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SUBSISTENCE ON THE SMALL FARM
With Special Reference to the Cumberland Plateau

By

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Harvesting subsistence wheat for family and livestock.

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SUBSISTENCE ON THE SMALL FARM

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INTRODUCTION

Subsistence Farming.—The problem of subsistence on small land units probably will always be a real one with thousands of Tennessee farmers. Farmers constitute 44 percent of Tennessee's population and farm an average of 45 acres of land available for crops. Little hope may be held for increasing the farm income materially on these small units without farm specialization, which in many cases is not possible. In addition to outside income, however, there is the possibility of improvement by reduction in the cost of living. Much emphasis is placed on the importance of raising the home food supply because of the national food emergency, and it appears from studies of living costs that the reduction of the food bill affords the outstanding possibility for improving the small-farm budget.

Questions Raised.—Attempted rehabilitation of large numbers of people on land after the depression that followed World War I focused attention on the matter of subsistence requirements. The problems raised may be listed as follows: (1) Number of acres required under local conditions; (2) practicalness of livestock farming; (3) dietary-change possibility—introduction of new foods; (4) relation between complete living on the land and physical status; (5) influence of previous experience on ability to live on the land. This bulletin is an attempt to answer some of these questions.

Location of Project.—The small-farm situation is typified by conditions on the Cumberland Plateau, where for many years the farms have averaged approximately 22 acres of cleared land (table 1). Less than 10 percent of the entire Plateau is cleared, and the availability of low-priced range land which under proper management could be made productive led to the establishment, in 1934, of the Cumberland Homesteads rehabilitation project, near Crossville. This emphasized the need in Tennessee, and particularly on the Plateau, for definite information pertaining to subsistence farming, and led to the establishment of the research project, "Home Production of Food Supplies," which was conducted at the Homesteads from 1936 to 1941, inclusive, and was later extended to native farmers in that vicinity.

The personnel of Cumberland Homesteads compared favorably with that of the rest of the Plateau, since the Homesteaders were drawn from the Plateau counties. The majority had had experience in coal mining, public works, lumber mills, or other small factories, as well as some contact with the farm. Their schooling averaged somewhat higher than the Plateau level for the same class.

TABLE 1—*Number and size of farms in four principal counties of the Plateau (1940 census), in comparison with Cumberland Homesteads.*

Item	Cumberland		Morgan		Fentress		Scott		Average 4 counties		Cumberland Homesteads
Number of farms.....	2,063		1,632		1,740		1,507		1,736		251
Acres per farm.....	62.5		60.6		60.5		40.7		56.1		35.3
Acres cropland ¹ per farm.....	24.6		22.4		24.0		17.1		22.0		20.0
Total acres available cropland.....	50,722		36,587		40,177		25,817		.....		.....
Classification by acreage divisions	Total	Harvested per farm	Total	Harvested per farm	Total	Harvested per farm	Total	Harvested per farm	Total	Harvested per farm	Total
	No.	Acres	No.	Acres	No.	Acres	No.	Acres	No.	Acres	No.
Under 10 acres.....	292	2.7	276	2.8	316	3.0	389	3.4	318	3.0	11
10-29 acres.....	628	7.3	397	6.7	491	7.8	479	7.6	499	7.4	127
30-50 acres.....	327	12.4	255	10.3	261	14.1	232	11.3	269	12.0	70
50-100 acres.....	474	18.7	419	15.0	332	20.7	264	15.1	372	17.4	34
Over 100 acres.....	346	38.0	285	27.0	340	20.9	143	21.8	279	26.9	9

Value of equipment by acreage divisions						
Under 10 acres.....	\$29.88	\$27.80	\$36.92	\$31.17	\$31.44	.....
10-29 acres.....	76.40	50.19	32.89	28.09	46.89	.....
30-50 acres.....	97.39	77.11	45.46	57.27	69.31	.....
50-100 acres.....	98.49	122.46	73.89	80.24	93.76	.....
Over 100 acres.....	233.43	218.38	121.02	144.42	179.31	.....

