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INVESTMENT COSTS OF DEVELOPING IRRIGATED LAND

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The views expressed in this Paper are of the Author, and should not be attributed to the Kuwait Fund for Arab Economic Development

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ABSTRACT

The aim of this study is to highlight the importance of investment in irrigated agriculture in expanding land productivity in order to sustain agriculture and ensure food security and alleviate poverty. Irrigated agriculture accounts for a substantial proportion of agricultural investment in most of the developing countries many of them suffer from shortage in financial resources. The study provides evidences about the role of the Kuwait Fund in assisting developing countries in developing their agricultural sector. The study further gives some recommendations on how to maximize the benefit from investment in irrigation.

INTRODUCTION

Land is an essential element in agricultural activities. It determines the development of rural communities by influencing the amount of production and employment. Land is viewed as a resource to maximize agricultural output, by suitable means of transporting water, land preparation and timely operation and maintenance. Efficient land utilization is considered a prerequisite to support agricultural development and the use of technology makes land more profitable and valuable for a richer rural life. However, limited availability of water in many countries, where the amount of rainfall is usually insufficient to sustain production, is a major constraint to agricultural development. Whereas, in other countries un-even distribution of rainfall, rather than the quantity of rain, is the problem. Irrigation is a system to supply land with water, by means of artificial canals and other infrastructures, to promote the production of agricultural crops. Although irrigation increases annual output, it does not replace traditional farming, where most agrarian countries are characterized by extensive rain-fed agriculture. Irrigated agriculture plays an important role in achieving food security, poverty alleviation, therefore improving the people's standards of living.

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Hence, irrigation is becoming a primary area for international financial assistance and considered one of the largest public investment in agrarian countries, whether to upgrade the efficiency of existing schemes or equip new ones. To meet growing demand for food and other agricultural products, positive changes in policy and management in the agriculture sector are needed to ensure efficient use of available water resources. The success or otherwise in water control of investments activities such as irrigation projects depends on technical, economical, social and institutional factors. However, high cost of such investments is a factor holding back new investments in some countries. Although it is not possible to apply, for comparative analysis, universal performance indicators of irrigation systems, the main objective of this study is to make comparison between different projects, in term of cost of developing irrigated land, and identify factors involved, in different countries within irrigation projects financed by the Kuwait Fund, and suggest means to reduce such costs. The following sections offer a brief review of related studies, the role of the Kuwait Fund in developing irrigated agriculture, suggestions to reduce irrigation costs and the last section contains the conclusion and recommendations.

Review

Given that irrigation is the most important factor determines land's productivity and the agricultural sector is the major

consumer of world's water resources and rain-fed farming is dependent on unpredictable rainfall, effective water conservation and protection are needed through efficient irrigated farming management. It is confirmed that investment in agricultural research together with cost-effective irrigation are urgently needed to minimize production risk faced by farmers in general and small holders, in particular. Such investment is expected to minimize fluctuation in food prices, reduce production cost, and ultimately lower food prices (FAO, 2011).

Land irrigation priorities and problems vary across regions and across countries. For example, in Sub-Saharan Africa, water availability is a key constraint to farming, and therefore resources needed for irrigation and water management. In Asia, limited land availability dictates intensifying agricultural production, while in Latin America, land reform investments are needed where land is unevenly distributed. In other regions, such as the former Union of Soviet Socialist Republics, and Eastern and Central Europe, investments needed for development of efficient storage systems, distribution and marketing infrastructures (ICARDA, 2000). From the technical point of view, irrigated rice projects are generally found where water is plentiful and cheap, notably in South East Asia, while irrigated non-rice projects are found in the drier or cooler part of developing countries. Dry areas of West Asia and North Africa face severe and growing challenges due to rapidly grown demand for water resources. FAO (1996) indicated that water logging, salinization, ground water mining and water pollution are adding pressure on land and water quality, and therefore new sources of water are becoming expensive to exploit, limiting the potential for expansion of new water supplies.

