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Estimation of the impact of tobacco curing on wood resources in Zimbabwe

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Abstract

This paper estimates the impact of tobacco curing on wood resources in Zimbabwe. The estimation was done using the year 2009 and 2010 tobacco production statistics for small scale farmers obtained from the Tobacco Industry Marketing Board (TIMB). The total mass of tobacco produced was multiplied by a factor 14 kilogrammes of wood required to cure one kilogramme of tobacco. The estimation of the annual forest woodland clearance per every hectare of tobacco cured was calculated using 0.6 hectares of forest woodland per every hectare factor obtained from literature. Wood consumption increased significantly across all major tobacco producing regions of the country. This was driven by a marked increase in the number of farmers and the size of land put under tobacco across provinces. There was 19% increase in hectarage of forests cleared to cure tobacco which may be linked to the growing shrinkage of forests in the country. *Miombo*woodlands were major sources of wood fuel due mainly to their high energy value and their ecological dominance within the tobacco farming regions. Despite efforts by the tobacco industry to provide farmers with coal for curing tobacco, small holder farmers continue to use wood fuel with negative impacts on wood resources. There is need for the stakeholders in the tobacco industry to educate farmers and enhance the use of coal, creation of woodlots and adoption of the energy saving technologies.

Keywords:Tobacco; impact; curing; wood resources; consumption

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1. Introduction

Tobacco (*Nicotianatabacum L.*) is an annual herbaceous plant which originated in South America and has been grown in Zimbabwe for over 100 years. The "golden leaf", as it is nicknamed, experienced a sharp increase in production volumes from one million kilogrammes in 1920 to 11.3 million kilogrammes in 1938 and peaking at about 200 million kilogrammes in 1999, before slumping to about 50 million kilogrammes in 2008 (Tobacco Industry Marketing Board, 2010). Prior to the year 2000 flue cured tobacco production was dominated by white commercial farmers who used coal for curing tobacco. The post 2000 era has witnessed a sharp increase in the number of small scale tobacco growers (approximately 90 000 farmers, TIMB 2014) who benefitted from the land reform programme. These farmers, 90% of them grow flue-cured tobacco and use wood resources as the main source of energy (Sacchetto, 2012). Deforestation for tobacco curing is a recent development resulting from the Fast Track Land Reform Programme and the ensuing economic crisis. There are attempts to revert to the use of coal in curing tobacco but this is overridden by economic imperatives. The economic significance of the crop in terms of monetary value is massive despite its negative impact on wood resources. Sacchetto(2012) described tobacco production as the major cause of deforestation and up to 10 times more aggressive than other factors of deforestation.

Tobacco production in Zimbabwe is propelled by the high incomes realized and the perceived farmer prosperity. Masvongoet al. (2013) in their research revealed gross margin analysis for tobacco production as a viable smallholder enterprise, and therefore has potential to contribute towards improving incomes and livelihoods of small scale farmers. Little attention has been given by the proponents of the prosperity thesis on the disastrous impacts of the crop on wood resources and biodiversity.Musoniet al. (2013) acknowledge the disastrous effects of tobacco curing on wood resources in Zimbabwe but however, advocate for redesign of the tobacco barns with a view to reduce wood consumption. The rate of wood consumption depends on the efficiency of the process particularly the tobacco barn. Tobacco barns used by the newly resettled farmers in Zimbabwe are known for being inefficient and require large volumes of wood against low production levels (Musoniet al., 2013). Improving efficiency in tobacco curing is critical but not a solution given that most farmers cannot afford new technologies and they take time to adapt.

Tobacco curing requires large quantities of fuel wood. Estimates are varied but small scale farmers consume approximately 43m^3 of fuel wood (15 000kg per year) to produce an average of 1 400kg of cured tobacco (Scott, 2006). This translates to a Specific Fuel Consumption (SFC) of 10.7kg/kg of tobacco (Scott, 2006), which is approximately a third of the farmer' income (Scott, 2006). In contrast, estimates by Clay(2003) show that 19.9 m^3 of wood is used to cure one metric tonne of tobacco. Geist(1999) suggests a value range between 9 and 37 m^3 of wood per tonne of tobacco cured. This translates to about 9.2 kg/kg of tobacco cured. In Kenya and Malawi the estimates are 8kg/kg of tobacco respectively (Geist, 1999). Experimental research on fuel wood consumption for flue cured tobacco done in Tanzania by Siddiqui and Rajabu (1996) showed that 14 kg of fuelwood is required to cure a killogramme of tobacco. Variations in wood resources consumption can be linked to a number of factors including the types of barns used, state and wood species and the knowledge of famers on the importance of improving tobacco curing efficiency.

