

FARM MECHANICS COURSE IN THE  
TUCSON SENIOR HIGH SCHOOL  
FOR RANCH BOYS

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FARM MECHANICS COURSE IN THE TUCSON SENIOR HIGH SCHOOL  
FOR RANCH BOYS

by  
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submitted to the faculty of the  
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Approved

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## TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION .....	1
II. DETERMINING THE MECHANICAL NEEDS .....	7
III. OBJECTIVES FOR FARM SHOP PROGRAM .....	16
Objectives for Agricultural Engineering Instruction .....	21
IV. A TWO YEAR FARM SHOP PROGRAM .....	26
V. CONCLUSIONS AND RECOMMENDATIONS .....	32
General Conclusions .....	32
Definite Conclusions Made from the Study ..	35
Recommendations .....	36
BIBLIOGRAPHY .....	37
APPENDIX .....	39

## TABLES

Number	Page
I. TYPES AND SIZES OF RANCHES SURVEYED .....	8
II. ANSWERS TO QUESTION NUMBER ELEVEN, FARM CONVENIENCES .....	9
III. ANSWERS TO QUESTION TWELVE .....	10
IV. ITEM THREE .....	12
V. FARM MECHANICS I .....	30
VI. FARM MECHANICS II .....	31

## CHAPTER I

### INTRODUCTION

The problem stated.-- To determine the types of training in farm mechanics that will meet the needs of ranch and farm boys in the agricultural area surrounding Tucson, Arizona.

The following minor problems should be considered in this study.

1. To determine what mechanical jobs the farmers already do on their farms.
2. To determine what jobs they consider to be the most important.
3. To determine what they would like to be able to do if they had the proper training.
4. To determine the attitude of the ranchers interviewed as to the value of a farm shop program in the Tucson Senior High School.

From an analysis of the survey to set up a farm shop program in the Tucson Senior High School to meet the discovered mechanical needs of boys, selecting agriculture as their life's work.

The total amount of power used annually on farms in the United States amounts to approximately 16,000,000,000 horse power hours, while the cost under 1924 conditions, averages about 19 cents per horse power hour or close to \$3,000,000,000 for the year. Power and labor represent on an average approximately 60 per cent of the total cost of producing farm products. The primary horse power available for use in agriculture is greater than that available for either mining or manufacturing and is second only to that used by the railroads. Implements and machinery on the farms of this country represent an investment equivalent to 27 per cent of that invested in farm buildings in the United States.<sup>1</sup>

Much has been said concerning the necessity that the farmer should know his soil, crop rotation, and maintenance of soil fertility; that he should know simple farm accounting and understand problems in marketing his products. These and many more are very essential but none of them are any more vital to his success than his ability to use farm tools and farm machinery.

Terms defined.-- The terms "farm shop work" and "farm mechanics" are used interchangeably in connection with the vocational agricultural program. Farm mechanics work includes all of the unspecialized mechanical activities that should be done on the average farm, such as farm woodwork, home conveniences, forge work, motors work, soldering, harness repair, rope work, simple electric wiring, pipe fitting, concrete work and farm machinery.

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1. Report of Committee on the Preparation of Farm Shop Teachers, Agricultural Education Section, American Vocational Association, Louisville, Kentucky. Dec. 2-4, 1926.

The farm boy of the present time is the farmer of the future and should be trained in the knowledge, skills and appreciations that he will need to meet the mechanical problems with which the average farmer has to deal. 2

Origin of the problem.-- The problem presented itself as an outgrowth of the writer's introducing vocational agriculture in the Tucson Senior High School after it had been eliminated for a period of eight years. The desirability of correlating textbook work with practical shop work resulted in the choosing of this problem. An analysis of the data collected will be the criterion for setting up the farm shop in the Tucson Senior High School.

Reasons for the study.-- Economic conditions as they now exist demand well trained, efficient farm operators. With the rapidly increasing mechanization of the farm and the ability to produce enormous surpluses under normal conditions ranks farming as the largest and most complicated business in the United States today.

Vocational education in agriculture has for its primary aim "To train present and prospective farmers for proficiency in farming." Proficiency in modern farming necessarily includes considerable ability to work with tools and farm machinery. Any comprehensive plan for farm training must provide opportunity for the development of

such abilities involving the use of mechanics that are essential to successful farm management.

Every community must assume a definite responsibility in regard to its youth. Every industry within its bounds must absorb as many young men as possible yearly. Agriculture must not be an exception. New avenues are opening in agriculture as well as other industries which well trained agricultural students can readily find employment. But they must be well trained. In order to round out the vocational agricultural curriculum in the Tucson Senior High School this study was selected. That such a course would not be built on the general instead of the specific mechanical needs of this community, the survey was made. Farm mechanics must receive more attention in our vocational agricultural schools today.