¹Includes acreage harvested, failed, idle, and plowable pasture.

The land selected for the development was typical of the Plateau area—uncleared range, low in productivity when first cleared, and requiring careful attention to erosion. Climatic conditions are similar over the entire Plateau and are well adapted to the home production of food supplies. The farms of the Homesteads closely approximated the Plateau farms in size, as indicated in table 1, and were well suited to the experimental project; all of them had been cleared from wild range and had a uniformity in farm productiveness which materially reduced experimental error.

Field experiments with fertilizers and liming for general farm crops were carried out for a number of years on Plateau soils prior to 1936, so that their special requirements were well known at the outset of the dietary studies.¹ Further information was desired, especially on the handling of new land, and much attention was directed to this subject, along with the dietary work. The information obtained properly belongs in a separate publication.

EXPERIMENTAL CONDITIONS

Number of Families Employed.—All Homesteaders were working on the construction phase of the Federal project at the time the experimental work was begun. Arrangements were made at the outset for the cooperation of 12 selected families. Others were brought in afterward, so that a total of 23 families were utilized during the period.

Dietaries.—Six diets, in duplicate, were based on low or high main food divisions—cereals, potato, soybean, meat, and vegetables (table 2). Milk allowance was unvaried among families, the attempt being made to furnish milk at the daily rate of one quart per child and one pint per adult. The soybean was relied on for an economical source of protein. Its full use could reduce materially the acres required for protein production through meats. The low garden referred to in the diet outline corresponds to the garden size recommended for the average farm, while the high garden is twice this size per family adult equivalent. The garden variation was prompted by the need to determine experimentally both the importance and the desirable size of the garden in the subsistence diet. Potatoes, sweetpotatoes, and dried beans were not included under the term. These items, though usually grown in the garden, are so different in make-up and are used in such quantities that they are considered separately.

The original plan of 6 diets in duplicate was changed to 4 diets in triplicate, beginning January 1, 1938 (table 3). This change was made primarily for reduction of error—naturally high in this type of experiment—and because, on the basis of experience in 1936 and 1937, a wider spread between the low and high food schedules was found desirable. Instead of several individual food intake levels

¹See Tennessee Experiment Station bulletins No. 101, *The Rational Improvement of Cumberland Plateau Soils*, and No. 141, *The Comparative Values of Different Phosphates*.

TABLE 2—Six dietary combinations, on basis of percentage caloric consumption and major food dominance, with garden and livestock sub-variables, applied in duplicate, 1936-1937.

Food Dominance	Potato—Soybean	Corn—Wheat	Diversified
Foods	Low garden and low livestock	Low garden and low livestock	Low garden and low livestock
	A-1	B-1	C-1
	Percent	Percent	Percent
Wheat.....	12}	20}	17}
Corn meal.....	8} 20%	13} 33%	11} 28%
Dairy.....	20	20	20
Potato.....	15}	10}	12}
Sweetpotato.....	6} 36%	5} 15%	5} 24%
Soybean.....	15}	—}	7}
Meat.....	12	20	16
Garden.....	2	2	2
Miscellaneous.....	10	10	10
	100	100	100
	High garden and low livestock	Low garden and high livestock	Low garden and high livestock
	A-2	B-2	C-2
	Percent	Percent	Percent
Wheat.....	14}	19}	15}
Corn meal.....	10} 24%	10} 29%	9} 24%
Dairy.....	20	20	20
Potato.....	15}	9}	12}
Sweetpotato.....	6} 34%	4} 13%	5} 25%
Soybean.....	13}	—}	8}
Meat.....	12	26	19
Garden.....	4	2	2
Miscellaneous.....	6	10	10
	100	100	100

indicated in the starting plan (table 2), a low and a high were established for each main food item. This schedule, carried through 1938 and 1939 with the same families, yielded the more reliable data. The calculated caloric requirements of the various families and individuals involved was used as a convenient approximation of the food quantities and acreages required. Scheduled dietaries also were based on this measure. For instance, the low-cereal families were to receive 20 percent and the high-cereal families 34 percent of their caloric intake from cereals (table 3). The dietary dominance is indicated in table 2. Two diets are dominated by potatoes, sweetpotatoes, and soybeans; two are dominated by corn and wheat and are typical of the high-cereal diet of the region; and two are diversified. The garden caloric supply may appear low, but Irish potatoes, sweetpotatoes, and dried beans were not included. This indicates that the large number of other garden items supply very few calories, the 2-percent garden being of average size.

