Economics of potato production in the Northern part of Khartoum State

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Abstract:

The Northern part of Khartoum State is the main area of potato production in the Sudan. Potato production in the study area is constrained by many factors including high cost of production, unavailability of seeds at the proper time and lack of credit. The objectives of this study were to evaluate the main constraints facing potato production and to examine farmers’ efficiency in using their resources in potato production.

A Cobb-Douglas production function was used for meeting the objectives of the study. The findings of the study indicated that potato variety, irrigation and fertilizer were the most important factors affecting potato production in the area. The findings indicated that there was under-investment in irrigation, land and fertilizer due to high cost and lack of credit. The study recommended the supply of inputs at reasonable prices and proper time for improvement of potato production.

الخص:

يعتبر الجزء الشمالي بولاية الخرطوم من المناطق المهمة لإنتاج البطاطس في السودان حيث يتم إنتاج 70% من الإنتاج الكلي للسعود. يتميز إنتاج البطاطس في السودان بموسمية الإنتاج حيث يتم إنتاجه في فصل الشتاء مما يتسبب على ذلك نقص في الإنتاج مع ارتفاع الأسعار في بقية أيام السنة. هناك ميزات تواجه إنتاج البطاطس في منطقة الدراسة تمثل في عدم توفر مدخلات الإنتاج في الأوقات المناسبة مع ارتفاع تكاليفها. هدفت الدراسة إلى تقدير العوامل التي تؤثر على إنتاج البطاطس ودراسة كفاءة استخدام الموارد في انتاجه. تم استخدام دالة كوب دوقلاس لتحقيق أهداف الدراسة. تشير النتائج التي توصلت إليها الدراسة إلى أن العينة والري والسماح من أهم الميزة التي تؤثر في إنتاج البطاطس، كما أوضحت نتائج الدراسة أن الأرض والري والسماح لا يتم استخدامها بكفاءة وذلك نتيجة لارتفاع أسعارها وعدم توفر تمويل للحصول عليها. ووصفت الدراسة بضرورة توفير مدخلات الإنتاج في الأوقات المناسبة وتسجيل عقولة بالإضافة إلى إجراء بحوث لاستثبات عينات من البطاطس تعاني الظروف المحلية بدلاً عن العينات المستوردة.
Introduction:

Potato is one of the most important food crops worldwide. It comes in the forefront of tuber-crops and occupies the fourth position after wheat, sorghum and rice as the most edible and consumed crops in the world (Singh et. al. 2004).

Potato is very rich source of nutrient contents containing good amount of starch, carbohydrate, vitamins especially C and B1 nutrients, protein, fat and amino acids (Buckenhuskes, 2005). The crop is grown in about 140 countries, more than 100 of which are located in the tropical and subtropical zones (Beukema and Van der Zagg, 1990).

Potato was introduced to the Sudan sometimes before the second War11 since then it has been expanding in a rapid manner both horizontally and vertically, as the crop suits wide range of conditions in the Sudan (El Ameen, 2003).

The northern part of Khartoum State, particularly the villages of Sheheinab, Elgezira Islanj, Elsheikh Eltayeb, Wad-Ramly, Wawisy, Elsarourab and Elgeily are the main potato producing areas in the country, whereas 70% of the crop is produced (El-Amin, 1993). Other production areas; areas around Shendi and Atbara in the River Nile state, Jebel Marra area in Darfur, Gilo in Southern Sudan, Kassala in eastern Sudan and some other new area of production in Gezira State (Geneif and Sadik, 1989).

Potato can play an important role in diversifying cropping systems and food supplies in the country. The availability of potato in the market is seasonal being abundant in February, March and April and scarce from August to December. This seasonality causes price fluctuations. Geneif and Sadik (1989) reported that the potential for improvement of potato production is enormous and feasible if certain constraints limiting yields are alleviated. The main objective of this paper was to study the economics of potato production in the study area. The specific objectives of this paper were (i) to evaluate the main constraints facing potato production and (ii) to examine farmers' efficiency in using scarce resources used in potato production.
Methodology