Previous studies in the field.-- There have been numerous books written on farm shop and farm mechanics. Desirable courses of study have been worked out. The present study aims to localize the general and make it meet the specific needs of the community. As far as can be ascertained this has not been done previous to this date.

Sources of data.-- The material upon which this study is based was obtained by the use of a questionnaire and by personal interview. Corroborated information was secured

from textbooks and bulletins dealing with farm mechanics. Vocational agricultural departments were visited throughout the state to learn various methods of procedure and farm shop organization.

Procedure for making the study.-- An analysis of the problem revealed the following procedure should be carried out.

- I. Construct an adequate questionnaire on the following basis.
  - A. Type of farm being surveyed.
  - B. Determine what jobs the farmers were already doing.
  - C. What they considered the most important.
  - D. What they would like to do if they could.
  - E. What value they place on the introduction of a farm mechanics course in the Tucson Senior High School.

With these objectives in mind a questionnaire was drawn up and presented to the teacher trainer in the College of Agriculture. With his approval it was tried out on five ranchers and found satisfactory. Forty additional ranches were interviewed in order to make it a representative study.

Upon completion of the survey the results were tabulated, necessary charts made and conclusions drawn.

In Chapter II will be found the data collected from the questionnaires. The charts illustrate the main objectives set forth in the questionnaire. In Chapter III are listed the objectives for the farm shop program in the Tucson Senior High School.

In the fourth chapter there is presented from the data collected a two-year teaching plan for a farm mechanics course in the Tucson Senior High School.

The conclusions found in Chapter V have been made from a summary of the data collected and are not in any way to be interpreted generally. No doubt they can be applied to the solution of the problems of any similar irrigated agricultural region in the west. Every farm shop program in any community should be organized to meet the particular needs of that locality.

## CHAPTER II

### DETERMINING THE MECHANICAL NEEDS

In determining the mechanical needs as a basis for instruction and time allotment plan for a course in farm mechanics in the Tucson Senior High School the following minor problems had to be solved.

1. Determine what mechanical jobs the farmers already do on their farms.
2. Determine what jobs they consider to be most important.
3. Determine what they would like to be able to do if they had the proper training.
4. Determine the attitude of the ranchers interviewed as to the value of a farm shop program in the Tucson Senior High School.

In collecting information to set up a farm shop program for a community care must be taken to get a fair representation of the types of farming in that region surveyed. Table No. I classifies the ranches as to type, size, and whether dry land or irrigated. It is readily seen that diversified, poultry, and dairy farming predominate. These three types of farming will also show the greatest growth with the increase in population of the community.

TABLE I  
 TYPES AND SIZES OF RANCHES SURVEYED

No.	:Poultry: : Acres	: Dairy : : Acres	: Beef : : Cattle	: Hogs : : Acres	: Vegetable: : Gardening:	: Diversified: : Acres
1	: 4 : I	: 15 : I	: 37,000 : N	: 23	: 90 : I	: 10 : I
2	: 10 : I	: 70 : I	: 12,800 : N	: 10	: 120 : I	: 3 : I
3	: 2 $\frac{1}{2}$ : I	: 80 : I	: 640 : N	: 5	: 10 : I	: 160 : I
4	: 40 : I	: 280 : I	:	:	:	: 40 : I
5	: 5 : I	: 80 : I	:	:	:	: 80 : I
6	: 5 : I	: 60 : I	:	:	:	: 53 : I
7	: 2 $\frac{1}{2}$ : I	: 15 : I	:	:	:	: 100 : I
8	:	:	:	:	:	: 40 : I
9	:	:	:	:	:	: 60 : I
10	:	:	:	:	:	: 4 $\frac{1}{2}$ : I

Total number of ranches surveyed -- 33

I -- irrigated  
 N -- non-irrigated

All of the ranches surveyed were being lived on and operated by their owners. The average number of years of operation was twelve years. This in itself indicates a healthy condition and aids materially in the value of the survey. Another interesting fact brought out was that those of long time occupation had the best farms. The "Master Farmer" of all interviewed had been living on his ranch for twenty six years.

It was also rather interesting to discover that those nearest to town were inclined to be the least independent. The automobile plus good roads made it quite convenient for even the most simple of farm jobs. Their argument was that it was cheaper than setting up a well equipped farm shop. Here is revealed what can be made another interesting study. The ranchers a greater distance from town felt that the time and cost factor prohibited them from depending on the village blacksmith. They considered a well equipped farm shop as very essential to economical ranch management.

TABLE II

ANSWERS TO QUESTION NUMBER ELEVEN, FARM CONVENIENCES

Water System	:Sewage Disposal:	Electricity:	Gas-Flamo
Pressure : Gravity:	:	:	:
2 : 31 :	22	27	2

The above table clearly indicates the trend toward modernization now going on in our rural communities.

This in itself necessitates a knowledge of all the jobs required for not only installation but the upkeep and expansion of these units on the ranch.

