of tertiary systems should replace pressure pumps, centre-pivot sprinklers and parts of the pipe and electricity supply networks, to increase reliability, lower pressure and

reduce pumping costs. Typical modernisation costs will be around \$ 1,400 per hectare, two-thirds on individual farms and one-third for the common pump station and pipe network. Rehabilitation will cost around \$ 2,400 per hectare, with two-thirds for common systems. Expansion may cost \$ 2,600 per hectare but take considerably longer. Repairs and improvements to canals and main pump stations will add further cost, as yet unquantified

S.17 Modernisation will bring lower electricity costs and higher yields worth around \$ 400 per hectare per year; rehabilitation and expansion bring benefits of around \$ 1,000 per hectare per year as farmers start growing soya and increase the area and yield of maize.

S.18 Across the six priority irrigation canals:

- modernisation of 147,000 hectares (50 %) would cost \$ 194 million;
- rehabilitation of 140,000 hectares (90 %) would cost \$ 342 million;
- expansion onto 20,000 hectares along the North Crimea and Chaplinky canals would cost \$ 52 million;
- total investment of \$ 560 million would result in an extra 160,000 hectares under irrigation, and an additional \$ 700 million of agricultural output per year.

S.19 In addition to these six priority canals, the SAWR 2013 inventory included 525,000 hectares of command area along twenty other canals, of which less than 80,000 hectares was irrigated that year. Some of these half-million hectares might be economic to rehabilitate and modernise in a second phase of investment, which would help to spread the overhead costs of these canals across a wider irrigated area and so increase profitability. However, investment costs, underlying profitability and environmental implications would need to be assessed carefully in each case.

S.20 A further 1.2 million hectares have been irrigated in the past but have now been written off by SAWR as the infrastructure is too badly deteriorated to bring them back into service without major investment. Whether it will ever be economic to restore irrigation on this area depends on multiple factors including climate change, world markets, the security situation and Ukraine's economic growth, but they are unlikely to be a priority for the country's limited capital resources in the duration of this current strategy.

S.21 The operational drainage system, including substantial areas of two-way drainage, stands at around 3 million hectares, or ten times the current irrigated area. Investment will also be required in this sector, with total needs likely to be of a similar order of magnitude to those for drainage. Further analysis of the costs and benefits should be conducted, and an appropriate investment programme developed and implemented in parallel with that for irrigation.

B5. The new role of government in irrigation and drainage

S.22 Transition to a market economy means that government should no longer intervene in markets or management decisions by farmers and private companies, but must: ensure that markets work efficiently; manage water resources and public infrastructure in the national interest; and involve farmers in the management of the irrigation and drainage systems.

C. Reform agenda

The case for reform

- S.23 Change is needed to adjust to the new market economy, reverse the decline in the irrigation and drainage sector, and improve efficiency. It should involve, in two phases:
- Reform 1: Improving stewardship of the national water resource
 - Reform 2: Improving the bulk delivery and removal of water
 - Reform 3: Transferring management to Water Users' Organisations
 - Reform 4: Ensuring financial sustainability
 - Reform 5: Stimulating profitable investment

Reform 1: Improving stewardship of the national water resource

- S.24 Ukraine must manage its national water in the interests of all users and the environment and in line with the EU Water Framework Directive, which introduces the two key concepts of ***Integrated Water Resource Management*** and ***River Basin Management***.
- S.25 The two functions of managing water resources and operating infrastructure should be separated because the roles are very different and there is a potential conflict of interest given the competing demands of other water uses and the impact of agricultural run-off on water quality.
- S.26 Phase I will strengthen the “Water Resources Division¹” and “Water Operations Division²” within SAWR, and begin a functional review of ancillary functions. The “Water Resources Division” consists of departments for each major river basin, each with a “Basin Council”, plus common supporting units. Further development of this division will involve reorganising resource-management staff in the current Oblast and Raion water management units, to better reflect the basin approach.
- S.27 Phase 2 will see the canals and drainage infrastructure moved out of SAWR into new regional bodies, leaving the State Agency for Water Resources to concentrate on water resource management in line with its name and its institutional location under the Ministry of Ecology. SAWR’s ancillary services, such as design bureaux and training institutions, will be retained, restructured, relocated or privatised, as determined by the functional review.
- S.28 Inter-ministerial coordination will continue under the Inter-Agency Commission for Water Resources during Phase 1, though with an independent chairman from outside SAWR. In Phase 2 it will be succeeded by a National Water Resources Committee to coordinate the activity of different ministries in the management and use of water resources.

Reform 2: Improving the bulk delivery and removal of water

- S.29 The Water Operations Division of SAWR will operate and maintain strategic irrigation and drainage infrastructure in Phase 1, supplying water and drainage services to water user (farmers, water users’ organisations and any municipalities or industries). Its main canal departments will be strengthened through reorganisation of operational staff in Oblast and

¹ Управління водних ресурсів.

² Управління експлуатації водогосподарських систем, енергозбереження та механізації.

Raion water management units, and new departments will be formed for main drainage systems. Each of these “infrastructure departments” managing a main canal or drainage system will establish a User Council to discuss budgets, tariffs, investment plans and other matters affecting users.

- S.30 In Phase 2, all responsibilities of the Water Operations Division will be transferred to new “Regional Irrigation and Drainage Organisations” (RIDOs), conceived as non-profit bodies of public law, and governed and increasingly funded by their users. Each RIDO will be based around a main canal or major drainage system, corresponding to the infrastructure departments of the Water Operations Division in Phase 1, and will be established through amendment to the Law on Land Reclamation.
- S.31 Once the new law is adopted, the transfer to RIDOs should be completed in relatively short time, after which the Water Operations Division will no longer be involved with canals or drainage systems, and will deal exclusively with operations in river basins, such as dredging, weirs and flood defences; state budget support for main canals and drainage systems will be redirected to the RIDOs (see S.54 below).
- S.32 Government will remain the owner of the canals and pump stations, and will supervise the operations of the RIDOs to ensure that they operate in line with the law. This responsibility will be exercised by a “RIDO Supervision Unit”.
- S.33 The Management Board of each RIDO will be constituted to reflect the main water users in its service area, normally WUOs and any municipalities or major industries receiving water supply or drainage services from the WUO, plus a representative of SAWR and a representative of the Ministry of Agrarian Policy and Food. RIDOs will in turn send representatives to the relevant Basin Council or Councils of the Water Resources Division of SAWR.
- S.34 Both the Water Operations Division of Phase 1 and the RIDOs of Phase 2 will operate in line with abstraction permits issued by the Water Resources Division of SAWR.
- S.35 Operation of secondary canals and tertiary systems will be progressively transferred to Water Users’ Organisations under Reform 3.

Reform 3: Transferring irrigation and drainage to local stakeholders

- S.36 Management and operation of local irrigation and agricultural drainage systems will be transferred to Water Users’ Organisations (WUOs), under a new WUO Law prepared in Phase 1. These will be non-profit bodies of public law set up and managed by their members to provide specified services in irrigation and drainage. They will employ professional management and must have sufficient scale to employ specialist staff, equipment and systems.
- S.37 An irrigation WUO will normally serve a command area of several thousand hectares, typically with 10-100 large farmers plus smaller farmers. It will maintain and operate the secondary canal supplying its command area, together with the pressure pump stations and pipe networks delivering water to the field hydrant. Its members will be all farmers connected to the irrigation system, who will pay a flat-rate charge per hectare plus a volumetric charge per cubic metre. All operating and investment costs will be met from these fees, according to a budget and investment plan adopted by the members.
- S.38 A drainage WUO will normally cover a similar area, maintaining and operate field drains, local drainage collectors and associated hydraulic structures and pump stations. All farmers served

by the drainage system will automatically be members of the WUO, entitled to vote and obliged to pay a flat rate per hectare.

- S.39 Drainage systems focussed on urban areas and non-farm infrastructure will continue to be operated and maintained by municipalities.
- S.40 Where field drainage benefits agriculture, urban areas and non-farm infrastructure, farmers and representatives of local government may agree to form a joint WUO. In this case, all farmers, residents and businesses served by the drainage system will automatically becoming voting and paying members of the WUO, either directly or through their local government representatives. Alternatively, farmers' WUOs may manage the field drains and municipalities operate the vertical drainage, with the RIDO managing the larger-scale infrastructure that serves both.
- S.41 Government will remain the owner of the secondary canals, pressure pump stations, pipe networks, tertiary canals and local drainage systems, but will grant WUOs a long-term right to use, maintain and upgrade them. Any irrigation or drainage infrastructure transferred to Village Councils should also be provided for use by WUOs, on the same conditions.
- S.42 Reform 2 will include creation of a "WUO Support Unit" within the Ministry of Agrarian Policy and Food, to encourage WUO formation, provide training and advice, help WUOs solve problems and resolve disputes, ensure that they are ready to take over management of secondary canals and pressure pump stations, and assist them to access investment funds. The WUO Support Unit should be established and staffed by the time the WUO Law is adopted, so it can begin operating immediately. It may include one or more regional offices in the main irrigated areas.
- S.43 At the same time, the Ministry of Agrarian Policy and Food will establish a "WUO Supervision Unit" to register WUOs once properly constituted, exercise ongoing financial supervision in line with the WUO Law and ensure that they respect the conditions under which they are granted the right to use public irrigation and drainage infrastructure.
- S.44 WUO establishment will be voluntary, at a pace decided by the users themselves, with transfer of management and use rights as soon as WUOs are legally established, staffed, checked by the WUO Support Unit and registered with the Irrigation & Drainage Supervision Unit. There will be a one-season hand-over period with joint operation of the secondary canal and pressure pump stations by the WUO and the Water Operations Division or RIDO, followed by full independent operation by the WUO.
- S.45 Each WUO will send a representative to the consultative body for its infrastructure department of the SAWR Water Operations Division in Phase 1, and elect a board member to its RIDO in Phase 2. They may also form Federations of Water Users' Organisations to represent all WUOs within one irrigation or drainage region or at national level.

Reform 4: Ensuring sound finances

- S.46 The funding and tariff system for irrigation and drainage should achieve economic efficiency, financial sustainability and fiscal clarity (i.e. making it clear where public money goes). Fees and limits may apply at three handover points: from the SAWR Water Resources Division to the RIDOs, from the RIDOs to the WUOs, and from the WUOs to their members.
- S.47 The SAWR **Water Resources Division** will regulate the quantities of water that each RIDO can abstract, balancing irrigation against other uses. This should be done in a way that allows for long-term planning by RIDOs and other water users, and encourages allocation of water to

the highest-value uses. It can be implemented through a system of long-term formal water rights, which may in future be traded. Details will be set out in a revision of the Water Law in Phase 2.