The potato cultivating areas in the season 2003 was divided into two strata; one on the western bank of the Nile and the other on eastern bank. A list of farmers growing potato was prepared and a sample of 80 farmers was randomly selected. Cross sectional data on socioeconomic characteristics of farmers and inputs and outputs of potato crop were collected by means of a personal interview survey using a questionnaire. The effects of different factors on the output of potato were studied through input-output relationship. A Cobb-Douglas production function was specified of the following general form:

\[ Y = a X_i^{b_i} e^{u_t} \]

Where:

- \( Y \) = the dependent variable (potato output)
- \( X_i \) = the independent (explanatory) variables
- \( B_i \) = regression coefficients to be estimated
- \( a \) = intercept (constant)
- \( e^{u_t} \) = disturbance term or disturbance error

For estimating the regression coefficients, the Cobb-Douglas production function was transformed in the following linear form:

\[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 + u_t \]

Where:

- \( a \) = The intercept;

This variable represents some variables that are not easy to incorporate in the model such as management factor, weather conditions and labour qualities, etc. In applied research, no major significance is normally attached to this term because there are relatively few instances where the intercept has an obvious economic interpretation (Johnson et.al. 1987). Moreover, the estimate of the intercept term in the Cobb-Douglas production function is biased (Kennedy, 1985).
\( X_1 = \text{Land}; \)  
Land area was measured in feddan. The size of the farm has an influence on output.

\( X_2 = \text{Irrigation}; \)  
The variable was measured in terms of the number of irrigations per season. In the study area, irrigation depends on pumping from the Nile and underground water. The high cost of fuel and spare parts were expected to affect the optimum number of irrigations (Abdelaziz, 1999).

\( X_3 = \text{Fertilizer}; \)  
Fertilizer levels used in the developing countries are very low relative to the recommended levels (Velck, 1999). The reasons are assumed to be lack of credit, lack of knowledge and availability of the fertilizers themselves (Green and Ngsongola, 1993 cited by ElFeil et.al., 2001).

\( X_4 = \text{Variety}; \)  
The variety is very important factor affecting the productivity, Ahmed et.al., (1989) claimed that the major limiting factor for extension in potato production is high cost and unavailability of seed tubers. The solution is to develop a technology to produce potato from true seeds. This variable was measured as a dummy variable were local variety grown was given code 1 and imported variety{Spunta and Alpha} was given code zero.

\( X_5 = \text{Time of sowing}; \)  
The sowing date of potato is very important factor affecting the yield of the crop. The optimum sowing date of potato is the first week of November. It was observed that the farmers planted after the optimum sowing date due to late preparation of land, lack of credit to buy inputs and late arrival of imported seeds. The variable was treated as a dummy variable. If sowing date was within the optimum time was given code 1 and otherwise it was given code zero.

\( X_6 = \text{Time of harvesting}; \)  
The optimum time of harvesting is the mid of March. If harvesting was conducted during the optimum time it was given code 1 and otherwise it was given code zero.
The farmers’ efficiency in using scarce resources was examined through the comparison between marginal values and marginal costs of inputs. The marginal values were calculated in the following way:

\[ \text{Let } \log y = \log a + b \log x \]

\[ (dy/dx) (I/Y) = b/x \]

Thus, marginal product = \( \frac{dy}{dx} = b \frac{y}{x} \)

Marginal value product = \( b \frac{y}{x} \) multiplied by the output selling price per unit. \( b \) is the estimated input coefficient, \( y \) is the mean output and \( x \) is the mean input. The marginal costs were estimated as the cost of purchasing an additional unit of an input at the market price. In case of land, the land rent per feddan was considered as the marginal cost of land.

**Results and Discussion**

The descriptive statistics of the variables in the Cobb-Douglas production function are presented in Table 1 below.

Table 1: The mean, standard deviation and coefficient of variation of the continuous variables in the Cobb-Douglas production function

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>St. dev</th>
<th>Coefficient of variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of irrigations</td>
<td>12.00</td>
<td>2.17</td>
<td>0.18</td>
</tr>
<tr>
<td>Fertilizer (kg/fed)</td>
<td>8.42</td>
<td>4.42</td>
<td>1.52</td>
</tr>
<tr>
<td>Farm size (fed)</td>
<td>7.60</td>
<td>8.30</td>
<td>1.09</td>
</tr>
<tr>
<td>Output (sack/fed)</td>
<td>100.80</td>
<td>34.67</td>
<td>0.34</td>
</tr>
</tbody>
</table>

