

Effect of Training on Yield and Quality of Tobacco (*Nicotiana Tabaccum*): A Comparative Study of Trained and Untrained Farmers in Mazowe District, Zimbabwe

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Abstract

Smallholder commercial agriculture in developing countries is based on cash crops and in Zimbabwe flue-cured tobacco is progressively becoming an important cash crop among smallholder farmers. Therefore, the broad objective of this study was to assess the impact of trained and untrained smallholder farmers on yield and quality of flue-cured tobacco in Mazoe District of Zimbabwe. A total of 48 smallholder farmers were selected from a total population of 480 using purposive sampling, 24 untrained and 24 trained. These farmers were interviewed using structured questionnaires, group discussion and field observation for the 2010, 2011, 2012, 2013 and 2014 production season in Mazoe District of Zimbabwe. Data was analyzed using descriptive statistics. The results show that trained farmers obtained average yields of 1650 kg per hectare and untrained farmers obtained an average yield of 1075kg per hectare for the period 2010, 2011, 2012 and 2014. Yields obtained were below the maximum environmental yield potential of 5000 kg/ha. The research recommends that stakeholders in the tobacco industry should capacitate the training of farmers through extension or training institutions to improve training efficiency in tobacco production by smallholder farmers. Adoption of farm modern farm technology in tobacco production is necessary for the farmers to improve yield and quality of tobacco leaf which fetch better prices at auction floors.

Keywords: impact, training, tobacco, productivity

1.0 Introduction

Zimbabwe is the fourth's world largest producer of flue-cured tobacco (*Nicotiana tabacum*), after China, Brazil, and the United States of America (Svotwa *et al*, 2013). It is a high value cash crop and in Zimbabwe its production is increasingly becoming an important smallholder cash crop (Jerie and Ndabaningi, 2011; Masvongo *et al*, 2013). The tobacco industry is a key sector and has remained an integral part of the Zimbabwean economy contributing an estimated 6% of the Gross Domestic Product (Rukuni and Eicher, 1994). Smallholder tobacco farmers accounts for about 10% of Zimbabwe's tobacco growers (TIMB, 2013). It is two-tiered, comprising of green leaf production on one hand (primary industry) and cigarette manufacturing (secondary industry) on the other hand. In Zimbabwe, tobacco is therefore a major source of direct employment in the growing, marketing, processing, manufacturing and distribution (Keyser, 2002). The industry is a major contributor to the fiscus through exercise duty on cigarettes and other taxes on tobacco products (Keyser, 2002).

Flue cured tobacco used to be grown successfully on large white commercial farms in Zimbabwe. It has been a highly profitable and lucrative crop for commercial farmers in Zimbabwe (Rukuni, 2006;

Masvongo *et al*, 2013). However, after the land and agrarian reforms, most of Zimbabwe's tobacco production comes from smallholder farms averaging 6.4 ha (Masvongo *et al*, 2013).

Tobacco is a tropical plant that originated in the south and central parts of America (Akuhurst, 1981). It is cultivated in a wide range of climates and sensitive to low temperatures and frost. It and requires 90 to 120 frost-free days for proper development and temperatures that range between 19 °C to 29 °C for its development in the field (Comis, 1996). Tobacco requires well distributed rainfall throughout its growing season. In Zimbabwe it is grown on sandy soils on the high veld with an altitude of about 1450 m above sea level that receives between 750mm and 1000 mm of rainfall per annum (Nyamapfene, 1991). Coupled with good soils, average yields of up to 2052 kg per ha can be obtained by smallholder famers (Masvongo *et al*, 2013).