- S.48 The SAWR **Water Operations Division**, and the **RIDOs** that succeed it, should set a two-part tariff with a *volumetric charge* (bulk water price) equal to the actual costs of delivering one additional cubic metre of water, plus a flat-rate *area charge* to cover the overhead costs of operating and maintaining the main canals and pump stations. If the marginal cost of water supply is higher than the average cost (e.g. when extra irrigation requires more pumping at the expensive day-time tariff), this may be passed on to WUOs through block pricing.
- S.49 Area charges will be set for each infrastructure department or RIDO to reflect its individual operating costs and agreed investment plan. Volumetric charges will also be different in each region, due to differences in the pumping height and the value of water for alternative uses.
- S.50 The **WUOs** should also apply a two-part tariff, again comprising a *volumetric charge* (farm-gate water price) equal to the actual costs to the WUO of delivering one additional cubic metre of water (i.e. the bulk water price paid to the RIDO plus the electricity cost of pumping) and a flat-rate *area charge* to cover the overhead costs of operating and maintaining the secondary canals and pressure pump stations, irrespective of the quantity of water supplied in each individual year. WUO members should agree the medium-term investment plan and annual budget for the WUO, which will be reflected in the area charge.
- S.51 WUO tariffs may also reflect the diversity of irrigation systems, such as users who require bulk water supply but not pressure (e.g. rice production using gravity-fed surface irrigation from open tertiary canals, and farmers who either operate their own pressure pump station or pump water direct from a canal into a hose reel or drip irrigation system).
- S.52 When a WUO is progressively upgrading its pump stations to operate more efficiently and at lower pressure, it may choose to use two sets of tariffs: an “unimproved” tariff (low area charge but high volumetric charge) and an “improved” tariff (high area charge to repay the investment but low volumetric charge due to reduced pumping cost).
- S.53 **Drainage tariffs** must reflect the fact that draining one area may benefit farmers and non-farmers elsewhere, e.g. a flat-rate area charge for all farmers in the drainage district, plus where appropriate an agreed contribution from the municipality on behalf of non-farming beneficiaries.
- S.54 In the long run, both WUOs and RIDOs should become fully self-funding for the services they provide to farmers, but as around half the total cost of the irrigation and drainage system is currently met by government, it is unrealistic to expect this goal to be achieved immediately. Transitional support should be delivered for a number of years, tapering off over perhaps a decade, to allow the organisations to invest, restructure and become more efficient. Government support to irrigation and agricultural drainage over this period should avoid distorting economic incentives and so should subsidise the area tariff rather than the volumetric charge.
- S.55 Flood protection and drainage to protect urban areas and infrastructure are public good activities that have to be paid by citizens through special levies or through local or national taxation. Central government could continue to support these activities in the long term, as well as funding the SAWR Water Resources Division in its management of national water resources.

Reform 5: Stimulating profitable investment

- S.56 Commercial finance alone will not meet the investment needs of the irrigation and drainage sector, due to the *public-good* nature of the infrastructure and the *market failures* caused by the land moratorium. The majority of investment will be required at the level of WUOs and individual farms, along with some for institutions and large-scale public infrastructure.
- S.57 Comprehensive financing to support both public and private-sector investment could include:
- **Projects and grants** for capacity development of the institutions, including WUOs;
 - **International development loans** for investment by RIDOs in strategic infrastructure, and by WUOs and farmers in local infrastructure;
 - **Private investment** through leasing, regular bank loans and farmers' own capital.

Projects and grants

- S.58 Donor-funded projects should help to build capacity and develop systems in the Water Resources Division and Water Operations Division of SAWR, and then in the RIDOs, to set up the Irrigation & Drainage Supervision Unit, and to and help establish the WUO Support Unit and through it the WUOs. Projects should include study tours and wide exposure to international best practice.
- S.59 Start-up grants to WUOs and RIDOs should contribute to establishment costs and design services. They will be financed from a grant or a development loan and managed by a Project Implementation Unit in close cooperation with the WUO Support Unit.

International development loans

- S.60 International finance will be delivered through an **international development loan** for public infrastructure, and an **irrigation and drainage credit scheme** for WUO and farm investments.
- S.61 The **international development loan** will enable the government to support urgent modernisation measures by the Water Operations Division in Phase 1, followed by a long-term investment programme in RIDOs starting from Phase 2.
- S.62 The **irrigation and drainage credit scheme** will comprise a **revolving fund** from an international financial institution, managed by the Ministry of Finance. It will co-finance loans by commercial banks to WUOs and their members, and guarantee a proportion of the loans.

Private investment

- S.63 Investment by farmers in irrigation equipment for their own use can also be through commercial bank loans and lease purchase, possibly with an international financial organisation capitalising the leasing company.
- S.64 The WUO Law should permit investment by individual members into WUO infrastructure, e.g. by reduction of their fees for an agreed "buyout period", and provide possibilities for them to recoup their investment if they lose the lease or cease farming. It should also allow for farms that build their own pump stations to pay just a bulk water supply fee and contribution to managing the secondary canal.

Alternative scenarios

- S.65 The World Bank/FAO team considered a number of alternative scenarios before proposing the concrete reform path set out here. Those options, and the reasons they were ultimately rejected, are as follows.

S.66 Option 1: **Convert the water operations part of SAWR into a joint stock company** to provide bulk irrigation and drainage services. **Firmly rejected**, because:

- Irrigation and drainage infrastructure is a core public good and needs to be owned by government and operated in the public interest both now and in the long term;
- The company model is best suited to activities where the primary objective is to make a profit, not to provide a public service, and there are no successful example of commercial for-profit irrigation and drainage companies anywhere in the world;
- Where irrigation infrastructure has been transferred to joint stock companies, such as in Armenia, Azerbaijan, Bulgaria and Georgia, they have all failed to achieve financial sustainability and remain heavily dependent on state subsidy;
- The successful examples in Australia and the US are simply WUOs by another name, as their shares can only be held by land holders, whilst the French public regional development companies are owned by regional governments and reflect unique features of the French legal system and the particular challenges of the 1950s when they were formed;
- Farmers in Ukraine have a well-founded fear of poor privatisation and are deeply concerned that a Joint Stock Company could become an exploitative monopoly, operating without proper transparency, liable to political interference and always at risk of corruption;
- The essence of this strategy is management transfer to give farmers a greater say in the provision of irrigation and drainage services – adopting a company model would run counter to the whole strategy and reduce the value of WUOs by giving them no voice in bulk water supply; overall it would be a step backwards rather than forwards.

S.67 Option 2: **Convert the SAWR “Water Operations Division” into a separate agency with infrastructure departments in place of RIDOs**. **Rejected**, as this will not give sufficient control to stakeholders, and is highly likely to perpetuate an inefficient structure dependent on government subsidy.

S.68 Option 3: **Continue with SAWR managing main infrastructure and just create WUOs**. **Firmly rejected**, as this would only be a half reform and would leave stakeholders with no control over bulk water supply and removal.

S.69 Option 4: **Skip the creation of a “Water Operations Division” within SAWR and form RIDOs immediately in Phase 1**. **Rejected**, as WUOs will be the primary organisation of irrigating farmers, interacting with and taking part in the governance of RIDOs.

A timetable for reform

S.70 By the end of Phase 1 (2020) the first WUOs will be established and operational, two new divisions will have been formed in SAWR, and financing mechanisms will be in place.

S.71 By the end of Phase 2 (2025) the majority of irrigated and drained land will be covered by functioning WUOs, all major irrigation and drainage infrastructure will have been transferred to RIDOs, the reform of government structures will be complete, and a significant proportion of the irrigated area will have been rehabilitated or modernised.

1 Introduction

- [1] This strategy offers a coherent vision for the rehabilitation and modernisation of Ukraine's irrigation and drainage systems and the way they are managed. It comes at a time when Ukraine's water resource management is undergoing major changes as the EU Water Framework Directive is transposed into national law, and fully supports the direction Ukrainian agriculture is taking to become a commercially viable world leader in food production.
- [2] The primary goal of Ukraine's agriculture is to generate wealth for the country, and the objective of this strategy is to support that goal by establishing an effective and efficient irrigation and drainage sector that responds to the needs of its farmers. This will result in increased water productivity, higher crop yields, greater agricultural output and exports,
- [3] This Strategy takes the changes in the domain of water resource management as an opportunity for much improved and more flexible irrigation service provision leading to more efficient and more productive water use in agriculture. This will be done on the basis of secure water allocations and service agreements between service providers and water user run organization, which are envisaged to become responsible managers of the tertiary systems. Main canals will be managed by public entities and co-managed by water user organizations making the service providers more accountable to their 'own' members.
- [4] Land with access to ameliorative systems will be restored and where appropriate expanded. Canal systems will be rehabilitated and modernized through a prioritization process, which channels priority investment into key system components. Smart investment means upgrading systems in such a way, that quality of water delivery is enhanced and associated cost of services reduced ((electricity) so that they become affordable to the farmers.
- [5] The Strategy is fully aligned to a number of key State policies including (i) "Ukraine 2020" Strategy for Sustainable Development; (ii) Comprehensive Strategy for Agriculture and Rural Areas Development 2015-2020 (draft), (iii) main principles (Strategy) for National Ecological Policy of Ukraine until 2020, (iv) Sustainable Development Goals until 2030, It recognizes Ukraine's Association Agreement with the EU, (v) National Strategy for Regional Development for the period until 2020, etc. Implementation of the Strategy will require changes and amendments to the existing legislation, as well as drafting and adoption of new laws and other regulatory instruments.
- [6] The strategy proposal recognizes, that legal and institutional change bears a significant political risk. Where appropriate options are discussed, which intend to manage risks adequately and with required respect. A key questions in this regard is the role of the private sector in irrigation management vis a vis the public sector, and where the hand-over point from public to private parties is defined.
- [7] The main body of the strategy proposal intends to provide a high level vision which is sufficiently comprehensive but not overly detailed. Much details will be annexed and supported by text, tabulation and maps.

