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EFFECTS OF SUBSIDIES ON IRRIGATION DEVELOPMENT IN KENYA: LESSONS FROM IRRIGATED MAIZE PRODUCTION IN KENYA

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ABSTRACT

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This study assessed maize productivity in irrigated fields in Kenya. The study used household surveys, KIIs and FGDs as the samples from which data was collected and analyzed to provide detailed information on the current local realities and use the economic value of resources to show how government efforts to support farmers lead to inefficient market development and low productivity. Profitability levels were analyzed at the data means while efficiency was analyzed using a regression model outputs and the geometric means of the supply-demand equation at equilibrium

The study established that maize production was profitable and with a productivity potential of 163%. Framers were found to be inefficiency in the use of land, fertilizer, and water. The later accounted for a production gap of 71%. The economic value of water was also found to be higher than farmers' willingness to pay. Inefficiency was attributed to water resource subsidy by the government. It was established that lack of accountability arose due to the existing principal-agent theory relation between the farmers and the politicians.

The study concludes that subsidy policies, institutional factors, and policy paradigms or belief systems impede irrigation development and hence agricultural transformation in Kenya. To enhance efficient production and reduce political neglect, promote invigorate participatory project prioritization and agricultural investment, the study recommends that farmers should pay a just price and the coordination between the county and national government should be improved.

KEYWORDS; *efficiency, irrigation, productivity, profitability and water*

INTRODUCTION 1.0

Kenya is an agricultural country with an area of 584,646 square kilometers of which 17% is arable and 81% arid and semi-arid lands. Food production is carried out in the arable land under rain fed conditions. The main crop grown by almost all farmers is maize. Maize is food as well as politics and income for large and small scale farmers. There are about 10 million households in Kenya with about 45%, 22% and 33% being involved in maize farming, Non-maize farming and no farming activities respectively.

Kenya produces 40 million bags of maize on good years and this can vary depending on the weather. The demand for maize is high, with more than 90% of the households consuming it as a staple food. In Kenya, maize makes up for more than half of a smallholder household production . However, Local production does not meet demand and the country imports about 15 million bags annually. The average per capita maize consumption is about 78 kg per person per year giving an annual demand of 42 million bags for a population of 47 million with the deficit being met through imports. The average yield range from 1.6-3.2 tons per acre and it has been declining over time. This yield is way below the average productivity in the developed world of about 7 tons per acre. Figure 1.