TABLE III  
ANSWERS TO QUESTION NUMBER TWELVE

36	:	Automobiles	::	Horses	:	20
:	:	:	:	:	:	:
27	:	Trucks	::	Wagons	:	23
:	:	:	:	Harvesting	:	:
19	:	Tractors	::	Machinery	:	17
:	:	:	:	Cultivating	:	:
24	:	Gasoline Engines	::	Machinery	:	20
:	:	:	:	:	:	:
30	:	Electric Motors	::	Dairy Equipment	:	10
:	:	:	:	Irrigation	:	:
23	:	Farm Shops	::	Equipment	:	30
:	:	:	:	:	:	:
22	:	Implement Sheds	::	Weed Burner	:	1

A great deal could be written about the training the ranch operator should have in keeping up his automobiles and trucks. We realize they are a ranch necessity. What just the problem of upkeep alone means can be best illustrated by relating what one ranchman had to say. He admitted that he was not an educated man and was not at all mechanically inclined. However, after paying a local garage eighty one dollars for a complete overhaul job which did not stand up he decided to tackle the job himself. He said he was rather amazed at his own proficiency; that his job stood the test and saved him about seventy two dollars which during the depression he did not have. Numerous

other similar experiences will be related in the explanation of another table.

In determining the mechanical needs for a farm shop in the Tucson Senior High School an examination of Table IV reveals the entire set up can be organized from the data collected here. Practically all the ranchers (97.7%) had experience in rough woodworking. Sixty two per cent (62%) had done rough concrete work. Ninety seven and seven tenths per cent (97.7%) had built rough buildings. Here already the survey reveals that it is very essential to train farm boys in the use of the hammer, saw, square, plane and level. If they become proficient in the use of these five tools alone they can be practically independent as far as farm carpentry is concerned. We find eighty two per cent (82%) of the ranchers checking building fences as most important. Another example of the use of simple tools signifying their importance in what is a year round job on any farm--building and repairing fences.

Only fifty per cent had built a house and seventy five per cent of these had secured an experienced carpenter to help them. Only six of the forty five ranchers had done the job alone. They had learned carpentry as boys and felt the time spent as apprentices was some of their most valuable boyhood training.

The less fortunate ranchers naturally felt that building a house was just too much of a job. However,

TABLE IV

## ITEM THREE

In column 1 will be checked the things the rancher has done.  
Column 2 - The things he considers most important.

Column 1-Single Checked:	:	:	Column 2-Double Checked:	:
Job	:	:	Job	:
Making rough wood farm	:	:		:
appliances	:	43:38:	Riveting harness	:
Making finished wood	:	:		:
farm appliances	:	19:10:	Harness stitching	:
Building rough	:	:		:
buildings	:	43:43:	Rope splicing	:
Building a house	:	24:11:	Belt lacing	:
Painting	:	35:35:	Electric Wiring	:
Building fences	:	28:37:	Pipe fitting	:
Glazing	:	14:27:	Soldering	:
Rough concrete work	:	28:35:	Installing shafting	:
Finished concrete work	:	17: 5:	Simple forging	:
Free hand drawing	:	20:18:	Welding	:
Farm drawing	:	18:20:	Tool grinding and	:
	:	:	sharpening	:
Farm surveying	:	16:24:	Saw filing	:
Land clearing	:	15:28:	Overhauling implements	:
Land leveling and	:	:	Operation, repair	:
checking	:	12:27:	automobile	:
	:	:	Operation, repair	:
Drainage	:	12: 6:	tractors	:
Irrigation construction:	:	7:32:	Overhauling gas engines:	:
Operation, repair	:	:		:
of pumps	:	7:36:	Babbiting bearings	:
Read a blue print	:	:		:
(written in)	:	2:		:

they did feel that schools today were better equipped and could teach the boys enough finished work that they would need very little outside help in building their future farm homes.

The relative simple jobs of leather work, harness riveting, stitching, rope splicing, and belt lacing received the expected amount of attention. The percentage was rather low due to the fact the tractor is rapidly replacing horse labor. At present, however, there is a trend back to horse labor again, especially on small ranches and for many short haul jobs where horses have proven to be more economical. The depression taught a great many small farmers that operating costs must be figured very closely.

Pipe fitting, soldering, welding, and simple forging averaged forty eight per cent (48%). about one half of the ranchers who no doubt had been forced to do it themselves valued this training highly. Especially was this true of the larger operators a great distance from town.

The ten dairy ranchers surveyed placed most of their emphasis on understanding electric wiring, motors, and operation of dairy machinery. The ability to test milk and cream was considered a prerequisite for dairy management. Fifty per cent were using milking machines, pasteurizing, and retailing their own milk. A great many dairy jobs present themselves in this kind of a set up.

