

# Commercialization of Smallholder Irrigation: Economic and Social Implications in Semiarid Areas of Eastern Kenya

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## Introduction

The observed increase in smallholder commercial irrigation and adoption of new irrigation technologies in Kenya provide new opportunities for increasing agricultural productivity and incomes especially in semiarid areas. Irrigation can lead to a reduction in crop-production risk and, therefore, provides greater incentives to increase input use, increase crop yields, intensify crop production and diversify into higher-valued crops. The resulting increase in marketable surplus and commercial activities has the potential to generate increased incomes for farmers. Yet as smallholder commercial irrigation expands, issues relating to access to water among competing user groups, enterprise profitability and access to markets take on added importance because they directly impact on the size and distribution of benefits accruing to various stakeholders.

Data were collected from secondary sources and key informants in the Makueni and Central Meru districts of eastern Kenya. Rapid market surveys using a checklist were conducted to fill in gaps in data. The results from the study are used to draw implications for likely economic and social impacts from the growth of smallholder commercial irrigation.

## Biophysical and Socioeconomic Profile of the Study Area

Makueni and Central Meru districts have a total area of 10,4520 square kilometers and an estimated population of 1.3 million (table 1). Both of these districts are characterized as arid and semiarid agro-ecological zones but with varying potential for agricultural production. These districts have a bimodal rainfall pattern with the first season known as the long rains falling between March and May and the second season known as the short rains falling between October and December. The average annual rainfall in both seasons varies from 500 mm to 2,600 mm in Meru Central and slightly over 1,000 mm in Makueni.

Agriculture, including livestock, is a major economic activity in the study areas with a predominance of smallholder farms. In the Makueni district, crop production contributes only 9 percent of the total agricultural income of Ksh1.3 billion. On the other hand, income from crop production accounts for 76 percent of an estimated total agricultural income of Ksh1.8 billion in the Meru Central district.

A similar proportion of land is classified as cultivable land in Makueni and Meru Central. However, the irrigated area of 1,866 hectares in Makueni represented 0.3 percent of the cultivable area while in Meru Central the irrigated area of 4,078 hectares represented 2 percent

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*Table 1. Area and population in the study area.*

District	Total Area (km <sup>2</sup> )	Cultivable Area (ha)	Proportion of Cultivable Land in Total Area (%)	Total Population (‘000)	Population Density (Persons/km <sup>2</sup> )
Makueni	7,440	554,000	74	767	103
Meru Central	3,012	216,500	72	500	166

*Sources:* Ministry of Agriculture, Central Bureau of Statistics.

of the total cultivable area. This relatively low proportion of irrigated areas in both districts implies that rain-fed agriculture is predominant in these areas.

The production of horticultural crops is an important economic activity in the Makueni and Meru Central districts. Although accurate estimates were not available at the time of our survey, anecdotal evidence suggested that smallholder farmers produced most of these crops. The area under horticultural crops in the Makueni district was estimated at 277 hectares in 1998. The total production was estimated at 5,572 metric tons of which vegetables accounted for 5,268 metric tons and fruits for 304 metric tons. Production of vegetables declined by 25 percent and fruit production by 86 percent between 1996 and 1998. In Meru Central an estimated 2,009 hectares were under horticultural crops in 1998. This represented a 69-percent increase over the acreage under horticultural crops in 1991. Production data show that 21,592 metric tons of horticultural crops were produced in 1998, a 174-percent increase over the total production in 1991 (table 2). Thus smallholder production of horticultural crops appears to be declining in the Makueni district and increasing in Meru Central.

*Table 2a. Trend in production of horticultural crops in Makueni, 1996–1998 (output in metric tons).*

	1996	1997	1998
<i>Vegetables</i>			
Brinjal	3,200	4,050	1,800
Chili	-	225	120
Okra	1,485	900	560
Karella	315	1,000	396
Tomato	1,800	2,000	1,400
Kale	144	720	800
Onion	90	240	192
<i>Fruits</i>			
Mango	120	-	42
Pawpaw	1,200	300	210
Custard apple	60	12	12
Citrus	850	120	40

*Sources:* MoA 1999a.

Table 2b. Trend in area planted to horticultural crops in Meru Central, 1991–1998.

