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PROJECT PERFORMANCE ASSESSMENT REPORT

ARMENIA

IRRIGATION REHABILITATION PROJECT (CREDIT 2667-AM)

May 5, 2004

Sector and Thematic Evaluation Group
Operations Evaluation Department

CURRENCY EQUIVALENTS

Currency Unit = Drams (AMD)

1994 (Nov)	US$1.00	=	AMD 385	(Irrigation Rehabilitation Approved)
2001 (Nov)	US$1.00	=	AMD 550	(Irrigation Rehabilitation Completed)

ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy
CAE	Country Assistance Evaluation (by OED)
DIMAs	Drainage and Irrigation Maintenance Agencies
DME	Dam Maintenance Enterprise
DWSI	Department of Water Supply and Irrigation
ERR	Economic Rate of Return
EU	European Union
FAO/CP	Food and Agriculture Organization/World Bank Coop.
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IFC	International Finance Corporation
IFAD	International Fund for Agricultural Development
IMS	Irrigation Management System
MoA	Ministry of Agriculture
M&E	Monitoring and Evaluation
MIS	Management Information System
OME	Operation and Maintenance Enterprise
O&M	Operation and Maintenance
PPAR	Project Performance Assessment Report
PIU	Project Implementation Unit
SAR	Staff Appraisal Report
SCWM	State Committee for Water Management
SWC	State Water Committee
TA	Technical Assistance
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WSA	Water Service Agency
WUA	Water User Association
WUF	Water User federation (composed of several WUAs)
WUCC	Water User Consumer Cooperative

FISCAL YEAR

Government: January 1 — December 31

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OED Mission: Enhancing development effectiveness through excellence and independence in evaluation.

About this Report

The Operations Evaluation Department assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the Bank's self-evaluation process and to verify that the Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, OED annually assesses about 25 percent of the Bank's lending operations. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or Bank management have requested assessments; and those that are likely to generate important lessons. The projects, topics, and analytical approaches selected for assessment support larger evaluation studies.

A Project Performance Assessment Report (PPAR) is based on a review of the Implementation Completion Report (a self-evaluation by the responsible Bank department) and fieldwork conducted by OED. To prepare PPARs, OED staff examine project files and other documents, interview operational staff, and in most cases visit the borrowing country for onsite discussions with project staff and beneficiaries. The PPAR thereby seeks to validate and augment the information provided in the ICR, as well as examine issues of special interest to broader OED studies.

Each PPAR is subject to a peer review process and OED management approval. Once cleared internally, the PPAR is reviewed by the responsible Bank department and amended as necessary. The completed PPAR is then sent to the borrower for review; the borrowers' comments are attached to the document that is sent to the Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the OED Rating System

The time-tested evaluation methods used by OED are suited to the broad range of the World Bank's work. The methods offer both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. OED evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (more information is available on the OED website: http://worldbank.org/oed/eta-mainpage.html).

Relevance of Objectives: The extent to which the project's objectives are consistent with the country's current development priorities and with current Bank country and sectoral assistance strategies and corporate goals (expressed in Poverty Reduction Strategy Papers, Country Assistance Strategies, Sector Strategy Papers, Operational Policies). *Possible ratings:* High, Substantial, Modest, Negligible.

Efficacy: The extent to which the project's objectives were achieved, or expected to be achieved, taking into account their relative importance. *Possible ratings:* High, Substantial, Modest, Negligible.

Efficiency: The extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared to alternatives. *Possible ratings:* High, Substantial, Modest, Negligible. This rating is not generally applied to adjustment operations.

Sustainability: The resilience to risk of net benefits flows over time. *Possible ratings:* Highly Likely, Likely, Unlikely, Highly Unlikely, Not Evaluable.

Institutional Development Impact: The extent to which a project improves the ability of a country or region to make more efficient, equitable and sustainable use of its human, financial, and natural resources through: (a) better definition, stability, transparency, enforceability, and predictability of institutional arrangements and/or (b) better alignment of the mission and capacity of an organization with its mandate, which derives from these institutional arrangements. Institutional Development Impact includes both intended and unintended effects of a project. *Possible ratings:* High, Substantial, Modest, Negligible.

Outcome: The extent to which the project's major relevant objectives were achieved, or are expected to be achieved, efficiently. *Possible ratings:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Bank Performance: The extent to which services provided by the Bank ensured quality at entry and supported implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of the project). *Possible ratings:* Highly Satisfactory, Satisfactory, Unsatisfactory, Highly Unsatisfactory.

Borrower Performance: The extent to which the borrower assumed ownership and responsibility to ensure quality of preparation and implementation, and complied with covenants and agreements, towards the achievement of development objectives and sustainability. Possible ratings: Highly Satisfactory, Satisfactory, Unsatisfactory, Highly Unsatisfactory.

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Contents

This report was prepared by George T. Keith Pitman, who assessed the project in September 2003. The report was edited by William Hurlbut, and Soon-Won Pak provided administrative support.

Principal Ratings and Key Staff Responsible

ARMENIA: IRRIGATION REHABILITATION PROJECT (CREDIT 2667-AM)

	*ICR**	*ICR Review**	*PPAR*
Outcome	Satisfactory	Satisfactory	Satisfactory
Sustainability	Highly Likely	Likely	Likely
Institutional Development Impact	Substantial	Substantial	Substantial
Bank Performance	Satisfactory	Satisfactory	Highly Satisfactory
Borrower Performance	Satisfactory	Satisfactory	Satisfactory

* The Implementation Completion Report (ICR) is a self-evaluation by the responsible operational division of the Bank. The ICR Review is an intermediate OED product that seeks to independently verify the findings of the ICR.

Project	*Task Manager*	*Division Chief/ Sector Manager*	*Country Director*
Appraisal (1994)	Ezriel Brooks	Geoffrey Fox	Basil Kavalsky
Completion (2001)	Mark Lundell	Joseph Goldberg	Judy O'Connor

Preface

This is the Project Performance Assessment Report (PPAR) prepared by the Operations Evaluation Department (OED) for the Armenia Irrigation Rehabilitation Project. The project was approved in December 1994 for an IDA Credit of US$43 million and an IFAD credit of US$8 million. The project closed two years behind schedule in May 2001 when US$1.5 million of the credit was cancelled. Total project costs at completion were US$51.8 million.

This report is based on the Implementation Completion Report (ICR) prepared by the European and Central Asia Region (No. 23168 dated November, 2001), the Memoranda and Recommendations of the President, Staff Appraisal Reports, loan documents, project files, and discussions with Bank staff. An OED mission visited Armenia in September 2003 and met stakeholders to discuss the effectiveness of the Bank's assistance with development and financing partners, project implementing agencies, private sector agencies, and beneficiaries. The cooperation and assistance of central government and regional officials and staff, nongovernmental stakeholders, cofinanciers, and other interested parties are gratefully acknowledged.

Armenia was a new Bank client and an evaluation of this project was required to support OED's Country Assistance Evaluation (CAE). Additionally, at completion the ICR raised issues of sustainability because of challenging socio-economic and national budget conditions, reliance on subsidies, and institutional restructuring needed to facilitate divestiture to farmer management and/or ownership.

Following standard OED procedures, the draft PPAR was sent to the borrower for comment before it was finalized. No comments were received.

Summary

The Armenia Irrigation Rehabilitation Project, approved in 1994, addressed three major problems. First, following independence from the former Soviet Union and the macroeconomic crisis 1991-94, there was a marked reduction in the ability of the state to operate, manage and maintain irrigation infrastructure. The second was that inferior construction standards, materials and building quality during Soviet times made public-sector infrastructure liable to premature ageing and failure, a problem exacerbated by deferred maintenance. And third there was a high reliance on cheap energy for pumping. The project's primary objective was to assist in maintaining the level of irrigated agricultural production over 164,700 ha or 60 percent of Armenia's irrigated lands. The secondary objective was to improve the country's water resources planning, paying particular attention to dam safety, hydropower and environmental concerns.

The outcome of the project is rated as satisfactory. The project substantially achieved most of its objectives, with few shortcomings. Following restructuring in its second year (when lower priority works were postponed to a second phase project), revised targets for irrigated area and physical rehabilitation were fully achieved. Primary and secondary canals and four dams were rehabilitated. Irrigation facilities needed for market-based privatized agriculture were completed satisfactorily. Operating costs were cut back primarily through reduction of energy consumption and water leakage. Flow measuring facilities were installed so that water volumes could be measured, accounted for and then sold. The International Fund for Agricultural Development's cofinancing (US$8 million) successfully reconstructed tertiary level and on-farm irrigation infrastructure on over a fifth of the total project area. And within this 27,000 ha, over 380 km of tertiary and quaternary-level irrigation canals, designed for large 500+ ha collective farms, were realigned, rehabilitated and downsized as needed to efficiently serve the area covered by newly created water user groups.

Institutional development is rated as substantial. Technical assistance facilitated sound procurement and contract administration procedures, established a viable private sector contracting capability, built government's capacity to undertake financial and economic analysis of projects, and helped develop a rational basis for prioritizing projects for investment. This was a marked improvement over the *ad hoc* approach based on Soviet practice used before 1996.

The formation of pilot water user consumer cooperatives was initially successful but subsequently they were found to be too small to be effective. Even so, government expanded them nationally in 1998 long before the lessons from the pilots could be utilized to improve their design. Building on studies funded by the project and lessons learned from the Bank's global experience, in 2002 water user groups were enabled to form voluntary water user associations shortly after the project closure. The new associations merged dozens of cooperatives into viable management units of 3,000 to 6,000 ha that benefited from economies of scale and are adopting commercially-oriented financial management and cost recovery. Because this reorganization has not yet matured and government failed to revitalize its irrigation operation and management agency, only a quarter of the planned full recovery of operation and maintenance costs was achieved.