Trends in international agricultural aid show that allocation of funds given to assist the agriculture sector between the mid of 1980s and 2010 has fallen by 43%. Also, the share of agricultural expenditure in total government spending dropped from 11% in 1980s to about 7% in 2002 (OECD, 2010). However, a renewed focus on agricultural aid to developing countries is taking place in recent years to support agriculture and rural development, to fight against hunger and poverty, as a response to the 2008 food crisis. FAO (2011) estimated an additional $83 billion need to be invested annually in food, agriculture and rural development to feed the growing population of the world in 2050. In other words, the current investment need to be risen by 50 percent to meet the future increase in the world's population. Investment in agriculture is expected to improve domestic production competitiveness and enhance farmers' income and make food prices more afordable to the needy. It is believed that the private sector should form the bulk of any investment in the agriculture sector, while the public sector can play a catalyst role in supplying public goods that the private sector is not prepared to provide. Investment in the agricultural sector should take into account the rights of existing land users and related natural resources. It must also benefit local communities, promote food security and protect environment.

Annual statistics published by the World Bank showed fluctuations in the amount of money lent to the Agriculture, fishing, and Forestry Sectors (World Bank, 2012). However, in average the World Bank devoted around 7% of its total lending to this sector. Yet, it's contribution in the sector is less than the additional amount needs to be invested in the sector to meet the increasing demand. The World Bank (1996) indicated that the cost of irrigation investments over the past decades has risen steadily. Such investments are cheaper in South and East Asia than in other parts of the world. On the other hand, medium and large- scale irrigation development projects are more expensive in Sub-Saharan Africa than in other region (about US$ 8,000 per hectare on the average).

Investigators have studied the factors involved in determining costs of irrigation systems. For example, Rosegrnt and Svendsen (1993) showed that real costs for new irrigation systems increased from about US$ 1740 per ha to about US$ 4400 in five countries in South east Asia (India, Indonesia, Philippines, Sri Lanka, Thailand) over the period 1966 – 1988. It is necessary to consider the reasons for some high cost for different projects, and several major factors contribute to this as follow:

- Severe climatical conditions which affect crop water requirements, and accordingly irrigation scheme design.
- Schemes often include expensive civil works such as flood protection, water storage works to regulate river flows.
- Require basic infrastructures and high transportation costs, because of the remoteness of locations.
- Lack of local expertise for design and supervision.
- The need to hire foreign contractor with high costs of over heads and mobilization.
- The needs to import materials and equipment.
- Weak project management and poor maintenance.
- Government political instabilities which affect institutional performance (Domestic Policies).

Merry (1996) showed that the performance of self- managed irrigation system, by autonomous organization such as water user associations, is higher than that of public managed systems, in which governments dominate the financial and management interests. The success of self-managed systems is due mainly to the capacity to mobilize adequate resources to meet the costs of operations and maintenance. FAO report (1997) indicated that in developing countries up to 75% of investment in agriculture in the years ahead is likely to be made by farmers investing their own labour and resources, and the other 25% will probably come from public and international sources. Irrigation technology (Arab Water World, 2001) proved that transfer of operation and maintenance services to the water user's organizations (WUOs) had significant and quantifiable positive impacts on water savings, both from technical and financial aspects.

Also, proper use of all water application techniques have the potential to achieve up to 80% field efficiencies. A success story for Turkey showed that irrigation management transfer, involving WUOs and adequate technology, yielded water saving of up to 34%. Studies from Jordan showed that application of drip irrigation decreased water consumption up to 50% and increased vegetable production up to 20%. Trials using modern irrigation techniques in Morocco have shown 20% water saving, 30% crop yield increase, 90% field uniformity of water distribution, 10% saving on inputs, 50%

savings on manpower costs, and a decrease of fertilizers losses and lower negative environmental impacts. The major outcome from the project "Enhancing Food Security in Arab Countries", which focuses primarily on improving wheat production and yield in 7 Arab countries, coordinated by ICARDA and co-financed by Kuwait Fund and others, is an average of about 30% increase in wheat yield, by using improved technology as compared to using farmers' own practices. The advantage of improved practices on yield averaged 18.5% in rainfed fields and 36.7% under irrigation. Additionally, using improved technologies, improved water use efficiency and saving in irrigation water (ICARDA, 2014).

