

assistance, and or materials are needed should contact private enterprises in his area which he thinks might be interested in his project and submit a proposed plan to them indicating his needs. Such contacts may prove very fruitful.

There are several non-profit organizations that have regular research assistance programs which may be of interest to NACTA members contemplating research. Assistance from these organizations is usually difficult to obtain. However, assistance is available. If the proposed research project has adequate depth and breadth it will be given appropriate consideration.

The National Science Foundation, Washington, D. C. has a regular research assistance program for technical research projects. Contact may be made through the national office concerning the type of projects for which financial assistance is provided and the requirements for assistance.

The Small Business Administration, Washington, D. C. has an annual research assistance program for research projects affecting a region and concerned with the management of a business enterprise. The type of research projects supported by the SBA may also include some technical research. The SBA generally grants funds for one research project in each state each year. Therefore, competition for a SBA research grant may be very great, particularly in states where there are Business Colleges seeking such a grant.

The Kettering Foundation, the Tennessee Valley Authority provide funds and other assistance for research related to crops and soils. The Kellogg Foundation and the Ford Foundation provide funds for research projects in general education. Contact should be made with these foundations concerning the requirements for grants and the conditions for conducting research projects with the foundation grant.

Although funds and materials for research are not available to NACTA members to grasp at all times for any research project they may wish to conduct, funds and materials are available if the researcher desires to seek them. The writer, (Dr. DeVeau), believes that sources for materials are virtually limitless and that funds for research are available if the researcher takes the necessary time and effort to seek appropriate sources of funds.

In the opinion of the associate editor, our continuous communication with one another in NACTA, and our favorable relationship with other agriculture colleges is dependent upon the development of a publication of high calibre that will merit a wide circulation. The editorial staff must have available some stable source of constructive information and it is the opinion of the associate editor that these research manuscripts could constitute one desirable source of material for publication. The Publication and Research Committee will continue to encourage the development of the third purpose as defined in the constitution of NACTA. . . . to encourage and promote research in agriculture among members of the association.

Education for Management Of Agricultural Business

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Perhaps the six words which form the title of this paper embody the goals of most students and teachers who have strong interests in agriculture. The panorama of events in agricultural industries which has occurred during the lifetime of the students and the working career of most agricultural educators is a story of high adventure. The risks, the ruthless competition, the obstacles, the failures and the successes furnish a real life drama second to none. The curiosity which every individual has concerning his environment adds further suspense to the tale.

Such adventure was forecast by Karl Pearson in his "Grammar of Science" by his definition of science.

"Science may be described as a classified index to the successive pages of sense impression which enables us readily to find what we want, but it in no wise accounts for the peculiar contents of that strange book of life."

In this paper, I shall concentrate on two types of changes in agriculture and suggest some of their implications for educators in the field: (1) changes in on-the-farm production, (2) changes in farm supply and in the marketing structure for farm products. Limitations of time and space prevent exhaustive examination of even two areas and implications for educators are tentative and subjective. References at the end of the paper are listed to encourage the reader's further investigation.

The agricultural fundamentalists, and a few soil conservationists, have frequently taken the alarmist view with such titles as "Standing Room Only", "Our Plundered Planet" and similar warnings of population's race with production. However large the demand side for farm production appears in the next few decades, the supply side seems even greater. Rate of increase in farm production has consistently exceeded the rate of population growth in the last decade. The average rate of increase in farm production was 2.4 per cent over the 10 year period 1950-59. The average rate of population growth in the United States was only 1.7 per cent in the same period.

This difference in growth rate is small but the margin seems to accumulate substantial surpluses. Too, the low price elasticity of demand for major farm products accentuates the difference in growth rates and causes severe depression of farm prices and income. The low price elasticity of demand causes large supplies of a crop to bring less total income than a small supply. If prices only fell 1 per cent when supplies rose 1 per

cent, income would be virtually unchanged. Unfortunately, relatively few farm products enjoy such a position. For example, past demand studies indicate that at the farm level, for a 1 per cent increase in output, hog prices decline about 2.5 per cent; cattle and calves, veal and poultry by about 1.7; eggs by 5 per cent; dairy products by 5 per cent; and feed grains by about 2.5 per cent. When used for feed, wheat has an elasticity similar to feed grains. However, when wheat is used for food its price decline in response to a 1 per cent increase in output is much greater. The price of an individual commodity also decreases when the quantity of a competing substitute increases.¹

Benefits To Society

Competition in agriculture combined with low price elasticity of demand for farm products promotes economic gains for society. The individual farmer is under pressure to improve his technology and increase productivity. The improved production process releases resources from agriculture, chiefly labor, for other functions desired by society. The size of these savings is indicated in Table 1. Today the consumer has a wide variety and quantity of food for selection; moreover, each unit was produced at lower cost. If such improvements had not been forthcoming, more than 45 per cent more resources would have been necessary in agriculture between 1940-59 to provide for population growth and improved nutritional standards.

