



# Challenges of introducing irrigation to small scale cotton growers in the Kingdom of Eswatini

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## Abstract

Irrigation is the most important factor in agricultural production in drought-prone areas especially under the prevailing climate change conditions. It's a practice that ensures high levels of productivity in cotton. Cultivation of cotton under irrigation is important for people's livelihood, industrial development and employment growth. Cotton impact on the cotton value chain contributing to economic growth through the production of different products used for diverse purposes, generating income, contribution to tax through stimulating different economy sectors.

Adoption of irrigation cotton by small-scale growers is essential, due to the occurrence of water deficiency during the crop cycle caused by low rainfall rates and poor distribution of precipitations. One of the problems found is that the small scale farmers are not irrigating cotton because of many reasons.

The objective of this study was to evaluate the challenges of introducing irrigation to small scale cotton growers in Eswatini. An evaluation was carried out using quantitative research. The study consisted of eight informants who are experienced in cotton production. Data were evaluated by using thematic areas.

The study revealed that higher infrastructure cost makes irrigation not to be affordable to small-scale cotton growers producing cotton in an area less than one hectare. The study further reveals that installation for irrigation is high and farmer cannot afford to pay for installation. There was also a lack of knowledge to execute irrigation from cotton farmers. Indication further states training is an essential component to handle cotton production under irrigation. Finally, the study recommends government intervention through subsidies to reduce the high cost of infrastructure and providing bank guarantees to small scale growers to access loans for buying and installing irrigation infrastructure.

Keywords: Cotton, cost, Irrigation, infrastructure, small scale farmers

## Introduction

This paper is investigating challenges that impede small scale cotton grower from adopting irrigation in cotton production in the Kingdom of Eswatini. Discussions in the paper are guided by management processes of adopting new technology in a country. In the Kingdom of Eswatini, agriculture plays a major role in the economy; it's a major source of food, and also employs more than 60% of the country's population (ISAAA, 2019). Sugar cane is the major cash crop ahead of forest and cotton in Eswatini. Cotton is the second-biggest cash crop grown by small scale growers under rain-fed condition. It is an important cash crop for most Swazis who live in drought-prone areas and smallholder farmers who are reliant on the crop for their livelihood (Central Bank of Swaziland, 2019). Eswatini farmers are still entirely reliant on rain-fed cotton. Irrigation in cotton is not practice due to lack of affordability by small scale growers yet most countries that have succeeded in cotton production adopted irrigation in cotton. The list entails countries such as the USA, India, China and South Africa (James, 2018). Without adopting irrigation, it is almost impossible to succeed in cotton production especially with the challenges posed by climate change.

Cotton remains important for people's livelihood, industrial development and employment growth, since its impacts on the cotton value chain (Power *et al.*, 2011). Cotton creation employment, generating income; contribute to tax through stimulating different economy sectors. Adoption of irrigation cotton by small-scale growers is the most important factor, especially in drought-prone areas. It ensures high levels of productivity due to water availability during the crop cycle (Richards *et al.*, 2008). Low rainfall rates and poor distribution of precipitations impact negatively on productivity. One reason for small scale farmers not to embark on irrigated cotton being that water sources for irrigation are scarce and in many regions they have been decreasing over time due to other uses.

Knowing the potential yield and productivity due to the influence of irrigation make one wonder what exactly are the hiccups experienced by growers that prevent them from embarking on irrigated cotton. Basso (2007) reported that the response of the cotton plants to different amounts of water, in environments is very important for the economy and farmers livelihoods. Lack of water causes stress on the plant, which may affect the growth and development of the crop culminating in significant yield losses and poverty for farmers (Gerardeaux *et al.*, 2013).

Considering that farmers who grow cotton without irrigation do not receive much yield due to water stress on the plant. Means must be made for cotton growers to access irrigation. Thus conduction of a study with appropriate observations to evaluate the challenges of introducing irrigation on cotton is very important. Considering that cotton cultivation under irrigation plays a key role in livelihood for small scale growers while

its absence course a significant reduction on yield resulting in poverty. It is necessary to study the key challenges experienced by the small farmers in introducing irrigation in cotton production. This paper, therefore, this paper aimed to evaluate the challenges impeding the introduction of irrigation by small scale cotton growers in the Kingdom of Eswatini.

