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RESEARCH ARTICLE

# THE ECONOMIC AND ENVIRONMENTAL VALUE OF BAGASSE-BRIQUETTES AS AN ALTERNATIVE SOURCE OF ENERGY IN THE LAKE VICTORIA BASIN: A CASE OF USING BRIQUETTES AS AN ALTERNATIVE SOURCE OF ENERGY TO CURE TOBACCO

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**ABSTRACT**

Tobacco production involve curing process which results to continued harvest of indigenous vegetation leading to depletion of forests resources and loss of biodiversity, which have long term negative effects on food security and livelihood of the communities living in the Lake Victoria basin. The continued use of unsustainable practices contributes towards increased environmental degradation leading to increased levels of pollution, fertilization and siltation of Lake Victoria and surrounding water bodies. This study looked at the economic value and environmental benefits of using bagasse-briquettes as an alternative source of energy to the tobacco growing communities. The objective of this study was to find out the economic gains and vegetation cover saved as a result of using bagasse-briquettes as alternative source of energy to cure tobacco. This was achieved by interviewing farmers exposed to briquettes made from bagasse (a sugarcane byproduct) as an alternative source of energy to cure tobacco, to determine the cost and quantity of briquettes, split wood and non-split wood used; source of the materials and their usability. The study then; compared the calorific value of bagasse-briquettes with bagasse pith briquette, bagasse-briquettes with binders, saw dust briquettes, saw dust, county council waste briquettes, coffee husks briquettes, split wood (eucalyptus), and non-split wood (indigenous flora); compared the cost of bagasse-briquette and an equivalent quantity of split wood and non-split wood; conducted a profit margin analysis to determine the cost of using bagasse-briquettes compared to split wood and non-split wood as a source of energy to cure tobacco; quantified woody vegetation cover saved in-terms of hectares by using bagasse-briquettes. A bomb calorimeter was used to find the calorific value of all the materials used as sources of energy. A survey methodology was used to find out the source, cost and quantity fuel materials used to cure one kilogram of tobacco leaves. A cross cut analysis was used to determine woody vegetation cover of different places within the tobacco growing areas in the Lake Victoria basin in-terms of tons per hectares. The woody vegetation cover and quantity of leaves cured using bagasse-briquettes was used to calculate the woody vegetation cover saved in different localities. The study found out that; calorific value of bagasse-briquette was significantly lower than the other sources of energy. However, the quantity of bagasse-briquettes used to cure one kilogram of tobacco leaves was significantly lower than split wood and non-split wood; the cost of one kilogram of bagasse-briquette was lower than an equivalent quantity of split wood and non-split wood, resulting into a reduced cost of curing one kilogram of tobacco leaves hence a higher profit margin to the farmers; tobacco curing is contributing to depletion of woody vegetation cover and loss of biodiversity. The use of bagasse-briquette to cure tobacco was economically and environmentally profitable as opposed to use of wood fuel. The information from this study is of significance to environment practitioners, farmers to improve their profits, policy makers and tobacco processing companies and stakeholders.

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## INTRODUCTION

Global assessment of deforestation related to tobacco conducted between 1990 to 1995, estimated that over 400,000 ha of forest/woodland are removed annually due to farming (Geist, 1999). This figure is projected to be more because of the increased tobacco production in developing nations. Land under tobacco in Kenya has rapidly grown from 600 ha in 1971 to 23,000 ha in 2011 while the number of farmers increased from 1,500 to 55,000 in the same period (Government of Kenya, 2010).

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Tobacco is mainly grown in Nyanza (Migori, Suba, and Homa-bay), Western (Bungoma, Busia, Teso, and Mt. Elgon), Eastern (meru, Kitui, Machakos) and Central (Kirinyaga, Muranga, and Thika) provinces with Nyanza producing up to 80% of the tobacco leaves in Kenya (Kibwage *et al*., 2009). The production of tobacco is mainly sponsored by three companies, Alliance One Kenya, Mastermind Tobacco and British American Tobacco (BAT). As much as tobacco farming provides the farmers with a livelihood and injects capital into Kenya's economy, it also adversely affects to the environment (Otanez and Glantz, 2011). With regard to tobacco and sustainable development, Bellagio stated that "in the developing nations, tobacco pose a major challenge; not just to health, but also to the environmental sustainability"(Phillips, 1995).

