

# Value-Added Wheat and Beef Product Exports to Middle-Income Developing Countries



## A Comparative Analysis of Foreign Market Potential

Bulletin B-791  
October 1990

Agricultural Experiment Station • Division of Agriculture  
Oklahoma State University

# Table of Contents

Abstract .....	1
Value-Added Agricultural Exports .....	2
Model Formulation .....	8
Empirical Results .....	13
Wheat Products .....	14
Beef Products .....	17
Summary and Conclusion .....	20
References .....	23

# **Value-Added Wheat and Beef Product Exports to Middle-Income Developing Countries: A Comparative Analysis of Foreign Market Potential**

**By**

**Jung-Hee Lee, David Henneberry,  
and David Pyles\***

## **ABSTRACT**

This study determined probable future directions in U.S. value-added agricultural exports to middle-income developing countries (MIDCs) under the assumption of continued income growth. Import share equations for U.S. bulk, semi-processed and value-added wheat or beef products, as a percent of total U.S. wheat or beef product exports to each MIDC, were econometrically estimated using the ordinary least squares (OLS) technique. The empirical results indicate that in most MIDCs, increases in real per capita income have negative effects on the import share of processed wheat products while having positive effects on the import share of bulk wheat. However, import shares of U.S. processed beef products are likely to increase with income growth in most MIDCs.

**Keywords:** Value-added agricultural exports, middle-income developing countries (MIDCs), processed and semi-processed products.

---

\* Research Assistant, Associate Professor, and Assistant Professor, respectively, Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma.

Constructive comments of Dr. Brian Adam (Assistant Professor, Department of Agricultural Economics, OSU) are greatly appreciated. This research was partially funded by a grant from the CSRS/USDA in cooperation with the Center for International Trade Development at Oklahoma State University. It is a paper of the OSU Agricultural Experiment Station Hatch Project Number 1944.

# Value-Added Agricultural Exports

"Value-added agricultural exports" can be described as processed products, since they have added value through some processing, as well as unprocessed high value commodities. Table 1 classifies agricultural commodities in bulk and value-added form. Nuts, fresh fruits, and vegetables are categorized as unprocessed high value commodities. Processed products can include both semi-processed and highly processed products depending upon the extent of processing.

**Table 1: Classification of Agricultural Commodities**

<b>Commodity Groups</b>	<b>Bulk</b>	<b>Value-Added*</b>
Grains and Feeds	Unmilled Wheat Feed Grains Rice-Paddy, Milled	Wheat Flour Bulgur Wheat  Feeds and Fodders Other Grain Products Other Wheat Products
Oilseeds and Products	Oilseeds	Oilcake and Meal Vegetable Oils
Animals and Animal Products	Animals, Live (Including Poultry, Live)	Meats Dairy Products Fats, Oils, Greases Hides and Skins Wool and Mohair Sausage Casings Bull Semen Misc. Animal Products
Horticultural and Tropical Products	Hops, Including Extract Rubber-Crude, Natural Pulses Fibers except Cotton	Fruits and Prep. Fruit Juices Wine  Nuts and Prep. Vegetables and Prep. (Excluding Pulses, Hops) Sugar and Tropical Products
Cotton, Tobacco, Seeds, and Others	Cotton Tobacco-Unmtg. Seeds	Beverages (Excluding Juices) Nursery and Greenhouse Products Essential Oils

\* Includes semi processed and processed product (because it has added value through some processing) as well as some unprocessed high value products such as fresh fruit and vegetable, and nuts.

Source: *Foreign Agricultural Trade of the United States (FATUS)*, USDA

Since value-added agricultural products involve a larger scope of economic activity than bulk commodities, the promotion of value-added agricultural exports is likely to stimulate the economy. Schluter and Clayton (1981) argue that

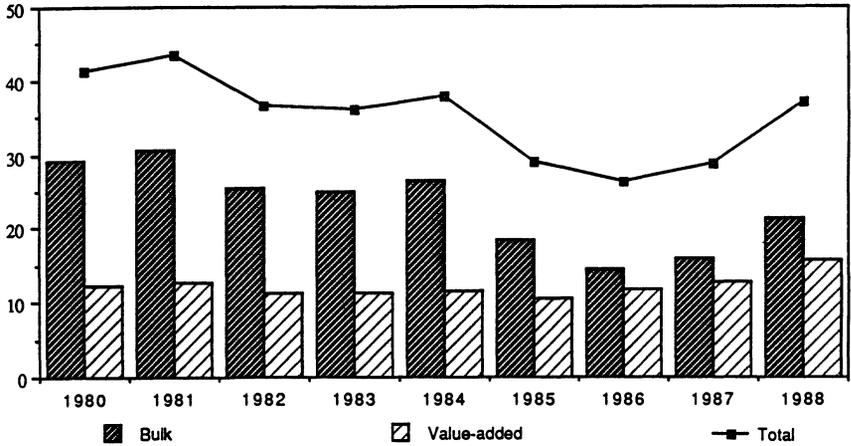
... exporting processed commodities instead of their bulk agricultural components provides an export market for those domestic goods and services required to assemble, process and distribute the processed commodities. Three measures of the potential increase in economic activity associated with processed commodities are appropriate for consideration: (1) direct plus indirect plus induced output or business activity; (2) the employment associated with this increased business activity; and (3) the personal income generated by the increased business activity.

Schluter and Clayton (1989) estimated that if one million dollars of wheat exported as bulk form were exported as wheat flour instead, an additional \$9 million of business activity, employment for 109 workers, \$1.9 million of personal income, \$160,000 of Federal personal income taxes, and \$199,000 of Federal corporate income taxes would be generated. If so, then prospects for expanding value-added agricultural exports, in addition to bulk exports, should be of great interest to policy makers.

The United States has recently become one of the largest exporters of value-added agricultural products. Historically, the United States has exported low-value primary products because it has had a comparative advantage in producing bulk commodities such as wheat, cotton, corn and soybeans (Nuttall, 1983). Since 1981, the value of total U.S. agricultural exports had decreased until the slight recovery in 1987. The principal factor causing the sharp drop in exports of bulk commodities was a substantial production increase in both major exporting and importing countries. Other factors include the strong value of the U.S. dollar, the impact of global debt and increased food self-sufficiency in many developing country markets. However, value-added exports have shown relatively little decline despite these circumstances, and the value of value-added exports has increased over the past four years. In 1988, value-added exports were 42.5 percent of total agricultural exports, up from 29.5 percent in 1980 (Figure 1 and Table 2).