## Research Methodology

The phenomenological research philosophy guided the study. Phenomenology entails the use of qualitative research approaches which endeavour to understand meanings as constructed by participants. It is more reflective of reality for research subjects' opinions and perceptions (Creswell, 2019). In the study, empirical data was used to understand contemporary phenomena( introduction of irrigation on genetically modified cotton) from the perspective of participants (Richey & Klein, 2020). The research, therefore, uses Eswatini's cotton industry as a case to study potential challenges associated with the introduction of irrigated genetically modified cotton in the country.

The study used an exploratory research design. Exploratory research designs promote a broader research scope than other research designs, thus enabling the researcher to explore as many variables as possible (Bryman *et al.*, 2018). The purpose of exploratory research is to gain familiarity with a given phenomenon. More importantly, exploratory research is often conducted in a business setting to explore the potential impacts of anticipated phenomena (Pickard, 2019). However, exploratory research findings may not be generalizable to the target population even though it enables the researcher to gain significant insight into the phenomenon being investigated (Leary, 2012).

An imperfectly identified target population result in invalid research finding (Creswell, 2020). The target population for this study includes key informants in Eswatini's cotton value chain selected based on their knowledge and understanding of the dynamics in Eswatini's cotton industry. The study relied upon the informants' experience and product knowledge. This enables them to fairly and accurately assess the potential challenges associated with the introduction of irrigation on recently adopted genetically modified cotton. Approximately 22 senior managers employed throughout the cotton value chain in Eswatini. Time and financial limitations prevented the researchers from conducting a census. Consequently, only 8 managers were interviewed.

Purposive sampling is entirely guided by the researchers' judgement and ability to select participants who can contribute to the study in a meaningful way. Thus, the researcher should be knowledgeable about the participant's knowledge, capacity and ability to add value before approaching them (Creswell, 2019). The selection process targeted to have at least a representative from each sector in the cotton value chain.

Qualitative research employs a variety of research instruments for the collection of raw data. Observations, focus groups and personal interviews are among the more popular qualitative research instruments. Observations would not yield the desired raw data and focus group interviews were irrelevant because the targeted informants were of varied orientations and background. Therefore, the personal, face-to-face interviews with key informants were used as the research instrument (Leary, 2012). A semi-structured, face-to-face interview was used to collect qualitative data for analysis. Semi-structured interviews can offer flexibility that allows the researcher to probe and follow-up questions based on the participants' responses.

During the recording Key words were marked to be used in word and tree clouds graphical representation. Finally, the transcribed interviews were submitted to interviewees for verification, to ensure that what they had said during the interview was correctly understood and transcribed by the interviewer (Creswell, 2019). In this study Dedoose-Version, 6.2.21 Word cloud and Word tree were used to analyse the data. Word and tree clouds are graphical representations of words frequency that give greater prominence to words that appear more frequently in a source text. This allows themes to emerge from the responses of participants that may enable the researcher to answer the research questions. To add further value to the analysis identification of sub-themes under each major theme was conducted. Sub-themes assist the researcher in identifying the major variables that influence each major theme (Creswell, 2019).

In qualitative research, sample until saturation is advisable; researchers continue to look for information until they are satisfied that all information required has been collected (Creswell, 2019). However, due to time and financial constraints, the search for data was limited to 8 key informants. As such, the findings may not be as insightful as a larger sample could have achieved. Additionally, the concept of irrigation on genetically modified cotton is fairly new, since only a few countries have adopted the technology in Africa. Therefore, there is limited literature about the challenges posed by introducing irrigation on genetically modified cotton. Researchers are therefore forced to be heavily dependent on information and opinions from irrigating conventional cotton.

## Results and discussion

A total of 8 informants representing cotton farmers, seed suppliers, chemical suppliers, ginning sector (primary processors), spinners (secondary processors), the regulator, the government and other stakeholders participated in the study. The informants had cotton industry experience ranging from 5 to 21 years and they hold key positions within the cotton industry. The findings are discussed based on four themes that emanated from the 8 interviews. The four themes are the benefits of introducing genetically modified cotton, the costs of introducing genetically modified cotton, capacity requirements for introducing genetically modified cotton, and

challenges associated with genetically modified cotton. The views given by the informants were personal and did not represent views of the companies they worked.