2 Background

2.1 The importance of irrigation and drainage to Ukraine's agriculture

- [8] Ukraine has some of the best soils and largest farms in Europe, making it a major producer and exporter of cereals, oilseeds and sugar, as well as producing large quantities of potatoes, fruits and vegetables for domestic consumption.
- [9] Agriculture is a major part of the Ukrainian economy, generating 10 % of GDP, over 20 % of exports and around 5 % of employment. The high export contribution derives from production significantly in excess of domestic requirements, whilst the more modest employment stems from highly mechanised crop production on large fields and farms.
- [10] If the input supply and food processing industries are considered together with primary production, these figures increase to roughly 22 % of exports and 10 % of employment. The share of agricultural products in total exports has steadily increased from 12 % in 2005 to 26 % in 2012, and they now make a crucial contribution to the country's trade balance and current account, with Ukraine a global leader in several growing commodity markets.
- [11] Irrigation underpins the production of potatoes, tomatoes and rice, and supports 5 % of soya production and 1 % of cereals output. It is concentrated in the south of Ukraine, where up to 14 % of the arable area is currently irrigated. Nationally around 1 % of agricultural land is irrigated through dedicated systems, with a further 3 % receiving water through two-way drainage.
- [12] Drainage is applied across large swathes of the north and north-west, covering up to 10 % of farmland in this region and making an important contribution to the national output of cereals and of beef, via the drainage of pastures and forage land.
- [13] Almost one-third of the Ukrainian population lives in rural areas, with around 15 % of the rural population directly involved in agriculture. The farm structure in Ukraine covers a tremendous range:
 - a. 14 % of agricultural land is farmed by around 70 very large "agribusinesses" averaging 70,000 ha;
 - b. 28 % is managed by just over 6,000 large corporate farms averaging 1,600 ha;
 - c. 13 % is managed by 35,000 private farms of around 130 ha;
 - d. 45 % is farmed by some 4 million agricultural households with an average of 4 ha each, producing partly for home consumption and partly for sale, and generating nearly two-thirds of the country's gross agricultural output.
- [14] There are important differences in the production profile of the different farms types, with household plots producing the large majority of potatoes, fruits, vegetables and milk, which mainly supply the domestic market, and larger commercial farms producing most of the cereals, oilseeds and sugar beet, which are more oriented to export. These directly generate export earnings, whilst the household plots make an equally important contribution to the balance of payments through their role in import substitution. Whilst most of the irrigated area lies on large farms and is used for cereals and oilseeds, the high-value irrigated crops are mainly on small farms

2.2 Climate change and its implications

- [15] Ukraine's climate has changed significantly over the last 20 years, becoming marginally wetter and markedly hotter, with the overall water balance becoming more negative. This has resulted in higher yields in the north, whilst in the south it has lowered rainfed yields and raised irrigation requirements, increasing both the costs and the benefits of irrigated agriculture.
- [16] Water flows and seasonal storage along the Dneiper river cascade constitute a water source far in excess of current irrigation requirements, and able to support a substantial increase in irrigation under all foreseen climate-change scenarios.

2.3 Land reform

- [17] Ukraine's privatisation process transferred most arable land to private ownership but has not yet established a land market, with a moratorium on land sales still in place. Large farms and agro-holdings have developed, including in the key irrigation areas in and around Kherson oblast, but on the basis of multi-annual land leases. This has two key implications for development of irrigation and drainage: insecurity of tenure discourages long-term investment and major system maintenance, and the inability to offer land as collateral hampers access to finance.

3 Irrigation and drainage system

3.1 Decline of the irrigation and drainage system

- [18] Ukraine's irrigation and drainage system was developed during the 1960s, '70s and '80s when the country was part of the Soviet Union and farming was carried out by large state and collective farms. The State Agency for Water Resources, under various names and reporting arrangements, was responsible for the delivery of irrigation water to, and the collection of drainage water from, these large farms. At its height, the system delivered irrigation to some 2.2 million hectares and supported drainage of over 3 million hectares.
- [19] The breakup of the Soviet Union and Ukraine's rapid economic and political transition brought the abrupt collapse of these large farm structures and created a vacuum with no clear responsibility for local irrigation systems. Widespread looting occurred, with the theft of buried metal pipes, equipment from pump stations and even the fabric of some secondary canals.
- [20] Development of new private farms occurred most rapidly in the south of the country, particularly in Kherson, Nikolaev and Zaporizhia oblasts, and the new businessmen had sufficient motivation and power to protect large parts of the irrigation system in this region. By 2013 the total irrigated area was 3-400,000 hectares, less than 20 % of its peak area, and concentrated almost exclusively in this region.
- [21] Drainage infrastructure fared rather differently, partly because there was less worth stealing and partly because of its recognised importance to flood protection and urban drainage. It is a story more of gradual deterioration than catastrophic collapse, with the drained area little changed but the effectiveness of drainage much reduced.

- [22] The system was almost entirely funded by the state, through budget allocation to the State Agency, through artificially low prices and deferred payments for electricity, and through payments made by state-controlled farms. After independence, Ukraine faced a major budget crisis and funding for the State Agency could not keep pace with the rapid increase in electricity and other costs, and payments from new private farms failed to fill the gap. Since then, the Agency's budget has gone almost entirely on day-to-day staff and running costs, with very little devoted to preventative maintenance, and with almost complete withdrawal from areas where the system is most seriously deteriorated.
- [23] A positive aspect of these changes is deterioration has been least in areas where irrigation is most economic, i.e. where the costs of water supply are low and the benefits of irrigation are high. Irrigation has thus become concentrated on the most profitable areas, and some of the systems that have largely collapsed would no longer be profitable with today's prices for agricultural products, electricity and other inputs, and so could not justify restoration.

3.2 Current institutional and funding arrangements

- [24] The State Agency for Water Resources currently reports to the Ministry of Ecology and Natural Resources, and plays the major role in developing and implementing policy for the water sector. Its main services to agriculture are:
- a. Operating and maintaining the national network of irrigation canals and drainages collectors, together with their pumping stations and other structures;
 - b. Delivering pressurised irrigation water to individual fields or, in the case of rice, supplying water in open tertiary canals;
 - c. Providing commercial design services to farms wishing to install new irrigation systems.
- [25] Going beyond agriculture, the Agency's functions include:
- a. Managing the national water resources in rivers, lakes, reservoirs and groundwater aquifers, authorising extractions and discharges by different users, and participating in international fora on trans-boundary waters;
 - b. Providing urban water supply to a number of small settlements located along irrigation canals and without alternatives sources, plus the transfer of large volumes of water to Ukraine's drier, industrialised and currently conflict-ridden east;
 - c. Transferring water from the Dnieper to the Ingulets river to help dilute pollutants from the mining and metallurgy industries, and thus mitigate their environmental effects;
 - d. Operate flood defences and urban drainage, often hydrologically linked to drainage of the surrounding agricultural land;
 - e. A range of supporting services including technical training, design, construction and research.
- [26] The State Agency is a large organisation, employing 34,000 people before the annexation of Crimea reduced this to 28,000. It comprises some 250 different legal entities, variously delineated by function, river basin, main canal or administrative

boundaries, in a complex web of overlaps and interactions. It is widely regarded as over-staffed and inefficient, particularly given that the irrigated area has contracted by around 80 %.

- [27] That difficulty is symptomatic of the State Agency's organisational culture, which still follows the Soviet top-down model, with very limited information disclosure and almost no participation of its main beneficiaries – farmers – in making decisions, establishing priorities or setting tariffs and service levels.
- [28] Total expenditure by the State Agency in 2014 was \$ 205 million, of which \$ 166 million (81 %) was for irrigation and drainage, including \$ 58 million for electricity. User fees into the "Special Fund" totalled \$ 89 million (44 %), with the remaining \$ 116 million provided from the state budget into the "General Fund". A rough apportioning of overheads gives a cost of \$ 72 per hectare of irrigated land and \$ 5 per hectare of drained land, not including electricity.
- [29] Given that the large majority of irrigation and drainage functions in Ukraine are currently performed by the State Agency for Water Resources, and these two functions account for the large majority of the Agency's staff and budget, it is clear that reform of the irrigation and drainage sector will inevitably involve major reform of the State Agency.
- [30] Given the looming need to reform other aspects of the water sector, to implement the EU Water Framework Directive, further the development of the market economy and improve the operation of government in this important area, this strategy proposes an outline for comprehensive reform, though it will fall to others to fill in the detail beyond the specific areas of irrigation and drainage.

3.3 An example of irrigation in practice

- [31] The practical and organisational realities of irrigation can be illustrated through the example of secondary canal R1, on the Kakhovska Main Canal. It is reasonable typical in its size and structure, apart from the fact that it is supplied by pumping from the main canal whereas most secondary canals are fed by gravity. Unlike many canal systems, it has survived almost intact and is still fully operational:
 - a. Water is drawn from Kakhovska reservoir, the lowest of the six reservoirs on the Dneiper cascade, before it can be discharged the final 16 metres through a hydro-power station to reach sea level. Almost 80 % of Ukraine's current irrigated area is supplied from this reservoir;
 - b. Water is lifted 22 metres from the reservoir into Kakhovska Main Canal by Kakhovska Main Pump Station. Some 70 % of all irrigation water passes through this pump station which, when running at full capacity, consumes the same amount of electricity as the entire state of Montenegro;
 - c. Kakhovska Main Canal runs for 130 km through Kherson and Zaporizhia oblasts, directly supplying 12 secondary canals as well as feeding the Sirogozska and Priazovska main canals. Through this network it supports an original command area of 348,000 ha, of which 261,000 ha were irrigated in 2013;
 - d. The first offtake on the southern bank of Kakhovska Main Canal is another pump station lifting water a further 18 metres into secondary canal R1, whilst all but one of the other secondary canals are fed by gravity;

- e. Secondary canal R1 is 27 km long and supplies 17 Pressure Pump Stations, each with 4-6 electric pumps delivering water at around 10 atmospheres' pressure into a network of buried metal pipes. These pipes terminate in 12-24 hydrants, each supplying one piece of irrigation equipment, most usually a large centre-pivot sprinkler covering around 65 hectares in a field almost one kilometre square;
- f. Each pump station supplies around 1,000 hectares on 2-3 large farms, plus an average of 50 hectares of small farms, typically growing vegetables with drip irrigation;
- g. Overall, the secondary canal provides irrigation to 17,500 hectares; 95 % of this area is managed by 30 large farmers, with the remaining 5 % run by an unspecified number of small farmers. The principle irrigated crops are soya, maize and vegetables, plus some wheat where required for rotation or because the system has insufficient capacity to meet the peak demand of soya and maize across its whole area.

[32] Organisationally:

- a. Kakhovska Main Canal and Pump Station come under the "Kakhovska Main Canal Management Department";
- b. The majority of secondary canal R1 comes under the "Kakhovska Inter-Raion Water Management Department", which is also responsible for a number of pump stations drawing directly from the main canal, and for the first section of the North Crimea Canal;
- c. The final section and last pressure pump station on R1 fall under the Water Management Department of the neighbouring Tsyurupinskiy raion.

[33] Economically, farmers will:

- a. generate a margin of around \$ 900/hectare from the production of irrigated crops (50 % soya, 30 % maize and 20 % wheat, by area);
- b. forego a margin of around \$ 300/ha that they would have made from rainfed production (X % wheat, Y % maize and Z % sunflower);
- c. increase their margin by around \$ 600/hectare as a result of irrigating

[34] The total cost of irrigation from R1 is around \$ 300/ha, including the costs of operation, maintenance and pumping for the main canal, secondary canal and pressure pump station, not including amortisation or replacement of the infrastructure and equipment.

[35] This example takes one of the best-maintained canals in the country and hence indicates how other parts of the system could operate if restored to their original state. The numbers demonstrate that irrigation is economically profitable, even for the production of relatively low-value bulk commodities, where water is cheap and the basic irrigation infrastructure is already in place and functional.