A significant proportion of the increase in both world and U.S. exports of value-added products since 1970 results from the rapid income growth in both developing and developed economies. The growth in U.S. value-added exports has occurred in spite of many trade barriers. Subsidized sales from competitors such as the European Community (EC) and Brazil have diminished the level of U.S. exports (Rahe, Dewain H. and Wills G., 1985).

**Figure 1. U. S. Agricultural Exports  
Bulk vs. Value-Added**



Source: USDA, *FATUS, Calendar Year 1980-88*

**Table 2. U.S. Agricultural Exports**

Year	Bulk	Value-Added	Total	Percentage*
(Million Dollars)				
1980	29,073	12,160	41,233	29.5
1981	30,545	12,792	43,337	29.5
1982	25,425	11,198	36,623	30.6
1983	24,925	11,174	36,099	31.0
1984	26,357	11,447	37,804	30.3
1985	18,506	10,520	29,026	36.2
1986	14,436	11,781	26,217	44.9
1987	15,813	12,825	28,638	44.8
1988	21,341	15,752	37,093	42.5

\* Value-Added as percent of total

Source: USDA, *Foreign Agricultural Trade of the U.S. Calendar Year, 1980 - 1988.*

The central objective of this study was to determine probable future directions in value-added exports to middle-income developing countries under the assumption of continued income growth. Wheat and beef products were selected. Beef products were disaggregated into live cattle, fresh or frozen beef, and prepared beef. Wheat products were disaggregated into unmilled wheat, wheat flour, and other wheat products (Table 3).

Most U.S. exports of wheat have been in bulk form. In 1988, 4.6 percent of all wheat exports were in value-added form. The majority of beef exports, however, have been in processed form. In 1988, 84.6 percent of all beef product exports were value-added (Table 4 and Figure 2).

**Table 3. Selected Agricultural Commodity Group**

<b>Group\Product</b>	<b>Beef</b>	<b>Wheat</b>
Bulk	Live Cattle	Unmilled Wheat
Semi-Processed	Fresh or Frozen Beef	Wheat Flour
Value-Added	Preserved or Prepared Beef	Wheat Products

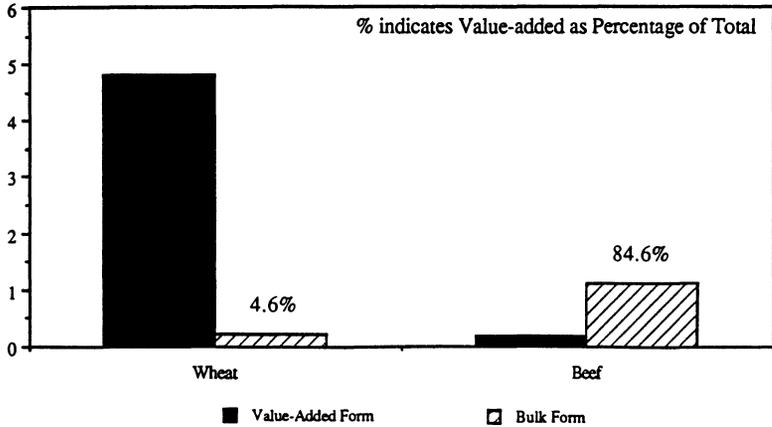
**Table 4. Total U. S. Wheat and Beef Exports: 1980 - 1988.**

<b>Year</b>	<b>Bulk</b>		<b>Value-Added</b>		<b>Total</b>			
	<b>Wheat</b>	<b>Beef</b>	<b>Wheat</b>	<b>Beef</b>	<b>Wheat</b>	<b>%<sup>1</sup></b>	<b>Beef</b>	<b>%<sup>1</sup></b>
----- Million Dollars -----								
1980	6,375	55	283	249	6,658	4.3	304	82.0
1981	7,844	65	309	300	8,153	3.8	365	82.1
1982	6,676	50	252	373	6,928	3.6	423	88.2
1983	6,235	44	325	392	6,560	5.0	436	89.9
1984	6,473	56	267	470	6,740	4.0	526	89.3
1985	3,607	122	291	467	3,898	7.5	589	79.3
1986	3,007	109	273	622	3,280	8.3	731	85.1
1987	3,043	105	236	771	3,280	7.2	876	88.0
1988	4,888	202	236	1,109	5,124	4.6	1,311	84.6

<sup>1</sup> Value-added as percent of total

Source: USDA, *Foreign Agricultural Trade of the U.S.*  
Calendar Year, 1980 - 1988.

**Figure 2. U. S. Ag Exports, 1988**  
**Wheat and Beef (Bulk vs. Value-Added)**



Source: USDA, FATUS, Calendar year 1988

As middle-income developing countries have emerged as large agricultural importers in world markets, the importance of further studies on these countries has increased. Table 5 and Figure 3 show total U.S. agricultural exports and U.S. agricultural exports to middle-income developing countries (MIDCs). As shown in the table, the U.S. agricultural export share to these countries has increased in the 1980's. U.S. agricultural exports to these countries were 14.1 percent of total U.S. agricultural exports in 1982, but have increased to 21.3 percent in 1988. Hence, these markets have become more important for U.S. agricultural exports.

Middle-income developing countries (MIDCs) are usually classified on the basis of income levels. In this study, MIDCs are defined by the following three criteria:

- 1) GNP per capita in constant 1985 U.S. dollars ranging from \$1500 to \$8,000,
- 2) A positive annual average growth rate of GNP per capita during 1980-1985,
- 3) Population greater than 2.5 million in mid-1988.

On the basis of the above criteria, MIDCs include Singapore, Hong Kong, Korea, Taiwan, Algeria, Malaysia, Israel, Jordan, and Mexico.

In the past decade, the majority of U.S. wheat exports to MIDCs have been in bulk form. The value-added share of wheat exports to MIDCs since 1980 has been less than 1 percent. However, the value-added share of total U.S. wheat exports to all world destinations has averaged 5.4 percent since 1980 (Table 4 and 6). In world value-added wheat markets, the European Community (EC) has had a lion's share. Recently, Japan is emerging as a strong value-added wheat exporter, especially in the Asian market.