However, after project closure, and in response to conditions for further Bank lending, the government completely reorganized Armenia's water management into water supply and water service agencies – but it is too early to judge their performance. A thoroughly modernized State Water Law was approved in 2002.

Sustainability is rated likely. There is greater clarity about the real costs and institutional reforms needed to make irrigation viable. The new WUAs are adopting a pragmatic approach to reducing costs, as is the government with its strategy to convert pumped irrigation to gravity supply where economically feasible. Improving cost recovery is high on the agenda.

Bank performance is rated as highly satisfactory. Rapidly changing market conditions and Bank experience of Armenia's realities led to project restructuring in the second year. Supervision was exceedingly thorough, and policy advice was of very high quality, appropriate and effective in moving an agreed reform agenda forward. The pace and extent of reform in the irrigation sector is remarkable considering the chronic situation in 1994. Borrower performance is rated satisfactory.

The project experience offers four lessons:

- Rehabilitation is only a partial solution for most irrigation projects because it is generally a symptom of inadequate management and insufficient maintenance funding. This project clearly demonstrates that rehabilitation should be supplemented by measures to foster creation of efficient institutions with the ability, *inter alia*, to measure and manage water and accurately cost operation and maintenance.
- Some of the most effective and simple investments leading to higher levels of efficiency in irrigation projects are the installation of a large number of water and electricity flow measuring devices and consultation with stakeholders to agree on operating rules.
- It is essential that adequate attention is given during appraisal to linking investments in agricultural technology with the measures to improve production and marketing of outputs. The absence of such complementary investment may jeopardize the ability of project beneficiaries to cover operation and maintenance costs and thus threaten sustainability.
- Social assessment and interventions are needed particularly when there is a high level of rural poverty. Such assessment will help to ensure that infrastructure investment give adequate attention to beneficiary ownership and their ability to contribute towards maintenance of facilities created. In the project, such an approach could have created smallholders' cooperatives or micro-credit groups that could have moved landowners beyond subsistence agriculture.

Gregory K. Ingram
Director-General
Operations Evaluation

1. Background

1. Armenia is a small, mountainous landlocked country in the Caucasus with an area of 29,800 square kilometers and a population of about 3 million. A third of the population live in Yerevan, which is located in the wide and fertile Ararat valley that forms the breadbasket of Armenia and the southwestern border with Turkey. Under the former centralized economic system of the Soviet Union, Armenia experienced relatively robust economic development, unparalleled among other former Soviet republics, which created a diversified industrial infrastructure, a flourishing agriculture and a modern transport network. As a producer of industrial, intermediate and finished goods, most trade was with Russia and surrounding republics – Georgia to the north and Azerbaijan to the east.

2. **The Economy**. Following independence in 1991, the loss of Soviet support, markets and highly-subsidized energy led to a rapid decline in industrial output and high unemployment. By 1993, GDP had fallen by almost two-thirds. Closure of gas and nuclear power (accounting for almost 80 percent of Armenia's energy consumption) was crippling to the economy.[1] The earthquake of December 1998 caused extensive damage to infrastructure and housing stock, destroying 40 percent of the country's manufacturing capacity, killing about 30,000 people and leaving 530,000 homeless. In response to all these adverse effects on the economy, the budget deficit reached 55 percent of GDP in 1993 and inflation hit 5,000 percent. Because of increasing poverty, high unemployment and rapidly falling living standards, an estimated 800,000 people emigrated to find better prospects.[2]

3. Despite these setbacks, government initiated some reforms prior to membership in the international financial institutions (IFIs). Before 1993, most commodity prices, with the exception of bread, were freed. The government broke up the collective farms and transferred property and land to rural residents, and liberalized retail and producer prices for agricultural goods. Early steps were taken to privatize most housing. These efforts received an impetus in 1994, following the lifting of the blockade after the Nagorny-Karabakh ceasefire, from a comprehensive reform program supported by the international community – its primary aim was fiscal stabilization, overhaul of the tax system and substantial expenditure cuts. The Irrigation Rehabilitation Project was included in the second round of Bank credits (FY95-97), the first round having addressed macroeconomic reform and earthquake reconstruction.

4. **Agriculture.** Land reforms had little effect on agricultural productivity because of the lack of competitive markets, delay in restructuring and privatizing agricultural industries and slow reform of institutions inherited from the Soviet period. A contraction of the economy increased the importance of agriculture whose contribution rose threefold to 37 percent of GDP, and its share of total employment rose from 18 percent to over 25 percent by 1993. Even so, agricultural production declined to 1994 and did not recover until after 1998. Overall, agriculture grew by only 13.7% in the decade 1990-2000, compared to industrial

1. Armenia's Medzamor nuclear power plant (of the same design as Chernobyl) closed because of safety concerns in 1988, only reopening in 1995. The economic embargo severely cut imported gas supplies.

2. The incidence of poverty rose to 55 percent by 1997. The Gini coefficient rose from 0.30 in 1990 to 0.57 in 1998/99 (the Gini coefficient would be zero for perfect income equality and one for total inequality). OED, Country Assistance Evaluation, 2003.

output which declined by 69% in the same period. As a result, in 2003 agriculture accounted for almost a quarter of GDP and remains an important sector of the economy. Irrigation accounts for about 80 percent of total crop production and its sustainability is key to agricultural performance and rural employment – a major justification for this project.

2. The Irrigation Rehabilitation Project

5. Three problems were addressed. The first was a marked reduction in the ability of the state to operate, manage and maintain irrigation infrastructure. Second, there was a high reliance on cheap energy for pumping. The third was that inferior construction standards, materials and building quality during Soviet times made public sector infrastructure liable to premature ageing and failure, a problem exacerbated by deferral of most maintenance after 1991.

OBJECTIVES

6. The Irrigation Rehabilitation Project's (IRP) primary objective was to assist in maintaining the level of irrigated agricultural production over 164,700 ha (or 60 percent) of Armenia's irrigated lands. The secondary objective was to improve the country's water resources planning, paying particular attention to dam safety and hydropower. Lake Sevan was being mined and it was feared that another potential Aral Sea environmental problem could develop. There was also concern that failure of wells in the Ararat valley would lead to waterlogging Armenia's most productive land. Details of project components to achieve these objectives and their costs, are given in Table 1. The US$57.2 million total cost of the IRP was funded through an IDA credit of US$43 million and US$8 million cofinanced by IFAD.

7. At mid-term review the projects objectives were increased to include two sub-objectives covering (a) facilities need for market-based privatized agriculture and (b) accelerated development of water distribution institutions. This modification only made explicit the focus of the original components and did not change either the scope or nature of the two main overall objectives.

IMPLEMENTATION ARRANGEMENTS

8. The Ministry of Agriculture (MoA) was responsible for the project, whose day-to-day management, administration and coordination was exercised through a Project Implementation Unit (PIU). Soon after independence, the Department of Water Supply and Irrigation (DWSI), was transferred to the MoA. DWSI had 11,000 permanent and 3,000 temporary staff, and was primarily an engineering and technical organization with little experience of project management, procurement, and economic and financial appraisal. The MoA established a Project Board of Management, chaired by a Deputy Minister to make policy decisions and provide general guidance to project implementation staff. Other members of the board are the Director of DWSI, Director of the Operation and Maintenance Enterprise (OME), Director of the Economic Department in the MoA, a second Deputy Minister, and a representative from the Ministry of Economy.

9. Day-to-day management of the project involved cooperation among five main line agencies that were directly or indirectly responsible for irrigation water management. The Dam Maintenance Enterprise (DME) supplied water to the OME that had prime responsibility for regulating and managing irrigation water supplies as well as maintaining the systems. The Drainage Enterprise operated drainage wells and systems primarily in the Ararat Valley. The Arva/Lake Sevan Tunnel Agency regulated outflows from Sevan Lake. The Water Supply Monitoring Agency collected operational information.

10. In early 2001, just before project completion, MOA's responsibility for water resources management was taken over by the newly-formed State Commission for Water Management as government separated water resources management from water resources use.

Table 1: Project Objectives, Components and Costs

Objectives	Components	Costs (US$, million)	
		Appraisal	Actual
1. Assist in maintaining the level of irrigated agricultural production			
(a) support facilities needed for market-based privatized agriculture (added after MTR)	❑ Rehabilitation of main, secondary canals in eight projects	14.72	26.68
	❑ Rehabilitation of four pumping stations	9.46	1.69
	❑ Rehabilitation of 650 tubewells and electro-mechanical equipment	6.94	4.50
	❑ Rehabilitation of four dams (safeguard issue)	1.31	0.93
(b) accelerate development of water distribution institutions (added after MTR)	❑ Pilot project to improve water management at village level and reorient the Operational Maintenance Enterprise	6.22	7.80
	❑ Incremental O&M costs	5.00	5.87
	❑ Design and supervision, TA and PIU	2.06	4.38
2. Improve the country's water resources management	❑ Introduce economic and financial considerations into draft water master plan	0.50	a/
	Price and Physical contingencies	10.94	-
	Total Cost	57.15	51.86

a/ water resources management activities were included within PIU expenditures

IMPLEMENTATION

11. Nine months into implementation several problems arose. First there was no prioritized list of project works and tender document preparation was *ad hoc* as a result. Second, consultants did little field inspection, relied too much on local engineering judgment that embodied Soviet practice, and many of the initial 'emergency' works could neither be justified technically nor financially. And third, the first round of bids (using mainly local

competitive bidding) was 50-100 percent higher than the appraisal estimate.[3] Fourth, the Ministry of Agriculture had not released its 15 percent funding for advance payment on contracts or paid its support for the PIU. These problems caused the project to be halted. After more careful consideration and using updated costs, it was estimated in November 1995 that the works specified in the SAR would cost about US$120 million to complete instead of the US$57 million agreed. To monitor project reformulation, supervision intensity was increased to every four months (instead of six) over the year from July 1995.