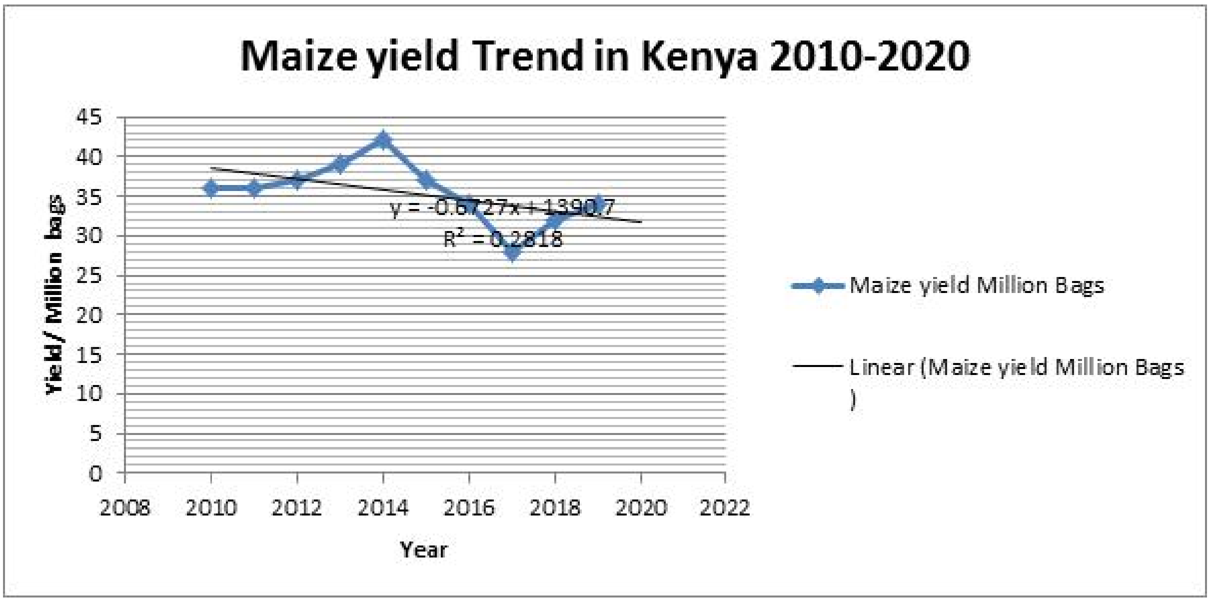

Figure 1. Maize production trend in Kenya 2010-2020..

The decline in yield has been attributed to among others climate variability, region and production system. Maize is highly susceptible to moisture stress, thus, its production varies with changes in climate change The least amount of rains required to produce maize is about 450 mm annually. Changing climate is characterized by erratic rainfall patterns and increasing frequency and severity of the drought. In Kenya, changing climate has led to declining crop yields, price volatility and increased incidence of pest and diseases (Derresa, 2007,). These challenges have made agricultural production to decline leading to a slowdown of economic growth.

Drought-induced crop failure and declining output levels may subject the vulnerable Kenyan population to food insecurity and increasing poverty amongst the vulnerable population mainly the youth, women and the elderly (Kimondo, Njogu and Kihoro, 2012 Price volatility can be tamed in the short run through maize imports.

Other than imports, strategic investment in new technologies targeting improved productivity through production capacity, commodity quality, and competitiveness may significantly reduce poverty and food insecurity as well as increase economic growth (Esrado, 2001 Where governments increase budgetary allocation to invest in irrigation, this may reduce over-reliance on rain-fed mode of production .

There has been increased production of crop and irrigated agriculture accounting for more area expansion. In the last 34 years, it has accounted for about half of the area increase in crop production with one-third worldwide's crops grown under irrigation on one-sixth of the total cropped area by 1986 (Makhura, and Mamabolo, 2000 Further, irrigation has the potential to increase agricultural output by 100% to 400% It is the main driver of increased agricultural production worldwide Therefore, irrigation is an indispensable option that can be used to achieve food self-sufficiency, food security, create wealth and provide employment opportunities in Kenya thereby driving economic growth.

PROBLEM STATEMENT

Maize is the main staple crop in Kenya. It is consumed by over 90% of households and produced by over 4.5 million households. With an increasing population whose annual demand approximates 42 million bags annually, the country experiences food insecurity due to her inability to meet domestic demand from local production. Production is mainly under rain-fed conditions. The long term average annual national output of about 40 million bags. Kenya meets her food deficit by importing maize, rice, and wheat. On average, she imports about 10-15 million bags of maize annually during drought years to meet the shortfall The imports play an essential role in increasing consumer surplus and negatively impacting the current accounts and producer surplus.

Maize production continues to experience declining yields and increased production has come about largely through area expansion into marginal areas that receive lower and more variable rainfall (d'Alessandro et al, 2015). This trend coupled with Kenya's increasingly erratic rainfall, has made the country's maize production more susceptible to moisture stress and year-on-year yield variability, with significant implications for the country's food security.

To increase food production, be self-sufficient. and hence improve consumer and producer welfare and livelihoods, the government of Kenya has been increasing its budgetary allocation to irrigation development to promote the adoption of irrigation technology countrywide (ROK, 2010 One major project was Galana Kulalu food security project (GKFSP). The project targeted large scale public and private sector investors to produce among others, sugarcane, beef and 40 million bags of maize on half a million acres annually This development was aligned with the government irrigation development initiative in Vision 2030, and the Constitution of Kenya 2010(;ROK, 2010).

However, given the history of poor performance of irrigation development in Kenya and inadequate information about the economic viability of irrigated maize production, there is no consensus on whether investing in irrigated maize production is profitable (IWMI, 2015). Further, the huge investment that prioritized maize production under irrigation in the ASAL areas was not welcomed by farmers in the high potential areas, though these farmers were more productive and were facing production and marketing challenges. The previous national irrigation development master plan or development strategy was developed in 1992. From what was documented, only 3 million acres (13%) of the irrigable land is under irrigation (RoK, 2010).