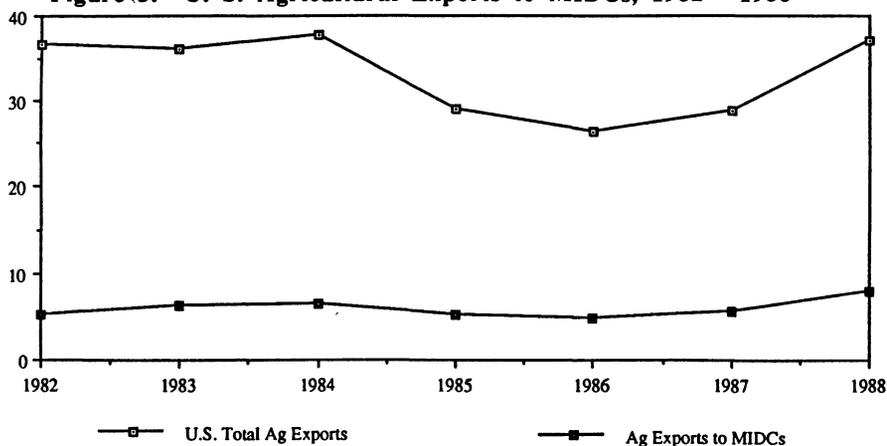
**Table 5. U.S. Agricultural Exports to MIDCs**

Countries	1982	1983	1984	1985	1986	1987	1988
(Million Dollars)							
Singapore	157	153	145	113	118	127	147
Hong Kong	392	357	412	389	400	466	489
Korea	1,581	1,840	1,650	1,413	1,306	1,833	2,274
Taiwan	1,155	1,308	1,458	1,231	1,171	1,285	1,661
Algeria	167	211	199	227	287	310	596
Malaysia	144	131	123	94	78	90	99
Israel	353	306	334	277	255	271	329
Jordan	73	79	98	48	45	44	83
Mexico	1,156	1,942	1,993	1,439	1,080	1,202	2,234
Sub Total	5,177	6,327	6,411	5,231	4,741	5,629	7,911
Total U. S. Agricultural Exports	36,627	36,099	37,804	29,041	26,222	28,709	37,093
Percentage*	14.13	17.53	16.96	18.01	18.08	19.61	21.33

\* U.S. agricultural exports to MIDCs as percent of U.S. total agricultural exports.

Source: USDA, *FATUS*, Calendar Year, various issues.

**Figure 3. U. S. Agricultural Exports to MIDCs, 1982 - 1988**



Source: USDA, *FATUS*, Calendar year various issues

**Table 6. U. S. Wheat and Beef Exports: 1980 - 1988.**

Year	Bulk		Value-Added		Total			
	Wheat	Beef <sup>1</sup>	Wheat	Beef <sup>2</sup>	Wheat	% <sup>3</sup>	Beef	% <sup>3</sup>
----- Million Dollars -----								
1980	729	15	3	18	732	0.4	32	54.3
1981	968	24	4	21	972	0.4	46	47.1
1982	726	22	2	27	728	0.3	49	55.0
1983	673	23	3	23	677	0.5	46	49.2
1984	688	31	3	26	692	0.5	57	45.4
1985	606	95	4	25	609	0.6	120	20.9
1986	646	55	1	22	647	0.2	77	28.5
1987	614	35	11	34	625	1.7	68	49.1
1988	795	144	5	94	800	0.7	238	39.5

<sup>1</sup> Beef in bulk: Live cattle

<sup>2</sup> Value-added Beef: Fresh or frozen and preserved or prepared beef

<sup>3</sup> Value-added as percent of total

Source: USDA, *FATUS*, Calendar years 1980 - 1988

Compared to wheat, U.S. value-added beef exports to MIDCs have been relatively high. Again, the value-added share of U.S. beef exports to MIDCs has been much less than the level of total U.S. value-added beef exports. In 1988, the value-added share of U.S. beef exports to MIDCs was 39.5 percent, whereas total U. S. beef exports accounted for 84.6 percent (Table 4 and 6). The reason for the lower percentage to MIDCs centers around Mexico, which is a MIDC. An examination of U.S. beef exports to Mexico shows that Mexico tends to import much more live cattle than processed beef. Mexico imported 140.6 million dollars of U.S. live cattle in 1988, but only 40 million dollars of value-added beef. Mexico is an isolated case. All the other MIDCs tend to import value-added beef rather than live cattle. However, Mexico's lower share was significant enough to reduce the average share of U.S. value-added beef exports to MIDCs.

## Model Formulation

Data limitations prohibit the estimation of import demand functions for value-added agricultural products in MIDCs. Data for U.S. exports to these countries is available, but unfortunately, proper estimation of an import demand function for U.S. products requires all the data necessary for a traditional import

demand function. However, if share equations are estimated instead, then all factors which affect the general level of beef and wheat product imports but which do not affect the allocation of imports among product classes can be dismissed.

The import share equation is based on the traditional import demand equation. This can be derived from a difference between a country's domestic demand and supply. Estimation of the import share equation allows for analysis of relations of the import share of U.S. bulk commodity and value-added products to personal disposable income and each of the product import prices.

For each country, U.S. beef imports were divided into three categories corresponding to various degrees of processing. These categories were live cattle, fresh or frozen beef, and prepared beef. The category of prepared beef included preserved or prepared beef and veal. Imports of U.S. wheat were divided into the three categories of bulk wheat, wheat flour, and other wheat products. The other wheat products included macaroni, spaghetti, wheat cereal, rolled wheat, bulgur wheat, etc.

The empirical models of beef import share equations are as follows:

Live Cattle:

$$SCV_h = \alpha_0 + \alpha_1 RPC_h + \alpha_2 RPBF_h + \alpha_3 RPBP_h + \alpha_4 IY_h + \epsilon_{b1},$$

Fresh or Frozen Beef:

$$SBFV_h = \beta_0 + \beta_1 RPC_h + \beta_2 RPBF_h + \beta_3 RPBP_h + \beta_4 IY_h + \epsilon_{b2},$$

Prepared Beef:

$$SBPV_h = \gamma_0 + \gamma_1 RPC_h + \gamma_2 RPBF_h + \gamma_3 RPBP_h + \gamma_4 IY_h + \epsilon_{b2},$$

where:

$SCV_h$  = Live cattle imports as a share of total cattle, beef and beef product imports from the U.S. in country h,

$SBFV_h$  = Fresh or frozen beef imports as a share of total cattle, beef and beef products import from the U. S. in country h,

$SBPV_h$  = Prepared or preserved beef imports as a share of total cattle, beef and beef product imports from the U.S. in country h,

$RPC_h$  = Real import price of live cattle in country h's currency,

- $RPBF_h =$  Real import price of fresh or frozen beef in country h's currency,  
 $RPBP_h =$  Real import price of preserved or prepared beef in country h's currency,  
 $IY_h =$  Real percapita income in deflated domestic currency (1985 = 100) in country h,  
 $\epsilon_{b1}, \epsilon_{b2}, \epsilon_{b3} =$  Random error terms which are assumed to be normally distributed with zero expectation and scalar-diagonal covariance matrix.

