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The socio-economic Impacts of Irrigated Smallholder Agriculture on Sustainable Household Food Security in Kenya

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Abstract

Kenya has a total land area of 582,646 square kilometres of which, about 99,050 square kilometres (17%) is classified as medium to high agricultural potential experiencing at least 700mm of rainfall per annum. The remaining 83% is classified as ASAL and needs some irrigation for meaningful farming to take place. Irrigation is necessary in order to increase food production to provide food security to support the rapidly growing population and ensure economic growth in the dwindling land holdings of high to medium potential areas (IDB, 1998). The Kenya Vision 2030 (2008-2030), targets the development and rehabilitation of irrigation schemes in the country to increase agricultural production and generate an additional Kshs. 80 – 90 billion increase in GDP. It also prescribes introduction of new land use policy through better utilisation of high and medium potential lands, prepare new lands for cultivation by strategically developing more irrigable areas in arid and semi-arid lands for both crops and livestock and by improving market access to smallholders through better marketing. However, participation of smallholder farmers in irrigation activities can be affected by socio-economic factors such as access to credit facilities, access to extension services and marketing of produce among others. The study investigated the socioeconomic factors of smallholder irrigation on household food security in Gem Rae irrigation scheme. The study used cross-sectional survey design in which a sample of 120 farmers was interviewed using structured questionnaire. The data was analysed descriptively using percentages and frequencies. The study revealed that factors such as access to credit, size and land ownership, level of education of the household head and access to extension services had impacted negatively on farmers' participation in irrigation activities, thereby impacting on household food security and household incomes. The study concluded that future development of smallholder irrigation needs to factor in the socio-economic trade-offs of irrigation in its suitability criteria for its development.

Key words: smallholder farmers, food security, household incomes, Gem Rae irrigation scheme, Vision 2030, socio-economic impacts.

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Introduction

Irrigation development in Kenya dates back some centuries where traditional types of irrigation were and still are practiced a long some of the major rivers of Tana, Kerio, and Wundanyi. Proper irrigation dates back some 90 years ago when it was introduced by the colonial government in 1930s. In 1946, the African land development unit (ALDEV) embarked on a broad agricultural rehabilitation programme, which included irrigation. The main objective of the programme was to contain the native Africans' agitation for the land occupied by the European settlers. In mid 1950s, the unit initiated a number of irrigation schemes, including Mwea, Hola, Perkerra, Ishiara and Yatta furrow, using free Mau- Mau detainee labour (RoK, 2004). In 1966 the National Irrigation Board (NIB) was established, through CAP 347 of the laws of Kenya, with a mandate to develop and manage national irrigation settlement schemes, which are based on a tenant system. At its inception, the NIB took over the running of Mwea, Hola and Perkera schemes. Later NIB developed Ahero, west Kano, Bunyala and Bura schemes and also expanded Mwea and Hola schemes (RoK, 2004). The system was based on an authoritarian management, proved costly to develop and was neither profitable nor sustainable and since 1977 Kenyan government has been in favour of smallholder irrigation systems (RoK, 1996). The smallholder irrigation was established in 1977 under an agreement for technical co-operation between Kenya government and the Netherlands government. The objective was to reduce the need for relief food supplies and to provide small-scale farmers with an alternative to pastoralism (Kimani, 1986). Other objectives included employment creation, household food supply and increased household incomes (Osoro, 1992).

Kenya has a total land area of 582,646 square kilometres of which, about 99,050 square kilometres (17%) is classified as medium to high agricultural potential experiencing at least 700mm of rainfall per annum. The remaining 83% is classified as ASAL and needs some irrigation for meaningful farming to take place. Irrigation is necessary in order to increase food production to provide food security to support the rapidly growing population, and ensure economic growth in the dwindling land holdings of high to medium potential areas (IDB, 1998).
The need for expansion of irrigation in areas with irrigation potential while encouraging introduction of supplemental irrigation in medium to high rainfall areas to guard against crop failure and ensure high quality produce is paramount. The Kenya Vision 2030 (2008-2030), targets the development and rehabilitation of irrigation schemes in the country to increase agricultural production and generate an additional Kshs. 80 – 90 billion increase in GDP. It also prescribes introduction of new land use policy through better utilisation of high and medium potential lands, prepare new lands for cultivation by strategically developing more irrigable areas in arid and semi-arid lands for both crops and livestock and by improving market access to smallholders through better marketing (RoK, 2007).