The negative effects of tobacco to the environment starts right from crop development to processing and finally to consumption (WHO, 2013). More than 90% of tobacco in Kenya is grown and cured in the lake basin region of Nyanza and Western Kenya provinces, who share Lake Victoria with other East African countries and beyond. Tobacco cultivation and curing results to deforestation, which in turn contributes to soil erosion, siltation of water bodies, shifting cultivation and cultivation on marginal lands (Sauer and Abdallah, 2007). In addition, those practices contribute to lose of soil fertility through soil pollution, high nutrient extraction and over use of inorganic fertilizers. During tobacco drying (flue curing), a lot of biomass from indigenous Flora is used. Indigenous Flora improves the quality of tobacco leaves by giving them a nice aroma (Sauer and Abdallah, 2007), hence up to 200,000 ha of indigenous trees are cut down annually (World Health Organization, 2011). Tobacco production also competes favorably for arable land space and family labour with other food crops, thereby making the farmers more food insecure (Phillips, 1995).

However, Alliance One Kenya, the leading producer of tobacco in Kenya has put efforts to comply with the WHO-Framework Convention on Tobacco Control (Article 18) on the protection of environment and health of persons, which the Kenyan government is a signatory to, and it also to complies with Vision 2030 that envisages a Kenya with clean secure and sustainable environment by putting up mechanisms to mitigate the negative effects of tobacco production (Quddus and Mia, 2010). The most striking mitigation effort conducted by the firm is the introduction of briquettes made from sugarcane bagasse as an alternative source of energy to cure tobacco leaves. This mitigation effort is aimed at; reducing deforestation, restoring biodiversity, protecting water catchment and soil conservation and stabilization. Alliance One Kenya company with more than 50% (22860) registered tobacco growing farmers in the country, set up a briquette making factory in 2012 to produce bagasse-briquettes are used by the farmers as an alternative source of energy to cure an annual production of over 12,400 tones of tobacco leaves. Bagasse is a fibrous residue that remains in large quantities upon the extraction of sugar juices from sugarcane. For every ton of sugarcane crushed 0.3 tons of bagasse is retrieved (Solomon, 2011). Bagasse is still considered a waste byproduct of sugarcane since it is not adequately used by majority of the sugar factories in Kenya (Rabah, 2000). In Tamil-Nadu in India, 50% of the bagasse generated by sugar factories is used to generate power used by the same factories to run production activities, while the rest is sold to paper mills as an alternative to wood pulp. However, the paper making process requires de-pithing (removal of the cellulose non-fibrous pith from bagasse) (Singh *et al*., 2007). The pith can also be used to make bagasse-briquettes (Solomon, 2011). Bagasse pith is cellulose but not fibrous material, which must be removed from bagasse in order to make good quality pulp, from which to make paper. Briquetting is the process of making briquettes by densification of biomass such as bagasse into different shapes by removing moisture from the material, improving its bulk density, thereby increasing their net calorific value per unit volume. This reduces the cost per calorific value, cost of transport and makes them cost effective to the users (Yumak, Ucar, and Seyidbekiroglu, 2010).

Bagasse is readily available as a waste material from the sugar factories such as South Nyanza (SONY) Sugar Factory, Sukari Sugar Factory, and Transmara Sugar Factories, that are within the lake basin region. This study was therefore designed to determine the economic and environmental benefits of bagasse-briquettes as an alternative source of energy to cure tobacco and household consumption.

## MATERIALS AND METHODS

The study used a cross-sectional survey methodology to collect information on the cost and quantity of bagasse-briquettes, split wood and non-split wood used; source of the materials and their usability as sources of energy to cure tobacco leaves. A profit margin analysis was conducted to quantify the economic value of using bagasse-briquettes against split wood and non-split wood. A cross-cut analysis was conducted in randomly sampled areas to determine woody vegetative cover of Suba-Kuria, Nyatike, Kuria-East, Kuria West, Oyani, and Rapogi areas in Migori County. This was then used to quantify woody vegetation cover saved in terms of size of land by use of bagasse-briquette as an alternatives source of fuel. The study used a desktop review methodology to get secondary information from Alliance One Kenya factory.