The empirical models of wheat import share equations are as follows:

Unmilled Wheat:

$$SWV_h = \alpha_0 + \alpha_1 RPW_h + \alpha_2 RPWF_h + \alpha_3 RPWP_h + \alpha_4 IY_h + \epsilon_{w1},$$

Wheat Flour:

$$SWFV_h = \beta_0 + \beta_1 RPW_h + \beta_2 RPWF_h + \beta_3 RPWP_h + \beta_4 IY_h + \epsilon_{w2},$$

Other Wheat Products:

$$SWPV_h = \gamma_0 + \gamma_1 RPW_h + \gamma_2 RPWF_h + \gamma_3 RPWP_h + \gamma_4 IY_h + \epsilon_{w3},$$

where:

- $SWV_h =$  Wheat imports as a share of total wheat and wheat product imports from the U.S. in country h,  
 $SWFV_h =$  Wheat flour imports as a share of total wheat and wheat product imports from the U.S. in country h,  
 $SWPV_h =$  Highly processed wheat product imports as a share of total wheat and wheat product imports from the U.S. in country h,  
 $RPW_h =$  Real import price of wheat in country h's currency,

$RPWF_h$  = Real import price of wheat flour in country h's currency,

$RPWP_h$  = Real import price of wheat products in country h's currency,

$\epsilon_{w1}, \epsilon_{w2}, \epsilon_{w3}$  = Random disturbance terms which are assumed to be normally distributed with zero expectation and scalar-diagonal covariance matrix.

The import shares of each product were obtained as follows:

$$S_{ih} = \frac{P_{ih}q_{ih}}{\sum_j P_{jh}q_{jh}}$$

$$\sum_i S_{ih} = 1$$

where:

$S_{ih}$  = The import share of the  $i$ th U.S. product (e.g., bulk wheat, flour, and other wheat products) of total U.S. products (e.g., total bulk wheat and wheat products) within a product class (e.g., wheat product) in country  $h$ ,

$P_{ih}$  = Price of the  $i$ th U.S. product in a product class to country  $h$  in U.S. dollars,

$q_{ih}$  = Quantity of the  $i$ th U.S. product in a product class to country  $h$ ,

$P_{ih}q_{ih}$  = Import expenditure for the  $i$ th U.S. product within a product class in country  $h$ ,

Real per capita gross domestic product (GDP) for each country is used as a proxy for consumer's personal disposable income. This proxy is expressed in domestic currency and deflated by the domestic consumer price index (1985=100).

$$IY_h = \frac{\left( \frac{GDP_h}{POP_h} \right)}{\left( \frac{CPI_h}{100} \right)}$$

where:

- $IY_h$  = Real per capita income in deflated domestic currency (1985=100) in country h,
- $GDP_h$  = Gross domestic product (GDP) in the domestic currency of country h,
- $POP_h$  = Population in country h,
- $CPI_h$  = Consumer price index (1985=100) in country h.

U.S. export unit values of wheat and beef products to MIDCs were used to calculate real import prices in MIDCs. These unit values were computed by dividing the U.S. export value by the number of exported units as follows:

$$P_{ih} = \frac{XUSV_{ih}}{XUSQ_{ih}}$$

where:

- $P_{ih}$  = U.S. export unit value of product i to country h (a proxy for price of the ith U.S. product in a product class to country h in U.S.),
- $XUSV_{ih}$  = Value of U.S. exports of product i to country h,
- $XUSQ_{ih}$  = Quantities of U.S. exports of product i to country h.

The unit values of the imported products are transformed into a particular country's domestic currency and then deflated by the domestic consumer price index (1985=100) of the country as follows:

$$RP_{ih} = \frac{P_{ih} \cdot EXR_h}{\left( \frac{CPI_h}{100} \right)}$$

where:

- $RP_{ih}$  = Real import unit value for U.S. product  $i$  in deflated domestic currency (1985=100) in country  $h$ ,
- $EXR_h$  = Exchange rate of country  $h$ 's currency per U.S. dollar,
- $CPI_h$  = Domestic consumer price index of country  $h$  (1985=100).

Annual time series data from 1970 to 1988 were used for wheat. The analysis for live cattle and beef products covers the period 1978 to 1988 because data for preserved or prepared beef from 1970 to 1977 are not compatible with data from 1978 to 1988.

U.S. export data for live cattle, fresh or frozen beef and preserved or prepared beef by destinations were obtained from USDA/FAS. The data for wheat, wheat flour and other wheat products were obtained from *Foreign Agricultural Trade of the United States*. All data were based on calendar years.

Gross domestic product (GDP), population, consumer price index (CPI), and exchange rates are reported in the *International Financial Statistics* of the International Monetary Fund (IMF) in various issues. However, macroeconomic indicators for Hong Kong and Taiwan could not be obtained from the IMF since these countries are not official members. Therefore, data for Taiwan were obtained from the Economic Research Service of the U.S. Department of Agriculture. The original source for the GDP, population, and CPI data is the Council for Economic Planning and Development of the Republic of China while the exchange rate data came from the *Financial Statistics* of the Central Bank of China. Reliable data for Hong Kong and Algeria were not available; consequently they were dropped from the study.

## Empirical Results

The import share equations were estimated using an ordinary least squares (OLS) technique. The equations were estimated for each country and product. The impact of own-price upon import share is largely determined by the elasticity of import demand. If the import demand is inelastic, then an increase in price will result in greater import expenditures. If the import demand is elastic, then price increases result in reduced import expenditures. Since the numerator of the import share for a particular product is equal to import expenditures for the product, the effect of a price increase upon the numerator may be completely inferred from the elasticity of import demand. On the other

hand, the impact upon the denominator is not so clear. To measure this effect, it is necessary to know the complement and substitute relationships between the products entering the calculation of the share. However, if the cross-price elasticities are small relative to the own-price elasticities, then changes in numerators will be proportionally greater than changes in the denominators, in which event the direction of the effect of increases in own-price upon the shares may also be inferred from the elasticities of import demand. There will be a tendency for inelastic products to have import shares that are positively related to own-price, and for elastic products to have import shares that are negatively related to own-price.

## **Wheat Products**

The wheat product category includes unmilled wheat, wheat flour and other wheat products. These correspond to bulk, semi-processed, and high-processed products, respectively.