[36] Despite being one of the best examples, the efficiency and profitability of this system could be improved in several ways:

- a. Replacement of pressure pumps and sprinklers with modern low-pressure equipment would allow the final pumping cost to be almost halved;
- b. Renovation or replacement of the pressure pumps, pipes and sprinklers would both reduce breakdowns and the consequent loss of yield, and increase the total

amount of water that can be delivered to field, allowing for a higher share of the more profitable crops like soya in the overall rotation;

- c. Replacement of sprinklers by sub-surface drip irrigation could significantly increase yields from the same water application, though at a greater capital and recurrent cost;
- d. A switch from combinable crops to vegetables would change the economics completely, bringing a major increase in both output value and operating costs and a significant increase in margins if the handling and marketing challenges could be overcome;
- e. Reorganising operation of the secondary canal and pressure pump stations could lead to a significant reduction in staff costs – and job losses;
- f. Restoration or expansion of irrigated area on other parts of the Kakhovska, Sirogozska and Priazovska main canals would allow the overhead costs of these canals and main pump stations to be spread across a greater area and number of farmers, but would also require an increasing share of water to be pumped at the higher daytime or even peak-time tariffs. Its main economic impact would arise in the new areas irrigated.

[37] The overall goal of irrigation reform is to create the conditions in which improvements such as these can take place successfully, thereby increasing the economic profitability of irrigated agriculture.

3.4 Investment opportunities in irrigation

[38] There are three main ways in which investment can increase the profitability of the overall irrigation system:

- a. **Modernisation** of systems that currently work, to make them work better. Benefits could include greater reliability, lower electricity costs, better scheduling of water flows, and savings in overall operating costs. The economic gain would normally be an increase in profitability per hectare, rather than an increase in irrigated area;
- b. **Rehabilitation** of systems that used to work but have fallen into disrepair, resulting in an increase in irrigated area. This step would normally include modernisation, so that systems are put back into function in better condition than before;
- c. **Expansion** of irrigation onto new areas that were not previously irrigated, by installation of new, modern systems.

[39] Over half of the original irrigation system is so badly deteriorated that it has now been written off and is no longer included in the State Agency's inventory. Rehabilitation and modernisation of the remaining 1 million hectares could cost up to \$ 2 billion³, whilst expanding the irrigated area would take this figure even higher. Given that such a sum will not be available any time soon, investments will need to be prioritised to focus on

³ The cost of rehabilitating and modernising the tertiary systems – from the secondary canals to the crop – is estimated at \$ 1.6 million, and significant investment would also be required in main and secondary canals and their pump stations. Crimea is not included in either the area or the cost estimate.

areas where a given investment will bring greatest benefit. This approach should favour:

- a. Areas where water is cheap, i.e. it has limited opportunity cost for electricity generation and does not need to be pumped up to a great height;
- b. The basic infrastructure is in reasonably good condition, so relatively little investment is needed to bring water close to the farm;
- c. The benefits of irrigation are high, with the margins from irrigated crops substantially higher than those from rainfed;
- d. Environmental and other social costs are low.

[40] Applying these criteria to Ukraine's 26 main irrigation canals gives highest priority to a group of canals drawing from the Kakhovska reservoir:

- a. **Kakhovska** main canal, together with **Sirogozska** and **Priazovska** canals that feed from it: pumping heights are modest, the canals are in reasonable condition, and three-quarters of the original command area is still in function;
- b. The first, gravity-fed, section of the **North Crimea Canal**, together with the **Chaplinsky** and **Krasnosnamenska** canals which it supplies; pumping heights are low or zero, but infrastructure is in rather poorer condition, with less than half the command area currently in use.
- c. These six canals currently irrigate almost 300,000 hectares, 80 % of the total irrigated area⁴, with water for 260,000 of these hectares passing through Kakhovska main pump station.

[41] Reasons for not prioritising other canals include:

- a. Canals higher up the Dneiper cascade use water of higher opportunity cost, many of them have lifts of 100 metres or more, and current coverage is typically less than a quarter of the original command area, indicating a high degree of deterioration;
- b. The Ingulets irrigation system may have potential, but it is affected by pollution of the Ingulets river and so expansion of irrigation here could require expensive pumped transfers of water from the Dnieper. If and when this pollution can be controlled at source, it would be worthwhile re-assessing whether this irrigation system should be targeted for investment;
- c. Irrigation schemes fed from the Danube also face major environmental issues linked to water storage and salinization, and potential solutions could require major infrastructural investment. Investment in this area should be subject first to an environmental impact assessment and full economic appraisal.

[42] **Modernisation of tertiary systems** would typically involve: replacement of high-pressure, water-driven centre-pivots by low-pressure, motor-driven sprinklers; repairs and improvements to the buried pipe network to reduce failures; replacement of pumps with newer, low-pressure pumps; modernisation of electrical transformers and control systems, depending on their current condition; general repairs and improvements to

⁴ The irrigation inventory conducted by SAWR in 2000 showed these six canals supplying 294,000 ha out of a total of 372,000. This represented 65 % of their command area, whilst overall utilisation of the other 20 canals was just 15 %.

the pump station building⁵. Total cost is estimated at \$ 1,200 per hectare, or around \$ 1.4 million for a typical pump station, of which around \$ 900,000 would be required for farmer-owned sprinklers and their power supply, and \$ 500,000 for the pump station and pipe network serving multiple farmers.

- [43] **Modernisation of primary and secondary infrastructure** would include: repairs to badly damaged sections of canals; repairs to gates and hydraulic structures, possibly including new systems for remote monitoring and operation; repairs to main pump stations, including a rolling programme of replacement of the main pumps on which so much of the system depends. Full cost estimates have not yet been prepared, and should be developed in cooperation with the State Agency.
- [44] **Rehabilitation** of tertiary systems would include all the elements of modernisation, typically plus replacement of a larger share of the buried pipe network and more major repairs to the pump station building. Costs will depend on the degree of deterioration in each case, but could average around \$ 2,000 per hectare or \$ 2.4 million for a typical pump station. The cost of farmer-owned components would be the same as for modernisation but renovation of the shared elements would cost around \$ 1.5 million.
- [45] The costs of **expansion** have been calculated for land that is within a few kilometres of functional main or secondary canals, so that only new tertiary systems need to be installed. Costs would be similar to rehabilitation but with complete replacement of the pipe network and construction of a new pump station building, and are estimated at around \$ 2,200 per hectare or \$ 2.6 million for a typical pump station⁶. Whilst the direct costs of expansion are not so much greater than those for rehabilitation, it will have to address issues such as access roads, pipe routes, high-voltage electricity lines and construction permits, which could make expansion onto a new site considerably more time-consuming than rehabilitation of a system where these issues were previously resolved.
- [46] The costs and benefits of these three options can be roughly summarised as follows:
- a. The main benefits of modernisation are lower electricity costs and higher yields from more reliable irrigation, together worth perhaps \$ 400 per hectare per year and bringing an annual return on investment of around 30 %;
 - b. The benefits of rehabilitation stem from being able to grow different crops and get higher yields with irrigation, worth perhaps \$ 1,000 per hectare per year and offering an annual return of 50 %;
 - c. The benefits of expansion are the same as those of rehabilitation but the costs are slightly higher, so the return drops to around 45 %.
- [47] These are impressive returns, even after factoring in a considerable cost for the managerial time and effort needed to make things like this happen, and explain why

⁵ The principle exception to this would be rehabilitation and modernisation of the Krasnosnamanska canal system, which uses gravity feed through open tertiary canals for surface irrigation of rice fields. Here the technical requirements and cost structure are very different and require separate evaluation. However, this system represents just a few percent of the total area served by these six canals, and so does not have a major impact on the overall cost estimate.

⁶ This assumes that expansion would again be based around large centre-pivot sprinklers. If instead it used drip irrigation more suited to small farms and high-value crops, then both the costs and the benefits would be considerably higher.

several farmers have already invested in irrigation infrastructure even without direct ownership of the land, the pipes or the pump station. One of the challenges of reform is to create structures that give private investors the security and incentives to invest in what appears to be quite a profitable business.

- [48] Applying these three models to the six priority canals gives the following estimates of overall investment requirements:
- a. If **modernisation** were carried out on 50 % of the current irrigated area (assuming that some areas have already been modernised and that many farmers would not rush to modernise before seeing the results of changes elsewhere), a total of **147,000 hectares** might be modernised at a cost of **\$ 162 million**;
 - b. If **rehabilitation** were carried out on 90 % of the command area that is not currently in use, which would require major government encouragement, some **140,000 hectares** could be rehabilitated at a cost of **\$ 285 million**;
 - c. The scope for **expansion** is considerable, but if the initial target was the area of around **20,000 hectares** easily accessible from the North Crimea and Chaplinksky canals, the cost would be around **\$ 43 million**.
- [49] Total investment of \$ 490 million would result in:
- a. an **extra 160,000 hectares under irrigation**, raising the national total by 43 % to 530,000 hectares;
 - b. a 70 % increase in the amount of irrigation water drawn from Kakhovska reservoir, from 1 billion to 1.7 billion cubic metres per year;
 - c. an **additional \$ 700 million of agricultural output** per year; the actual benefit to farmers, and the cost or benefit to taxpayers, would depend on the level of direct and indirect subsidies, such as the state budget repaying an international loan to improve irrigation.
- [50] No detailed assessment has yet been made of investment needs and potential benefits for the **drainage** sector, but with a drained area of some 3 million hectares, eight times the current irrigated area, the investment potential could be as high or even greater than that for irrigation.

3.5 The new role of government in irrigation and drainage

- [51] Ukraine's irrigation system developed when a state agency received electricity from a state generator and supplied water to state-run farms through irrigation machines built by state-owned companies, at prices set by the state and with information about the process treated like state secrets. Now that Ukraine has chosen the path of the market economy and EU integration, its role in irrigation and drainage must become much more selective, intervening only in specific areas where necessary for the public good.
- [52] In future, government should *refrain* from the following actions, which are better left to markets and private operators:
- a. Telling farmers what to grow or how to grow it, setting prices or controlling trade;
 - b. Telling farmers how much water to use or how to apply it, or intervening in irrigation tariffs beyond the handover point from the state bodies;
 - c. Producing or supplying irrigation equipment or design services.

- [53] However, to ensure that agriculture works efficiently and that the irrigation and drainage sector meets society's wider needs, government must do the following:
- a. Ensure proper management of resources recognised as belonging to society as a whole, including water resources and strategic irrigation and drainage infrastructure;
 - b. Ensure the fair and efficient operation of markets through appropriate regulation, provision of information, and actions to prevent cartels and monopolies and the capture of public resources by local elites. This applies at many levels, from the supply of irrigation equipment to the relationships between big and small water users.
 - c. Finally, the relationship between citizens and government has changed, and farmers now expect a much greater say in how their irrigation and drainage services are delivered, including taking over the management of some of those services.

