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### **Title**

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# THE LUMINA PROJECT

<http://light.lbl.gov>

## Research Note #2

### Self-reported Impacts of LED Lighting Technology Compared to Fuel-based Lighting on Night Market Business Prosperity in Kenya

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*#Renewable Energy Systems Revival Africa*

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*Left-to-right: a Pressure lamp, hurricane lamp, and LED lamp illuminate night market businesses*

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*The Lumina Project includes an Off-Grid Lighting Technology Assessment activity to provide manufacturers, resellers, program managers, and policymakers with information to help ensure the delivery of products that maximize consumer acceptance and the market success of off-grid lighting solutions for the developing world. Periodic Research Notes present new results in a timely fashion between the issuance of more formal and lengthy reports. Our results should not be construed as product endorsements. For a full archive of Research Notes and Technical Reports see: <http://light.lbl.gov/library.html>*

## Premise

The notion of “productive use” is often invoked in discussions about whether new technologies improve productivity or otherwise enhance commerce in developing-country contexts. It is an elusive concept, especially when quantitative measures are sought. Improved and more energy efficient illumination systems for off-grid application—the focus of the Lumina Project—provide a case in which a significant productivity benefit can be imagined, given the importance of light to the successful performance of many tasks, and the very low quality of baseline illumination provided by flame-based sources.

This Research Note summarizes self-reported quantitative and qualitative impacts of switching to LED lighting technology on the prosperity of night-market business owners and operators. The information was gathered in the context of our 2008 market testing field work in Kenya’s Rift Valley Province, which was performed in the towns of Maai Mahiu and Karagita by Arne Jacobson, Kristen Radecsky, Peter Johnstone, Maina Mumbi, and others. Maai Mahiu is a crossroads town; provision of services to travelers and freight carriers is a primary income source for the residents. In contrast, the primary income for Karagita’s residents is from work in the large, factory style flower farms on the eastern shores of Lake Naivasha that specialize in producing cut flowers for export to the European market. According to residents, both towns had populations of 6,000 to 8,000 people in June 2008.

We focused on quantifying the economics of fuel-based and LED lighting technology in the context of business use by night market vendors and shop keepers. Our research activities with the business owners and operators included baseline measurement of their fuel-based lighting use, an initial survey, offering for sale data logger-equipped rechargeable LED lamps, monitoring the adoption of the LED lamps, and a follow-up survey. (See Radecsky et al., 2008; details are available at <http://light.lbl.gov/field.html>)

The people whose photographs, thoughts, and opinions are presented here are a subset of those who purchased LED lighting products during our study and completed both surveys. Their qualitative statements about LED products were translated to English from the original Kikuyu and Swahili in the field by Maina Mumbi and were responses to the one or more of the following questions:

- “How do you feel the LED lamp has impacted your business in terms of revenue, customer attraction, hours of operation, or other factors?”
- “What are things you liked about the LED lamp?”
- “What are problems you had with the LED lamp?”
- “What do you tell others about the LED lamp?”

*Lumina researcher Kristen Radecsky measures the burn rate of a hurricane-type kerosene lamp at a Maai Mahiu business [7/2008]*



## Summary

- Overall, people who purchased and/or operated LED lamps as part of our research effort have been happy with their choice. The lamps were purchased at unsubsidized market prices by approximately 60% of those to whom they were originally offered. We offered to buy the lamps back for the full price in January 2009 after about six months of use and none of the lamp buyers accepted the offer.
- The operating costs of the LED lamps we marketed were perceived by buyers and measured by our team to be lower than the operating costs of kerosene lamps, even if one pays to charge their LED lamp at a charge-shop. The typical price for charging an LED lamp at a shop is 20 Ksh/charge (~US\$0.28), which lasts for 2-5 days depending on use.
- When LED lamps are novel and scarce they tend to give a comparative advantage to early-adopting businesses compared to businesses still using fuel-based lighting. The advantages are attributed to attraction of customers and the quality of lighting service from LED lamps. Business owners reported that their LED lamps tend to attract customers because people are not generally familiar with LED lighting technology and are interested to look closer. Some of the interested people subsequently purchase goods. Also, there is a sense among business owners that potential customers can see goods more clearly when they are illuminated by an LED lamp, which is thought to increase sales. Therefore, the distribution of market activity appears to be impacted by early adoption of LED lamps, but more research would be required in order to determine the effect of widespread LED lighting on overall night market activity.
- LED lamps are perceived to be safer than kerosene lamps, particularly around children.
- There is significant interest in purchasing LED lighting products similar to the ones we deployed, both among the general public and night market vendors who did not participate in the market test. Several research participants who purchased LED lamps report that they are asked very often where they purchased the lamp and if more are available. (Currently, there is no source for similar LED lighting products in the places we worked.)