12. In June1996 the project was downsized to fit within the budget. Lower priority works were postponed to a second phase project (recently approved). Benefited area fell from 165,000 to 148,000 ha and the economic rate of return was revised downward from 53 to 35 percent. The idea of differential water charges to reflect the wide variation of operating conditions and eliminate cross-subsidies was introduced, as was marginal cost pricing to eliminate uneconomic subprojects. In addition the IFAD tertiary level development and pilot water user groups was redesigned to cover a larger area. The Development Credit Agreement was formally amended in May 1997.

3. Evaluation

OUTCOME

13. **The outcome of the project is rated as satisfactory.** The basis for this rating is shown in Table 2 . Both major objectives were of equal importance. The basis for these ratings is elaborated in the following sections.

RELEVANCE

14. **Overall relevance is rated as high.** The project predated the first Country Assistance Strategy (CAS) for Armenia (1995), but was highly relevant to the major issues identified in the 1993 Country Economic Memorandum. The 1995 Armenia Agriculture and Food Sector Review highlighted the importance of making irrigation sustainable. The 1997 CAS reaffirmed the project's relevance to country development priorities through three of its four objectives (poverty alleviation and support for better social protection; infrastructure rehabilitation; reforms to complete the transition to a market economy; and promote private sector development).

15. **Irrigation is important for rural poverty alleviation.** The overall relevance of project's objectives to poverty alleviation is high because agriculture is the primary safety net for almost 400,000 rural households, most of whom are subsistence farmers, and half are below the poverty line. In 1999 agriculture provided employment for 43 percent of Armenia's labor force.

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3. The Armenian cost of living index rose by 1,860 percent in 1994, the unit cost of material by 200-300 percent. Some of these increases were not offset by the exchange rate. The first three LCB contracts were not sent to the Bank for prior review as required, competition was minimal, contractors were only given 10 days to submit bids, and most bidders were associated with the Ministry of Agriculture.

16. **Land reform had made operation of the irrigation systems exceedingly difficult.** Originally designed as centrally-managed schemes distributing water to 860 large collective and state farms (50 to 400+ ha), land privatization and redistribution had turned these farms into a patchwork of 300,000 smallholdings. New landholdings were a mismatch to existing irrigation systems. The majority of new owners had not been farmers and ranged from clerks, policemen and accountants to mechanics and managers. Average land holdings were about 1.4 ha, and even that was split in to 3 or 4 plots, each owner having an equal share of good and poor land. To access water, low efficiency ditches were dug to the nearest outlet or people broke into canals and pipes. Consequently, those near outlets had plenty of water, while those at the tail-ends of the system had little. Water supply became increasingly unreliable due to unregulated use and poor maintenance.

Table 2: Ratings for Achievement of Project Objectives

Objectives	Relevance	Efficacy	Efficiency	OUTCOME
1. Assist in maintaining the level of irrigated agricultural production				
Physical				
Rehabilitation of main, secondary canals in eight projects, pumping stations, tubewells , and four dams (safeguard issue)	**High**	**Substantial**	**Substantial**	**Highly Satisfactory**
Support [irrigation] facilities needed for market-based privatized agriculture	**High**	**High**	**High**	**Highly Satisfactory**
Institutional				
Accelerate development of water distribution organizations	**High**	**Substantial**	**Substantial**	**Satisfactory**
2. Improve the country's water resources management				
Institutional				
Introduce economic and financial considerations into water master plan	**High**	**Modest**	**Not applicable**	**Moderately Satisfactory**
Overall ratings	***High***	***Substantial***	***Substantial***	***Satisfactory***

17. **The project's emphasis on rehabilitation was timely.** Restoring the system managers' ability to deliver water on demand was important. It would also reduce water loses and thus potential revenue for water sales. Poor construction and inadequate maintenance expenditures were primarily responsible for the failing state of the irrigation infrastructure and inability to deliver when needed. Originally, all irrigation canals were lined, but landslides, erosion, and deterioration of poor quality concrete caused excessive water losses and reduced conveyance efficiency. Steel pipelines were heavily corroded. Leaking aqueducts threatened system continuity, and many storage dams needed urgent repair. Recognizing the hazard poorly-maintained dams posed, expert surveys of the 24 most at risk were made during appraisal, and designs to ensure upgrading of seven dams were completed in time to be included in the project. The survey of the remaining dams was completed and

remedial works were implemented through the Bank's Dam Safety Project approved in May 1999.

18. **New arrangements to collect water fees for maintenance were needed.** Despite chaotic farming arrangements, government authorized the OME in 1992 to levy an irrigation fee on farmers. As OME could not manage the 260,000 agreements needed, only 26 percent of billings were collected. Initially, village councils supervised up to four watermasters (supplied by OME) each, paying them 7-10 percent of the fees collected. Subsequently, cost recovery declined further as many village councils felt they could not put further financial burdens on what was mainly subsistence farming. This put OME into an almost impossible situation. They could not collect sufficient fees to slow declining O&M performance and central government subsidies were generally too small and too late to make a difference.

19. **The project's focus on improving operation and maintenance of irrigation through water distribution organizations was highly relevant.** OME was caught in a failure chain because farmers were unwilling to pay fees for declining system reliability. The project addressed this problem through payment of O&M costs, estimated at US$5 million, for five years. In return, OME was expected to increase its cost recovery to 100 percent and utilize technical assistance to build its technical and managerial capacity, turning it from an administrative to a service organization, and also improve its performance. Additionally, IFAD cofinanced US$8 million for irrigation system improvements at the farmer interface, piloting water user associations to improve water management, system maintenance, and implement users' water fee collection. With these measures in place it was expected that farmers would contribute the equivalent of US$2 million in labor and materials.

20. **Reduction of power costs was highly relevant for market-based, privatized agriculture.** Almost two-thirds of irrigation's operational costs were for energy and this were paid through preferential pricing and hidden subsidies as in former Soviet times. Since the post-1991 energy crisis, less than half the power needs of irrigation could be supplied and an increasing share of these costs had to be paid by users.[4] Consequently, the policy focus to make energy costs and subsidies transparent and bring them into the structure of water fees was appropriate, as was physical rehabilitation of gravity systems and improvement of energy efficiency in pumped schemes.

EFFICACY

21. **Overall efficacy is rated substantial.** The project substantially achieved most of its objectives with few shortcomings. Although revised agricultural production and physical rehabilitation targets were fully achieved, this was not so for institutional objectives. Generally, institutional targets were too ambitious given the time needed for adjustment to a market-driven economy, changing entrenched attitudes, and building national and local capacity for cost-effective management of irrigation and water distribution.

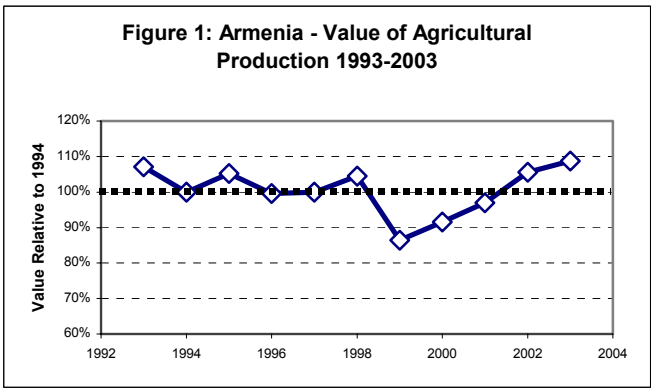
4. Over 40 percent of Armenia's irrigation depended on electric pumps to lift water either from groundwater in the Ararat valley or from rivers to higher level command areas. While groundwater lifts were relatively small (5-20 m), pumping from rivers involved high lifts ranging from 10 to over 400 m.

Objective 1: The level of irrigated agricultural production was maintained

22. **Counterfactual.** In the absence of the project it was estimated that agricultural production dependent on irrigation would decline because of failing irrigation systems.[5] The SAR projected that, without rehabilitation, assured irrigation water supplies would shrink by 5 percent a year, stabilizing at 20 percent of pre-project levels by 2010 when 30 percent of farmers would be without irrigation water. Similarly, it was projected that dams supplying 35 percent of irrigated area, mainly located in the medium to high elevation lands, would cease to function. With the project, it was estimated that pre-project (pre-1994) agricultural production levels would be reached by 1999.

23. **Outcome.** The gross national value of national agricultural production, of which about 80 percent was dependent on irrigation, stabilized for the period 1994-1998 before bottoming out in 1999 (Figure 1).[6] Thereafter it appears to have made a sustained recovery and in 2003 it was almost ten percent above 1994 levels. Thus, the project met its production objective, albeit with some delay.