In this survey naturally all problems connected with irrigation: pumping, motors, gasoline engines, piping, and ditch construction received a great deal of attention. Also those related jobs: surveying, land leveling, and checking are becoming more important daily. A recent University of Arizona bulletin makes the startling statement that crop yields<sup>3</sup> have been increased as much as thirty per cent (30%) the first year after a careful land leveling practice has been employed.

Water must not be lost or wasted while irrigating. There is a very definite relationship between cost of irrigation and cost of crop production. Excessive irrigating costs have many times kept the farmer from showing a profit at the end of the year. Needless to state, no factors concerning irrigation management must be slighted in the agricultural classroom and shop.

Three items in the survey: the operation, repair, and upkeep of farm automobiles, tractors, and gasoline engines need to be called to the attention of vocational agricultural teachers throughout the land. No doubt this situation exists in every state. With only seventeen per cent (17%) doing these jobs and eighty-two per cent (82%) signifying its great importance, it is about time vocational agricultural teachers realized the necessity for such

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3. Wood, C. J., "Preparation and Use of Seedbed,"  
Extension Circular No. 102, March, 1937, p. 7.

training.

The examination of Table IV in its entirety is not only extremely interesting but also quite enlightening. The solution of a great many of the farmer's numerous ills are revealed here. We are well aware that farm mechanics is only one of the numerous problems the farmer has to deal with. However, it is a very vital and important one.

Economical crop and animal production depends to a large extent upon cost of production which in turn hinges upon the wise use of the various mechanical aids now available to the farmer.

It is both pleasing and gratifying to find the rural people one hundred per cent for the introduction of a farm mechanics course in the Tucson Senior High School. Those interviewed were quite frank in pointing out instances in their own experience where the lack of proper training had cost them dearly. They expressed the hope that all who followed in their footsteps would be better trained and more adequately prepared to meet the numerous problems confronting the American farmer today.

## CHAPTER III

### OBJECTIVES FOR FARM SHOP PROGRAM

Most farm boys are interested in mechanical work. More attention must be given to this phase of our vocational agricultural instruction because of the development of mechanical devices and the increased use of labor saving equipment on the farm and in the farm home.

Farm shop and agricultural engineering provide a method of training for the development of the individual as well as a development of social cooperation. Recently we have seen a flood of literature by well known authors on the secret of getting along with people, social responsibility, the art of living, et cetera. We who are engaged in teaching know that the basis for social independence--the foundation upon which in America is built all those attributes of good citizenship--lies in a well trained, competent, socially minded people. We need not ever be afraid of foreign isms if such can be attained.

It is necessary that the individual acquire certain information, appreciations, interests, ideals, and skills in order to fit in with a changing social life. These courses offer a splendid opportunity for the development of the understanding of those working principles that always exist between producer and consumer.

Many of the boys who leave the farm find employment in related occupations requiring mechanical skills similar to those in which they have had a good deal of training on the farm.

Training is needed in the construction, installation, and repair of home conveniences in order to reduce depreciation of farm appliances and buildings. This can be partially met by the proper instruction in a well equipped farm shop.

Major Objectives:

- I. Arouse an interest in practical farm mechanics.
- II. Establish the proper ideals and standards in repair and construction of mechanical devices for the farm and home.
- III. Stimulate an interest in occupations requiring mechanical skill such as is needed for certain farm shop and agricultural engineering jobs.
- IV. Foster an appreciation of the economic importance of careful selection, proper use, and repair of farm equipment.
- V. Train boys to think so they may analyze and solve intelligently any problems they encounter when conducting their farm mechanical activities.

- VI. Fit boys to do repair and construction jobs on the farms of the community.
- VII. Train boys to use good judgment, taste, and an appreciation of values, so they may wisely choose those articles needed on the farm and in the home.
- VIII. Help socialize the boy through group activities.
- IX. Create an appreciation and desire for good workmanship.
- X. Motivate the formation of good habits.

Contributory Objectives:

Abilities to be developed:

I. Carpentry abilities.

- A. Make proper selection of lumber for use on the farm.
- B. Make out a bill of lumber and figure cost of constructing a project.
- C. Perform tool operations necessary in the construction of farm appliances.
- D. Make proper selection of builder's hardware when building or repairing farm appliances.
- E. Cut glass, knead putty, and properly place a window pane.

- F. Select and apply proper finish to any article constructed in the farm shop.

II. Sketching and Drawing abilities.

- A. Make a working sketch or drawing of small appliances.
- B. Interpret blue prints and plans of farm appliances and structures.

III. Tool Fitting and Sharpening abilities.

- A. Sharpen tools used in the farm shop.
- B. Fit hand, crosscut, and timber saws.
- C. Fit handles to hammers, hatchets, and small tools.

IV. Harness Repairing, Cleaning and Oiling abilities.

- A. Make harness sewing threads.
- B. Do all ordinary repair jobs such as sewing, and assembling ready made repair parts.
- C. Wash, oil, and assemble harness.
- D. Adjust or fit a set of harness to a horse.

V. Rope and Tackle Work abilities.

- A. Splice a hay rope.
- B. Tie useful knots.
- C. Make rope halters.
- D. Reeve a set of block and tackle.
- E. Select and care for rope.

VI. Hot and Cold Metal Work abilities.

- A. Drill holes in metals.
- B. Use hack saws, files, cold chisels, punches, metal drills, taps, and dies.
- C. Hot and cold bending and re-shaping iron rods, braces, etc.

VII. Soldering abilities.

- A. Tin soldering coppers.
- B. Solder, rivet and repair utensils.
- C. Make small appliances from light metals.

VIII. Electrical abilities.

- A. Repair electrical appliances.
- B. Understand principles of electricity.

IX. Miscellaneous abilities.

- A. Properly care for belts.
- B. Lace belts with rawhide and use metal belt fasteners.
- C. Appreciate a well equipped farm shop.
- D. Wisely select tools and equipment for a home farm shop.

## Objectives For Agricultural Engineering Instruction

### Major Objectives:

- I. Give the student training and develop confidence in unspecialized agricultural engineering jobs that the farmer may be called upon to do.
- II. Develop the proper attitude and ideals toward all phases of agricultural engineering.
- III. Develop an interest in keeping the farm home and buildings neat and attractive.
- IV. Instill pride in keeping the farm equipment well organized and in good repair.
- V. Develop in farm boys the desire to own and operate efficiently farm machinery and equipment.
- VI. Give a practical training in the purchase, use, and care of tools necessary for repairing and overhauling farm machinery and equipment.

### Contributory Objectives:

#### Abilities to be developed.

- I. Farm Machinery abilities.
  - A. Operate machinery commonly found on farms of the community.
  - B. Replace worn or broken parts.
  - C. Make proper adjustments when operating farm machinery.

- D. Purchase wisely such farm machinery as is necessary for replacement and successful operation of the home farm.
- E. Provide proper storage of farm implements and farm machinery.
- F. Overhaul machinery commonly needing overhauling.

## II. Farm Power abilities.

- A. Hitch horses to a plow and eliminate sidedraft.
- B. Clean spark plugs, remove carbon, and grind valves on tractor or gas engine.
- C. Adjust a tractor or gas engine when the occasion arises.
- D. Select the proper size tractor or motor for the job to be performed.
- E. Perform small jobs commonly necessary about the light system.
- F. Splice electrical wires when necessary.

## III. Farm Convenience abilities.

- A. Lighting.
  - 1. Estimate cost of installing electric lights.
  - 2. Select the type of farm lighting for a given situation.
  - 3. Install the wiring system.

4. Repair electrical appliances.

B. Water Supply.

1. Determine best source of water for farm.

2. Select plumbing.

3. Install and overhaul a pump.

4. Build a system or water storage plant.

C. Sewage Disposal.

1. Plan a sanitary means of disposing of  
sewage on the farm.

2. Make a plan for a cesspool.

3. Build a cesspool.

4. Plan a septic tank.

5. Plan a disposal of waste from kitchen.

D. Heating.

1. Decide upon the type of heating plant  
necessary for farm home.

2. Build a fire place.

3. Properly adjust heating plant.

E. Household Equipment.

1. Select conveniences for the farm home.

IV. Farm Construction abilities.

A. Buildings.

1. Interpret blue prints and plans.

2. Determine the available sources of plans  
for farm structures.

3. Draw plans for the most simple farm structures.

4. Estimate material necessary for the construction of farm buildings.

5. Construct small farm buildings.

B. Painting.

1. Select paint.

2. Apply paint to different kinds of surfaces.

3. Care for brushes.

C. Fences.

1. Determine type of fence to build.

2. Set and line fence posts.

3. Stretch and fasten wire.

4. Determine kind of farm gate to use.

5. Make and hang a farm gate.

D. Concreting.

1. Determine the kind of a mixture to use in various constructions.

2. Estimate materials needed.

3. Build forms.

4. Mix and pour concrete.

5. Remove forms and finish concrete.

V. Miscellaneous abilities.

A. Tools and Supplies.

1. Care of tools for farm repairs.

2. Select tools for farm use.

B. Drainage, Leveling and Surveying.

1. Level a timber.

2. Locate drainage ditches.

3. Locate irrigation ditches.

4. Construct borders for irrigating.

5. Lay out a field.

6. Level stakes for building foundation.

C. Explosives.

1. Determine the amount of explosives to  
use.

2. Blast out a stump.

3. Blast holes for trees.

4. Blast out irrigation ditch.

## CHAPTER IV

### A TWO YEAR FARM SHOP PROGRAM

The purpose of mechanical instruction is more than merely to develop skill, to impart a knowledge of tool processes and of materials, or to construct and repair articles that have an economic value. This course, like any other which has a place in the high school curriculum, should stimulate reflective thinking on the part of the student and aid him in developing the proper attitudes. On account of the natural interest which many boys have in working with tools, it is entirely possible to keep a group busy making things in shop without really learning through problem solving. The presentation of the work must be carefully planned, so that the students will be working with a definite purpose. Provision must be made for testing the result of each student's work, so that both he and the teacher may know the degree of his accomplishment. Further provision must be made to balance the course so that each student performs a wide variety of jobs, giving him a corresponding range of shop experiences.

Instead of setting aside a certain portion of the school year to be devoted to farm carpentry, another portion to harness repairing, another to soldering, etc., the teacher should,

in planning the course, prepare a list of jobs which will involve the development of the desired skills, the acquisition of the related information, the solving of the necessary problems, and indirectly through the variety of experiences, the development of the proper attitudes. The jobs must not be "set up" as exercises to be performed. The normal boy is not interested in doing things for which he sees no purpose. Fortunately there is a better method of teaching mechanical activities than the "exercise" one. The project method of shop teaching holds the interest of the student, and at the same time affords a maximum of teaching value.<sup>4</sup>

The project method allows each boy to tackle those jobs within the range of the development of his abilities. He can proceed systematically from the simple manipulation of the tools required for beginning construction to the more complex finished projects. This offers the boy an opportunity of correlating farm shop practices with farm problems. It necessitates on the part of the instructor a knowledge of the boys' farm problems. This carryover of skills learned in the school shop to farm practices is the consummation of the "ideals" set up by the modern school system.

A course in Farm Mechanics I for the Tucson Senior High School is based upon the analysis made in Chapter II. Here we can classify the "needs" under the following headings.

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4. Hutchison, C. S., Farm Shop and Agricultural Engineering, Department of Agricultural Education, Ohio State University, Columbus, Ohio, 1936, p. 7.

- I. Carpentry and Construction (wood).
- II. Farm Sketching and Drawing.
- III. Painting and Glazing.
- IV. Tool Fitting and Sharpening.
- V. Harness Repairing, Cleaning and Oiling.
  - A. Saddle repair.
  - B. Leather work.
- VI. Rope and Tackle work.
- VII. Simple Forging.
  - A. Hot metal work.
  - B. Cold metal work.
  - C. Welding.
- VIII. Soldering.
  - A. Tin and Copper.
  - B. Sheet Metal.
- IX. Farm Plumbing.
- X. Electricity and its Application to the Farm.
- XI. Planning the Farm Shop.
- XII. Miscellaneous Shop Activities.

For a course in Farm Mechanics II we have the following headings:

- I. Farm Buildings.
- II. Farm lighting.
  - A. Electricity.
    1. Power lines.
    2. Generating plants.

- III. Farm Water Supply.
  - A. Irrigating.
  - B. Home Use.
- IV. Sewage Disposal.
  - A. Septic tanks.
- V. Heating Plants and their Operation.
  - A. Fireplace.
- VI. Farm Fences.
- VII. Farm Machinery.
- VIII. Gasoline Engines.
- IX. Tractors.
- X. Power Transmission.
- XI. Farm Surveying and Leveling.
- XII. Irrigation Construction.
- XIII. Concrete Construction.
- XIV. Explosives.

Farm Mechanics I and II cover two years work-- approximately three hundred and sixty days. On the yearly basis the allotment of time is the main problem. Professor Louis M. Roehl, of the Department of Rural Engineering, Cornell University, after many years of teaching and studying farm shop work, made a careful estimate of the best distribution of the time for each type of work. This is based on double periods (ninety minute) available for

farm shop work.<sup>5</sup>

The time allotted for the various farm shop jobs has been modified somewhat to meet the needs of a farm shop program in the Tucson Senior High School.

TABLE V  
FARM MECHANICS I

	:Time Allotted in Days	
	: Ideal	: T.S.H.S.
1. Carpentry and Construction (Wood):	70	30
2. Farm Sketching and Drawing :	15	10
3. Painting and Glazing :	5	5
4. Tool Fitting and Sharpening :	10	5
5. Harness Repairing, Cleaning and :		
Oiling :	15	10
a. Saddle Care and Repair :		
b. Leather Work :		
6. Rope and Tackle Work :	10	5
7. Simple Forging :	15	10
a. Hot Metal Work :		
b. Cold Metal Work :		
c. Welding :		
8. Soldering :	10	5
a. Tin and Copper :		
b. Sheet Metal :		
9. Farm Plumbing :	10	5
10. Electricity on the Farm :	5	5
11. Planning the Farm Shop :	5	4
12. Miscellaneous Shop Practices :	10	6
Total :	180	100

Note--Farm Mechanics I will have to be worked in with Vocational Agriculture I and II. May actually have to cut time allotted to 90 days.

5. Hutchinson, C. S., Farm Shop and Agricultural Engineering, Department of Agricultural Education, Ohio State University, Columbus, Ohio, 1936, pp. 8-10.