Tobacco crop is threatened by multiple factors such as climate change (Jerie and Ndabaningi, 2011) and untimely distributions of inputs often in short supply (Dekker and Kinsey, 2011). Tobacco production costs are expected to rise and profitability will decline when farmers switch over to coal or electricity for curing due to deforestation (Masvongo *et al*, 2013; Keyser, 2002). Training in tobacco production is one of the major challenges faced by among smallholder farmers from long way back in Zimbabwe. It was non existence as noted by (Kosmin, 1977) in his work that in 1906, van Gielgud, the Native Commissioner for the Shangwe people of Gokwe in the Midlands District, persuaded the British South Africa Company administration to take some farmers for training in curing methods, but this was rejected by the Department of Native Agriculture. Flue cured

tobacco is a high skill requiring crop therefore lack of the necessary production skills and attention to every detail are most probably one of the major causes of the yield gaps among smallholder farmers (Manyumwa *et al.*, 2013; Magadlela, 1997). Therefore training is necessary as evidenced by greater returns for trained tobacco farmers than untrained farmers though statistically insignificant (Mutandwa *et al.*, 2008; Masvongo *et al.*, 2013). Training is a learning process that involves the acquisition of knowledge, sharpening of skills, concepts, rules or changing of attitudes and behaviours to enhance the performance of work by an individual (Anthony, 1999; Singh, (2012; Ameerq and Hanif, 2013). In the context of this study, a trained farmer is one who has undergone formal training in tobacco production, through a tobacco training institute, agricultural college, agricultural extension services and non Governmental Organisation or tobacco contract growing companies (Mutandwa *et al.*, 2008). The same authors further described an un-trained farmer as one who has not undergone any form of training (formal or informal) in tobacco but grows the crop through experimentation or watching others. Tobacco production comprises some important training in seedling production, leaf harvesting, leaf conditioning, leaf grading and tobacco grouping for the market (NC Cooperate Extension, 2013; Reed *et al.*, 2012).

Tobacco training commences with seedling production techniques. Seedling production comprises of the conventional seedbed and float tray system. The conventional seed bed method has used methyl bromide for soil fumigation before seeding over the past decade. However use of this fumigant has been phased out in most countries including Zimbabwe because of its negative effects on the environment and in addition a global call to phase it out by 2015 has been given a priority (Karavina and Mandumbu, 2012). However, to mitigate the negative effects associated with methyl bromide as a soil fumigant; in Zimbabwe smallholder farmers to date were being encouraged to use cheap combustible materials such as cow dung and maize cobs to sterilize their paprika and tobacco seed beds (AGRITEX, 2000). This method may result in drastic reduction in soil micro-organisms activities in the seedbed but may result in rapid re-infestation of the sterilized soil by a contaminating inoculum that may have the potential to increase disease incidence, which could be even higher compared to non sterilized soil due to a “biological vacuum”(Baker, 1962). Float system (water based) is the alternative method being encouraged for seedling production and researches have proved the potential of this method in replacing the conventional seed bed method in Zimbabwe (Katsaruware and Justin Gwembire, 2014). As a result some smallholder tobacco growers in Zimbabwe have received training in the use of float tray system for tobacco seedling production which proved successful in countries such as the USA, Brazil and Malawi (Mazarura, 2004).

Tobacco harvesting is a labour intensive process and a tobacco leaf is ready to be harvested when it has reached its maximum size and weight, and when it has shown signs of chlorosis (nitrogen deficiency) or yellowing (Hawks, 1980). The same author described maturity index for tobacco leaf into three categories namely: immature (green), mature (yellow/green and over mature (yellow). The other method of determining time of tobacco leaf harvesting is the use of ethephon. Ethephon may be used by growers in flue-cured tobacco to enhance uniform yellowing and shorten the curing time (Steffens *et al.*, 1970).

Tobacco leaf conditioning is a process that involves addition of a small amount of water to the cured tobacco. Tobacco leaves should not be removed from the curing barn until all the stems and midribs of the leaves have dried to a firm condition (Seebold *et al.*, 2007). During the curing process the leaves become dry and as result most smallholder farmers use many ways of conditioning tobacco leaf including barn floor watering and drum steam methods. These processes allow the tobacco leaf to become more pliable for ease of handling and for market preparation (Musoni *et al.*, 2013; Seebold, *et al.*, 2007). However, barn water floor and drum steam methods are laborious and time consuming as they require drawing of water. However, the technology that was approved in Malawi that uses a micron ULVA + spinning disc player for conditioning tobacco took much less time compared to the use of green grass (Kaipa and Mvulaatera, 2010). Bailey (2006) also showed that tobacco conditioning should be used in moderation and overhead misting should be used with regard to improved leaf chemistry. In Zimbabwe most farmers use the steam method for conditioning tobacco leaf in barns (Musoni *et al.*, 2013; Masvongo *et al.*, 2013).