24. The project halted the overall decline in the area actually irrigated. From1990 Armenia's irrigated area declined from 320,124 ha to a low of 172,578 ha in 1995, a contraction of 9 percent/year. The PIU states that the area actually irrigated in 1995 was only 108,000 ha.[7] After the project started in 1995 this trend was reversed and actual irrigated area grew by 5,077 ha/year to reach 150,000 ha in 2003. Even though irrigated area increased, it did not translate into marked increases in agricultural value-added because the crop mix significantly changed and yields of most crops stagnated – the exceptions being grapes and melons. This reflected the predominantly subsistence nature of agriculture that had become established by the mid-1990s in response to sub-economic landholdings, low farming skills, lack of rural credit, deteriorating rural roads, poor markets, and high levels of poverty (paras 15-16). Thus, for example, the area and production of grapes and fruit declined because of poor husbandry and limited markets, particularly for export, while staples such as wheat increased, Figure 2. These changes are also a rational response to more expensive water. Yield of fruit increases



Data sources: IMF World Economic Outlook Database 2003, CAS 1998, 2002, and EIU. Using GDP at constant prices.

5. About 60 percent of the total value of agricultural production is derived from the crop subsector, the balance from livestock. But most of the livestock subsector depends on fodder and feed produced under irrigation.

6. The value of agricultural production was derived from time series of GDP at constant prices and proportion of GDP attributed to agriculture – see Annex B for details. Between 1987 and 1998 the cropped irrigated area fell from 314,000 ha to 188,000 ha, thus the project covering 146,800 ha rehabilitated almost 80 percent.

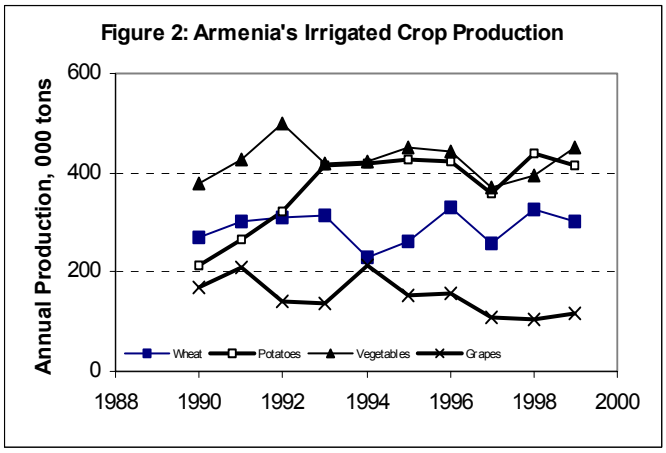
7. PIU Personal communication March 2, 2004.

by 30 percent with irrigation, but vegetable yields increase by 70 percent, hay by 65 percent and wheat by 60 percent.[8]

Physical rehabilitation was successful

25. The substantial program to repair dams, rehabilitate canals, pumping stations and tubewells ensured water supply to 146,800 ha of irrigated land, only slightly less than the revised target of 148,000 ha.[9]

26. **Integrity of water supplies from dams was assured.** About 40 percent of water used for irrigation is supplied from 24 dams, of which 15 were considered in need of major repairs, and some even required urgent attention to avoid dam failures if operated at full capacity.[10] Repairs and upgrades to four dams by the project initiated a program to meet the Bank's Dam Safety safeguard requirements.[11] The importance of this component was emphasized by the collapse of the 15-year old Artik earthfill dam in 1994 because of progressive failure of the upstream slope and overtopping. Initial improvements included modification to spillways, tunnels and towers. Strengthening and modifications were based on micro-seismic studies (to determine precise seismic risks at the dam sites) and dam break analyses. Even so, investigation carried out under the project indicated that significantly more work was required to fully meet dam safety requirements. These requirements have recently been completed, financed by the Bank's ongoing Dam Safety Project that allocated more than US$2.2 million for increasing spillway capacities and other works, including instrumentation.[12] Project works reduced the risk of dam failure that could affect about



Data Source: EIU

8. The data are from a 1998 survey of family farms undertaken as part of the integrated water resources management studies by the project's water resources management team.

9. Irrigation Rehabilitation Project: Emergency repair and rehabilitation of the Arzni-Shamiram, Shirak, Lower Hrazdan, Artashat, Talin, Armavir, Kotayk, Nalband irrigation schemes.

10. There are 83 dams in Armenia. 24 dams account for 67 percent of reservoir storage and are used for agriculture, 5 store an additional 11 percent for municipal and industrial use. The remaining 54 are mostly small and are used for various purposes, accounting for 22 percent of national reservoir capacity.

11. The four embankment-type dams and were: Aperan, Karnout, Mantash and Sarnskhpiur. Spillway redesign took a fixed 1:10,000 year flood event rather than a Probable Maximum Flood approach because the maximum runoff is due to snowmelt rather than storm events. Although the seismic safety of the dams was initially designed using a pseudo-static loading that is no longer internationally accepted, more refined dynamic loading analyses undertaken in 1999 indicated that the Armenian norms provided adequate factors of safety.

12. The Dam Safety Project (Cr.3260) signed in May 1999, provided rehabilitation for 20 major dams classified in the highest at risk category because of poor maintenance and/or design flaws. It also provided

219,000 people living in the downstream areas, property valued at $3.1 million in 1991, water supplies for 25,000 people and 19,300 ha of irrigation.

27. **Rehabilitation of canals and pumping stations maintained the integrity of the irrigation system – but only for the medium-term.** After the project was reconfigured, project management refined the criteria for identifying critically-at-risk sections of canals and pipelines to cover more works from project funds. Even so, significantly more rehabilitation work was completed than planned due to lower than anticipated costs and very careful monitoring of them by the PIU (Annex B).

28. Three approaches to the rehabilitation of 260 km of main and secondary canals were adopted. Some used a systematic approach working downstream from the headworks – for example, the Getik irrigation scheme (located near the epicenter of the 1988 earthquake) rebuilt the upper 10 km of the heavily damaged main canal: irrigation over 1,600 ha is now assured, leaving 1,800 for future rehabilitation. In the Talin scheme, for example, there was 4.6 km of new canal and only 1.4 km of rehabilitation. Conversely, the general approach adopted elsewhere was to patch and mend throughout the system. In consequence, the three rehabilitated systems in the Ararat valley and environs inspected by the OED assessment mission have sections of moderate to good quality repairs to canal lining interspersed with unrepaired non-critical deteriorated sections, where concrete lining slabs are missing or crumbling away. However, most pressure pipelines, siphons, aqueducts and their foundations have been repaired to a generally high standard. As a result of these improvements, overall water losses in the main and secondary canals covered by the project fell from 59 percent in 1995 to 27 percent in 2002 – beating the target of 30 percent. An important issue is that the emergency system improvements only solve part of the problem – the unrepaired canal sections continue to deteriorate so that, in the longer-term, transmission efficiency is likely to decline again.

29. In the Ararat valley, installation of new tubewells and rehabilitation of existing tubewells, including replacement of electromechanical equipment, ensured water supplies and augmented drainage to about 12,200 ha. Additionally, about 310 km of drainage collectors were cleaned and deepened. This improved drainage under 2,500 ha of the central Ararat valley that is affected by water-logging and local salinization, and unconfirmed government reports state that it also reduced health-related hazards such as malaria.

Improved irrigation facilities support market-based privatized agriculture

30. This sub-objective was fully achieved and efficacy is rated as high. Operating costs were cut back primarily through reduction of energy consumption and water leakage. Flow measuring facilities were installed so that water volumes could be measured, accounted for and sold.

31. **Operations were improved – but only latterly.** At the primary and secondary canal level, most of the improvements were the result of physical remediation that ensured

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significant institutional support to enhance in-country capacity to manage and maintain Armenia's stock of dams, dam safety plans and early warning systems.

the continuity of the systems and reduced water losses by about 150 million cubic meters a year. A major contribution affecting 7,000 ha was the elimination of 24 unreliable and expensive pumping stations and their replacement with gravity supplies, and improvements to 4 pumping stations. While system-wide supplies were effectively augmented and transmission times improved, supplies to individual water user consumer cooperatives (WUCC) remained unreliable until 1998 because of totally inadequate monitoring of regulation of canal flows - some WUCCs got far more then they needed, others far less.[13] And this uncertainty and lack of accurate measurement increased farmers' dissatisfaction with OME's service, contributed to a low willingness to pay, and caused a shortfall in expected revenues from WUCCs to maintain the system.

32. **Substantial energy savings were achieved.** Even so, energy remains the largest cost element in the O&M of Armenia's irrigation and averaged US$52/ha in 2002, costs mostly covered by an 80 percent government subsidy. Energy consumption increased as the rehabilitation increased the area irrigated and reached a peak in 1999. Thereafter, elimination of, or improvement to pumping stations reduced consumption by 30 percent from 324 to 227 GWh by 2003.

33. **Billing mechanisms improved.** The ability to monitor and bill water sales was improved from 1999 when project savings were used to purchase and install 2,145 water measuring posts and 1,545 water meters in open sections of canals and pipelines (Annex B). Simultaneously, OME improved its hydrometric communication system and water management using specially designed software and computer equipment supplied under the Bank's Structural Adjustment Technical Assistance II Project. The project also introduced two-tariff electricity meters so that differential day and night tariffs could be introduced. In the four irrigation schemes inspected by the OED assessment mission, water measuring devices were found to be in excellent working order, and all water users expressed their satisfaction with the metering and billing procedures that were now seen as objective and fair – measurements at the point of sale to water user groups being jointly carried out and agreed by the water user group and the successors of OME.

34. **Tertiary irrigation system and on-farm water management also improved.** The IFAD cofinancing was successfully directed at rehabilitation of tertiary level and on-farm irrigation infrastructure over a fifth of the total project area.[14] Interventions ranged from fully piped buried systems, as observed by OED at Getik in the mountains, to raised pre-cast concrete canals observed in the Ararat valley.

