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Social Factors Influencing the Adoption of Biogas in the Households of KISII Central District, Kenya

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Abstract:
This study was based on a research interested in the determining the social factors that influenced the adoption of biogas as a source of energy in the households of Kisii Central District, Kisii County, Kenya. A number of factors influenced the study. First, the District had been affected by fuel constrains, inadequate land, and diminishing forest resources. Secondly, the district was faced with rapid population growth, high demand for fuel for cooking, lighting and energy source to run homes. Thirdly, there was extensive use of traditional sources of fuel such as fuel wood and charcoal, a situation that lead to uncontrolled cutting down of trees.

In addition, there was pollution of environment through animal wastes and emission of smoke through burning charcoal and firewood. Fourthly, the District was listed among the areas where GTZ and government of Kenya (GoK) had constructed a number of biogas plants to be used as a source of household energy. The study was conducted in Kisii Central District, Kenya where a sample of 150 rural households comprising of 50 biogas users and 100 non-biogas users was used. The study showed that social factors such as Family size, Level of Education, Religion, Affiliation to social groups, and Cultural beliefs on cow dung had significant influence in adopting biogas as a source of household energy in the district.

There was a need to for serious and urgent policy measures that focus on widespread creation of awareness of biogas use and that would include all stakeholders in the district. The government should not leave NGOs like GTZ to run biogas programmes as private affair but should provide a framework that will protect the local people from exploitation by such groups. This will ensure sustainability in the biogas adoption not only in Kisii Central but also in Kenya at large.

Keywords: *Social factors, Influencing, Adoption, Biogas, Households*

1. Introduction

This paper provides an insight into the social factors influencing the adoption of biogas in the households of Kisii Central, Kisii County, Kenya. The. History of biogas use dates back to the 10 BC in Assyria when it was used to heat bathing water **(**Moutik, 2003). Moutik (2003**)** notes that, cow dung-fed digesters produced energy in Bombay, India in 1859. Since then, biogas use has spread across other countries such as Nepal, Germany, China, Colombia, Rwanda and United States of America, which have successfully used biogas as source of energy for household and industrial need, (GTZ, 2009). In these countries, it has substituted the costly Liquefied Petroleum Gas and hydroelectric power, thus improving people's living standards in the rural areas (Dutta, 2004).

Biogas technology was introduced in Kenya by Tunnel Technology Limited in the 1950s (O'keefe 2001). The company had constructed about 150 biogas plants by 1980s. Consequently, several households in different parts of the country, including Kisii central district adopted biogas technology as a source of household energy (O'keefe, 2001). The district was characterised by high population that acutely affected the available resources (Mironga, 2005). Fuel wood, the major source of energy was diminishing at a high rate due to reduced forest cover. Hence, the residents resulted in exploring alternative sources of energy (GTZ, 2009). In the late 1990s, the Government of Kenya, in collaboration with GTZ promoted biogas technology in the district (GTZ, 2009). Survey done by GTZ in 2009 to ascertain progress of biogas in the district showed that a few households had adopted it, despite having fuel constrains. According to the study, households in the district have basic requirements for biogas installation and sustenance. Such requirements include livestock farming under zero grazing units, small farms, skilled biogas construction companies, government support, and locally available materials for instance bricks (Bajgain and Shakya, 2005). This formed the

basis under which the study was done; to understand why most of the households in the district, despite having all the basic requirements for adoption of biogas had not done so. The study thus examined the socio-economic factors that the adoption of biogas for in the households of Kisii Central district, Kenya.