4 Reform agenda

The case for reform

- [54] Considering the current condition and organisation of the irrigation and drainage system, the scope to improve and expand irrigation, and the new role that government should play in a market economy, there is a strong case for reform to:
- a. Adjust the system to the new reality of private farms and free markets;
 - b. Halt the decline, and stimulate investment and recovery;
 - c. Improve efficiency
- [55] Just as the primary objective of irrigation is economic, to make Ukraine richer, so the primary objective of irrigation reform is to increase the net economic benefit from irrigated agriculture. Put simply, the benefits of reform and investment must outweigh the costs.
- [56] The new legal, institutional and financial structure should consider all three stages in the irrigation chain:
- a. **Management of national water resources**, by government on behalf of society, seeking to benefit and involve all stakeholders and align with EU standards;
 - b. **Delivery of water to fields and crops**, managed by the farmers themselves;
 - c. The intermediary stage of **bulk water supply** from the source rivers and reservoirs, through canals, to the farmers.
- [57] Drainage mirrors these three steps:
- a. Drainage water contributes to national water resources and affects their quality, and so should come under the same overall planning and monitoring framework;
 - b. Maintenance and operation of field drainage should be managed by farmers themselves, along with other local stakeholders who depend on drainage to prevent flooding and protect urban areas and infrastructure;
 - c. Long-distance transfer of water away from drained areas and into rivers again requires a strategic intermediary organisation.

[58] A reform to meet these objectives and properly address each stage in the irrigation and drainage systems will include:

- a. Reform 1: Improving stewardship of national water resources
- b. Reform 2: Improving the bulk delivery and removal of water
- c. Reform 3: Transferring management of irrigation and drainage to local stakeholders, through Water Users' Organisations
- d. Reform 4: Ensuring financial sustainability
- e. Reform 5: Stimulating profitable investment

[59] This reform will be carried out in two phases:

- a. Phase 1 will involve internal reorganisation of the State Agency into a Water Resources Division and a Water Operations Division, and begin the process of creating Water Users' Organisations;
- b. Phase 2 will transfer the responsibilities of the Water Operations Division to new stakeholder-run Regional Irrigation & Drainage Organisations, and complete the process of transferring management of tertiary systems to Water Users' Organisations.

KEY TERMS

- **Water Resources Division:** The unit within SAWR responsible for managing national water resources in line with the EU Water Framework Directorate and the principles of integrated water resources management; divided into geographical departments following river basins ("river basin departments"), plus technical and support departments; initially a Division within the State Agency for Water Resources, later a separate Authority.
- **Water Operations Division:** The unit within SAWR responsible for management, operation and maintenance of major irrigation and drainage infrastructure in Phase 1; divided into geographical departments following major infrastructure units such as main canals ("infrastructure departments"), plus technical and support departments.
- **Regional Irrigation & Drainage Organisation (RIDO):** The new organisations to be created in Phase 2 to take over management of main canals or drainage regions, succeeding the infrastructure departments of SAWR's Water Operations Division and managed by their stakeholders.
- **Water Users' Organisation (WUO):** A legal entity established by farmers and other water users to provide irrigation and/or drainage services to its members.
- **Federation of Water Users' Organisations (WUO Federation):** A body managed by and representing all WUOs within an irrigation or drainage region.

Reform 1: Improving stewardship of national water resources

[60] Ukraine's water resources are used by many different people, in very different ways. Surface and groundwater is extracted for use by homes, industry and hydro-power, with the large majority of it later returned to the river basin in a different place or condition. Much of the water extracted for irrigation is lost to the atmosphere by evapotranspiration, though a significant proportion is returned through field drainage and leakage from pipes and canals. Navigation and recreation use water in place, but have

requirements concerning water levels and structures. Almost wherever it is, water affects the environment, and the requirements of a healthy ecosystem include quantity, quality, flow rate and temperature. Balancing all of these different uses and requirements to the benefit of society as a whole, and within international obligations, is the job of government as the ultimate manager of the national water resource.

[61] An overall structure for water resource management is provided by the EU Water Framework Directive, which Ukraine has committed to adopt. It introduces two key concepts:

- a. ***Integrated Water Resources Management***, covering all uses of water in the natural environment, including abstractions and discharges. Once water is taken into an irrigation canal or urban water system, it leaves the scope of the Directive unless and until it is returned to the natural environment;
- b. ***River Basin Management***, whereby one organisation or department is responsible for management of an entire river basin or sub-basin, including both its surface and ground waters. Where a river crosses or forms an international frontier, the responsible authorities in each country should coordinate their management of water in the river basin.

[62] The EU Water Framework Directive focuses on water quality more than quantity, which remains a competence of Member States to be addressed through national legislation, but a good system for balancing the quantitative requirements of different users and the environment will be essential for effective development of Ukraine's irrigation system. This will require moving from the Soviet system of water allocation to a system of durable water rights that provide a sound basis for long-term investment decisions by all water users. Water rights should be protected in law, should in due course become tradeable, and may be temporarily restricted or suspended in periods of drought and low river flow, but can only be terminated in the public interest and on the payment of compensation to the right holder.

[63] The third of the Framework Principles adopted under this project is the separation of functions between water resource management and water infrastructure management, for three main reasons:

- a. The two ***roles are functionally different***. Water resource management organisations manage information, not water. They deal with modelling and monitoring, policy and planning; when they decide that water should be moved or used in some way, they issue permits or instructions to other organisations to physically handle the water. By contrast, the organisations managing canals and irrigation systems work with water itself – they store it, convey it, pump it and spray it.
- b. There is potential for a major ***conflict of interest*** between water resource management and water infrastructure management: the water resource manager issues permits and standards in the public interest, seeking to balance the concerns of different stakeholders; infrastructure managers operate within the constraints laid down by the resource manager, for the commercial benefit of their particular users. Agriculture is a major water user but can also be a significant polluter through fertilisers, pesticides and animal manures.

- c. It is recognised best practice to separate policy making from policy implementation, and this applies to water just as much as other areas.

[64] Reform 1 will comprise the following elements:

- a. Placing water resource management and water infrastructure management under two separate institutional structures. In the short-term they will be two separate divisions within the State Agency for Water Resources – a **Water Resources Division** and a **Water Operations Division** – with care to ensure sufficient separation between them to minimise conflicts of interest. In the long-term, management of irrigation and drainage infrastructure will be transferred to local and regional stakeholder-run organisations, leaving the State Agency with responsibility just for water resource management.
- b. Sub-division of the **Water Resources Division** into **river-basin departments** each responsible for one main river basin, with sub-basin units where appropriate. These river basin departments will be responsible for all natural waters within their geographical area, including ground water and adjoining coastal waters.
- c. The Water Resources Division should also include **common departments for cross-cutting subjects** such as monitoring, modelling and standards, supporting all river-basin departments.
- d. The entire Water Resources Division of the State Agency should be **one legal entity** with common information systems and procedures, and the scope for personnel to move around the organisation as their careers develop.
- e. Establishment of **consultative stakeholder structures** for each river basin or sub-basin department, plus a consultative group on water standards. The Water Resources Division should have an obligation to convene these groups, to provide them with relevant information and to consult them on major issues, such as each new budget, strategy, standard or draft legislation.
- f. The initial structure of the Water Resources Division could be based around the existing nine Basin Management Boards within the State Agency, plus analytical units.
- g. The Water Resources Division will remain part of the State Agency for Water Resource and **report to the Ministry of Ecology and Natural Resources**, as the ministry responsible for implementation of the Water Framework Directive. It will be a permanent part of government, funded primarily by the state budget.
- h. Overall coordination of national water policy, bringing together the Water Resource Division, the Water Operations Division and other concerned ministries, such as those responsible for health, urban planning and emergencies, will initially continue to be carried out by the Inter-Agency Commission for Water Resources, which advises the Ministry of Ecology. In the long it should be succeeded by a **National Water Resources Committee**, reporting to the Council of Ministers and with a remit to coordinate water policy across multiple ministries and the new stakeholder-led irrigation and drainage organisations at local and regional level.

Reform 2: Improving the bulk delivery and removal of water

- [65] The role of the Water Operations Division of Phase 1 will be to operate and maintain strategic infrastructure, providing two main services:
- a. *Irrigation*: To convey water from rivers and reservoirs to irrigation WUOs, and to maintain and operate the main canals, pump stations and hydraulic structures to do this.
 - b. *Drainage*: To remove drainage water discharged by drainage WUOs, and to maintain and operate the main collectors, drainage canals, pump stations and hydraulic structures to do this.
- [66] In Phase 2 of reform, these responsibilities will be transferred to new **Regional Irrigation & Drainage Organisations** (RIDOs), governed and increasingly funded by their users. RIDOs will be formed along major units of irrigation or drainage infrastructure, generally corresponding to the infrastructure departments of the Water Operations Division created in the first phase of reform.
- [67] Government will remain the owner of the canals and pump stations, with the Water Operations Division and its successor RIDOs responsible for maintaining and operating them.
- [68] The RIDOs will be involved in three main kinds of contracts or agreements:
- a. Agreements with the Water Resources Division of SAWR setting out a multi-annual framework for abstracting irrigation water from rivers and reservoirs, together with a mechanism to agree variations in response to weather conditions and river flows. These permits will be based on the principle of long-term water rights, which may in future be tradeable;
 - b. Commercial contracts with staff and with suppliers of goods and services, including electricity;
 - c. Water supply contracts with each WUO in their region, again with a multi-annual framework and mechanism to agree variations. These contracts will set out the tariff structure, as discussed under Reform 4 below.
- [69] Thus reform 2 will comprise the following elements:
- a. Establishment of a **Water Operations Division** within the State Agency for Water Resources, in the first phase of reform;
 - b. Sub-division of the Water Operations Division into **infrastructure departments**, each responsible for a major irrigation canal, group of canals or drainage basin. This division may also have a number of common departments to provide support in technical areas;
 - c. The structure of the Water Operations Division can in many cases be based around the existing Canal Management Boards within the State Agency. Its local management boards at Oblast, Raion and Inter-Raion level will initially come under the Water Operations Division, though over time most of their functions and many of their staff will be transferred to Water Users' Organisations under Reform 3;
 - d. Each infrastructure department will have a **consultative user group** involved in setting priorities and agreeing budgets and investment plans;

- e. In the second phase of reform, the infrastructure departments will be replaced by **Regional Irrigation & Drainage Organisations** (RIDOs), separate legal entities fully governed by their users;
- f. RIDOs will be supervised by a new unit established in the Ministry of Ecology and Natural Resources.

Reform 3: Transferring irrigation and drainage to local stakeholders

[70] In line with framework principles 8-12, management and operation of local irrigation and drainage systems will be transferred to new Water Users' Organisations (WUOs), to be set up by users under new primary legislation. Most WUOs will be focussed on either irrigation or drainage, though some will combine both roles.

