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Research Article

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Effect of Labor Saving and Production Enhancement Technologies on Cotton Production in Omiya Anyima Sub County-Kitgum District

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Abstract

The study made an assessment of the effect of labor saving and production enhancement technologies on cotton production in Omiya Anyima sub County-Kitgum District. The specific objectives were to: identify the types of labour saving and productivity enhancement technologies being employed by farmers in cotton production, compare cotton production by farmers using labour saving and productivity enhancement technologies and those not using the technologies, identify areas of research that could enhance cotton productivity and lessen drudgery and excessive labour use, and the challenges associated with the use of labor saving and productivity enhancement technologies in cotton production and recommend some innovative solutions. The study was cross-sectional in nature employing qualitative and quantitative approaches for data collection and analysis. A questionnaire was used to capture information from 376 respondents. The study identified different labour saving and productivity enhancement technologies used in the area such as; animal draft power, tractors, sprayers, herbicides, fertilizers and pesticides. An average production difference between adopters and non-adopters of labour saving and productivity enhancement technologies were 519.8 kilograms per acre in a season. The identified areas of research to enhance cotton productivity and lessen drudgery included; automated irrigation systems, automated weed control systems, auto-guided agricultural systems, automatic motorized sprayers while and robotic planters. Adoption and use of labour saving and productivity enhancement technologies was influenced by factors like economic status, land tenure system, lack of credit to services, and high costs of procurement and operations. The study concluded that Labor Saving and Production Enhancement Technologies have a positive effect on Cotton Production but the users were still affected by challenges like poverty, low knowledge on use, lack of accessibility, costs of hire, capital and land tenure system. The study therefore recommended more education for farmers on the technologies, revisiting land tenure policies to allow farmers have access to bigger land to apply the technologies, supporting farmers through credit services and more capacity building and external support.

Keywords: Labor Saving, Production Enhancement, Technology, Cotton Production

Introduction

Cotton (Gossypium hirsutum L.) is a subtropical, perennial plant belong to the family Malvaceae, with 50 wild and cultivated species. Cotton is one of the most important cash crops across the world and a major source of export earnings [1]. It is third to coffee and crude oil as the most important internationally traded commodity in monetary value [2]. Cotton production accounts for 1.5% in global Gross Domestic Product (GDP) and 7.1% of agriculture value addition. In spite of its high global export earnings, the cotton sector across the globe still sufferserous setbacks including labour shortage and low yields. The dynamics in labour supply coupled with incompatible and unsustainable production technologies affect production hence upsetting the overall global cotton section. Labour saving and production enhancement technologies have been adopted to revamp the poorly performing sector however, the rate of uptake is still low due to socio-economic and environmental factors [3].

In Africa and Sub Saharan African countries in particular, cotton yields have remained low and fetch low prices compared to cotton from other continents [4]. There is evidence of farming households using rudimentary farming tools like hand hoe and pangas which are labour and time consuming [5]. Wide spread use of traditional farming practices not only affect output but equally quality. In a move to sustain production, governments have promoted labour saving and production enhancing technologies to improve cotton survival and productivity [6]. For instance, mechanized systems and crop management practices have been introduced at low cost to increase production while conserving the environment. These technologies balance the

tradeoffs between farmers' economic needs, ecosystem services and biodiversity conservation [7].

In Uganda, cotton is the third largest export crop after coffee and tea [8]. It contributes to 15 percent of the country's total agricultural export. Cotton is produced in all regions of the country, though most production is concentrated in the Northern and Eastern regions. The crop is a main source of income for households in these areas, who cultivate it under rain-fed conditions with minimal use of inputs like such as fertilizers and chemicals [9]. Currently the cotton sector across the country faces a number of setbacks including climate change, declining soil fertility, shortage of labour and limited adoption to production enhancement technologies [10]. These factors trap smallholder cotton farmers who depend on the crop for their livelihoods in a vicious circle of low incomes and poverty [11]. Improving cotton production at a cost undoubtedly has remained one of the greatest challenges facing the Ugandan government today [12]. Since cotton is an important cash crop for the country and individual households, several interventions in the sector have be done since independence in an attempt to improve production. These labor-saving technologies in agriculture have been fundamental to the advancement of the agricultural industry [13].