A bomb calorimeter was used to get the calorific values of at least ten samples of each of nine materials including bagasse-briquette, bagasse pith briquette, bagasse-briquettes with binders, saw dust briquettes, saw dust, county council waste briquettes, coffee husks briquettes, split wood (eucalyptus), and non-split wood (indigenous flora). Stratified random sampling approach was used to identify 200 farmers receiving briquettes from Alliance One Kenya briquette factory, who were visited and interviewed. The study estimated the quantity of bagasse-briquettes, split wood or non-split wood used to cure tobacco leaves harvested through a cross sectional survey. This information was then used to determine the quantity of bagasse-briquettes, split wood and non-split wood to cure a kilogram of tobacco leaves. A t-test was used to compare the calorific values of the nine materials, the quantity of the materials used to cure one kilogram of tobacco leaves and the cost of a kilogram of the materials used as a source of energy to cure tobacco leaves.

## RESULTS AND DISCUSSION

### Comparative analysis of Calorific value of bagasse-Briquette and other material

A bomb calorimeter was used to find out the calorific value of ten samples of materials that can be used to provide energy to cure tobacco leaves. The materials tested include, bagasse-briquette, bagasse pith briquette, bagasse-briquettes with binders, saw dust briquettes, saw dust, county council waste briquettes, coffee husks briquettes, split wood (eucalyptus), and non-split wood (indigenous flora). The materials tested were dried to a moisture content of 11-13%. A one sample t-test analysis to determine any statistical difference between the calorific values of the materials, with t-test value set at 18.10 MJ/Kg (mean calorific value for bagasse-briquettes) indicates that mean calorific values for bagasse-briquettes (18.10MJ/Kg) is significantly lower than mean calorific value for split wood (19.18MJ/Kg, MD = 1.08, t-value= 6.217, p-value = 0.000) and non-split wood (19.03MJ/Kg, MD= 0.93, t-value= 5.180, p-value= 0.001).

However, the mean calorific values of the materials has a standard deviation of 1.0MJ/Kg at an overall mean of 18.9 MJ/Kg (Table 1). The mean calorific value of briquettes were found to be within the required range (17-21MJ/Kg) of materials with the ability to produce energy to cook or cure tobacco leaves (Tawiri, 2011). The mean calorific value of bagasse briquette was also consistent with a study done by Suhartini *et al*. (2011). The use of bagasse briquettes also offer benefits of reduced emissions of sulfur dioxide ($SO_2$), nitrogen oxides ($NO_x$) which are greenhouse gases with tremendous effect of causing global warming compared to other conventional fossil fuels. Bagasse also has low ash content of 2-10% as compared to 20-40% of coal (Leibbrandt *et al*., 2011).

### Comparative analysis of quantity and cost of bagasse briquettes and wood fuel used to cure tobacco

An average quantity of split wood, non-split wood fuel and bagasse-briquettes used by the farmers to cure a kilogram of tobacco leaves (Table 2) was arrived at by averaging a measured quantity of each of the materials used by all the 200

**Table 1. Mean calorific value, Temperature change and weight of different materials used as fuel to cure tobacco leaves**

| | Bagasse Briquette | Bagasse briquette+ binder | Bagasse briquette Pith | Saw Dust briquette | Saw Dust | Wastes briquette | Coffee Husks briquette | Split Wood | Non-Split wood |
|---|---|---|---|---|---|---|---|---|---|
| Dry weight (g) | 0.925 | 0.999 | 1.010 | 1.037 | 1.023 | 1.020 | 1.020 | 1.031 | 1.025 |
| Temperature change in $^0$c | 1.644 | 1.883 | 1.741 | 2.053 | 1.846 | 2.053 | 1.780 | 2.012 | 1.914 |
| Calorific value (MJ/Kg) | 18.1 | 19.2 | 17.6 | 20.2 | 18.4 | 20.5 | 17.8 | 19.2 | 19.0 |