TABLE 1

Indices of Farm Production and Resources
Used U. S. 1940-59

Year	Total Farm Production	Total Farm Resources Used	Resources Per Unit of Production
1940	100	100	100
1945	116	102	89
1950	123	104	84
1955	138	105	76
1959	152	103	68

Source: U. S. D. A.

1. Thus in price elasticity of demand terms at the farm level the percentages in this paragraph would approximate: Hogs—0.4; cattle, calves, veal and poultry —0.6; eggs—0.2; dairy products —0.2; and feed grains—0.4.

The use of more capital resources by farmers has pushed increased production against the inelastic demand for food and fiber. In this situation income per farmer can be maintained only if we have fewer farmers and fewer farms. Societies' saving in resources used in agriculture since 1940 has been in terms of fewer farmers but increased capital investment in adoption of new technology or more extensive use of known techniques in production.

The increase in capital expenditures by individual categories was approximately 135 per cent for machinery, 142 per cent for lime and fertiliz-

er, 125 per cent for feed and livestock and 37 per cent for miscellaneous items. But during this same period, the number of farms declined 30 per cent and total farm labor declined 47 per cent. In summary, the exchange left the total value of resources used about 3 per cent higher than in 1940 while production increased 52 per cent. The consolidation of farms which took place brought about a savings in production. For example when two farms of 160 acres each are consolidated, the new unit no longer needs to duplicate the machinery used on the two previous units. The relative price position of farm inputs is indicated in Table 2. Labor is the highest price resource used while fertilizer is the cheapest.

TABLE 2

Index of Prices Received and Prices Paid
By Farmers 1935-59. 1935-39=100

Index of:	1935-39	1945-49	1950-54	1955-59
Prices received				
by farmers	100	231	252	221
Price of fertilizer	100	132	150	151
Price of machinery	100	130	173	191
Price of labor	100	333	395	455
Price of land (above)	100	188	254	325
Prices paid, all costs	100	184	220	229

Source: U. S. D. A.

During the two decades, land in cultivation remained almost constant but rose in price to 325 points while fertilizer which serves as a substitute rose only 51 points. Machinery rose to 191 but the machines of 1959 and 1960 are larger and more efficient than those of the 1935-39 period and produced declining per unit costs of production. The labor force in agriculture has declined consistently since 1910 when 13.6 million were employed to 11.0 million in 1930 and approximately 7 million in 1960. In contrast, had only 1910 productivity been maintained agriculture would need more than 26 million persons in 1960.

Implications for Educators—Farm Production

Training of the replacements for commercial agriculture has an importance out of proportion to the number so trained. But given the continued high birth rates in rural areas, only 15 per cent of the boys born on farms have an opportunity to return to productive agriculture and operate a commercial farm. The 6.8 million 1961 employment figure for farms includes 3.8 million farm operators, about 1.2 million year-around hired laborers, 900 thousand migratory laborers and 900 thousand seasonal laborers who work in agriculture on a part time basis. Potential college students for training in agriculture will largely come from the 1.9 million commercial farms where the value of sales exceeds \$5,000. One indication of the proportion of educational resources to be devoted to training in technical agriculture can be obtained from studies by the National Bureau of Economic Research Incorporated.

TABLE 3
Shifts in Distribution of U. S. Labor Force Among Industrial Sectors, 1890-1920 and 1920-50