The country has an estimated potential irrigable of 539,000 hectares (RoK, 2003). The greatest proportion of the irrigation potential lies along the major rivers draining Lake Victoria and Indian

Ocean. Currently, only 105,800 hectares (20% of the total irrigable land) has been developed. Based on analysis of land suitability, 13 million hectares can be irrigated. However, the National Water Master Plan of 1992 estimates that, those 539,000 hectares are suitable for irrigation by matching mean flow with irrigation demand but assuming no storage facilities are constructed. This indicates that with water storage, the potential irrigable area would significantly increase considering the fact that flood flows contribute about 90% of annual renewable fresh water resources.

To ensure household food security and improved living standards of the rural population, the government and donor agencies continue to support the development of smallholder irrigation schemes (Gichuki *et al*., 1992). This is due to their ease of management and because they have direct impact on household food security and incomes. Smallholder irrigation can be used to mitigate water scarcity and overreliance on rainfall for agricultural production. Investing in smallholder irrigation schemes is one of the strategies to improve production levels especially for small holder farmers (Pinstrup, 2011; Hussain, 2004).

Although access to irrigation water may be the potential to improve production, it needs to be complemented with other agrarian reforms (access to credit, market restructuring, access to extension), institutional restructuring of land reform issues, change in the farming system by using appropriate technology which uses less labor, and finally investment in infrastructure (Todaro, 2012). The study investigated the socioeconomic factors of smallholder irrigation on household food security in the study area.

Methods and materials

Study area

The study was conducted in Gem Rae irrigation scheme. This is a rice-growing smallholder irrigation scheme close to Lake Victoria, about 30 kilometres from Kisumu City, Kenya. Topography across the scheme is flat with an average gradient of about 0.5% and prior to irrigation the area was mainly swampland prone to flooding. The prevailing soils across the scheme are medium to heavy, dark grey or black clay soils suitable for rice cultivation. The scheme is in the lower midlands agro-ecological zone classified as humid/arid. Annual precipitation is 1250mm with peaks in April and November. The rainfall pattern is unpredictable, however, with monthly maximum typically two or three times the mean. Temperatures are fairly constant throughout the year with monthly maximum ranging from 25ºC and 35ºC. Most residents are food insecure despite their participation in smallholder irrigation.

The current irrigated area is approximately 90 ha with a total of 270 plots averaging 0.3 ha. There are 250 landowners. A further 28 ha is occupied by out growers on the fringe of the scheme making use of excess water from scheme.

Sampling and Data collection procedure

The study employed simple random sampling to select 120 household heads participating in smallholder irrigation. All the leaders of scheme management committees were involved in focus group discussion. The secondary data was collected from journals, irrigation development reports and research publications from ministry of water and irrigation. The collection of primary data relied on a rapid assessment procedure using structured questionnaire addressed to farmers within the study area and interview schedule to guide a focus group discussion with leaders of scheme management committees. Data was collected at one point in time from a sample of 119 household heads with one not responding. Data was analysed descriptively using frequencies, percentages and means; and presented in frequency tables.

Results

Age Distribution of the Farmers.