Musoniet al. (2013) acknowledges that 98.5% of energy is lost as a result of inefficient barns. Such high levels of energy loss have negative impacts on the availability of wood resources not only for tobacco curing but for other uses. Fuel wood consumption in flue cured tobacco is accompanied by forest woodland clearance. More than 300,000 hectares of indigenous forests in Zimbabwe are destroyed annually mostly by new small-scale tobacco farmers (FAO, 2010; Musoni, 2013). This statistic is highly disputed but reflects the extent to which wood resources are used in most tobacco farming regions of the country. To meet the wood demand for tobacco curing, 140,000 ha of *Miombo* woodlands are annually cleared, and this accounts for 4–26% of the *Miombo* deforestation (Chenje and Johnson, 1994). On the other hand Geist (1999) gives a contrasting estimate of 200 000 hectares of forests/woodlands removed by tobacco farming each year, in the developing countries.This rate is very high considering that there are other uses that the rural communities require for their survival. Wood harvesting is selective and normally biased towards the *brachystegia species*. Neither natural nor artificial regeneration has been able to keep pace with the rate of exploitation. For example, in eastern Tanzania the estimated annual wood removal for all uses (6.4 m^3 ha^{-1}) exceeds the reported mean annual increment (4.4 m^3 ha^{-1} yr^{-1}) (Luogaet al., 2002). Thus, the most elusive aspect of estimating the impact of tobacco production has to factor in the proportion of wood lost to cultural and land practices as well as to the other uses.

Research on the impact of flue cured tobacco on wood resources in Zimbabwe is scanty and focuses on general ecological impacts of the crop. Miller and Gwaze (2012) noted that farmers in newly settled areas require assistance in developing practices that support sustainable agriculture so that they reduce the impact they are having on the forests, grasslands, soils, and water sources. They further infer that priority should be given to small scale tobacco farmers.In recent years, there has been a massive population movement onto the formerly commercial zones where tobacco was grown as the major cash crop particularly on sandy soils in agro-ecological zones straddling the central and northern parts of the country. This movement of new farmers has been associated with the general clearance of land for various farming activities including tobacco production (Maposa, Hlongwana and Muguti, 2011). Thus, there is a link between the massive destruction of trees and the production of tobacco in newly resettled areas of Zimbabwe (Utete, 2003). This agrees with estimates that tobacco production accounts for 5 percent of Africa's total deforestation (Geist, 1999), 12 percent in Southern Africa (Clay, 2003) and 20 percent in Malawi (Geist, 1999). In Zimbabwe the deforestation caused by tobacco production is serious and is not only a threat to biodiversity, but also to the sustainable production of tobacco itself. Despite campaigns to contain deforestation initiated by the Forestry Commission of Zimbabwe its impact is insignificant. Farmers are encouraged to plant fast growing exotic tree species such as eucalyptus for tobacco curing. On average these tree species take five years whilst indigenous trees can take up to 15 years to mature. Meanwhile farmers continue to use wood resources. Furthermore, the ecological impacts of exotic species in Zimbabwe are not adequately documented. Studies in Kenya among small scale farmers actually showed that famers had limited land to plant enough eucalyptus trees that can be used to cure tobacco (Muller, 1976 and Hose, 1988). Thus, the tree planting ceremonies are largely viewed as a public relations and political gimmick when assessed against the ecological impacts of tobacco farming. Wood shortages are expected as a result of deforestation in the main tobacco producing areas threatening both the volume and quality of output.

