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# The Effects of Changes in Location of Production on A.R.E.Cotton Yields

By

Dr. Kamal El-Ganzoury

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CAIRO
SALAH SALEM St.-NASR CITY

Introduction:

In last two decades, there has been a substantial increase in the yield per feddan [1] of some major crops in the Arab Republic of Egypt. For instance, the average cotton yield per feddan of 1965-69 was 160% of that of 1935-39.

This continued phenomenon has raised a problematic situation to agricultural researchers and introduced many interesting questions such as, can this dynamic increase in crop yields be attributed to changes in location of production, [2] favorable weather, [3] and technological advance, or to other economic factors such as favorable prices which may lie behind changes in technology and some changes in the areas of production ? Also, has the technology advance in recent years reduced the effect of unfavorable weather on crop yields ? The answers to these questions have very important implications for agricultural policy.

1/ One feddan is equal to 1.03 acres.

2/ D.G. Johnson, and R.G. Gustafson, Grain yields and American Food Supply, An Analysis of yield changes and possibilities. The University of Chicago Press, 1962.

3/ * L.H., Shaw, and D.D., Durost, The Effect of weather and Technology on corn yields in corn Belt, 1929-62. USDA Econ. RPT. No. 80, July 1965.

* L.M. Thompson, Weather and Technology in the Productions of Corn and Soybean. CAED, Rpt. 17, I.S.U. 1963.

* _____, Evaluation of Weather Facors in the Production of Grain Sorghum. Agronomy Journal, Vol. 55: 182 - 185, 1963.

Thus, this phenomenal increase in the yield per feddan of some crops has prompted agricultural researchers to investigate the roles of changes in location of production, weather, technology, economic, and other factors in yields of some major crops.

Hence, the main objective of this study was to analyze the effects of changes in location of production on Arab Republic of Egypt cotton yields during the period 1939-69 and to analyze the relative importance of location factor compared with all other factors related to past changes in cotton yields per feddan.

Cotton Yields:

Table (1) shows the national average cotton yields per feddan over the period 1920-69. A closer look to the trend of average cotton yield per feddan in Arab Republic of Egypt during past sixty years can be divided into distinct linear patterns, the first period is from 1920 to 1938. The trend during that period was downward with a very slight slope. The least squares line of the best fit decreases very slightly at the rate of 2.5 pounds per year. 1/ The second distinct period begins in 1939 and runs to 1969. Throughout that period the trend was upward with a relatively sharp slope. The least squares line of the best fit rises at the rate of 18.7 pounds per year. 2/

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1/ $Y_1 = 1236.79 - 2.5\ (X)$

2/ $Y_2 = 1334.60 + 18.7\ (X)$.

Table (1): Arab Republic of Egypt Cotton Yields per fedda (1920-69).

| Year | Yields in pounds | year | yields in pounds |
|---|---|---|---|
| 1920 | 935.5 | 1945 | 1480.5 |
| 1921 | 844.2 | 1946 | 1395.1 |
| 1922 | 932.4 | 1947 | 1420.6 |
| 1923 | 967.0 | 1948 | 1723.0 |
| 1924 | 1020.6 | 1949 | 1445.8 |
| 1925 | 1036.3 | 1950 | 1241.1 |
| 1926 | 1074.1 | 1951 | 1178.1 |
| 1927 | 1004.8 | 1952 | 1467.9 |
| 1928 | 1159.2 | 1953 | 1578.1 |
| 1929 | 1159.2 | 1954 | 1458.4 |
| 1930 | 919.8 | 1955 | 1215.9 |
| 1931 | 875.7 | 1956 | 1313.5 |
| 1932 | 1055.2 | 1957 | 1461.6 |
| 1933 | 1074.1 | 1958 | 1515.1 |
| 1934 | 998.5 | 1959 | 1502.5 |
| 1935 | 1149.7 | 1960 | 2011.2 |
| 1936 | 1184.4 | 1961 | 1136.7 |
| 1937 | 1242.2 | 1962 | 1813.0 |
| 1938 | 1055.2 | 1963 | 1805.9 |
| 1939 | 1283.3 | 1964 | 2004.2 |
| 1940 | 1222.2 | 1965 | 1777.6 |
| 1941 | 1143.4 | 1966 | 1558.0 |
| 1942 | 1345.0 | 1967 | 1671.3 |
| 1943 | 1149.7 | 1968 | 1859.0 |
| 1944 | 1241.1 | 1969 | 2050.2 |

Source: Ministry of Agriculture, Agricultural Economics and Statistics Department, yearly Reports.