*A night market vegetable stand operator in Maai Mahiu using two illumination sources: An LED lamp for directional light and a Hurricane lamp for ambient light [1/2009]*

**“M.J.”  
Market: Maai Mahiu**

<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Hurricane lamp (20 Ksh/night)
<i>Post 07/2008</i>	LED-NiMH lamp (~0 Ksh/night) (grid-charged at home)

“I stay open longer now than before. I’ve noticed more customers are attracted to my business in the evening compared to before, and they can see my goods more clearly. More customers means more sales and more money for me. Some people come from far [out of their way] to see the lamp, [due to the novelty of the lamp.]”  
[1/2009]



*Left: M.J.’s kiosk [7/2008]*

*Below: M.J. smiling and leaning on the front of his kiosk [1/2009]*





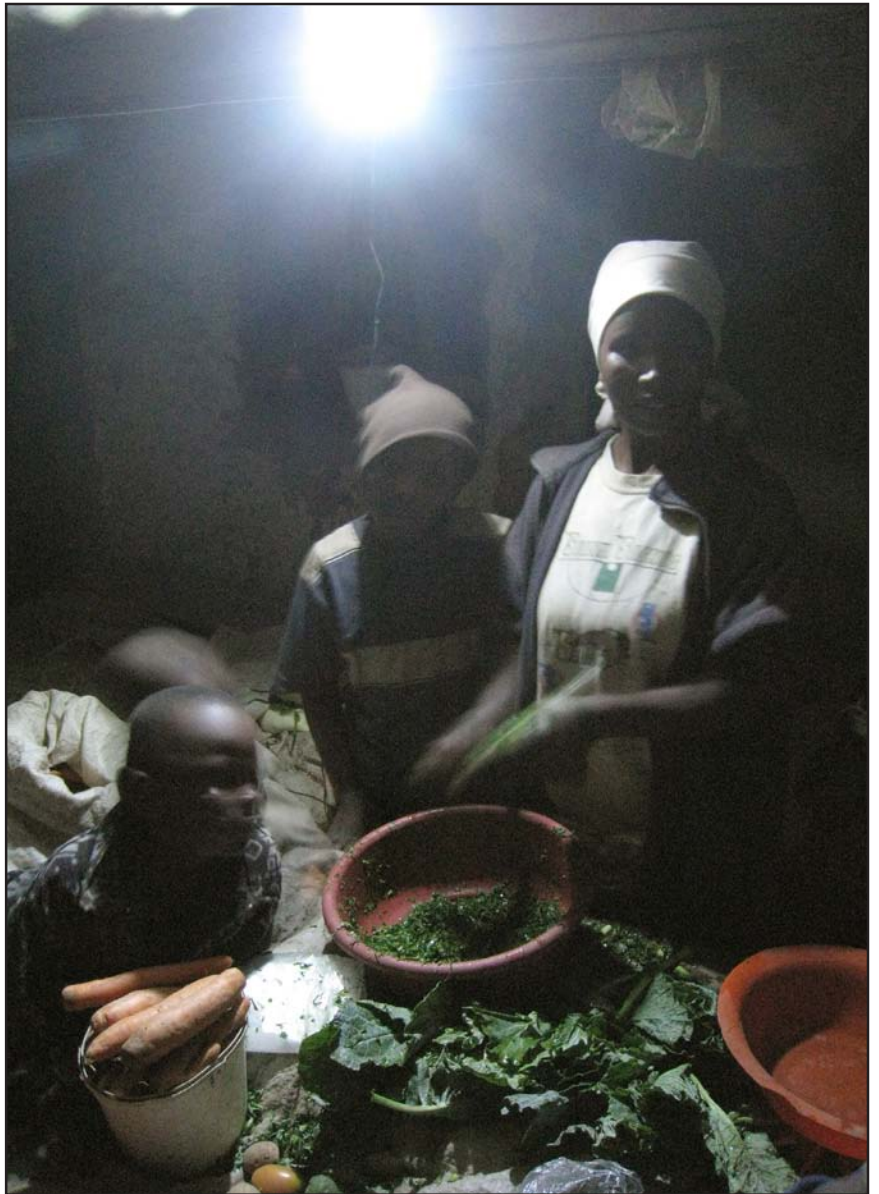
*Top: "Before" - M.J. inside his kiosk, illuminated by his hurricane lamp [7/2008]  
Bottom: "After" - M.J. inside his kiosk, illuminated by his LED lamp [1/2009]*