1.1 Tobacco grading

Tobacco grading is very complex especially when dealing with international buyers with very particular requirements. Good returns can be obtained if there is sound knowledge about buyer's requirements and where such knowledge is scarce, it creates economies of scale in management and production level (Fafchamps, 2004). Tobacco grading is therefore one of the most important stages in tobacco production for the market. It requires more skill as it involves placing individual leaves in grades based on leaf position on the plant, leaf colour, and defects such as water staining, mould and wetness. Furthermore, the building of skills and capacity amongst smallholder farmers has the potential to reduce the amount of time required to perform operations such as leaf grading. Graded tobacco is then pressed in bales for presentation to the sales floors (Aret, 2005, Aret 2012). However, Tobacco Commission Control (2006) noted that 69 percent of the bales were withdrawn for failure to meet reserve prices while 34 percent were rejected by buyers and poorly graded by farmers. Grading can be improved by use of various technologies and changes in operational efficiencies that result in positive effects on

savings (Baker and Ngwira, 2011). Therefore, the purpose of this study was to assess the impact of trained and untrained smallholder farmers on yield and quality of flue-cured tobacco in Mazowe District of Zimbabwe.

2.0 Materials and method

2.1 Study area

The study was conducted in Mazoe district, which lies in Mashonaland Central Province. Mazoe district is located in agro-ecological region IIa. Natural region IIa is an intensive farming region with a mean annual rainfall range of 750 to 1000 mm (Nyamapfeni, 1991). It has high humidity during summer, an average annual temperature of 24 C°. The study area comprises mainly of smallholder farmers who are into cash, food crop and semi-intensive livestock production systems.

2.2 Experimental procedure and design

Mazoe district was divided into eight strata comprising of tobacco growing wards. Purposive sampling was used to select 48 from 480 farmers provided by Agriculture and technical Department of Zimbabwe in the study area. A total of 6 farmers (3 trained and 3 un-trained) were purposely selected from each stratum to give an overall total of 48 respondents that were issued with structured questionnaires. A pilot survey was carried out by means of a pre-test on 10 farmers to test the appropriateness and relevance of the structured questionnaire.

2.3 Data collection methods

For the purpose of data triangulation focus group discussions, key informant interviews, and questionnaires were used.

3.0 Results and discussion

3.1 Seedling production

The results showed high use of conventional (soil based) method in tobacco seedling production by both trained 22(92%) and untrained 24(100%) smallholder farmers. A small percentage 2(8%) of trained farmers used float tray system (Table 1). This concurs with Agritex, (2000) to date which

encourages smallholder farmers to use these cheap combustible materials to sterilize tobacco seedbeds. Though this method is cheap it may result in drastic reduction of soil micro-organisms activities in the seedbed but later may cause a rapid re-infestation of the sterilized soil by a contaminating inoculum that may have the potential to increase disease incidence, which could be even higher compared to non sterilized soil due to a "biological vacuum" (Baker, 1962). High incident of pests such as nematodes which thrive well in soil under tobacco cropping systems may result in reduced quality and yield of tobacco leaf that fetches low prices at the market (Lownsbery and Peters, 1955; LaMondia, 1995; Crowder, 2000). Mathews and Wilshaw, (1992) further noted that that poor quality of tobacco leaf often fetches low prices or is rejected at the market.

