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ECONOMIC IMPLICATION OF CROP LOSS DUE TO LOW TOPPING AMONG TOBACCO FARMERS IN TANZANIA

Muhidini Salehe Zungo¹ and Maliwaza Mbwana²

¹University of Dar es Salaam, College of Agricultural sciences and food technology, Department of Agricultural Economics and business, P.O. Box 35134, Mobile phone: +255687149512,
E-mail: dinizungo@yahoo.com or Zungo.muhiadini@udsm.ac.tz

²University of Dar es Salaam, College of Agricultural sciences and food technology, Department of Agricultural Economics and business, P.O. Box 35134, Mobile phone: +255713747425,
E-mail: mbwana.maliwaza@udsm.ac.tz or maliwaza@ymail.com

ABSTRACT

This study addresses the problem of low topping practice (LTP) among tobacco farmers in selected tobacco growing areas in Tanzania. It explores economic implications of LTP through investigating whether the observed median topping height in sampled farms is statistically different from the recommended topping height of 16, 18 and 20. The paper estimates the practical significance of the observed difference in terms of unrealised volume of tobacco/Ha by farmers, unrealised ISC/Ha and unrealised district cess/Ha to the government. It used secondary data on crop survey for 2017/2018, 2018/2019 and 2019/2020 seasons sourced from TTB while data on topping height were sourced from TLTC and AOTTL. A “one sample sign test” (OSST) was used instead of “one sample t-test” to compare the observed median topping height and the recommended topping height because the latter cannot be used to analyse count data i.e., topping height due to violation of normality assumption. The findings suggest that the observed median topping height of 14.9≈15 is statistically different from the recommended topping heights with p-values of 0.000. The implication is that a substantial volume of tobacco is not realised due to LTP which affects adversely the income of the farmers, financial stability of primary societies and revenue that could be collected as district cess by the government. Thus, government investments in terms of employing more crop development officers for TTB and institutions like TORITA is in dire need in order to increase the capacity of these institutions in conducting researches, trainings and close supervision of good agricultural practices among farmers. It should also ensure on time procurement and logistics for fertilizer importation in order to ensure on time distribution of fertilizers to the farmers.

Key words: Crop loss, Topping height, Low topping, Tobacco, Tanzania

1.0. BACKGROUND INFORMATION

Tobacco is one of the major cash crops in Tanzania which contributed 288 million US\$ in export revenue in 2015 (BOT, 2018). It contributes about 36% of the country's foreign currency earnings and is the main source of income for over 100,000 farmers (Tuinstra, 2015; Mayuya, 2013). Moreover, the revised tobacco export in 2016 was amounted to US \$ 312.7 million and became the first traditional crop in terms of export value (BOT, 2018). In Tanzania, Tobacco is grown in Tabora, Shinyanga, Singida, Katavi, Mbeya, Iringa and Kigoma administrative regions (Ntibiyoboka, 2013).



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In the tobacco sub-sector, the responsibility of providing training on good agricultural practices (GAP) to the farmers is a shared function among tobacco stakeholders such as Tanzania Tobacco Board (TTB), Tobacco Research Institute of Tanzania (TORITA) and tobacco buyers. Specifically, tobacco buyers are highly responsible to provide day to day training on crop production, sustainability and agricultural labour practices (ALP) to the farmers for each contracted agricultural marketing cooperative societies (AMCOSs) in order to ensure supply of high-quality tobacco and adherence to sustainable tobacco production (STP) (STP Agronomy guide 1.2, 2017). Tanzania Tobacco Board (TTB) has legal mandate to oversee other stakeholders' actions within tobacco sub-sector in ensuring that all farmers in contracted primary societies adhere to GAP (Tanzania Tobacco Industry Act number 24, 2001). In Tanzania, two main types of tobacco are grown namely Flue-cured Virginia (FCV) and dark fire cured (DFC) differentiated based on how each is cured. FCV is the one which is highly cultivated compared to DFC. For the case of FCV, the varieties mostly grown in Tanzania are K326, RG17 and LFT10 whereby K326 is a dominant one (Tanzania tobacco board, n.d.).