Crop	Area (ha)							
	1991	1992	1993	1994	1995	1996	1997	1998
Cabbage	325	250	271	519	400	360	420	440
Tomato	204	212	112	284	300	380	400	430
Kale	158	138	112	139	123	75	70	85
Onion	45	35	159	254	200	240	260	280
Karella	-	-	50	78	87	50	62	70
Brinjal	-	-	70	54	37	33	40	52
Snowpea	-	-	100	150	180	280	-	-
Fr. bean	390	400	705	600	400	350	390	410
Okra	-	-	60	60	43	50	44	50
Dudhi	-	-	11	15	18	15	29	32
Valore	-	-	178	15	12	20	-	-
Carrot	74	70	92	86	109	90	130	160

Source: MoA 1999a.

Table 2c. Trend in production of horticultural crops in Meru Central, 1991–1998 (output in metric tons).

	1991	1992	1993	1994	1995	1996	1997	1998
Cabbage	3,365	2,445	1,626	5,190	4,000	3,600	6,300	6,600
Tomato	1,164	1,300	1,680	1,988	2,400	3,420	4,000	5,160
Kale	854	754	224	278	264	300	210	340
Onion	334	245	636	1,270	1,600	3,600	3,900	4,200
Karella	-	-	198	287	609	400	558	700
Brinjal	-	-	214	366	296	264	360	468
Snowpea	-	-	30	56	360	980	-	-
Fr. bean	1,720	1,420	2,999	3,160	800	1,050	1,170	1,640
Okra	-	-	240	516	365	450	396	500
Dudhi	-	-	45	54	162	150	319	384
Valore	-	-	714	76	48	100	-	-
Carrot	444	440	368	344	545	720	1,300	1,600

Source: MoA 1999b.

The nutritional status of children and the percentage of the population with access to safe drinking water are important indicators of the welfare or general well-being of the population.

Table 3 shows that large proportions of the population in the Makueni and Meru Central districts can be classified as living in poverty. This implies that interventions, which promoted improved economic opportunities in these areas, could offer significant prospects for raising the poor out of poverty.

*Table 3. Selected welfare indicators.*

Province/District	Children	Population
	Chronically Undernourished	with Access to Safe Water
Eastern Province	39	35
Makueni	50	17
Meru Central	38	63

*Source:* Central Bureau of Statistics 1994.

## **Trends in Demand for Smallholder Irrigation**

Irrigation in the Kibwezi division started in the 1950s with 100 acres (40 hectares) under the Kwa Kyai irrigation scheme. Small pockets of farmers in the division also used bucket kits to irrigate kitchen gardens outside the scheme. Since then smallholder irrigation has evolved involving irrigation groups and individual owners cultivating food crops, horticultural crops and other high-valued vegetables and fruits for domestic and export markets. The Kwa Kyai irrigation scheme was extended under the Makueni Smallholder Irrigation Program to 200 acres (80 hectares) in 1993. Data available indicate that the record of the number of smallholder farmers involved in smallholder irrigation has not been updated since 1993 at which time it was estimated that there were 13 irrigation groups and 133 individual irrigators in the Kibwezi division of the Makueni district. Our rapid survey estimated 4 smallholder irrigation schemes and 22 irrigation groups. We could not accurately estimate the number of individual irrigators but anecdotal evidence from farmers suggested that their numbers have increased since 1993.

Irrigation in Meru Central started in the 1930s during the colonial period. It took an upward trend in the 1980s with the implementation of the Mitunguu irrigation scheme in 1986. Smallholder farmers involved in this scheme produce mainly high-valued horticultural crops for export. Since the start of this scheme several individual- and group-based irrigation schemes have been developed. The most recent data available for Meru Central suggest that the number of irrigation projects increased from 131 in 1990 to the current estimate of 190 in 2000, a 45-percent increase in 10 years. These values however underestimated the growth of smallholder irrigation because many new projects were not recorded (personal communication, District Irrigation Engineer).

## **Production Systems**

### ***Sources of Irrigation Water***

In the Kibwezi division of the Makueni district, irrigation activities are concentrated along Kibwezi, Athi and Thange rivers. In Meru Central irrigation activities are concentrated along the main rivers originating from Mount Kenya, Kathita, Kithino, Thigithu and Mutunga rivers, and their tributaries.