Role of Kuwait fund in developing irrigated agriculture

Kuwait Fund has been involved in financing agricultural projects in many developing countries, where majority of population depend on farming activities for their livelihood. As at the end of year 2015, the total assistance to agricultural sector amounted to about KD 990 million (US$ 3.4 billion), or 17% of its total lending as indicated in Table (1), of which about 85% of such projects are related to irrigation sub-sector.

The share of Kuwait Fund to agricultural sector fell from about 33% in early 1960s and 1980s to about 18% in the 2000s, as borrowing governments of developing nations reduced their priorities they gave to agriculture, and given priority to social spending in the areas of health and education. However, there are now signs that requests to finance agricultural projects are increasing since 2008, after the crisis of high food prices.

It is important to point out that different regions have a wide array of climatical and environmental conditions, with a diversity in the structural characters and design of irrigation systems, and what might be considered large size project in some country, would be as only small or medium size in other countries. For such irrigation projects, the total costs, excluding operation and maintenance, are calculated according, inter alia, to the following contributing factors:

- Distance of the project from water resource (location).
- Topographical conditions and needs for land preparation, clearing and leveling (topography).
- Size of the field to be irrigated (size)

Table 1. Kuwait Fund contribution in financing agricultural projects in comparison with all projects' financing

Period	Total No. of Projects	Total amount lending (million KD*)	Total No. of Agricultural Projects	Total Amount Lending to Agriculture (Million KD)	% of Total Lending
1962 – 1972	33	103	14	39	37.8
1973 – 1983	222	1105	62	304	27.5
1984 – 1994	188	1080	48	243	22.5
1995 – 2005	255	1687	37	207	12.2
2006 – 2012	171	1486	25	103	6.93
2013 – 2015	68	340	11	94	27.6
Total	937	5801	197	990	17.0

Kuwait Fund Statistics (1961 – 2015)

Table 2. Geographical Distribution of Agricultural Projects financed by Kuwait Fund up to the end of 2015

Region	No. of Loans	Amount (Million KD)	%
Central Asia and Europe	8	41.6	4.2
Latin America and the Caribbean	3	39.6	4.0
East South Asia and the Pacific	30	175.2	17.7
Arab Countries	93	562.3	56.8
West Africa	40	114.8	11.6
Central East and South Africa	23	56.4	5.7
Total	197	989.9	100

Kuwait Fund Statistics, 2015

Table (2) shows the geographical distribution of agricultural projects financed by the Fund since its establishment. Such projects contribute to the achievement of the development targets established by different borrowing Governments.

In general, Kuwait Fund loans for agricultural projects are highly concessional and reflected in the following characteristics and lending terms, as an average for each project:

Amount = KD 5.0 million (US$ 17.0 million)
Interest Rate = 2% - 3%
Maturity period = 20 – 25 years
Grace period = 3 – 4 years
Grant element = 45% - 80%

- Type of soil and nature of materials underlying it (soil)
- Volume of earth to be removed.
- Crop pattern and water requirements, and accordingly design of irrigation and drainage networks (Design)
- Machinery and Equipment needed.
- Engineering and consultancy services
- Institutional and organizational support (Management)
- Required settlement and resettlement.
- Assessment of probable environmental impact (EIA)

Investment costs of implementing irrigation projects, and data used for computation have been derived from feasibility studies and up-dated during actual appraisals of the projects that financed by the Kuwait Fund, with a wide range of different characteristics.