Cotton is a major cash crop in the Kitgum District and an income source for many households. Production is done by smallholder with land holdings of 2.5 – 5 acres [10]. Cotton farming has been promoted as part of the strategies to fight poverty [13]. Despite of her economic role in the area, the cotton sector continues to suffer labour shortage and over reliance on traditional management practices which explains the continuous low productivity and quality. The debate on the relative benefits of labour saving and production enhancement technologies has in recent time gained significant interest.

Problem Statement

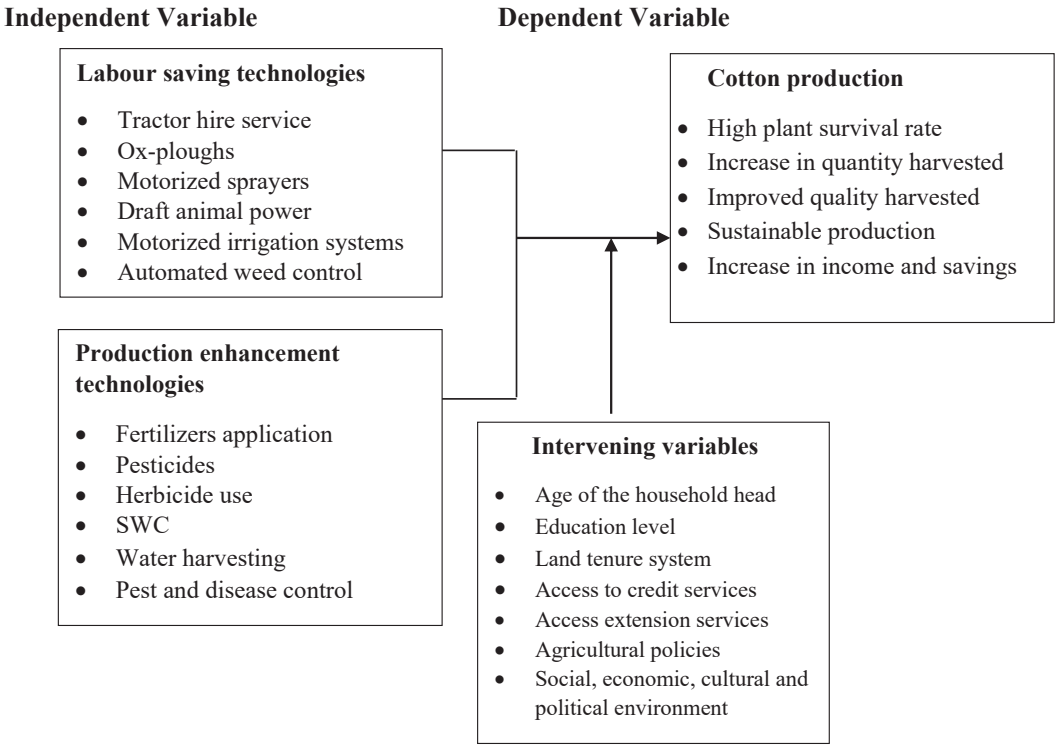
The cotton sub-sector in Uganda plays a critical role in the Nation's economy [14]. It was, however, observed by Mugisha & Alobo and IL&FS Clusters, as well as during the 2016 Cotton Development Organization (CDO) survey on status of cotton value addition in Uganda that, despite the ongoing government efforts to strengthen the competitiveness of the sector, several impediments constrain its potential growth [9, 6]. The fundamental problem of Uganda's cotton sector is its low profitability, which reflects the displacement of cotton by food crops [14]. Due to the fact that cotton production has a high labor requirement Ahmed & Ojangole, (80% of total production cost with about 40% of total recurrent cost) coupled with price fluctuations, low prices, poor market reliability [12, 15]. High labour demand and low productivity are the major constraints reducing the profitability and competitiveness of the enterprise this is due to the fact that cotton is not a high value crop; other sources also report low yields for Uganda, which point to a problem for policy makers and researchers to solve [16]. Chemical fertilizers are basically absent as a production input, and apart from the cost of it in itself there seem to be some serious misconceptions around this "technological input", that has to be sorted out before producers will use it with confidence. This study therefore seeks to ascertain the effect of labour saving and productivity enhancement technologies by cotton farmers on cotton production thereby increasing the competitiveness and profitability of the cotton enterprise in Uganda.