According to International Monetary Fund (2015), Sub-Saharan Africa (SSA) remains highly dependent on agriculture in terms of its share of total GDP and employment. However, crop losses in agricultural production due to various sources affect agricultural production adversely which leads to low productivity. For instance, World bank (2011) argues that 10 - 20 percent of the total grain produced in SSA encounters post-harvest physical loss. For the case of tobacco production, low topping could mainly be one of the poor on-farm practices which affect yield for the farmers. It is clear that low topping leads to wastage of tobacco leaves (unrealized volume) which is not known. The important question in this course is "what are the possible economic implications of low topping practice among tobacco farmers? In this regard, it is likely that farmers and other key actors in tobacco sub-sector are losing significantly and economically impacted through this poor practice. Thus, it is not surprising that majority of the tobacco farmers have been earning little incomes from tobacco farming activities and or remaining poor in spite of the fact that tobacco is one of the high value crops grown in the country.

Based on the authors' experience in tobacco sub-sector, low topping despite being discouraged by training on GAP, yet is such a recurring practice among tobacco farmers and it might be a problem causing great unobserved loss (unrealised benefits) in terms of tobacco volume and investment made that subsequently affect farmers' and other stakeholders' incomes, including revenues to the government in the form of tax and district cess from tobacco sales. The tendency of small-scale farmers to do topping at a fewer number of leaves than the recommended number of leaves might have adverse economic implications to farmers, other parties and the sub-sector at large, hence need to be explored (The recommended topping height ranges between 18 – 20 leaves excluding the leaves came with the seedling from the seedbeds). For example, data sourced from TTB reports of 2017-2020 crop surveys, registered that the average number of leaves per plant in three consecutive cropping seasons is 14 leaves (The average number of leaves per plant i.e., topping height observed during crop survey exercise in 2017/2018, 2018/2019 and 2019/2020 is 13, 15 and 14 respectively). Moreover, a study by Ntibiyoboka (2014) shows that most of the tobacco farmers in Tanzania do topping at 14 to 16 leaves against the recommended topping height that is ranges between 18 to 20 leaves.



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According to TTB (2017) tobacco is mainly produced by small scale farmers (Most of the small-scale farmers cultivate on plots of 1.5 Hectares) under contract farming. Usually, tobacco buying companies enter into contract with individual primary societies (PSs) to buy a certain volume of tobacco with a maximum of 10% excess of the agreed volume. Over the past ten years, tobacco production in Tanzania increased from 26,000 tons in 2000 to over 120,000 tons in 2012 (FOASTAT, 2017). Unfortunately, in recent years data show that tobacco production has been declining due to various factors including poor practices by farmers.

The production trend of tobacco for 2013/2014 to 2017/2018 cropping seasons as per data sourced from TTB indicated that the production is declining. Data indicate that in 2013/2014 the production was 109,986,320.0 kilogrammes (kgs), in 2014/2015 production was 88,275,643.0 kgs, 2015/2016 it was 60,934,607.0kgs, 2016/2017 was 85,860,663.71kgs of the produced tobacco while in the year 2017/2018 the production was 50,522,107 this is fluctuating production trend but indicating the decline in production. The trend generally indicated to be declining in the production of tobacco in Tanzania as compared to the previous years. This might be a result of various reasons such as competition that the Tanzanian tobacco faces in the world market that might be resulted from quality and compliances issues.

According to Yazdani (2013), poor farming practices cause inefficiency in terms of low productivity that might be due to crop losses attributed by poor practices. This justifies that poor farming practices are linked to technical inefficiency in agricultural production. For example, Kidane *et al.* (2015) argue that small scale farmers in Tabora region are inefficient (efficiency less than 100%) in producing tobacco with an efficiency of 73.89%. Therefore, crop losses resulting from low topping practice might be contributing to this inefficiency among small scale tobacco farmers in Tabora.

It is known that low topping decreases tobacco yields (Yazdani, 2013). Therefore, if topping decreases yield, hence, it decreases the income of the tobacco farmers and revenue for the government through collection of tax and district cess. Therefore, an empirical analysis of the possible economic implications of the low topping practice among farmers in tobacco sub-sector is in dire need. The current study is an attempt to fill this knowledge gap while expecting that the findings of this paper will inform key stakeholders on the extent of the problem and its economic implications. Furthermore, the study will offer possible solutions as the way forward to farmers and other parties while suggesting areas for further researches towards competitiveness of tobacco sub-sector.

2.0 METHODOLOGY

This study used secondary data on topping height for various plots obtained from Tanzania Leaf Tobacco Company Limited (TLTC) and Alliance One Tobacco Tanzania Limited (AOTT). The two companies were selected because they have great share of the market, wide geographical area of operations and number of farmers comparing to the rest of the companies. The data provided were collected by the FTs of the respective companies in their daily field visit programs. Moreover, data on crop survey aspect were collected from the Tanzania Tobacco Board (TTB) in Tabora office (headquarters). On the other hand, the data on crop survey aspect were collected in order to supplement the findings from the plots' information data i.e., topping height.