<b>“L.N.”</b> <b>Market: Karagita</b>	
<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Hurricane lamp (10 Ksh/night)
<i>Post 07/2008</i>	LED-NiMH lamp (7 Ksh/night) (pays to charge at a shop)

“The [LED] lamp saves money for me because I charge it once and use for three days, and if [I were still using] kerosene I would purchase [kerosene] every day. It is brighter than the kerosene lamp.” [1/2009]



*L.N. and others in her market stand listen to a Lumina Project researcher, Maina Mumbi (the man in light blue), explain the purchase agreement for a datalogger-equipped LED lamp. [7/2008]*



*L.N. cutting kale by the light of her LED lamp [1/2009]*



*L.N.'s market stand as viewed from across the street [7/2008]*



**“M.N.”**  
**Market: Maai Mahiu**

<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Pressure lamp (30 Ksh/night)
<i>Post 07/2008</i>	LED-NiMH lamp (7 Ksh/night) (pays to charge at a shop)

“The LED lamp has reduced my kerosene intake and this saves me money. Before I bought [kerosene worth] Ksh 30 every day for my [pressure] lamp. [It is inconvenient that] the [LED] lamp has to be taken [to a shop] for charging and I have to pay. [But, the LED lamp is] very useful, I even use it in the morning when I wake up. Many people ask about the [LED] lamp...” [1/2009]



*Above: M.N. inside the back room where she prepares food for sale by the light of a pressure lamp. [7/2008]*



*Right: M.N. in front of her vegetable stand [7/2008]*



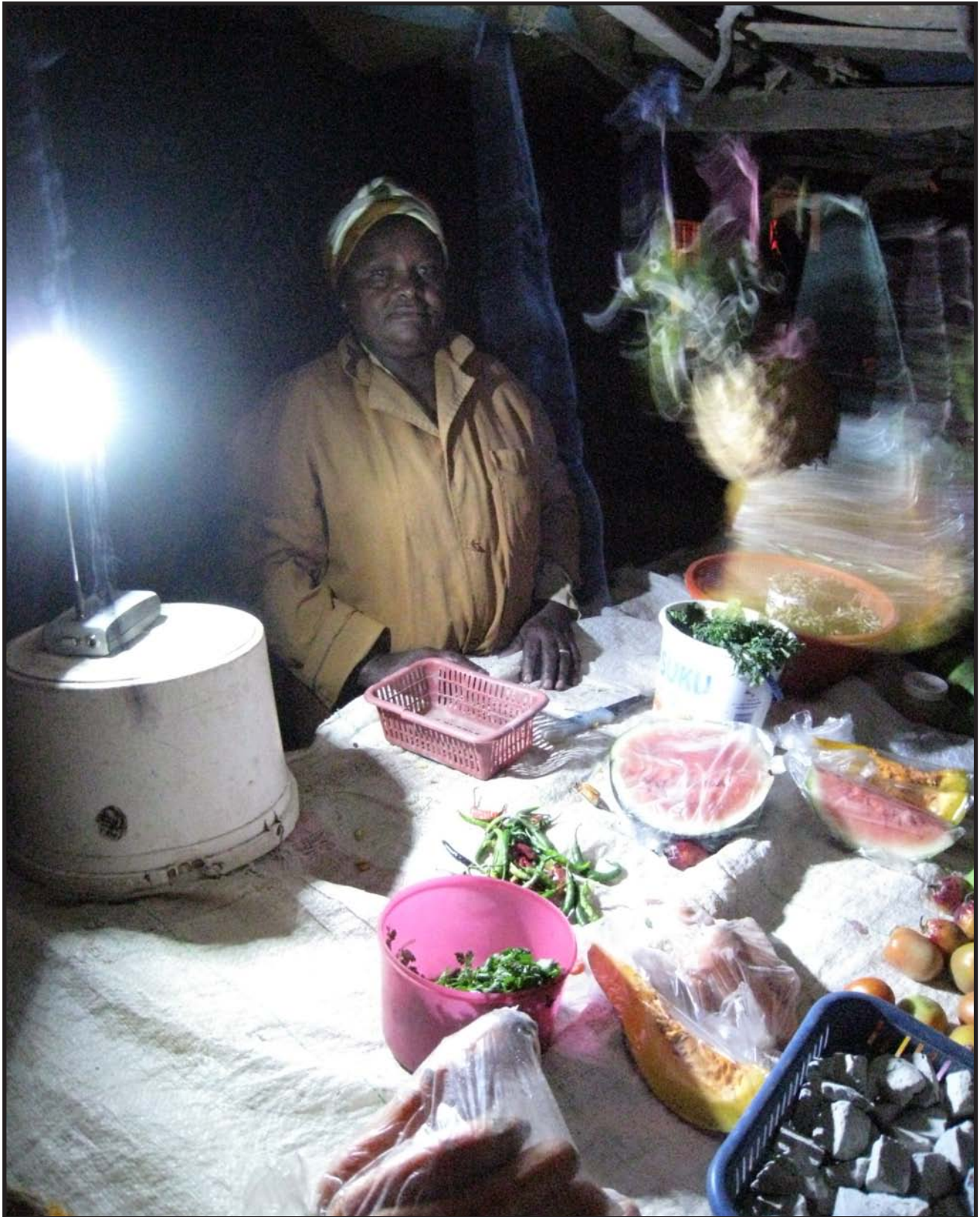
*M.N. in the back room, preparing and packaging Githeri (beans and corn) by the light of her LED lamp [1/2009]*