Tobacco production is a challenge to environmental sustainability as it greatly impacts on wood resources availability and disrupts the natural regeneration of wood resources. The sustainability of tobacco production is threatened by the declining supply of wood to meet growing household demands for fuel, building material and tobacco curing (Bunderson and Hayes, 1998). The tobacco industry in their defense advances the hypothesis that 'deforestation associated with tobacco curing cannot currently be considered a significant negative externality (International Tobacco Growers Association, 1997). This is in contrast to earlier findings by Fraser (1986) and Fraser and Bowels (1986) who on the basis of wood consumption data, population statistics and forest density figures, concluded that the proportionof the tobacco growing areas in developing countries lie within areas identified as being in wood deficit and prospective deficit situations. The impacts of tobacco production are not only ecological but also in irreversible social costs to the resource poor farming communities (Otañez, 2008 and Kagaruki, 2010; Geist et al., 2009). Therefore sufficient forest area is required to supply fuelwood for tobacco curing at the expense of other forest services (Mangora, 2005; Sauer and Abdallah, 2007; Kagaruki, 2010; Yanda, 2010; Mangora, 2012). The tobacco farming regions of Zimbabwe are located in areas dominated by the *Miombo* woodlands species and are the major sources for tobacco curing. Therefore the thrust of this paper is to estimate the impact of tobacco curing on wood consumption in those ecoregions where tobacco is grown in Zimbabwe.

2. Method and materials

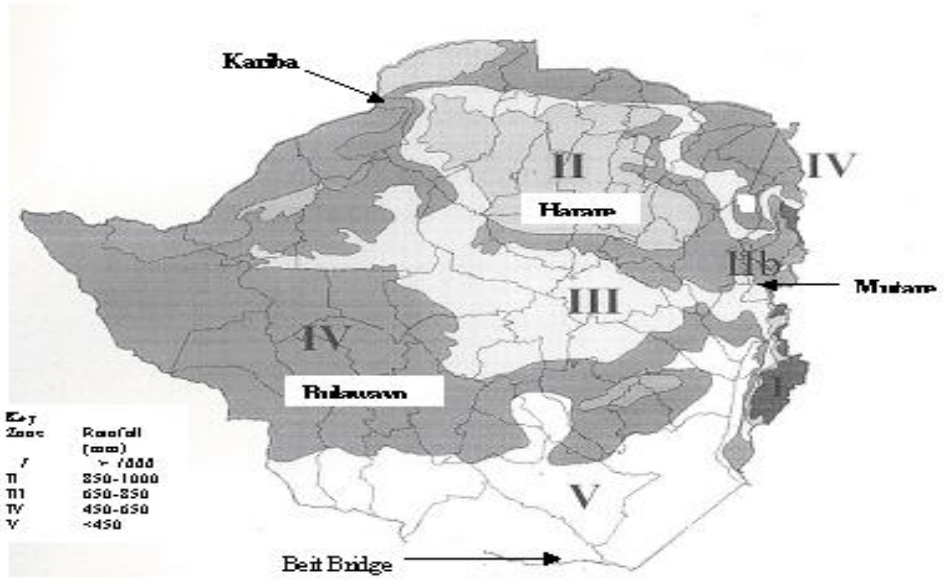

Figure 1. Agro ecological Regions of Zimbabwe

2.1. The study area

Tobacco is grown in Agro-ecological zones II and III of Zimbabwe where the general climatic and edaphic conditions are favourable and provide the highest potential for tobacco production (Figure 1).Zimbabwe is divided into five natural regions. A natural region is an area, in which defined environmental variables are more or less uniform (Vincent and Thomas, 1960). The division into agro ecological zones or natural regions was done on the basis of major climatic variables (rainfall, temperature) and topographic and edaphic conditions. There is a strong physical relationship between rainfall distribution and the demarcations of agro-ecological regions.

2.2. Method

Wood consumption for curing tobacco varies among producers according to different authors (Table 1). Wood consumption estimates vary accordingto the type of barn and experimental design used to cure one kilogram of tobacco. However, the variation in wood consumption is affected by the type of barn and fuel wood used.