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The sample size decision for this study was guided by the sample size calculation facility by Raosoft Inc. which is a company which produces software programs for information gathering and analysis. It has an online/web-based sample size calculator which calculates sample size for a study based on the confidence level, population size, level of margin of error acceptable and the response distribution which is kept constant at 50%. According to Raosoft sample calculation, the minimum required sample size (n) for the present study is 379 plots which is about 1.5% of the total population size (N) which is 25,138 plots. Thus, any sample greater or equal to 379 is acceptable.

Sampling procedures for the study involved two stages. In the first stage data cleaning was conducted especially in removing outliers from the dataset by developing boxplots using the aid of the Statistical Package for Social Science (SPSS) version 16.0 software. After data cleaning, a sample frame of 25,138 plots owned by 17,676 farmers was obtained. In the second stage, random numbers for each plot were developed aided by the use of Excel software. Thereafter, tobacco plots were sorted in ascending order and then a sample size of 22,000 plots owned by 15,975 farmers were randomly selected to make a sample for this study.

This study used “one sample sign test” (OSST) to determine the statistical significance of the existing difference between the recommended topping heights (18 – 20 leaves) where the Tanzania Tobacco board recommend the topping height should be ranging between 16 – 18 leaves. However, it is allowed to top and remain with 20 leaves depending on the health of the tobacco plant, and the actual (observed value) by the farmers. The OSST was preferred to “one sample t-test since the latter cannot be used to analyse non-normally distributed variable such as topping height which obviously does not adhere to normality assumption as a target variable. Specifically, the OSST was used to compare the observed median topping height of the sample with the known values of the recommended topping height i.e., 16, 18 and 20. This study was guided by two hypotheses:

H_0 : The median topping height is equal to the recommended topping height.

H_{01} : $M_o = 16$

H_{02} : $M_o = 18$

H_{03} : $M_o = 20$

Where:

M_o represents observed median topping height.

H_1 : The median topping height is not equal to the standard/recommended topping height.

3.0 FINDINGS AND DISCUSSION

3.1 Summary of the plots data used

This part provides a summary and discussion on distribution of plots subjected in this study according to the tobacco buying company (Table 1). Specifically, the distribution shows the number of plots included in the sample according to the company which is buying that tobacco. Moreover, there is a distribution of plots included in the analysis based on the area where they are located (Table 2). On the other hand, Table 3 shows the distribution of tobacco plots based on the frequency for each observed topping height i.e., number of leaves. Last but not the least, table 4 below depicts two measures of central tendency namely mean and median.



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Table 1 suggest that TLTC had high number of farmers comparing to AOTT since the number of plots used in this analysis is linked to the number of farmers. Unfortunately, TLTC closed its operation in Tanzania due to various factors relating to tobacco business in Tanzania. Therefore, with the summary in Table 1, it is obvious that a significant number of the farmers were affected with the closure of operations by TLTC since more than 70% of the plots included in the analysis came from farmers who were growing tobacco for TLTC.

Table 1: Distribution of tobacco plots by tobacco buying company

Company	Frequency	Percent (%)	Cumulative percent (%)
AOTT	6,523	29.6	29.6
TLTC	15,477	70.4	100.0
TOTAL	22,000	100.0	

Table 2 suggests that more than 50% of the plots included in the analysis are located in Tabora and Urambo tobacco regions. This indicates to what extent tobacco sub-sector is very crucial for the livelihood of the farmers in these two tobacco regions. Thus, policy makers should take into consideration this finding and do the needful in terms of improving tobacco sub-sector in general and in Urambo and Tabora tobacco in particular in order to improve the livelihood of farmers.

Table 2: Distribution of tobacco plots by location/area

Location	Frequency	Percent (%)	Cumulative Percent (%)
Chunya	3007	13.7	13.7
Geita	106	0.5	14.2
Kahama	3272	14.9	29.0
Kigoma	1357	6.2	35.2
Shinyanga	1881	8.6	43.7
Tabora	8343	37.9	81.7
Urambo	4034	18.3	100.0
Total	22000	100.0	

Specifically, table 3 indicates that about 58.1% of the plots were topped below the minimum recommended topping height of 16 leaves. Moreover, it can be observed that about 90.5% of the plots were topped at less than 18 leaves (Table 3). Basically, it is clear that timing of fertilization, drought, farmers' awareness of the correct topping height are the key issues affecting topping height. Thus, key stakeholders within tobacco sub-sector should make efforts to ensure on time procurement and distribution of fertilizer to the farmers, more emphasis on training regarding correct topping height and commercialization of tobacco farming especially through shifting to irrigation farming rather than relying on rainfall.