Objective 2: Armenia's s water resources management was reformed

35. The objective was substantially achieved but with some shortcomings. DWSI's 1993 preliminary water master plan for Armenia was updated and the PIU used its findings, adding economic and financial criteria, to identify the next round of water sector investments

13. For example, in 1999 some regions received 70 percent more than planned, others 50 to 55 percent less.

14. Within this 27,000 ha, over 380 km of tertiary and quaternary-level irrigation canals, designed for large 500+ ha collective farms, was realigned, rehabilitated and downsized as needed to efficiently serve the area, averaging 250 ha, covered by a water user group that typically had 180 or more individual farmers.

and prepare projects for rehabilitation of additional dams and further investments in irrigation. The Integrated Water Resources Management Planning Study also undertook extensive institutional analysis and consultation with all national stakeholders for the first time at the Tsahkadzor Seminar held in 1999 and at the final seminar in Yerevan in 2001. Institutional recommendations have been acted on and Armenia's water resources and irrigation subsector management has been successfully reorganized. These changes accord with international best practice. However, it is too early to judge the efficacy of the improvements.

36. While the studies delivered the results the Bank wanted, the government consultants' final report notes that attempts to involve government economists were unsuccessful.[15] This may explain why the final report is primarily concerned with Armenia's water balance, allocating water and exploring engineering alternatives with almost no attention to water resources economics or cost-recovery. Thus the sub-objective to also mainstream economic and financial management into Armenia's water planning was only partially achieved.

EFFICIENCY

37. **Efficiency is rated substantial.** Despite the initial setbacks because of inadequate planning information and evolving post-Soviet institutions, the project successfully used the funding available to make marked improvements to Armenia's irrigation infrastructure and institutions. Although the economic rate of return (ERR) was revised downward during restructuring from 53 percent to 35 percent, the ICR projected an ERR of 29 percent – primarily because of yield increase, the large sunk costs and low investment costs per ha. Average cost was $283/ha compared with the appraisal estimate of $230/ha. The ICR's ERR may, however, be applicable only to the more commercialized irrigation in the Ararat Valley. Outside the Ararat Valley, production levels are low, yields have not risen very much, and subsistence farming is practiced. If, however, the social benefits of irrigation could be captured, they would be substantial, particularly in these marginal areas. Overall, OED believes it is probable that economic returns exceed the acceptable threshold level of 12 percent.

38. The ERR was not recalculated because data are unavailable. OME did not maintain systematic records of irrigated crops and irrigated area during the period 1992-2002. The WUCCs generally did not keep statistically valid agricultural records either. The new WUAs have only partial records for 2003.

INSTITUTIONAL DEVELOPMENT

39. **Overall institutional development is rated substantial.** Irrigation planning and construction organizations were substantially reformed and have made a successful transition from command-and-control to a market-sensitive and competitive environment. Government's irrigation operation and management organizations are now more accountable

15 . Government of Armenia. Integrated Water Resources Management Planning. Final Stage II Report. May 2001. Section 1.5, page 14.

but have not yet demonstrated efficiency improvements. Water user organization were reorganized and made voluntary, their water and accounting practices were thoroughly modernized. Water resources management was streamlined but has yet to give adequate attention to financial and economic criteria in the national water planning effort – omissions made good in the short term by the PIU.

Rehabilitation is now effectively managed

40. Initially, micro-management by the Ministry of Agriculture precluded introduction of best design practice, contract management and costing practices.[16] In addition, the former state hydraulic construction agencies, recently 'privatized', effectively formed cartels to exclude genuine private sector contractors. After the Bank raised these issues with government in 1996, a new Chair of the Project Supervisory Board and a new Director of OME were appointed and a fully independent and enlarged PIU staff was established. When project works were rebid from 1997, government promoted greater involvement of private sector companies and international firms and the number of bidders increased. As a result, tendered unit rates decreased and allowed a slight expansion of project components. During contract supervision, government fully supported the PIU in imposing high construction standards, and exercising remedies allowed under contract markedly improved the standard and timeliness of construction. The PIU's procurement practice – having prepared and let 173 contracts at US$24.7 million - was found satisfactory following an independent Bank review in 2000-2001.

41. Technical assistance for the first two years enhanced the capacity of the PIU to undertake sound financial and economic analysis of projects and develop a rational basis for prioritizing projects. Compared with the *ad hoc* approach used before 1996, this was a marked improvement. Indeed, most of the economic appraisal of the follow-on Irrigation Development Project (IDP) was undertaken by PIU staff. During the OED assessment mission, PIU convincingly demonstrated application of sound and economically-based project appraisal and screening processes. The PIU also procured and effectively utilized expatriate and local consultants to assist Armenian working groups in preparing a 2002 State Water Law and bylaws for the establishment of water user cooperatives.

But management of major canals is still a problem

42. Poor management and lack of resources undermined OME's performance in operation of primary and secondary water distribution systems and their maintenance. The US$5 million allocated under the Bank credit to cover incremental operation and maintenance costs and ensure adequate routine maintenance was spent in the first three years primarily on *ad hoc* physical remediation and maintenance without any economic rationale.[17]

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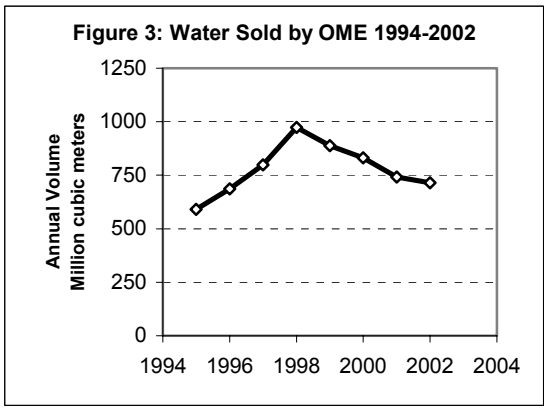
16. For example, state-owned design institutes allowed design costs to be 10 percent of contact value. International best practice was 3 percent or less. In addition, the government preferred Soviet-period unit rates updated by a multiplier constructed by the Ministry of Urban Development, and these unit rates markedly departed from market prices after 1991.

17. Annual O&M costs were estimated to be US$5 to US$6 million a year. Of this $3 million was provided through the government budget, leaving the balance to be raised by increased water user fees. It was expected that water charges to be collected would cover 40% of the O&M costs by the end of 1995, 60% by 1996, 70%

Very little was spent, as intended, to reorient OME using technical assistance to build capacity in order to reach higher levels of efficiency and service. Additionally, OME never sold more than 40 percent of the 2,400 million cubic meters of water available thus losing valuable revenue, Figure3.[18] In consequence, OME never covered its operating expenses (Figure 4).

43. **These reforms reduced OME's administrative burden throughout the 1990s.** The 1993 order making some 1,000 Village Councils responsible for managing tertiary-level water distribution instead of 260,000 individual farmers cut the number of clients and made water management feasible. Further reform in 1998 reduced the number of clients to 470 Water User Consumer Cooperatives (WUCCs) - of which 160 were formed under the project. However, minimal training of the 310 formed outside the IFAD support program contributed to their non-functionality and officials interviewed by OED referred to them as "paper" WUCCs.

44. **Mechanisms for fee collection improved but had problems.** Village councils were billed by OME and paid after fees were collected from farmers – an onerous task. In 1999 village Post Offices agreed to open an OME account to take farmers' payments for a small fee (5 percent). This arrangement worked well for OME but not always for the WUCCs as it broke the fee paying link to the tertiary level service manager. There was also political interference. It was reported to the OED assessment team that Marz governors pressurized WUCCs not to take their share so that OME's fee collection had a better chance of reaching collection targets specified in the SAC III conditionalities[19] – an approach that not only missed the target but further undermined the effectiveness of WUCCs.



Source: PIU 2003

45. Government's willingness to subsidize OME's operations while holding down water tariffs, emphasized their parastatal status and gave little incentive to becoming financially self-sufficient. Already low water charges were reduced prior to the election in early 1998, government covering the shortfall in revenue. For these reasons, fee collection and adequate financing for OME's activities remained problems to the end of the project. Even so, the Bank was able to persuade government and OME to adopt geographically

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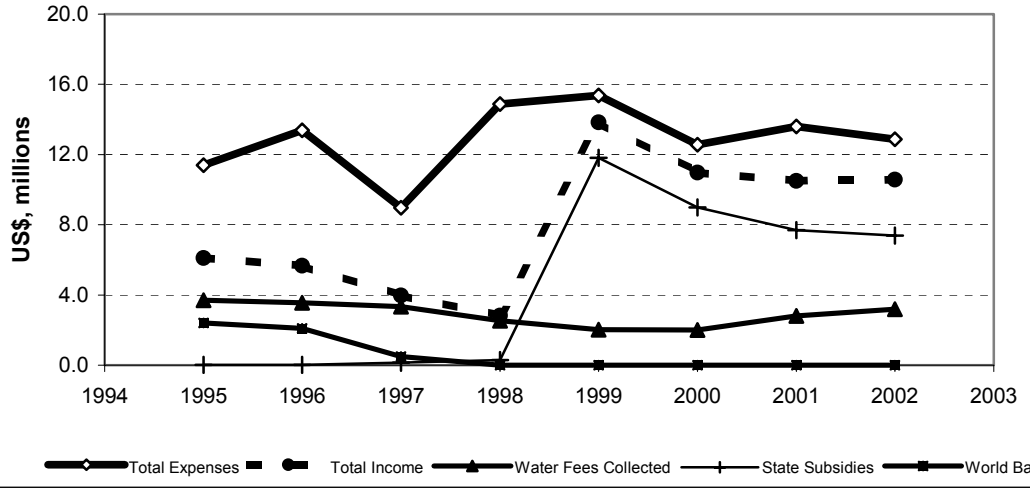
by 1997, and 100% by the end of 2000. The shortfall in maintenance funds on this scheduled was estimated to be about US $5 million over the four-year project period.