<b>“M.N.”</b> <b>Market: Karagita</b>	
<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Pressure lamp (30 Ksh/night) and LED-dry cell torch (2 Ksh/night)
<i>Post 07/2008</i>	LED-NiMH lamp (5 Ksh/night) (pays to charge at a shop)

“The [LED] lamp has helped me very much. It is good, since I bought it I have stopped using kerosene. I didn’t feel [the impact] when there was a kerosene shortage.” [1/2009]



*M.N. next to her market stand [7/2008]*



*M.N. takes a break from selling to pose for a quick photo on a busy night. Her stand is illuminated by an LED lamp. [1/2009]*

<b>“J.N.”</b> <b>Market: Maai Mahiu</b>	
<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Hurricane lamp (15 Ksh/night)
<i>Post 07/2008</i>	LED-NiMH lamp (7 Ksh/night) (pays to charge at a shop)

“The lamp attracts people very much, and [my] business is increased. Many people ask about the lamp and I tell them how well it works, saving me very much money on fuel.” [1/2009]

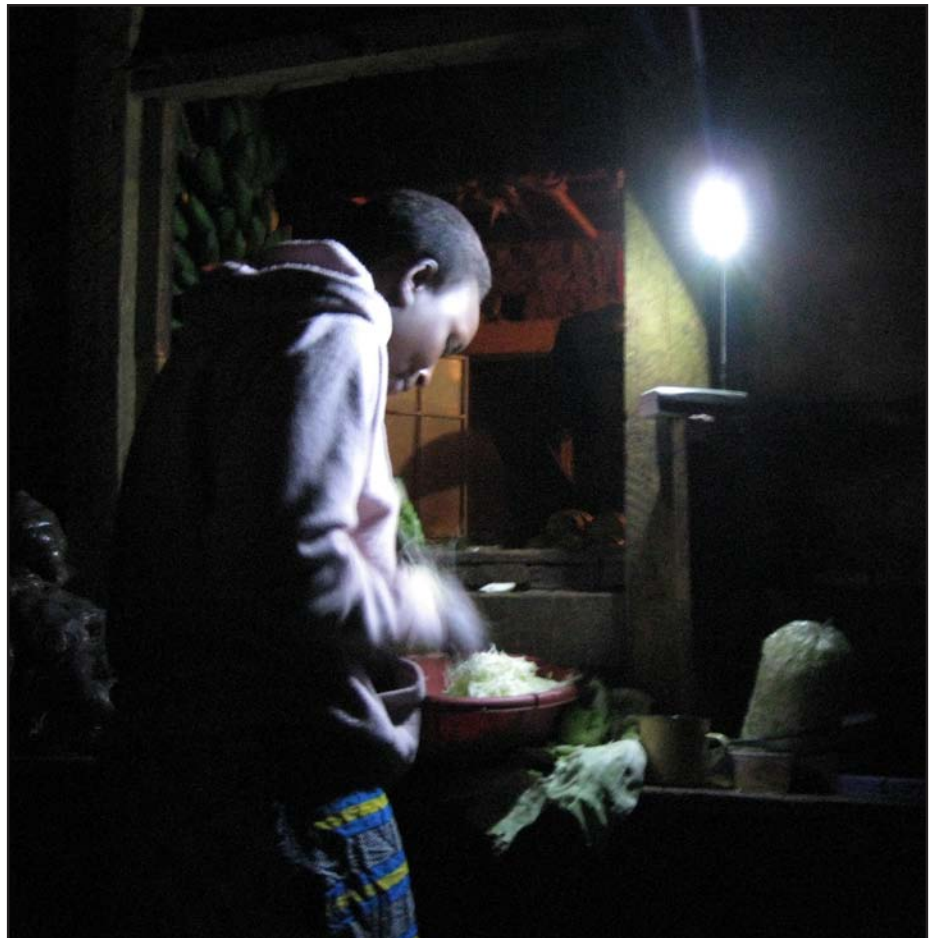


*J.N. in front of her market stand [7/2008]*

*J.N.'s sister minds the shop,  
illuminated by an LED lamp  
[1/2009]*



*One of J.N.'s neighbors came to  
chop kale by the light of the LED  
lamp [1/2009]*



<b>“E.W.”</b> <b>Market: Maai Mahiu</b>	
<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Hurricane lamp (20 Ksh/night)
<i>Post 07/2008</i>	LED-NiMH lamp (7 Ksh/night) (pays to charge at a shop)

“[The LED lamp is] safer than kerosene lamps in terms of fire, glass breaking, and other things. My customers have increased since I bought the lamp, they are attracted by the light and thus buy things in the process [of coming to look at it]. My revenue has increased since before, [but] my time of operation has not changed.” [1/2009]