Research Objectives

The overall objective of the study was to assess the effect of labour saving and productivity enhancement technologies on cotton production in Omiya Anyima Sub County – Kitgum District. The specific objectives were to; identify the types of labour saving and productivity enhancement technologies being employed farmers in cotton production, compare cotton production of farmers using labour saving and productivity enhancement technologies and that of farmers not using labour saving and productivity enhancement technologies, identify areas of research that could enhance cotton productivity and lessen drudgery and excessive labour use, and identify challenges associated with labor saving and productivity enhancement technologies in cotton production and recommend some innovative solutions.

Conceptual Framework

The study addressed at labour saving and production enhancement technologies as the independent variable and cotton productivity as the dependent variable. Labour saving and production enhancement technologies included; mechanization and automated systems, organic application, herbicides, timely planting, spacing, weeding management, spraying, Soil Water Management, pest and disease control etc. Application of these technologies saves labour costs as well as improves cotton productivity by ensuring plant survival, quantity and quality harvested. Adoption of the practices was however influenced by household socio-economic characteristics, environmental factors and policies as presented in the diagram above.



Methodology

The study was conducted in Omiya Anyima Sub County, Kitgum District. The district borders South Sudan to the north, Karenga District to the East, Kotido District to the Southeast, Agago District to the South, Pader District to the Southwest and Lamwo District to the Northwest. It lies between latitudes 20 North and 40 N and longitudes 320 East and 340 East, with an average altitude of 1,100metres above sea level. The vegetation of the district is mainly of woody Savannah characterized by woody cover and grasslayer. The dominant grasses are *Hyperemia, Penicum, Bracharia* and *Seteria*. *Acacia Cambrelium* constitutes the dominant tree. The District is drier in the Northeast and the vegetation includes shrubs. The soil types vary with localities but is generally well-drained sandy, Clay, Loam and sand clay. The climate of the area is bimodal with both dry and rainy seasons. The district receives average annual rainfall of 1300mm. Like other districts in Uganda, the economy of the Kitgum District is predominantly dependent on small scale agriculture, animal husbandry and produce buying. Over 90% of the farmers are engaged in crop production as their major activity and source of income. The major food crops grown include; Sim-Sim, Upland rice, Green Vegetables, Fruit trees (Citrus/Mangoes) Beans, Groundnuts, Sorghum, Maize, Millet Cassava, Sweet Potatoes, Pigeon Peas and Sunflower. Cotton and Tobacco are the major traditional cash crops.

The study was cross sectional in nature applying a quantitative approach to data collection and analysis. Data was captured from of cotton farmers and other key informants across the study area. Non-cotton farmers were excluded from the study. The quantitative approach enabled exactness and clarity in the measurement of the variables.

A population of 376 cotton farmers was drawn using a formula by Yamane (1967) at 95% confidence interval and 5% error term.

A combination of simple random and purposive sampling techniques was used in the selection of respondents from Omiya Anyima Sub County. All households involved cotton production activities constituted a sampling frame. Random numbers were used to pick farmers from each parish. 94 cotton farmers were randomly selected from each of the 4 parishes to make a total of 376 farmers. Purposive sampling was applied in the selection of key informants.

A semi-structured questionnaire in English language was translated in local languages and then administered to the farmers. The questionnaire gathered information on socio-demographic characteristics like gender, age, level of education in years, household size, landholdings and source of income. The tool was checked for completeness, coded and entered into SPPSS version 16 software package for and cleaning and analysis. Both descriptive and inferential statistics were generated and used to summarize the findings. Results were presented in tabular form.

Results

Farmer Characteristics

The major demographic characteristics studied include; gender, marital status, education level, age, household size, farming experience and total farm size in acres.

Table 1: Distribution of respondents by gender and level of education

Variable	Classification	Frequency	Percent
Gender	Male	251	66.8
	Female	125	33.2
	Total	376	100.0
Level of education	Not attended school	22	5.9
	Primary school	74	19.7
	Secondary school	208	55.3
	Tertiary education	72	19.2
	Total	376	100.0

Result in table 1 above showed that (66.8%) of the respondents were male, and 33.2% female. 55.3% of the respondents had secondary education, 19.7% primary education, 19.2% primary education while 5.9% had not attended any formal education.