Table 3: Distribution of tobacco plots by observed topping height

Topping height (number of tobacco leaves)	Frequency	Percentage (%)	Cumulative Percentage (%)
11	387	1.8	1.8
12	1999	9.1	10.8
13	1585	7.2	18.0
14	6162	28.0	46.1
15	2642	12.0	58.1
16	5926	26.9	85.0
17	1199	5.4	90.5
18	2008	9.1	99.6
19	92	0.4	100.0
Total	22000	100.0	

Table 4 shows that the observed median and mean topping height are 14.9≈15 and 15 respectively. Intuitively, the observed median topping height is below all three recommended topping height of 16, 18 and 20. Topping height of 20 is included in the analysis because it is acceptable depending on the vigour of the tobacco plant.

Table 4: The median and mean of topping height for the given data

S/N	Recommended topping height by TTB (Number of leaves)	Observed average topping height (Number of leaves)	Observed median topping height (Number of leaves)	Variance (Recommended – Median) (Number of leaves)
1	16	14.9≈15	15	1
2	18	14.9≈15	15	3
3	20	14.9≈15	15	5

3.2 Results of the one sample sign test (OSST).

As described above, the OSST was used instead of one sample “t” test due to statistical limitation of the counting variable used which is a non-normally distributed variable. The results from the OSST show that the difference between the observed median topping height and the recommended topping height (number of leaves) of 16, 18 and 20 leaves is statistically significant. The findings in Table 5 justify statistically that the observed median topping height is different from the recommended topping heights with the p-value 0.000 in all three cases (when recommended topping height is 16, 18 and 20). This has implication in the tobacco productivity, income earned by the farmers and their primary societies in tobacco farming and the revenue received by the government in the form of tax and district cess. In fact, this finding is in line with the information presented by Ntibiyoboka (2014) and TTB reports on crop survey for 2017, 2018 and 2020 which showed that topping height by farmers are 14 to 16, and 14 respectively.

Table 5: Hypothesis testing and decision based on Z-statistic and corresponding p-values

Hypothesis	Observed median topping height	Recommended topping height scenarios	Z statistic (P-value)	Decision
H ₀₁ : 15 = 16	15	16	-74.734 (0.000)	Reject null hypothesis
H ₀₂ : 15 = 18	15	18	-140.085 (0.000)	Reject null hypothesis
H ₀₃ : 15 = 20	15	20	-148.317 (0.000)	Reject null hypothesis



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3.3 The practical significance of the findings

Based on the results of the OSST, the practical significance was assessed by deriving the economic implications (Economic implications in terms of the monetary value of the unrealised tobacco volume, district cess paid to the government and primary society levy (into store cost) paid to the primary societies) of the difference between observed median topping height and recommended (standard) topping height. Therefore, this section derives the economic implications of the low topping practice through the following procedures:

- i. Calculating the number of lost (unrealized) tobacco leaves per plant.
- ii. Calculating the number of lost (unrealized) tobacco leaves per acre and hectare (Ha) as well.
- iii. Estimating and expressing the loss (unrealized) tobacco sales in monetary value by taking into consideration the average price per Kg of tobacco based on recent trends of the national average price after tobacco markets.
- iv. The estimation of primary society levy (into store cost - ISC) paid to the primary societies.
- v. On average each primary society is supposed to receive about US \$ 0.0613 per Kilogram of tobacco it sold to the respective tobacco buying company. However, this value is subjected to changes each season whenever deemed necessary based on the agreed value at TTC.
- vi. The estimation of unrealised district cess (The value/Kg to be paid as a levy to the primary societies is established each season by the Tanzania Tobacco Council) which is paid to the government by tobacco buying companies. The government is supposed to receive three (3%) of the total tobacco sales from each tobacco buyer as a district cess.