OBJECTIVES OF THE STUDY

This study set out to investigate the performance of practical irrigation cases used country wide. As an agenda setting study, it intended to provide planning information to inform irrigation development in the country

The study was guided by the following research questions.

- Is irrigated maize production profitable?
- How efficient are farmers in the use of irrigation water and services?
- What are the lessons from irrigated maize productions for other similar projects?

METHODOLOGY 2.0

The study adopted a mixed-method cross-section research design in which qualitative and quantitative data were collected through key informant interviews, focus group discussions and individual respondent interviews using a structured questionnaire. We conducted a survey, KIIs and FGDs to collect the required data. The survey questionnaire used captured socio-economic and demographics of the irrigation farmers, types of institutional support they accessed; and their perception of maize production under irrigation, maize production activities and inputs used as well as their willingness to pay for irrigation water (Adesina and Baidu-Forson, 1995, Burton, Rigby, and Young, 1999 Focus group discussions were used to generate information needed for evaluating the perception of farmers about the adoption of irrigation practices in different schemes, namely Bunyala, Nandi, Mwea, Pekerra, Hola, Galana Kulalu, Hola, Lower Kuja and Bura. Finally, the key informant interviews just helped to tie the missing links from the FGDs, Farmer survey and any issues that could be relevant for policy development.

Table 1: Participants in irrigated maize production

Irrigation Scheme	Survey respondents	Focus Group Discussion	Key informant interviews
Lower Kuja /Nyatike	10	17	3
Bunyala	10	21	2
Nandi	10	33	1
Perkerra	10	16	4
Mwea	10	-	1
Bura	10	13	3
Hola	10	23	1
Galana Kulalau	10	10	4
Total	80	123	19

Source. Field data 2015 not found in the references

The focus groups were used to develop a typical farm from which a sample area model farm could be generated. At least 10 participants took part in each of the focus group discussions. The objective of focus group discussion was to collect in-depth qualitative information about the irrigated maize production in Kenya. It captured the community's expectations, planned activities, contributions towards setting up the scheme. Scheme and plot-level factors affecting irrigated maize production as well as perceptions of the levels of maize production under irrigation. A checklist with key questions was drawn up to guide the discussions. Male and female participants were combined during the discussions as the proposed irrigation scheme was expected to benefit them equally with no special bias to gender. Efforts were made to have both the youth and adults to accommodate diversity in views and perceptions.

A total of 220 community members participated in the eight focus group discussions conducted in the eight irrigation-farming units. The data quality was guaranteed through instrument validity and reliability, as well as thorough training of enumerators. Field supervision was also done to enhance the same. The returned questionnaires were subjected to thorough data cleaning exercise.

For descriptive analysis, data were analyzed at the means and for inferential analysis. A regression model was used to provide the parameters that were used to establish allocative efficiency at the geometric means of the supply-demand equation.

RESULTS AND DISCUSSION 3.0

The study established that irrigated maize production was profitable with a positive margin of USD 7.72 per bag. The production costs per acre for irrigated and non-irrigated maize were USD 157.05 and USD 131 per bag, respectively. The breakeven point was found to be inversely related to price and directly related to the cost of production with irrigated maize having a higher break-even point of about 7.14 bags compared with non-irrigated maize of 5.5 bags, Table 2.

Table 2 Comparative costs of production in irrigated and non-irrigated maize production.

	Irrigated	Non irrigated	Simulated 1 crop	2 crops
Maize yield (bags/acre)	11	7.6	11	22
Sale price per 90kg bag	2,200	2382	2,382	2,382
Total revenue	**24,200**	**18,103**	**26,202**	**52,404**
Water	3,086		3,086	6,172
Total production costs (TC)	**15,705**	**13,100**	**15,705**	**31,410**
Breakeven yield (90kg bags)	7.14	5.50	6.59	13.19
Margin per bag w/o WC (Ksh)	772.3	658.3	954.3	954.3
Margin per bag as % of cost w/o WC	54%	38%	67%	67%

Source. Field data 2015

Using the NPV criteria, the study further established that it can takes 9 and 21 years for one and three seasons respectively to payback on the USD 6000 investment per acre, Table 2. The operations and maintenance index (O&MI) and financial performance index (FPI) Indices (Table 3), are greater than zero, implying that there were positive gains on over costs of investment on irrigated maize production. The replicability index (RI) showed that farmers cannot be able to reinvest their returns and perpetuate them for long.