Hence, all emphasis in this present study is devoted to the second period in which a substantial increase in cotton yields has occurred.

Analytical procedure:

It was expected that the shifts in location of production toward higher yielding areas have substantially increased the national average yield. Therefore, data on cotton acreages and yields by governorates from 1935 to 1969 were used as source material for this analysis. These were used to obtain weighted averages for 1939, 1949, 1959, and 1969 (1935-39 averaged for 1939, and 1945-49 averaged for 1949, etc.). Thus there were available, by governorates, four sets of average for acreage, and four for yield. Governorate by governorate, each of the four acreage figures was multiplied by each of the four yield averages-- a total of sixteen combinations. The results for each of these sixteen combinations were summed and standardized by being divided by the sum of corresponding acreages.

It is obvious that the effect of shifts in location of production by using this method was confounded with the effects of all other factors influencing yields, particularly weather factors [1]. Therefore,

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1/ * J.L. Fulmer, and R.R., Bolts, Analysis of Factors Influencing cotton yields and their variability. U.S.D.A. Tech. Bul. No. 1042? Oct. 1951.

* T.Y. Patil, A Study of recent changes in cotton production pattern and Techniques in the U.S.A. and their Applicability to Indian conditions. M.S. Thesis, MSU, 1955.

five year averages for yield were used to smooth out (approximately) the annual weather effect.

By using this method, it will be possible to answer some questions such as:

1. If yields had remained contant in each and every governorate, how much effect would the shifts in cotton production among the various governorates have had on national average yields ?

2. If the distribution of cotton among various governorates had not changed over time, how would the national yield have changed due to the influences that affected the yields in each of the governorates.

In general, the method used here to measure the effect of shifts in location of production among governorates can be summarized in the following equation [1] :

$$Y_{t,t'} = \frac{\sum_{g=1}^{G} Y_{gt} A_{gt'}}{\sum_{g=1}^{G} A_{gt'}}$$

where,

$\sum_{g=1}^{G}$ = the summation over all governorates,

g = 1,2, ... G, and G = 17 .

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[1] D.G., Johnson, and R.L., Gustafson, Grain Yields and the American Food Supply. Analysis of yield changes and possibilities. The University of Chicago Press, 1962.

$Y_{gt}$ = yield per feddan in governorate g in period t.

$A_{st'}$ = acreage in governorate g in period t'.

$t, t'$ = represent years 1939, 1949, 1959, and 1969 -- t represents years for governorate yield figures, and t' represents years for governorate acreage figures.

$Y_{t,t'}$ = calculated national average yield, assuming no change in governorates acreage distribution over time -- by moving across the columns of Table (2) or assuming no change in governorates yield over time -- by moving across the rows of the same table. Thus calculated national average yield is what the average yield in year t would have been if acreage distribution in year t had prevailed.

The results of using the above method are reported in Table (2). By moving across a row in Table (2), yield is held constant and the differences in the national average yield are due to different acreage distributions. These differences are listed in table (3).

Each of the different rows in Table (2) and Table (3), indicates that the change in distribution of cotton acreage among the governorates

had the effect of increasing the national average yield. In th fourth row in Table (2) , for example, yield is held constant at the 1969 level and the governorate acreage distributions change over time. This shift in acreages among governorates has resulted in an increase in the national average yield from 1750 pounds in 1939 to 1825 pounds in 1969.1/

Thus, on the basis of the calculations used in this method, it appears that the change in the distribution of cotton acreages among the governorates had the effect of increasing the national average yield over the period 1939-69 by 75 pounds compared with average yield in 1969. Since the actual increase in the national average yield over the same period was 490 pounds, then about 15.3 percent of this increase in the national average yield was due to the shifts in the location of production toward higher yielding governorates.