Table 6: Unrealised tobacco leaves per Ha due to low topping practice

Recommended number of plants per Acre by TTB	Number of lost (unrealised) tobacco leaves per Plant	Number of tobacco leaves lost (unrealised) per Acre	Number of leaves lost (unrealised) per Hectare
6300	1	6,300	15,567
6555	3	19,665	48,593
6555	5	32,775	80,988

Table 7: Tobacco loss (unrealised) volume (Kg/Ha) due to low topping

Loss (unrealised) tobacco leaves/Ha	Average weight of the top leaves (leaf) (Minimum: Gram)	Average weight of the top leaves (leaf) (Maximum: Gram)	Total tobacco loss in Kg per Hectare (Minimum)	Tobacco loss in Kg per Hectare (Maximum)
15567	7	9	108.97	140.11
48593	7	9	340.15	437.34
80988	7	9	566.92	728.90

The findings in Table 6 and table 7 present the extrapolation of low topping practice in terms of unrealised tobacco leaves and unrealised tobacco volume per hectare. Specifically, table 7 indicates that the loss (unrealised tobacco volume) in terms of Kilogram lies between 108.97Kg/Ha to 728.9Kg/Ha. Moreover, in monetary terms, these losses imply that on average an average farmer is losing TZS



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343,255.50/Ha to TZS 2,296,035/Ha (The exchange rate assumed is 2,250TZS/USD while national average price/Kg of tobacco used in calculation is 1.4USD/Kg) as a result of low topping practice. Nonetheless, the actual economic implication in terms of cost is practically greater than this when taking into consideration the opportunity cost of resources such as man hours used to raise the said unrealised tobacco.

The government gets revenue from tobacco sub-sector through collection of taxes and cesses on tobacco profits and sales respectively which are paid by tobacco buying companies. The most direct collection is a district cess of 3% of the total tobacco sales for each tobacco buyer. Essentially, every tobacco buyer is supposed to pay 3% of the total value of the tobacco bought from primary societies as a district cess. Thus, from the findings of the present study, establish that the government fails to realise or is losing an average of TZS 10,297.67/Ha to TZS 68,881.05/Ha which is the 3% of the value of the lost (unrealised) tobacco. The figures of unrealised district cess per hectare appear small but once taken for the total planted hectares in a specific cropping season, it is practically significant. Table 8 and table 9 show an estimation of the potential unrealised district cess by the government due to the unrealised tobacco volume in three consecutive seasons namely 2017/2018, 2018/2019 and 2019/2020. The exchange rate used for each cropping season is an average exchange rate in a month close to the end of tobacco markets of the respective cropping season i.e., average exchange rate in July, by BOT.

Table 8: Estimation of the value of unrealized tobacco volume in 2017/2018, 2018/2019 and 2019/2020 cropping seasons (Minimum estimation)

Cropping year	Planted Hectares	Loss volume per Ha (Kg): Minimum	National average price (USD)	Monetary value of the lost weight (Minimum: USD)	Average exchange rate close to the end of tobacco markets	Monetary value of the lost weight (Minimum: TZS)
2019/2020	39862	108.97	1.475	6,407,049.16	2,297.84	14,722,361,019.67
2018/2019	44654	108.97	1.53	7,444,897.96	2,289.14	17,042,422,653.24
2017/2018	44516.6	108.97	1.475	7,155,186.51	2,271.33	16,251,789,049.91

Table 9: Estimation of the value of unrealized tobacco volume in 2017/2018, 2018/2019 and 2019/2020 cropping seasons (Maximum estimation)

Cropping year	Planted Hectares	Loss volume per Ha (Kg): Minimum	National average price (USD)	Monetary value of the unrealised weight (Maximum: USD)	Average exchange rate close to the end of tobacco markets	Monetary value of the unrealised weight (Maximum: TZS)
2019/2020	39,862.00	728.9	1.475	42,856,732.41	2,297.84	98,477,828,276.04
2018/2019	44,654.00	728.9	1.53	49,798,899.92	2,289.14	113,996,713,516.97
2017/2018	44,516.60	728.9	1.475	47,861,020.87	2,271.33	108,708,167,738.61

Table 10: Minimum and maximum value of unrealised primary society levy due to low topping

Description	Loss of tobacco (Kg)	Primary society levy per Kg (US\$)	Unrealised primary society levy/Hectare (US\$)	Unrealised primary society levy/Hectare (TZS)
Minimum	108.97	0.0613	6.68	15,030
Maximum	728.9	0.0613	44.68	100,530



Table 11: Unrealised primary society levy (ISC) due to loss of tobacco attributed by low topping practice