Table 1. Fuel wood in kilogrammes per kilogramme of flue cured tobacco

Variety of Tobacco	Wood requirement kg/kg*	Country	Type of barn	Source of information
Flue-cured	4.8	Africa		Fraser, (1986)
Flue-cured	8.0	Kenya		Fraser, (1986)
Flue-cured	10.8	Zimbabwe		Fraser, (1986)
Flue- cured	14.2	Tanzania	Traditional barn	Siddiqui and Rajabu, (1996)
Flue-cured	13.0	Malawi	Traditional barn	Fraser and Bowles, (1986)
Flue-cured	15-20	Malawi	Traditional barn	Breag and Hawker, (1980)
Flue -cured	8.0	Malawi		Geist, (1999)

Source: Geist 1999 Key: Kg/kg- kilogramme of wood per kilogramme of cured tobacco*

The study used 2008/9 - 2010 tobacco production statistics for small farmers obtained from TIMB and expert criteria decisions. The data used covered the major tobacco growing regions of Zimbabwe (Figure1) and their distribution by type of farmer, communal, resettled and newly resettled. The data were reorganized to calculate percentage changes in numbers of growers, hectarage and tobacco production. Woodland clearance factor of 0.6 hectares per one hectare of cured tobacco and wood consumption factor of 14 kilogrammes per one kilogramme of cured tobacco (Siddiqui and Rajabu, 1996) were used to estimate wood consumption. These factors were considered more accurate because they were based on an experimental

study on energy efficiencies in tobacco curing in Tanzania under conditions that are similar to those of Zimbabwe. However, these methods must be used with caution because the volume of wood used depends on type of wood species, status of wood and type of barn used.

3. Results and discussions

The number of tobacco growers in Zimbabwe increased by 82% between the period 2009 and 2010 (Table 2). This sharp increase is attributed to the availability of land through the Fast Track Land Reform Programme that started in the year 2000, firewood for curing tobacco and 'fair' prices on the auction floors. The area under tobacco increased by 19% over the same period (Table 2). This shows that tobacco is an important cash crop in Zimbabwe as more people are producing it in non-tobacco producing regions of the country. The increase may also be attributed to contract farming where competitive prices are offered to farmers together with inputs. Land for tobacco growing does not seem to be a problem now because small scale famers can afford to use on average one to two hectares. However, this minimum hectarage is achieved through clearing new land allocated by the state with potential environmental implications. Wood resources are likely to be depleted if the trend continues. In addition, the number of growers in non tobacco growing regions has been increasing because tobacco is currently viewed as the most profitable cash crop in the country (Keyser, 2002). The increase in the number of growers can partly be due to some successful small scale farmers who are 'success stories' for the communities (Shumba and Whingwiri, 2006). The average price of a kilogramme of tobacco for the 2010 season was US$ 2.88 while the best leaf fetched US$ 4.96 and the lowest price was US$0.10 (TIMB, 2010). These prices were comparatively higher than prices fetched by other crops like maize and groundnuts.

Table 2. Changes in the Number of growers and Hectarage under tobacco in the 2008/9-2010 seasons

Province	2009 Ng	2009 Ha*	2010 Ng	2010 Ha*	Increase Ng	% increase Ng	increase Ha*	% increase Ha*
Mashonaland East	6132	12199	10273	11690	4141	68	-509	-4
Mashonaland West	9534	6770	15276	17991	5742	60	11221	62.3
Masvingo	13	18	31	50	18	138	32	179
Mashonaland Central	7698	14053	13873	11155	6175	80	-2898	-21
Manicaland	5777	9178	9400	9556	3623	63	378	4
Totals	29154	42218	48853	50442	19699	409	8224	19
Average	5831	8444	9771	10088	3940	82	1645	19

Key: Ng-Number of growers/Ha-Hectare under tobacco per province*
Source: Tobacco Industry and Marketing Board (TIMB, 2009 to 2010)

Before the year 2000 a small percentage of small scale farmers engaged in tobacco production in Zimbabwe. Elsewhere in the world tobacco production was a domain of the small scale farmer (Jaffe, 2002). This has since changed and the small scale farmers are the current drivers of the tobacco industry. This sharp increase in number of small scale growers has a huge impact on forest woodland clearance and fuelwood resources for tobacco curing. This is because these new brand of farmers grow flu cured tobacco and they wholly depend on wood resources for curing tobacco. Zimbabwe, like other countries in the Southern African Development Community (SADC) faces the challenge of balancing population growth and resources. Forestry resources, the source of energy for tobacco curing are disappearing at alarming rates. According to FAO (2002) annual forest losses range from about 2.7% for Zambia, 2.4% for Malawi, 0.7% for Zimbabwe to about 0.1% for South Africa respectively. The actual forest losses for Zimbabwe are much higher than these 2002 estimates and tobacco production is a major variable in the process of forest carnage. This may need to be pursued through a nationwide on site verification of tobacco curing wood requirements. Pressure on wood resources can be reduced through raising prices of other agricultural commodities that do not require the use of wood at the processing stage.