### **Cost of irrigation infrastructure**

It emerges informants believes that the cost of irrigation infrastructure will be too high for small scale growers. This attributed to the fact that most farmers have no financial muscles to afford the irrigating equipment. The fact that growers have limited capacity to access bank loans make them vulnerable to the high cost of infrastructure such was cited by four of the 8 informants.

*Informant 4 mentioned that:*

*Small-scale growers are hesitant to adopt the irrigated cotton due high cost of irrigation infrastructure. This is a major stumbling block. We must therefore consider intervention from the government to give the required assistance. In my opinion, the government will have to incur a significant cost in infrastructure development and farmers training. The cost to buy this equipment takes its toll on the available resources; hence a sound support system is demanded effective and success of these farmers.*

Interviewee 3 and 5 agree that for cotton farmers to be successful in implementing this project in cotton, the government need to invest in the programme. This entails infrastructure development and training of farmers on the use of the technology.

**Informants 5** indicated that:

*Our smaller farmers are not exposed to irrigating cotton, and with the high cost of the infrastructure, we would want them to get a good harvest in their first harvest. I believe that it is very important for the government to assist our smallholding farmers on the entire issue around the introduction of irrigation in cotton. The government would need to embark on a big project to capacitate them on what to do differently, and what to avoid altogether. The government must consider the cost implication of this drive to help people; otherwise, the adoption will be slow. Implementing group schemes will definitely be affordable for farmers like using the sugar cane and Eswatini Water and development (ESWADE) the model currently applied at siphofaneni Lower Usuthu project 11.*

**Interviewee 6:** referred to a cotton farmer in Kenya, who was familiar with the higher cost of irrigated GM cotton in comparison with production under the rain-fed condition he used, stating that:

*He Adopted irrigated cotton in 2014, and was certainly shocked by the significantly higher cost of irrigation infrastructure. While he obviously did expect the cost to be higher, Mr Visser said that it was also paying more, because of the guaranteed higher yield and improved management practice in cotton production. Furthermore, his assessment of cost-benefit analysis indicated an increase of 20% more than rain-fed cotton.*

**Interviewee 3** predicted that:

*Whenever irrigation in cotton is adopted, regardless of geographic location, the cost of production will increase. Infrastructure costs are bound to be higher for irrigated cotton. I have witnessed this trend in South Africa, where infrastructure cost is unaffordable unless you access a bank loan, and I am aware that in Australia, prices of infrastructure can be as high as 20% of the land value. I am, therefore; fairly certain that farmers in Eswatini can expect to pay higher prices for irrigation infrastructure if they adopt irrigated genetically modified cotton.*

The above observations are in line with the fact that, since genetically modified cotton is purposely created to be resistant to many types of worms and insects, cotton farmers find that there is no need to excessively spraying different types of pesticides to protect their cotton crops. Thus, the introduction of genetically modified cotton reduces the use of pesticide (James 2018).

The above observations are in line with the fact that since the cost of irrigation infrastructure was high for cotton farmers vividly, therefore, those farmers will need support to buy irrigation equipment. ISAAA (2019) provided similar conclusions adding that resources for introducing such an initiative were a limiting factor. It remains to be seen whether the government of Eswatini will afford to assist the farmers financially.

### ***Training and cost associated with the technology.***

It emerges information believes that farmers training and capacity building to handle irrigation technology. This attributed to the fact that most farmers have not used irrigation before. The fact that growers have not used irrigation in cotton before make them lack knowledge and capacity to handle this technology was reported by 3 informants.

Informants 5 and 3 agree that training and guidance need to be provided to small- scale farmers on how best to leverage the benefits of irrigation of cotton, and as such, the cost should be factored into the profits accrued through the technology.