2. Methodology

The study area was Kisii Central District of Kisii County, Kenya. It is located in western Kenya, about 50 Kilometres east of Lake Victoria and about 380 Km North-West of Nairobi, 220 Km from Nakuru town. It is divided into five divisions namely Keumbu, Kisii township, Marani, Mosocho and Suneka. Temperatures in the district range from 10 °C to 31 °C (Mironga, 2005). According to GTZ (2009), this is an optimum temperature for biogas operation since a simple biogas plant in tropical regions function within a temperature range of 15^{o}C and 35^{o}C. On the other hand, the district lacks adequate infrastructure like electricity, telecommunications and sufficient roads inhibiting full exploitation of resources. According to the 2009 Kenya National Census, the district has an estimated rural population of 347,855 and 57,976 households.The study employed survey design. Survey design usually involves collection of data on a number of variables at a single juncture. Survey design is also referred to as correlation design to denote the tendency for such research to be able to reveal relationships between variables (Bryman & Cramer, 2001). One of the survey designs used in social science research is causal comparative research also referred to as *ex facto* research. The study used *ex post facto* design that involves teasing out possible antecedents of events (observing dependent variable) that have already occurred and cannot therefore, be engineered or manipulated by the researcher, then studied the independent variable in retrospect (Mugenda & Mugenda, 1999). It involved collecting information from biogas user and biogas non-users respondents. The design was suitable for the study since some households had already adopted biogas technology as a source of energy for cooking. Therefore, the factors could only be studied retrospectively. Moreover, the nature of the study required some respondents to have used biogas and others to be in a place where biogas was being used as a source of household cooking energy but had not adopted it. This was important because it gave information on what influenced some households to adopt biogas technology in the district. The data collected was later coded and analyzed using SPSS. After the analysis, the findings were presented in form of graphs, charts and tables. Thereafter, meaningful interpretations of the findings were done and recommendations made thereof.

3. Social Factors and the Adoption of Biogas

Perceptions and attitudes are social issues. People usually perceive things and form attitudes in relation to what they interact with regularly and depending on their socialization process. Perception of environmental degradation problems are related to the sources of household energy that have been adopted by residents of any particular region. Cook and Grut (1989) explicate that most adopt new practices based on perception of priority needs and services within their community, which arises due to prevailing poor environmental conditions. For example, under conditions of low population density, people ha adopt passive systems of protecting environment without engaging in active afforestation activities (Cook and Grut, 1989). In highly populated areas, the people adopt new practices like zero grazing cattle keeping. According to Singh (1988) cultural and social practices may hinder general uptake of innovations, due to reluctance to adopt different behaviour, particularly regarding the use of latrines and cattle dung in biogas systems.

The role of gender in the adoption of biogas has to be understood in the ethnic context in which the communities are operating. Moutik (2003) notes the woman is not necessarily the decision maker in a household and the man of the household may not consider benefits, which mainly accrue to the woman, to be of significant urgency. In some ethnic groups, gender roles have ceased to be such an issue. However, some like it is the case among the Abagussi and Luhya of western province of Kenya, gender plays a big role in influencing whether or not the farmers will adopt and practice new sources of energy for cooking (Moutik, 2003). Narayan et al (2000) states some fundamental questions; could it be that the women are simply ignoring the call for adoption of the new practices given that they are the ones whom do the kitchen work while the men control the resources that may be needed for the installation of the biogas technology? In line with this question, Narayan et al (2000) quoted a participant from Uganda during their PPAs in Uganda in 1998 as follows: “whether a woman wants it or not, the man must control the money, and if she refuses, she is in danger of being retrenched (sent away from home)”. He poses the second question that; is it possible that the men are the ones to decide the kind of practice to be adopted by the family and yet they are hardly available when such decisions are to be made? The poverty participatory appraisals (PPAs) also relate the entrenched nature of men’s identities as breadwinners and decision makers even as these roles are undermined and eroded by changing social and economic environments. These socially defined roles of men and women are not only unattainable; they sometimes are in stark contradiction with reality.

Rono (1999) claims that gender factor in rural development is a crucial variable that determines the level of community development and project performance. The way a society’s culture determines the distribution of social roles is very important, as this will manifest itself in the level of participation of men and women in development projects within that society community. In addition, Cotter et al (1996) notes that in the modern America, there are still differences between beliefs over whether women should work in paid labour force or not. Men and women accomplish certain goals differently. Traditionally, in most societies there were distinct roles for women and men as prescribed by the society. The distinctions touched on all matters affecting the society (Cotter et al, 1996).