Table 3. Investment Costs of Irrigation Projects

Country	Project	Year	Benefited area (ha)	Cost (KD. 1000)	Foreign: Local (%)	Cost/ha	
						(KD)	US$
Albania	Irrigation and Drainage Rehab (Phase 1)	1995	73,000	11,196	64:36	153.4	499
	(Phase 2)	1999	22,000	7,978	32:68	358	1,164
	(Phase 3)	2004	50,000	12,023	63:37	240	842
Burkina Faso	Bagre Integrated	1999	1,440	8,580	70:30	5,958	19,346
	Small Irrigation	2003	1,000	1,204	81:19	1,200	3,900
China	Ningxia Integrated	1996	86,700	58,780	1:99	678	2,204
Cote D'Ivoire	Nzi River Basin Irrigation	1999	783	4,764	65:35	6,084	19,773
Egypt	Land Reclamation (North of Sinai)	1990	160,000	440,000	36:64	2,750	9,400
Gambia	Rice Development	2000	1,206	1,114	83:17	924	3,003
Guinea Bissau	Rice Development	2002	7,000	1,530	75:25	219	712
Honduras	Rehabilitation, Irrigation and Drainage Networks	1992	2,400	3,427	36:64	1,428	4,641
Kenya	Rehabilitation of Bura Irrigation System	2007	5,500	14,500	77:23	2,636	9,227
Mali	Kemacina (1)	1996	1,400	3,852	62:38	2,751	8,941
	Kemacina (2)	2001	2,844	5,860	70:30	2,060	6,695
	Manantali D/s Devel	1999	1,562	7,810	68:32	5,000	16,250
Morocco	Middle Houz	1994	19,000	19,510	45:55	1,027	3,338
	El Merja	2000	4,000	8,985	46:54	2,246	7,299
Mozambique	Xinavan Rehabilitation	1997	5,400	4,600	95:5	852	2,769
Nepal	Babi River Irrigation	1993	13,240	16,557	68:32	1,251	4,066
	Pragna Kulo Irrigation	1998	5,230	1,824	70:30	349	1,134
	Community Managed Irrigated Agriculture	2014	7,600	6,830	70:30	897	3,056
Senegal	Small Irrigation Bakel Agricultural Dev.	2001	1,820	660	61:39	363	1,180
		2002	1,800	5,620	84:16	3,122	10,147
Sri Lanka	Mahaweli Ganga Dev.	1982/94	28,000	47,797	45:55	1,700	5,525
	Hambantota Irrig. Rehab.	1999	11,200	3,343	30:70	298	969
	Kalu Ganga Development	2008	9,000	69,000 (includes dams and resettlement)	56:44	7,667	27,000
Syria	Khabour Irrigation	1995	40,000	72,300	36:64	1,808	5,876
	Winter Pumping	1998	11,500	11,190	39:61	973	3,162
Turkmenistan	Irrigation and Drainage	2000	1,400,000	18,000	85:15	12,850	41,763
Uzbekistan	Karshi Rehabilitation	2002	400,000	45,779	85:15	114.4	372
	Djizakh and Syrdarya Irrig. and drainage Rehabilitation	2009	432,000	28,600	66:34	66.2	232
Tajikistan	Dangara Irrigation	2006	1,750	8,980	70:30	5,131	17,447
Vietnam	- Ayun Irrigation	1993	13,500	6,546	70:30	485	1,576
	- Dak Lak Irrig. and Drainage Rehab	2005	5,000	5,640	64:36	1,128	3,948
	- Rural Infrastructure Development in Ha-Tinh Province	2010	4,318	1,580	20:80	366	1,244
	- Rural Dev.in Da bac	2012	8,250	(excludes rural roads)			
	- Irrigation Infrastructure in Hai Hu	2014	5,900	5,900	20:80	715	2,432
				5,430	20:80	920	3,129
Laos	Rehab. Nabong-Khosta	2014	4,130	10,060	17:83	2,436	8,782
Tchad	Rice Production Dev. In Chari-lagoon	2015	400	4,980	36:64	12,450	42,330
Lebanon	Hydro Agri Dev. of S. Lebanon	2010+14	15,000	140,000	65:35	9,333	31,733
Sudan	Dam Complex of Upper Atbara	2010	89,000	10,500 (only land Rehab.)	27:73	118	413