**Unmilled Wheat.** In most of the selected countries, the import share of U.S. bulk wheat has been high compared with shares from other major wheat exporters. The import share of U.S. bulk wheat, as a percent of total U.S. wheat and wheat product imports, has generally been over 90 percent in these countries.

Coefficients on per capita income are statistically significant except for Mexico and Israel (Table 7). For Jordan, Malaysia, Singapore, and Korea, the regression coefficients have positive signs. As the countries' per capita incomes increase, the import share for U.S. bulk wheat will increase, while decreasing for processed U.S. wheat products.

Meanwhile, in Taiwan the import share of U.S. bulk wheat had a negative relation with per capita income over the period studied (Table 7). However, in terms of quantity imported from the U.S., imports have generally increased since 1980. Taiwan imported 550 thousand metric tons (MT) from the U.S. in 1980, and about 829 thousand MT in 1988. Therefore, since income in Taiwan increased over this period, it is likely that total imports of bulk wheat are positively related to income, even though their share of imports of all wheat products has decreased.

For Mexico and Taiwan, the regression coefficients for own-price of wheat are statistically significant with a negative sign. The negative sign suggests that in Mexico and Taiwan import demands for U.S. bulk wheat are elastic with respect to U.S. wheat prices. However, for the other countries, except Malaysia, the own-price coefficients have positive signs but are insignificant. The own-price coefficient for Malaysia is statistically significant and positive; that is, increases in the own-price of U.S. wheat have positive effects on the import share of U.S. wheat.

**Table 7. OLS Estimates of U.S. Unmilled Wheat Export Shares as a Percent of Total U.S. Wheat and Wheat Product Exports to Selected MIDCs, 1970-88**

Country	Independent Variables					R <sup>2</sup>
	Intercept	RPW	RPWF	RPWP	IY	
Mexico	1.0831 (4.155)	-8.688D-6 (-4.502)	-5.380D-6 (-3.183)	1.113D-6 (3.516)	5.465D-7 (1.184)	0.76
Israel	0.8645 (5.176)	0.022953 (0.454)	-0.034541 (-0.936)	0.000222 (0.032)	0.004482 (0.848)	0.30
Jordan	-0.8675 (-2.429)	0.000205 (0.901)	0.000517 (1.935)	2.333D-5 (0.352)	0.002919 (3.97)	0.71
Malaysia*	0.3668 (2.933)	0.000459 (2.734)	NI	9.082D-6 (0.958)	9.126D-5 (4.498)	0.67
Singapore	0.6503 (4.273)	0.000310 (1.541)	1.347D-5 (0.262)	1.114D-5 (1.63)	1.244D-5 (1.899)	0.37
Korea	0.9059 (40.015)	5.659D-8 (0.576)	4.840D-8 (0.44)	1.456D-8 (0.597)	4.054D-8 (2.972)	0.67
Taiwan*	1.0035 (916.9)	-2.647D-7 (-3.869)	NI	-5.088D-9 (-1.306)	-1.573D-8 (-2.972)	0.62

The t-values are in parentheses.

NI: not included; the variable was not included in the regression model.

\* unmilled wheat and value-added wheat products.

**Wheat Flour.** Because of lack of data, wheat flour and other wheat products were aggregated to one category for Taiwan and Malaysia. An analysis of this product category is in the next section.

Coefficients on per capita income in Jordan and Korea are statistically significant and negative for the import shares of wheat flour (Table 8). These results suggest that as MIDCs' personal disposable incomes grow, they develop their own flour milling industries. This is not surprising since these industries do not require high-technology. The results are not encouraging for U.S. firms wishing to promote wheat flour exports to middle-income developing countries.

For all countries except Mexico and Jordan, the regression coefficients for own price of wheat flour are not statistically significant. For Mexico and Jordan the coefficients are statistically significant with a positive sign for Mexico and a negative sign for Jordan. These results suggest that the import demand for U.S. wheat flour is inelastic to U.S. flour prices in Mexico, but elastic in Jordan.

**Table 8. OLS Estimates of U.S. Wheat Flour Export Shares as a Percent of Total U.S. Wheat and Wheat Product Exports to Selected MIDCs, 1970-88**

Country	Independent Variables					R <sup>2</sup>
	Intercept	RPW	RPWF	RPWP	IY	
Mexico	-0.1283 (-0.522)	8.587D-6 (4.72)	4.978D-6 (3.125)	-1.082D-6 (-3.627)	-4.547D-7 (-1.045)	0.77
Israel	0.1843 (1.114)	-0.034364 (-0.686)	0.044051 (1.206)	-0.002799 (-0.41)	-0.006114 (-1.169)	0.32
Jordan	1.8502 (5.256)	-0.000208 (-0.927)	-0.000518 (-1.969)	-2.411D-5 (-0.37)	-0.002876 (-3.968)	0.71
Singapore	0.1147 (1.724)	-0.000120 (-1.359)	-1.139D-8 (-0.001)	-3.839D-6 (-1.285)	-3.275D-6 (-1.143)	0.22
Korea	0.0932 (4.141)	-5.343D-8 (-0.548)	-5.189D-8 (-0.475)	-1.373D-8 (-0.566)	-4.023D-8 (-2.969)	0.67

The t-values are in parentheses.

**Other Wheat Products.** For all countries except Taiwan and Malaysia, other wheat products include only highly processed wheat products. Coefficients on per capita income are statistically significant in all countries except Mexico (Table 9). For four out of six countries, the regression coefficients have negative signs in the import share equations. As per capita incomes in Jordan, Malaysia, Singapore, and Korea increase, the import share of other wheat products falls while increasing for Israel and Taiwan. This suggests that highly processed U.S. wheat products lose relative to bulk wheat for five of the countries as income increases.

In contrast, for Taiwan and Israel, highly processed wheat products have shares that increase with income. With the exception of these two countries, the results are generally discouraging for the promotion of highly processed wheat products.

Coefficients on own-price are statistically significant in Israel and Korea. For Korea, there is a negative relation between own-price of wheat products and import share. For Israel, however, there is a positive relation. This suggests that the import demands for U.S. high-processed wheat products are elastic to U.S. prices in Korea, but inelastic in Israel.