Table 2: Descriptive statistics of age, household size, land and experience

Classification	n	Minimum	Maximum	Mean	Std. Deviation
Age in years	376	12	68	34.53	14.960
Size of the household	376	2	14	5.63	2.306
Farming experience	376	1	18	7.73	3.180
Size of your farm	376	1.0	33.0	5.907	5.1876

The above data indicates that cotton production is done by a relatively young population averaging 34 year with a relatively good experience of 7 years in farming and with considerable family size to provide labour for the crop.

Table 3: Labour saving and productivity enhancement technologies employed in cotton production

Variable	Classification	Frequency	Percent
Labour saving technologies	Tractors	94	25.0
	Ox-ploughs	207	55.1
	Motorized Sprayers	40	10.6
	Draft animal power	35	9.3
	Total	376	100.0
Production enhancement technologies	Herbicide use	59	9.0
	Pesticides	158	42.0
	Fertilizers application	125	33.2
	Others	34	15.7
	Total	376	100.0

Results on labour saving technologies used in cotton production were presented in table in table 3 above. 9.3% of the farmers used draft animal power, 25% tractors, 10.6% motorized sprayers and 55.1% ox-ploughs. In addition, of the production enhancement technologies used in the area, 9.0% used herbicides, 33.2% applied different kinds of fertilizers, 42% used pesticides and 15.7% other technologies like minimum tillage, Soil Water Conservation and cover cropping.

Table 4: Cotton production between users and non-users of labour saving and productivity enhancement technologies.

Test Value = 0						
	T	Df	Sig. (2-tailed)	Mean Difference	95% CI of the Difference	
					Lower	Upper
Cotton production for users	24.565	375	.000	776.971	714.78	839.16
cotton production for non-users	83.065	375	.000	257.168	251.08	263.26

According to table 4 above, average cotton production for users of the technologies was 776.97 kilograms per acre in a season and 257.17 kilograms for non-users respectively. Average production difference were 519.8 kilograms between users and non-users and the difference was significant at (p=0.000).

Table 5: Model Summary for effectiveness of technologies on cotton output

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.519a	.325	.212	2.292

The results in table 5 above summarized the regression model used in the analysis. A direct moderate correlation of .519 was observed between labour saving and production enhancement technologies and cotton production in the area. The R Square of .325 implied that the application of the technologies contributed to 32.5% of the total cotton produced by users. An Adjusted R Square of .212 showed that application of labour saving and production enhancement technologies accounted for 21.2% variation in total cotton produced.

Table 6: Anova Results For The Perceived Of Labour Saving and Production Enhancement Technologies On Cotton Output

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	50.692	5	10.138	1.931	.003[a]
Residual	1942.922	370	5.251		
Total	1993.614	375			
a. Dependent Variable: Cotton production					

The influence of labour saving and production enhancement technologies on cotton output was statistically significant at 5 and 370 degrees of freedom at p-value = 0.003 less than 0.05. The effectiveness of the technologies on cotton production was ascertained through multiple regression analysis was performed.

Table 7: Regression Output For Different Labour Saving and Production Enhancement Technologies On Cotton Output

Model	Unstandardized Coefficients	Standardized Coefficients		t	Sig.
	B	Std. Error	Beta		
(Constant)	6.900	.659		10.479	.000
Cotton production under tractors	.005	.000	-.073	-1.391	.165
Cotton production under animal draft power	5.027	.031	.130	2.252	.001
Cotton production under fertilizer application	9.156	.783	.412	3.223	.000
Cotton production under pesticides	4.003	.001	.137	2.605	.010
Cotton production under herbicide use	.000	.001	.036	.689	.491
a. Dependent Variable: Cotton production					

According to the findings in table 9 above, five labour saving and production enhancement technologies were set as predictors of cotton output but only three were significant including; animal draft power, fertilizer application and application of pesticides.

Use animal draft power was a significant predictor of cotton output at 5% level of significance. The Coefficient (β = 5.027 at p= .001) was an indication that a unit increment in animal draft power used in cotton systems, increases output by 5 kilograms.

Similarly, fertilizer application was also a significant predictor of cotton output at 5% level of significance. The Coefficient (β = 9.156 at p= .000) indicated that a unit increase in fertilizer applied on cotton farm, increased output by 9 kilograms.

Application of pesticides had a significant effect on cotton output at 5% level of significance. The Coefficient (β = 4.003 at p= .0i0) indicated that a unit increase in the use of pesticides, affected cotton output by 4 kilograms.