Industry	1890		1920		1950		Change	Change
	No.	Percent	No.	Percent	No.	Percent	1890 to 1920	1920 to 1950
	(000)		(000)		(000)		(percent)	(percent)
Farming	9,990	42	11,120	27	7,015	12	+ 11	- 37
Forestry & fishing	180	1	280	1	127	0*	+ 56	- 55
Total primary	10,170	43	11,400	28	7,142	12	+ 12	- 37
Mining	480	2	1,230	3	1,035	2	+156	- 16
Manufacturing	4,750	20	10,880	27	15,930	27	+129	+ 46
Construction	1,440	6	2,170	7	3,940	7	+ 51	+ 82
Transportation & utilities	1,530	7	4,190	10	4,750	8	+174	+ 13
Total secondary	8,200	35	18,470	45	25,758	44	+125	+ 40
Trade & finance	1,990	8	4,860	12	12,650	22	+144	+160
Personal services	640	3	1,630	4	3,600	6	+155	+121
Other services	2,570	11	4,810	11	9,310	16	+ 87	+ 94
Total tertiary	5,200	22	11,300	27	25,560	44	+117	+126
All industries ¹	23,570	100	41,170	100	58,460	100	+ 75	+ 42

* Less than 1 percent.

1. Exclude unallocated workers.

Source: Fabricant, Solomon, "The Changing Industrial Distribution of Gainful Workers." **Conference on Income and Wealth**. Vol. XI. National Bureau of Economic Research, Inc., New York, 1949; and Stigler, George, "Trends in Employment in the Service Industries," National Bureau of Economic Research, Inc., New York, 1956. Comparable data for primary, secondary, and tertiary classification estimated from data in the **U. S. Census of Population, 1950**. Vol. II, Part I.

Trends shown in the preceding table place heavy responsibility on those who advise high school and college students. Why should society make large capital investments in promoting farm technology (which has the chief aim of displacing farm labor) without investing equally in guiding flexible and enthusiastic farm youth into training for the production of those goods and services most desired by consumers.

II.

The basic structure underlying growth in farm supply and marketing was found in table 3. More specifically the farm supply industries employ six million people. Those industries and commercial enterprises that process, store, handle and merchandise farm products form a third segment of agriculture. Roughly called marketing activities, this segment employs more than ten million people.

In the broadest sense, farm production, farm supply and marketing activities taken together employ more than 35 per cent of the nation's labor force. The three groups represent an important part of our national economy from any point of view. Furthermore, if we are to compete effectively with synthetic products, and other regions of the world, in the competitive market, efficiency in the supply industries as well as the processing and marketing industries is essential. Taken as a group, the three segments have remained relatively constant in size even though the "on-farm" portion is declining.

Farm Supply Industries

Since 1940, the purchased resources used in agricultural production (machinery, fertilizers, hired labor, feed mixing services and additives, pesticides, herbicides, veterinarian services, etc.) have

increased by 40 per cent.

The non-purchased items of agricultural production (operator and family labor, real estate and capital produced on the farm) has declined 25 per cent according to the Agricultural Research Service, U.S.D.A. The increase in selected items of current farm operating expense indicates the importance of this part of agriculture although inflation exaggerates the comparison slightly.

TABLE 4
Current Farm Operating Expenses
1940, 1950 and 1960

ITEM	1940	1950	1960
	(million)	(million)	(million)
Feed	998	3,283	4,848
Livestock	517	2,004	2,508
Seed	197	531	538
Fertilizer and lime	306	978	1,463
Petroleum, fuel and oil	350	1,192	1,572
Other motor vehicle operations	229	767	1,365
Repairs on buildings and machinery	427	962	1,049
Miscellaneous	708	1,750	2,728
Total excluding hired labor	3,732	11,467	16,071
Hired Labor	1,029	2,678	2,035
Total	4,761	14,145	19,006

Source: Farm Income Situation, U. S. D. A.

Future demand on the farm supply sector, i.e., demand for off-farm production resource items has been estimated by Barton and Daly that production needed in 1965 could be obtained on perhaps 40 to 50 million fewer acres of cropland than

we have used in recent years.¹ The authors estimated that by 1975, with projected yield increases, our needs for farm products will require the use of about as much cropland as we have used in recent years. They consider that by 1975, we may need one-third fewer man hours of farm labor or two million fewer workers in farming, but that non-farm expenditures may increase by about 50 per cent and all resources used in farming may increase by 15 per cent.

Farm supply manufacturing industries vary in size from a few large ones to a substantial number that are small. Table 5 overstates the number of firms since some have more than one establishment.

TABLE 5

Selected Farm Supply Manufacturing Industries; Number of Plants and Employees, 1954 and 1958

Industry	Plants with 20 or more employees		Number of Employees*	
	1954	1958	1954 (thousand)	1958 (thousand)
Prepared animal feeds	685	720	60	59
Tractors	74	68	65	60
Farm machinery, except tractors	397	449	74	75
Insecticides and fungicides	78	90	7	7
Fertilizers	418	406	32	31

*Including those in plants employing less than 20.
Source: 1958 Census of Manufacturers, Preliminary General Statistics, U.S. Department of Commerce, 1959.