TABLE VI  
FARM MECHANICS II

	:Time Allotted in Days	
	: Ideal	: T.S.H.S.
1. Farm Buildings	: 30	: 20
2. Farm Lighting	: 10	: 5
a. Electricity	:	:
1) Power lines	:	:
2) Generating plants	:	:
3. Farm Water Supply	: 10	: 5
a. Irrigating	:	:
b. Home Use	:	:
4. Sewage Disposal	: 5	: 3
a. Septic Tanks	:	:
5. Heating Plants and their Operations	: 5	: 2
a. Fireplace Construction	:	:
6. Farm Fences	: 5	: 3
7. Farm Machinery	: 50	: 25
8. Gasoline Engines	: 5	: 3
9. Tractors	: 10	: 5
10. Power Transmission	: 5	: 2
11. Farm Surveying and Leveling	: 10	: 5
12. Irrigation Construction	: 10	: 5
13. Concrete Construction	: 10	: 5
14. Explosives	: 2	: 2
15. Miscellaneous	: 8	: 0
Total	: 180	: 90

If within the next few years Tucson builds a vocational school with ample room the ideal time allotted plan will work in very advantageously. However, for the present and under cramped conditions approximately one half of the time required can be devoted to the farm shop program.

At least two rooms are required for the instruction of vocational agriculture--one room to be used for a class room and laboratory, while the second or larger room is provided for the teaching of farm shop and agricultural

engineering.

Separate rooms are necessary because one is needed for class and laboratory work and the other for repair and construction work in mechanical courses. Ample space is necessary for the storage of illustrative material, reference library, apparatus and equipment for the class room. The room should be equipped in such a way that practically any piece of farm machinery may be repaired and overhauled. The accomplishment of those objectives outlined in Chapter III depends upon the facilities and equipment available.

## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

This study deals with the needs for and types of training that should be given the farm youth in the area surrounding Tucson, Arizona. It appeared essential for an economical yet adequate farm shop set up to discover the "mechanical needs" of the ranchers in the community. The difficulties the farmer is struggling with today will be the ones the farmer of tomorrow will have to conquer. He must be prepared to keep up with the modernization and mechanization of the farm. In order to find a solution to this problem the following questions were asked of those ranchers interviewed.

1. What mechanical jobs have you done in connection with your work the last few years?
2. What do you consider to be the most important?
3. What jobs would you like to be able to do if you could?

#### General Conclusions

There is no specific need to draw lengthy conclusions from the above three questions. Neither is anything gained in trying to compare job needs as indicated in the study with other regions. It is perfectly obvious that a good foundation in the use of tools is absolutely

necessary in teaching vocational agriculture today.

The most amazing discovery in the entire study was revealed rather incidentally to the direct answering of the questions asked. Perhaps it also indicates to some extent a serious problem among our present rural people. Invariably they pointed out that most of the skills they possessed had been "picked up" here and there in their early days and without anyone teaching them or even lending a helping hand. Some possessing a certain amount of natural ability mechanically had done excellent work on their farms. The terse comment of one rancher to the effect that if he hadn't learned anything else in high school he surely wished he had been taught how to saw a board straight. Again and again the survey revealed the need of more practical instruction in the use of the simple tools.

It was rather difficult to draw any worth while conclusions relative to those jobs most important. The dairymen naturally stressed all phases of dairy industry. New type milking machines, coolers, et cetera caused them a good deal of worry. The mechanics of tractors, automobiles, gas engines and electric motors seemed to be troubling the rancher considerably. In the first place he wasn't equipped to do the work and secondly he hadn't the proper training--at least the majority were afraid to tackle these jobs.

It was interesting to find two ranchers who had literally taken "the bull by it's horns" and tackled the job seemingly beyond their ability. How pleased they were that their overhaul job had stood the test so much better than the garage man's. There are no doubt some mechanical jobs about tractors, automobiles, gas engines and farm motors that it would be neither practical nor economical for the rancher to attempt to do. However, the great majority of the ranchers, eighty two per cent in fact, wished they had the training necessary to do most of their repair jobs.

Most agricultural departments are today far from meeting the present and future needs of our farmers. Here is a real need that must be met for the future welfare of our farm people and incidentally the welfare of the nation.

#### Definite Conclusions Made from the Study

1. There is a need for a farm shop in the Tucson Senior High School.
2. The rural people are one hundred per cent behind such a program.

Changing agricultural conditions demand better trained farmers. The rapid increase in the mechanization and electrification of rural communities must not be overlooked by the vocational agricultural teacher.

### Recommendations

It is the duty of the high school to train boys in those vocations they desire to follow. It is also the duty of the high school to attempt to guide boys and endeavor to interest them in those vocations they should follow.

A room should be equipped in the Tucson Senior High School to provide for adequate instruction in farm mechanics to meet the needs of the community.