An additional purpose for using the above method of measuring the effects of shifts in the location of production among governorates was to show how the national average yield would have changed due to the influences that affected yields in each of the governorates if the distribution of acreages among various governorates had not changed over time. In other words, if cotton acreages had remained constant in each

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1/ Note however, that the actual yield using the actual acreage distribution was 1335 pounds for the five year period centering on 1939.

Table (2):

The calculated National Average yield 1/ of cotton using Different Acreage Distributions for weights, 1935 - 1969.

(in pounds per feddan)

| Yields used | Acreage distribution used | | | |
|---|---|---|---|---|
| | 1939 | 1949 | 1959 | 1969 |
| 1939 | 1335 | 1343 | 1354 | 1360 |
| 1949 | 1417 | 1427 | 1433 | 1446 |
| 1959 | 1452 | 1461 | 1471 | 1485 |
| 1969 | 1750 | 1770 | 1796 | 1825 |

1/ The calculated national average yield is what the average yield in year t would have been if acreage distribution in year t had prevailed.

Table (3):

The estimated Effect of Shifts in Location of production Among governorates on the National Average Yield of Cotton per Feddan over Time, 1935 - 1969. 1/

( in pounds per feddan)

| Yields used | Interval | | | |
|---|---|---|---|---|
| | 1939-49 | 1949-59 | 1959-69 | 1939-1969 |
| 1939 | 8 | 11 | 12 | 31 |
| 1949 | 10 | 6 | 13 | 29 |
| 1959 | 9 | 10 | 14 | 33 |
| 1969 | 20 | 26 | 29 | 75 |

1/ Derived from Table (2).

and every governorate, how much effect would the other factor (technical, economic, and weather factors) have had on the national average yield ? The information relevant to this question is also found in Table (3). By moving across a column in Table (3), acreage is held constant so that the differences in the national average yield are due to all factors (affecting yields) other than the shifts in location of production. These differences are listed in Table (4). In the first column (Table 4), the acreage distribution is held constant at the 1939 acreages by governorates while the yields are allowed to change in each governorate in accordance with the actual changes that did occur. Then, if the 1939 acreage distribution had been maintained, the national average yield would have increased by 415 pounds. This is a smaller increase, by 75 pounds, than the actual increase. If the 1969 acreage distribution had existed throughout the whole period, the national average yield would have increased by 459 pounds which is less than the actual increase. Also, if 1949, 1959 acreage distribution had existed throughout the whole period, the national average yield would have increased by less than the actual increase.

Thus, on the basis of the above calculations, it is quite obvious that the shifts in location of production among governorates over time have generally increased the national average yield.

Table (4):

The Estimated Effects of Factors (Influencing Yields) on the National Average Yield of Cotton Holding Acreage Constant, 1939-1969. 1/

( in pounds per feddan)

| Interval | Acreage distribution used | | | |
|---|---|---|---|---|
| | 1939 | 1949 | 1959 | 1969 |
| 1939-1949 | 82 | 84 | 79 | 80 |
| 1949-1959 | 35 | 34 | 38 | 39 |
| 1959-1969 | 298 | 309 | 325 | 340 |
| 1939-1969 | 415 | 427 | 442 | 459 |

1/ Derived from Table (2).

Concluding points:

1. The shifts in location of production positively affected the national average yield indicating that acreage has been moving toward higher producing areas.

2. An increase of 75 pounds in the National average yield was imputed to the shifts in the location of production toward higher yielding areas. This means that about 15.3 percent of increase in the national average cotton yields per feddan was due to the shifts in the location of production.

3. If this shift in location of cotton production continues toward better land, one can expect further increase in cotton yields.

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