N= 9, Mean of 18.9, Standard Deviation of 1.016

**Table 2. Cost and calorific value of a kilogram of the material, and quantity and cost of curing one kilogram of tobacco leaves**

| Fuel | Cost in Ksh. per Kg | Calorific value in MJ/Kg | Quantity of fuel to cure 1Kg of Tobacco | Cost/kg of tobacco leaves |
|---|---|---|---|---|
| Split wood (eucalyptus) | 20 | 19.2 | 4.2 | 84 |
| Non-split wood (indigenous tree) | 15 | 19.1 | 3.8 | 57 |
| Bagasse briquettes | 5 | 18.1 | 3.6 | 18 |

**Table 3. Profit margins (in USD) when different materials are used to cure tobacco at different production levels**

| Production level (yield in Kg/Ha) | Split wood (eucalyptus) Profit in USD | Indigenous Non-split wood Profit in USD | Bagasse Briquette Profit in USD |
|---|---|---|---|
| 1470 | -34 | 53 | 225 |
| 1600 | 213 | 300 | 472 |
| 1800 | 593 | 680 | 852 |
| 2000 | 973 | 1060 | 1232 |

**Table 4. Quantity of leaves cured, briquettes used and woody biomass saved**

| Year | Total leaves cured in Tons | Total briquettes used in Tons | Wood saved (split wood) ( Tons) | Wood saved (indigenous) (Tons) |
|---|---|---|---|---|
| 2012 | 12367 | 44532.5 | 18179.5 | 31486.4 |
| 2013 | 14673 | 528242 | 21569.3 | 36242.3 |

Number of farmers = 2,292 in 2012 and 2,563 in 2013.

**Table 5. Indicates the quantity of woody biomass saved in 2012 in each of the regions sampled**

| Area | Woody vegetative cover (tons/Ha) | No. Of farmers using briquettes | Amount of leaves cured (tons) | Amount of briquettes used (tons) | indigenous non-split wood saved (tons) | Indigenous vegetation cover saved (Ha) |
|---|---|---|---|---|---|---|
| Suba-Kuria | 38 | 279 | 1394 | 5022 | 3549.1 | 93.3 |
| Nyatike | 12 | 421 | 2391 | 8617 | 6087.5 | 507.3 |
| Kuria East | 11 | 514 | 3112 | 11190 | 7923.2 | 720.3 |
| Kuria West | 15 | 371 | 1942 | 6992 | 4944.3 | 329.6 |
| Oyani | 43 | 310 | 1601 | 5767.5 | 4076.1 | 94.8 |
| Rapogi | 16 | 397 | 1927 | 6944 | 4906.1 | 306.6 |
| Total | | 2292 | 12367 | 44532.5 | 31486.4 | 2052 |

sampled farmers in the last season to cure one kilogram of tobacco leaves [biomass/tobacco Leaves (in kgs)]. One sample t-test to determine the statistical difference between the quantity of bagasse-briquette, split wood and non-split wood used to cure one kilogram of tobacco leaves, with test value set at 3.59 kgs (the average quantity of bagasse-briquettes used to cure one kilogram of tobacco leaves), found out that the average quantity of bagasse-briquettes required to cure one kilogram of tobacco leaves was significantly lower than the quantity of split wood (4.19 Kgs, MD= 0.598, t-value = 20.579, p-value = 0.00) and indigenous non-split wood (3.81 Kgs, MD=0.216, t-value = 7.404, p-value = 0.00) to cure the same quantity of tobacco leaves.

One kilogram of briquettes was also found to be less costly (Ksh. 5) compared to the average cost of the same quantity of split wood (Ksh. 20) and non-split wood (Ksh. 15). The study therefore found out that it is comparatively lower (Ksh. 18) to use bagasse briquettes than non-split wood (Ksh.57) and split wood (Ksh.84) to cure a kilogram of tobacco leaves (table 2). This finding contradicts the earlier finding that bagasse-briquettes produced a significant lower calorific value compared to split wood and non-split wood. This contradiction could be attributed to wastages incurred on split wood and non-split wood during tobacco curing process. These findings are consistent with other studies conducted to evaluate bagasse-briquette as an alternative source of energy (Dantas *et al*., 2013).