[71] Key principles of Water Users' Organisations are:

- a. They are a new legal structure as non-profit bodies of public law set up to provide specified water-related services to their members, and are not the same as associations, cooperatives or companies under existing law.
- b. To be efficient, they must have professional management and sufficient scale to employ specialist staff, equipment and systems, and should be based around coherent hydrological units.
- c. They are governed by their members, through a charter adopted by the members in line with the WUO Law, which must strike a good balance between the rights of large and small farmers.
- d. Experience shows that they should focus just on irrigation and/or drainage, and not diversify into input supply, marketing etc. If WUO members wish to work together in these areas, it is normally best to establish a separate organisation for that purpose.

[72] An irrigation WUO will:

- a. Normally serve a command area of thousands or tens of thousands of hectares, typically with 10-100 large farmers plus small farmers, so as to achieve economies of scale but still allow all members to participate in decision making.
- b. Maintain and operate the pressure pump stations and pipe networks or tertiary canals within its area, delivering water to the field hydrant or boundary. These tertiary systems will normally be based along one secondary canal, but the WUO may also incorporate nearby pressure pump stations drawing directly from the main canal.
- c. Operate the secondary canal supplying its command area; normally this will be an entire secondary canal but could also be part of a long canal. Maintenance of the secondary canal is the financial responsibility of the WUO and could be carried out by them directly or sub-contracted to another public or private organisation.
- d. Have a membership normally consisting entirely of farmers involved in irrigated crop production and/or fish-farming. All users of water from the secondary canal supplying the WUO should be members of the WUO.
- e. Collect water fees from its members, typically consisting of a flat-rate charge per hectare plus a volumetric charge per cubic metre. The water tariff will be agreed by the members along with the annual budget.

- f. Pay all operating expenses from these fees, including payments to the Water Operations Division or RIDO for bulk water supply, to the electricity company, to other suppliers and to staff.

[73] A drainage WUO will:

- a. Normally serve a drainage area of thousands or tens of thousands of hectares, typically with 10-100 large farmers plus small farmers, so as to achieve economies of scale but still allow all members to participate in decision making.
- b. Maintain and operate field drains and local drainage collectors, plus associated hydraulic structures and pump stations, together with storm drains and flood defences feeding into the same drainage system.
- c. Discharge water into a main collector, river or drainage canal maintained by the Water Operations Agency or RIDO.
- d. Have a membership consisting of farmers, in some cases supplemented by representatives of local government where drainage systems also protect urban areas and/or non-farm infrastructure such as roads and railways. All farms and any other residents and businesses served by the drainage system will automatically be members of the WUO, entitled to vote and obliged to contribute, either directly or through their local government representatives.
- e. Collect water fees from its farmer members as a flat rate per hectare, and from any non-farmer members or representatives through a tariff structure as agreed by the WUO.
- f. Pay all operating expenses from these fees, including any payments to the Water Operations Division or RIDO for bulk water removal, to the electricity company, to other suppliers and to staff.

[74] In areas where drainage is predominantly or entirely designed to protect urban areas and non-farm infrastructure, and is currently managed by the municipality or village council, these arrangements may continue without needing to form a WUO.

[75] Government will remain the owner of the secondary canals, pressure pump stations, pressure pipe networks, tertiary canals and local drainage systems, but will grant the WUOs a long-term right to use and maintain and upgrade them. These rights will initially be granted to the Water Operations Division and progressively transferred to WUOs as they are established and approved. Where ownership of local irrigation or field drainage infrastructure has been transferred to Village Councils, it should also be provided for use by WUOs under the same conditions.

[76] Each WUO will send a representative to the consultative group of its infrastructure department within the Water Operations Division to participate in agreeing the budget, investment plan and tariff for that main canal or drainage region. In phase 2 the WUOs will elect members to the governing body of the RIDO.

[77] Reform 2 will comprise the following elements:

- a. Preparation and adoption of a Law on Water Users' Organisations.
- b. Establishment of a WUO Support Unit and a WUO Supervisory Unit within the Ministry of Agrarian Policy and Food.
- c. Voluntary establishment of WUOs, with encouragement and assistance from the WUO Support Unit but at the pace decided by farmers themselves.

- d. Transfer of responsibilities and usage rights to WUOs as soon as they legally established, staffed, checked by the WUO Support Unit and registered with the Supervisory Unit, followed by a one-season hand-over period and then full independent operation.
- e. Establishment of Federations of Water Users' Organisations, each representing all WUOs within one irrigation or drainage region.

KEY ELEMENTS OF A WUO LAW

- WUOs are non-profit organisations established to provide irrigation &/or drainage services.
- They must be registered with the competent ministry.
- Their members are all farmers using irrigated or drained land in the WUO area.
- The members elect a Board, which employs a professional manager and other staff.
- Members pay a two-part fee:
 - An area charge per hectare to cover WUO overheads & maintenance;
 - A volumetric charge per cubic metre of irrigation water to cover water & pumping cost.
- All farmers with access to irrigation must pay the area charge, even in years when they don't irrigate; all farmers benefitting from drainage must pay the area charge, even if the drainage takes place on other land.

Reform 4: Ensuring sound finances

[78] The funding and tariff system for irrigation should achieve three main objectives: economic efficiency, financial sustainability and fiscal clarity:

- a. **Economic efficiency:** The price farmers pay for water will influence what they grow, how much water they use, and how they apply it. If water is too cheap, farmers may irrigate low-value crops and will have little incentive to improve their irrigation technologies and management; in some cases, the extra output value from irrigation will be less than the cost of pumping and the value of water to the rest of the economy. If water is too expensive, farmers may reduce the areas they irrigate and over-invest in water-saving technologies, such as expensive imported drip irrigation systems.
- b. **Financial sustainability:** Both the WUOs and the Water Operations Division or RIDOs need an income that will let them cover their regular expenses, keep their infrastructure and systems well maintained and up to date, and fund any agreed investments. Water tariffs, plus any state subsidies, should cover these costs and allow the organisations to operate without running up debts or running down their infrastructure. Funding should also consider the variability of weather and ensure that overheads and operating costs are properly covered in both wet and dry years, when the quantity of water delivered may vary considerably.
- c. **Fiscal clarity:** Currently around half of the State Agency's expenditure is covered from the state budget; government may decide to continue supporting the water sector but the budget should make clear where the money is going, including how much is for the public function of water resource management and how much is a subsidy to irrigated agriculture.

[79] Irrigation tariffs or quantitative limits can potentially apply at three points:

- a. When the Water Operations Division or RIDOs abstract water from rivers and reservoirs, represented by the Water Resources Division of the State Agency;
 - b. When the Water Operations Division or RIDOs deliver bulk water to WUOs;
 - c. When WUOs deliver water to farmers.
- [80] The **Water Resources Division** will regulate the amount of water that the Operations Division or RIDOs can extract into a particular canal. This should be done in a way that balances the interests of different users and gives priority to the highest-value uses, that establishes long-term water rights as a sound basis for investment decisions, and that includes mechanisms to agree variations in unusually wet or dry years
- [81] If the irrigation water would have a value for an alternative use, such as hydropower or the environment, then the Water Resources Division may wish to send a signal to farmers encouraging them to reduce water use where it is economic to do so. This can be done in various different ways, such as:
- a. Applying a small volumetric charge for every cubic metre extracted, i.e. a water price. Here the problem is that a price high enough to influence farmers' marginal use would add up to a high cost across all the water supplied, and a price considered reasonable by farmers would be too low to have much impact on their decisions;
 - b. Allowing the Operations Division or RIDOs to extract e.g. 80 % of their annual quota free of charge and apply a higher volumetric charge to all water extracted above this quantity;
 - c. Making water rights tradeable, so that the farmers governing a RIDO might choose to sell part of their water allocation to another user if this would give them a higher income than using it for irrigation. Another RIDO, whose members are involved in production of high-value irrigated crops, might choose to buy additional water rights to expand their profitable production.
- [82] Water has a different value, or opportunity cost, in different parts of the system, so any volumetric abstraction charge at the top of the Dneiper cascade should be higher than at the bottom, and the charge could be zero on rivers without hydro-power or other alternative economic uses.
- [83] Income from any volumetric abstraction charge should accrue to the state and could be used to offset some of the public costs of managing the water sector. However, income should go to the state budget, not to the Water Resources Division, so that the volumetric abstraction charge is set on economic grounds and not to maximise institutional revenue.
- [84] Developing an appropriate system of water rights and allocation will be an important issue in a future revision of the Water Law, which must find a solution that works well within the political, economic and institutional realities of Ukraine.
- [85] The **Water Operations Division** and the **RIDOs** that succeed it should set a two-part tariff:
- a. A *volumetric charge* (bulk water price) equal to the actual costs of delivering one additional cubic metre of water, i.e. the volumetric abstraction charge plus the electricity cost of any pumping required. This price will and should be different for each canal to reflect differences in the water source and pumping height. This

pricing structure will encourage the development and expansion of irrigation in those parts of Ukraine where it is most economic.

- b. A flat-rate *area charge* to cover the overhead costs of operating and maintaining the main canals and pump stations, irrespective of the quantity of water supplied in each individual year. This fee could be calculated per hectare of irrigated land across the whole irrigation region (i.e. main canal command area) and charged annually to each WUO in proportion to its command area. The WUO representatives in the RIDO management board would agree the medium-term investment plan for the main canal, which would be reflected in the area charge.

[86] Increasing the area irrigated from a main canal could reduce the area charge as overheads were spread across a bigger area, but could also increase the pumping costs as a greater share of the water had to be pumped with more expensive day-time electricity. Both factors should be taken into account when considering potential investments.

[87] Where a main pump station operates mainly at night but partly during the day, each extra cubic of water delivered will incur a pumping cost at the day-time electricity tariff, and so this should form the basis of the volumetric fee. If this price were applied to the entire water volume then revenue would exceed actual costs; two possible solutions are:

- a. Reducing the area charge so that total projected revenue equals total budgeted costs (with the risk that revenue would not cover costs in a very wet year when little water was delivered), or:
- b. Applying block pricing, so that the area charge includes the provision of e.g. 2,000 m³/hectare, and all water supplied above this incurs the full volumetric charge.

[88] In Phase 1, each infrastructure department of the Water Operations Division, responsible for a specific irrigation region, should function as a cost centre with its own sub-budget agreed with its WUO and farmer customers. Common administrative and support costs could be allocated between departments in proportion to their command area, separately from other operating costs of the State Agency.

[89] In Phase 2, each RIDO will be a separate legal entity with its own budget and must ensure that its income from WUOs and other customers, plus any state subsidy, is sufficient to cover its investment costs and investment programme.