18. These data show water sales to WUCCs from the turnouts of the secondary irrigation system. Despite the improvements by the project to about a quarter of all tertiary levels distribution systems, it is highly unlikely that improved water use efficiency alone could account for the decline in sales after 1998.

19. The SAC III conditionality included: reaching a 36% cost recovery level on O&M in 1998 and 48% in 2000, instituting substantial differentiation of the tariff rate across groupings of 14 irrigation schemes, and committing OME to reach 65% of contracted delivery charges in 1999 and to collect payments solely in cash.

differentiated water tariffs that shadowed the true supply costs.[20] To cover some of OME's costs the Ministry of Finance and Economy assumed responsibility for OME's backlog of energy debt which was more then half of the total debt.[21] This 1998 arrangement made explicit that energy subsidies were being used to benefit irrigation and the employment it generated. And at the same time, government's general subsidy payment to OME was made transparent (Figure 4 and Annex B).

Figure 4: OME Cash Flows 1995-2002



Source: PIU 2003

46. Even with these subsidies, farmers (via WUCCs) only paid half the water billed, not all as expected by the Bank. The subsistence nature of farming and high levels of poverty meant that many farmers could not pay (paragraphs 15-16), an issue that highlights the absence of a thorough social assessment at appraisal. In consequence, the government and the Bank agreed on a long-term strategy to reduce costs of agricultural inputs and enhance farmers' productivity – and four complementary Bank-funded projects were approved starting in 1996.[22] The strategy aims to convert much of the irrigation system to gravity supplies, reorganize OME, empower water user groups through enlargement and training to become better managers, and improve agricultural input and output markets. A critical issue not yet resolved is that the level of funding budgeted for irrigation system maintenance (excluding pumping) is not related in any meaningful way to what is needed.

20. Irrigation was allocated to one four tariff zones that took into account the proportion of energy costs in the O&M costs of the scheme. Thus high lift irrigation schemes were allowed to charge more for water.

21. Total operating costs were 4.289 billion Drams in 1997. Energy accounted for 55 percent of these total costs and VAT (levied at 20 percent) was 17 percent. A major problem was that many farmers could not pay in cash and more than half of the payments to 1997 were made in kind.

22. Enterprise Development Project, Credit N006 of December 1996; Agriculture Reform Support Project, Credit 3035 of January 1998; Title Registration Project Credit 3568 of October 1998; and the Irrigation Development Project, Cr.3568 of August 2001.

47. Shortly after project completion, December 2001, and in response to conditions for further Bank lending, the government completely reorganized Armenia's water management. The four agencies responsible for water were reorganized into two: the Water Supply Agency responsible for infrastructure that captured and stored water, and the temporary Drainage and Irrigation Management Agency (DIMA) responsible for O&M of primary and secondary canals and drainage.

48. The OME was split into a central management unit that became the Water Supply Agency and 13 regional DIMAs organizations that report to the State Committee for Water Management. The long-term objective is that the responsibility for infrastructure managed by the DIMAs will be taken over by federations of water user groups who would carry out O&M activities or contract them out – in effect the DIMAs will be privatized. To build sufficient financial capacity for this task, government plans that farmers will pay the full cost of water by 2007. Full cost includes O&M for the irrigation system under users' management, and the costs of the O&M of the primary supply infrastructure.

Water user groups were amalgamated to gain economies of scale

49. Most of the WUCCs had too small an area to generate sufficient income to pay for O&M and cover overhead costs, and insufficient training to manage tertiary-level irrigation systems effectively. In mid-2002, Parliament approved a new law authorizing formation of large-scale voluntary Water User Associations (WUAs) to take over O&M of tertiary-level irrigation from existing WUCCS. The law also authorized Water User Federations (WUFs), comprised of several WUAs, to take over the O&M of the primary and secondary irrigation systems from DIMAs. Of the 12 WUAs established in early 2003, five were randomly selected and visited by OED.[23]

50. The new elected WUAs are taking their responsibilities seriously and are anxious to gain financial sustainability. Caution is warranted, however, because at the time of OED's assessment the new organizations had only been functioning for six months. All the WUAs visited had detailed annual budgets, were able to justify proposed expenditures with detailed back-up and had adequate professional staff to manage day-to-day activities. There were some notable efficiency improvements compared with the former setup. For example, the Vedi WUA now employs one ditch master to manage water distribution, billing and fee collection for each 100 ha; formerly three were required for the same task. There is a heightened awareness that water leakage from the distribution system is lost revenue – the Ararat WUA which currently serves 6,300 ha, estimate that they lose about $200/day due to inefficient pumping plant and inability to serve the potential command area of about 9,000 ha.

51. Concerns cross-cutting all WUAs interviewed were increasing energy costs, the need for consolidation of very small-scale farming operations to improve on-farm resource management and increase water use efficiency, and the need for improved rural credit and marketing. Uneven availability of heavy equipment for maintenance tasks was also an issue.

23. The WUAs interviewed were: Vedi (Artashat), Ararat, Kassakh (Arzni-Shamirna), Getik and Aygezoz

A big problem is that not all farmers are members of the WUA and 1,300 ha free-ride on the WUAs efforts.

New transparency and accountability highlight management issues

52. Installation of new water measuring devices and multiple tariff electricity meters supplemented by the introduction of updated and transparent accounting systems for DIMAs and WUAs paved the way for better water management and financial accountability. This is now focusing attention of ways to reduce costs and increase efficiency and their efficacy is rated high.

53. OME's former staff are having difficulty in adjusting to their new DIMA mandate – some are doing well, others are struggling. The common problems are inadequate budgets for O&M, energy costs, staffing and morale as illustrated by two examples, Box 1.

Box 1: DIMAs are coping with the reforms in different ways – not always successfully

The Arzni-Shamiran Nairi Division DIMA has a budget of 90 million drams in 2002. Staff costs are 28 million drams and O&M costs 27 million. Energy costs are 28 million drams but are subsidized at 80 percent by central government and cost the DIMA only 5.5 million drams. Income from water sales was 63 million leaving a deficit of 27 million. In consequence almost nothing was spent on O&M – the only discretionary item on the budget – and OED's inspection of the main canals found a growing problem of deferred maintenance. The Courts have authorized the DIMA to collect 69 million drams from defaulting farmers but 229 million drams are still in dispute. The main problem is that there is strong civic pressure not to pursue defaulting subsistence farmers who have almost no assets, an issue complicated by unreliable crop yields due to the vagaries of climate in this elevated area (1500 m). The future situation for this DIMA looks grim as government plans to significantly reduce future energy subsidies while effectively capping the water tariffs DIMAs can charge.

The Artashat DIMA was the biggest and strongest part of OME in Armenia until 2002. Even though 90 WUCCs were formed, the OME continued O&M of the whole system as the WUCCs were totally ineffective. This changed in 2002 when the DIMA was set-up to manage only 35 km of the original 420 km of irrigation canals. Six voluntary WUAs were established and took over about a third of the former OME staff. The total number of people managing the system is now much lower, as OED found when visiting WUAs. The DIMA manager was optimistic about the future primarily because the new water and financial accounting practices introduced via the PIU have given him a tool to identify management priorities and highlight the main operational and budget problems. His major concerns for the future were cutting energy costs and ensuring adequate water tariffs. Unlike the Nairi Division DIMA, the Artashat DIMA in the Ararat valley has some of the most productive land in Armenia and farmers are able to potentially cover water costs.

BANK PERFORMANCE

54. **Bank performance is rated as highly satisfactory.** The difficulties at appraisal reflected the difficulties of moving from Soviet-era design and contracting approaches and the gradual establishment of a free market for traded building materials (para 11). Prompt attention to the emerging problems and decisive management led to the project restructuring in 1996-97. Subsequent supervision was exceedingly thorough, policy advice was of very high quality, appropriate and effective in moving the reform agenda forward. Supervision reports were complete, accurate and consistent with interim ratings, particularly development effectiveness. Utilizing the Bank's advice, both the pace and scope of irrigation sector reform

were remarkable considering the dire situation in 1994. Attention to monitoring and evaluation of water and cash flows, although late in the project, produced results that can be ranked best technical practice compared with similar projects across the Bank. In addition, the Bank's agriculture sector team moved quickly to stimulate agricultural marketing, establish a land cadastre, and improve rural credit through parallel operations (see paragraphs 62-64). As a result, the Bank enjoys a fruitful and positive partnership with the government and IFAD, and the reform program continues. And most of this reform can be attributable to leverage of the Bank's global experience to Armenia's problems – the unrealistic target of 100 percent cost recovery over five years being the exception. It appeared that the Bank took a strong policy position on fiscal rectitude and full cost recovery as conditions of engagement in Armenia; similar conditions were expected in other projects approved around the same time and they also failed to deliver on unrealistic targets.