**Economic savings by the farmers**

Economic savings by the farmer was evaluated by conducting a gross margin analysis when split wood (eucalyptus), indigenous non-split wood, or bagasse briquettes are used to cure tobacco leaves (Table 3). The analysis took into consideration only the price differences of the sources of energy to cure one kilogram of tobacco leaves at the local market as illustrated in Table 2. It is important to note that Alliance One Kenya provides their registered farmers with the briquettes free but the firm incurs overhead costs. Further analysis indicated that farmers incurred extra costs associated with wood fuel including cutting them into required sizes and splitting as opposed to briquettes. The profit margin analysis indicate that the farmer were still able to make profit at the breakeven level of production for both split wood and non-split wood by using briquettes (Table 3). Using briquettes to cure tobacco at all the production levels is the most profitable material. This is consistent with other studies conducted to evaluate the profitability of using agro-based briquettes as alternative energy sources including Hu *et al*. (2014), and Akowuah *et al*. (2012).

**Vegetation cover saved as a result of using the briquettes**

This was done by estimating the quantity of split wood and non-split consumed to cure tobacco in the last 2 years since the briquette factory was set up by getting the quantity of tobacco leaves cured using briquettes. The quantity of wood fuel saved was then converted to ground vegetation cover saved using the results of cross cut survey of woody vegetation cover. A total of 2,292 farmers were able to use briquettes to cure tobacco leaves in 2012, and another 2,563 farmers in 2013, resulting into 12,367 (10%) and 14,673 tons (11%) of flue cured tobacco leaves respectively (Table 3). The farmers were able to use 44532.5 tons and 528242 tons of briquettes in 2012 and 2013 respectively. Using the information from the cross sectional survey conducted on 200 farmers indicating that 67% of the tobacco farmers used indigenous trees as fuel before they adopted the use of briquettes, 31,486 tons or 73,363 (2.33 x 31486.4) cubic meters of indigenous woody biomass was saved in 2012, while 36,242.3 tons or 84,444.6 cubic meters of indigenous woody biomass was saved in 2013 (Table 4).

A cross cut analysis of woody vegetation cover indicated an average of 22.5 tons of woody biomass per hectare of land in the whole of Migori County. Kuria East and Nyatike regions has the lowest woody biomass per hectare of land at 11 and 12 tons/ha respectively while Suba-Kuria and Oyani had the highest woody biomass at 38 and 43 tons/ha respectively. The cross cut analysis of existing woody vegetation cover was used to calculate the size of land of woody vegetation cover saved in hectares as a result of using briquettes to cure tobacco leaves. This method is consisted with the method used by Geist, (1999) in determining the global deforestation due to tobacco production and is also consistent with methods used by others such as, Friedel and Chewings, (1988) and Lunt *et al*. (2010). A total of 2,052 hectares of woody vegetation was saved or conserved as a result of using bagasse briquettes in 2012 (Table 5). It is important to note that a larger size of land was conserved in areas with lower vegetation cover, not because the ground woody vegetation cover is sparse but because more farmers used briquettes (Table 5).

The woody biomass saved in 2012 was allowed to grow and become habitat to various micro organisms and macro-organisms, protect the soil from erosion as well as protect the rivers from siltation. Further analysis indicate a strong negative correlation (r = -0.846, p-value = 0.034) between the number of farmers taking briquettes and woody vegetation cover of the areas. For instance the highest number of farmers received briquettes in Kuria East had the lowest woody vegetation cover. This could mean that the farmers resorted to using briquettes because the natural vegetation to cure tobacco was lacking after continuous deforestation. This relationship can be used as a warning to environmentalists and forest officers to encourage farmers to conserve and preserve the existing vegetation cover.

**Conclusion**

Bagasse-briquettes is of significantly lower calorific value compared to split wood and non-split wood but within the range of materials commonly used to provide energy to cure tobacco leaves or cook meals in tobacco growing regions. This means that bagasse-briquettes can be used as alternative source of energy. Bagasse-briquettes are less costly compared to other sources of energy thereby giving the farmers an advantage of higher profit margins in tobacco production. Woody vegetation cover is significantly preserved by using bagasse briquettes to cure tobacco. The vegetation cover conservation due to use of bagasse briquette as an alternative source of fuel is concentrated more in areas with lower vegetation cover, while more destruction is taking place in areas with more vegetation cover to support the destruction. The study recommends an increased investment on the bagasse-briquette making machines to supply more briquettes to farmers in the tobacco growing region of the lake basin and beyond for curing tobacco and domestic consumption. The farmers in areas with higher vegetation cover are encouraged to adopt the use of bagasse-briquette as an alternative source of fuel to cure their tobacco leaves as opposed to wood fuel.