A very small percentage 2(8%) of trained smallholder farmers used floating trays (water based) (Table 1). The low usage of float tray system by smallholder farmers concur with findings by Katsaruware and Gwembire (2014) who reported challenges that were faced by adoption of this method by smallholder farmers such as labour extensive and less cost effective as compared to conventional method in tobacco seedling production. In Addition, the floating tray system may not always be readily adopted by smallholder farmers because it conflicts with convectional seed bed practices which are inherent in farmers. Some of the problems arise from deep socio-cultural beliefs and downgrading of floating tray technology (Manyumwa et al, 2013). However, float trays have advantages of reduced labour, reduced effort that is required for pulling plants, reduced risk of plant failure, maintains yield, controls weeds, uniformity of seedlings, reduced the use of pesticides, saves land and reduced incidence of diseases (Katsaruware and Gwembire, 2014; Manyumwa et al, 2013). Good quality and yield in tobacco leaf obtained from using floating trays have a potential to fetch high prices at the auction floor (Koester, 2005; Vidal, 2005).

Both trained 0(0%) and untrained 0(0%) did not use soil fumigants such as methyl bromide (Table 1). This indicates awareness and compliance by smallholder farmers from using this chemical because of its negative impact on the environment and a proposed global ban to use it by 2015 (Karavina and Mandumbu, 2012; Sande et al, 2011). Also use of fumigants can be expensive and require specialised equipment both which is out of reach for the resource poor smallholder farmer (LaMondia, 2008). However, use of fumigants such as methyl bromide is effective in control of nematodes which has the potential to increase yield in tobacco production (Lownsbery and Peters, 1955; LaMondia, 1995; Crowder, 2000; Miller and Ahrens, 1969). Fortnum et al (2004) in his paper also acknowledged fumigation increased yields to 464 kg/ha over non-fumigated tobacco.

Table 1. Effect of training on tobacco seedling production

Seedling production method	Trained farmer	Untrained farmer
Conventional	22(92%)	24(100%)
Float trays system	2(8%)	0(0%)
Fumigation (methyl bromide)	0(0%)	0(0%)
Total	24(100%)	24(100%)

3.2 Tobacco harvesting

Smallholder farmers lacked appropriate technology to determine tobacco maturity index but relied on visual methods such as colour changes in tobacco leaves (Hawks, 1980 and Weybrew, 1984). The results showed that tobacco leaf harvesting among the smallholder farmers ranged between green/yellow and yellow/green colours (Table 2). 14(58%) of trained and half 13(54%) of untrained smallholder farmers harvested tobacco leaves at the desired tobacco leaf colour of green/yellow. This concurs with findings from Hawks, (1980) and Weybrew, (1984) who suggested that tobacco leaf harvesting commences when it has reached maximum size and weight and has shown signs of chlorosis. They went on further to say that harvesting tobacco leaves when over mature (yellow) or immature (green) result in massive yield and quality losses. The same authors suggested that harvesting should commence when tobacco leaves show green-yellow colour for increased yield and quality. It can be noticed from the results (Table 2) that harvesting of tobacco leaf when it is yellow/ green can result in over curing of the leaf in the barn. Visual method is not hundred percent effective because nitrogen deficiency (Sarmadnia and Koochaki, 1994; Sankar *et al.*, 2013) and diseases such as root knot nematode have the potential to cause tobacco leaves to turn green/yellow (Garner, 1949). To overcome this problem among smallholder farmers training should be enhanced in appropriate technologies such as use of ethephon, a ripening regulator for determining tobacco leaf harvesting (Steffens *et al.*, 1970; Watada, 1986; Abeles *et al.*, 1992).

Table 2: Effect of farmer training on leaf harvesting

Leaf Colour	Trained smallholder farmer	Untrained smallholder farmer
Green	0(0%)	0(0%)
Green/yellow	14(58%)	13(54%)
Yellow/green	10(42%)	11(46%)
Yellow	0(0%)	0(0%)
Total	24(100%)	24(100%)