Age is an important factor in terms of its influence upon decision making at household level and sustainability of irrigation project. Twenty-eight out of the one hundred and nineteen farmers (23.5%) interviewed indicated that they were between the ages 34 – 41 years. This is a prime age when the farmers are active and can work for long hours and for many years. This is an important aspect for sustainable food production. Such people are also ready to adopt technologies delivered to them. Similar results were obtained by Martey et al., (2013) that younger household heads are more innovative in terms of technology adoption and are more likely to take risk than older household heads. Farmers who are within the age group 18 – 43 years tend to be more active in practical, as compared to older farmers. It can however be seen from the table that majority of the farmers interviewed (66.4%) had the age of forty-two years and above. This is an aging group and may be detrimental to sustainability of production. Burkey (1996) indicates that groups with majority of members within similar age group are expected to be more effective. This is because members of the same or similar age group tend to have similar interests.

Age of the farmers

Age group	Frequency	Percentage
26.33	12	10.1%

34.41	28	23.5%
> 42	79	66.4%
Total	**119**	**100.0%**

Level of Education

On the level of education, the farmers were asked to indicate the highest level of education they attained. Sixty-six out of the one hundred and nineteen farmers interviewed (55.0%) had at least primary level of education and another twenty-two farmers (18.5%) had secondary school level of education. Those with secondary level of education and above were 21.9%. The farmers with high level of education are expected to have high intellectual capacity. This high level of education enhances the understanding of information given and should also improve the farmer's level of participation in agricultural activities. Education enables an individual to make independent choices and to act on the basis of the decision, as well as increase the tendency to co-operate with other people and participate in group activities (Etwire et al., 2013).

Level of Education of the Farmers

Level of education	Frequency	Percentage
None	27	22.7
Primary	66	55.5
Secondary	22	18.5
College	4	3.4
Total	**119**	**100.0**

Gender Distribution

More than half of the farmers interviewed (53.8%) were female compared to 46.2% being male. This is an indication that women play a significant role in scheme management and operations, especially in situations where men are on off-farm employment or are looking after livestock. The intensification of agricultural production, which goes hand in hand with irrigation, results in considerably more work for smallholder households. Women were observed to be having bigger workloads, as they were also responsible for all domestic duties such as fetching water and firewood. Women were also represented in scheme management committee. This was observed since the treasurer of scheme management committee was a woman. However there is need for an increased representation of women since they are the majority. The traditional attitude of the

scheme communities towards women's roles needs to be investigated, so that appropriate approaches to encourage their participation are identified.

Gender Distribution of Farmers

Gender	Frequency	Percentage
Male	55	46.2%
Female	64	53.8
Total	**119**	**100.0**

Household Size

Household size refers to the number of dependants in the household including children and relatives staying within a household. Forty four out of the one hundred and nineteen farmers interviewed (37.0%) had household size of between seven and ten people. 36.1% of the farmers interviewed had between four and six people in their households. With the large households sizes coupled with occasional poor crop harvests, most farmers indicated having problems in meeting food demand for the household members. However, in many cases the household size provides a measure of the availability of family labour for farming activities. Household size serves as a form of family labour and complements the effort of the household heads on the farm (Martey et al., 2013). The availability of family labour provides the household head the opportunity to share responsibility and save time for other development activities (Sithole et al., 2014).

Household Sizes of Farmers

Size	Frequency	Percentage
1 – 3	28	23.5
4 – 6	43	36.1
7 – 10	44	37.0
> 10	4	3.4
Total	**119**	**100.00**

Size of Land Used for Rice production

On the size of land for irrigation, one hundred and seven out of the one hundred and nineteen farmers (89.9%) in the scheme own small pieces of land (2 acres and below). The small pieces of land re fully utilized due to high population pressure. Only twelve farmers (10.1%) of the farmers interviewed had over 2 acres of land with the largest recorded having 4 acres. The smallest piece of land recorded was 0.25 acres owned by up to 15.1% of the farmers. The scale of production is

influenced by a household farm size. A unit increase in farm size increases likelihood of household head to participate in smallholder irrigation. Martey et.,al (2013); Mohammed and Jema, (2013) and Nxumalo and Oladele (2013), also observed that farm size influenced the household heads decision to participate in agricultural projects.