Table 3: Viability indices for irrigated maize production

OMI	1.91	Costs are recovered
FPI	1.734	Made positive financial returns
RI	0.734	Able to reinvest in the same venture

Source. Field data 2015

We used the results from Table 1 and for simulation using scenarios for a bilateral government investment, at Galana Kulalu food security project. We established that there was a 71% production gap due to inefficient water use, Table 4. The efficiency was based on marginaliy analysis which showed inefficiency in the use of land and water Table 5. Intensive land and water use in maize production and less fertilizer application were identified as the solution to the existing inefficiency problem. The wastage of these resources was due to irrigation subsidy where farmers did not bear the full cost of production and therefore place low value on subsidized commodities irrigation, and water services, land and fertilizer.

Table 4: Simulated maize production potential under irrigation in Kenya, 2014/2015.

	Current technology		Efficient technology	
	Season	**Annual**	**Season**	**Annual**
Efficiency	29%		100%	
Output (Million bags)	5.5	16.5	10	30
Losses (Million bags)	4.5	13.5	-	-
EVW	9,252	27,706	21,432	64,264
Potential Output	163%			

Source: Field data 2015

We evaluated the economic value of water using the regression coefficient of labour, water, seed, land and fertilizer. Chemicals were found not to have a significant influence. The coefficients of these were used to evaluate factor use efficiency at their geometric means using MVP and MFC criteria, Table 5. The results showed that water and land were underutilized while fertilizer was excessively used. The underutilization of water is a sign of poor water management in this era of climate change

Table 5 : Regression results of irrigated maize production function

	Coef.	Std. Err.	t	P>|t|
Chemicals	-0.079	0.089	-0.89	0.378
Labor	0.116	0.040	2.85	0.006
Water	-0.208	0.108	-1.92	0.059
Seeds	0.604	0.092	6.56	0
Land	-0.096	0.039	-2.45	0.017
Fertilizer	0.092	0.021	4.39	0
_cons	-617.78	361.14	-1.71	0.092

Source; Field data 2015

The underutilization shows that the farmers place a low value to water and a pricing mechanism needs to be established that will stimulate efficient use of this commodity. If water is priced efficiency, it will not be left to run over the farms as was observed in the field. This showed that farmers placed a low value on irrigation water.

On irrigation plots, water flowing mainly through the fields has been paid for yet it is not being used by the crops. This is wastage. The same applied to land where there were wastages when used s canals for water distribution through the fields and pathways in the field. These can be used to increase area under crops.

The excessive use of water and land leads to the reduction in output. This shows the need to intensify land use in maize production and seek water saving technology to prevent excessive waterlogged production conditions. Fertilizer, seed and labour have the potential to increase output if additional amounts are used.

Further, the economic value of water (EVW) per season per acre was USD 93 and USD 214. With the current production technology and the most efficient allocation, respectively, Table 6. The farmers were paying a rate of USD 31 for irrigation water and services. Good agricultural practices i.e, 20 million bags for two seasons, Table 6.

Table 6: Allocative efficiency in irrigated maize production IN (USD).

Factor	GM MVP	Price	Ratio	Decision	Action
Water	169	50	3.43	Under	Intensify use
Labor	26	3	0.08	Optimal	No change
Land	59.8	30	1.99	Under	Intensify use
Seed	34	38	0.9	Optimal	Not significant
Fertilizer	11	24	0.45	Excess	Reduce application rates

In this study, it was assumed that irritation investments have project lifespan of 30 years. T payback period was evaluated using the net present value (NPV) criteria to determine when the investment would start positive return and results presented in Table 4. The analysis revealed that irrigation would be able to pay back the initial investment within the first ten years. This is further supported by the positive viability indices, Table 3

Table 5: NPV cash flows for irrigated maize.