Cotter et al (1996) found out that, in non-metropolitan areas 80.4% of the respondents approved of women working while 81.6% did in metropolitan areas, a difference Cotter et al attribute to the effects of traditional norms, close personal networks and less inequality within disadvantaged groups, or more limited employment opportunities in non-metropolitan areas. Women are likely to depend on societal expectations in order to make decisions on whether or not to adopt biogas. Narayan et al (2000) contend

that the household is the basic unit of society where individuals both co-operate and compete for resources. It is the primary habitation where individuals confront and reproduce societal norms, values, power, and privileges. Narayan et al (2000) further says that gender norms expressed within the household, are reinforced and reflected in the larger institutions of the society. According to Narayan et al (2007), gender relations are not confined to domestic arena, although households provide an important institutional site on which gender relations are not only played out but are made, remade, and contested in a range of institutional arenas. Narayan et al. (2000) found out that in the countries studied, women are identified and identify themselves as homemakers, the keepers of the family, a responsible for the well-being of their children and husbands.

Lekesike (1998) asserts that men's senior positions in decision-making are crucial aspects as far as women participation in development is concerned. This was so among the Samburu community whom he studied and he concluded that they still cling to traditional ways of doing things. He reported that despite the changing roles and socio-economic status in the society, male dominance is still prevalent in the Samburu community (Lekesike, 1998). Bo Tengnas (1994) argues that the gender factor in relation to tree growing covers the roles that male and female family members play in tree planting, tending and harvesting. He further asserts that in different societies there are differences in responsibilities, user rights, legal status, division of labor, decision–making etc., between men and women. Dima et al (1994) found out the following socio-cultural constraints in tree planting: Trees are owned by men, tree planting is dominated by men, taboos prevented women from participating in tree planting- trees are planted for poles, construction purposes and for sale but not for fuel wood and that, fuel wood collection is women's duty.

Chivanga (1989) concurs with Dima et al (1994) on the concern of taboos preventing women's participation in tree planting. He argues that women's lack of participation in tree planting is sustained through various taboos and beliefs. In his study on Socio-economic issues in agro-forestry in Kakamega, he cited examples such as; beliefs that if a woman plants trees her husband will die, or that she will be barren. Since traditionally child bearing is the only guarantee of stability in marriage, no woman would dare plant trees for fear of becoming barren. Similarly, the life of a widow is difficult and no woman would plant trees if doing so is seen as a threat to her husband's life. Older women who already have the number of children they want can, however, plant trees and often do so (Chivanga, 1989). In a story, "Maine woman teaches organic farming in Kenya," Chivanga (2004) is reported to have said, "In Mangu, a small village in Nakuru district, Kenya, women do all the work; they plant, harvest, weed, run the family and the home and are responsible for their children's education. The men are supposed to work but it is impossible to find jobs."

A number of social factors unique to Nepal have contributed to successful adoption of biogas technology. Biogas systems fit very well into the Nepalese integrated farming system, which combines crop production and animal husbandry (Hansen, 1995). Most rural households in Nepal rear some cattle and the dung collected feeds biogas digesters. BSP-N (2004) notes that handling of cattle dung is not a taboo in Nepal and therefore feeding biogas digester does not counteract people's values and norms. The success in the development of biogas in Nepal can be applied into the Kenyan situation because many Kenyans in rural areas practice mixed farming, integrating crop production and animal husbandry, thus the cow dung can be collected to feed biogas digesters (GTZ, 2009). This would highly supplement or replace the costly sources of fuel such as hydroelectric power and liquefied petroleum gas (LPG). Further, there would be environment protection from felling of trees for wood fuel and charcoal burning. The promotion of biogas by Food and Agriculture Organization and Swedish International Development Cooperation Agency Farming Systems Programme in Kenya was questionable because it did not seem to have much effect in Kenya (GTZ, 2009).

According to AEPC (2000), 75% of the biogas owners in Nepal are educated. However, AEPC (2000) expounds that it is very difficult to convince uneducated farmers about the importance of a biogas plant. While it's not directly BSP's role to reduce illiteracy, it is necessary to keep this indicator in mind in promotional and information transfer-related activities (AEPC, 2000). BSP has promoted biogas through radio and TV broadcasting, exhibitions and its user trainings and manual are largely illustrative with little text. Nonetheless, it must be said that BSP was not targeting the very poorest segment of the rural population, as other factors, like the initial investment costs, would leave out the option of biogas use for a large part of rural population. AEPC (2000) shows that he previous sections have contributed to the understanding of how to overcome barriers in sustainable biogas dissemination in Nepal from the perspective of the technology itself, the multi-actor programme approach and the GoN. Overall, it is proven that benefits of biogas plants can have a positive impact on basic livelihood indicators as well as rural economic development. The Nepalese biogas sector contributes to the development of other sectors, among others, agriculture (through bio-slurry use), sanitation (through attachment of a latrine to the plant), financing (loan product development for farmers) and construction (increase in skilled labour through training). BSP has positively affected the lives of the poor and especially women and children in the rural areas. BSP has provided a number of important lessons regarding implementation for other alternative energy initiatives in Nepal and other countries. In addition to the general successes described in this paper, one of the most important achievements of BSP is the sense of ownership it has managed to generate amongst the stakeholders. This achievement cannot be minimized, as it is a key factor in the overall success.