1. Glen T. Barton and Rex Daly, "Prospects for Agriculture in a Growing Economy," in **Problems and Policies of American Agriculture**, Iowa State University Press. Ames, 1959.

Growth of the Feed Industry

In terms of dollar volume, Table 4 indicates that the mixed feed industry has increased nearly five times since 1940. In 1954, the largest feed manufacturers accounted for 21 per cent of shipments for the industry. The 20 largest companies accounted for 43 per cent of the total value of shipments. The 1954 census reported 16,530 hay, grain and feed stores with payrolls of 62,337 persons. Keen competition among feed manufacturers takes the form of special services, bulk delivery, discounts on quantity rates and contract arrangements. Bulk handling and special formula consultation service for large users represent new trends to replace price competition.

Farm Machinery Manufacture

Eight companies produce 65 per cent of the sales of the industry. Another 10 per cent of domestic sales are accounted for by 12 to 15 medium sized companies. The 1954 census reported 18,689 retail farm equipment dealers with a payroll of 79,625 persons. Also 46,026 persons were hired by 1,112 farm and garden machinery wholesalers.

Competition among dealers has led to diversification due to the seasonal nature of demand for many farm implements. Manufacturers have helped some dealers with financing to ease the pressure

of heavy capital investment in sales room inventories. Trends in the industry include larger multiple row tillage and harvesting equipment and new materials handling systems for the mechanization of livestock feed operations including cutting, drying, handling and storage of hay. Personalized service to the large individual farms in the form of consultation for the lay out and design of livestock production systems is receiving increasing attention among some equipment manufacturers.

The Fertilizer Industry Growth

In 1958, 2.37 million tons of nitrogen were used as fertilizers as compared with 1.5 million tons in 1951. Excess capacity for the manufacture of nitrogen, due to conversion of World War II government munition plants, has been a major factor in making fertilizer one of the best bargains in farm supply. Manufacturers and distributors have sometimes by-passed dealers and sold direct to large farm users. As in the case of livestock feed, competition is keen and some emphasis has been placed on bulk delivery and handling to reduce bag costs.

Farm Credit

One feature of farm supply is that of credit for purchase and operation of farms. Inspection of the 1961 balance sheet of agriculture reveals that individuals hold 5.4 billion, insurance companies 2.98 billion, Federal Land Bank 2.54 billion, commercial banks 1.62 billion, and Farmers Home Administration .48 billion of the nation's farm-mortgage debt. During the past 12 years, 1950-61, Federal Land Bank loans have increased 180.2 per cent. Total farm mortgage debt increased 134.8 per cent for the period.

Marketing Activities

Today's market for most farm products is nation wide. Moreover, marketing takes a larger share of the consumers expenditure. In 1958, consumers spent 86.1 billion for food and non-food items. The farmer received an estimated \$23 billion or approximately 27 per cent of consumer expenditures.

Changes in labor used in marketing food products relative to changes in number of workers on farms suggest the increased importance of food marketing services. During the period 1939-1959 the number of full-time jobs in marketing domestically produced food products rose from 3.8 million to 5.3 million, an increase of 40 per cent. During this same period, the number of farm workers declined by one-third. One of the important avenues of agricultural adjustment involves cost reduction to improve the competition position of our farm products with foreign farm products and with synthetic substitutes. Opportunities for increasing efficiency will be found in the off-farm industries of food and fiber production, processing and distribution as they now comprise two-thirds to three-fourth of the total employment and total cost. Cost reduction in the farm supply industries should reduce farmers' costs.

Implications for Educators

With farm supply and marketing activities bulking so large in the total agricultural scene,

vocational guidance to these fields and provision for effective training in those sciences and skills needed are highly appropriate.

(See Reference Page 18)

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FLUID MECHANICS OF A ROPE PUMP

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INTRODUCTION

It is possible to raise water vertically by using a continuous rope moving around two pulleys. The lower pulley must be submerged and the water being lifted will be discharged at the upper pulley. Langharr (1) reported that by using cotton clothesline he was able to lift 11 gallons of water per minute through a vertical distance of 25 feet. He used a double pulley driven by an electric motor and two cotton clotheslines. The clotheslines were not enclosed in a tube.

The objectives of the experiments reported