Cropping year	Planted Hectares	Unrealised primary society levy/Ha (US \$): Minimum	Unrealised primary society levy/Ha (US \$): Maximum	Average exchange rate close to the end of tobacco markets	Total unrealised primary society levy (TZS): Minimum	Total unrealised primary society levy (TZS): Maximum
2019/2020	39,862	6.68	44.68	2,298.45	599,125,860	4,093,617,965.05
2018/2019	44,654	6.68	44.68	2,288.58	671,149,620	4,489,066,620
2017/2018	44,516.6	6.68	44.68	2,289.36	669,084,498	4,475,253,798

Table 11 summarises the unrealised primary society levy. Technically the primary society levy is known as into store cost (ISC) which is paid to the primary societies (PSs) by the tobacco buying companies. This finding has implication on the financial stability of PSs because they do not realise a substantial amount of income which could be used to build the financial strength of the PSs and financing of PSs' operations. Thus, PSs' leadership should insist tirelessly to their farmers about adherence to GAP in general and avoiding low topping in particular.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Attempt is made to explore the economic implication of crop loss in tobacco farming resulting from low topping among tobacco farmers in various areas of Tanzania. The study is presenting an empirical investigation of whether the observed median topping height in various farms is statistically different from the recommended topping height. It is clear that more than 90.5% of the farms involved this study have a topping height of less than 18 leaves. This observation has a substantial economic implication in the form of unrealised tobacco volume by the farmer, unrealised ISC as a source of income to the PSs and revenue to the government in the form of tax and district cess. In addition, the financial stability of the primary societies is highly affected due to the unrealised tobacco volume because of its equivalent monetary value.

It is clear that topping depends on the vigour of the tobacco plant which is also determined by the proper timing of fertilization, adequate supply of water and clear understanding of the farmers regarding the correct topping height which is recommended. Thus, in order to ensure correct topping height by our farmers, transformation in tobacco farming must take place especially insisting irrigation in order to avoid relying on rainfall. On the other hand, the government should continue with the efforts directed towards ensuring on time procurement, logistics and distribution of fertilizer to the farmers in order to avoid stagnant crops. The government should also increase its investment in tobacco sub-sector especially in the area of employing more crop development officers for government institutions such as TTB and TORITA. This will increase the capacity and coverage of these institutions in conducting researches, trainings and supervision of GAP implementation.



4.2 Recommendation

4.2.1 Policy implications of the study

Many efforts have been made to increase tobacco farms' productivity in order to pull farmers out of poverty by key stakeholders in agriculture sector in Tanzania including reducing crop loss due to various sources such as poor farming practices and poor post-harvest handling. The study reveals that majority of farms have topping height of less than the recommended topping height. This has economic implication to the incomes and livelihoods of farmers themselves, financial stability of cooperatives (primary societies) and revenue to the government through district cess and tax on tobacco volume. Therefore, stakeholders in agriculture sector in general and tobacco sub-sector in particular should make efforts to make sure that farmers top their farms at the recommended topping height. Specifically, more investments to transform tobacco sub-sector are needed especially in the area of irrigation as a coping mechanism with drought which affect topping height. Moreover, TTB and other stakeholders within tobacco sub-sector should put much emphasis on good agricultural practices (GAP) in order to ensure sustainable tobacco production (STP). Specifically, the government should increase its investment in tobacco sub-sector especially in the area of employing more crop development officers for government institutions such as TTB and TORITA. This will increase the capacity and coverage of these institutions in conducting researches, trainings and effective supervision of GAP implementation.

The government should also set proper arrangements to ensure early procurement and logistics of fertilizer importation and its distribution to the primary societies in order to avoid late fertilization by farmers which affect vigour of the tobacco plant and eventually leads to low topping.

4.2.2 Area(s) for future research

The main limitation of the present paper is the fact that it does not identify key factors contributing to low topping practice among tobacco farmers. The study mainly recommends on further research which will focus on key determining factors contributing to the observed practice of low topping among tobacco farmers in Tanzania. The study on factors influencing low topping practice will provide answers to what issue(s) to be addressed in order to avoid low topping practice among tobacco farmers. Generally, the topping height might be influenced by farmers themselves based on local believes or lack of awareness on correct topping height, poor timing of fertilization (late fertilisation) which might be a result of farmers themselves or it might be due to delay in disbursement of fertilizers to the farmers through their cooperative societies, climatic condition such as drought or excess rainfall and other factors of the same nature. Future researches on this aspect are needed in order to explore the influence of each possible factor on the topping height.

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