## ***Crops Grown under Irrigation***

Smallholder farmers irrigate a wide range of high-valued horticultural crops, mainly vegetables and fruits year-round, for sale in domestic and export markets. Farmers rarely irrigate food crops but a few irrigate maize and napier grass for livestock feed. A wide range of high-valued horticultural crops are grown including Asian vegetables (brinjal, ravaya, chili, okra, karella, guar, dudhi, turia, curry leaves, patra and saragua); vegetables for the domestic and export market (tomato, kale, onion, spinach, baby corn); and fruits (mango, pawpaw, custard apple and citrus).

## ***Organization of Irrigated Production***

There are variations in the organization of irrigated agriculture in the two sites. In the Makueni district, individual farmers generally use their own motorized pumps on their plots. These farmers make their own decisions on when to irrigate and are not affected by water rationing and management problems that those in the group-based schemes face. However, they are constrained by a lack of investment capital, high maintenance costs and low bargaining power in marketing. Though required by the Water Act (Chap. 372 of Laws of Kenya) few individual irrigators obtain water permits as a result of weak enforcement by authorities and bureaucracy involved in getting permits.

The group-based irrigators pool their resources by collective ownership of motorized pump sets and communal production. The groups are allocated water at different schedules. They tend to benefit from pooling their resources, but frequently face problems of management and limited water availability for group members at the lower end of the canal. Some farmers in irrigation schemes, mostly along the Kibwezi river, grow crops independently on their own plots but are members of groups that control the water supply. A water-management committee allocates water according to a water-allocation timetable. Most farmers in group-based schemes obtain water permits because many donors stipulate obtaining of permits as a requirement.

In the Meru Central district, group-based irrigation was dominant but few individuals own irrigation equipment. These group-based schemes are mostly donor-driven as some donors require the formation of groups as a prerequisite for funding. Many of these schemes operate on a cost-sharing basis with donor funds provided for the initial investment to establish water intake pipes and storage tanks. The farmers generally manage these groups by appointing a committee to manage the project while the farmers themselves enforce bylaws. Few individual farmers, mostly large-scale producers, use their own motorized pumps on their plots.

## ***Irrigation Technology***

There were also differences in the types of irrigation technology used in the two districts. In the Makueni district, motorized pump-fed furrow irrigation was dominant but a few farmers along the Kibwezi river used gravity-fed furrow irrigation. The Super MoneyMaker manual treadle pump was introduced recently but it has not been widely adopted. A few large-scale farmers and institutional operators such as the University of Nairobi and Tana and Athi River Development Authority use drip and sprinkler irrigation systems.

In the Meru Central district, sprinklers were dominant, due mostly to the nature of the topography. Furrow irrigation where water flows by gravity was another common irrigation technique. A few farmers used the bucket kit while some large-scale farmers used motorized pumps.

## Profitability of Horticultural Crop Production

The enterprise budget data in table 4 suggest that smallholder production of horticultural crops is a highly profitable enterprise when compared to alternative investment options that farmers can undertake in other crops. For example, gross margin for the most profitable enterprise is about 400 percent higher than that for the competing maize crop. This raises the question as to why every farmer in the area is not jumping on this bandwagon. Several reasons explain why the industry has not seen a massive entry into the sector as the profitability estimates would suggest. One important factor is that the enterprise budget values do not explicitly include transaction costs that are not explicitly measured. These costs arise mainly from the specific institutional arrangements that determine the production, market access and trade in horticultural crops. Because such costs are not included as monetary costs in the enterprise budget it is likely that these budgets erroneously overestimate the actual profitability of horticultural crop enterprises by underestimating the cost of inputs and overestimating the price of farm outputs. Consequently, the enterprise budget makes horticultural crop enterprises more profitable than they actually are, especially in the study areas where poor rural infrastructure, risk and other market imperfections lead to high transaction costs. These considerations need to be explicitly considered when designing technology interventions for farmers in these areas.

*Table 4. Gross margins of selected crop enterprises in the Makueni and Meru Central districts.*

