Marketing Channels, Wages and Employment: Wula Nafaa in Senegal

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For Presentation at the International Conference of Agricultural Economics

June 24, 2014

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Abstract

One of the policy goals in the U.S.'s Feed the Future agenda involves increasing the profitability of smallholder agriculture by increasing the investments in marketing channels. One program that falls under this rubric is Wula Nafaa in Senegal. This study demonstrates that the Wula Nafaa program led to changes in the employment pattern at the village level which imply increased wages in these villages.

Keywords: marketing margins, agribusiness development, agro-forestry, forest resources, poverty reduction

JEL Codes: O10, C12, Q26

1. Introduction

This paper examines the effect of Wula Nafaa on the village employment patterns in the Teambacounda and Kedougou regions of Senegal. Wula Nafaa is part of the U.S.'s Feed the Future initiative to reduce global hunger and increase food security. Lanjouw and Lanjouw (2001), Haggblade, Hazell, and Reardon (2009) and Brooks et al. (2013) recognize the impact of non-farm employment as an important attribute in the development process. De Janvry and Sadoulet (2010), Christianesen and Todo (2014) recognize off-farm employment as an important source of poverty reduction. Programmatically, Wula Nafaa falls under the Feed the Future's goal to increase the private incentives for investments in more environmentally friendly production activities. Specifically, Wula Nafaa provides incentives for investments in natural products (i.e., baobab fruit and lalo) by providing technical expertise and capital for the development of the marketing

channels. By increasing these activities, one of the policy objectives is to shift the region away from the production of charcoal while increasing household income.

2. Marketing Channels and Village Employment

At the most basic level we envision a number of potential entrepreneurs within a village that choose the level of inputs to maximize profit

$$\max_{x} p'f\left(x,z\right)-w'x \tag{1}$$

where p is a vector of output prices, $f\left(x,z\right)$ is a vector valued production function based on variable inputs x and quasi-fixed inputs z, and w is a conformable vector of input prices for variable inputs. Next, we consider a slight modification to Equation 1 which incorporates marketing costs at the firm level

$$\max_{x_1,z_2}\left(p-\tau\left(z_2\right)\right)'\ f\left(x,z_1\right)-w'x \tag{2}$$

where $\tau\left(z_2\right)$ is the marketing margin faced by the agribusiness. In addition, we now divide the quasi-fixed assets for the agribusiness into traditional quasi-fixed assets (z_1) such as the entrepreneur's labor and capital used in production and z_2 which is capital or investments in the marketing channel. Intuitively, investment in this second type of capital item reduces the price spread

$$\frac{\partial\tau\left(z_2\right)}{\partial z_2}<0\ . \tag{3}$$

In equilibrium the marginal return on capital invested in the marketing channel equals the marginal return on capital invested the firm's primary production activity. The basic concept is that the overall level of capital is constrained in the context of the developing country.

Next, we change the specification of the production function in Equation 2 by assuming that the production decisions for two goods (i.e., charcoal and natural products) are separable

$$\max_{x} \left(p_1 - \tau_1\left(z_{21}\right)\right) f_1\left(x_1, z_{11}\right) + \left(p_2 - \tau_2\left(z_{22}\right)\right) f_2\left(x_2, z_{12}\right) - w'\left(x_1 + x_2\right) \quad z_{11} + z_{12} \le z_1,\ z_{21} + z_{22} \le z_2 \tag{4}$$

where $f_1(.)$ and $f_2(.)$ are the production functions for output 1 and output 2, x_1 and x_2 are the vectors of inputs used in the production of output 1 and output 2, and z_{11} and z_{21} are the levels of quasi-fixed inputs used in the production of output 1 and z_{12} and z_{22} are the quasi-fixed inputs used in the production of output 2. The profit maximization problem in Equation 4 yields two different demand functions for variable inputs: $x_1\left(p_1, p_2, w; z_1, z_2\right)$ - the derived demands for inputs used in the production of output 1 and $x_2\left(p_1, p_2, w; z_1, z_2\right)$ - the derived demands for inputs used in the production of output 2.