[90] The **WUOs** should set their irrigation tariffs in a very similar way:

- a. A *volumetric charge* (farm-gate water price) equal to the actual costs to the WUO of delivering one additional cubic metre of water, i.e. the bulk water price paid to the RIDO or Water Operations Division, plus the electricity cost of pumping.
- b. A flat-rate *area charge* to cover the overhead costs of operating and maintaining the secondary canals and pressure pump stations, irrespective of the quantity of water supplied in each individual year. This fee would be calculated per hectare of irrigated land across the whole irrigation district (i.e. WUO command area) and charged annually to each farmer in proportion to his area covered by the irrigation network. WUO members would agree together the medium-term investment plan and annual budget for the WUO, which would be reflected in the area charge.

- c. If the RIDO or Water Operations Division applies block pricing, with a relatively high volumetric fee for water supplied above the basic allowance, then the WUO should also apply block pricing: its members would receive the first e.g. 2,000 m³/hectare within their fixed charge and pay the volumetric charge for all water use above this level.
- [91] The diversity of irrigation systems across Ukraine means that WUOs will have to deal with a number of special cases, including:
- a. Farmers who pump water direct from a secondary canal into e.g. operating their own pressure pump station or using a portable pump to feed a hose reel system or a short-term drip irrigation installation for rotational vegetable production. Here the services provided by the WUO are limited to water purchase from the RIDO or Water Operations Division, and the use of the WUO's secondary canal; the farmer provides the rest of the infrastructure, management and pumping. A separate tariff should be developed and applied, either a volumetric fee where water is metered or an area fee for different crop types where it is impractical to measure actual usage.
 - b. Rice production normally uses gravity-fed surface irrigation from open tertiary canals. In this case there may be no WUO pumping cost and lower overall costs, but the same approach can be used, with an area charge plus a volumetric charge.
- [92] One objective of forming WUOs is to encourage investments and improvements, such as the installation of new low-pressure pumps, renewed electrical systems and improved pipe networks. Improving an entire WUO would result in a higher area charge to cover the investment cost but a lower volumetric charge as the pumping cost is roughly halved. Where a WUO has a mixture of both "unimproved" and "improved" pump stations, its members must decide whether to apply the same tariff structure throughout or to have different tariffs for improved and unimproved systems (see also the discussion on farmer-funded investment in the section on *Reform 5: Stimulating profitable investment*). This issue is likely to apply for some years until the WUO manages to upgrade all its pump stations, and can then switch to a unified tariff for all members.
- [93] **Drainage tariffs** should pursue the same three objectives of economic efficiency, financial sustainability and fiscal clarity, plus a fourth objective of **equity**:
- a. Rain falling on one farm may create a drainage requirement on a second farm, and drainage there may bring benefits to a third farm further downstream; equitable treatment of such interactions typically involves setting a uniform per-hectare charge across the whole drainage area.
 - b. Agricultural drainage may also help to protect homes, roads and other infrastructure from flooding; the funding system must strike a fair balance between the different beneficiaries.
- [94] For drainage, the goal of economic efficiency largely comes down to the strategic decision of whether or not to drain a particular piece of land; water price is generally not relevant and so only an area charge is required.
- [95] In some cases, there are economic interactions between irrigation and drainage, for example where irrigation creates a drainage requirement, or where drainage increases the supply of water for irrigation and other economic uses. Usually these interactions

are small and can be ignored, but there are exceptions, such as the pumped drainage up into Kiev reservoir, which creates the possibility to generate electricity through six successive hydro-power stations on the way to the sea; the economic value of this should be deducted from any pumping charge levied on drainage WUOs.

- [96] One special case is the two-way drainage systems found in parts of north-west Ukraine, where open channels and underground pipes are used to lower the water table in winter and early spring, and to raise it in late spring and summer. Water for the irrigation function comes from the upstream drainage system rather than from purpose-built irrigation canals, and it is not possible to measure field applications in the same way as with sprinkler irrigation. In most cases the most appropriate funding mechanism will be a flat-rate area tariff to cover both irrigation and drainage throughout the year.
- [97] If government wishes to **subsidise irrigation**, and to do so without reducing economic efficiency, it should subsidise the area charge and not the volumetric charge:
- a. Support to the Water Operations Division and its successor RIDOs should be towards the general operating budget and/or investment programme, allowing them to set a lower area charge to cover these costs;
 - b. Support to WUOs could take the form of a modest per-hectare irrigation subsidy, which again would be used to reduce their area charge. Pumping costs should not be subsidised as this would create a major distortion and encourage over-use of electricity and water.
- [98] However, government might wish to consider whether long-term support to irrigated agriculture is in line with society's overall goals, given that economic development of agriculture is possible without subsidy, and that the majority of support would go to large farmers who are considerably more wealthy than the average taxpayer. A more appropriate policy might involve:
- a. Long-term government funding of the Water Resources Authority, as a body implementing policy in the national interest;
 - b. Long-term funding of public-good drainage to protect urban areas and infrastructure; this may be provided through a mixture of local government and central government funds;
 - c. Limited start-up funding to WUOs, possibly through co-financing of a donor-supported grant scheme;
 - d. Transitional funding to the RIDOs as they moves from approximately 50 % cost recovery (the current situation and the initial situation of the Water Operations Division within the State Agency) to become fully self-financing over a number of years.

Reform 5: Stimulating profitable investment

- [99] Ukraine's irrigation and drainage system has suffered more than two decades of neglect, under-funding and deprecation, and now major investment will be needed to let the sector fulfil its economic potential. Analysis above showed that investment along priority irrigation canals would require around half a billion dollars, with the large majority of this going into tertiary systems. Under modernisation, around one-third of the investment would be at the WUO level and two-thirds by farmers; for rehabilitation,

the WUO requirement would rise and form around two-thirds of the total. Investment needs for drainage have not yet been analysed in detail but initial data suggest that, as with irrigation, the majority of funds will be required at the level of farms and local infrastructure.

[100] Investment in tertiary irrigation systems and farm drainage has several specific features and challenges:

- a. Most infrastructure is old and in poor repair, so the need for investment is large and urgent;
- b. WUOs will have little or nothing to offer as loan collateral, since they will be granted a right to use public infrastructure but will not own it, and it would anyway have very limited resale value;
- c. Newly-formed WUOs will have no accumulated capital unless their members agree to contribute it;
- d. Conversion to modern low-pressure systems requires simultaneous investment by WUOs and farmers;
- e. Most farmers do not currently own their land but work on leases of several years' duration, imposing a relatively short investment horizon and precluding the use of land as collateral;
- f. Large irrigation machines can in principle be removed from one farm and sold to another, and hence could function as collateral, but installed drip irrigation systems and drainage systems have little or no re-sale value;
- g. Progressive upgrading to spread out investment costs will result in a transition period where some WUO members are served by improved pump stations and some by unimproved;
- h. Investment in secondary canals can be seen as a benefit to all members of the WUO, though those at the head of the canal may be less affected than those at the tail.

[101] In these complex circumstances, commercial finance alone is unlikely to support sufficient investment and so the irrigation and drainage sector will fail to fulfil its economic potential for some time. Because of these market failures, there is a clear case for government to facilitate the provision of finance to WUOs and their members, investment until normal market conditions are established.

[102] A comprehensive financing plan to support both public and private sector investment could include:

- a. **Projects and grants** for capacity development of the institutions, including WUOs and RIDOs;
- b. **International development loans** for investment both by government in strategic infrastructure, and by WUOs and farmers in local infrastructure;
- c. **Private investment** through leasing, regular bank loans and farmers' own capital.

Projects and grants

[103] **Donor-funded projects** would help to build capacity and develop systems in the two new divisions of the State Agency and then in the RIDOs once formed. Projects would also help establish the WUO Support Unit and the WUOs.

[104] **Project support to the Water Resources Division** could include:

- a. Development of GIS systems and water resource models, supported by increased access to satellite imagery and hydro-meteorological data;
- b. Installation of automated monitoring equipment for river flows, ground-water and reservoir levels, and canal offtakes;
- c. Improvement of mechanisms for water-quality monitoring, including sampling systems and access to reliable laboratory analysis;
- d. Practical development of the permitting system, including databases and a risk-based inspection system;
- e. Technical assistance in adoption and implementation of the EU Water Framework Directive;
- f. Training and study tours.

[105] **Project support to the RIDOs** and the Water Operations Division before them could include:

- a. Installation of automated monitoring equipment for canal water levels and flows, and for main pump stations;
- b. Upgrading of management systems for canals and pump stations, building from the existing paper-based systems that are typically effective but time-consuming;
- c. Development of efficient systems for managing contracts, billing and payments by WUOs;
- d. Improvement of information systems, including an annual inventory of irrigation and drainage resources managed by the Operations Agency, and regular publication of data on resources and activities;
- e. Training and study tours.

[106] **Project support to the new WUO Support Unit** could include:

- a. Technical assistance for creation of the unit, including its structure, functions, staffing and budget;
- b. Development of models for WUO charters and agreements with farmers;
- c. Establishment of a dispute resolution mechanism for disputes between WUOs and their members, and between WUOs and the Operations Agency;
- d. Preparation of publicity materials, resource packs and information campaigns to stimulate WUO formation;
- e. Creation of an assessment procedure to check WUOs' readiness, firstly to begin joint management alongside the Operations Agency, and then to take over full management;
- f. Development of a WUO register;
- g. Development of an irrigation and drainage information system, including an annual inventory of key resources, and sample-based surveys for additional detail on land and water use, irrigated crop yields and margins, and the capital and operating costs of irrigation and drainage systems. Universities, research institutes and farmers' organisations should be encouraged to use and analyse the data;

- h. Creation of procedures and systems for implementation of the WUO start-up grant scheme, to be managed by the Support Unit;
- i. Training and study tours.

[107] **Project support to the Irrigation & Drainage Supervisory Unit**, responsible for both WUOs and RIDOs, could include:

- a. Technical assistance for creation of the unit, including its structure, functions, staffing and budget;
- b. Development of the register of WUOs and RIDOs;
- c. Design of procedures for supervision and audit;
- d. Training and study tours.

[108] **Start-up grants to WUOs and RIDOs** would contribute towards establishment costs, office equipment, staff training and design services for system modernisation. They would be managed by a Project Implementation Unit, in close cooperation with the WUO Support Unit, and delivered along with training and advice. Finance for the start-up grants might come from a project grant or from a development loan.

International development loans

[109] International finance can be delivered in two ways:

- a. An **international development loan** to support investment in strategic, public irrigation and drainage infrastructure;
- b. Capitalisation for an **irrigation and drainage credit scheme** support irrigation and drainage investments by WUOs and their members.

[110] The **international development loan** would be made to the Government of Ukraine support investment in the strategic irrigation and drainage infrastructure that is currently managed by the State Agency for Water Resources and be transferred to the RIDOs. A small package of urgent modernisation measures will be implemented through the Water Operations Division in Phase 1, together with detailed project preparation for wider-scale investment once the RIDOs are formed. The loan could also be used to fund the WUO start-up grant scheme if no other sources were available.