Size of Farmland under Irrigation

Size of land in acres	1 and below	1.25-2.00	2.25 And above.	Total
Frequency	80	27	12	119
Percentage	67.2	22.7	10.1	100.0

Land Ownership

Of the one hundred and nineteen farmers interviewed nineteen farmers (16.0 %) were tenants while one hundred farmers (84%) owned their pieces of land individually. Only twelve farmers (10.1%) out of the one hundred and nineteen farmers interviewed had title deeds. Those farmers who had title deeds indicated that they had not benefited much from these titles especially in acquiring farm credit but were enjoying tenure security. Lack of title deeds by most farmers interviewed has an influence on level of rice production as it hindered farmers from acquiring the much-needed agricultural credit.

Possession of Land Title Deed by Farmers

Availability of title	Frequency	Percentage
Yes	12	10.1
No	107	89.9
Total	**119**	**100.0**

Crops Grown by Farmers

One hundred and eighteen farmers (99.2%) of the total farmers interviewed grow rice under irrigation as the main crop. Only one farmer (0.8%) of the farmers interviewed was growing horticultural crops (kales). Farmers also indicated that they grow other crops like maize, sorghum, beans and green grams, with many complaining that these crops do not do well due to persistent drought and floods. This means that many farmers depend on rice both as food and cash crops. Performance of this crop is therefore important to many households in this region.

Crops Grown by Farmers

Type of crop	Frequency	Percentage
Rice	9	7.6
Rice and maize	14	11.8
Rice maize and sorghum	78	65.5
Kales	1	0.8
Rice, maize, green grams and sorghum	15	12.6
Maize, beans and sorghum	2	1.7
Total	**119**	**100.0**

Level of Household Food Security

On household food security, one hundred and fifteen farmers (96.6%) of the total number of farmers interviewed indicated that there are months they could go without adequate food. The same number of farmers said that the yield of rice obtained is inadequate to sustain the family particularly because they depend on it both for food and cash. 97.5% of farmers interviewed agree that expansion; both intensive and extensive would be necessary for sustainable food production at household level. However, 98.3% of these farmers indicated that expansion would affect them negatively in terms of input supply given that most of them are resource poor. Expansion may also lead to encroachment resulting in land use conflicts. Still on that, 5.5% of the farmers interviewed were at least sure of getting three meals in a day with 6.7% only sure of a meal in a day. This is a strong indicator of food insecurity in some of the households covered by the study. The months that are so much affected in terms of food adequacy ranged from April to December. This is because these months coincided with off-season of rice as the harvesting period starts in November. When asked to state how they cope with food insufficiency, 93 farmers (78.2%) of 119 farmers interviewed indicated that they reduce the quantity of food consumed. Fourteen farmers (11.8%) said that they sell livestock for income while 9 farmers (7.6%) said that they supplement with off-farm employment.

Adequacy of Yield of the Main Crop

	Frequency	Percentage
Adequate	4	3.4
Not adequate	115	96.6
Total	**119**	**100.0**

Availability of Farm Inputs

Insufficient availability of farm inputs (seeds, fertilizer, machines and other agricultural chemicals) is a margin problem in Gem-Rae scheme where 99.2% of the farmers interviewed indicated lack of quality seeds and only recycle their seed from the previous crop. The recycled seeds have low hybrid vigour and may result in low yields. The use of seeds from previous harvest leads to spread of seed-borne diseases (rice yellow mottling virus) and pests (stem borers). On the variety of rice grown 99.2% of the farmers interviewed that they grow local variety called IR, which is not liked by most consumers because it lacks an aroma possessed by varieties like Basmati. On use of fertilizers in rice fields, 58% of the farmers interviewed indicated that they occasionally use fertilizers though at very low rates which do not bring much change on the yield. The farmers said that they only use nitrogenous fertilizers (Urea and CAN), which are applied as top dressers. On the use of other agricultural chemicals, 70.6% of the farmers interviewed mentioned that they had never used the chemicals, citing lack of finances to buy them as the main reason. Despite the potential benefits of improved technologies such as fertilizer and hybrid seed, farmers are reluctant to invest in them because of high purchase costs (Ndove et al., 2006).