4. Results

The objective of this study was to analyse the relationship between social factors and adoption of biogas in the households of the Kisii Centraldistrict. Social factors were analysed in seven dimensions namely, level of education, family size,religion, affiliation to cooperative societies, cultural values on handling of cow dung, source of information on biogas, and gender roles in decision-making. Biogas adoption was assessed by considering two dimensions; owned biogas plant and used it for cooking, and had not adopted biogas. These dimensions were used to capture the full complexity of the two concepts under the study.

The relationship between highest level of education and biogas adoption is as indicated on table 1 below.

		Use biogas		
Highest Level of Education		**Yes**	**No**	**Total**
No formal education	Count	0	36	36
	Expected Count	12.0	24.0	36
	% within Highest Level of Education	0.0	100.0	100
	Residual	-12.0	12.0	
Primary	Count	6.0	45.0	51
	Expected Count	17.0	34.0	51
	% within Highest Level of Education	11.8	88.2	100
	Residual	-11.0	11.0	
High School	Count	19.0	9.0	28
	Expected Count	9.3	18.7	28
	% within Highest Level of Education	67.9	32.1	100
	Residual	9.7	-9.7	
Diploma	Count	9.0	6.0	15
	Expected Count	5.0	10.0	15
	% within Highest Level of Education	60.0	40.0	100
	Residual	4.0	-4.0	
Degree	Count	16.0	4.0	20
	Expected Count	6.7	13.3	20
	% within Highest Level of Education	80.0	20.0	100
	Residual	9.3	-9.3	
Total	Count	50.0	100.0	150
	Expected Count	50.0	100.0	150
	% within Highest Level of Education	33.3	66.7	100

X^2 = 68.094 *df = 4* *p = 0.000* *Cramer's V = 0.674*

Table 1: Highest Level of education by biogas adoption
Source: Field Data (2010)

Table 1above shows the cross tabulation of level of educationand biogas adoption. Chi-square is 68.094, Cramer's V value is 0.674, degree of freedom is 4 and Chi-square p value is 0.000.

This study sought to establish the number of people that were living and feeding under the same roof in order to establish the income per-capita and its relationship with household adoption of biogas. The study therefore investigated the phenomenon and tabulated the results as shown on table 2 below.

Statistic	**Value**
n	150
Mean	5.1133
Median	5.0000
Mode	6.00
Minimum	2.00
Maximum	9.00

Table 2: Statistics of the Household Size
Source: Field Data (2010)

Table 2 above shows the distribution of respondents by household size. The table discloses that the average number of household size in the region was 5, with most households having 6 members. The minimum number of members was 2 while the maximum was 9.

Further, the study sought to find out whether there was association between household size and biogas usage. The results of the analysis are as shown on table 3 below.

		Use biogas		
Household Size		**Yes**	**No**	**Total**
1 to 3	Count	11	8	19
	Expected Count	6.3	12.7	19
	% within Size of Household	57.90%	42.10%	100.00%
	Residual	4.7	-4.7	
4 to 6	Count	30	21	51
	Expected Count	17	34	51
	% within Size of Household	58.80%	41.20%	100.00%
	Residual	13	-13	
7 to 9	Count	9	39	48
	Expected Count	16	32	48
	% within Size of Household	18.80%	81.30%	100.00%
	Residual	-7	7	
10 and above	Count	0	32	32
	Expected Count	10.7	21.3	32
	% within Size of Household	0.00%	100.00%	100.00%
	Residual	-10.7	10.7	
	Count	50	100	150
	Expected Count	50	100	150
Total	% within Size of Household	33.30%	66.70%	100.00%

X^2 = 40.663 *df = 3* *p = 0.000* *Cramer's V = 0.521*

Table 3: Size of household and biogas use
Source: Field Data (2010)

Table 4-14 above show that the Chi-square is 40.663, df is 3, Chi-squre p-value is 0.000 while Cramers V is 0.521.