The area of forest woodland cleared to cure one hectare of tobacco increased by 19% across tobacco farming regions in Zimbabwe (Table 3). There were marginal decreases in Mashonaland Central and Mashonaland East Provinces in annual forest woodland clearance per hectare of cured tobacco. In contrast there has been marginal increase in Manicaland and Masvingo provinces. However, this marginal increase has significant impact on local wood resources. In some provinces forest woodland hectarage clearance has declined but production has increased.

Table 3. Estimated changes in forest woodland cleared to cure one hectare of tobacco

Province	2009 Ha*	0.6ha/ha Cured tobacco	2010 Ha*	0.6ha/ha cured tobacco	Increase in 0.6ha/ha cured tobacco	% increase 0.6ha/ha cured tobacco
Mashonaland East	12199	7319	11690	7014	-305	-4
Mashonaland West	6770	4062	17991	10795	6733	166
Masvingo	18	11	50	30	19	173
Mashonaland Central	14053	8432	11155	6693	-1739	-21
Manicaland	9178	5507	9556	5734	227	4
Totals	42218	25331	50442	30266	4935	19
Average	8444	5066	10089	6053	988	19

Key: Ha –hectares under tobacco per province*
**0.6 ha-forest woodland cleared per one hectare of cured tobacco (Siddiqui and Rajabu, 1996)*
Source: Tobacco Industry and Marketing Board (TIMB 2009 to 2010).

In experimental studies carried out in Tanzania it was estimated that 0. 6 hectares of woodlands were cleared to cure one hectare of tobacco, leading to a deforestation of 13.000 hectares per annum (Siddiqui and Rajabu, 1996). However, there is variation in the amount of woodland cleared to cure one hectare of tobacco. The amount of woodland cleared depends on type of barn used, variety and condition of wood. For example a traditional barn is inefficient and consumes large areas of woodland when compared with a rocket barn. The use of fire wood to cure tobacco is a long term threat to ecological sustainability. A short term measure to address this disturbing trend will be to make mandatory for small scale farmers to adopt the use of coal in curing tobacco. Input providers can assist through training of farmers, construction of efficient barns and making coal part of the input package as a short term measure. The long term measures to the control of deforestation due to tobacco curing is research in alternatives technologies and investing in other crops that do not have long term negatives implications on the livelihoods of farmers.

Annual tobacco production and firewood consumption increased in all provinces by 205.46% (Table 4). This was probably due to an increased number of growers, hectarage, inputs, better tobacco agronomic cultural practices and fair prices at the auction floors. The increase in tobacco production in all provinces of Zimbabwe has a significant impact on local wood resources availability. Therefore alternative sources of energy to cure tobacco such as coal and solar energy must be developed. This will reduce the pressure on wood resources and ecosystems. The impact of tobacco on ecosystems is more penetrative than this study can demonstrate. The growth of the tobacco industry has increased the demand for fuelwood. In experimental studies carried out in Tanzania it was estimated that 14kg of fuel wood is consumed to cure one kilogramme of tobacco (Siddiqui and Rajabu, 1996).

Table 4. Estimated wood consumption to cure one kilogramme of tobacco*

Province	2009 Tp t	wood consumed 14kg/kg 0.14t/0.01t	2010 T p t	Wood consumed14kg/kg 0.14t/0.01t	Tp increase t	Changes in wood consumption 14 kg/kg 0.14t/0.01t	% Increase Tp	% increase 14 kg/kg 0.14t/0.01t
Mashonaland East	6086	852.04	16471	2305.94	10385	1453.90	170.60	170.60
Mashonaland West	8336	1167.04	24323	3405.22	15987	2238.18	191.70	191.70
Masvingo	4	0.56	23	3.22	19	2.66	475.00	475.00
Mashonaland Central	6039	845.46	21745	3044.30	15706	2198.84	260.07	260.07
Manicaland	4077	570.78	12404	1736.56	8327	1165.78	204.24	204.24
Totals	24542	3435.88	74966	10495.24	50424	7059.36	205.46	205.46
Average	4908.40	687.18	14993.20	2099.05	10084.80	1411.87	205.46	205.46

Key: Tp-Tobacco Production in tonnes
**14kg/kg-14 kg of firewood per kg cured tobacco (Siddiqui and Rajab, 1996)*

Source: Tobacco Industry and Marketing Board (TIMB 2009 to 2010).