Table 8: Areas of research that could enhance cotton productivity and lessen drudgery

Classification	Frequency	Percent
Auto-guided agricultural systems	64	17.0
Automatic motorized sprayers	69	18.4
Small-scale irrigation systems	91	24.2
Pest resistant cotton varieties	76	20.2
Uniformly maturing cotton varieties	76	20.2
Total	376	100.0

The recommended areas of research that could enhance cotton productivity and lessen drudgery were presented in table 8 above. 24.2% of the farmers suggested use of small scale irrigation systems, 20.2% pest/disease resistant cotton varieties, 20.2% uniformly maturing cotton varieties, 18.4% r automatic motorized sprayers and 17.0 auto-guided agricultural systems.

Table 10: Variable estimates for challenges associated with labor saving and productivity enhancement technologies

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1a	Age of the household head	-.145	.262	.305	1	.581	.865
	Economic status	.895	.266	11.316	1	.001	2.446
	Level of education	.327	.256	1.638	1	.201	1.387
	Land tenure system	.550	.275	4.017	1	.045	1.734
	Lack of credit to services	-.882	.248	9.536	1	.004	2.834
	Access to extension services	-.414	.258	2.578	1	.108	.661
	High costs of purchase and operations	.708	.256	1.178	1	.003	1.114
	Low levels of skills	.028	.261	.012	1	.914	1.029
	Constant	-1.696	.523	10.533	1	.001	.183

The logistic regression output for challenges associated with labor saving and productivity enhancement technologies were presented in table 9 above. Adjusted odd ratios were calculated and used in the interpretation of significant challenges at 95% confidence interval and 5% level of significance. Eight (8) challenges were hypothesized and only four (4) remained significant including; economic status [AOR = 2.446, p=0.001], land tenure system [AOR = 1.734, p=0.045], lack of credit to services [AOR = 2.834, p=0.004], and High costs of purchase and operations [AOR = 1.114, p=0.003].

Discussion

The study addressed different labour saving technologies used by cotton producers in Omiya Anyima Sub County. The most commonly technology was draft animal power. This type of labour is provided by locally domesticated animals like oxen and donkeys. This type of labour is widely used across the sub-county and it dates back from the 60's. Its dominance reflects on its economic viability in terms of costs and being accessible to farmers. Draft animal power is used in opening land for crop planting. This study finding is in line with Elepu & Ekere, (2010) who argued that domestic animals have been widely employed by people to simplify the execution of domestic and field chores since time immemorial [16]. Many communities around the globe remain dependent on animal power for crops cultivation, rural transport etc. Domestic work animals exist in all regions of the world. Animals assist in eliminating poverty, reducing drudgery and creation of wealth. Animal traction is particularly important for food security in smallholder farming systems. Animals assist directly with crop production (ploughing, planting, and weeding).

Respondents reported tractors as another form of labour used in cotton production systems. Although the number of tractors in the area are limited, a few that exit are owned by organizations and government. Farmers access these tractors through hire services. Tractors help in activities like clearing land, planting, harvesting and transportation. This study finding is in line with Alvarez-Cuadrado et al., who argued that tractors provide affordable tractor hiring services to smallholder farmers in Uganda [17]. These farmers previously relied on manual labor and ox-ploughs. Affordable mechanization helps them increase productivity and therefore increase their income. Advantages of tractor hire services; Eliminates risks of owning a tractor, it is cheaper, No maintenance costs are incurred, one can hire several tractors depending on amount of work, Enables farmers who cannot afford a tractor to acquire the service.

Herbicide use was identified as part of the production enhancement technologies being used in cotton production in Anyima Sub County. In cotton systems, weeds cause several direct and/or indirect negative impacts, such as (a) reducing the quality of fiber, (b) reducing crop yield, (c) increasing production costs, (d) reducing irrigation efficiency, and (e) serving as hosts and habitats for insect pests, disease-causing pathogens, nematodes, and rodents. Weeds can directly hinder cotton growth by competing for available resources and, in some cases, by releasing allelopathic, or growth-suppressing, chemicals. However, the degree of damage from weed competition is related to the weed species composition (type of weeds), weed densities, and the duration of weed-cotton competition as related to the lifecycle of the cotton plants. Specific herbicides have been applied by farmers in the control of weeds hence boosting production. This study finding is in line with Prathyusha, who argued that weed control in cotton has relied mostly on herbicides, consisting of various functional groups (active ingredients) that are capable of impeding the growth and development of weeds [5]. A list of currently registered herbicides for cotton in New Mexico and some information regarding their usage. Successful chemical weed control requires the uniform application of the correct quantity of herbicide(s) over the target area. This makes the application of herbicides a precision operation, and accurate calibrations of sprayers are therefore very important since rates that are too high may injure the crop and rates that are too low may not provide weed control.