For convenience in estimating required food amounts, the data in table 3, column 1, were included in the revised schedule. This also gives a relative caloric content of the main food divisions and

indicates that 8 pounds of soybeans as commonly consumed will supply 1 percent of the adult annual requirement, whereas it required 114 pounds of mixed garden produce to supply the same amount.

Adult Equivalent.—The adult equivalent was determined for the various individuals and families on the basis of caloric requirements—an adult man at moderate work being considered at 3000 calories per day.² Food quantities required were determined by the adult equivalent and dietary schedule in each case, the acreage and livestock amounts needed to supply this being based on average expected yields indicated in table 4. Extra-high yields of subsistence crops were not sought for, but would be practical on land longer cultivated.

TABLE 3—*Revised dietary schedule, involving four combinations, on the basis of percentage calorie consumption, applied in triplicate, 1938-1939.*

Chief food divisions	Pounds required per 1% per adult equivalent	Dietaries			
		No. 1	No. 2	No. 3	No. 4
		Family Numbers			
		16, 21, 22	15, 14, 19	17, 13, 20	18, 12, 23
		Percent of total diet	Percent of total diet	Percent of total diet	Percent of total diet
Cereals (wheat and corn).....	8	20	34	20	34
Potato.....	33	14	3	14	3
Soybean.....	6.6	10	—	—	10
Meat.....	6.3	20	30	30	20
Garden.....	114	2	2	4	4
Sweetpotato (constant).....	22.7	3	3	3	3
Milk (constant).....	40.3	20	20	20	20
Miscellaneous.....	6.9	11	8	9	6

Crops and Livestock.—The subsistence-crop acreage and livestock schedule for 1936 and 1937 is presented in table 5. The subsistence acreage as required by the various adult equivalents and dietary schedules varied from 3.36 to 13.39 acres, the division into the various crops being indicated. Corn acreage, for instance, varied from 1.23 acres, with no cow, small livestock schedule, large garden, and an adult equivalent of 3.4, to 5.10 acres, which involved the high corn and wheat schedule, including large livestock, low garden, and an adult equivalent of 5.9. Another adult equivalent of 5.9—family No. 16—required only 2.92 acres of corn under the potato-soybean dominance.

Feed for work stock was not planned on the original farms, it being considered more economical to hire horsepower on the small units—and work stock was available through a local cooperative. A later increase in size of farm units, however, required the maintenance of workstock.

²Growth and Development of the Child. The White House Conference on Child Health and Protection, Part III, Nutrition, 1932.

TABLE 4—Basic data pertaining to dietary, crops, and livestock; and average retail prices used in subsistence food study, 1936-1939.

Food	Retail price per pound	Yield per acre	Basic allowances
	Cents		
Wholewheat flour ¹	4	12 bu.	
White flour.....	4		
Corn meal ¹	3	30 bu.	1 bu. per hen, 15 bu. per cow, 12 bu. per pig
Prepared cereal.....	18		
Sweetpotato.....	3	125 bu.	
Irish potato ²	3	100 bu.	
Soybean.....	5	10 bu.	
All other vegetables.....	4	3600 lbs.	
All fruits.....	6		
Milk.....	4		1 qt. per day per child under 15, ½ qt. per adult
Butter.....	35		
Beef, miscellaneous.....	25		
Pork, miscellaneous.....	28		No sows kept. Young pigs bought @ \$5.00 per head
Lard.....	15		
Poultry.....	16		
Cheese.....	25		
Eggs.....	20		9 dozen per hen
Sugar.....	6		40 lbs. per adult equivalent
Sirup.....	10		50 lbs. sorghum per adult equivalent
Beverage.....	25		

¹Requirement based on 1/7 to 1.²Requirement based on 50% allowance for seed loss.