**Table 9. OLS Estimates of U.S. Other Wheat Product Export Shares as a Percent of Total U.S. Wheat and Wheat Product Exports to Selected MIDCs, 1970-88**

Country	Independent Variables					R <sup>2</sup>
	Intercept	RPW	RPWF	RPWP	IY	
Mexico	0.0452 (1.387)	1.010D-7 (0.418)	4.013D-7 (1.899)	-3.068D-8 (-0.775)	-9.180D-8 (-1.59)	0.36
Israel	-0.0488 (-5.519)	0.011412 (4.259)	-0.009510 (-4.867)	0.002576 (7.049)	0.001632 (5.834)	0.91
Jordan	0.0173 (2.577)	2.921D-6 (0.681)	1.494D-6 (0.297)	7.860D-7 (0.631)	-4.298D-5 (-3.105)	0.67
Malaysia <sup>*</sup>	0.6332 (5.064)	-0.000459 (-2.734)	NI	-9.082D-6 (-0.958)	-9.126D-5 (-4.498)	0.67
Singapore	0.2349 (2.388)	-0.000191 (-1.464)	-1.346D-5 (-0.404)	-7.300D-6 (-1.652)	-9.168D-6 (-2.164)	0.44
Korea	0.0009 (3.898)	-3.165D-9 (-3.117)	3.484D-9 (3.066)	-8.317D-10 (-3.298)	-3.017D-10 (-2.139)	0.68
Taiwan <sup>*</sup>	-0.0035 (-3.197)	2.647D-7 (3.868)	NI	5.090D-9 (1.306)	1.573D-8 (2.973)	0.62

The t-values are in parentheses.

NI: not included; the variable was not included in the regression model.

<sup>\*</sup> unmilled wheat and wheat products.

## Beef Products

This beef product category consists of live cattle, fresh or frozen beef, and preserved or prepared beef. These correspond to bulk, semi- processed, and high processed products, respectively.

The selected countries, except for Mexico, Korea, and Taiwan, have imported few live cattle from the U.S. Consequently, the import share of U.S. live cattle of the total U.S. beef category was estimated only for Mexico, Korea, and Taiwan. Import shares for the other countries represent a percentage of the sum of fresh or frozen beef and preserved or prepared beef.

In general, the t-statistics for several of the estimated coefficients are low. One of the reasons is the short time series used.

**Live Cattle.** Coefficients on per capita income are statistically significant at the 20% or higher level in Mexico, Korea, and Taiwan. Income in

Mexico and Korea has a negative relationship with the import share of U.S. live cattle. Mexico has historically been a major importer of U.S. live cattle, with its import share of the total U.S. beef category being over 90 percent in the 1970's (Table 10).

In the 1980's the live cattle import share for Mexico has been around 80 percent. The econometric results indicate that decreases in the import share of U.S. live cattle are likely to occur with increasing personal disposable income in Mexico. For Korea, the import share also decreases with increasing personal disposal income. In contrast, for Taiwan, import share is positively related to income.

In Korea, the coefficient on own-price is statistically significant at the 20% level with a positive sign. This suggests that Korean import demand for U.S. live cattle is inelastic with respect to U.S. cattle prices. The own-price coefficients were not significant.

**Fresh or Frozen Beef.** For fresh or frozen beef, the regression coefficients for per capita income are statistically significant at the 10% or higher level of significance, with positive signs for Mexico and Korea and negative signs for Israel and Jordan (Table 11). These results are encouraging for the prospects of promoting fresh or frozen beef to all countries but Israel and Jordan.

The denominators in the shares for all countries but Mexico, Korea, and Taiwan do not include live cattle. Therefore, the signs on the income coefficients for all countries but these show the relative effect that income should have upon fresh or frozen beef and preserved or prepared beef import shares. A negative sign indicates that the share of fresh or frozen beef will be lost to

**Table 10. OLS Estimates of U.S. Live Cattle Export Shares as a Percent of Total U.S. Live Cattle and Beef Product Exports to Selected MIDCs, 1978-88**

Country	Independent Variables					R <sup>2</sup>
	Intercept	RPW	RPWF	RPWP	IY	
Mexico	1.3599 (4.399)	5.803D-7 (1.274)	-1.269D-7 (-1.08)	-3.552D-8 (-0.212)	-7.510D-7 (-1.835)	0.62
Korea	2.4800 (4.544)	1.594D-7 (1.705)	-1.499D-7 (-1.685)	4.285D-8 (0.979)	-9.739D-7 (-3.975)	0.81
Taiwan	-1.5248 (-2.048)	2.625D-6 (0.544)	3.488D-6 (2.193)	1.041D-6 (0.941)	6.418D-6 (1.846)	0.72

The t-values are in parentheses.

**Table 11. OLS Estimates of U.S. Fresh or Frozen Beef Export Shares as a Percent of Total U.S. Live Cattle and Beef Product Exports to Selected MIDCs, 1978-88**

Country	Independent Variables					R <sup>2</sup>
	Intercept	RPW	RPWF	RPWP	IY	
Mexico	-0.1910 (-1.246)	-1.881D-7 (-0.833)	4.539D-8 (0.779)	9.572D-9 (0.115)	4.054D-7 (1.998)	0.59
Israel	7.3695 (2.18)	NI	0.000641 (0.114)	-0.016188 (-1.411)	-0.214538 (-2.083)	0.68
Jordan	5.5791 (1.936)	NI	-3.344D-7 (-0.028)	-1.041D-5 (-1.782)	-0.010286 (-1.602)	0.59
Malaysia	-0.5120 (-0.548)	NI	1.115D-5 (0.730)	6.730D-6 (0.670)	0.000199 (1.185)	0.25
Singapore	-0.3517 (-0.332)	NI	2.296D-5 (1.329)	-1.224D-6 (-0.102)	4.770D-5 (1.041)	0.23
Korea	-1.3958 (-3.109)	-1.431D-7 (-1.86)	1.044D-7 (1.427)	-3.179D-8 (-0.883)	9.464D-7 (4.695)	0.84
Taiwan	2.1706 (3.853)	-7.529D-7 (-0.206)	-3.764D-6 (-3.127)	-6.781D-7 (-0.81)	-5.073D-6 (-1.928)	0.82

The t-values are in parentheses.

NI: not included; the variable was not included in the regression model.

preserved or prepared beef as income increases. A negative sign was estimated for Israel and Jordan.

The regression coefficient on per capita income is not significantly different from zero at the 10% level in Taiwan. Taiwan's imports of U.S. fresh or frozen beef have not changed much since 1979. The quantity of fresh beef imports from the U.S. has shown a moderate increase since 1985.

The regression coefficient on own-price is statistically significant for Taiwan. The import share of U.S. semi-processed beef products in Taiwan is negatively related to own price.