Fertilizers application was reported as part of the production enhancement technologies used in cotton production in Anyima Sub County. The commonly used fertilizers are inorganic like NPK which are access through local dealers. NPK is applied to Increase plant height, root development, water use efficiency, the energy balance and weight, oil and protein contents, boll-bearing capacity and seed weight, and highest efficiency.

Despite being expensive in terms of purchase costs, farmers prefer inorganic fertilizers because of their accessibility compared to organic fertilizer. This study finding concurs with Prathyusha, who revealed that basic fertilization is crucial to crop yields, as it secures the necessary quantities of Nitrogen (N), Phosphorus (P) and Potassium (K) for early plant growth [5]. He further argued that without basic fertilization, crops exhibit deficiencies and enter the reproductive stage without having achieved the necessary vegetative growth. This leads to a loss of produce which cannot be counterbalanced by later fertilization or other cultivation practices.

Respondents further reported pesticides as a productivity enhancement technology used in cotton production in Anyima Sub County. Pesticides are mainly used to control pest and diseases. Various kinds of pesticides have been used in cotton production to increase yield and farm income. This study finding concurs with Garratt et al., who argued that more chemical pesticides are used for cotton than for any other crop [18]. Cotton accounts for 16 percent of global insecticide releases. 60 percent of the world's cotton is used for clothing and another 35 percent for home furnishing. Aldicarp is a commonly used cotton pesticide. A single drop of aldicarp absorbed through the skin can kill an adult. Cotton pesticides so toxic that they were banned under the Soviet regime are still being used in Uzbekistan. Uzbekistan is the world's second largest cotton exporter.

There was an observed production between adopters and non-adopters of labour saving and productivity enhancement technologies. Users of technologies attained an addition of 519.8 kilograms per acre in a season compared to non-adopters and the difference was significant at ($p=0.000$). This study finding concurs with Garratt et al., who argued that labour saving and production enhancement technologies are the key to ensure high yield and profitability [18]. Cotton in Uganda has become highly input oriented following the widespread cultivation across the country. As a result, cotton farming has become less profitable but labour demanding. Thus, it is has become more imperative to produce more cotton on a given piece of land within minimum costs of labour and technology. Labour saving and production enhancement technologies are a solution to this problem given that they are not only profitable but also environmentally safe.

The key areas of research that could enhance cotton productivity and lessen drudgery and excessive labour use included; introduction of automated irrigation systems. Given that increase in water scarcity has led to improvements in irrigation technology over time. Research and development on innovative irrigation systems is paramount in meeting future agricultural water needs. This study finding is in support with Smith, who stated that an increase in water scarcity has led to improvements in irrigation technology over time [19]. Traditional (gravitational) irrigation technologies have low water-use efficiencies (percentage of applied water actually utilized by crops), especially on lands with low water-holding capacity (sandy soil). Technologies like drip irrigation and sprinkler systems require extra investment but increase water-use efficiency by improving water holding capacity of the soil and the timing of irrigation.

Respondents also recommended research on auto-guided agricultural systems. These systems are automated vehicle navigation systems that can be classified according to the level of human involvement and include operator-assisted steering systems, automatic steering systems, and complete autonomous steering systems. Use and application of such auto-systems would boost agricultural productivity especially in rural areas where labour is increasingly becoming scare due increasing rural-urban migration. This study finding relates with findings by Esau et al., who opined that automated vehicle navigation systems are classified according to the level of human involvement and include operator-assisted steering systems, automatic steering systems, and complete autonomous steering systems [20]. He further argued that the development of the global positioning system (GPS) in the late 1980s revolutionized this field and promoted the widespread adoption of automatic guided vehicles.