Most important challenges are to do with capacity and training issues,

For example, Informant 7 said:

*I do not think farmers have enough capacity to handle irrigation technology in cotton...training will be important if a farmer is to leverage on irrigated. These challenges are best managed through a proper strategy that must be created at a national level.*

**Interviewee 5** states that:

*We could talk to our farmers and ascertain what they already know about irrigation on genetically modified cotton and how they believe it should be installed... we will see after we discuss with them and we can take it from there. Regardless of what transpires out there, we know that they do not know on the technical know-how of irrigation installation... it is a new technology and will be a learning curve for all of us. It is important to develop the required capacity to the farmers by providing intensive training at all stages of the project.*

The findings generally established a lack of knowledge in installation capacity by farmer's remains which may pose a challenge in growing irrigated cotton. The findings further established a lack of capacity to manage the irrigation system in the cotton field. Farmers needed to be trained on technology installation and management, an exercise that may take time. Thorp (2018) provides similar conclusions, adding that training resources for technology installation were a limiting factor. It remains to be seen whether capacity building to farmers would be possible under these conditions.

### **Water sources for irrigation**

Informants highlighted the scarcity of water and further indicated the need to apply for permits to irrigate cotton

**Interviewee 6** stated that water is a necessity for introducing irrigated to cotton:

*Farmers will be expected to acquire water permits as water will be one of the major inputs in production. The Ministry of Natural Resources only permits free water when irrigating less than one hectare of land. Currently, most water permits have been issued to sugar cane farmer, leaving an insignificant number to irrigate another crop including cotton.*

*Production techniques, including budgeting and forecasting, must be improved if we are to be able to afford the cost of irrigated cotton after every harvest. Management techniques will also form part of the capacity needs. This will be a critical capacity requirement as irrigation in cotton will be essential in the absence of rain. We must therefore consider our capacity to forecast our profits and budget for the irrigation cost once we have sold the cotton to the ginnery.*

**Interviewee 2** stated that:

*If farmers adopt irrigation they will be forced to embark on groundwater uses which may be even more expensive to access. It's only feasible once farmers are group into an association to conduct business as a group. Such a model has been are adopt and was successful with ESWADE in Eswatini. It must be clearer how we structure our capacity to accommodate the shortage of water bodies. I would believe that farmers need to be trained to able to produce cotton using more advanced technology.*

The findings undoubtedly indicated that for a successful implementation of the programme farmers need to apply for water permits or look for other sources like groundwater. Bazarovich & Maratovna (2020) provides similar conclusions when assessing challenges faced by farmers in common in tropical areas compared to the equatorial region. It remains unclear if farmers have water rights to grow cotton, a challenge.

### **Shortage of irrigation material in Eswatini**

The main observation in this regard was the importation of irrigation material in the country posing a serious challenge if farmers will be able to pay for materials imported from neighbouring South Africa.

**Interviewee 5** states that:

**Interviewee 3** provided a broader, macroeconomic perspective on the potential challenges of adopting irrigated cotton production in Eswatini by revealing the following:

*It has been established that the irrigation material like drip irrigation does not manufacture in Eswatini leaving a gap in sourcing such material. This implies that farmers must import the equipment from abroad. Prices may escalate or almost triple the buying price as currently; the dollar rate is high due to COVID 19 pandemic. This will add to the cost of production. With the monopoly that currently exists globally and the fact that these drips are manufactured outside Eswatini, farmers will have to revert to farrow irrigation than exploring economically viable drip irrigation. Farmers are likely to find themselves in a situation where companies drastically increase their prices, in my opinion; this is a major challenge that must be dealt with from the top. Government intervention is required to save farmers from reverting to dryland cotton.*

The findings established a Shortage of irrigation material in prompting Eswatini prompting importation from neighbouring South Africa. The result is unstable market prices because South Africa import from abroad bringing in the element of exchange rates. Farmers need to use alternative irrigation means like farrow and canal systems, which are cheaper to avoid the cost. Yan *et al.*, (2020) provided a similar finding when



elaborating on a potential challenge related to irrigation raw material importation and cost implication. Eswatini government is challenged to provide cushion to such predicament.