**Preserved or Prepared Beef.** Coefficients on per capita income are statistically significant at the 20% level and positive for Mexico, Israel and Jordan (Table 12). In Mexico, per capita income has a statistically significant positive relationship with the import share of U.S. preserved or prepared beef.

**Table 12. OLS Estimates of U.S. Prepared Beef Export Shares as a Percent of Total U.S. Live Cattle and Beef Product Exports to Selected MIDCs, 1978-88**

Country	Independent Variables					R <sup>2</sup>
	Intercept	RPW	RPWF	RPWP	IY	
Mexico	-0.1689 (-1.078)	-3.922D-7 (-1.699)	8.153D-8 (1.368)	2.595D-8 (0.306)	3.456D-7 (1.666)	0.66
Israel	-0.6395 (-1.884)	NI	-0.000641 (-0.114)	0.016188 (1.411)	0.214537 (2.083)	0.68
Jordan	-4.5791 (-1.589)	NI	3.344D-7 (0.028)	1.041D-5 (1.782)	0.010286 (1.602)	0.59
Malaysia	1.5120 (1.657)	NI	-1.115D-5 (-0.731)	-6.730D-6 (-0.682)	-0.000199 (-1.222)	0.25
Singapore	1.3517 (1.274)	NI	-2.296D-5 (-1.329)	1.224D-6 (0.102)	-4.770D-5 (-1.041)	0.23
Korea	-0.0843 (-0.678)	-1.640D-8 (-0.77)	4.551D-8 (2.249)	-1.106D-8 (-1.109)	2.754D-8 (0.494)	0.63
Taiwan	0.3542 (1.498)	-1.873D-6 (-1.222)	2.767D-7 (0.548)	-3.624D-7 (-1.032)	-1.345D-6 (-1.219)	0.45

The t-values are in parentheses.

NI: not included; the variable was not included in the regression model.

The other countries import only fresh or frozen beef and preserved or prepared beef in significant quantities. For these countries, the empirical results for highly processed beef products are simply the negative of those found for semi-processed beef products.

## Summary and Conclusion

This study has analyzed the import shares of U.S. value-added wheat and beef products in MIDCs (Singapore, Hong Kong, Korea, Taiwan, Algeria, Malaysia, Israel, Jordan, and Mexico). However, Hong Kong and Algeria were excluded from the empirical estimations because of data limitations.

In estimating the import share equations for U.S. wheat, wheat flour and other wheat products, and for live cattle, fresh or frozen beef and preserved or prepared beef, the ordinary least squares (OLS) technique was applied to annual

data from 1970 to 1988. A linear functional form of the import share equation was estimated.

The empirical results from the estimated import share of bulk wheat and wheat products indicate that in all selected MIDCs except Taiwan, U.S. bulk wheat exports have better prospects than U.S. processed wheat product exports. The results showed that increases in real income growth have negative impacts on U.S. processed wheat products in all MIDCs except Taiwan.

International wheat flour trade has declined since 1980. In 1980/81, total world wheat flour trade was 9.48 million tons, but decreased to 5.72 million tons in 1985/86 (Table 13). In the world wheat flour market, major exporters have been developed countries, while major importers have been developing countries in Asia and Africa (Tables 13 and 14). In 1985/86, developed country exports accounted for over 94 percent of world wheat flour trade, and developing countries of Asia and Africa accounted for 90.6 percent of world wheat flour imports (Table 13). In the Asian countries, wheat flour imports have mostly decreased since 1979/80. Japan, which has been a large bulk wheat importer, turned out to be a large net exporter of wheat flour in 1985/86 (Table 15). This indicates that the Asian countries tend to develop their

**Table 13. Total World Trade in Wheat Flour and Imports by Asia and Africa, 1970/71 to 1985/86**

Year *	Asia		Africa		World
	Percentage <sup>†</sup>	Percentage <sup>‡</sup>	Percentage <sup>†</sup>	Percentage <sup>‡</sup>	Total
(1,000 MT)					
1970/71	2830	50.9	1360	24.5	5559
1971/72	2300	41.6	1590	28.8	5530
1972/73	2472	44.1	1633	29.2	5602
1973/74	2325	47.0	1344	27.2	4948
1974/75	2178	45.9	1615	34.1	4743
1975/76	2325	44.0	2024	38.3	5285
1976/77	2933	46.3	1870	29.6	6328
1977/78	3003	42.2	2295	32.3	7108
1978/79	2518	34.6	2537	34.9	7279
1979/80	3197	38.9	2650	32.3	8209
1980/81	1914	20.2	4175	44.0	9480
1981/82	1530	17.9	3541	41.5	8532
1982/83	1887	26.7	3950	55.9	7065
1983/84	2141	26.7	4334	54.1	8006
1984/85	1317	20.7	4293	67.6	6348
1985/86	1264	22.1	3914	68.5	5718

\* the crop year, July/June

<sup>†</sup> Asia as percent of world total

<sup>‡</sup> Africa as percent of world total

Source: International Wheat Council, *World Wheat Statistics*, various issues.

**Table 14. Major World Exporters of Wheat Flour to Asia:  
Exports to Asia**

Year <sup>1</sup>	EC <sup>2</sup>	U.S.	Canada	Japan	USSR	Australia	Total <sup>3</sup>
(1,000 MT)							
1980/81	732	606	38	NA	110	29 1	914
RMS <sup>4</sup>	0.38	0.32	0.02		0.06	0.02	1
1981/82	889	328	27	NA	90	27	1530
	0.58	0.21	0.02		0.06	0.02	1
1982/83	954	325	76	149	200	35	1887
	0.51	0.17	0.04	0.08	0.11	0.02	1
1983/84	1001	341	93	305	300	21	2141
	0.47	0.16	0.04	0.14	0.14	0.01	1
1984/85	832	88	80	202	80	8	1317
	0.63	0.07	0.06	0.15	0.06	0.01	1
1985/86	514	199	97	306	100	12	1264
	0.41	0.16	0.08	0.24	0.08	0.01	1

NA : Not available

1\ the crop year, July/June

2\ European Community

3\ world total exports to Asia

4\ a rate of market share

Source : International Wheat Council, *World Wheat Statistics*, various issues.

milling industries as their economies grow. However, there has been a tendency for African countries to increase wheat flour imports (Table 13).

On the other hand, the empirical results from the estimated import shares of U.S. live cattle and processed beef products indicate that U.S. processed beef products have better prospects than U.S. cattle exports in Mexico and Korea under the assumption of continued income growth. The results showed that imports of U.S. fresh or frozen beef are likely to increase with income growth in Mexico and Korea, while decreasing in Taiwan. In Israel and Jordan, the share of fresh or frozen beef is likely to decrease with income growth, but the share of prepared beef increases.