The goal of programs such as Wula Nafaa is to shift the production decisions through changes in the marketing margins. Without loss of generality, let us assume that output 1 is charcoal. As a traditional product, we assume that it has a zero (or near zero) marketing margin. Given this assumption the specification in Equation 4 can be simplified to

$$\max_{x} p_1 f_1\left(x_1, z_{11}\right) + \left(p_2 - \tau_2\left(z_2\right)\right) f_2\left(x_2, z_{12}\right) - w'\left(x_1 + x_2\right) \quad z_{11} + z_{12} \le z_1 . \tag{5}$$

Under this scenario, the value of an additional unit of capital in marketing is

$$\frac{\partial \pi}{\partial z_2} = -\frac{\partial \tau_2\left(z_2\right)}{\partial z_2} f_2\left(x_2, z_{12}\right) \ge 0 \tag{6}$$

given the assumption in Equation 3. Hence, providing capital to the village for the improvement of marketing natural products increases the profits of agribusiness firms. In addition, the investment in marketing natural products shifts the factor demands at the village level

$$\nabla_{z_2} x_2\left(p_1, p_2, w; z_1, z_2\right) = \begin{bmatrix} \frac{\partial x_{21}\left(p_1, p_2, w; z_1, z_2\right)}{\partial z_2} \geq 0 \\ \vdots \\ \frac{\partial x_{2m}\left(p_1, p_2, w; z_1, z_2\right)}{\partial z_2} \geq 0 \end{bmatrix} \tag{7}$$

where $x_{21}\left(p_1, p_2, w; z_1, z_2\right), \cdots x_{2m}\left(p_1, p_2, w; z_1, z_2\right)$ are inputs used in the production of output 2.

In this developing market context, we are particularly interested in the effect of these policies on village employment. Letting $x_{11}(.)$ be the labor demand from the traditional industry (charcoal) and $x_{21}(.)$ be the labor demand from the new industry (baobab fruit or lalo), the total demand for labor at the village level shifts outward given the investment in the marketing channel for nature friendly outputs. However, the outward shift is primarily due to the increased demand from nature friendly outputs

$$\begin{aligned} x_{11}\left(p_1, p_2, w; z_1, z_2\right) + x_{21}\left(p_1, p_2, w; z_1, z_2\right) &\leq x_{11}\left(p_1, p_2, w; z_1, z_2'\right) + x_{21}\left(p_1, p_2, w; z_1, z_2'\right) \\ x_{11}\left(p_1, p_2, w; z_1, z_2\right) &= x_{11}\left(p_1, p_2, w; z_1, z_2'\right) \\ x_{21}\left(p_1, p_2, w; z_1, z_2\right) &\leq x_{21}\left(p_1, p_2, w; z_1, z_2'\right) \end{aligned} \quad . \tag{8}$$

Thus, the share of employment in traditional industries will decline while the share of employment in the more environmentally friendly (i.e., sustainable) industries will increase

$$\begin{aligned} ds_{11} &= \frac{x_{11}\left(p_1, p_2, w; z_1, z_2'\right) - x_{11}\left(p_1, p_2, w; z_1, z_2\right)}{x_{11}\left(p_1, p_2, w; z_1, z_2'\right) + x_{21}\left(p_1, p_2, w; z_1, z_2'\right)} \leq 0 \\ ds_{21} &= \frac{x_{21}\left(p_1, p_2, w; z_1, z_2'\right) - x_{21}\left(p_1, p_2, w; z_1, z_2\right)}{x_{11}\left(p_1, p_2, w; z_1, z_2'\right) + x_{21}\left(p_1, p_2, w; z_1, z_2'\right)} \geq 0 \end{aligned} \quad . \tag{9}$$

Hence, while the increase in the wage rate in the village may not increase due to micro-market conditions, the overall wage earnings of the village will increase as a result of the additional investment in marketing of natural products.

3. Data and Empirical Results

To examine whether Wula Nafaa has affected the employment patterns in Senegal, we use data from a USAID commissioned survey of 20 households in 20 villages of Tambacounda and Kedougou (Mbaye 2013). This survey asked questions about each member of the household's employment status. The sample contained information on 2,109 indviduals with 726 individuals in a control group (i.e., villages not affected by Wula Nafaa) and 1,381 individuals who were affected by Wula Nafaa.