Respondents recommended research on automatic motorized sprayers. Automated motorized sprayers could enhance cotton productivity and lessen drudgery in rural settings where hand sprayers are used on the large. Unlike automatic motorized sprayers, hand sprayers are laborious in terms currying and sprayer. Therefore introducing motorized sprayers would help farmers cut on labour input and time. This study finding concurs with Läderach et al., who argued that automated chemical sprayers are important for several reasons, such as reducing humans' exposure to chemicals [21]. Moreover, applying the precise amount of chemicals can protect the crop, as over-application could damage the environment, pollinators, and the plant itself, as well as increase the plant's resistance to the chemical. They also have the potential to reduce labor costs. One way to determine the precise rate of application for automated sprayers is to use aerial spectral imaging converted into geographic information system (GIS) coordinates obtained by a receiver in a tractor, which is used with computer-controlled nozzles.

The study came out with various challenges associated with labor saving and productivity enhancement technologies in cotton production in Omiya Anyima Sub County. Economic status was reported as a significant challenge associated with labor saving and productivity enhancement technologies in cotton production systems. Households with a limited financial resources to invest had less chances of using technologies and vice varsa. This is because use and application of the technologies require investment in terms of procurement and hire services. This study finding concurs with Mugagga & Buyinza, who argued that low-wealth farmers are often reluctant to adopt technologies because they need stable income especially when the returns to adopt are unclear or will only bear fruits in the future [10].

Land tenure system in the area was a significant challenge to the use labor saving and productivity enhancement technologies in cotton production at 5% level of significance. Land tenure security influences farmers' decision to adopt agricultural technology by influencing the length of farmers' planning horizon and sense of responsibility. Farmers affected by land tenure issues were 1.7 times less likely to use the technologies and vice vasa. This study finding agrees with Mugagga & Buyinza, who stated that farmers not interested to invest in agricultural technology when

the land tenure is too insecure. For example, a study made in different parts of Uganda attributed the low level of success of natural resource conservation to insecure land tenure [10].

Lack of credit access was significant challenge associated with use labor saving and productivity enhancement technologies in cotton production at 5% level of significance. It was observed that farmers who did not have access to credit services were 2.8 times less likely to use technologies and vice vasa. Given the nature of the agriculture sector in the area, many financial institutions do not normally give out loans to farmers in fear of the risks associated. A few that are willing to give loans to farmers have complicated loan terms of which most farmers may not satisfy like security, payback period etc. This lack of credit therefore limits farmer's capacity to invest in production technology. This study finding agrees with Mugagga & Buyinza, who argued that while adding value, chances are high that you will pay cash for the raw material and offer credit to the retail. This approach places a big load on the business' cash flow [10]. Borrowing money is one of the most expensive ventures in Uganda with interest rates hardly going below 25% per annum while informal money lenders charge exorbitant rates of not less than 10% per month.

Other challenges could be: the need to ensure adequate labour during harvesting and sorting, factors associated with soil chemical accumulation due to herbicides. You may want to say something about them.

Conclusions

The study concluded; that there are different labour saving and productivity enhancement technologies such as: draft animal power, tractors, hand sprayers, herbicide use, fertilizers application and pesticides. There was an average production difference of 519.8 kilograms per acre a season between adopters and non-adopters of labour saving and productivity enhancement technologies. The key areas of research that would enhance cotton productivity and lessen drudgery include; automated irrigation systems, automated weed control systems, auto-guided agricultural systems and robotic planters. Use of labour saving and productivity enhancement technologies is associated with challenges like economic status, land tenure system, lack of credit to services, and high costs of procurement and operations. Providing more education and awareness, establishment of off income activities and credit extension are some of the immediate solutions to the challenges faced by users of the technologies.

Recommendations

There is need for more education for farmers on the technologies. Educating farmers would help them acquire a specific level of knowledge needed to use specific agricultural technologies.
Land tenure policies need revisited to allow farmers have access to bigger land to apply the technologies. This is because land tenure systems was highlighted among the challenges associated with use of labour saving and productivity enhancement technologies in the area.

Farmers must be encouraged to form groups, associations and cooperatives. Groups and cooperatives formation would ease farmer's access to technologies and credit services.

There is need to support farmers through credit services. Credit extension can be achieved through establishing village banks, and initiating loan schemes for farmer's loans at low interest rate.

More capacity building and external support is needed. This can be achieved through agricultural extension and collaborations.

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