BORROWER PERFORMANCE

55. **Borrower performance is rated satisfactory with some shortcomings**. The shortcomings were that government did not maintain a consistent and progressive policy on water user fees, replicated the WUCCs prematurely and did not provide adequate and timely counterpart funds. Even so, on other institutional issues, including wide-scale reform of water resources management and irrigation management, government's actions were timely. Ownership was high and the PIU was given the autonomy it needed after restructuring. Thereafter procurement and management of implementation was excellent. The PIU has steadily built its professional capacity but is still an enclave of the new approach to irrigation management, and financial and economic appraisal, within the State Committee for Water Managment. One point of concern is that the financial audit of OME, completed in 2002, was heavily qualified and revealed scant attention to fiduciary responsibilities. Given that the core group of OME is now the Water Supply Agency, and other parts of OME became the DIMAs charged with improving the cost-efficiency of the upper parts of the irrigation systems, this is cause for concern.

4. Findings and Lessons

56. Armenia has made good progress in its transition from a centrally planned economy to a market economy and GDP growth is now among the highest in the former Soviet Union countries. Although reform progress slowed after 1997, it accelerated again from 2000 with a focus on improving the business environment and implementing bankruptcy and liquidation proceedings. The growth of small and medium-sized firms, which in many transition economies make a major contribution to employment growth, is hindered by less attention to restructuring large firms, enforcement of contracts, availability of adequate financing for private firms, and development of adequate government capacity to support a market economy.

57. However, despite this improvement, Armenia continues to have the highest income inequality among the countries of the Europe and Central Asia (ECA) Region.[24] The

24. World Bank, "Armenia Poverty Profile in 2001," p. 24. The Gini coefficient of earnings went from 0.296 in 1991 to 0.486 in 2000; the latter figure, while high, is only slightly above other CIS-7 republics (Falkingham, p. 8).

incidence of poverty was estimated at 55 percent in 1996 and 1998.[25] Recent 2001 data indicate that poverty has declined by seven percentage points – but still remains high at 48 percent; extreme poverty has fallen from 27 percent to 20 percent. Confronting poverty and improving social indicators remain key challenges. Fiscal austerity will continue to limit the resources available for social sector expenditures, although recent efforts at improving targeting have helped ease the plight of the poor.

FINDINGS

58. **The Irrigation Rehabilitation Project reversed the physical decline in Armenia's irrigated area.** However, it only provides a medium-term fix to the effects of deferred maintenance because rehabilitation was partial. Until the residual problems are fixed and brought up to the same good standard, there is a risk that the steady expansion of irrigated service area may halt in the longer-term. Currently, the level of funding for maintenance is inadequate. It is not well-founded on system needs and detailed diagnosis. Improved monitoring and evaluation is required to develop realistic budgets for maintenance. The on-going Bank-financed Irrigation Development Project is addressing these issues.

59. **It is clear, however, that the irrigation sector cannot survive without continued subsidies in the medium term and more pragmatic attention to maintaining only the core irrigation infrastructure that is economically viable.** Robust growth of the economy (GNP growth greater then 10 percent) in the recent past enhances government's stated intention to continue to subsidize irrigation and its energy costs until 2007 – a policy driven primarily by social safety-net considerations.

60. **The proposal to transfer the liability for financing operation of the irrigation system to farmers by 2007 is an ambitious target.** A target made more difficult to achieve because the major part of the budget is for energy, the costs of which will rise dramatically as government policy is to pass on full costs of generation to consumers. Although urgent attention is being given to minimizing energy use in irrigation through gravity conversion, the OED assessment found that the level of attention is too low, notwithstanding the Bank's IDP project. Many irrigation systems managers interviewed – including WUA chairmen – see expansion of the irrigation to near historic levels as part of their mandate, an objective that is neither feasible or economically realistic. Accordingly, more attention needs to be given to the political economy of irrigation and tailoring aspirations to the completely different agricultural marketing opportunities and constraints and that emerged over the last five years. Most importantly, cost-benefit analysis have not yet been mainstreamed within the irrigation and agricultural community.

61. **The successful rescue of the irrigation sector is out of phase with the rest of Armenia's rural economy.** Effectively, the Bank has supported development of a high-tech system to serve a smallholder subsistence agriculture. Specifically, the project's success highlights the need for more attention to better farm management, revitalized extension services, incentives for land consolidation, credit, crop insurance and other rural institutions

25. Comparison of 1996 poverty data with that collected later in the decade is difficult due to differences in the definitions and measures used.

and infrastructure to support agricultural productivity and marketing. An important first step should be rural roads that are in very poor condition and inhibit efficient input supply and output markets.

62. Farmers will only be able to pay the full cost of O&M if they are able to adjust their small and fragmented landholdings into more economically viable and productive units – only 12 percent of farms are larger than two hectares. This major challenge is being addressed through the Bank's ongoing Land Titling Project that has, to date, secured about 600,000 titles to land, benefiting private farmers, small and medium-size enterprises as well as urban property owners. In rural areas, it is expected that land titling will promote land consolidation, reduce the cost of property transactions and thereby increasing the potential for agricultural productivity growth.

63. Pervasive rural poverty in the 1990s has shifted cultivation to crops for self-consumption (cereals, potatoes) at the expense of fodder crops, fruit trees, vineyards and industrial crops.[26] Yields are low because agricultural inputs are of poor quality (even when affordable), and most 'farmers' have little technical knowledge and skills having entered the sector via land privatization as a survival strategy to cope with the collapse of employment in other sectors of the economy. Extension services are notable by their absence. Most tillage equipment from former state farms is defunct and of sizes inappropriate for current landholdings, and agro-processing equipment, except for the active private sector covering tomatoes and grapes, is moribund.

64. Policy-makers in Armenia are giving growing attention to mitigating these problems and the Bank, IFAD and USAID in particular are active in building farmers' capacity, supporting rural institutions such a farmers' unions, and promoting export-led horticultural development. The Bank's Agricultural Reform Support Project, effective in 1998, has provided loans for working capital and investments to small, rural farms and businesses and a US$15 million revolving fund established. Shortage of essential fertilizers required emergency use of funds for imports. Restructuring of the agribusiness development center, and research and extension, are not going as smoothly as planned. The insolvency of four rural credit banks created unforeseen problems. To date, the better-off citrus, fruit and grape farmers have been the main beneficiaries. To mitigate some of these problems, IFC has recently established with the Agricultural Cooperative Bank of Armenia a new "ACBA Leasing" joint stock company aimed, for example, at mobilizing rural finance for production and harnessing remittance funding.

65. More generally, the Bank's CAS (2001-04) is focused on developing the private sector as the engine for job creation and poverty reduction, reducing corruption through improved public sector management and accountability, and investing in better education to expanding the country's skill base. Thus as the economy enlarges, it is likely that many smallholders will seek non-agricultural employment, thus facilitating land consolidation and commercialization of the sector – helped by the high quality of Armenia's human capacity.

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26. IFAD. 2003. Country Strategic Opportunities Paper (Draft). 11 September, 2003

LESSONS

66. The project experience offers four lessons:

- Rehabilitation is only a partial solution for most irrigation projects because it is generally a symptom of inadequate management and insufficient maintenance funding. This project clearly demonstrates that rehabilitation should be supplemented by measures to foster creation of efficient institutions with the ability, *inter alia*, to measure and manage water and accurately cost operation and maintenance.
- Some of the most effective and simple investments leading to higher levels of efficiency in irrigation projects are the installation of a large number of water and electricity flow measuring devices and consultation with stakeholders to agree on operating rules.
- It is essential that adequate attention is given during appraisal to linking investments in agricultural technology with the measures to improve production and marketing of outputs. The absence of such complementary investment may jeopardize the ability of project beneficiaries to cover operation and maintenance costs and thus threaten sustainability.
- Social assessment and interventions are needed particularly when there is a high level of rural poverty. Such assessment will help to ensure that infrastructure investment give adequate attention to beneficiary ownership and their ability to contribute towards maintenance of facilities created. In the project, such an approach could have created smallholders' cooperatives or micro-credit groups that could have moved landowners beyond subsistence agriculture.

Annex A. Basic Data Sheet

ARMENIA IRRIGATION REHABILITATION PROJECT (CREDIT 2667-ARM)

Key Project Data *(amounts in US$ million)*

	Appraisal estimate	*Actual or current estimate*	*Actual as % of appraisal estimate*
Total project costs	57.15	51.86	91
Loan amount	43.0*	40.90*	95
Cofinancing	8.00	7.80	97
Cancellation	-	1.5*	3

* The amount cancelled is less than the difference between appraisal and actual disbursement due to fluctuations in the value of the loan designated in SDR.