Source of Seeds

Source	Frequency	Percentage
Recycle	118	99.2
N/A	1	0.8
Total	**119**	**100.0**

Access to Agricultural Credits

For smallholder farmers, access to agricultural credit can be difficult. This was the case in the study area with one hundred and seventeen farmers (98.3%) out the total number of farmers interviewed indicating that they had never accessed any credit facilities. Two respondents (1.7%) indicated that they had acquired some credit from CARE but found it very difficult to repay the loan after a poor harvest. However, many farmers expressed the need to be given loans to expand rice cultivation through purchase of adequate inputs and renting more plots. The farmers argued that rice cultivation was a high labour and input intensive enterprise that given finances, high yield would be achieved. This means that an increase in credit facilities to farmers will likely encourage farmers to participate in irrigation activities. The result is consistent with the findings by Martey et al., 2013; Nxumalo and Oladele (2013) and Etwire et al., (2013). Access to credit enables farmers to overcome their financial constraints associated with production and adoption of innovations. It also encourages group formation and learning.

Accessibility to Agricultural Credit

Source	Frequency	Percentage

None	117	98.3
CARE	2	1.7
Total	**119**	**100.0**

Availability of Farm Labour

The labour demand for rice is quite high. Therefore, a lot of hired labour is used. This results in labour shortage during peak periods. During these periods, farmers hire extra labour on labour exchange basis with neighbouring farmers. Some farmers may engage in casual labour to be able to employ other people on their plots later e.g. for transplanting, cutting, threshing etc if they do not have other sources of income. At this time, the cost of hiring labour escalate and therefore some farmers resort to using only farming labour which may be slow leading to delay in carrying out farm operations resulting in negative effect on agricultural produce. Of the one hundred and nineteen farmers interviewed, 42.9% indicated that they use only farming labour in carrying out farming activities, 31.0% of the respondents hire labour to carry out farm activities while 26.1% indicated that they use family but hire labour during peak periods.

Labour Availability.

Labour type	Frequency	Percentage
Own family	51	42.9
Hired	37	31.0
Hired and own family	31	26.1
Total	**119**	**100.0**

Marketing of the Produce

Marketing is a major problem and 98.3% of the farmers interviewed responded with complaints about exploitation by middlemen. Two farmers (1.7%) interviewed indicated that they sell their produce individually. There was a feeling by many farmers that selling to middlemen is not profitable and quick intervention was necessary. Asked about how they would want the produce to be sold profitably, 31.9% indicated that price per unit weight should be used. 21.8% of the respondents said there was need for marketing cooperative society to help them market while 5.9% of the respondents felt that there was need for more marketable seed varieties. The remaining 40.3% of the respondents wanted a combination of fixed prices, marketing cooperative and need of marketable seed varieties.

Marketing of Produce.

Method	Frequency	Percentage
Middlemen	117	98.3
Individual	2	1.7
Total	**119**	**100.0**

Income Generation

On other sources of income, seventy-six farmers (63.9%) out of the total number of farmers interviewed indicated that they had no off-farm employment. This category of farmers depends entirely on rice as source of income. Any factor that may lower its production deals a big blow to them. 8.4% of the farmers interviewed said that they get extra income from off-farm employment, while 26.9% do business get extra income. It is however expected that high income from off-farm employment may have a negative relationship with probability to participate in agricultural activities. Household head that earns off-farm income may have little time to participate in farming activities in small holder irrigation schemes (Sithole et al., 2014).

Other Sources of Income.