11 bags 3 season	0	1	2	3	9	21
Example	-600000	105600	105600	105600	105600	105600
cash flow	100%	91%	83%	47%	15%	14%
PV Factor	-600000	536640	87273	49263	44784	33600
PV of cash flow	-600000	-504000	-416727	-36632	8153	313302
	Time in years					
11 bags 2 seasons	0	1	2	11	21	23
Example	-600000	70400	70400	70400	70400	70400
cash flow	100%	91%	83%	47%	15%	14%
PV Factor	-600000	64000	58182	32842	10464	9513
PV of cash flow	-600000	-53600	-257263	-224421	-645	86621

Source. Field data 2015

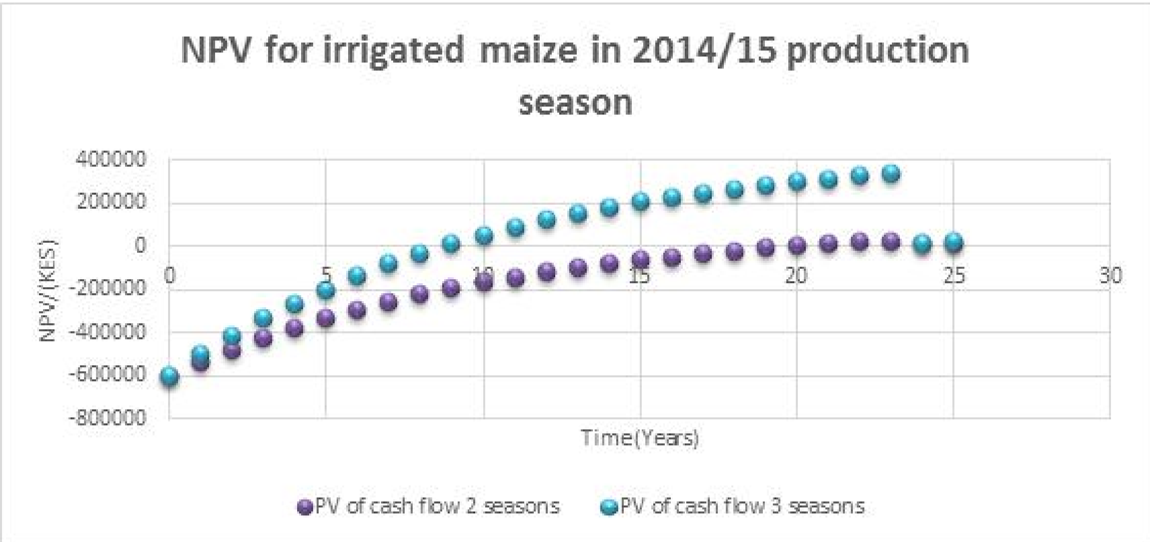

Figure 2: Price productivity payback period relationship for irrigated maize production.

It was further established that the payback period depended on price and productivity. Table 4 shows the scenario, assuming constant interest rates. If maize is grown for only one season under irrigation, it will take 20 years to payback on investment of 600,000 in an acre plot at USD 32 per bag and a production cost of USD 151 the output levels. Increasing the production seasons to three reduces the repayment period to 9 years. Further, increasing productivity to 20 bags per acre cuts back the repayment period. As output and price increases, the time it takes to recover the initial investment declines.

These outcomes where subsidies maintain the factor cost artificially low are well aligned with the government's policies and agricultural development strategies that target improving production through subsidy programs for small-scale farmers (ROK, 2010):. Further, people with vested political power will shield farmers from paying the just price. When farmers continue paying low rates, they place a low value on irrigation water and are more likely to waste it. Their unwillingness to pay a just price for water service may lead to poor service delivery and poor infrastructure (Hussain, 1995: Kadigi et al, 2013; Topalova, 2010 The net effect is; an inefficient allocation of resources that does not maximize social welfare, increase income inequality, poverty and food insecurity (Rausser and Zusman,1991: Ravallion and Datt, 1995: Allesina (in the ref. was written as Alesina) and Rodrick, 1994: and De Janvry and Sadoulet 2000). The subsidy program, therefore, impacts negatively on anticipated welfare gains by slowing down poverty reduction, consumption and create a dependency syndrome that may difficult to wad off under political patronage (Topalova, 2010). Further, it may exclude the deserving farmers and create deep structural inequality in the production sector leading to increased income inequality, low investment and increased demotivation among entrepreneurs.