The results of the Cobb-Douglas function are presented in Table 2.
Table 2: Results of the Cobb-Douglas production function of potato in the Northern part of Khartoum State (season 2003)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>T-value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.375</td>
<td>14.885</td>
<td>0.092</td>
<td>0.000</td>
</tr>
<tr>
<td>Variety (dummy variable)</td>
<td>-0.076</td>
<td>0.027</td>
<td>2.87</td>
<td>0.005</td>
</tr>
<tr>
<td>Time of sowing (dummy variable)</td>
<td>0.033</td>
<td>0.028</td>
<td>1.202</td>
<td>0.250</td>
</tr>
<tr>
<td>No. of irrigations</td>
<td>0.204</td>
<td>0.077</td>
<td>4.837</td>
<td>0.000</td>
</tr>
<tr>
<td>Fertilizer (Kg/fed)</td>
<td>0.791</td>
<td>0.046</td>
<td>4.116</td>
<td>0.001</td>
</tr>
<tr>
<td>Time of harvesting (dummy variable)</td>
<td>0.029</td>
<td>0.025</td>
<td>1.160</td>
<td>0.220</td>
</tr>
<tr>
<td>Farm size (fed)</td>
<td>0.046</td>
<td>0.032</td>
<td>1.453</td>
<td>0.140</td>
</tr>
</tbody>
</table>

R-square = 0.856

\[ F\text{-Statistics} = 14.28 \]

Adjusted R-square = 0.843

Standard error = 0.0607

Table 2 shows that the production function used provided very good fits to the data according to the high R-square. All the coefficients of the estimated parameters have the expected signs according to the economic theory. The irrigation variable was highly significant (0.000) reflecting the importance of irrigation for potato production and confirmed that is, the number of irrigations applied in the study area were less than the recommended due to high costs of fuel and spare parts. This means that one percent increase in the number of irrigations will increase potato output by 0.2 percent.

The fertilizer variable was highly significant (0.001), meaning that one percent increase in fertilizer increases potato production by 0.791 percent. This result indicates that the current usage of fertilizer in the study area is less than the required and the reasons were unavailability and lack of funds. Like wise, the variety variable was highly significant indicating that the use of local seeds reduced drastically the yield. The rest of the variables
included in the model were not significant at reasonable levels of significance because there were little or no variations in the use of these variables among the farmers.

**Farmers' efficiency in using their resources**

In order to examine the farmers' efficiency in using resources, the marginal value products were compared with the marginal factor costs (Table 3). The marginal value product of irrigation \(212\ \text{S.D}\) was found to be greater than the marginal cost \(795\ \text{SD}\). This indicates that farmers spent less than the recommended. Accordingly, farmers should spend more in irrigation. The fertilizer had a marginal value product of \(7220\ \text{SD}\) and a marginal cost of \(3150\ \text{SD}\) and this also revealed signs of under investment in fertilizer. The marginal value product of land was \(184000\ \text{SD}\) and the marginal cost was \(20000\ \text{SD}\) reflecting signs of under investment.

Producers appeared to use their resources inefficiently and this may be due to unavailability and high cost of these inputs.

**Table 3:** The values of marginal products of potato and marginal costs of inputs (S.D)$^1$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Marginal value product</th>
<th>Marginal cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>2121</td>
<td>656.3</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>7720</td>
<td>3150.0</td>
</tr>
<tr>
<td>Land</td>
<td>18782</td>
<td>3000.0</td>
</tr>
</tbody>
</table>

**Conclusions**

The Cobb-Douglas production function adequately modeled the input-output relationship for potato production in the northern part of Khartoum state. The findings were consistent with the economic theory; the coefficients of potato variety, irrigation and fertilizer were highly significant (0.01 level of significance) showing that they were the most important factors affecting potato production in the study area. The coefficients of land, time of sowing and time of harvesting were not

$^1$ Sudanese Dinar
significant in explaining the variations in the productivity. The findings indicated that more investments should be directed to irrigation, fertilizer and land as the current practices were less than the required due to lack of funds and high cost of inputs. In order to improve the productivity in the area, there is a need to consider the supply of inputs at the proper time and reasonable costs. In addition, work is needed to develop varieties of potato adaptive to Sudan conditions and make farmers less dependent on imported seeds.
References:


