

EXTENSION PLAN OF WORK FOR AGRICULTURAL
MECHANIZATION IN PUERTO RICO

by

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CHAPTER I

INTRODUCTION

Puerto Rico is the most eastward of the four major islands known as the Great Antilles.

The Island's development during the last decade or two is a remarkable story of economic progress. Starting as a low income sugar economy, Puerto Rico has undergone a rapid process of industrialization which has led to an average annual increase of the Island's net income by 7.4 per cent during the last ten years.¹ The ensuing increase in the standard of living, rising wages and change in outlook, have brought about a modernization of agriculture. In spite of industrialization, agriculture remains to this date the largest employer of labor and it is still the second most important branch of the economy.

A little more than 100 miles long and 35 miles wide, Puerto Rico has an area of 3,435 square miles and a population of 2.3 million inhabitants. About 56 per cent of the population lives in rural areas.

The Island's physical features are characterized by a coastal plain which almost completely encircles a central

¹Facts and Figures on Puerto Rico's Agriculture, 1963. Special Publication No. 8, Commonwealth of Puerto Rico, Bureau of Agricultural Statistics, 1963, P. VI.

east-west mountain range. These mountains rise gradually from the wide northern coast, but drop steeply to the narrower south coast. Most of the rivers have their source high in the mountains. Most of the rivers, especially the larger ones, flow northward into the Atlantic Ocean, while the rivers in the south are smaller and usually dry part of the year. None is navigable.

Puerto Rico lies in the path of the trade winds which blow steadily from the northeast and ensure a mild climate throughout the year. The daily and seasonal temperature variations are minimal; thus the average mean temperature for San Juan varies only from 74.4°F in January and February, to 80.9°F in August and September. At Carite Tunnel, a typical mountain station, the range is from 69.1°F in January to 76.2°F in August. The combined action of the trade winds and the east-west mountain range, which stands in their path, causes wide variations in rainfall; 59 to 73 inches along the northern coast, 66 to 159 inches in the mountainous interior and well under 60 inches along most parts of the southern coast. There is no clearly marked dry season. However, in the north, the months February to May, and in the south, December to May, are normally periods of light showers only, while the largest precipitation usually occurs from August to November. Irrigation is practiced on the south coast and the northwest corner of the

Island.²

A little over half the land is suitable for cultivation. There are about 534,000 cuerdas (one cuerdas = approximately one acre) with slopes of 15 per cent or less, and around 600,000 cuerdas with slopes ranging from 16 to 45 per cent. The other half of the land includes soils which, because of steepness and low fertility, are not suitable for clean cultivated crops. Large areas require conservation measures.³

Puerto Rico has an unusual variety of soils. There are 115 soil series and 352 soil types and soil phases. The most productive of these are on the coastal plains, where sugar cane growing and dairying predominate.

Puerto Rico's total land area is only about 2,191,000 acres (2,256,000 cuerdas) and over 70 per cent of this area is hilly and mountainous.⁴ The total agricultural land amounts to 1,936,370 cuerdas. The Bureau estimates that about 745,000 cuerdas are cropland, around 794,000 cuerdas are pasture and range, and nearly 300,000 cuerdas are forest and woodland.⁵

²Ibid., p. vii.

³Ibid., p. viii.

⁴Hanson Earl Parker, Puerto Rico: Ally for Progress, D. Van Nostrand Company, Inc., New York, 1962, p. 47.

⁵Facts and Figures of Puerto Rico, op. cit., p. viii.

The variety of climatic and topographical conditions lead to the production of a large number of different crops. Traditionally, sugar cane, coffee and tobacco form the mainstay of Puerto Rico's agriculture.

Farm mechanization in Puerto Rico has increased rapidly during the last years. Evidence of this is that the number of tractors used in the last decade increased from 1,912 in 1952 to 3,973 in 1962. Around 80 per cent of these tractors are on sugar cane farms. Also there is a notable increase in equipment for the pick up and carrying of sugar cane. In 1962 there were 295 sugar cane carrier machines. In 1962, 39 per cent of the sugar cane harvesting was done by machine loaders.⁶

Cultivation machinery is also used in coffee production. There is a great increase in dairy cattle mechanization. During 1956 to 1960, 263 new first class dairies were established. In 1960 there were 652 first class dairies on the island. In 1962 there were 1,023 milking machines.⁷

Three factors affect agricultural education programs

⁶Negron Pedro Ramos, *Importancia Economica y Social De LA Mecanizacion Agricola en Puerto Rico*. *Revista de Agricultura de Puerto Rico*, Vol. XLVIII, Julio-Diciembre, 1961, Num. 2.

⁷Ibid., p. 7.

in the island. Guillermo Irizarry, in a study he carried out on the island, found that 24 per cent of the island's farmers do not have formal education and that 85 per cent have less than seventh grade; that 40 per cent of the farmers are 55 years old or more; and 65 per cent have had 20 years of farm working experience.⁸

⁸J. L. Descartes, *Perspectivas De La Agricultura Puertorriquena Para El 1975*. *Revista Del Cafe*. Enero, 1965, p. 16.

CHAPTER II

THE PROBLEM AND DEFINITIONS OF TERMS USED

The development of farm mechanization throughout the island of Puerto Rico during the last ten years has greatly increased the need for more effective extension programs in farm machinery management. The trend towards larger, faster and more productive tools has resulted in equipment capable of doing high speed and efficient work over many additional acres. As in industry, farmers are finding it more profitable to reduce rising labor costs by further replacing hand labor with systems of suitable machines.

Problems facing farmers and their extension advisors are also increasing because of these changes. Some of these problems are: (1) Few Available Operators have the intelligence, skill, and enthusiasm to put these more complicated machines to their most efficient use. (2) Higher Costs of Both Machines and Labor in the face of lower unit profits from agricultural products, making imperative more efficient operation as well as wise selection of equipment. (3) Heavier Use and Higher Operating Speeds demand greater attention to proper service and maintenance. Excessive repair and breakdown during critical crop periods contribute considerably to higher operating costs. (4) Changing Production Practices and rapidly increasing numbers of

specialized equipment demand better trained and equipped dealer organizations to more adequately service their sales territories. (5) The Larger Amount of Used Equipment being acquired by small farmers is seldom accompanied by the necessary manuals or information on its operation and care. (6) More Machinery Research is Needed on developing or adapting special equipment and techniques to further reduce production costs. (7) Young People's Interest in mechanized and automatic systems of farming needs strengthening by more effective training in the basic principles of machinery management. (8) Unskilled Labor required in the new urban industries (especially construction) has shifted from agricultural employment.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study (1) to develop an Extension Plan of Work for agricultural mechanization in Puerto Rico, using the Kansas Extension Agricultural Mechanization Plan of Work as a guide.

Importance of the study. Since Kansas is an Agricultural State, many techniques designed for Kansas may be used to aid in the attainment of these goals.

II. DEFINITION OF TERMS USED

Extension. It is an informal educational system.⁹

Farm mechanization. It embraces every form of farm equipment from the simplest to the most complex.¹⁰

Method demonstration. It is a public showing that emphasizes the silent merits, utilities, efficiency of an article or product. A method is an orderly procedure or process, regular way or manner of doing anything. The method demonstration involves showing and telling simultaneously--visual and verbal explanation of a process or fact or idea. The plan of presentation for a demonstration is divided into three parts: introduction, presentation and summary.¹¹

Result demonstration. It is a demonstration conducted by the farmer or other person under the supervision of the extension worker to prove that the extension recommended practice will work locally. It involves careful

⁹Building a Strong Extension System, International Cooperation Administration, Washington, D. C., p. 5.

¹⁰A. M. Acock, Progress and Economic Problems in Farm Mechanization, p. 6.

¹¹Meredith Wilson and Gladys Gallup, Extension Teaching Methods. Washington: U. S. Dept. of Agric. Extension Circular 495, 1955, p. 36.

planning, a substantial period of time, adequate records and comparison of results. It is designed to teach others in addition to the person who conducts the demonstration.¹²

Short courses, schools and workshops. These methods are considered more suitable to teaching adults than youth. In a workshop people meet in small groups to work together on problems of their own choosing, under the guidance of a well-qualified staff of consultants. A workshop is composed of three sessions: (1) planning in which participants are involved; (2) a working session of problems; and (3) summarizing and evaluating. The significance of this method is that the individual solves his own problems. This method is used to (1) identify a problem from a situation; (2) to find a solution to a problem; (3) to promote individual participation; and (4) to promote the personal growth of the individual through democratic discussion and cooperative participation.¹³ Schools are designed to give the participants knowledge, attitudes and skills in some particular subject matter. The teacher plans and conducts the learning experiences.

Short courses are a method of intensive training in

¹²Lincoln David Kelsey, Cooperative Extension Work (New York: Comstock Publishing Associates, 1963), p. 394.

¹³Ibid., p. 425.

some specific area. A short course may vary in length from one day to two weeks. It is limited to a particular group and is a means for keeping up to date in technical subject matter.¹⁴

Tours and field days. Methods for providing learning experiences such as tours and field days are effective in gaining understanding of what is to be learned; they dramatize the significance of what is being learned, and expand experience of the learner by providing an opportunity to see and hear what another has accomplished.¹⁵

Meetings. Extension meetings are generally educational in nature. They are intended to bring about change: change in attitudes, change in values or change in practices. Factors to be considered in planning meetings are size of audience, character of audience, facilities available, time and audience comfort. For a meeting they may have a speaker, a speaker and panel, a speaker and open discussion, a forum or symposium, a forum and open discussion panel discussion, or even just open discussion with a chairman present.¹⁶

¹⁴H. S. Sanders, and others, The Cooperative Extension Service (New York: Prentice-Hall, 1966), p. 115.

¹⁵Meredith Wilson and Gladys Gallup, op. cit., p. 52.

¹⁶Lincoln David Kelsey, op. cit., p. 405.

Visit. They can be of different kinds, according to their objectives or planned purpose:

1. The get-acquainted visit--this face-to-face conversation explores both the personal and material situation.
2. The technical visit which tries to find visit:
 - a. The correct answer to a specific problem.
 - b. Facts related to a situation where the answer must be a judgment, as in the analysis of an entire enterprise.
3. The organizational visit which adapts and enlarges the existing communication channels for extending information in the community.
4. The inter-neighbor visit which is the essential by-product of all other educational activities. This is the route by which the community teaches itself.¹⁷

Office calls. They are visits in person by an individual seeking agricultural information, the result of which some definite assistance or information is given. The office call is a time consuming, but highly effective means for contacting people on an individual basis. Some

¹⁷H. S. Sanders and others, op. cit., p. 115.

essentials for promoting better office calls are: (a) comfortable chairs for visitors; (b) office cooling equipment and ventilation; (c) private office for agents and secretaries; and (d) correct lighting, adequate furnishing and equipment.¹⁸

Telephone calls. They are an important means of person-to-person communication linking the Extension agents and the people in the county. It facilitates the use of other teaching activities.¹⁹

Mail requests. They are personal requests for information on a particular topic to an agent by mail that offer effective personal contact teaching opportunities. All letters should merit the 4-S formula of honor: shortness, simplicity, strength and sincerity.²⁰

Contest. It is competition between individuals or groups for achievement of specified standards of performance to obtain recognition or reward.²¹

Achievement day. It is a significant annual

¹⁸Meredith Wilson and Gladys Gallup, op. cit., p. 36.

¹⁹H. S. Sanders and others, op. cit., p. 24.

²⁰Ibid.

²¹Lincoln David Kelsey, op. cit., p. 402.

extension event. The purposes are to give special recognition to volunteer local leaders, to focus attention on program accomplishments, to provide leadership experiences, and to acquaint more people with the Extension contributions.

CHAPTER III

REVIEW OF LITERATURE IN FARM MECHANIZATION

According to Raney and Butler, farm machinery is an extremely diverse family of equipment. Its members range from peg-tooth harrows to cotton pickers, from walking tools to mobile power plants, and from mowers to self-propelled threshing machines; so the family is as broad as the total range of tasks to be performed in agriculture in any climate or nation of the world.²²

Another definition for farm mechanization is pointed out by Acock. He states that "Mechanization" embraces every form of farm equipment from the simplest to the most complex. He adds that the tractor has been used as the symbol of power-operated equipment in general.²³

McColly defines agricultural mechanization as the art of equipping agriculture with mechanical implements for increasing the efficiency of the enterprise.²⁴

²²R. R. Raney and D. K. Butler, "Criteria for the Design and Development of Farm Equipment," *Agricultural Engineering*, March, 1959, p. 137.

²³A. M. Acock, Progress and Economic Problems in Farm Mechanization, p. 6.

²⁴H. F. McColly, Agricultural Mechanization in East Asia, Vol. 46, *Agriculture Engineering*, January, 1965, p. 26.

I. LITERATURE ON AGRICULTURAL MECHANIZATION
IN DIFFERENT COUNTRIES

Agricultural Mechanization in North America

North America is usually regarded as the outstanding example of progress in modern farm mechanization. With some 17 per cent of the world's available land, the region has over 70 per cent of the world's tractors. In addition to equipment for land preparation, seeding, etc., large numbers of complex machines are used for such agricultural operations as harvesting wheat and corn, haymaking, and the preparation and handling of livestock feedstuffs.²⁵

U. S. A. and U. S. S. R. Farm Mechanization

Krebs states that the living standard of a nation is directly dependent on the productive capacity of its farmers.²⁶

During the past century startling changes have taken place in the development and use of farm machinery and power equipment on farms in the U. S. According to Krebs, these developments are divided into three periods: (1) the human or hand power age; (2) the animal power era; and (3)

²⁵A. M. Acock, op. cit., p. 6.

²⁶Alfred H. Krebs, The Mechanical Age in Farming (Illinois: Interstate Printers and Publishers, Inc., 1964), p. 201.

the mechanical power era that is the one with which this study is concerned.²⁷

Some of the developments of the mechanical power era in the U. S. A. include the tractor which has been made lighter in weight with more "pay load", ease of operation, and general usefulness. Small, medium-size, and large tractors have been developed for varying conditions on farms. Special implements have been designed for use with tractors. In recent years, rubber tires have become standard on tractors and on many other types of farm machinery.

With the coming of trucks and tractors to farms, horses decreased rapidly in number. In recent years there were nearly 5 million tractors on farms in the United States; many farms are entirely without horses, at least for draft purposes.

One of the most spectacular developments of modern times is the application of the airplane to farming. Although its use is still limited, its possibilities have been demonstrated on such widely diverse jobs as spraying and dusting crops to control insects and diseases, broadcasting grass and legume seed, seeding rice and some other grains, broad-casting fertilizers, and spreading chemicals to kill weeds and brush on range land. In 1955, for various

²⁷Ibid., p. 202.

operations, several thousand airplanes were used for one-sixth of the crop acres in the United States.²⁸

An interesting comparison between the U. S. A. and U. S. S. R. farm mechanization was given by Butler in an article in the Agricultural Engineering Journal. He brought out that Soviet agriculture has one worker for about each 15 acres of cropland, compared to one worker for each 60 acres of cropland in the U. S. The much greater farm mechanization in the U. S. is the dominant factor in the difference of average manpower in the two countries.²⁹

Farm mechanization research in the U. S. S. R. is entirely carried out by government organizations.³⁰ The training of engineers for agriculture is receiving great emphasis on the Soviet because of the urgent need for increasing agricultural efficiency and expansion into new areas.³¹

Estimates indicate that there are about one million tractors, almost 100 per cent diesel, in use on farms in

²⁸Ibid., p. 204.

²⁹D. Karl Butler, "U. S. A. and U. S. S. R. Farm Mechanization - A Comparison," Agric. Engineering Journal, November, 1960, p. 760.

³⁰M. Walter Carleton, "Farm Mechanization in the Soviet," Agricultural Engineering, March, 1959, p. 134.

³¹Ibid., p. 135.

the U. S. S. R. today. Over half are crawlers, the most common crawler being equipped with an engine of slightly over 50 horsepower. Plans call for the per cent of wheel tractors to be increased in the future. Tractors presently being manufactured appear to be rugged, heavy-duty units built according to the Soviet's own engineering design.³²

Table I and Table II are inventories of selected farm equipment for the years 1957 and 1958. Both show a comparison between U. S. A. and U. S. S. R. farm equipment.³³

Mechanization in Underdeveloped Countries

Rapid farm mechanization in underdeveloped countries is dangerous according to Nervik and Høghjoo.³⁴ The main dangers of rapid mechanization are: (1) the prevailing social system may be upset, and many farmers may be forced to leave the land before other sectors of the economy are ready to absorb them, and (2) investments may be wasteful because the machinery is inefficiently used or even ruined because of lack of skill or because of organizational

³²Ibid.

³³D. Karl Butler, "U. S. A. and U. S. S. R. Farm Mechanization - A Comparison," Agric. Engineering Journal, November, 1960, p. 760.

³⁴O. Nervik and E. Høghjoo, Mechanization in Underdeveloped Countries, Taps Journal Farm Economics, 43, 663-6, August, 1961, p. 663.

difficulties.³⁵

TABLE I
SELECTED FARM EQUIPMENT INVENTORY

	Approx. USSR end of 1958	USDA estimate for USA July 1, 1958
Tractors	1,000,000 ^a (about 52 per cent crawlers)	4,500,000 (79 per cent wheel type)
Trucks on farms	660,000	3,030,000
Grain combines	500,000 ^b	1,050,000
Corn pickers and corn forage harvesters	170,000	750,000
Field forage harvesters	---	260,000
Sugar beet harvesters	30,000	--- ^c
Cotton pickers	26,000	20,100 ^e
Cotton strippers	---	23,900 ^e
Balers	2,000	600,000
Mowers	299,000 ^d	1,615,000 (pto) 805,000 (ground driven)
Rakes	78,000 ^d	1,400,000
Plows	718,000 ^e	2,990,000
Planting drills	829,000 ^e	1,535,000
Corn and cotton planters	---	2,248,000
Cultivators	616,000 ^d	3,000,000 ^e
Manure spreaders	nil	1,540,000

^aOfficial figure, but data from various sources indicate that about 600,000 would be more accurate.

^bOfficial figure, but checking indicates 318,000 would be more accurate.

^cBecause of so few producers in the USA, actual figures are not available.

^dEnd of 1955.

^eEnd of 1956.

³⁵Ibid., p. 663.

TABLE II
 SELECTED FARM EQUIPMENT PRODUCTION (1957)

	USSR	USA
Trucks	126,000	1,083,670
Tractors	145,000 (actual numbers* at capacity)	233,000 (about 50 per cent of capacity)
Combines	131,000	44,700
Corn pickers and corn forage harvesters	51,000 (both)	40,000 (pickers) 18,300 (harvesters)
Sugar beet harvesters	8,600	1,600
Mowers	46,000	86,200
Plows	128,000	147,400
Planting drills	278,000	26,100
Cultivators	208,000	102,500

*In terms of 15 hp, they produced 204,000.

To avoid these difficulties Nervik and Høghjoo stated that the most useful way to discuss farm mechanization is to start with the farm's income and the reasons it is so low.³⁶ They pointed out three main reasons for the low income: (1) unsatisfactory land tenure relationship; (2) too small units; and (3) inefficient methods of production.³⁷

To answer, "What benefits do the farmers get from mechanization?" Nervik and Høghjoo pointed to two common forms of mechanized operations--tractor plowing and

³⁶Ibid.

³⁷Ibid.

combining.³⁸ Tractor plowing reduces the time spent in plowing and may enable the farmer to farm more land, either irrigated or dry land. Tractors may further add to the land resources when there is land available which can be plowed by tractor but not by oxen plows. The tractor, by plowing deeper, usually will also increase yields.

Combining may provide improved recovery of grains, as well as reduce the harvest time from 2-3 months to 1-2 weeks, thus greatly reducing risk of losses through spoilage and through weather hazards.

When mechanization is introduced in an underdeveloped country, Nervik and Hoghjoo pointed out that efforts should be made to provide repair shops, spare parts and fuel. Even more important is the providing of good training programs for tractor drivers and mechanics.³⁹

II. LITERATURE ON BUYING AND SELECTION OF FARM EQUIPMENT

Raney and Butler suggest three viewpoints from which any farm machine may be considered: (a) machine performance, (b) economics and (c) personal human satisfaction.⁴⁰

³⁸Ibid.

³⁹Ibid., p. 666.

⁴⁰D. Russell Raney and Karl Butler, op. cit., p. 137.

The function of any piece of farm equipment is to perform some agricultural task, especially one concerned with the handling or processing of such materials as soils, chemicals, seeds and crops.⁴¹

Any part in any piece of farm equipment may be classified in at least one of five functional systems: (1) a material processing system, (2) a power transmission system, (3) a structural system, (4) a control system, and (5) a protection system.⁴²

Raney and Butler suggest that the agricultural systems of all farm equipment are composed of one or more of the following eight general classes of processing units:⁴³ (a) cutters, (b) conveyors, (c) separators, (d) reducers (in the sense of particle size reduction), (e) compressors, (f) quantifiers, (g) binders, and (h) containers.

Protection systems are of two kinds: those which protect the machine, and those which protect human beings against bodily injury in the operation of the machine.⁴⁴

According to Raney and Butler, three considerations which enter into any personal relationship with a machine are comfort, convenience, and safety.⁴⁵

⁴¹Ibid.

⁴⁴Ibid.

⁴²Ibid.

⁴⁵Ibid.

⁴³Ibid.

Hull states seven basic management practices that offer cost-saving possibilities for machinery ownership.

- (1) Reduce the number of field operations. Example: In corn production, cut tillage--with wheel-track planting.
- (2) Develop and use power and laborsaving tractor-implement tool combinations. Example: Trail the corn planter behind the disk-harrow.
- (3) Increase the annual hours or acres of use for tractors or implements. Example: Self-propelled combine with both small grain and corn heads for all harvesting.
- (4) Reduce capital invested by buying and using "used" implements, a good idea for new or beginning farmers.
- (5) Either perform or hire custom work or rent machines on a short-time or seasonal basis when ownership is not possible or practical.
- (6) Use full-service leasing arrangements for both field and farmstead machines where investments are large and maintenance is a problem.
- (7) Arrange joint ownership with a neighbor or a member of the family. However, this method is least desirable, as neither partner ever seems to accept responsibility for maintenance.⁴⁶

Larson listed three points to consider when buying farm machinery.⁴⁷ (1) The best size for any farm machine

⁴⁶Dale D. Hull, Successful Farming, January 1964, p. 83.

⁴⁷H. L. Larson, "Be a Smart Buyer," Successful Farming, January, 1964, p. 72.

is the one which gives the farmer the greatest return over the cost of buying, operating, and maintaining it--not the size that may appear to give minimum total cost or maximum total return. (2) The capacity of a machine does not increase in direct proportion to its size. In some cases the farmer can gain more by streamlining his present methods than by simply getting a bigger machine. (3) "Timeliness" can often be the deciding factor whether a farmer should trade for a bigger and better model. This is especially true for machines with seasonal use, such as a combine or planter. If the machine is too large, as is often the case, the farmer is overmechanized and cost per acre is too high. If it is too small, the farmer is paying heavily for time and crop losses.

According to Larson, Fairbanks and Fenton the factors that affect the cost of using farm machinery may be grouped under two headings:⁴⁸

- I. Factors related to machine ownership
 - A. Original cost
 - B. Service life (depreciation)
 - C. Interest on the investment
 - D. Miscellaneous items: taxes, insurance,

⁴⁸G. H. Larson, G. E. Fairbanks, and F. C. Fenton, What It Costs to Use Farm Machinery, Agricultural Experiment Station, KSU, 1960, Bull. 417, p. 9.

shelter, etc.

II. Factors related to machine operation

- A. Fuel, oil, and lubrication
- B. Repairs
- C. Labor
- D. Number of days used per year

Larson, Fairbanks and Fenton also point out that the service life of a machine depends on (1) amount of annual use, (2) nature of use, and (3) care and maintenance.⁴⁹

Depreciation is by far the largest cost-of-ownership item. Once the expected service life of a machine has been determined, it is necessary to select one of several methods to calculate annual depreciation. According to Larson, Fairbanks and Fenton the methods commonly used are: (1) straight-line, (2) declining balance, and (3) sum of the digits.⁵⁰

The following equation was developed by Larson and others to find the value in percentage of initial cost at the end of a given year for any desired estimated life and rate of depreciation:⁵¹

$$V = C(1 - \frac{R}{L})^X$$

⁴⁹Ibid., p. 11.

⁵⁰Ibid., p. 12.

⁵¹ibid., p. 13.

where

V = value in percentage of initial cost at end of
year in question

C = initial investment (100%)

R = ratio of depreciation rate used to straight-
line method rate (R cannot exceed 2)

L = estimated service life in years

x = year in question

Two basic reasons to replace machines according to Larson and others are when they cease to function, or when they do not provide service as economically as a replacement.⁵²

Hull suggested four considerations when making decisions on ownership vs. custom work: (1) Annual fixed expenses--those incurred even though the machine never turns a wheel. (2) Operating cost per-acre or per-hour. (3) Prices charged by custom operators. (4) Factors that might change a decision to own, hire, or lease based on cost.⁵³

Hull suggests the following form for comparing farm equipment cost relations.⁵⁴

⁵²Ibid., p. 44.

⁵³Dale D. Hull, "How Much Machinery Do I Need?", Successful Farming, January, 1964, p. 82.

⁵⁴Ibid.

OWNERSHIP VS. CUSTOM WORK

Ownership data;

(a) Original cost of implement (include attachments).....	\$ 1,000.00
(b) Estimate value at trade-in or resale	\$ 200.00
(c) Estimate useful life in years (10-yr. life is considered average) ..	8
(d) Estimate annual use in hours or acres per year	<u>75 acres</u>

Annual or fixed costs

Depreciation = $\frac{\text{Original cost (a)} - \text{trade-in (b)}}{\text{Estimated useful life (c)}} = \frac{\$1,000.00 - \$200.00}{8 \text{ years}} = \100.00

Interest on

Average = $\frac{\text{Original cost} + \text{trade-in}}{2} \times 6\% = \frac{\$1,000.00 + \$200.00}{2} \times 0.06 = \36.00

Investment

Insurance,

Taxes and = $\text{Original cost} \times 2 \frac{1}{4}\% = \$1,000.00 \times 0.0225 = \22.50

Housing

Operating or variable costs

Repairs = $\text{Original cost} \times \% \text{ rate table} = \$1,000.00 \times 3\% = \$30.00$

Tractor use = $\text{Hours} \times \text{rate table} = \text{hours/year} \times \$$

Fuel, oil, = $\text{Belt HP} \times \text{price fuel/gal.} \times 0.1 \times \text{hours} = \text{yrs. of use}$

Lubricants

(for auxiliary power units) = $\text{HP} \times \$0. \times 0.1 \times \text{hrs./year} = \$$

Supplies (include wire, twine, chemicals, etc.) Actual costs = \$

Labor = $\text{Going local rate} \times \text{hours machine used/year} = \$ \times \text{hrs./yr.} = \$$

Total annual cost of owning and operating implement \$188.50

Cost of use per hour or per acre = $\frac{\text{Total annual costs}}{\text{Hours or acres/year (d)}} = \frac{\$188.50}{75 \text{ Hr. or A/yr.}} = \$2.51/\text{acre}$

The annual repair costs in percentage of new cost are shown in Table III. Table IV shows the hourly cost of tractors according to size.⁵⁵

TABLE III
ANNUAL REPAIR COSTS IN % OF NEW COST

Baler	3.0%
S. P. combine with corn head	5.0
Pull-type combine	3.5
Grain drill	1.5
Disk-harrow	3.0
Hay conditioner	3.0
Mowers	3.5
Plows	7.0
Wagon--trailer	1.5
--self unload	4.0

TABLE IV

Tractor size	Fuel used	Hourly costs*		
		Tractor	Fuel	Tractor* fuel
3-plow	gasoline	\$1.10	\$0.50	\$1.60
4-plow	gasoline	1.30	0.60	1.90
4-plow	diesel	1.40	0.45	1.85
5-plow	gasoline	1.40	0.70	2.10
5-plow	diesel	1.50	0.55	2.05

*Based on 600 hours of use per year.

⁵⁵Ibid.

Larson states three basis for decision on the right purchase of a sizeable machinery investment: (1) good performance records, (2) careful analysis, and (3) best price.⁵⁶

Hull pointed out some indirect financial factors to be considered before the final decision is made when buying farm machinery: (1) Capital position--Can the farmer's money bring a higher return invested in fertilizer, feed and insecticides: (2) Timeliness--Can the farmer get the service of the custom operator or rental machine when he needs it? This is especially vital in planting and harvesting operations. (3) Labor--How much is it worth? This is an especially big point in farmstead equipment where the labor-saving is an every-day proposition.⁵⁷

The farmer can buy a tractor, can lease it, or have custom work done. Keast pointed out six things that agreements for long-term leasing should include. (1) A portion of the lease payment is set aside as equity due the leaser. (2) The leaser gets title to the equipment after he has paid a certain amount of rental. (3) The lease payments are much greater than normal for the equipment that is leased (indicating that the leaser is paying for more than

⁵⁶H. L. Larson, op. cit., p. 72.

⁵⁷Dale D. Hull, op. cit., p. 83.

the mere use of the equipment). (4) Some of the payment is designated as interest, or is easily recognized as interest. (5) The agreement gives the farmer an option to buy the equipment at a price clearly less than the market value. (6) The rental payment, plus the option price, are about equal to the normal sale price. At the end of the regular lease period, the leaser is permitted to use the equipment for a small sum.

Short-term leases based on an hourly, daily, weekly or a monthly rate will seldom ever cause any trouble. The farmer can deduct the full amount as an expense.⁵⁸

O'Brien states six points that he believed a machinery lease should include in order to work out best. (1) Repairs are to be made by the owner at the end of the year. (2) There should be no purchase option because that would make the machine a capital asset. A straight fixed cost per year--as nearly the same cost per year as possible. (3) An individual contract on each item with a year-by-year renewal clause works best. If there is a machine that is not needed for the coming year, return it and get it off the list. (4) The lease is less complicated if the lessor pays all but the liability insurance. (5) A

⁵⁸J. D. Keast, "Buy, Lease or Have it Done?" Machinery Tax Management, Farm Journal, V. 88, 22 February, 1964, p. 221.

reasonable one-year lease works out to about 20% of the negotiated sale price. (6) Machinery should be the best obtainable for the jobs it will do.⁵⁹

According to Larson, rental of farm machinery is gaining in popularity. It eliminates the initial investment. The farmer pays a per cent of the machine's delivered price, depending on the length of time used.⁶⁰

The selection of a dealer to buy from is important. Successful Farming, January, 1964 gives six points concerning the dealer's place of business which should be considered: (1) a suitable building to house service operation, warehousing, stock parts, and display equipment; (2) a "trade-in" lot which is well located; (3) a service shop which is well equipped with specialized repair and service tools; (4) employees who are competent, friendly, and interested in the work they are doing; (5) facilities for assembling and checking equipment before delivery; and (6) a visible supply of parts on hand for prompt repair service.⁶¹

Farmers, on occasion, need to replace farm machinery,

⁵⁹K. Donald O'Brien, "It Pays Us to Lease Machinery," Farm Journal 87, A-5 December, 1963, p. 5.

⁶⁰H. L. Larson, op. cit., p. 72.

⁶¹G. H. Seferovich, "How to Choose a Service Dealer," Successful Farming, 62, January, 1964, p. 66.

especially tractors. Reece recommends knowing how much power the new tractor has and what it will offer that the old one will not.⁶²

Larson, Fairbanks and Fenton worked out an alignment chart to show effective capacity of farm machinery.⁶³

Estimating the amount of annual use required of a machine involves the effective capacity of the machine and the rate of performance required. Alignment charts have been prepared to substitute for the mathematical calculations needed to determine optimum annual use.

An alignment chart graphically solves mathematical equations by using a straight-edge with it.

Figure 1 is an alignment chart to determine the effective capacity of farm machines. The chart accounts for (a) width of swath in feet, (b) speed of travel in miles per hour, and (c) lost time in performing the operation, in percentages.

The percentage of time lost is due to factors such as lubrication, adding fuel, making adjustments, loading speed, fertilizer, etc., unloading harvested products, idle

⁶²Floyd N. Reece, "Machinery Maintenance Loses Dollars," Successful Farming, January, 1964, p. 53.

⁶³G. H. Larson, G. E. Fairbanks, and F. C. Fenton, What It Costs To Use Farm Machinery, Bull. 417. Agricultural Experiment Station, Kansas State University, 1960, p. 33.

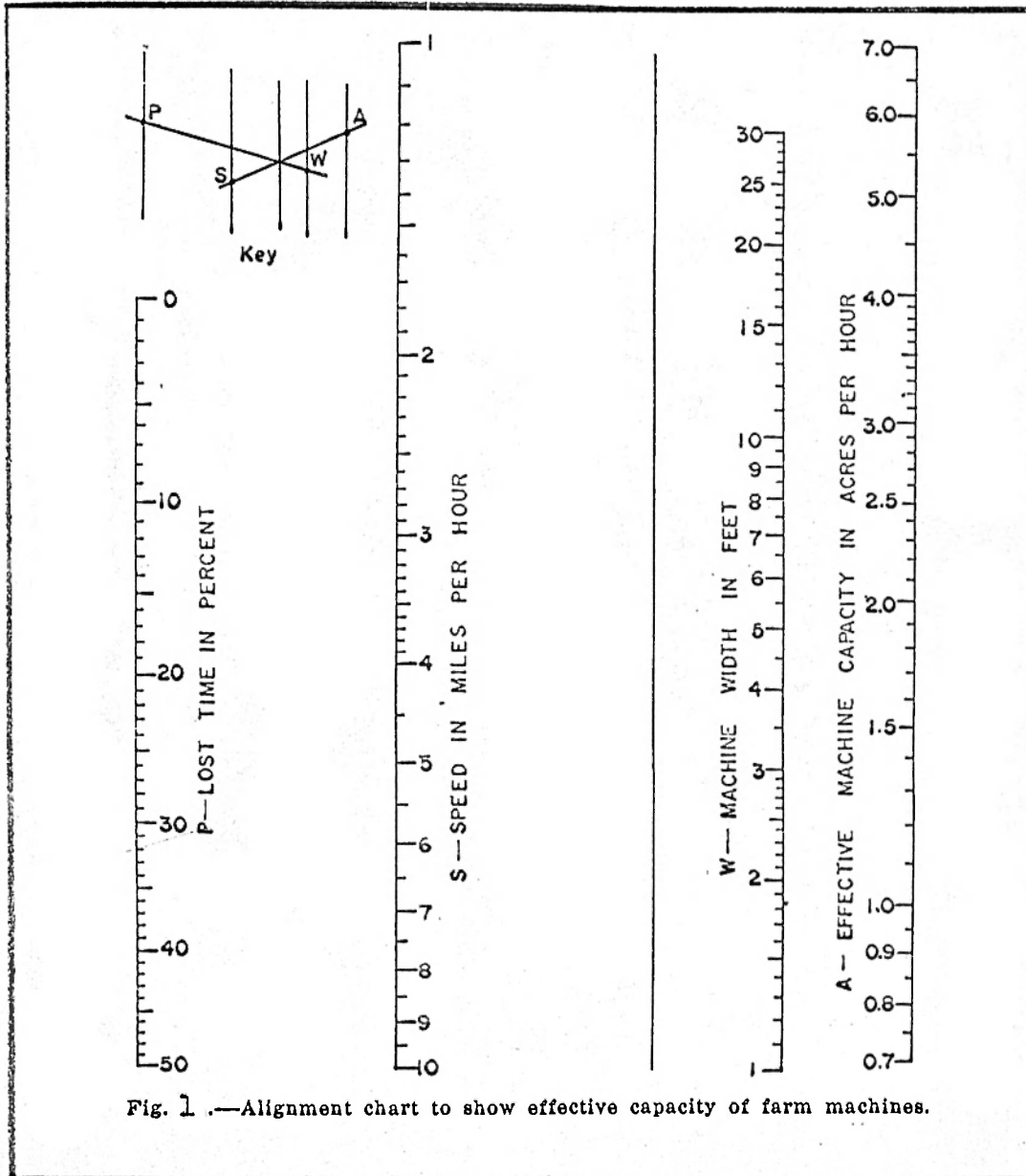


Fig. 1.—Alignment chart to show effective capacity of farm machines.

travel such as to the field, turning at ends, etc., clogging, and breakdowns. The percentage of lost time is difficult to evaluate. Naturally it varies under different field operations. If lost time for a particular machine is not known, a value of 17.5 per cent is generally used. This figure should be adjusted up or down to suit local conditions for a given operation.

The alignment chart in Fig.1 graphically solves the equation, $A = \frac{WS(100-P)}{825}$, where A is the effective machine capacity in acres per hour, W is the width of machine swath in feet, S is the ground speed in miles per hour, and P is the lost time in per cent of total time.

As an example, using the alignment chart in Fig. 1 assume a 12-foot self-propelled combine, with ground speed of 3.0 mph with lost time of 25 per cent. How to find the effective capacity of the machine in acres per hour: the key in the upper left-hand corner of the alignment chart shows that a line should be drawn from the 25 per cent point on the P scale to the 12-foot point on the W scale with the aid of a straight-edge. The point on the blank or pivot line where the line from the P to W crosses is marked. Next, put the straight-edge on a line from the point just located on the pivot line to the "3.0" on the S scale. The line just established intersects the A scale at about 3.3. This is the capacity in acres per hour for

a 12-foot self-propelled combine when operated at 3.0 mph and with a 25 per cent loss of time.

In using the chart it is not necessary to draw lines, only mark the point where a line crosses the pivot line. A straight-edge can be used to establish the second line. Both lines will always pass through a common point on the pivot line. This keeps the chart from becoming cluttered with lines, so it can be used indefinitely.

Once the point of the pivot line has been established with a line from the P scale to the W scale, a new effective machine capacity can be determined easily for any ground speed. Simply use a straight-edge to establish a new line from the point on the pivot line through the desired mph on the S scale. For example, if ground speed for a combine were 4 mph, the effective capacity shown on the A scale would be 4.4 acres per hour.

Larson and others also worked out an alignment chart to determine the number of acres the machine can effectively cover per year. The number of acres a machine can cover in a year depends on hours per day, days per year, and the effective capacity of the machine in acres per hour.⁶⁴

To illustrate the use of the alignment chart in

⁶⁴Ibid., p. 35.

Fig. 2 , assume that effective capacity of a 14-foot self-propelled combine is 3.85 acres per hour, with 8 hours a day and 10 days a year available. To find the number of acres the machine can cover per year, connect the point at 8 on the H scale with the point at 10 on the D scale which locates a point on the pivot line. Then with a straight-edge establish a second line through this point and the point at 3.85 on the R scale. This shows 320 on the A scale. That is the number of acres the machine could be expected to cover effectively per year.

Figure 2 also can be used to determine the capacity required of a machine in acres per hour to cover a certain number of acres per year. For example, if 500 acres are to be covered per year in the ten 8-hour days, find the point on the pivot line as before. Then establish a line through this point and the point at 500 on the A scale. Since the line thus established does not even cross the R (or acres per hour) scale, more than 4-acres-per-hour capacity would be required to cover 500 acres in the time available. Using two machines to cut 250 acres each, one can go from the point on the pivot line through the 250-acre point on the A scale. That shows on the R scale about 3.08 acres per hour, a reasonable expected capacity for a 14-foot machine. So a second machine could be purchased or hired to get the job done in the time allotted.

WHAT IT COSTS TO USE FARM MACHINERY

35

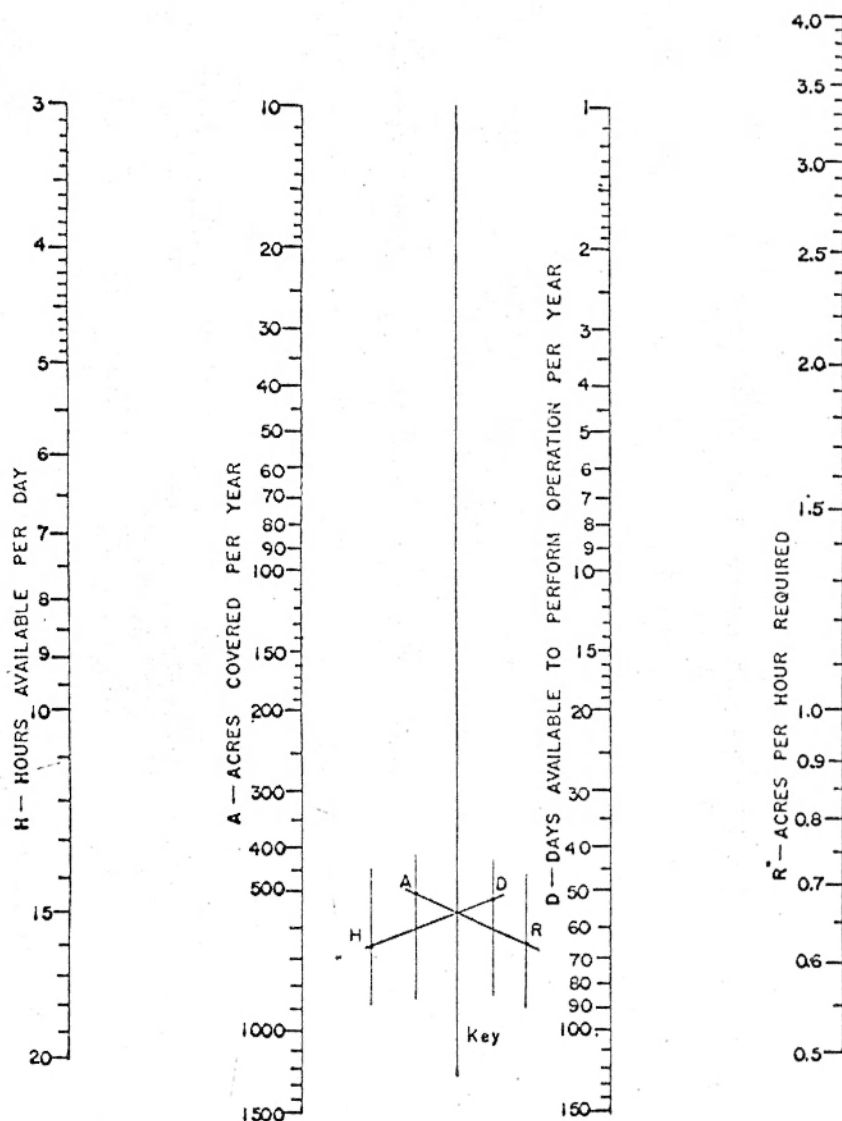


Fig. 2.—Alignment chart to show required rate of performance for farm machines.

Little is known about how many hours per day are available for the various operations of farm equipment. During the 1952 wheat harvest in Kansas, combines could be operated practically day and night, but wheat usually gets tough in the evening and may not be ready to combine until 8 a.m. or later the next day. The number of hours available per day is likely to vary from year to year and in different geographical locations.

The machine capacity, time available, and number of acres to be covered must correlate for an operation to be successful.⁶⁵

Larson and others prepared a table and a figure to show the relationship between annual cost and average cost to date for a group of seven tractors for a period of ten years.⁶⁶

Table V and Figure 3 show the relationship between annual cost and average cost to date for a group of seven tractors for a period of ten years. Not included in the analysis were fuel, oil, lubrication, daily service, and

⁶⁵G. H. Larson, G. E. Fairbanks, and F. C. Fenton, What It Costs To Use Farm Machinery, Bull. 417, Agricultural Experiment Station, Kansas State University, 1960, pp. 32-34.

⁶⁶G. H. Larson, G. E. Fairbanks, and F. C. Fenton, What It Costs To Use Farm Machinery, Bull. 417, Agricultural Experiment Station, Kansas State University, 1960, pp. 45-46.

Table V.—Relationship between average cost to date and marginal cost, based on average values for seven tractors operated an average of 550 hours each per year.

End of year	Value	Depreciation		Int. on investment, 6%	Insurance, 1%	Taxes, 2%			Average cost to date	Annual cost
		%	Dollars			% of new cost	Repairs			
0	\$100.00	0.0	0.00							
1	68.00	32.0	32.00	\$6.00	\$1.00	75	\$1.50	\$ 0.30	\$40.80	\$40.80
2	59.16	13.0	8.84	4.08	0.68	65	1.30	0.90	28.30	15.30
3	54.13	8.5	5.03	3.55	0.59	55	1.10	1.80	22.89	12.07
4	48.50	10.4	5.63	3.25	0.54	50	1.00	2.90	20.50	13.32
5	43.12	11.1	5.38	2.91	0.48	45	0.90	4.20	19.17	13.87
6	38.12	11.6	5.00	2.58	0.43	40	0.80	5.70	18.40	14.51
7	33.32	12.6	4.80	2.29	0.38	35	0.70	7.30	17.98	15.47
8	28.96	13.1	4.36	2.00	0.33	30	0.60	9.00	17.77	16.29
9	24.59	15.1	4.37	1.74	0.29	25	0.50	10.90	17.77	17.80
10	20.85	15.2	3.74	1.48	0.25	20	0.40	12.90	17.87	18.77

This table merely presents a method to calculate average cost to date and annual cost. It is not intended to be used for direct application.

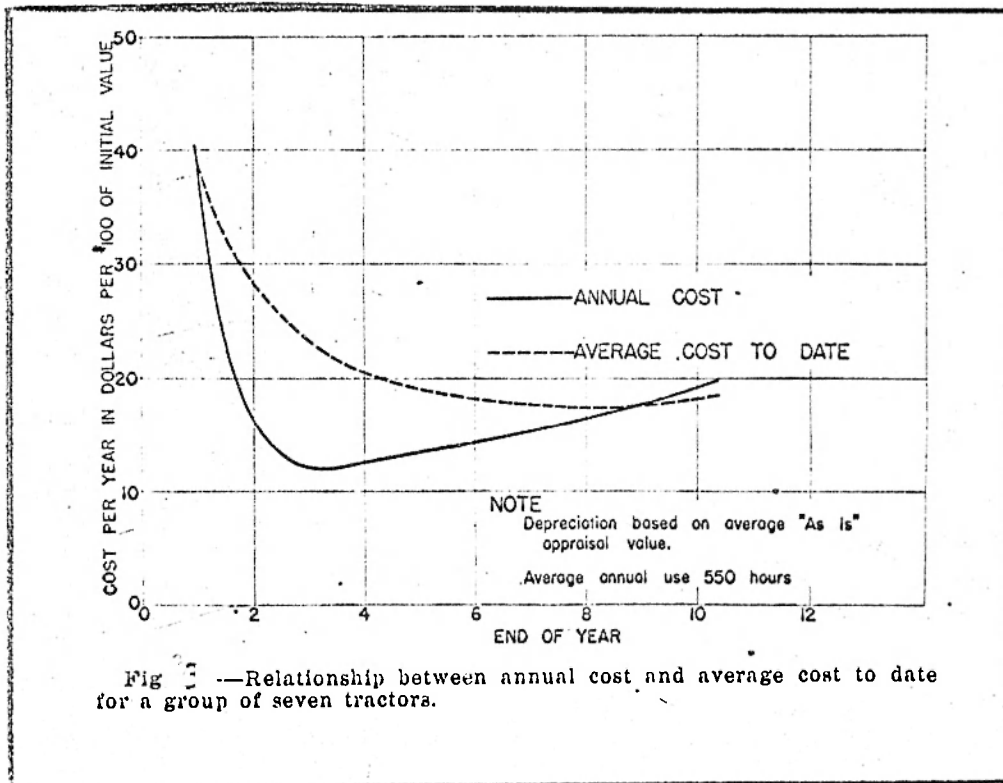


Fig. 3 — Relationship between annual cost and average cost to date for a group of seven tractors.

housing costs. Those costs are practically the same for each unit of output, provided the machine is kept in good repair, so they would have a negligible effect on the point when the average cost curve crosses the annual cost curve.

Table V and Figure 3 show that the average-cost-to-date and annual cost are equal at approximately the end of the ninth year. Rate of depreciation and cost of repairs have the greatest influence when the year of lowest operating costs will occur.⁶⁷

III. LITERATURE ON FARM MACHINERY MAINTENANCE

Tractors are one of the most important farm machines. According to Reece a good maintenance program should accomplish three things: (1) Increase life and dependability. This cuts cost by lowering yearly depreciation, saves crops by preventing untimely breakdowns, and lowers total repair costs. (2) Speed up field work. A tractor operating at top power will speed up field operations, especially those such as plowing, chopping forage, etc. Kansas research indicates that simple maintenance, routinely performed, increases horsepower by about 11% on the average farm tractor. (3) Save on fuel. Tractor fuel is a major

⁶⁷G. H. Larson, G. E. Fairbanks, and F. C. Fenton, What It Costs To Use Farm Machinery, Bull. 417, Agricultural Experiment Station, Kansas State University, 1960, p. 45.

farm expense. Good maintenance will save on fuel. Research indicates that good maintenance will reduce fuel costs almost 15%, on the average.⁶⁸

To keep tractors in good condition, Reece says that proper maintenance and adjustment of the following are most important for air cleaner, engine governor, carburetor adjustment, ignition spark timing, and spark plugs.⁶⁹

Six good ways to stretch machinery dollars and at the same time get more mileage from equipment are pointed out by Gerald.⁷⁰ (1) The farmer should give machinery much work. More time at work means lower ownership cost per acre or hour used. (2) Machinery should be doubled up on tillage jobs. Today's powerful tractors can do two or three jobs in a single trip across the field. (3) Good care should be given to equipment. (4) Trading should be done at the right time. The risk of breakdown and repair cost on a year-old machine would not be as high as the depreciation of a new machine. (5) Buy equipment to fit the farm. The size of each machine will depend largely on the size of the job and on the time available to do it. (6) Hire custom work--If capital is limited or if the farm

⁶⁸Ibid., p. 54.

⁶⁹Ibid., p. 55.

⁷⁰Larry Gerald, "Six Ways to Cut Your Machinery Costs," Hoards, 105, 790, August 10, 1960.

small, it may pay to hire the work done rather than buy the necessary equipment.

Caffee pointed out five key practices to keep machinery cost down: (1) store in a dry place; (2) wash and oil before storing; (3) replace worn and broken parts; (4) keep machines adjusted; and (5) not only read the operator's manual (furnished with every machine), but study and follow it.⁷¹

According to Fletcher, farm machinery costs can be cut in fuel, overhaul, and tires. Preventive maintenance and adjustments of machines are both important to cut costs of farm machinery.⁷²

A study of the performance of fifty farm tractors, tested for horsepower output and specific fuel consumption under conditions being used and again after selected adjustment to correct deficiencies resulting from improper maintenance, carried out by Floyd N. Reece and G. H. Larson shows that under conditions used, tractors were capable of developing 74.9 percent of maximum power as determined by the Nebraska Tractor Tests, and were using 1.32 times as much fuel. After simple adjustment and maintenance to

⁷¹Vermon A. Caffee, "We Keep Machinery Cost Down," Hoards, 108, 212, February 25, 1963.

⁷²William J. Fletcher, "Cut Machinery Costs," Successful Farming, March, 1963, p. 67.

engine governor, air cleaner, spark plugs, carburetor, and timing, the tractors were capable of developing 83.3 percent of maximum power and used 1.13 times as much fuel.⁷³

Simple adjustment and maintenance of indicated items increased maximum power an average of 3.07 horsepower per tractor, or 11.1 percent, and decreased specific fuel consumption 0.105 lb./HP-Hr. per tractor, or 14.4 percent.

It was possible to adjust, to manufacturers' specifications, engine governors on 10 tractors which resulted in an increase in horsepower of 9.1 percent and a decrease in fuel consumption of 4.8 percent. Another 10 tractors required no adjustment or repair of engine governors. Governors on the remaining 30 tractors were worn, so new parts were needed.

Air cleaners on five (10 percent) of the tractors were choked in varying degrees with dirt and chaff. Servicing air cleaners in them increased power an average of 7.6 percent and decreased fuel consumption 11.4 percent.

Spark plugs were changed on 45, or 90 percent of the tractors, for an average increase of 5.3 percent in power and decrease of 6.1 percent in fuel consumption. In seven

⁷³G. H. Larson and F. Reece, A Study of the Performance of Fifty Farm Tractors Bulletin 99, Agricultural Experiment Station, Kansas State University, 1962, p. 25-26.

cases (14 percent) spark plugs were in such bad condition that they caused misfiring under full load. On these seven tractors, power was increased 21.5 percent and fuel consumption decreased 14.2 percent by installing new spark plugs. Several instances of excessive engine deposits were observed, perhaps caused by additives used in some fuels.

Carburetor adjustments were needed on 36 (72 percent) of the tractors; 13 were set to lean; 23, too rich. The 23 set too rich decreased fuel consumption an average of 9.5 percent. Attempting to save fuel by excessively "leaning" the carburetor of John Deeres may increase fuel consumption, especially at full load.

Ignition timing was changed on 27 (54 percent) of the tractors, for an average increase of 5.3 percent in maximum power and a decrease of 5.3 percent in fuel consumption. On 10 tractors it was possible to obtain correct timing by merely adjusting breaker points to proper gap setting.

Larson and Reece point out the following suggestions for improving tractor engine performance:⁷⁴

1. Emphasize more the proper servicing of governors. Manufacturers might improve present governor designs.
2. Use a dynamometer to determine engine condition

⁷⁴Ibid., p. 27.

and to perform necessary adjustments to get optimum performance. Periodic check-ups of tractors with a dynamometer should result in savings that justify the testing expense.

3. Give more attention to deposits on spark plugs. There is evidence that certain conditions cause excessive deposits to accumulate and thus optimum performance of the power unit is reduced.

4. Follow routine maintenance schedule recommended in the Operator's Manual. Manufacturers might develop a simple maintenance schedule to be readily available on tractors.

The farm shop or a good farm repair center makes it easier to do maintenance needed on farm machinery. Pederson suggests six questions a farmer should ask before deciding how far to invest in shop facilities. (1) Does he like to work with tools? (2) Does he have the knowledge and skill to use tools effectively? Or, is he eager to learn? (3) Does he have time to make good use of a farm shop? (4) Does he already have good repair facilities available? (5) How much could he save a year in time and charges by having his own well-equipped shop, assuming he has the skills and time? Considering the size of the investment required is important. (6) Would a shop have hobby value in addition to its farm business value?

Storage space is important for farm machinery maintenance. Roth and Pederson established a method to figure the annual cost for machinery storage. They specified that depreciation and interest would total about 7 percent of the initial investment each year. Taxes, insurance and repairs add another 2 or 3 percent each year.⁷⁵ For example, a 30' x 90' shed costing \$3,600 would have an annual overhead cost of \$360 (10 percent of \$3,600).

According to Ferguson and True, the following four basic points should be kept in mind when the shop is planned: (1) type and size of farm, (2) availability of good commercial servicemen, (3) mechanical ability of the operator and (4) personal tastes of the owner.⁷⁶

IV. LITERATURE ON FARM MECHANIZATION

ADVANTAGES AND DISADVANTAGES

Krebs pointed out five advantages brought by the mechanization of farming: (1) drudgery and backbreaking toil in farming have been greatly reduced. (2) Production and

⁷⁵John H. Pederson, "Plan A Machinery Service Center," Successful Farming, January, 1964, p. 65.

⁷⁶John M. Ferguson & John A. True, The Farm Shop. Agricultural Extension Service, Kansas State University, January 1966, p. 1.

income per person engaged in farming have been markedly increased. (3) Workers formerly engaged in agriculture have entered other occupations for producing devices and conveniences which make possible higher standards of living for farm and city people. (4) Acreages formerly needed to produce feed for horses and mules are available to produce food for humans. Many people can be fed from the 60 million or more acres thus released since 1910. (5) The nation has greater security because a smaller percentage of its people is needed to produce the necessary agricultural products and a larger percentage is available to provide industrial products and services needed in peace or war. It should be recognized, however, that some of this manpower is used to produce machinery and other materials for farms; in reality some of these workers have replaced persons who formerly worked on farms. (6) Farm work can be done quickly when weather and soil conditions are most favorable. Crops can be planted, tilled, and harvested in a fraction of the time formerly required.⁷⁷

Krebs also states seven disadvantages of farm mechanization. (1) Farmers require more capital than formerly to engage in farming, due primarily to the large investments

⁷⁷Alfred H. Krebs, op. cit., p. 201.

in machinery, tractors, and other equipment. On the larger farms in the Corn Belt, for example, this investment in equipment ranges from \$12,000 to \$30,000, or more, per farm. In effect, through the adoption of modern equipment, farmers have substituted capital for labor. (2) Farmers require a larger and more stable farm income than formerly because they need to purchase tractor fuel, electricity, and replacements for mechanical equipment. (3) Some persons displaced from farming may find difficulty in establishing themselves elsewhere and adjusting to other types of work. (4) Farms have increased in size in order to make the greatest possible use of equipment. The resulting decrease in number of farms has decreased opportunities to become established in farming. (5) Farmers need to have considerable mechanical ability and skill to maintain and operate modern farm equipment effectively. (6) Farmers must have a continuous supply of tractor fuel and electricity if they are to maintain production of essential farm products. Difficulties may arise in periods of war or at other times if supplies of fuel and electricity are reduced or diverted to other uses. (7) Operators of large farms have benefited more than small operators, because the per-acre cost is higher for providing the necessary equipment for small layouts. To be most economical, farm machines must be operated

more hours per year than many small farmers can operate them.⁷⁸

Acock pointed out some economic problems relative to the introduction and utilization of farm machinery, problems of (1) agricultural labor supply and wage rates; (2) displacement of draft animals; (3) cost of maintenance of machinery; (4) training of personnel; and (5) trends towards further specialization of machinery.⁷⁹

McColly states that one of the greatest difficulties in achieving mechanization is to change established practices.⁸⁰

⁷⁸Ibid., p. 28.

⁷⁹A. M. Acock, op. cit., p. 18.

⁸⁰H. F. McColly, op. cit., p. 26.

CHAPTER IV

KANSAS AGRICULTURAL MECHANIZATION

Kansas has 52.5 million acres. All except about one million acres is in farms and ranches (1958). Only 2.2 per cent is held by corporations and institutions.

Three-fifths of the land owners are husbands and wives. A fourth are single men and women.

The most common age of owners is between 55 and 64 years.

About one half of the owners are active farmers. Many of the other owners are retired farmers who have had some farm experience. A third of the owners do not farm any of their lands.

Fifty-four per cent of owners rent out part or all of their farms and two fifths of them depend on the rent for their principal source of income.

Landlords rent to sons or sons-in-law in 12 per cent of the cases. Sons and sons-in-law as well as other renters are involved in additional cases.

Slightly more than one half of the owners live on their farms; the proportion is greater in eastern Kansas than in western Kansas.

Nonoperating landlords visit their farms an average of 15 times a year. Annual visits of 2 to 9 times are common.

One half of the owners acquired land by purchasing only; 18 per cent was by gift or inheritance only, the rest involved a combination of methods.

Nearly four-fifths of the owners hold their lands as full owners, including those purchasing with contracts and with mortgages.

Mortgage debt is 21.6 per cent (1958) of the value of land held by those owners with mortgages on part or all of their farms.

Three fourths of the owners hold the mineral rights.

Only 10 per cent of the owners plan to transfer their farms within 2 or 3 years. Nearly one third of all owners have wills.

A third of all owners have two or more farms.

Concentration of ownership has increased slightly since 1945. Except for North Dakota, the concentration in Kansas is less than in the other Great Plains states.⁸¹

Kansas has about 170,000 farm tractors, or about 1.4 tractors per farm. The almost complete change from animal to mechanical power for Kansas agriculture has taken place since 1920. In 1920 Kansas farms had 1,326,129 horses and mules and only 17,177 tractors. In 1954, there were only 91,360

⁸¹Wilfred H. Pine, Land Ownership in Kansas, Bull. 430, Agricultural Experiment Station, Kansas State University, 1958, p. 1.

horses and mules on Kansas farms. Number of farms with horses and mules but no tractors decreased from 25,215 in 1945 to 4,643 in 1954.⁸²

Production of most Kansas crops can be almost completely mechanized. Likewise, caged layers, pig parlors, and contract cattle feeding enterprises are making mechanization more complete.⁸³

The changes in Kansas agriculture as they affect the cost of using farm machinery are listed under four headings: increased investment; reduced labor requirements; larger farms; and reduced dependence on hired labor.⁸⁴

⁸²G.H. Larson and Floyd N. Reece, A Study of the Performance of Fifty Farm Tractors, Bull. 99, Agricultural Experiment Station, Kansas State University, 1952, p. 3.

⁸³G. H. Larson, G. E. Fairbanks, and F. C. Fenton, What it Costs to Use Farm Machinery, Bull. 417, Agricultural Experiment Station, Kansas State University, 1960, p. 4.

⁸⁴Ibid., p. 8.

CHAPTER V

KANSAS AGRICULTURAL EXTENSION SERVICE FARM MACHINERY SPECIALIST PROJECT-AREAS ON FARM POWER AND MACHINERY

Farm power and machinery

Work in area of mechanical equipment and farm power sources and 4-H Tractor and Automotive Projects - Farm Machinery Specialist - John True

Automation of livestock feeding

- (a) Subject matter. Mechanization of livestock feeding to include feeding systems and feed processing
- (b) Correlation. Wendling, True, Stover
- (c) Type program.
 1. Winter school - county or area (1 day)
 2. Tour - county or area
 3. Farm visits to establish demonstrations
 4. Agent training on district or area basis (2 days)
 5. Special Interest Workshops

Automobile care and safety

- (a) Subject matter. Preventive care maintenance and safe operation of the family auto

- (b) Correlation. True, Ferguson, Farm Bureau Safety Department
- (c) Type program. Home Economics Units Leader Training - county, one day school and demonstration

Automotive 4-H project

- (a) Subject matter. Organization, requirements, methods of conducting meetings, and project aids in 4-H automotive projects
- (b) Correlation. True, Ferguson, 4-H Staff - Hanna
- (c) Type program. Winter Leaders Training School - area or district ($\frac{1}{2}$ - 2 days)

Demonstration farms (Great Plains Program)

- (a) Subject matter. Demonstrate on a farm basis the production potentials, full utilization of resources, importance of sound management practices and need for a continual conservation program on farms in this area of Kansas
- (b) Correlation. Area Agriculturalist (Edelblute), Herpich, Miles, Selby, True, Fitzgerald, Appropriate Crop and Livestock Specialists
- (c) Type program.
 1. Field Day - annual
 2. Farm visit to establish demonstration

Drainage development of plans

- (a) Subject matter. Assist with development of drainage plans for drainage or irrigation district, individual farm or feedlot facility, both surface and sub-surface; includes dry land as well as irrigated land, construction specifications and machinery for constructing
- (b) Correlation. Selby, Fitzgerald, Miles, Herpich, True
- (c) Type program. Leader training, demonstrations, tours, farm visits

Hay drying and harvesting

- (a) Subject matter. Natural air drying of hay in mow, pole barn, stack or special structure (Haykeeper), quality hay production, and use of hay conditioning and harvesting equipment
- (b) Correlation. Stover, True, extension agronomists
- (c) Type program.
 1. Summer school - county or area
 2. Field demonstration - county or area
 3. Tour - county or area

Farm machinery management, care, and adjustment

- (a) Subject matter. Factors in selection, care, and adjustment of machinery which affect efficient management of machinery and lower costs

- (b) Correlation. Ture, Selby, Herpich
- (c) Type program. 1. Winter schools - county
($\frac{1}{2}$ day)
- 2. Demonstration (field) -
county

Farm shop techniques

- (a) Subject matter. Planning, arrangement and wiring of farm shops; electric arc and oxy-acetylene welding and cutting equipment
- (b) Correlation. True, Stover
- (c) Type program. Winter school ($\frac{1}{2}$ day), includes welding demonstrations

Irrigation - machinery for irrigation farming

- (a) Subject matter. Specialized machinery for developing and farming irrigated land
- (b) Correlation. Herpich, Miles, Fitzgerald, True
- (c) Type program. Demonstration

Irrigation pumping plant selection and costs

- (a) Subject matter. Selection and costs of irrigation pumps, power units, and fuels; development of irrigation wells
- (b) Correlation. Herpich, Miles, Fitzgerald, True
- (c) Type program. 1. Winter school - county or area ($\frac{1}{2}$ day)
- 2. Tour - county or area

Irrigation - schools

- (a) Subject matter. Basic concepts and practices for making irrigation farming more profitable
- (b) Correlation. Wendling, Herpich, Miles, True, Fitzgerald, Baird, Soils, Crops and Conservation Section, Animal Science Section, Forestry and Horticulture Section, Farm Management Section
- (c) Type program. Agent training (series of 3 schools over a 3 year period), annual clinic

Market engineering

- (a) Subject matter. Assistance with engineering problems associated with the physical movement of agricultural products through the marketplace
- (b) Correlation. Fitzgerald, True, Stover, marketing specialist, appropriate production specialist
- (c) Type program.
 - 1. Agent training
 - 2. Leader training
 - 3. Demonstration and tour
 - 4. Farm and off-the-farm agricultural visits

Program projection

- (a) Subject matter. Assistance in analysis of county survey and situation and planning county extension engineering programs

- (b) Correlation. Schindler, Wendling, Selby, Herpich, Hiles, Fitzgerald, True, Ferguson, Stover
- (c) Type program. Agent and leader training - county

Rural development

- (a) Subject matter. Assist with implementing findings of the Rural Development Team
- (b) Correlation. Soils, Crops and Conservation Section; Animal Science Section; Forestry and Horticulture Section; Farm Management Section; Wendling; Schindler; Selby; Herpich; Fitzgerald; Miles; True; Ferguson; Stover
- (c) Type program. Leader training, demonstrations, farm visits

Safety

- (a) Subject matter.
 1. Farm architecture: safety practices around the farmstead, fire prevention, and related subjects
 2. Land reclamation: safety practices around irrigation canals and farm ponds

3. Farm power and machinery:
safety practices around
farm tractors, power units
and farm machinery
 4. Rural electrification:
safe electrical wiring,
proper electrical grounding,
fire prevention, fire
extinguishers, and safety
in use of electrical
equipment
- (b) Correlation. Ferguson, Wendling, Schindler,
Herpich, Miles, Fitzgerald, Selby, True, Stover,
home management specialist, 4-H specialists
- (c) Type program.
1. 4-H leader training
 2. Winter school - area or
county
 3. Demonstrations - area or
county
 4. Tours - area or county

Sewing machine care and maintenance

- (a) Subject matter. Cleaning, oiling and adjustment
of all types of sewing machines
- (b) Correlation. True, Stover, clothing specialist

- (c) Type program. 1. Leader training - county or area (1 day)
2. Agent training - county or area

Soil and water conservation contracting

- (a) Subject matter. Technical specifications and business principles for successful conservation contracting
- (b) Correlation. Selby, Fitzgerald, Herpich, Miles, True, Soils, Crops and Conservation Section
- (c) Type program. 1. Leader training
2. Demonstrations
3. Tours

Soil and water conservation - stubble mulch farming

- (a) Subject matter. Methods, machines, techniques and benefits from stubble mulch farming
- (b) Correlation. Selby, Fitzgerald, True
- (c) Type program. 1. Leader training
2. Demonstration
3. Tours
4. Farm visits

Soil and water resources, development of

- (a) Subject matter. Plans, programs and techniques for developing water storage facilities (ponds

and reservoirs), grade stabilization structures, improved terrace system, demonstration farms, watersheds, contour farming systems

(b) Correlation. Selby, Fitzgerald, True, Soils, Crops and Conservation Section

(c) Type program.
1. Agent training
2. Leader training
3. Winter schools
4. Demonstrations
5. Tours
6. Farm visits

Tractor care and maintenance

(a) Subject matter. Methods of proper adjustment and care of tractors, effects of care and adjustments on efficiency of tractors, selection of lubricants and fuels

(b) Correlation. True

(c) Type program.
1. Winter school - county ($\frac{1}{2}$ day)
2. Demonstration - county (1 day)

Tractor 4-H project

(a) Subject matter. Organization, requirements, methods of conducting meeting and project aids in 4-H Tractor Projects

- (b) Correlation. True, Ferguson, 4-H Staff - Hanna
- (c) Type program. Winter leaders training school -
area or district ($\frac{1}{2}$ or 2 days)

CHAPTER VI

KANSAS COOPERATIVE EXTENSION SERVICE FARM MECHANIZATION
SPECIALISTS PLAN OF WORK FOR
JULY 1, 1965 - JUNE 30, 1970

STATEMENT OF PROBLEMS

Conservation of moisture is the major crop production problem in the low rainfall areas of western Kansas. This area is subject to extreme variation in rainfall. The rainfall fluctuates from season to season and from year to year. There are periods of above average rainfall interspersed with periods of drought. Sometimes the periods of drought are of long duration. On the average about 45% of the precipitation comes in rains of less than 1/2 inch resulting in high evaporation. Many rains of high amounts are of the hard, dashing type, resulting in heavy run-off.

Most soils in the low rainfall area are subject to wind erosion during periods when vegetative cover is inadequate. Failing to recognize this fact during periods of adequate rainfall increases the hazards of erosion during dry periods.

Many unwise agronomic practices result in the inefficient use of moisture in the low rainfall area. Perhaps the most outstanding example is the heavy seeding rate or plant population of dry land grain sorghum. Other practices causing inefficient use of moisture are seeding wheat too early, excessive tillage, the use of varieties not resistant to insects and diseases, failure to control insects and diseases, and the failure to control weed growth on fallow land as well as in growing crops.

PLAN OF ACTION

Objectives

(1) Stabilize soil and crop production through the acceptance on the part of a greater number of farm operators in the low rainfall areas of Kansas of proven soil management and moisture conserving practices. These practices include stubble mulch farming; terracing; contour farming; proper crop sequences; proper rates and dates of seeding; limiting tillage operations to only those necessary to control weeds, preventing excessive wind erosion when cover is inadequate and to prepare a good seed bed; using recommended varieties; and maintaining a feed reserve.

Extension Methods

A coordinate educational program conducted under the leadership of Extension Agronomists, Frank Bieberly and Dale Edelblute; Extension Engineers, Walter Selby and John True; and Extension Soil Conservationists R. C. Lind and H. B. Harper. The program to include training of county agents, agency personnel, and equipment and machinery dealers through district workshops. It will include farm operators by means of result demonstrations, radio, television, and press. Farm operators will be instructed on latest techniques by means of field method demonstrations, publications, and public meetings.

Plans for Evaluation

Evaluation of the educational program will be made each year and at the conclusion of this 5-year Plan of Work by the project leaders. Methods of evaluation will include reports of the state statistician, county agents, ASCS, and SCS. Accomplishments will be based on number of acres on which the proven practices are in operation and the effect of this change in soil management on crop yields and soil conservation.

STATEMENT OF PROBLEMS

Irrigation

A major problem concerning Kansas irrigators is the selection of irrigation equipment which is of adequate size to permit the most economical pumping, conveyance and distribution of the irrigation water. Much of the irrigation pipe now used is of a size which causes excessive pumping costs, and poor distribution of the irrigation water. These problems are reflected in the generally below optimum yields being secured.

PLAN OF ACTION

Objectives

(1) Increase the productivity from irrigated farms by the use of equipment which permits the operator to transport and distribute water more efficiently. This can be done by using more pipelines that are of a size which is adequate to transport and distribute the water without excessive head loss.

Extension Methods

Leadership for this activity will be provided by Ext. Irrig. Engrs., Russell Herpich, Donald Miles and Ext. Spec. Farm Machinery, Jack True. Educational programs will be conducted through the Irrigators Associations, the irrigation equipment dealers, through demonstrations, all media of the press, technical publications and through personal consultations.

Plans for Evaluation

The effectiveness of this program will be evaluated through analysis of reports from County Agricultural Agents, S. C. S. Districts, equipment suppliers and irrigation associations.

STATEMENT OF PROBLEMS

Safety

Fires and burns continue to be leading killers among the home and farmstead accidents. In addition to human loss, fires also destroy much property with a large economic loss each year. Every householder needs to be continually reminded and made aware of potential fire hazards, causes of fires, ways to reduce or eliminate fires, and methods of combating fires.

The increase of mechanization on the farm continues to compound the hazards to farm workers. While manufacturers of equipment supply shields wherever possible, the farmers' occupation is still a most dangerous one. Equipment, fuels, and chemicals are often handled by inexperienced, immature, or untrained personnel, as well as by operators who may become careless through familiarity and prolonged use of a dangerous product or machine. Warnings and safety instructions are often unread or unheeded.

The need for safety does not stop at the farmstead gate nor at the city limits. Hazards in, and around, the home and on the highway exist for urban as well as our rural citizens.

PLAN OF ACTION

Objectives

(1) Make the people of Kansas aware of potential fire hazards in their homes and around their farmsteads and stimulate them to eliminate these hazards, thereby avoiding or reducing at least this loss of life and property. Also to promote safe use of fuels, solvents, cleaners, etc.

Extension Methods

This will be a coordinated and continuous educational effort for Extension Engineers, Harold Stover and Leo Wendling; Extension Architect Dale Schindler; Home Management Specialist, Vera Ellithorpe and others. Fire safety will be emphasized at most public or special interest meetings conducted by these specialists. In addition, special emphasis will be given through radio, TV and the press, Fire Prevention Week and seasons of the year when certain fire hazards are most likely. Subject matter to be emphasized includes, detection and elimination of potential fire hazards, fire resistant construction, methods of combating fires, and developing suitable fire protection and fire safety facilities.

Plans for Evaluation

Each year various State, Federal, and Insurance Company statistical reports will be studied to determine the most common causes of fires and the areas that need special emphasis. At the end of the 5-year period covered by this Plan of Work the Extension Engineers will review statistical reports to determine the impact of fire safety activities conducted over the period.

PLAN OF ACTION (continued)

Objectives

(2) Teach the farm operator and his family to practice good safety around the home and farmstead at all times. This will result in a minimum loss of our human resource to accidental injury or death.

Extension Methods

Teaching safety must be a continuous process, to be changed or directed to specific hazards as they become evident. The safety aspects of power and machinery--as should be done with all farming operations--will be pointed out in every meeting dealing with selection, operation and maintenance of farm equipment. News releases, newsletters, and radio spots will be used for timely reminders to the public and to county staff personnel.

Plans for Evaluation

County agent reports and accident statistics may indicate, in part, the value of the program, but should also be used to indicate a need for special emphasis. The whole safety program will be difficult to evaluate but must continue, and be adjusted to meet specific hazards as they arise.

(3) To create an awareness of danger on the highway and around the home.

News releases, newsletters, radio announcements of general interest will be issued as a season or conditions may indicate a need. Work with 4-H youth in safety will be used as a means of making the members, their parents, and leaders more safety conscious.

Same as No. 2.

STATEMENT OF PROBLEMS

Weed Control

Weed control is essential for obtaining maximum crop yields and minimum interference with cultivation and harvesting operations. There is a need for a better understanding of the use of weed control methods and their application. This includes herbicide application and tillage.

Shattercane has been in Kansas fields for several years. Large areas of very fertile bottom land as well as upland fields have reached the stage where profitable row crop production is questionable. The problem is increasing across the state on all types of land.

PLAN OF ACTION

Objectives

(1) More efficient and more profitable crop production by proper application or weed control methods on part of farm operators and weed supervisors.

Extension Methods

This program will be under the leadership of H. B. Harper and Erick Nilson and will include assistance from the other Extension agronomists. Methods will include schools, meetings, news releases, and newsletters.

Plans for Evaluation

An evaluation will be made each year by H. B. Harper using State Board of Agriculture and county agent reports. Basis for accomplishments will be acreage of weeds controlled.

PLAN OF ACTION (continued)

Objectives

(2) Eradication of shattercane from infested fields by farmer adoption of eradication practices including crop rotations and herbicides.

Extension Methods

H. B. Harper, Howard Wilkins, Dean Dicken, Frank Bieberly, Erick Nilson, E. A. Cleavinger and Dale Edelblute will conduct an educational program including result demonstrations, public meetings, publications, and other mass media.

Plans for Evaluation

Accomplishments of the program will be evaluated at the end of 5-years, by county agent reports and surveys. Basis for measurement will be crop acreage cleared of shattercane.

STATEMENT OF PROBLEMS

Harvesting and Storing

It is estimated 20 to 25% of the potential feeding value of forage feed crops (hay and silage) harvested each year on many farms is lost before it reaches the feed bunk. Producers could greatly reduce this loss by following better harvesting, ensiling and storage methods and procedures. The resulting economic gain would be sizable in many cases.

PLAN OF ACTION

Objectives

(1) The establishment of harvesting handling and storage systems of hay and silage making on all farms designed to make maximum use of the feeds' potential as livestock feed. This will result in much lower spoilage losses and subsequent economic gains to the producers.

Extension Methods

A program involving public meetings special interest meetings, demonstrations, tours, reports on laboratory analysis tests of feeds from producers and research reports will be conducted for livestockmen and dairymen. These programs will be a coordinated effort of county Ext. Agents, Extension Engineers, Leo Wendling, Harold E. Stover and John A. True, plus Ext. dairymen E. Ralph Bonewitz and Ed Call. Also contributing to this program will be staff members of the Agricultural Engineering, Dairy Science, and Animal Husbandry Depts. News releases radio and TV as well as publications will also be used to stimulate action by the producers.

Plans for Evaluation

Annual evaluation will be measured by the amount of improved storage erected as reported to the Extension engineers by County Extension Agents. The 5-year or long-time evaluation will be on observed changes in the ratio of feed loss and on the quality of hay and silage feeds being fed as reflected in the numerous feed analysis tests made and reported to the Ext. Engineers and dairymen.

STATEMENT OF PROBLEMS

Feed Handling and Processing

As livestock production units increase in size, many producers find the demand on their labor requires them either to purchase off-the-farm feed processing services or develop a more efficient system for handling and processing feeds on the farm. Producers are seeking information which will enable them to analyze the needs and requirements of a feed handling and processing system to accommodate their program and give them a basis for sound economic evaluation of alternative methods of doing this job either on or off the farm.

PLAN OF ACTION

Objectives

(1) Provide the livestock producer with the information needed to analyze his feed processing system needs, evaluate economically the alternative methods available to do the job efficiently and effectively and subsequently develop a system that best fits his needs and program. The development of these improved feed handling and processing systems will

Extension Methods

Ext. Engrs. Leo Wendling, Harold Stover and John True work together on a coordinated program with county agents to accomplish this objective. Special interest workshops or schools and public meetings will be conducted for producers studying the problem and planning developments. Selected local leaders will be provided special planning

Plans for Evaluation

Annual progress measurement will be through the number of producers improving their feed handling or processing systems as reported by county agents. The 5-year evaluation measure of accomplishment will be the average change in labor required to handle and process feeds on the farm plus the quality of the

PLAN OF ACTION (continued)

Objectives

decrease livestock production costs and labor requirements. This will result in greater production efficiency, economy and profit for the producer.

Extension Methods

assistance to establish Demonstrations. When completed these demonstration units will provide stops on the tours discussed under specific livestock production programs. Individual producers receive help through conferences and publications supplied upon request.

Plans for Evaluation

feeds developed by the farm processing systems as observed by the engineering specialists, county agents and producers. Ext. Engrs. will assume major responsibility for the evaluation of progress.

STATEMENT OF PROBLEMS

Equipment Selection, Installation and Maintenance

There is a lack of adequate service facilities for home sewing machines in most rural areas of Kansas. Most homemakers lack confidence in their ability to do the routine cleaning, oiling and adjusting that is required on their sewing machines. This lack of proper care and adjustment allows many sewing machine troubles to develop.

Much machinery repair (short of major overhauls) is done in farms shops. Approximately one out of three farmers in Kansas has welding equipment in his farm shop, with a higher percentage in the western counties. Many of these farmers are using this

STATEMENT OF PROBLEMS (continued)

welding equipment with little, or no training in its use. The resultant welds may be weak and require additional repairs and there may be costly breakdowns of farm equipment in seasons of heavy use. Some modern equipment is utilizing material other than mild steel and requires special handling or materials for successful repair welding.

PLAN OF ACTION

Objectives

(1) To train the homemaker to properly clean, oil and adjust her sewing machine. To help her develop confidence in analyzing sewing machine malfunctions and correct them.

Extension Methods

A workshop type of training program will be coordinated by Ext. Engrs. Harold Stover and John True. This training will include county agent leaders, 4-H Junior leaders, and county cooperators as the need develops. The basic plan for such workshop training will include from 10 to 20 counties each year. Each two or three years a district or statewide training workshop will be planned for all new County Home Economics Agents.

Plans for Evaluation

Yearly county agent reports will be furnished showing the total number of people being given sewing machine workshop training as well as number of sewing machines cleaned, oiled and adjusted. Yearly reports of county agents being given training will be made by the Ext. Engrs. A 5-year summary will be made showing total machines cleaned and people given training by counties. It will include reports of workshop training being given by leaders to members of home economics units.

PLAN OF ACTION (continued)

Objectives

(2) To maintain a continuing program teaching the farmers, where needed, the basics in gas and arc welding, and providing them with information on new materials and techniques as they are developed.

Extension Methods

New welding materials and techniques as well as basic techniques will be taught through one-day county-wide schools, held in local school or farm shops. John True and Harold Stover, Ext. Engrs., will present the information with assistance from commercial representatives, where appropriate, to demonstrate new techniques and materials. The need for training will be indicated by county agent requests for this work or when the specialist learn of new materials or techniques that should be brought to the farmers' attention.

Plans for Evaluation

County agents will evaluate both the effectiveness of the program and the need for further work in his county. He will notify the specialists through personal contact and annual reports, and by requests for additional schools.

STATEMENT OF PROBLEMS

4-H enrollment in the Tractor and Automotive programs is far below the potential enrollment. Many Kansas youth are operating tractors, trucks, and cars without sufficient knowledge of the machine they are controlling to do so efficiently and safely.

PLAN OF ACTION

Objectives

(1) To interest more Kansas youth in the 4-H Tractor and Automotive Program that they might benefit from the knowledge received and make the farms and highways safer.

Extension Methods

County agents and volunteer county leaders will be trained, through district meetings, in organizing and conducting the Tractor and Automotive Programs. Assistance will be given through available literature, movies, film strips, from the Ext. Information Service and other sources. An enthusiastic and well trained staff of leaders will be the key to attracting new members and retaining those presently in the program. Ext. Engrs. John True and John Ferguson will cooperate with specialists from the 4-H and Youth project to conduct this program.

Plans for Evaluation

4-H enrollment figures will reflect the interest in the training program. Accident report data for the 4-H group should reflect the value of the programs to the youth of the state. The Ext. Engr. will review these accomplishments each year.

CHAPTER VII

DISCUSSION OF KANSAS COOPERATIVE EXTENSION SERVICE FARM MACHINERY SPECIALISTS--PLAN OF WORK AND ITS ADAPTATION TO PUERTO RICO COOPERATIVE EXTENSION SERVICE AGRICULTURAL MECHANIZATION PROGRAM

The first problem pointed out in the Extension Specialist Farm Mechanization plan of work is in relation to Dryland Soil Management. The problem consists of the conservation of moisture in the low rainfall areas of western Kansas.

In Puerto Rico the dryland soil management problem affects mostly the southern coast of the island. On the southern coast there is a rainy season of approximately six months with an amount of 40 to 50 inches of rain. The other five or six months are the dry seasons.

Unwise agronomic practices used on the island result in inefficient use of moisture in the low rainfall area. The methods used in Kansas to solve this problem can be used in Puerto Rico. The method consists of a coordinated educational program. The program includes training of county agents, agency personnel, and equipment and machinery dealers through district workshops. It will include farm operators by means of result demonstrations, radio, television and press. Farm operators will be instructed on

latest techniques by means of field method demonstrations, publications, and public meetings.

Another problem in Farm Mechanization in Kansas concerns irrigation. The major problem concerning Kansas irrigators is the selection of irrigation equipment which is of adequate size to permit the most economical pumping, conveyance and distribution of the irrigation water.

In Puerto Rico the problem is the same, and the methods used in Kansas to solve this problem can also be used on the island. Educational programs can be conducted through the irrigation equipment dealers, through demonstrations, through all media of the press, through technical publications and through personal consultations. The irrigator associations that are used as a means to develop individual programs in Kansas cannot be used in Puerto Rico because such associations have not yet been organized there.

The third problem concerns safety. Fire and burns continue to be a leading killer among the home and farmstead accidents. The increase of mechanization on the farm continues to compound the hazards to farm workers. Equipment, fuels, and chemicals are often handled by inexperienced, immature, or untrained personnel. Also, the need of safety exists for urban as well as the rural citizens.

In Puerto Rico fire and burn accidents are not a leading killer as in Kansas. However, the hazards to the farm worker produced by the handling of fuels and chemicals by inexperienced, immature, and untrained personnel is a great safety problem on the island.

The methods used in Kansas can be adapted to Puerto Rico. Fire safety will be emphasized at most public or special interest meetings. In addition special emphasis will be given through radio, television, and the press.

The teaching of safety will be a continuous process, to be changed or directed to specific hazards as they become evident. The safety aspects of power and machinery--as should be done with all farming operations--will be pointed out in every meeting dealing with selection, operation, and maintenance of farm equipment. News releases, newsletters, and radio spots will be used for timely reminders to the public and to county staff personnel.

Work with 4-H youth in safety will be used as a means of making the members, their parents, and leaders more safety conscious.

The fourth problem is in relation to harvesting and storing. In Kansas it is estimated that 20 to 25 per cent of the potential feeding value of forage feed crops (hay and silage) harvested each year on many farms is lost before it reaches the feed bunk. In Puerto Rico the forage feed crop

practice is not commonly used. However, some farmers could greatly reduce loss in forage feed crops' feeding value by following better harvesting, ensiling and storage methods and procedures.

The methods used in Kansas can also be used in Puerto Rico. A program involving public meetings, special interest meetings, demonstrations, tours, reports on laboratory analysis test of feeds from producers and research reports could be conducted for livestockmen and dairymen. News releases, radio and television as well as publications could also be used to stimulate action by the producers.

The fifth problem in farm mechanization in Kansas is concerned with weed control. There is a need for a better understanding of the use of weed control methods and their application. This includes herbicide application and tillage. Shattercane is a problem in Kansas fields. Large areas of very fertile bottom land as well as upland fields have reached the stage where profitable row crop production is no longer possible. This problem is increasing across the country on all types of land.

The first part of the problem exists in Puerto Rico but the second part does not.

The extension methods used in Kansas can also be used on the island. These methods could include schools, meetings, news releases and newsletters.

The sixth problem in farm mechanization in Kansas is in relation to feed handling and processing. As livestock production units increase in size, many producers find the demand on their labor requires them either to purchase off-the-farm feed processing services or develop a more efficient system for handling and processing feeds on the farm. Producers are seeking information which will enable them to analyze the needs and requirements of a feed handling and processing system to accommodate their program and a base for sound economic evaluation of alternative methods of doing this job either on or off the farm.

In Puerto Rico animal feeds are supplied off the farm. It comes directly from the mills in bulk. However, the farmers need information which will enable them to analyze the needs and requirements of feed handling.

Some of the extension methods used in Kansas can be used also in Puerto Rico. Special interest workshops or schools and public meetings can be conducted for farmers studying the problem and planning developments.

The seventh problem in agricultural mechanization in Kansas is in relation to equipment selection, installation and maintenance. One aspect of this is a lack of adequate service facilities for home sewing machines in most of rural Kansas.

The other aspect of this problem is that much farm machinery repair is done in farm shops. Many of the farmers who have welding equipment are using it with little, or no training in its use. The resultant welds may be weak and require additional repairs and result in costly breakdowns of farm equipment in seasons of heavy use. Some modern equipment requires special handling or materials for successful repair welding.

In Puerto Rico the same problem exists, though there is no lack of service facilities for home sewing machines. The companies that sell the equipment give good service. There is a need, however, for information in relation to maintenance of sewing machines.

The extension methods used to solve the first part of the problem in Kansas can be used on the island. A workshop type of training program could be planned. This training could include county agent leaders, 4-H Junior Leaders, and county cooperators as the need develops. The basic plan for such workshop training may include about 20 districts out of 60.

The extension method used in Kansas to solve the second part of the problem - welding equipment - can also be used in Puerto Rico. New welding materials and techniques as well as basic techniques can be taught through one-day, county-wide schools held in local schools or farm shops.

The need for training will be indicated by agricultural agents' requests.

The eighth problem in agricultural mechanization in Kansas is in relation to 4-H programs. 4-H enrollment in the Tractor and Automotive Programs is far below the potential enrollment. Many Kansas youth are operating tractors, trucks and cars without sufficient knowledge of the machine they are controlling to do so efficiently and safely.

In Puerto Rico this same situation is also a big problem. The extension methods used in Kansas to solve this problem can be used on the island. Agriculture agents and volunteer county leaders should be trained, through district meetings, in organizing and conducting the Tractor and Automotive Programs. Assistance should be given through available literature, movies, and film strips from the Extension Information Service. An enthusiastic and well trained staff of leaders will be the key to attracting new members and retaining those presently in the program.

CHAPTER VIII

PLAN OF WORK DEVELOPED FOR PUERTO RICO COOPERATIVE
EXTENSION SERVICE FARM MECHANIZATION PROGRAM
PLAN OF WORK FOR JULY 1, 1965 - JUNE 30, 1970

STATEMENT OF PROBLEMS

Dryland Soil Management

The dryland soil management affects mostly the south coast of Puerto Rico. On the south coast there is a rainy season of approximately six months with an amount of 40 to 50 inches of rain. The other six months is the dry season.

Unwise agronomic practices used on the island result in inefficient use of moisture in the low rainfall area during the six months dry season.

PLAN OF ACTION

Objectives

(1) Stabilize soil and crop production through the acceptance on the part of greater number of farm operators in the low rainfall area of Puerto Rico of proven soil management and moisture conserving practices. These practices include stubble mulch farming; terracing, contour farming, proper drop sequences, proper rates and dates of seeding, limiting tillage operations to only those necessary to control weeds, the use or recommended varieties, and maintaining a feed reserve.

Extension Methods

A coordinate educational program should be conducted. The program to include training of county agents, agency personnel, and equipment and machinery dealers through district workshops. It will include farm operators by means of result demonstrations, radio, television, and press. Farm operators will be instructed on latest techniques by means of field method demonstrations, publications and public meetings.

Plans for Evaluation

Evaluation of the educational program will be made each year and at the conclusion of this 5-year Plan of Work by the project leaders. Methods of evaluation will include reports of the state statistician, county agents, ASCS, and SCS. Accomplishments will be based on number of acres on which the proven practices are in operation and the effect of this change in soil management on crop yields and soil conservation.

STATEMENT OF PROBLEMS

Irrigation

A problem concerning Puerto Rico irrigators is the selection of irrigation equipment which is of adequate size to permit the most economical pumping, conveyance and distribution of the irrigation water. Much of the irrigation pipe now used is of a size which causes excessive pumping costs, and poor distribution of the irrigation water. These problems are reflected in the generally below optimum yields being secured.

PLAN OF ACTION

Objectives

(1) Increase the productivity from irrigated farms by the use of equipment which permits the operator to transport and distribute water more efficiently. This can be done by using more pipelines that are of a size which is adequate to transport and distribute the water without excessive head loss.

Extension Methods

Leadership for this activity will be provided by Ext. Irrig. Engr. and Spec.-Farm Machinery. Educational programs will be conducted through the irrigation equipment dealers, through demonstrations, all media of the press, technical publications and through personal consultations.

Plans for Evaluation

The effectiveness of this program will be evaluated through analysis of reports from County Agricultural Agents, SCS Districts, equipment suppliers and Puerto Rico Water Reserves.

STATEMENT OF PROBLEMS

Safety

The increase of mechanization on the farm continues to compound the hazards to farm workers. While manufacturers of equipment supply shields wherever possible, the farmers' occupation is still a most dangerous one. Equipment, fuels, and chemicals are often handled by inexperienced, immature, or untrained personnel, as well as operators who may become careless through familiarity and prolonged use of a dangerous product or machine. Warnings and safety instructions are often unread or unheeded.

The need for safety does not stop at the farmstead gate nor at the city limits. Hazards in, and around, the home and on the highway exist for urban as well as our rural citizens.

PLAN OF ACTION

Objectives

(1) Teach the farm operator and his family to practice good safety in farm and home at all times. This will result in a minimum loss of our human resources by accidental injury or death.

Extension Methods

Teaching safety must be a continuous process, to be changed or directed to specific hazards as they become evident. The safety aspects of power and machinery-- as of all farming operations-- will be pointed out in every meeting dealing with selection, operation and maintenance of farm equipment. News releases,

Plans for Evaluation

County agent reports and accident statistics may indicate, in part, the value of the program, but should also be used to indicate a need for special emphasis. The whole safety program will be difficult to evaluate but must continue, and

PLAN OF ACTION (continued)

Objectives

Extension Methods

Plans for Evaluation

newsletters, and radio spots will be used for timely reminders to the public and to county staff personnel.

be adjusted to meet specific hazards as they arise.

(2) To create an awareness of danger on the highway and around the home.

News releases, newsletters, radio announcements of general interest will be issued as a season or conditions may indicate a need. Work with 4-H youth in safety will be used as a means of making the members, their parents, and leaders more safety conscious.

County agent reports and accident statistics may indicate, in part, the value of the program, but should also be used to indicate a need for special emphasis. The whole safety program will be difficult to evaluate but must continue, and be adjusted to meet specific hazards as they arise.

STATEMENT OF PROBLEMS

Weed Control

Weed control is essential for obtaining maximum crop yields and minimum interference with cultivation and harvesting operations. There is a need for a better understanding of the use of weed control methods and their application. This includes herbicide application and tillage.

PLAN OF ACTION

Objectives

More efficient and more profitable crop production by proper application of weed control methods on the part of farm operators and weed supervisors.

Extension Methods

This program will be under the leadership of the Extension Horticulturist and will include assistance from the other Extension agronomists. Methods will include schools, meetings, news releases, and newsletters.

Plans for Evaluation

An evaluation will be made each year by the Extension Director's assistants in charge of the field personnel, and county agent reports. Basis for accomplishments will be acreage of weeds controlled.

STATEMENT OF PROBLEMS

Harvesting and Storing

In Puerto Rico approximately 30 percent of the farmers yearly report losses in forage feed crops. These farmers could greatly reduce loss in forage feed crops' feeding value by following better harvesting, ensiling and storage methods and procedures.

PLAN OF ACTION

Objectives

The establishment of harvesting, handling and storage systems of hay and silage making on all farms, designed to make maximum use of the feeds' potential as a livestock feed. This will result in much lower spoilage losses and subsequent economic gains to the producers.

Extension Methods

A program involving public meetings, special interest meetings, demonstrations, tours, reports on laboratory analysis tests of feeds from producers and and research reports will be conducted for livestockmen and dairymen. These programs will be a coordinated effort of county Extension agents, Extension engineers, Extension farm machinery specialists and Extension dairymen. Also contributing to this program will be staff members of the Agricultural Engineering, Dairy Science, and Animal Husbandry Departments. News releases, radio, and television as well as publications will also be used to stimulate action by the producers.

Plans for Evaluation

Annual evaluation will be measured by the amount of improved storage erected as reported to the Extension engineers by county Extension agents. The 5-year or long-time evaluation will be observed changes in the ratio of feed loss and the quality of hay and silage feeds being fed as reflected in the numerous feed analysis tests made and reported to the Extension engineers and dairymen.

STATEMENT OF PROBLEMS

Feed Handling

In Puerto Rico animal feeds are supplied off the farm. They come directly from the mills in bulk. According to Agricultural County Extension Agent reports, there is need for information in relation to feed handling on the farm. This information would enable the farmer to analyze his needs and requirements for feed handling in order to develop a more efficient system for handling his feeds.

PLAN OF ACTION

Objectives

Provide the farmer with the information needed to analyze his feed handling system needs, evaluate economical and alternative methods available to do the job efficiently and effectively and subsequently develop a system that best fits his needs and program. The development of these improved feed handling systems will increase farm production. This will

Extension Methods

Extension engineers and Farm Machinery Specialists work together on a coordinated program with county agents to accomplish this objective. Special interest workshops or schools and public meetings will be conducted for farmers studying the problem and planning developments. Selected local leaders will be provided with planning

Plans for Evaluation

Annual progress measurement will be through the number of producers improving their feed handling as reported by county agents. The 5-year evaluation measure of accomplishment will be the average change in labor required to handle feeds on the farm as observed by the engineering specialists, county agents and producers. A selection of Extension engineers will assume major

PLAN OF ACTION (continued)

Objectives

result in economy and profit for the farmer.

Extension Methods

assistance to establish demonstrations. When completed these demonstration units will provide stops on the tours discussed under specific livestock production programs. Individual farmers receive help through conferences and publications supplied upon request.

Plans for Evaluation

responsibility for the evaluation of progress.

STATEMENT OF PROBLEMS

Equipment Selection, Installation and Maintenance

There is need for information in relation to maintenance of sewing machines in most rural areas of Puerto Rico. Most homemakers lack confidence in their ability to do the routine cleaning, oiling and adjusting that is required on their sewing machines. This lack of proper care and adjustment allows many sewing machine troubles to develop and causes failure to work properly.

STATEMENT OF PROBLEMS (continued)

Much of the machinery repair (short of major overhauls) is done in farm shops. Many farmers are using welding equipment with little, or no training in its use. The resultant welds may be weak and require additional repairs and/or cause costly breakdowns of farm equipment in seasons of heavy use. Some modern equipment is utilizing material other than mild steel and requires special handling of materials for successful repair welding.

PLAN OF ACTION

Objectives

To train the homemaker to properly clean, oil and adjust her sewing machine. To help her develop confidence in analyzing sewing machine malfunctions and correct them.

Extension Methods

A workshop type of training program will be coordinated by a selection of Extension engineers. This training will include county agent leaders, 4-H Junior leaders, and county cooperators as the need develops. The basic plan for such workshop training will include 15 out of 60 counties each year. Each two or three years a district or statewide training workshop will be planned for all new County Home Economics Agents.

Plans for Evaluation

Yearly county agent reports will be furnished showing the total number of people being given sewing machine workshop training as well as number of sewing machines cleaned, oiled and adjusted. Yearly reports of county agents being given training will be made by the Extension engineers. A 5-year summary will be made showing total machines cleaned and people given training by counties. It will include reports of workshop training being

PLAN OF ACTION (continued)

Objectives

To maintain a continuing program teaching the farmers, where needed, the basics in gas and arc welding and providing them with information on new materials and techniques as they are developed.

Extension Methods

New welding materials and techniques as well as basic techniques will be taught through one-day county-wide schools, held in local school or farm shops. Extension engineers will present the information with assistance from commercial representatives, where appropriate, to demonstrate new techniques and materials. The need for training will be indicated by county agent requests for this work or when the specialist learns of new materials or techniques that should be brought to farmers' attention.

Plans for Evaluation

given by leaders to members of home economics units.

The county agents will evaluate both the effectiveness of the program and the need for further work in his county. He will notify the specialists through personal contact and annual reports, and by requests for additional schools.