In this study, analysis of import demand for value-added agricultural exports was conducted using share equations. This approach was taken because extreme limitations in data availability and quality prevented estimation of ordinary import demand functions. Unfortunately, share equations cannot be used to explain or predict absolute movements in exported quantities or revenues. Absolute measures would be more valuable in assessing potential markets for

**Table 15. Major World Wheat Flour Exporters**

Year <sup>1</sup>	EC <sup>2</sup>	U.S.	Canada	Japan	USSR	Australia	Total <sup>3</sup>
(1,000 MT)							
1980/81	4331	1705	638	NA	200	137	9480
RMS <sup>2</sup>	0.46	0.18	0.07		0.02	0.01	1
1981/82	4381	1320	536	NA	200	130	8532
	0.51	0.15	0.06		0.02	0.02	1
1982/83	3690	1825	401	149	200	124	7065
	0.52	0.26	0.06	0.02	0.03	0.02	1
1983/84	4190	2166	730	319	300	78	8006
	0.52	0.27	0.09	0.04	0.04	0.01	1
1984/85	4088	1087	428	210	200	81	6348
	0.64	0.17	0.07	0.03	0.03	0.01	1
1985/86	3609	1103	355	308	100	50	5718
	0.63	0.19	0.06	0.05	0.02	0.01	1

NA : Not available

<sup>1</sup> the crop year, July/June

<sup>2</sup> a rate of market share

Source : International Wheat Council, *World Wheat Statistics*, various issues.

value-added products. Were high quality data to become available, significant improvements could be made to this study by estimating and analyzing the ordinary import demands.

The empirical models in this paper do not include variables such as political and sociological factors. Improvements could be made to this study by the quantification of institutional variables.

The truncated samples upon which the share equations are based are another limitation of the study (the manner in which the price regressors were calculated requires positive exported quantities). The estimates of the share equations might be improved by truncated - sample estimation techniques (e.g., Tobit analysis) rather than OLS.

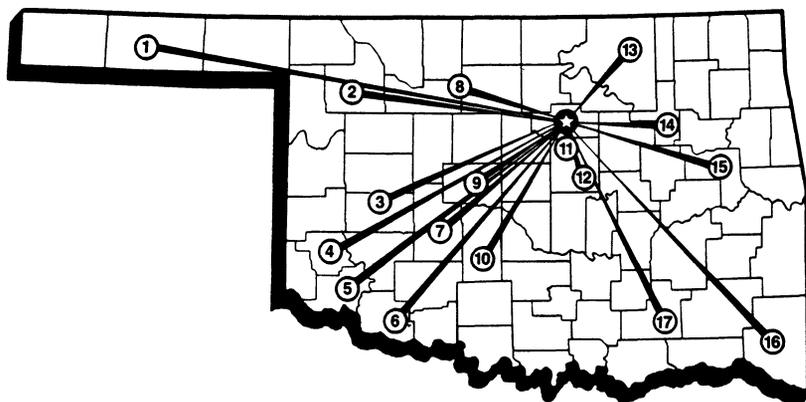
## REFERENCES

Ackerman, Karen, Stephen MacDonald, and Steve Milmo. "International Trade." *National Food Review*, Vol. 12, 1989, P.44.

- Council for Economic Planning and Development. *Industry of Free China*. The Republic of China, Vol. L12, No. 1, July 1989.
- International Wheat Council. *World Wheat Statistics*. London, various issues.
- Lee, Jung-Hee, David Henneberry, and David Pyles. "Value-Added Agricultural Exports: An Overview for Oklahoma and the United States." *Current Farm Economics*, vol. 63, no. 1, Agricultural Experiment Station, Division of Agriculture, Oklahoma State University, March 1990.
- Nuttall, John. "U.S. Farm Exports: The Value-Added Factors." Washington, DC: USDA, FAS, Foreign Agriculture, January 1983.
- Rahe, Dewain H. and Willis G. Collie. "Value-added Exports Around the World." *1985 Yearbook of Agriculture*, USDA.
- Schluter, Gerald and Kenneth C. Clayton. "Expanding the Processed Product Share of U.S. Agricultural Exports" USDA/ERS, National Economics Division, Staff Report, No. AGES810701, July, 1981.
- Schluter, Gerald and William Edmondson. "Exporting Processed Instead of Raw Agricultural Products." USDA/ERS, Agriculture and Rural Economy Division, Staff Report No. AGES 89-58, November 1989.
- The Central Bank of China. *Financial Statistics*. The Republic of China, various issues.
- United Nations, Food and Agriculture Organization. *FAO Production Yearbook*. Rome, Italy, various issues.
- United Nations, Food and Agriculture Organization. *FAO Trade Yearbook*. Rome, Italy, various issues.
- United Nations, International Monetary Fund. *International Financial Statistics*. Washington, DC, various issues.
- U.S. Department of Agriculture, Economic Research Services. *Foreign Agricultural Trade of the United States*. Washington, DC, various issues.

# THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION

## System Covers the State



- ★ **Main Station – Stillwater and Lake Carl Blackwell**
- 1. **Panhandle Research Station – Goodwell**
- 2. **Southern Great Plains Field Station – Woodward**
- 3. **Marvin Klemme Range Research Station – Bessie**
- 4. **Sandyland Research Station – Mangum**
- 5. **Irrigation Research Station – Altus**
- 6. **Southwest Agronomy Research Station – Tipton**
- 7. **Caddo Research Station – Ft. Cobb**
- 8. **North Central Research Station – Lahoma**
- 9. **Forage and Livestock Research Laboratory – El Reno**
- 10. **South Central Research Station – Chickasha**
- 11. **Agronomy Research Station – Perkins**  
**Fruit Research Station – Perkins**
- 12. **Pecan Research Station – Sparks**
- 13. **Pawhuska Research Station – Pawhuska**
- 14. **Vegetable Research Station – Bixby**
- 15. **Eastern Research Station – Haskell**
- 16. **Kiamichi Forestry Research Station – Idabel**
- 17. **Wes Watkins Agricultural Research and Extension Center – Lane**



Reports of Oklahoma Agricultural Experiment Station serve people of all ages, socio-economic levels, race, color, sex, religion and national origin. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agriculture and has been prepared and distributed at a cost of \$776.69 for 1,030 copies. AI-9698 RO.