Activity	Meru Central			Makueni		
	French bean	Tomato	Potato	Karella	Ravaya long	Brinjal
Land preparation	3,705	3,705	3,705	7,200	7,200	7,200
Seeds	29,640	741	29,640	0	0	0
Planting	2,470	7,410	2,964	2,012	1,817	1,817
Weeding	5,928	5,928	4,940	5,415	10,381	10,381
Manure	0	17,290	17,290	0	0	0
Fertilizer	8,892	11,115	13,338	3,735	3,960	3,960
Irrigation	0	0	0	32,230	25,300	25,300
Chemical	16,796	55,328	21,489	29,208	21,872	21,872
Nursery management	0	4,940	0	0	0	0
Pruning	0	1,976	0	0	0	0
Ridging	0	0	3,705	0	0	0
Fertilizer application	1,482	0	988	0	0	0
Spraying	2,470	2,470	7,410	0	0	0
Harvesting	39,520	6,175	14,820	5,425	12,472	12,472
Others	0	0	0	13,469	0	0
Miscellaneous costs 10%	0	0	0	9,869	14,048	14,048
Total variable cost (Ksh/ha)	110,903	117,078	120,289	108,563	97,050	97,050
Mean output (kg/ha)	9,880	24,700	19,760	12,500	20,000	20,000
Average price/kg	30	10	10	25	15	13
Total revenue	296,400	247,000	197,600	312,500	300,000	266,600
Gross margin (Ksh/ha)	185,497	129,922	77,311	203,937	202,950	169,550

Sources: MoA. 1999b; Kimenyi 2000.

## Gender Issues

Both male and female farmers were involved in production and marketing of horticultural crops. Women farmers however appeared to allocate more time to planting, weeding, harvesting, grading, sorting and retail trade. Men, on the other hand, allocated more time to land preparation and maintenance of irrigation systems. In some cases, there was joint decision making while in others men had full control over all production and marketing decisions.

## Organization of Marketing

Marketing arrangements were similar across both sites but marketing channels were different in domestic as opposed to export markets.

### *Domestic Markets*

The main crops sold in domestic markets were cabbage, onion, kale, tomato and “export crops,” such as French bean, that were rejected by exporters because they did not meet export standards. Most farmers sold their crops at the farm gate to rural traders within the village or to traders who came from other districts to save time and to avoid transport costs from the farm to the market. Rural assemblers sold the produce to larger traders in local markets who, in turn, sold it to other traders in regional markets or large urban markets, such as Nairobi and Mombasa. Some traders entered into informal contracts with farmers before the crop was harvested. Rural traders collected and assembled small quantities of produce from many farmers scattered all over the rural areas. However, a few farmers, especially those who were located close to market centers, sold crops directly in local markets because they could get better prices. Crops were mostly packed in bags, except for tomato, that were packed in cartons and all transactions in local markets were in cash.

### *Export*

The major crops sold in export markets were French bean, baby corn and Asian vegetables. There were several companies involved in marketing of export crops. In Meru Central it was estimated that the number of companies involved in marketing rose from 13 in 1997 to 20 in 1999, an increase of 54 percent in 2 years. Some of the exporting companies were seasonal, involved in crop marketing only during the peak season while others were engaged in marketing year-round.

There were several marketing arrangements for export crops:

- Exporting companies organized marketing directly with individual farmers or farmers’ cooperatives with written contracts specifying volumes, dates of collection and prices. This was a common practice with large-scale producers but few smallholder farmers had formal contracts with exporting companies or their agents.

- Company agents or brokers entered into verbal and informal contracts with groups of farmers. Penalties were agreed on in case of a breach of contract but without a written document it was difficult to enforce these penalties. Farmers were not restricted to sell to one agent but they invariably sold to agents who provided farm inputs such as seeds and chemicals.
- Company agents or brokers entered into verbal and informal contracts with individual farmers.
- Individual farmers sold their produce to company agents or brokers without a formal or informal contract. Transactions with informal contracts were usually on credit and it could take up to one month between collection of produce and payment.

Interlinked transactions are very common with company agents providing farmers with seeds, chemicals, advice on planting, application of chemicals, grading, sorting and packing. In some cases, technicians hired by the exporting company supervise farm activities from production to marketing and schedule planting through control over quantities of seed provided to avoid gluts in the market.

Farmers themselves usually harvest the crop. The produce is taken to collection centers where it is sorted and graded under the supervision of committee members. The produce is then packed in cartons provided by exporting companies, weighed and loaded into company vehicles. Members in the farmers' committee are also involved in weighing and recording of deliveries. Payment is by cash or check to the farmers' committee that then pays farmers after one or two weeks depending on the contractual agreements.

Farmers constructed the collection sheds. In some cases, collection sheds are rented. These sheds have rudimentary infrastructure and provide limited facilities. Further grading of the crop is done in company warehouses in Nairobi before export.