3.3 Tobacco conditioning practices

Tobacco conditioning practices showed that 24(100 %) of the trained farmers and 24(100 %) of the untrained farmers used the traditional water flow system and drum steam methods (Table 2). The first method was carried out in the tobacco ban and the latter method was carried out on the grading shade to soften the leaf if it was suspected to be brittle. Steam conditioning of tobacco leaf involves the addition of a small amount of moisture back to the cured tobacco leaf which allows it to be more pliable and for ease of handling for market preparation (Musoni *et al.*, 2013). Massie and Smiley, (1974) in their findings agree that moisture conditions in barns determine the final quality of cured tobacco. Final quality of the tobacco determines the grade and price of tobacco leaf at the market (Kadzandira *et al.*, 2004; Vidal, 2005). Traditional and drum steam methods if not properly carried out can result in over or under watering of tobacco leaves. In most cases over watering takes place in the ban and at the grading shade resulting in tobacco leaves that fetch low prices or rejected at the market because they become less pliable for ease of handling and for market preparation (Musoni *et al.*, 2013; Seebold, *et al.*, 2007; Manickavasagan *et al.*, 2007).

However, the traditional water flow and drum steam methods are cheap and less laborious compared to the cylinder steam method.

Table 3. Effect of farmer training on tobacco leaf conditioning

Method used	Trained farmers	Untrained Farmers
Drum steam	24(100%)	24(100%)
Over head sprinkler	0(0%)	0(0%)
Total	24(100%)	24(100%)

3.4 Tobacco grading

The results revealed that 24(100%) of the trained farmers and 24(100%) of the untrained farmers graded their tobacco according to leaf size before sending to the market (Table 3). Both farmers are grading tobacco leaves because it has a bearing on prices of the tobacco leaf at the market. When the bales are ungraded the bargaining

power of the farmer is dwindled as there will be reduction in price with the best bale being sold at the price of lower quality bales adjacent to it (Fafchamps, 2004). Smallholder farmers' potential in flue-cured tobacco production can be enhanced through use of Tobacco Production handbooks (Aret, 2005, Aret, 2012). Sound knowledge about buyers' requirements can also contribute to positive results (Fafchamps, 2004, Baker and Ngwira, 2011).

Table 4. Effect of grading on Market

Grading	Trained smallholder farmer	Untrained smallholder farmer
A	0(0%)	0(0%)
B	8(33%)	3(13%)
C	16(67%)	21(87%)
Total	24(100%)	24(100%)

3.5 Tobacco yield trends

The results show that trained farmers obtained average yields of 1562.5 kg per hectare and in contrast untrained farmers obtained an average yield of 1037.5 kg per hectare for the period 2010, 2011, 2012, 2013 and 2014 (Figure 1). These yields are low among both trained and untrained farmers compared to findings by Masvongo *et al* (2013) who revealed that, smallholder tobacco production were achieving average yield of 2052 kg/ha. However, training had an impact on trained farmers who had higher mean yields than the untrained farmers for the four year period. Training has a huge impact on quality and yield of tobacco. Training farmers on tobacco production have a high potential of obtaining higher yields than untrained farmers (Mutandwa, 2008).

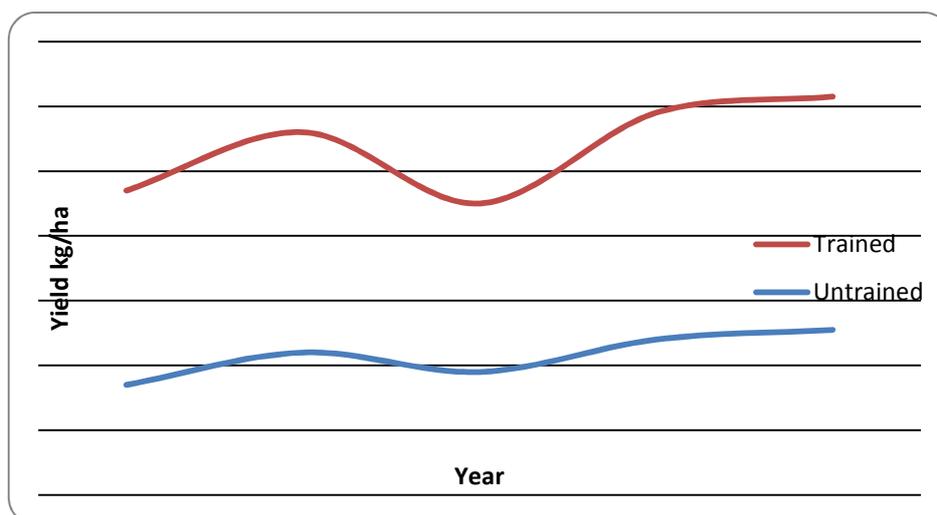


Figure 1. Tobacco yield trends between trained and untrained farmers for the 2010-2014 seasons