[111] The **irrigation and drainage credit scheme** would comprise:

- a. A **revolving fund** capitalised by an international financial institution and managed by the Ministry of Finance, providing money to commercial banks for onward lending to WUOs and their members. Money would be lent to the banks at or close to the interest rate paid by the Government of Ukraine on the fund capital;
- b. **Co-financing by commercial banks** in a proportion to be agreed;
- c. **Retail loans** to WUOs and their members for designated investments, at an interest rate no higher than the lending rate of the revolving fund plus an agreed maximum spread. WUOs would contribute a share of the total investment from members' contributions, whilst individual borrowers would typically supply a larger share of the total capital;
- d. A **loan guarantee scheme** covering a substantial proportion of the commercial banks' exposure on unsecured loans to WUOs, underwritten by government. Loans to individual farmers might also be eligible for the guarantee scheme, or

might be secured against the irrigation equipment itself and other assets and capital put up by the farmer.

Private investment

[112] Investment by farmers in irrigation equipment for their own use could be funded in various ways in addition to the irrigation and drainage credit scheme. These include:

- a. **Outright purchase** using accumulated profits from farming and other businesses;
- b. **Bank loans** direct to the individual farmer;
- c. **Lease purchase**, possibly with an international financial organisation capitalising the leasing company.

[113] In some cases, farmers will have better access to capital than WUOs and so provision should also be made for **investment by individual members into WUO infrastructure**. This would typically apply where 1-3 farmers want to upgrade the pressure pump station and pipe network serving their farms, and are prepared to put in the necessary funds. The main obstacle at present is insecure land tenure, as farmers want to be sure that they will receive a return on their investment even if they fail to renew all the leases.

[114] WUOs may choose different ways of encouraging investment by their members, but one approach would be as follows:

- a. The farmers served by one pressure pump station agree amongst themselves and with the WUO on the investment to be made;
- b. The farmers contribute the funds in proportion to their area served, or as otherwise agreed between them;
- c. The WUO manages the works and takes ownership of the equipment;
- d. For an agreed “buyout” period, such as ten years, the farmers continue to pay the lower “unimproved” area charge plus the lower “improved” volumetric charge reflecting the reduced costs of pumping at low pressure. The farmers’ return on investment consists of the saving in water fees over the buyout period, plus the higher yields from a more reliable water supply;
- e. If any of these farmers ceases to farm area under this pump station during the buyout period, the new land-user will immediately start paying the higher “improved” area charge and the WUO will each year transfer the difference between the “improved” and “unimproved” area charge to the departed farmer or his estate. Alternatively, the incomer could agree a settlement with the out-goer and take over the existing agreement until the end of the buyout period, possibly also purchasing the farm irrigation equipment;
- f. At the end of the buyout period, all farmers served by this pump station would switch to paying the “improved” area charge and “improved” volumetric charge;
- g. Once the WUO had completed modernisation of all pump stations in its command area, it might be in a position to fund future investment from bank loans and accumulated service fees and so could end the two-tier structure of “improved” and “unimproved” charges. Alternatively, the members might decide to reapply the model to further rounds of investment.

[115] Once the land market has been established, some large farms may emerge that wish to build and operate their own pressure pump stations and pipe networks. WUOs should be open to this option as the most straightforward way of getting private investment into the system, and the tariff system would in principle be the same as that for a small farmer pumping water direct from a canal into a hose-reel or drip system. However, the WUO must be satisfied that this approach does not result in small farmers being cut off from irrigation, and that the private pump stations will conform to the management system for water flow and allocation along the secondary canal.

A timetable for reform

[116] The following pages present an Action Plan for reform, divided into two phases and covering three themes:

- a. Reform of government structures (A)
- b. Establishment of water users' structures (B)
- c. Finance and investment (C)

[117] Phase 1 (2017-20) will:

- a. Establish the new Water Resources Division and Water Operations Division within the State Agency for Water Resources;
- b. Support upgrading of monitoring and management systems within the State Agency, and provide funding for critical rehabilitation of public water infrastructure;
- c. Create a WUO Law and begin the creation of WUOs and the handover of responsibilities to them;
- d. Establish financial mechanisms to support investment by WUOs and farmers;
- e. Establish the regular funding structure of tariffs and subsidies.

[118] Phase 2 (2021-25) will:

- a. Form new Regional Irrigation & Drainage Organisations and give them responsibility for managing strategic irrigation and drainage infrastructure. Once this transfer is complete, the Water Operations Division will no longer be involved with canals or drainage collectors but will continue to manage control structures, dredging etc. on rivers;
- b. Develop long-term solutions for each of the ancillary functions currently performed by the State Agency;
- c. Reform the national coordination mechanism for the water sector;
- d. Finance widespread rehabilitation and modernisation of public irrigation and drainage infrastructure;
- e. Review WUO experience to date, amend mechanisms as appropriate, and complete the establishment of WUOs on the majority of irrigated and drained land;
- f. Continue financial support to WUOs and farmers.

[119] By the end of Phase 1 the first WUOs will be established and fully operational, and the reform of government structures will have begun. By the end of Phase 2 the majority of irrigated and drained land will be covered by functioning WUOs, the reform of

government structures will be complete, and a significant proportion of the irrigated area will have been rehabilitated or modernised.

	Objective	Activity	Expected outcome	Responsible body	Partner organisation	Timeframe	Est. budget	Source of funding	
A. REFORM OF GOVERNMENT STRUCTURES	A1. Establish Phase 1 structures	A1.1 Review existing structures	Plans for “Water Resources Division” & “Water Operations Division” within SAWR, including organisational structure, functions, consultative bodies & implications for existing structures		World Bank	2017		Donor organisations	
		A1.2 Create legal basis	SAWR legal basis amended to implement new structure & functions	MoE	World Bank	2018		Donor organisations	
		A1.3 Implement Phase 1 structures	New divisions functioning within SAWR; consultative bodies created & representatives appointed	MoE		2018			
		A1.4 Build capacity	Staff trained and information, monitoring & management systems upgraded		Donors	2018-20		Donor organisations	
	A2. Establish Phase 2 structures	A2.1 Conduct functional review of SAWR	Detailed plan for transformation of all SAWR supporting units, potentially including privatisation, reassignment to other institutions or restructuring and retention within SAWR			Donors	2019		
		A2.2 Create new legal basis	Development and adoption of a new Law on Land Amelioration (or Law on Irrigation & Drainage) as legal basis for creation of RIDOs; amendment of state budget to fund SAWR and provide transitional subsidy to RIDOs; outstanding ownership issues (e.g. earlier transfers to Village Councils) resolved				2019-20		
		A2.3 Implement Phase 2 structures	New RIDOs established, staffed and operational; non-core SAWR units privatised or transferred elsewhere; users’ representatives elected to consultative groups or user boards				2020		
		A2.4 Build capacity	Second-phase donor projects to help build capacity and systems in the Water Resources Division and RIDOs			Donors	2020-25		

	Objective	Activity	Expected outcome	Responsible body	Partner organisation	Timeframe	Est. budget	Source of funding
B. ESTABLISHMENT OF WATER USERS' STRUCTURES	B1. Initiate WUOs	B1.1 Create legal basis	WUO Law drafted, discussed and adopted		World Bank	2017-18		
		B1.2 Establish support unit	WUO Support Unit established, staffed and trained; publicity campaign conducted and support service begun	MAPF	Donors	2018		MAPF & Donor organisations
		B1.3 Establish supervision unit	Irrigation & Drainage Supervision Unit established, staffed and trained					
		B1.4 Establish first WUOs	WUOs established by farmers, registered, staffed and assessed	Farmers + MAPF		2018-20		
		B1.5 Handover	Use-rights assigned to WUOs, with full transfer of management responsibility over a one-season handover period	SAWR + WUOs		2018-20		
	B2. Complete WUO formation	B2.1 Mid-term review	Detailed report prepared on WUO experience so far, including survey and case-study findings, with recommendations for any necessary legal and financial changes, and an action plan to complete the establishment of WUOs throughout the country	MAPF	World Bank	2020		
		B2.2 Implement recommendations	Review recommendations implemented; WUO coverage progressively extended to the majority of irrigated and drained land	MAPF	Donors	2021-25		

Objective	Activity	Expected outcome	Responsible body	Partner organisation	Timeframe	Est. budget	Source of funding
C. FINANCE & INVESTMENT	C1. Establish financial structure	C1.1 Set tariffs & subsidies	Overall structure and tariff-setting mechanisms agreed for bulk water tariffs, WUO members' tariffs and any government subsidies; initial tariffs and subsidies set and implemented		World Bank	2018	
		C1.2 Planning and prioritisation	Detailed investment and finance plan adopted, covering all levels of the irrigation and drainage system	MAPF + MoE	SAWR; Donors	2018	MAPF & Donor organisations
		C1.3 Invest in public infrastructure	Loan/grant projects developed and initiated for urgent rehabilitation of critical irrigation and drainage infrastructure		IFIs	2018-20	IFIs
		C1.4 Invest in WUOs	Funding facility established to support modernisation and rehabilitation of irrigation and drainage systems by WUOs		Ministry of Finance; IFIs; commercial banks	2018-20+	IFIs; commercial banks
		C1.5 Invest on farms	Finance mechanism established for purchase of irrigation systems by farmers		IFIs; commercial banks	2018-20+	IFIs; commercial banks
		C2. Upgrade infrastructure	C2.1 Invest in public infrastructure	Loan/grant projects developed and initiated for modernisation and rehabilitation of major irrigation and drainage infrastructure operated by RIDOs, together with improved management and monitoring of water resources and infrastructure		IFIs	2021-25+

Timetable for reform of the irrigation & drainage sector in Ukraine

Theme	Objective	Activity	Phase 1				Phase 2					
			2017	2018	2019	2020	2021	2022	2023	2024	2025	
A. REFORM OF GOVERNMENT STRUCTURES	A1. Establish Phase 1 structures	A1.1 Review existing structures										
		A1.2 Create legal basis										
		A1.3 Implement Phase 1 structures										
		A1.4 Build capacity										
	A2. Establish Phase 2 structures	A2.1 Conduct functional review of SAWR										
		A2.2 Create new legal basis										
		A2.3 Implement Phase 2 structures										
		A2.4 Build capacity										
B. ESTABLISHMENT OF WATER USERS' STRUCTURES	B1. Initiate WUOs	B1.1 Create legal basis										
		B1.2 Establish support unit										
		B1.3 Establish first WUOs										
		B1.4 Handover										
	B2. Complete WUO formation	B2.1 Mid-term review										
		B2.2 Implement recommendations										
C. FINANCE & INVESTMENT	C1. Establish financial structure	C1.1 Set tariffs & subsidies										
		C1.2 Planning and prioritisation										
		C1.3 Invest in public infrastructure										
		C1.4 Invest in WUOs										
		C1.5 Invest on farms										