About 90 percent of the total horticultural export from Kenya is destined for European markets. In these markets, the European Union sets the grades and standards for exports including maximum pesticide residue levels, size, shape and weight of packaging materials.

## **Marketing Constraints at Smallholder Level**

Farmers face several marketing constraints. These include

- *Infrastructure:* Lack of physical infrastructure reflected in inaccessible roads, lack of market facilities, power and electricity.
- *Inputs:* Unavailability of quality seeds and other inputs including production and trading capital.
- *Post-harvest losses:* High levels of post-harvest losses.
- *Assembly cost:* Lack of economies of scale leading to high cost of assembly.



- *Quality of produce:* High levels of crops rejected at both farm level and at company warehouses because products did not meet market standards. In some cases, farmers were not compensated for rejected products.
- *Risk:* High levels of price and market uncertainty.
- *Market information:* Unreliable information on market trends or scheduling of production decisions to meet market needs. Farmers and other market intermediaries were not aware of important information on prices and marketing, grades and standard information further up the marketing chain.

## **Implications Arising from Commercialization of Smallholder Irrigation**

### ***Water Scarcity***

As smallholder irrigation expands in a regime of lack of enforcement of water regulation, lack of water pricing and uncontrolled water use, water scarcity is likely to be an overarching concern that could lead to social conflicts. What are the likely impacts of policy reforms given growing water-scarcity problems? What types of institutional innovations for allocating water are likely to have the greatest impact on the poor? What are the likely equity and efficiency considerations?

### ***Gender***

In what specific ways does commercialization of smallholder agriculture impact on gender relations? How do women farmers get access to resources and information? How do questions of access and control over resources impact on the participation and investment decisions of women farmers in profitable commercial activities?

### ***Technology***

What explains the differential use of alternative technologies? What technologies are cost-effective and under what conditions?

### ***Farm Profits***

What are the implications of inefficient use of pesticides on farm profits and consumer health?

### ***Health***

What are the health implications of diverting products, which do not meet export standards, to domestic markets?

### ***Markets***

The accepted wisdom is that unscrupulous middlemen exploit farmers. But is this a useful paradigm for designing market interventions? The case study suggested the following:

- Market intermediaries rarely knew or provided important information such as price trends, seasonal requirements, market product specifications or quality standards.

The cost of acquiring such information was high, precluding many smallholder farmers from using such information to make production and investment decisions.

- Rural assemblers faced high opportunity costs in collecting small volumes of product from large numbers of producers scattered all over the rural areas.
- Many producers continued to sell to particular market intermediaries even when they were dissatisfied with the service because they could not find an alternative market outlet or because the cost of finding and/or negotiating with an alternative buyer was too high.
- Market intermediaries could misinform farmers about overall market conditions, wrongly claiming that the quality of produce deteriorated in transit, or delaying payments because of imperfections in information collection and dissemination systems.
- Most farmers and market intermediaries relied on their own funds to finance production and trading activities. There was a lack of credit available for lending despite the need for production and trading credit. Formal credit was not available for traders because lenders either found it difficult, or encountered high costs, to assess the creditworthiness of potential borrowers. This high cost of acquiring information on potential borrowers is reflected in widespread failures of credit markets in rural areas.
- Farmers lost cash income because of the high cost of enforcing contracts.
- Both production and trading were characterized by high levels of uncertainty about the availability of markets, the quality of the product and the conditions of trading.

Given the complex production and trading environment in which smallholder farmers operate, is it likely that they will survive in the highly competitive and “exacting world” of horticultural exports where high transaction costs in the smallholder sector typically favor large producers? Our research suggests that marketing interventions in the horticultural sector must focus on improving the competitive advantage of smallholder farmers through improvements in the efficiency of markets and lowering of transaction costs that arise from high cost of information, contract enforcement and negotiation in marketing transactions. The focus of research and development efforts should be to increase the returns to farmers through the promotion of transparent marketing activities and combination of marketing functions that exploit economies of scale and improve information flows between market participants and farmers. Promising initiatives in this area include contracting options that reduce rather than impose additional costs on smallholder farmers, interlocking markets that combine input provision and produce marketing, effective group marketing schemes that reduce unit marketing cost and improvements in collection points to better serve farmers’ needs. A closer examination of the design of innovative marketing interventions that focus on the realities of cost of production, marketing and trade in rural areas can translate potential for income generation in real and sustainable income-earning opportunities for large numbers of smallholder farmers.

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