4.0 Conclusion

Floating tray system and its adoption in tobacco seedling production is insignificant among trained and untrained smallholder farmers. Majority of trained and untrained smallholder farmers used visual colour method of harvesting tobacco leaf resulting in massive yield and quality losses. Both trained and untrained farmers used the barn floor water and drum steam method for tobacco leaf conditioning resulting in huge yield and quality losses. Grading of tobacco leaf was done by farmers before delivering to the market but was affected by seedling production, conditioning and harvesting methods. Yields obtained by both farmers were far below 4000 kg/ha although trained farmers had higher yields than untrained because of better knowledge and skills in tobacco production.

5.0 Recommendations

Smallholder farmers should be trained and capacitated in all aspects of tobacco production by relevant authorities in the tobacco industry such as the Tobacco Research Board and Tobacco Industry Marketing Board (TIMB) of Zimbabwe. Other stakeholder in the tobacco industry should also be involved in training of farmers and these include Universities, the Government through the department of Agriculture and Extension Services and also government subsidies on training costs if farmers are to be trained by private organisations.

REFERENCES

- Abeles, F.B., Morgan, P.W., Saltveit, M.E., (1992). Ethylene in Plant Biology, Vol.15. 2nd ed. Academic Press, San Diego, California
- AGRITEX (2000). Paprika. Harare, Zimbabwe.
- Anthony, L. (1999). Gower Handbook of Training and Development. Gower Publishing Ltd.
- Ameeq, A. and Hanif, F. (2013). Impact of Training on Employee's Development and Performance in Hotel Industry of Lahore, Pakistan, *Journal of Business Studies Quarterly*, Vol. 4, (4).pp.68-82
- Akuhurst.B.C, (1981). Tobacco.Longman, London.
- Aret, (2005). Burley Tobacco Handbook. Aret, Lilongwe, Malawi. Aret, (2012). Flue Cured Tobacco Handbook. Aret, Lilongwe, Malawi.
- Bailey, A. (2006). Harvesting, Curing and Preparing Dark Fire-Cured Tobacco for Market. AGR-152. Coop. Ext. Serv., Coll. of Agric., Univ. of Ky., Lexington.
- Baker K.F. (1962): Principles of heat treatment of soil and planting material. *Journal of Australian Institute of Agricultural Science*, 28: 118–126.
- Baker, P.B, and Ngwira, R. (2011). Burley Productivity Options. Alliance One International, Lilongwe, Malawi.
- Crowder, B. (2000). Inheritance of resistance of the tobacco cyst nematode *Globodera tabacum solanaracearum*. Masters Thesis. Virginia Polytechnic Institute and State University. pp. 78.
- Hawks, Jr. (1980). Tobacco Flue-cured Madrid.
- Comis, D. (1996). Resetting a plant's Thermostat, ARS.
- Dekker, M and Kinsey, B (2011). Coping with Zimbabwe's economic crisis: Small-scale farmers and livelihoods under stress ASC Working Paper 93, pp 2-29.