This study also analysed relationship between religious affiliation of the respondents and biogas adoption. The study findings are tabulted on table 4 below.

		Religion			
Use biogas		**Christian**	**Muslim**	**African tradition**	**Total**
Yes	Count	50	0	0	50
	Expected Count	48	0.3	1.7	50
	% within Religion	34.70%	0.00%	0.00%	33.30%
	Std. Residual	0.3	-0.6	-1.3	
No	Count	94	1	5	100
	Expected Count	96	0.7	3.3	100
	% within Religion	65.30%	100.00%	100.00%	66.70%
	Std. Residual	-0.2	0.4	0.9	
	Count	144	1	5	150
	Expected Count	144	1	5	150
	% within Religion	100.00%	100.00%	100.00%	100.00%

X^2 = 3.125 *df = 2* *p = 0.210* *Cramer's V = 0.144*

Table 4: Religion and use of biogas
Source: Field Data (2010)

Table 4 indicate that all 50 (100%) biogas users were Christians and 94% of biogas non-users were Christians. The chi square value was 3.125 with df being 2, p=0.210, and Cramer's V was 0.144.

This study further analysed question on whether there were taboos influencing the adoption of biogas. The results are as shown on figure 1 below.

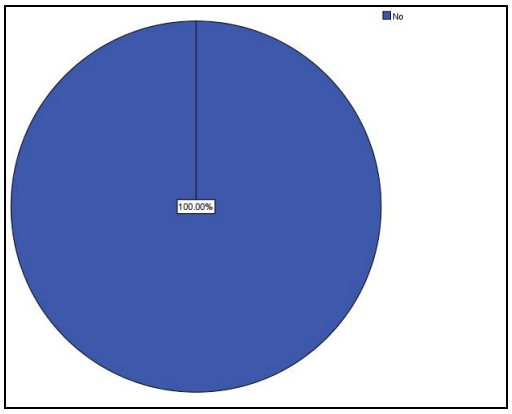

Figure 1: Beliefs / Taboos on Handling of Cow Dung

Examination of figure 1above reveal that 100% of the respondent said no to the question on whether there are traditional beliefs / tabooson handling of cow dung.

This study analysed decision-making in relation to the sources of energy used at household level in Kisii Central district. Findings of the results are as shown table 5 below.

	Frequency	**Percent**
Male Partner	139	92.7
Female Partner	5	3.3
Both Partners	6	4
Total	150	100

Table 5: Decision-Maker on Source of Energy to Use
Source: Field Data (2010)

Table 5above illustrate that household heads made the final decision on what source of energy touse as reported by 92 percent (139) of the respondents.

On household heads decision-making on sources of energy to use, the study compiled the results as shown on table 6 below.

		Decision-maker on sources to use			
Head of the household		**Partner**	**Partner**	**Both**	**Total**
Male	Count	139	2	6	147
	Expected Count	136.2	4.9	5.9	147
	% within Head of the household	94.60%	1.40%	4.10%	100.00%
	% within Decision-Maker on what Sources of Energy to Use	100.00%	40.00%	100.00%	98.00%
	Std. Residual	0.2	-1.3	0	
Female	Count	0	3	0	3
	Expected Count	2.8	0.1	0.1	3
	% within Head of the household	0.00%	100.00%	0.00%	100.00%
	% within Decision-Maker on what Sources of Energy to Use	0.00%	60.00%	0.00%	2.00%
	Std. Residual	-1.7	9.2	-0.3	

	Count	139	5	6	150
	Expected Count	139	5	6	150
	% within Head of the household	92.70%	3.30%	4.00%	100.00%
	% within Decision-Maker on what Sources of Energy to Use	100.00%	100.00%	100.00%	100.00%

$X^2 = 88.77$ df = 2 p = 0.000 Cramer's V = 0.769

Table 6: Head of the household by decision-making on the sources of Energy to Use
Source: Field Data (2010)

Table 6 above indicates the relationship between household head and decision making on source of energy to use for cooking. Cramer's V is 0.769, p is 0.00, while df is 2.