Source: Computed from Kuwait Fund data collected from different technical appraisal reports and feasibility studies.
K.D. = US$ 3.25-3.4

Investment costs include interests during implementation with an average of 3.5% and physical and price contingencies with an average of 8.6% and 10.5%, respectively.

Table (3) gives the costs of land development component and supporting items for 41 projects in 24 countries at different periods of time that the Author participated in appraisal. The cost per unit varies from about US$ 232.5 for a rehabilitation project in a country like Uzbekistan to US$ 42,330 per hectare for a new project in remote area in a country like Chad. The average cost of about US$ 7181 per hectare for all projects, while the average cost for rehabilitation projects is about US$ 2647 per hectare, and for new project is about US$ 12,369 per hectare. Differences in the costs are mainly due to the merits of the nature of the projects, i.e. rehabilitation of irrigation systems versus construction of new projects and different components involved. The water delivery infrastructure systems include, inter alia, water intakes, lined and unlined canals, tunnels, storage, pumping from river, diversion and drainage related structures items, represent about 55% of the total costs of the main components, excluding infrastructures related to dams.

Although there is no single solution for high irrigation investments is identified, cost control is one of the most effective and essential tools for successful management performance and planning. Irrigation investment must focus on lower cost solutions, and to bring such investment costs down, it is worthwhile to consider the following:

- Application of simple irrigation and drainage scheme design with realistic planning.
- Water users organization or farmer groups (beneficiaries), should play an active role in order to have a sense of ownership and commitment, should use and control their own resources to participate in financing plans for implementation, operation and maintenance.
- Better utilization of local capabilities, by improved management and capacity building of local specialists, such as consultancy and construction contracting firms, in addition to adequate transfer of know-how to local stakeholders.
- Encourage the involvements of non-governmental organization (NGOs), private sector and local communities in irrigation efforts.
- Improving the efficiency of water use by the application of economically sound modern irrigation techniques, including conveyance and distribution networks, from water source to the fields (improving on farm water-use efficiency).

Investment costs include interests during implementation with an average of 3.5% and physical and price contingencies with an average of 8.6% and 10.5%, respectively.

Main common components

- Civil works for irrigation and drainage network (water intakes, lined/unlined canals, weirs, dikes…..etc.)
- Pumping stations and electro-mechanical works
- Land reclamation and leveling
- Service and field roads
- Equipment and vehicles
- Engineering and supervision services

Conclusion and Recommendations

Investment in irrigated agriculture is crucial and essential to expand productive land and increase productivity, for sustainable agriculture and reducing hunger and poverty alleviation. Responsibility to help poor farmers lies on governments, financing donors, Non Governmental Organizations, private sector, and farmer groups and communities to ensure meeting desirable goals of sustainability. Irrigation accounts for a large portion of agricultural investment in developing countries. There are ways to improve and enhance such investments as the following recommendations:

- Apply suitable engineering design that promote sustainability of irrigation networks of projects targeting mainly small farmers.
- It is better to finance projects with large command areas, for higher economic returns.
- Attention should be paid for drainage works to avoid irrigation system problems, where poor drainage leads to water logging, salinization and negative environmental impacts.
- Emphasis should be given to finance projects with upgrading of existing systems, in order to reduce unit costs.
- Improve project monitoring, evaluation and reduce operation and maintenance costs. Operation and maintenance tend to be best under the management of financially autonomous entities such as small farmer groups.
- Irrigation projects should make a positive contribution to human health, by reducing the risks and effects of water borne diseases. Therefore, financing such projects should include health components associate with all project design.

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