## BIBLIOGRAPHY

### A. Books

1. Cook, Scranton, McColly  
Farm Mechanics Text and Handbook.  
Interstate Printing Co., Danville, Illinois.  
(1935) pp. 9-11.
2. Field, Olson, Nylin  
Farm Mechanics.  
The Century Company, New York.  
(1928) pp. xix-385.
3. Robb and Behrends  
Farm Engineering.  
John Wiley and Sons, Inc., New York.  
(1924) xi-xvii.
4. Roehl, Louis M.  
The Farmer's Shop Book.  
The Bruce Publishing Company, Milwaukee, Wisconsin.  
(1923-24) pp. 9-429.
5. Roehl, Louis M.  
Fitting Farm Tools.  
The Bruce Publishing Company, Chicago.  
(1934) pp. 5-101.
6. Schmidt, Ross, Sharp  
Teaching Farm Shop Work and Farm Mechanics.  
The Century Vocational Series, New York.  
(1927) pp. 3-127.
7. Sharp, M. A. and Sharp, W. M.  
Principles of Farm Mechanics.  
John Wiley and Sons, Inc., New York.  
(1930) pp. 257-265.
8. Schaenzer, J. P.  
Rural Electrification.  
The Bruce Publishing Company, Milwaukee, Wisconsin.  
(1923-24) pp. 9-429.

## B. Bulletins

1. Hutchison, C. S.  
Farm Shop and Agricultural Engineering.  
Department of Agricultural Education.  
Ohio State University, Columbus, Ohio, (1936).
2. Klemmedson, L. D.  
A Suggestive List of Farm Shop and Farm Mechanics Jobs.  
State Department of Vocational Education,  
Phoenix, Arizona, (1927)
3. Miller, Halbert W.  
Job Instruction Chest for Farm Mechanics.  
State Department of Vocational Education,  
Phoenix, Arizona.
4. Walker, Clyde  
A Survey of Agricultural Engineering.  
Co-op Book Store, Corvallis, Oregon,  
(1936).

A P P E N D I X

## SURVEY IN FARM MECHANICS

1. Name of Farmer or Rancher \_\_\_\_\_.
2. Location \_\_\_\_\_.
3. Size \_\_\_\_\_ . 4. Kind of Farm or Ranch \_\_\_\_\_.
5. Owner or renter \_\_\_\_\_ . 6. Years on land \_\_\_\_\_.
7. Irrigated or non-irrigated \_\_\_\_\_.
8. Distance from town \_\_\_\_\_ . 9. Hours to go to town \_\_\_\_\_.
10. \_\_\_\_\_.
11. Has he the following in his farm home or ranch
  - (1) Pressure water system \_\_\_\_\_ . (3) Electricity \_\_\_\_\_.
  - (2) Sewage system \_\_\_\_\_ . (4) Gas \_\_\_\_\_.
  - (5) \_\_\_\_\_.
12. How many of the following things has he on his place
 

(1) Automobile	(9) Wagons
(2) Truck	(10) Harvest machinery
(3) Tractor	(11) Cultivating ma- chinery
(4) Gas engines	(12) Dairy machinery
(5) Electric motors	(13) Irrigating ma- chinery
(6) Farm shop	(14) Irrigating pump
(7) Implement shed	(15)
(8) Horses	(16)
13. Check once those things the farmer has done in the last few years in connection with his work, check twice those he says are the most important, and make a note of those he would like to do, if he could
 

(1) Making rough woodfarm appliances	(19) Riveting harness
(2) Making finished farm appliances	(20) Harness stitching
(3) Building rough buildings	(21) Rope splicing
(4) Building a house	(22) Belt lacing
(5) Painting	(23) Electric wiring
(6) Building fences	(24) Pipefitting
(7) Glazing	(25) Soldering
(8) Rough concrete work	(26) Installing shafting
(9) Finished concrete work	(27) Simple forging
(10) Free hand drawing	(28) Welding
(11) Farm drawing	(29) Tool grinding and sharpening
(12) Farm surveying	(30) Saw filing
(13) Land clearing	(31) Overhauling implements
(14) Land leveling and checking	(32) Operation, upkeep, and repairing automobile

## SURVEY IN FARM MECHANICS (Continued)

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|--|--|
| (15) Drainage                                  | (33) Operation, upkeep,<br>and repair of<br>tractors |
| (16) Irrigation construction                   | (34) Overhauling gas<br>engines                      |
| (17) Operation, upkeep, and<br>repair of pumps | (35) Babbiting bearings                              |
| (18)   | (36)   |
|  | (37)   |
|  | (38)   |

14. Do you believe a course teaching these jobs should be introduced in the Tucson Senior High School? 6
15. Comment:

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6. Schmidt, Ross, Sharp. Teaching Farm Shop Work and Mechanics, The Century Vocational Series, New York, 1927, p. 31.