- Fafchamps, M. (2004). Market Institutions in Sub-Saharan Africa: Theory and Evidence. Cambridge, Mass, MIT Press.
- Fortnum, B. A.; Gooden, D.; Lewis, S. A.; Johnson, A.(2004). Management of mixed populations of *Meloidogyne* spp. with 2- year rotations. Paper presented at the 41st Tobacco Workers Conference, 2004. Clemson University, Pee Dee Research and Education Center, 2200 Pocket Road, Florence, SC 29506-9706 USA.
- Garner, W.W. (1949). Tobacco culture. U.S. Department of Agriculture, Farmers' Bulletin, Vol.571 (571), pp.1-29.
- Jerie, S., and Ndabaningi, T. (2011), "The Impact of Rainfall Variability on Rain-Fed Tobacco in Manicaland Province of Zimbabwe," *Journal of Sustainable Development in Africa*, Vol. 13. No.1, pp. 241-250.
- Kadzandira, J.M., Phiri, H.M., and Zakeyo, B. (2004) 'Malawi – Tobacco Sector Performance Audit: The Perceptions and Views of Smallholder Tobacco Farmers on the State of Play in the Tobacco Sector', Lilongwe, The World Bank
- Kaipa, J. and Mvulaatera, P. (2010), Evaluation of Micron Ulva+spinning Disc Sprayer for Conditioning Tobacco. ARET Annual Report for 2010/11 Season, Lilongwe, Malawi.
- Karavina, C. and Mandumbu, R. (2012). Phytoparasitic nematode management post methyl bromide: Where to for Zimbabwe? *Journal of Agricultural Technology*, Vol. 8(4): pp. 1141-1160.
- Katsaruware, R. D. and Gwembire, J. (2014). Float Trays as an Alternative to Methyl Bromide in Tobacco Production in Hurungwe District, Zimbabwe, *Asian Journal of Applied Science and Engineering*, Volume 3, No 2 pp119-127.
- Keyser, J.C. (2002).The Costs and Profitability of Tobacco Compared to Other Crops in Zimbabwe. Economics of Tobacco Control Paper No 1. HNP Discussion Paper. World Bank.
- Koester, U. (2005) 'A synthesis paper of "Pathways to Greater Efficiency and Growth in the Malawi Tobacco Industry by Antonio Nucifora"', presented at Stakeholder's Workshop On Tobacco Reforms, Chitedze Research Station, Lilongwe
- Kosmin, B. (1977). 'The Inyoka tobacco industry of the Shangwe people: The displacement of a pre-colonial economy in Southern Rhodesia, 1893-1938', in Palmer, R. and Parsons, N. (eds.) *The Roots of Rural Poverty in Central and Southern Africa* (Berkeley, UCP).
- LaMondia, J.A. (1995). Shade tobacco yield loss and *Globodera tabacum tabacum* population changes in relation to initial nematode density. *Journal of Nematol*, Vol.27 (1), pp. 114–119.
- Lownsbery, B. F and Peters, B.G. (1955). The relation of the tobacco cyst nematode to tobacco growth. *Phytopathology*. 45:163–167.
- Magadlela, D. (1997). A Smoky Affair: Challenges Facing Some Small-Holder BurleyTobaccoProducers in Zimbabwe, *Zambezia*, XXIV (i), pp.13-30.
- Manickavasagan, A, Gunasekaran, J.J, Doraisamy, P.(2007). Trends in Indian Flue Cured Virginia Tobacco (*Nicotiana tabacum*) Processing: II. Threshing, Packing and Warehousing, *Research*