The estimates of the volume of wood consumed to cure a kilogramme of tobacco using a traditional barn are highly variable across Southern African Countries. When it comes to the firewood use of flue, the range of Specific fuel Consumption (SFC) is as low as 5 kg and as high as 130 kg (Geist, 1997). On the other hand a rocket barn consumes between 10kg and 30 kg of wood/kg of cured tobacco (Scott, 2007). The lowest value of 4.8 kg of wood per kilogramme of cured tobacco was drawn from empirical values of the mid-80s from Kenya, Zimbabwe and Malawi. It is assumed that technology improvement would result in lower rates (Fraser, 1986). The figure of 5.5 given by the International Tobacco Growers' Association (ITGA, 1997) was based on estimates from 14 countries worldwide. It is imperative that when permuting wood requirement estimates for tobacco curing the local conditions be factored. Quantitative information on wood resources consumption in curing tobacco is inconsistent and sometimes is lacking (Abdallah and Monela, 2007).Earlier estimates by Temu (1979) reported that 20 $m^3$of miombo woodlands is used to cure 1 ha of tobacco, while Wahid (1984) revealed that 15 $m^3$is used to cure 500 kg and Abdallah and Sauer (2007) reported 1 m^3firewood to cure 57 kg of tobacco. The actual amount of firewood used varies with the design of the barn and the type of wood species. Most farmers in the tobacco growing regions of Zimbabwe prefer to use the varieties of miombo woodlands such as *Julbernadiaglobiflora, Brachystegia*spp. and *Combretum*spp (Millington et al., 1994; Frost, 1996; Campbell, 1996; Frost, 1996; Bradley and Dewees, 1993). However, with the depletion of wood resources famers are forced to use any wood species that are available within their localities. Miombo woodlands support a significant proportion of rural and urban livelihoods in Zimbabwe. Unfortunately, the current forest utilization has resulted in continued deforestation (Chidumayo, 1997; Luogaet al., 2002; Abbot and Homewood, 1999 Geist, 1999). The present patterns of utilization of *Miombo* resources are unsustainable (Abbot and Homewood, 1999; Geist, 1999; Luogaet al., 2002). Thus, loss of biodiversity and extinction of most of the woodland resources are imminent if the current intensive exploitation of *Miombo* resources continues unchecked. Unfortunately, there is a lack of decisive policy instruments and management measures to effectively curb the biodiversity loss and woodland destruction related specifically to tobacco production.

Tobacco curing using wood resources has serious environmental implications on forest biodiversity particularly miombo woodlands. The use affects both genetic diversity, species diversity and ecological diversity (Krishann, 2008; Magurran, 1988). However, estimates of precise loss rates with respect to biological diversity are hampered by the absence of any baseline measurement (Pearce and Moran, 1994). Kontoleonet al. (2008) acknowledges the importance of promoting and preserving species diversity because a uniform population of a single species of plants adapted to a particular environment is more at risk if environmental changes occur and a more diverse population consisting of many species of plants has a better chance of surviving including individuals that might be able to adapt to changes in the environment.

4. Conclusions and policy implications

There was a significant increase in the number of growers, hectarage and firewood consumption in all the five provinces of Zimbabwe. This was driven by the perceived high prices at the auction floors, improvedinput availability and the impact of the fast track land reform programme. The consequence of the sharp increase in tobacco production has been linked to increased carnage of wood resources. This has significant impacts on the ecology of the *Miombo* woodlands which are the major sources for the farmers. Furthermore, wood clearance, leaves the soil exposed to agents of erosion. To minimize the impact of tobacco production on wood resources it is recommended that coal be used in the short to medium terms. Otherwise the farmers have to be trained to continue to produce tobacco in a sustainable way. That is balancing the daily demands for survival with the rate of forestry replenishment.

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