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## REFERENCES

Akowuah, J. O., Kemausuor, F. and Mitchual, S. J. 2012. Physico-chemical characteristics and market potential of sawdust charcoal briquette. *International Journal of Energy and Environmental Engineering*, doi:10.1186/2251-6832-3-20

Dantas, G. A., Legey, L. F. L. and Mazzone, A. 2013. Energy from sugarcane bagasse in Brazil: An assessment of the productivity and cost of different technological routes. Renewable and Sustainable Energy Reviews. doi:10.1016/j.rser.2012.11.080

Friedel, M. H. and Chewings, V. H. 1988. Comparison of crown cover estimates for woody vegetation in arid rangelands. *Australian Journal of Ecology*, 13, 463–468.

Geist, H. J. 1999. Global assessment of deforestation related to tobacco farming. Tobacco Control, 8, 18–28.

Government of Kenya. (2010). Agricultural Sector Development Strategy (2010-2020). Nairobi.

Hu, J., Lei, T., Wang, Z., Yan, X., Shi, X., Li, Z. and Zhang, Q. 2014. Economic, environmental and social assessment of briquette fuel from agricultural residues in China - A study on flat die briquetting using corn stalk. Energy, 64, 557–566.

Kibwage, J. K., Odondo, A. J. and Momanyi, G. M. 2009. Assessment of livelihood assets and strategies among tobacco and non tobacco growing households in south Nyanza region, Kenya. *African Journal of Agricultural Research,* 4, 294–304.

Leibbrandt, N. H., Knoetze, J. H. and Geargens, J. F. 2011. Comparing biological and thermochemical processing of sugarcane bagasse: An energy balance perspective. *Biomass and Bioenergy,* 35, 2117–2126.

Lunt, I. D., Winsemius, L. M., McDonald, S. P., Morgan, J. W. and Dehaan, R. L. 2010. How widespread is woody plant encroachment in temperate Australia? Changes in woody vegetation cover in lowland woodland and coastal ecosystems in Victoria from 1989 to 2005. *Journal of Biogeography,* 37, 722–732.

Otanez, M. and Glantz, S. A. 2011. Social responsibility in tobacco production? Tobacco companies' use of green supply chains to obscure the real costs of tobacco farming. Tobacco Control. doi:10.1136/tc.2010.039537

Phillips, A. 1995. Bellagio statement on tobacco and sustainable development. Bulletin of the Pan American Health Organization.

Quddus, M. A. and Mia, M. M. U. 2010. Agricultural Research Priority: Vision-2030 and beyond. Final report on food availability and consumption, postharvest losses, agro-processing technology, food safety and human nutrition, *Bangladesh Agricultural Research Council,* Dhaka (pp. 1–48).

Rabah, K. V. O. 2000. Sugarcane Residues as Biofuel for Cogeneration of Electricity in Kenya. In World Renewable Energy Congress VI (pp. 1340–1343).

Sauer, J. and Abdallah, J. M. 2007. Forest diversity, tobacco production and resource management in Tanzania. *Forest Policy and Economics,* 9, 421–439.

Singh, S. P., Asthana, R. K. and Singh, A. P. 2007. Prospects of sugarcane milling waste utilization for hydrogen production in India. *Energy Policy*, 35, 4164–4168.

Solomon, S. 2011. Sugarcane By-Products Based Industries in India. Sugar Tech. doi:10.1007/s12355-011-0114-0

Suhartini, S., Hidayat, N. and Wijaya, S. 2011. Physical properties characterization of fuel briquette made from spent bleaching earth. *Biomass and Bioenergy,* 35, 4209–4214.

WHO, 2013. WHO Report on the Global Tobacco Epidemic. WHO Report on the Global Tobacco Epidemic. doi:10.1002/aehe.3640230702

World Health Organization, T. 2011. WHO report on the global tobacco epidemic, 2011: warning about the dangers of tobacco. Most, 152, 1–152.

Yumak, H., Ucar, T. and Seyidbekiroglu, N. 2010. Briquetting soda weed (Salsola tragus) to be used as a rural fuel source. *Biomass and Bioenergy,* 34, 630–636.

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