In order to test the effect of Wula Nafaa, we use the data to define the share of individuals employed in seven agricultural sectors (charcoal, baobab, lalo, jujube, fonio, livestock, and other agricultural activities). In addition we observe students and unemployed individuals for nine different employment shares. The average shares for each labor component for the control and treatment households are presented in Table 1. To test for the effect of the initiative on the industrial structure of employment, we exploit the adding up characteristic of the specification. Specifically, the shares of employment presented in Table 1 are defined as

$$\hat{S}_{ij} = \frac{1}{n_i}\sum_{k=1}^{n_i} I_{ijk} \tag{10}$$

where $\hat{S}_{ij}$ is the share of individuals in group i (where $i=1$ is the control group and $i=2$ is the treatment group) employed in industry j, n_i is the number of individuals in each group, and I_{ijk} is either a 1 if the individual is employed in industry j and a 0 otherwise. Note that

$$\sum_{k=1}^{9} I_{ijk} = 1 \Rightarrow \sum_{i=1}^{n_i}\sum_{k=1}^{9} I_{ijk} = n_i \Rightarrow \sum_{j=1}^{9} \hat{S}_{ij} \equiv 1 \tag{11}$$

or that the variables must sum up. Because of the summing-up restriction, the variance matrix for the $\hat{S}_{ij}, j = 1,\cdots 9$ must be singular.

Note that $\hat{S}_{ij}$ follows the conditions for the central limit theory (Moss, 2014 pp. 145-148). Hence, to test for the effect of Wula Nafaa, we construct

$$T = \left(\hat{S}_{2\bullet} - \hat{S}_{1\bullet}\right)' \Omega^{-1} \left(\hat{S}_{2\bullet} - \hat{S}_{1\bullet}\right) \sim \chi^2_9 \tag{12}$$

where $\hat{S}_{2\bullet}$ is the vector of employment shares in the treatment villages (i.e., the second column of Table 1) and $\hat{S}_{1\bullet}$ is the vector of employment shares in the control villages (i.e., the first column of Table 1 – see Moss, 2014 pp. 210-211). To estimate the variance matrix (Ω) we jackknife the sample drawing 2/3 of the control group 15,000 times. Given the conjecture that the employment shares will add to one, the minimum eigenvalue of the estimated variance matrix is computed to be 1.3734×10^{-18} which is statistically zero. Hence, we conclude that the variance matrix is singular. To test the hypothesis in Equation 12, we use the approach adopted for tests of seemingly unrelated regression formulation. That is we compute

$$\tilde{T} = \left(\tilde{S}_{2\bullet} - \tilde{S}_{1\bullet}\right)' \tilde{\Omega}^{-1} \left(\tilde{S}_{2\bullet} - \tilde{S}_{1\bullet}\right) \sim \chi^2_8 \tag{13}$$

where $\tilde{S}_{1\bullet}$ is the vector of the first eight employment shares from the control villages, $\tilde{S}_{2\bullet}$ is the first eight shares for the treatment villages, and $\tilde{\Omega}$ is the conformable eight by eight matrix from the variance matrix. Note that due to the summing up condition, we reduce the number of restrictions from nine to eight. Empirically, the value for Equation 13 is 410.06 which can be rejected at any conventional level of significance.

4. Conclusions

One of the goals of Feed the Future is to increase the returns smallholder agriculture by increasing the investment in marketing channels. One example of this approach is the Wula Nafaa program

in Senegal which increased the incentives for the production of nature friendly outputs such as baobab, jujube, lalo and fonio by investing providing technical assistance and providing capital for the enhancement of the market channel for these products. One indication of the success of this program is the shift in employment toward these products and away from charcoal production. In addition to signaling an improvement in the environmental quality, this shift implies an increase in the labor income to village labor. The empirical results support the hypothesis that Wula Nafaa has led to these shifts. The share of labor in the charcoal sector falls from 15.9 percent to 9.2 percent while the share of labor allocated to baobab production increases from 13.3 percent to 19.4 percent, the share of labor used lalo production increases from 3.4 percent to 12.8 percent, and the labor dedicated to fonio production increases from 4.5 percent to 7.5 percent. Against these gains, the labor used in the production of jujube remains relatively unchanged.

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Tables

Table 1. Employment Shares

Industry	Control	Treatment
Charcoal	0.1593	0.0917
Baobab	0.1331	0.1935
Lalo	0.0342	0.1283
Jujube	0.0822	0.0758
Fonio	0.0450	0.0748
Livestock	0.0007	0.0042
Other Agriculture	0.2025	0.1352
Student	0.2989	0.2314
Unemployed	0.0441	0.0651