The cow was considered a necessity on all but one unit, this unit having less than 6 acres of crop land. One family was allowed 2 cows, but calves were not raised. Enough chickens were raised to produce the required number of laying hens annually. No sows were kept, and small pigs for meat supply were bought in the spring at \$5.00 per head.

No rotation of crops for the subsistence acreage was planned because of the topographical limitations. Two acres of clover and grass were seeded on 6 of the 12 farms for rotation with corn. On the remaining 6 farms, crimson clover was to be the cover crop following continuous corn and other crops. One acre per cow was planted to soybeans for hay, and an edible variety was planted separately for the family dietary. Wheat for family use was grown on each farm and a full crop of lespezeza was plowed under for the first seeding. Each slope area was seeded to one of 6 experimental mixtures of clover and grass. In addition to liming, all permanent seedings received 64 pounds of P_2O_5 per acre, or 400 pounds of 16-percent superphosphate.

Farm Condition and Equipment.—All farms included in the study were newly cleared, limed at the rate of 2 tons per acre, plowed, and given one discing when turned over to the various Homesteaders. The land was naturally in a rough state of preparation for cropping; and the farm tools possessed by the men created a problem in view of the fact that all of the original units were too small to afford adequate equipment for efficient work. In most cases the equipment consisted of a turning plow, row cultivator, bulltongue, a pitchfork or two, and a few hoes. Table 1 indicates the average Plateau farm of 30 to 50 acres to be similarly equipped at a valuation of \$69.31. The Cumberland Homesteads management attempted to make available tools and workstock through cooperative ownership, but the plan proved impracticable. To carry out the project on the basis of a reasonable level of farming, and to meet the requirements for experimental work with crops, the more expensive tools, including grain drill, cultipacker, power sprayer, weeder, and, later, a potato planter and digger, were supplied from an outside source. During 1937 and 1938 a team-hauled 4-row power sprayer was used on experimental work, and in 1939 a 6-row, tractor-mounted, specially designed sprayer was used, not only for experimental work, but for demonstration of the practical operation of a cooperative spray ring on approximately 65 acres of potatoes on 14 farms. Five cradles were purchased by the group for grain harvesting.

Adequate water for livestock and spray was insured by the construction of ponds on 6 of the farms (Fig. 1). It was found that the majority of farms in this region have one or more locations where year-round water may be made available. Earth dams proved adequate when the highly organic soil was first removed down to the rock, usually from 3 to 5 feet.