STATEMENT OF PROBLEMS

4-H enrollment in the Tractor and Automotive Programs is far below the potential enrollment. Many Puerto Rican youth are operating tractors, trucks, and cars without sufficient knowledge of the machine they are controlling to do so efficiently and safely.

PLAN OF ACTION

Objectives

To interest more Puerto Rican youth in the 4-H Tractor and Automotive Program that they might benefit from the knowledge received and make the farms and highways safer.

Extension Methods

County agents and volunteer county leaders will be trained, through district meetings, in organizing and conducting the Tractor and Automotive Programs. Assistance will be given through available literature, movies, film strips, from the Extension Information Service and other sources. An enthusiastic and well trained staff of leaders will be the key to attracting new members and retaining those presently in the program. A selection of Extension engineers will cooperate with specialists.

Plans for Evaluation

4-H enrollment figures will reflect the interest in the training program. Accident report data for the 4-H group should reflect the value of the programs to the youth of the state. The Extension engineer will review these accomplishments each year.

CHAPTER IX

CONCLUSIONS

Since Kansas is an agricultural state in which agricultural mechanization is developed to a high degree, its Agricultural Extension Service Plan of Work for Agricultural Mechanization was used as a basic pattern to develop an Extension Plan of Work for Agricultural Mechanization in Puerto Rico.

Results of this study indicated that in the island one of the problems in which an agricultural mechanization program should be emphasized is in dryland soil management where unwise agronomic practices result in inefficient use of moisture in the low rainfall area. The extension educative method to be used is a coordinated educational program including training of county agents, agency personnel, and training of equipment and machinery dealers.

Another area to be emphasized in the Extension Plan of Work for Agricultural Mechanization in Puerto Rico concerns irrigation - selection of irrigation equipment which is adequate in size to permit the most economical pumping, conveyance and distribution of irrigated water. An educational program should be conducted through the irrigation equipment dealers, through demonstrations, through all mass media methods; press, television, radio and publications.

The study also showed that safety is another problem which will be considered in the Extension Plan of Work for Agricultural Mechanization in Puerto Rico. Fire safety should be emphasized at most public or special interest meetings. In addition, special emphasis will be given through radio, TV, and press.

Harvesting and adequate storing present other problems which need emphasis in the Puerto Rico Extension Plan of Work for Agricultural Mechanization. A program involving public meetings, special interest meetings, demonstrations, tours, radio and TV programs, and news releases are methods that should be used here.

The study brought out that weed control is another problem to be included in the Puerto Rico Extension Plan of Work. Extension methods to be used include schools, meetings, news releases and newsletters.

Feed handling also needs to be emphasized, according to the results of the study, in the island's Extension Plan of Work for Agricultural Mechanization. Special interest workshops or schools and public meetings should be conducted.

Equipment selection, installation and maintenance is another problem that should be considered in the Extension Plan of Work for Agricultural Mechanization. A workshop type of program should be carried out to solve this problem.

According to the results of the study the last problem to be considered in the Puerto Rico Extension Plan of Work for Agricultural Mechanization is the low enrollment in the 4-H Tractor and Automotive Programs. Training of project leaders through district meetings in organizing and conducting the Tractor and Automotive programs will be organized in order to solve this problem.

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APPENDIX

Project III - Plan of Work Report Form
Annual Supplement

(Use a separate sheet for each entry)

Name _____ Title _____

I. Problems and Programs (1965-70 Plan of Work Outline)

A. Project Area: _____

Problem Area: _____

Problem Identity: _____

B. Objective () (Copy from Plan of Work or revise if needed)

C. Annual Goals (1966-67)

(Use additional sheets if needed.)

CO-OPERATIVE EXTENSION WORK
IN
AGRICULTURE AND HOME ECONOMICS
STATE OF KANSAS

Edelblute
True
106

KANSAS STATE UNIVERSITY OF AGRICULTURE AND APPLIED SCIENCE
AND UNITED STATES DEPARTMENT OF AGRICULTURE CO-OPERATING

EXTENSION SERVICE

MANHATTAN, KANSAS

Present Schedule	
Date	County
May 3	Rush
June 9	Hodgeman
June 10	Rush
July 25	Rush

Proposed Schedule	
Date	County
May 5	Rush
June 9	Rush
June 10	Hodgeman
August 2	Rush

REQUEST FOR REVISION OF SCHEDULE

July 14, 1965

Date

Dale Edelblute

Name of Originator of Request

Agent's schedule affected Rush & Hodgeman County Agent's

Specialist's schedule affected Dale Edelblute

I want to change the date of May 3 to May 5
June 10 to June 9
July 25 to August 2

I want to cancel the date of _____

I want to add the date of March 15

Reason: May 5 - Correlate with True & Selby
June 9 & 10 - Avoid Sales Day in Hodgeman
March 15 - Crops School
July 25 changed to August 2 - County Agents' Request

Approved _____ By _____
Rejected _____ Specialist _____ Date _____ Letter, telephone, etc. _____

Approved _____ By _____
Rejected _____ Department Head _____ Date _____ Letter, telephone, etc. _____

Approved _____ By _____
Rejected _____ County Extension Agent _____ Date _____ Letter, telephone, etc. _____

Approved _____ By _____
Rejected _____ District Agent _____ Date _____ Letter, telephone, etc. _____

Final Action: The above revision, approved by all parties concerned, has been recorded on the master schedule

this date AUG 6 1965

Copy to: The County
The Specialist
The Department Concerned
Schedule Committee File

Very truly yours,
Oscar W. Norby
Chairman, Schedule Committee

Instructions: Prepare four or more copies of this form. (See Handbook instructions.) Keep all copies together until distributed by the chairman of the schedule committee.

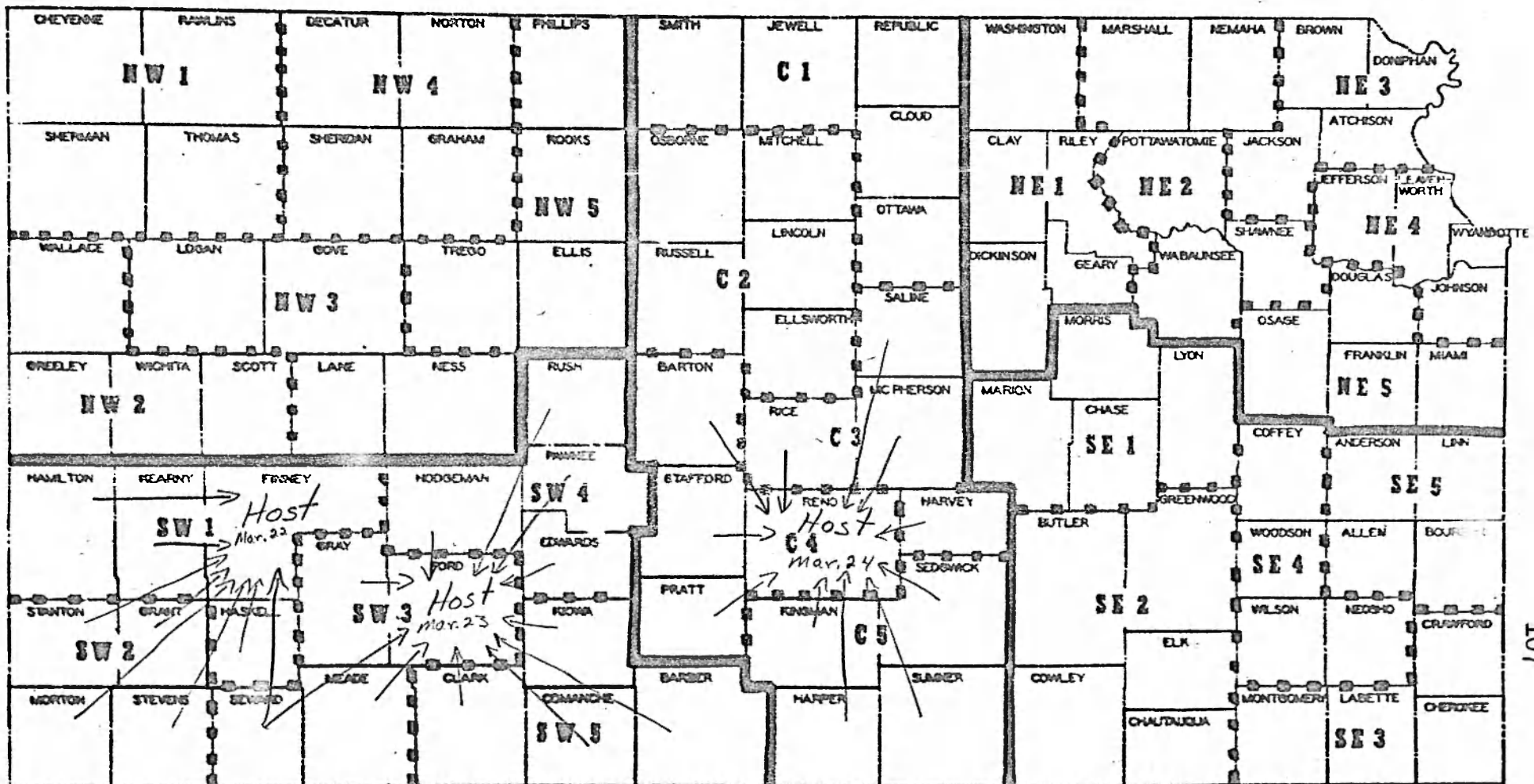
1965 KSU 1-10d District events or activities proposed by: Name of Specialist H. Harper, W. Selby, J. Truc

Indicate the host, the date, and the counties to attend at each location. (See maps) If a series of activities or events is proposed, list those for at least one week on each map.

County Agents to be scheduled: All, (Agr.), Home Ec., Club, (Asst. Agr.) Asst. Home Ec., Asst. Club
(Circle those applicable)

If held the date should not be earlier than Feb. nor later than March.

Further comments on this event or activity Also include Forestry & Agronomy Specialists.



Person's Name Harper, Selby, True Week Starting _____

Code to give Purpose of County Visits or District Meetings in Column 8

- | | | |
|--------------------------------------|--|-------------------------------------|
| AT - Agent Training | ED - Establish Demonstrations | SI - Special Interest Groups |
| ATU - Agent Training for Unit Lesson | TR - Tours | PM - Public Meetings |
| PP - Program Projection | FD - Field Days | RW - Recreation Workshop |
| LT - Leader Training | MF - Mid-America Fair | 4H - 4-H Club Camps |
| OC - Office Conference | SF - State Fair | OB - Observer Only (Inservice Trg.) |
| FV or HV - Farm or Home Visits | OM - Organization Mtg. (Mtg. of an Org.) | Specify any other purposes |

If more than one purpose, indicate all purposes and division of time for each.

If the event is on a district basis, place the letter "D" before the code.

1 County	2 Proposed Date	3 Day of Week	4 Final Date	5 Correlated With	6 Agents* Involved	7 No. Unit Lessons If Any	8 Purpose (Use Code)	9 Subject Matter To Be Covered	10 Date Could Be:	
									Not Earlier Than	Not Later Than
		Mon.								
Finney	Mar 22	Tue.		Agronomist Forester	A		AT	Weed Control	Feb	March
Ford	Mar 23	Wed.		"	A		AT	Weed Control	Feb	March
Reno	Mar 24	Thu.		"	A		AT	Weed Control	Feb	March
		Fri.								
		Sat.								

Further comments on above proposed schedule Dist Mtgs proposed to train County Agents, weed supervisors, and county leaders in weed control practices.

* A-Agriculture; AA-Assistant Agriculture; H-Home Economics; AH-Assistant Home Economics; C-Club; AC-Assistant Club; All for all agents

EXTENSION PLAN OF WORK FOR AGRICULTURAL
MECHANIZATION IN PUERTO RICO

by

VICTOR A. COLON MARTINEZ

B. S., Southwestern Louisiana University, 1955

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Farm Mechanics

Department of Agricultural Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1966

Farm mechanization in Puerto Rico has increased rapidly during the last several years. Evidence of this trend is that the number of tractors used in the last decade increased from 1,912 in 1952 to 3,973 in 1962. In 1962 there were 295 sugar cane carrier machines. In 1962, 39 per cent of the sugar cane harvesting was done by machine loaders. Cultivation machinery is used in coffee production. There is a great increase in dairy cattle mechanization. During the period 1956 to 1960, 263 new first class dairies were established. In 1960 there were 652 first class dairies on the island and in 1962 there were 1,023 milking machines.

Three factors affect agricultural education programs on the island. Twenty-four per cent of the farmers do not have formal education, and eighty-five per cent have less than seventh grade education. Forty per cent of the farmers are fifty-five years old or more, and sixty-five per cent have had twenty years of farm working experience.

Puerto Rico's total land area is about 2,191,000 acres (2,256,000 cuerdas). The total agricultural land amounts to 1,936,370 cuerdas. Of these around 794,000 cuerdas are pasture and range, 745,000 are cropland and nearly 300,000 are forest and woodland.

Kansas has 52.5 million acres. All except about one million acres are in farms and ranches (1958). Three-fifths

of the land is held jointly by husbands and wives. The most common age of owners is between 55 and 64 years. About one-half of the owners are active farmers. Many of the other owners are retired farmers who have had some farm experience. A third of the owners do not farm their land. Slightly more than one-half of the owners live on their farms. A third of all owners have two or more farms.

Kansas has about 170,000 farm tractors, or about 1.4 tractors per farm. An almost complete change from animal to mechanical power for Kansas agriculture has taken place since 1920. Production of most Kansas crops can be almost completely mechanized.

It is the purpose of this study to develop an Extension Plan of Work for Agricultural Mechanization in Puerto Rico, using the Kansas Extension Agricultural Mechanization Plan of Work as a guide but adapting it to Puerto Rican conditions of smaller farms and rougher topography.

Since Kansas is an agricultural state in which agricultural mechanization has developed to a high degree, its Agricultural Extension Service Plan of Work for Agricultural Mechanization was used as a basic pattern to develop an Agricultural Extension Service Plan of Work for Agricultural Mechanization in Puerto Rico.

The areas in which Agricultural Extension Service Plan of Work for Agricultural Mechanization in Puerto Rico

should be emphasized are Soil Management, Irrigation, Safety, Harvesting and Storing of crops, Weed Control, Feed Handling, the Selection, Installation and Maintenance of Equipment, and the 4-H Tractor and Automotive Program.

The educative extension methods to be used are meetings, demonstrations, training meetings, radio and TV programs, press, workshops, circular letters, and personal farm visits.