### ***Cotton price and return on investments***

Most important other challenges are to do with cotton prices issues, which instable in the market. Farmers are likely to experience losses due to world market variation as per the previous theme. Inputs or variable cost should be properly managed for the farmer to break even. This was identified by informants during their submissions.

Informant 3 said:

*Cotton farmers would need to transcend from the traditional management methods of cultivation to a newer more sophisticated approach but knowledge is important in discharging this exercise. Issues of price need to be considered timely by the market to avoid losses. Issues of budgeting are important to align production with the output of the irrigated cotton. Famer's are likely to experience an unnecessary loss due to low cotton prices in the market. They need to know how to make the best from the expensive technology if they are to be successful. They need to gain knowledge of what is required to benefit from the new technology. For example, they should know that irrigated cotton requires more fertilizer due to leaching and they must know when to apply this fertilizer and how. Finally knowing the types of irrigation technique suitable for the different soil type will be important.*

Informants 6 indicated that:

*Time preparation and good foresting remain the most important aspect to farmers when using irrigation, furthermore planning and timely supply of required nutrients ids important for farmers growing cotton under irrigation*

The above observation reveals that returns are linked to price fluctuations and increase in total variable cost. Fang *et al.*, (2020) reported a similar finding when studying optimal forecast combination based on ensemble empirical mode decomposition for agricultural commodity futures prices. Efforts need to be made to lower input cost and improve productivity by controlling price volatility by promoting price hedging to ascertain future cotton prices. It remains a challenge, whether farmers will cope with the volatile world cotton price to sustain production under irrigation.

## **CONCLUSIONS AND RECOMMENDATIONS**

Based on the study's objectives and findings the following conclusions were made regarding the possibility of introducing genetically modified cotton in place of hybrid cotton in the Kingdom of Eswatini:

- There is a need to promote water harvesting and construction of a water reservoir to increase water sources and avoid water losses during the rainy season.
- Government need to shoulder infrastructure cost to enable every farmer to produce cotton under irrigation
- The government of Eswatini has a responsibility to shoulder the export cost of irrigation material to minimize the exchange rate of the imported raw material
- Farmer companies should be capacitating to be able to install and maintain irrigation infrastructure to minimize cost of employing experts from other countries.
- There is a need to train individual farmers on management and handling of irrigation equipment
- There is plenty of room for financial institution to play in this space a farmer will be relying on them for finance.
- Stabilizing cotton prices index through negotiating and future prices will eliminate the uncertainties of farmer and contribute to sustainable production.

## Recommendations

- In business, survival is not about unlimited resources; it is about the business being adaptable to change. It is therefore recommended that with the prevailing climate change condition in agriculture new farming strategies that are adaptive to the changing climate-smart agriculture must be adopted. Farmers in other countries have benefited from adopting irrigation in cotton production, so will be the kingdom of Eswatini. The country may face challenges using how other countries have overcome the above-mentioned challenges.
- Enacting enabling legislative reforms to create opportunities for investors to invest in irrigation infrastructure and attract investment partners at national, industry and individual levels. Therefore, it is recommended that legislation related to investment and importation of irrigation raw material be proposed as one of the strategies to fast-track the cost of infrastructure in Eswatini to the revival of the moribund cotton industry.
- In light of the several challenges associated with irrigation in cotton, the study recommends a robust training programme for farmers who are interested in embarking on irrigated cotton. The farmers require training in handling and managing under the new technology. Short courses in irrigation management can be organized in liaison with colleges that offer agriculture courses.

- To deal with the restrictive environment, it is recommended that the Government of Eswatini introduces a water harvesting strategy. The strategy should entail a dam construction policy and a downstream development policy to facilitate water availability and use in rural communities.
- To curb the issue of lack of capital from a financial institution to buy irrigation equipment government should provide loan guarantee that will be accompanied by technical support from the financing institution to ascertain good delivery by the farmers. This recommendation will not require a lot from the government hence it can be implemented as soon as an appropriate agreement is made.
- Finally, it is recommended that further research be conducted on the different types of support needed in a country that is experiencing challenges in adopting irrigation with small scale farmers. Studies on effective strategies to deal with anticipated challenges and management of the farmers 'knowledge in sustaining the new technology at their level.

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