The study investigated whether respondents belong to any cooperative societies and recorded the despondences as shown on figure 2 below.

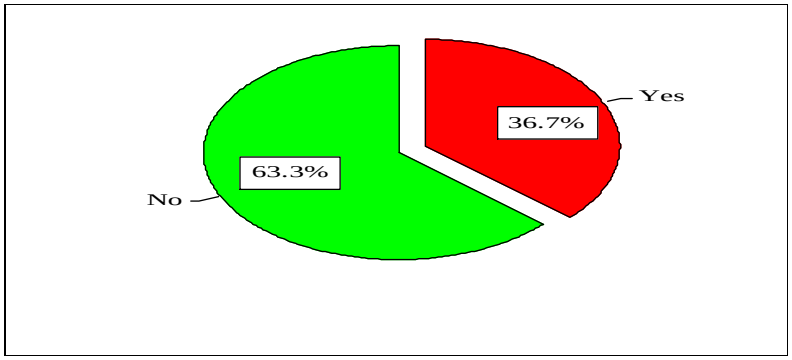

Figure 2: Membership to Cooperative Society

Figure 2 above indicates that 63.3% of respondents did not belong to any cooperative society as opposed to 36.75 who belonged to belonged to cooperative societies.

On whether belonging to cooperative society played any role in biogas promotion the responses are as shown on figure 3 below.

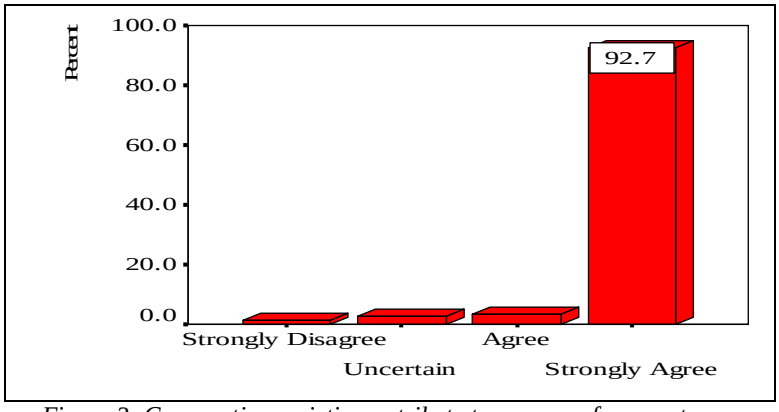

Figure 3: Cooperative societiescontribute to sources of energy to use

Figure 3 above indicate that 92.7% strongly agreed, 3.3% agree, 2.7% uncertain while 1.3% strongly disagreed.

Further, this sociological inquiry analysed the correlation of biogas use and belonging to cooperative society. The study findings are as shown on table 7 below.

		Use biogas	**Belong to coop society**
Use biogas	Pearson Correlation	1	.929(**)
	Sig. (2-tailed)	.	.000

	N	150	150
Belong to cooperative society	Pearson Correlation	.929(**)	1
	Sig. (2-tailed)	.000	.
	N	150	150

** Correlation is significant at the 0.01 level (2-tailed).

Table 7: Use of biogas and membership to Cooperative Societies
Source: Field Data (2010)

As indicated by table 7 above, the correlation of biogas use and belonging to cooperative society is 0.929.

5. Conclusions and Implications

Biogas adoption has often been explained in terms of introduction, utilization and spread all over the world. In spite of this, biogas has not yet been adopted in many households not only in Kisii Central district, but also in many parts of Kenya. From the findings of the study, biogas information remains a crucial factor especially the source of information. This is so because the source will determine other factors such as cost of construction materials required, cost labour, and the sustainability of the biogas plant. The study also established a strong relationship between biogas adoption and the source of biogas information. The study therefore concludes from here that, though adoption is related to biogas awareness, the adoption and sustainability of biogas in the households of Kisii Central district is also influenced by social and economic factors.

The study affirms that socio-economic factors play a significant role in influencing adoption of biogas. From the findings, the more one gets biogas information and has resources for the adoption of the biogas as well as the function-ability of the technology, the higher the propensity to adopt biogas. The study also established that other sources of energy, household heads occupation and land size owned by an individual influence adoption of biogas in Kisii Central district.

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