The low replicability index, Table 3, is an indicator of inefficient allocation of water, land and fertilizer. Pricing the inputs at their market rate may make them more valuable, leading to efficient use. However, with subsidy, the prices of inputs are lower than their market value and this could probably be the reason why farmers place low value in the use of water, fertilizer and land. This reveals market inefficiencies, where, rent-seeking investors distort the input markets, leading to higher cost of production and higher maize prices contrary to liberalization policy.

Inefficient budgets: Stronger institutions with stable and reliable budgetary allocations. These may cause inefficiency due to political patronage, inefficient procurement, and weak institutions, inflated cost that may disincentivize maize production. Some of these changes are political and involve incompetent contracts and bureaucratic processes. Bura and Hola irrigation projects also experience changing project costs in the 1970s. Testing donor technology that may not be suitable for local conditions could also inflate costs. The best example is the constant revision at Galana Kulalu food security project. Initially, the project areas that was budgeted for was 1 million acres at Galana ranch, and over time, it has been scaled down to about 720,000 acres. Such changes affect the actual project costing for feasibility and future reviews.

Accountability is another factor that arises from political neglect. Failure to be accountable in resource use, farmer involvement, provision of extension services, and project ownership can create confusion leading to low productivity. Farmers through water users association are stakeholders in this flagship project. Their involvement together with the County leaders in planning by the National government is important since it helps to make them develop a sense of ownership to these development projects regardless of their scale of operations. The policy direction in Galana Kulalu is to lease land and irrigation infrastructure to the private sector through a public-private partnership (PPP) arrangement without regard to land and water rights of the local communities. Where a resource is taken from the locals and given to another group is a major source of conflict that can lead to low motivation to produce.

Weak Institutions and Devolution: Water users association are held accountable by their members for the services they provide, whereas the national government works through the NIB in irrigation projects countrywide and are answerable to higher authorities. The contentious ownership of irrigation projects and failure by the National government to harmonize the competing interests is the cause of low productivity and failure as in Pareto optimality principle. Agricultural extension is a devolved function and with the counties starved of funds, extension services are not well staffed. Harmonizing competing interests between these two levels of governance and failure to support agricultural extension, farmers are neglected, especially when a resource is taken from the locals and given to another entity. This also calls for designing and formulating efficient participatory policies that harmonize competing views of all stakeholders the interest of the farmers, indirectly politicians'and local and international agencies (Spiller and Savedoff , 1999).

4.CONCLUSION

This study concludes that market failure occasioned by over-reliance on subsidies is the root causes of inefficient use of water. The political agents maintain an artificially low water price for the benefits of their subjects. As long as the subjects have access to water and water services, they are more likely to waste water since their interest has been taken care of by the agents, the politician. Farmers thus end up placing low value on irrigation water and see no need to conserve it. An understanding of the politics underlying irrigation development and management is crucial for improvement in the future. New policies should reconcile competing interests to enhance project success.

Due to lack of accountability, farmers have to contend with inefficient services. Their bargaining power can be strengthened through stronger institutions whose mission is based on participatory decision making. A strong Water Users Associations (WUAs) may be able to enforce rules and regulations guiding the use of irrigation water and services at the field level. It can be critical in rallying and mobilizing farmers and supporting changing irrigation policies. It can also help farmers forge a common ground when making investment prioritization that would meet the needs of their communities. The value of water use in irrigation has been kept artificially low since it is considered a public good. This has promoted the usual wastage that is observed in local schemes. Prioritizing efficient resource use needs mutual learning through exchanges of ideas, experiences, expertise and interests leads to increased stakeholder commitment and support to projects and thus enhanced sustainability.

Accountability can be enhanced through good coordination among the actors with the National and County government's priorities being well aligned and roles clearly defined. Improved coordination between the two levels would only benefit the farmers.

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