*E.W. inside her market stand [1/2009]*



*Above: E.W. cuts potatoes by the light of her LED lamp [1/2009]*

*Below: E.W. and her children in front of her market stand [1/2009]*





<b>“P.M.”</b> <b>Market: Maai Mahiu</b>	
<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Hurricane lamp (15 Ksh/night)
<i>Post 07/2008</i>	LED-NiMH lamp (10 Ksh/night) (pays to charge at a shop)

“The light attracts my customers and I make more money. The lamp is good, works well, and helps my customers to see. [It is] brighter than a kerosene lamp. [However,] the lamp has to be charged every two days and I would like it to last longer” [1/2009]



*P.M. inside her kiosk, surrounded by goods for sale [1/2009]*



*Above: P.M.'s selection of produce on the platform in front of her kiosk window [1/2009]*

*Below: P.M.'s kiosk illuminated by her LED lamp [1/2009]*



<p style="text-align: center;"><b>“A.N.”</b>  <b>Market: Maai Mahiu</b></p>	
<b>Time period</b>	<b>Lighting Technology (Nightly Cost, Ksh)</b>
<i>Pre 07/2008</i>	Pressure lamp (20 Ksh/night)
<i>Post 07/2008</i>	Pressure lamp (25 Ksh/night) and LED-NiMH lamp (4 Ksh/night) (pays to charge at a shop)

“The [LED] lamp is very important and my husband would not like it to be moved away from the business. We recently shifted to our new home, and I would have liked to take it. I want to buy another one for the house.”  
[1/2009]



*A.N. and her husband in the back room of their market stand, illuminated by a pressure lamp [7/2008]*



*View of A.N.'s  
market stand  
from the street  
[7/2008]*



*A.N.'s market stand at dusk,  
illuminated by a pressure  
lamp; the kiosk to the right is  
illuminated by a hurricane lamp.  
[1/2009]*