Cumulative Estimated and Actual Disbursements

	FY95	*FY96*	*FY97*	*FY98*	*FY99*	*FY00*	*FY01*	*FY02*
Appraisal estimate (US$M)	0.0	4.0	15.0	31.0	43.0	43.0	43.0	43.0
Actual (US$M)	4.1	10.9	15.3	18.5	27.1	35.1	39.8	40.9
Actual as % of appraisal		272	102	60	63	81	93	95
Date of final disbursement:	December 3, 2001							

Project Dates

	Original	*Actual*
PCD	n.a.	4/14/93
Appraisal	n.a.	10/8/93
Board approval	n.a.	12/8/94
Signing	n.a.	12/16/94
Effectiveness	3/1/95	2/23/95
Closing date	6/30/99	5/31/01

Staff Inputs (staff weeks)

	Actual/Latest Estimate	
	No. of Staff Weeks	*US$ ('000)*
Appraisal/Negotiation	82	328
Supervision	130	610
Completion	5	25
Total	217	963

Mission Data

				Performance rating	
	Date (month/year)	***No. of persons***	***Specializations represented***	***Implementation progress***	***Development objective***
Identification/ Preparation	03/1993	4	1 Task Team Leader/Economist, 1 Land and Water Development 1 Specialist, Economist,1 Agronomist		
Appraisal	10/1993	6	1 Task Team Leader/Economist, 1 Water Resources and Irrigation Engineer, 1 Agriculturist, 1 Economist, 1 Sociologist, 1 Water Management Specialist		
	PIU Establishment and Procurement 04/1994	2	Task Team Leader/Economist Procurement Specialist		
Supervision	01/1994	3	Task Team Leader/Economist, Irrigation Engineer, Business Specialist	HS	HS
	07/1995	5	Task Team Leader/Economist, Economist, Water Development Specialist, Water Resources Engineer, Irrigation Engineer	U	HS
	10-11/1995	3	Division Chief, Irrigation Specialist, Irrigation Engineer	U	S
	02-03/1996	6	Task Team Leader/Agricultural Economist, Agricultural Economist, Agricultural Survey Specialist, Irrigation Specialist, Irrigation Engineer, Water User Association Specialist	S	S
	06-07/1996	5	Task Team Leader/Agricultural Economist, Division Chief, Irrigation Specialist, Irrigation Engineer, Agricultural Survey Specialist	S	S
	12/1996	2	Task Team Leader/Agricultural Economist, Irrigation Specialist	S	S
	06/1997	3	Task Team Leader/Agricultural Economist, Irrigation Specialist, Financial Analyst	S	S
	10/1997	3	Task Team Leader/Agricultural Economist, Irrigation Specialist, Financial Analyst	S	S
	04-05/1998	7	Task Team Leader/Agricultural Economist, Economist, Irrigation Specialist	S	S
	01-02/1999	5	Task Team Leader/Agricultural Economist, Sector Manager, Agriculturist, Irrigation Engineer, Dam Engineer, two Agricultural Economists	S	S
	09-10/1999	4	Task Team Leader/Agricultural Economist, Agricultural Economist, Natural Resources Economist, Land and Water Development Engineer, Financial Analyst Task Team Leader/Agricultural Economist, Ag Economist, Economist, Financial Analyst	S	S

				Performance rating	
	03/2000	4	Task Team Leader/Agricultural Economist, Economist, Land and Water Development Engineer, Financial Analyst	S	S
	10/2000	4	Task Team Leader/Agricultural Economist, Economist, Procurement Specialist, Financial Analyst	S	S
Completion	07/2001	3	Task Team Leader/Agricultural Economist, Economist, Financial Analyst	S	S
	10/2001	2	Task Team Leader/Agricultural Economist, ICR Specialist	S	S

Other Project Data

Borrower/Executing Agency:

FOLLOW-ON OPERATIONS

Operation	*Credit no.*	*Amount (US$ million)*	*Board date*
Enterprise Development Project	Cr. N006	16.7	12/24/1996
Agriculture Reform Support Project	Cr. 3035	14.5	01/27/1998
Title Registration Project	Cr. 3135	8.0	10/13/1998
Irrigation Dam Safety Project	Cr. 3260	26.6	06/24/1999
Irrigation Development Project	Cr. 3568	24.9	08/30/2001

Annex B. Tables

Table B1:Key Performance Indicators

Outcome / Impact Indicators: Indicator/Matrix	Specified in the SAR	Actual/Latest Estimate (January 2004)
Outcome: 1. To maintain the level of irrigated agricultural production 2. Improve the country's water resources management	Outcome indicators were not defined at project appraisal. The development objective was reformulated in April 1997, to be more concise and measurable. To maintain the level of irrigated agricultural production, improve the country's water resources management, and accelerate the development of water distribution institutions and support facilities needed for a market-based privatized agriculture.	The PPAR used the aggregate agricultural production statistics. These show that agricultural production – 80% dependent on irrigation – increased after the project. There are no national indicators for improved water resources management. Project specific indicators are listed in the main report.
Number of hectares receiving irrigation water in the project area (and as expressed as share of all irrigable acreage in the project area).	164,700 ha in SAR but revised down to 148,800 ha in 1997	146,800 hectares (92.3% of all irrigable acreage in 2001)
Average farm income per family in project area (including farm production consumed).	$1,600	Not available
Coverage of O&M costs by OME as measured by cost recovered rate multiplied by collection rate.	Originally 100%, revised downwards to 33.6% by 2000	25% (as of December 2002)
Output Indicators: Number of Water Users Groups to whom management of O&M for tertiary canals has been successfully transferred from OME (and area covered by these transferred tertiary canals).	100 WUGs, 25,000 hectares	106 WUGs, 27,800 hectares
Share of irrigation water in main canals reaching farm level.	70%	73%

Table B2: Physical Works Constructed/Rehabilitated

Works	Works Planned After Restructuring	Additional Works	Total Implemented
Rehabilitation of main and secondary canals	140 km, 74 aquaducts amd 52 siphons	120 km	260 km, 74 aquaducts and 52 siphons
Rehabilitation of pumping stations	4	-	4
Rehabilitation of dams	4	-	4
New and rehabilitated tubewells	160	78	238
Construction of water measuring posts	-	2,150	2,150
Cleaning and rehabilitation of drains	-	310 km	310 km
Reconstruction of pumps in deepened collector drains	-	7	7
Rehabilitation of on-farm irrigation networks	10,000 ha	16,500 ha	26,500
Establishment of WUAs	100	5	105
Supply and installation of two-tariff electricity meters	-	672	672
Supply and installation of flow meters	-	1,545	1,545

Table B3: OME's Budget 1995-2002

	1995	1996	1997	1998	1999	2000	2001	2002
Total Expenses	11.4	13.4	9.0	14.9	15.4	12.6	13.6	12.9
Electricity	5.3	7.7	6.2	11.6	11.5	9.7	9.6	7.7
Labor	0.0	0.0	0.0	0.0	1.1	1.1	1.4	2.0
Total Income	6.1	5.7	4.0	2.8	13.8	11.0	10.5	10.6
Water Fees Collected	3.7	3.5	3.3	2.5	2.0	2.0	2.8	3.2
State Subsidies	0.0	0.0	0.1	0.3	11.8	9.0	7.7	7.4
World Bank	2.4	2.1	0.5	0	0.0	0.0	0.0	0.0
% of Total O&M Costs Collected	32%	27%	37%	17%	13%	16%	21%	25%
Water Fee Drams/m3	5.0	5.5	2.7	1.9	2.3	3.3	3.9	5.0
Drams/US$	450	480	500	510	520	530	540	560
Water fee US$/m3	0.011	0.012	0.005	0.004	0.004	0.006	0.007	0.009

Source: PIU October 2003

Table B4: Flow Measurement Devices Installed

Branch of Irrigation System	Number of Water Metering Points	Points Installed by the Project	Open Channel Measurement	Pipeline Flow Measurement
Aparan-Aragats	52	17	9	8
Arzni-Shamiran	285	300	290	10
Armavir	214	143	136	7
Artashat	346	352	332	20
Arpa	94	86	29	57
Gavar-Sevan	65	23	11	12
Goris	28	22	5	17
Yerevan	48	10	8	2
Talin	250	260	254	6
Toumanyan	67	45	40	5
Ijevan	60	29	13	16
Kapan-Meghri	37	38		38
Katayk	166	89	38	51
Hrazdan	10	18	16	2
Martouni	75	43	24	19
Noyemberyan	115	77	51	26
Shirak	262	273	273	
Jrvezh-Dzaraghjour	-	16		16
Sisain	65	24	12	12
Spitak-Gougark	74	63	63	
Stepanavan-Tashir	70	49	49	
St. Hrazden	205	115	113	2
Vendenis-Chambarak	50	32	30	2
Tavoush	35	26	13	13
TOTAL	2,703	2,150	1,809	341

Source: PIU October 2003

Table B5: Armenia's Production of Key Crops, 000 tons

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Wheat	271	303	309.6	315.7	229.2	262.7	328.5	258.2	325.8	301.1	224.8	367.3	415.5
Potatoes	213	267	322.4	414.1	417	427.7	423	359.8	439	414.1	290.3	363.8	374.3
Vegetables	378	425	497.5	417	424.3	450.9	444.5	369	394.3	449.1	375.7	466	466.1
Grapes	170	211	142.1	134.9	212.4	154.9	158.5	107.7	106	114.8	115.8	116.5	104

Source: Economist Intelligence Unit

Annex C. Project Costs and Financing (US$ million)

Project Costs By Component	SAR Estimates	Revised Full Cost of SAR Estimates	Revised Project at MTR (to fit original budget)	Actual Final Expenditures	Percentage of MTR Revised Project
Rehabilitation					
Main and Secondary Canals	14.72	36.00	24.32	26.68	109.7%
Rehabilitation of 4 Pumping Stations	9.46	12.20	3.50	1.69	48.4%
Rehabilitation of Tubewells	6.94	10.39	3.60	4.50	125.1%
Rehabilitation of 4 Dams	1.31	3.50	2.00	0.93	46.6%
Pilot Projects to improve water management/rehabilitation of tertiary canals	6.22	30.37	7.62	7.80	102.3%
Incremental O&M costs	5.00	5.00	5.00	5.87	117.4%
Technical Assistance	1.10	6.60	4.18	3.46	82.8%
Project Implementation Unit	1.46	3.30	1.46	0.92	62.7%
Total Base Cost	***46.21***	***107.36***	***51.69***	***51.86***	***100.3%***
Physical contingencies	8.06	5.37	2.58		
Price contingencies	2.88	6.69	2.88		
Grand Total	**57.15**	**119.42**	**57.15**	**51.86**	**90.7%**