Determinants of Irrigated Cotton Farming among Smallholders in Bura Irrigation Scheme, Kenya

by

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INTRODUCTION

- Under the Kenya Government's policy in Vision 2030 for addressing poverty, cotton production has been identified as a key sub-sector for economic development for the drier areas of the country.
- Bura Irrigation project was set up by the government in 1977; the project functioned fairly well in production of cotton and maize from 1982 to 1990 with an area of 2,500 hectares being irrigated.

- For the next fifteen years, there was little or no crop harvest due to lack of adequate irrigation water.
- In 2009, the project was revived through an Economic Stimulus Programme and irrigated cotton was reintroduced in 2010 by Cotton Development Authority in partnership with National Irrigation Board, Equity bank and Ginners among other stakeholders.

- Various farmer circumstances influence decision for technology adoption , These may include natural (climate, soils or topography), institutional (government policies) as well as farmer specific (education level, age, household size and attitudes) factors.
- Literature on smallholder irrigation focuses mainly on the "formal" irrigation . The government has had too much control on irrigation schemes and in the process puts pressure on the irrigators to:

- Use conventional irrigation methods which the government can afford to finance;
- Pay water rates;
- Practice prescribed crop rotations and plant on specific dates; and
- Produce surplus food crops for the market and later cash crops.

A healthy Cotton Crop

Spraying teams under CODA Supervision

MAIN OBJECTIVES OF IRRIGATION SCHEMES IN KENYA

The government has mainly propelled these objectives which include:

- To counteract the effects of drought, which is prevalent in the ASAL areas;
- To increase and sustain crop production per unit area of land (a scarce resource);
- To ensure food security and hence reduce malnutrition in the communal areas;
- To create employment opportunities in the rural areas;
- To improve the standards of living of ASAL farming societies (communities); and
- To produce for the export market hence a source of foreign currency .

DATA COLLECTION

- A case study was conducted at Bura irrigation scheme , the unit of analysis was the individual household. The sample included adopters and non adopters of irrigated cotton farming.
- Purposive sampling enabled identification of farmers planting cotton in the scheme. For constraint ranking, Friedman test which yielded mean ranks for the constraints depending on responses based on a pre-determined scale was used.
- Since the researcher had been in the area previously, there was knowledge on the universe of production constraints faced by the farmers. Scaling was from 1 "extremely severe" to 5 "not a serious problem".

TECHNIQUES

- The one sample t-test allowed for the comparison of hypothesized mean adopters to the mean generated from the study. The number of adopters was obtained from the sample where farmers were noted to have been free to adopt without coercion.
- A multiple regression model allowed for the establishment of the relationship between a dependent variable (cotton output) and several independent variables affecting the cotton yields. A set of independent variables was established and included credit level, income level, and education level. This model enabled the assertion of the combined effect of different variables on cotton yields in the study area.

The model used can be expressed as:

$$Y = B_0 + B_1X_1 + B_2X_2 + \dots + B_nX_n + U$$

Where:

- **Y** = Dependent variable
- $\mathbf{B_0}$= Constant
- $\mathbf{B_{1, \dots}}$,$\mathbf{B_n}$ = Partial regression coefficients
- $\mathbf{X_{1,\dots}}$, $\mathbf{X_n}$= Independent variables
- **n** = n^{th} variable
- **U** = disturbance term

The disturbance term contains all factors other than those captured in the model but that affect the cotton yield.

- The dependent variable (adoption) was a dichotomy, that is, it had only two distinct possible values for adoption or no adoption. Without loss in generality, the outcomes were coded as (Y = 1 for adopters) and (Y =0 for non-adopters) yielding a binary dependent variable.
- Since the response was qualitative, a qualitative response model (the logit model) was used. This is a non linear model since binary dependent variables ("dummy Y's) are not effective in linear regression models.
- This model assumes that the probability of observing the dependent variable (adoption of irrigated cotton farming), P_i, relies on a vector of independent variables, (X_{ij}) and a vector of unknown parameters.

The likelihood of observing the dependent variable (P_i) was tested as the function of variables including sex, age and training of household head therefore:

- $\mathbf{P_i = F(Z_i) = F(a + BX_i) = 1 / \{1 + \exp(-Z_i)\}}$

Where:

- **F (Z_i) =** the value of the standard normal density function associated with each possible value of the underlying indexes $\mathbf{Z_i}$.
- $\mathbf{P_i}$ = the probability of observing a specific outcome of the dependant variable (such as adoption of irrigated cotton production).