Source	Frequency	Percentage.
Off-farm employment	10	8.4
Businesses	32	26.9
Other	1	0.8
None	76	63.8
Total	**119**	**100.0**

Accessibility to Agricultural Extension Services

The farmers were asked to state whether they access agricultural extension services. 82.4% of the total farmers interviewed responded with complaints, saying that they had never received any since they started practicing irrigation. Since sufficient provision of extension services is key to increased crop production, improved farm management techniques and improved public health services, many farmers are bound to lose on this. It is often argued that there are many reasons why farmers' production is low, such as lack of credit facilities, low prices, inaccessible markets and insecure land tenure and concentrating on extension alone ignores the environment in which they operate and takes only part of the problem. While the comment is no doubt valid, it is

however, certainly the job of extension to go ahead even if the other services are lacking. For example, if the credit is not performing well, it is certainly the responsibility of the extension to take this factor into account while giving recommendation to farmers; they could focus on the use of low cash – input technology for those farmers who cannot afford to purchase inputs from their own resources (Roling, 1995; Zijp, 1992). On source of extension services, 19 farmers (16.0%) said that they had attended seminars while 2 farmers (1.6%) indicated that they had gone for study tours.

Source of Extension Services.

Source	Frequency	Percentage.
Study tours	2	1.6%
Seminars	19	16%
None	98	82.4%

Water use conflicts.

Irrigation water shortage was found to be a problem to many farmers in the scheme. This problem was mentioned by one hundred and fifteen farmers (96.6%) out of the total of farmers interviewed. The problem is mostly encountered towards the end of the growing season, which coincides with low water supply by the river. During this period, conflicts within the scheme and with surrounding non-scheme farmers are common. Most of the conflicts reported were resolved through negotiations between the parties involved at the local level and by agreeing to adopt and enforce rules. Farmers interviewed mentioned water use conflicts with upstream water users, whom they held responsible for creating serious shortages during the dry season due to poor abstraction methods. 57.2% of the farmers interviewed indicated that high demand especially during dry season and poor supervision of water distribution are the major reasons for water supply problems. 34.4% of the farmers mentioned canal siltation at the intake point as the main source of water supply problem. Yields of rice in the previous season were seriously affected by insufficient water supply as confirmed by all the farmers interviewed. Other reasons included insufficiency due to many users and lack of uniformity in planting time and poor maintenance of irrigation structures.

Water Supply Problems.

Cause of water problem.	Frequency	Percentage
Conflicts (high demand) & dry season	68	57.2
Canal siltation	41	34.4

Dry season & canal siltation	3	2.5
Insufficiency & conflicts	2	1.7
Lack of uniformity in planting	1	0.8
None	4	3.4
Total	**119**	**100.0**

While growing water scarcity, increasing population pressure, and a rising fluctuation in precipitation rates have served to increase the need for irrigation, irrigation is at the same time a crucial factor contributing to this same water scarcity.

Conclusion

Participation of farmers in smallholder irrigation is important for rural development in the study area as it improves the household food security and household incomes. However, the socioeconomic factors identified in the study can be an impediment to this noble goal. The socio-economic factors which include land ownership, credit facilities, and market accessibility of farm inputs, accessibility of agricultural extension services and accessibility of farm labour among others need to be addressed in order to make smallhoder irrigation a gain full activity.

Recommendation

The study recommends a revitalization of smallholder agricultural activities from merely subsistence oriented to commercial. There is need to improve access to extension services and credit facilities for the farmers. Agricultural extension is important in improving farming system and transferring useful knowledge to farmers on a personal basis. Extension as an essential part of an agricultural knowledge and information system, should take into account not only the status of other services to farmers, but also that of the markets, prices and infrastructure (Roling, 1995; Zijp, 1992). Microfinance institutions should be available for farmers, and such projects should target farmers whose primary source of income is farming, this will ensure full time participation (Etwire et. al., 2013). There is need to improve infrastructural access to facilitate marketing of produce and diminish income losses due to perishing harvest on the way to the market. There is need for the establishment of marketing association to help farmers market their produce at reasonable prices and also possibly provide loans to farmers. The study also recommends the establishment of water users association in the study area to enhance user - based coordination of water abstraction. This will promote conflict prevention and resolution mechanisms.

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