- Journal of Agriculture and Biological Sciences*, 3(6): 682-686.
- Manyumwa, D., Mafuse, N., Matovere, M., Musara, J., Munyati, V.T., Chimvuramabwe, J., Chagwiza, G., Zivenge, E. and Dudu, V. (2013). Extent and adoption determinants of floating tray technology by small holder tobacco farmers: A case of Zimbabwe, *Journal of Development and Agricultural Economics*, Vol. 5(10), pp.416-424
- Massie, I.E. and J.H. Smiley. (1974). Harvesting and curing burley tobacco. AGR-14, Coop. Ext. Service, Coll. of Agr., Univ. of Ky., Lexington.
- Masvongo, J., Mutambara, J., and Zvinavashe, A. (2013). Viability of tobacco production under smallholder farming sector in Mount Darwin District. *Zimbabwe Journal of Development and Agricultural Economics*. Vol. 5(8), pp. 295-301.
- Mathews, A. and Wilshaw, C. (1992). *Fodya. The Malawi tobacco handbook*. Blantyre
- Mazarura, U. (2004). A guide to the use of the floating tray system for tobacco seedling production in Zimbabwe. The Tobacco Research Board of Zimbabwe.
- Miller, P.M and Ahrens, J.F.(1969). Influence of growing marigolds, weeds, two cover crops and fumigation on subsequent populations of parasitic nematodes and plant growth. *Plant Dis. Rep.* 53, 642-646.
- Musoni, S., Nazare, R., Manzungu, E., Chekenya, B. (2013). Redesign of Commonly Used Tobacco Curing Barns In Zimbabwe For Increased Energy Efficiency, *International Journal of Engineering Science and Technology (IJEST)* Vol. 5 No.03, pp 609-616.
- Mutandwa, E., Gadzirayi, T.C., and Foti, R. (2008). Measuring pay offs to agricultural training among smallholder tobacco producers. *Int. NGO J.* 3(3):033-037.
- Nyamapfene, K.W. (1991). Soils of Zimbabwe. Harare: Nehanda Press.
- Reed, T.D., Johnson, C.S., Semtner, P.J., Wilkinson, C.A. (2012). Flue-cured Tobacco Production Guide, Virginia Cooperative Extension.
- Rukuni M, Eicher, C. K. (1994). Zimbabwe's Agricultural Revolution, 1st edition, University of Zimbabwe Publications, Harare, Zimbabwe.
- Rukuni, M. (2006). Revisiting Zimbabwe's Agricultural Revolution. In: Rukuni M, Tawonezvi P, Eicher C. Zimbabwe's agricultural revolution revisited. University of Zimbabwe Publications, Harare. pp. 143-160.
- Sarmadnia, G H., Koochak, i E., (1994). Crop physiology. Mashhad University.
- Sankar, H. R., Chandrasekhararao, K. and Sivaraju, K. (2013). Decision support system for soil and water analysis and fertilizer recommendation for flue-cured Virginia (FCV) tobacco. *African Journal of Agricultural Research*. Vol.8 (44), pp.5550-5554.
- Singh, H. (2012). Training and Development: A Prominent Determinant for Improving HR Productivity, *International Conference on Management and Education Innovation IPEDR*, Vol.37, pp.274-278, IACSIT Press, Singapore
- Sande, D., Mullen, J., Wetzstein, M. and Houston, J. (2011) Environmental Impacts from Pesticide Use: A Case Study of Soil Fumigation in Florida Tomato Production
- Steffens, G. L., Alphin, J. G., Ford, Z.T., (1970). Ripening tobacco with ethylene-releasing agent 2-chloroethylphosphonic acid. *Beiträge zur Tabakforschung International* Vol 5:262-265.
- Svotwa, E., Masuka, A. J., Maasdorp, B., Murwira, A., and Shamudzarira, M., (2013) Remote Sensing Applications in Tobacco Yield Estimation and the Recommended Research in Zimbabwe, *ISRN Agronomy*, Volume 13 Article ID 941873, 7 pages.
- Tobacco Control Commission (TCC) (2006) Second Tobacco Market Report to date – 15th July 2006, Lilongwe: Tobacco Control Commission.
- Tobacco Industry and Marketing Board, (2013). Treasury Quarterly Bulletin: Jan-Mar 2013. Available: www.zimtreasury.gov.zw/treasury-quarterly-bulletins.
- Vidal, J. (2005). 'How Malawi's livelihood went up in smoke: Tobacco giants reap profits as price slump hits impoverished country's cash crop', *The Guardian*, <http://www.guardian.co.uk/print/0,,5210572-103681,00.html> accessed in 2007. Workshop On Tobacco Reforms, Chitedze Research Station, Lilongwe.
- Watada, A. E., (1986). Effects of ethylene on the quality of fruits and vegetables. *Food Technol.* Vol.40, pp. 82-85.
- Weybrew, J. A. (1984). Harvesting and curing of flue-cured tobacco. *Tech.Bull.*275. North Carolina Agricultural Research Service, North Carolina State University, Raleigh, NC.

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