B = regression parameters to be estimated.
$\mathbf{X_i}$ = set of explanatory variables.
a = regression intercept.
$\mathbf{BX_i}$ = linear combination of independent variables so that:

$$\mathbf{Z_i = Log\{P_i / (1-P_i)\} = B_O + B_1X_1 + B_2X_2 + \dots + B_nX_n + U}$$

- The dependant variable (Z_i) is the natural logarithm of the probability that a particular choice (adoption of irrigated cotton production) would be made.This model implies diminishing magnitude of the partial effects for the independent variables and the coefficients give the signs of the partial effects of each of the independent variables on the adoption probability .
- The dummy variables included were defined to distinguish between two groups and the coefficient estimates the ceteris paribus difference between the two groups such as males and females.

- Results show that farmers view late input delivery as the major constraint. This was followed by the inefficient irrigation systems being used by the farmers. A mean rank value of 2.85 placed water shortage at Bura irrigation scheme as the third obstacle to sound production for the farmers. Inefficient Irrigation Management Committees were the least problematic in the scheme. The test statistic for the Friedman test is statistically significant (P< 0.05).
- Results from multiple regression analysis showed that duration of the farmer in the scheme, area under cotton crop,, level of credit, labour and level of fertilizer use have a significant (P<0.05) impact on cotton output.

DISCUSSION

- Late supply of inputs (cotton seed, fertilizers and chemicals) is the main production constraint. This may be attributed to poor infrastructural development (road and telephone networks) in the areas where the schemes are situated, making transportation of the inputs to the farm difficult.
- Furthermore, the smallholder irrigation farmer gets second preference to their commercial counterparts when it comes to input allocation by input suppliers. With the acute shortage of these inputs at the national level, smallholder irrigation farmers with their poor management skills are always faced with the problem of inputs.

- Water scarcity has also called for the need to commercialize the water supply system in Kenya. This has given birth to the National Irrigation Board(NIB) to supply and monitor water use and charging and hence a shift from the subsidized water rates.
- Since water in the scheme is delivered by costly assets, there needs to be some service cost recovery mechanism and charging farmers for water use. This reduces the burden on government fiscal capacity and allows funds to be channeled to other more rewarding projects.

- From the results, a farmer's duration in the scheme has a significant (P<0.05) impact on cotton production probably due to the farming experience acquired over time by the farmer. This experience may enrich the farmer on the major production aspects such as a sound knowledge of agronomic practices, soil type and the pests as well as the disease outbreaks common in the area.
- Credit has a catalytic effect on productivity in most sectors of the economy, the agriculture sub-sector included; in other words, credit is important for farmers in a country like Kenya, where they (famers) are among the poorest members of society. This is especially true for women, who generally lack clear title to land or other assets that lenders require as collateral.
- This study showed a significant (P<0.05) contribution of credit to cotton output as depicted by a positive coefficient of 0.182. This is mainly due to the increased access to inputs and availability of requisite capital for farm operations as well as the ability to invest in innovations leading to enhanced production

- Nutrient availability is central to sound plant growth. Furthermore, irrigation development and increased fertilizer use have driven agricultural productivity for the past 50 years The *ceteris paribus* effect of fertilizer use on cotton yields is given by the coefficient of level of fertilizer use. This means that a 1% increase in level of fertilizer use leads to a 437% increase in cotton out put.
- Farmers have to be aware of the optimal levels of fertilizer use and guard against diminishing marginal returns to fertilizer use. Since water is largely removed as a growth limiting factor in irrigated farming systems, appropriate fertilizer and manure application can lead to quantum-leap yield increases as shown for the South-Asian Rice-Wheat Consortium.

- Revelations from the study are that access to credit must be enhanced for smallholder irrigation farmers to allow them to access inputs such as fertilizers and make use of the available technologies .
- Also extension services to enlighten the older farmers coupled with field trials to allow evaluation and observability and appreciate the greater relative advantage, might create an enabling set-up for use of micro irrigation to boost cotton yields.

CONCLUSION

- There is need for a plan that will bring all the stakeholders into a coherent framework for action to address the water problem in irrigation schemes.
- To try and address the low adoption problem, focus can be placed on agricultural training to capacitate the farmers and enable them to utilize the irrigation system and boost production for those embarking on the cotton enterprise.
- In addition, adapting technologies to the level of farmers' willingness to change their habitual way of farming could have helped improve irrigated cotton adoption. Some farmers complained that they had not adopted cotton farming, as the projects were difficult and time consuming.