TABLE 5—*Crop and livestock schedule, 1936-1937.*

Family number	Dietary schedule	Size of farm	Suitable for experiments	Adult equivalent	Subsistence land	Corn	Clover and grass	Soybeans	Garden	White potatoes	Sweetpotatoes	Wheat	Pigs	Hens
		Acres	Acres		Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	No. & lbs.	No.
16	A-1	25.2	7.7	5.9	7.24	2.92	.....	1.00 (hay) .68 (seed)	.42	.77	.21	1.24	2 @ 192	31
11	A-1	14.2	1.7	3.9	7.44	2.25	2.00	1.00 (hay) .46 (seed)	.28	.51	.14	.80	1 @ 253	21
9	A-2	11.8	1.8	3.4	3.36	1.23	.....	.34 (seed) 2.00 (hay)	.42	.44	.12	.81	1 @ 220	16
12	A-2	30.6	5.6	5.9	13.39	3.68	4.00	.59 (seed)	.71	.77	.22	1.42	2 @ 192	34
15	B-1	21.6	3.5	5.3	7.98	4.18	.....	1.00 (hay)	.36	.46	.16	1.82	3 @ 191	43
7	B-1	20.8	4.0	4.8	9.32	3.75	2.00	1.00 (hay)	.32	.42	.18	1.65	2 @ 259	30
8	B-2	13.5	3.5	3.4	5.46	2.77	.....	1.00 (hay)	.24	.26	.08	1.11	2 @ 240	24
13	B-2	54.2	8.9	5.9	11.06	5.10	2.00	1.00 (hay) 1.00 (hay)	.42	.45	.14	1.95	4 @ 207	46
14	C-1	20.0	2.1	4.8	6.54	2.91	.....	.25 (seed) 1.00 (hay)	.35	.49	.14	1.40	2 @ 208	25
10	C-1	13.7	2.5	3.7	7.28	2.28	2.00	.20 (seed) 1.00 (hay)	.23	.38	.11	1.08	2 @ 160	19
6	C-2	23.4	5.5	6.0	8.53	4.31	.....	.38 (seed) 1.00 (hay)	.49	.62	.17	1.56	3 @ 205	48
5	C-2	39.0	5.7	4.0	8.00	2.88	2.00	.26 (seed)	.29	.41	.12	1.04	2 @ 205	27
	Total	288.0	52.5 ¹	57.0	95.60	38.26	14.00	12.00 (hay) 3.16 (seed)	4.53	5.98	1.79	15.88	26 5401	364
	Average	24.0	4.4	4.75	7.97	3.19	1.18	1.00 (hay) .26 (seed)	.38	.50	.15	1.32	2 208	30.3

¹51.35 acres in plot experiments, 1937.

Transportation of heavy tools between farms was facilitated by the use of a "tip-top" 2-wheeled trailer, illustrated in figure 2. The field experimental work, whether on the individual farms or elsewhere in connection with the project, was done cooperatively. The construction of a cooperative potato-storage building, which made possible the more efficient use of certain foods raised, was typical of the cooperative work done by the group.



Fig. 1—One of six ponds for supply of spray and stock water.

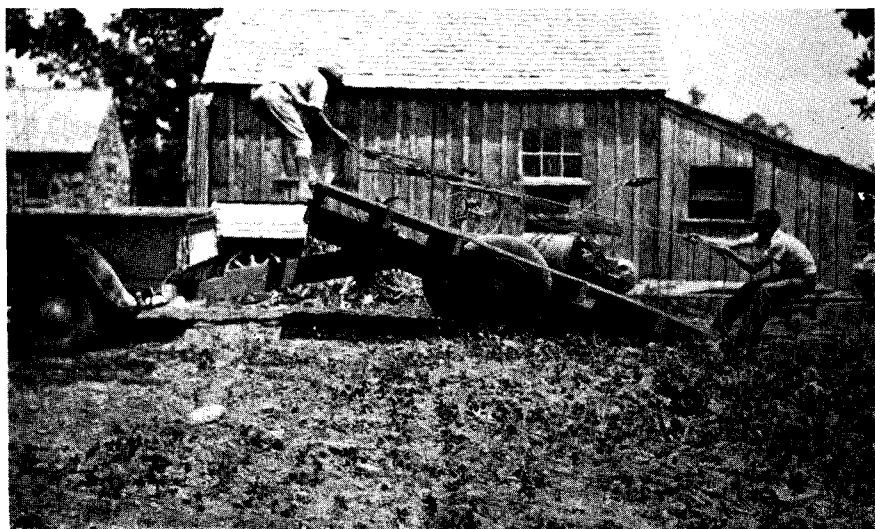


Fig. 2—Tip-Top trailer used in transporting tools between farms.

Records.—Accurate record keeping was demanded and was found to be obtainable through small extra compensation. A good platform scale with a capacity of 250 pounds was furnished each family for use in determining food consumption and child weights, as well as livestock feed consumption and crop yields on the farm.

The household record involved weights of all foods consumed, produced, bought, sold, and canned, as well as monthly weights of children, cost and income, and health records of each member of the family. A special record book was devised which met the requirements of both the farm and the family. It had extra-heavy covers and spaces large enough for easy entry of data.

The weekly method of recording food consumption was used as the most practical over a long period. The amount of each food consumed during the week was recorded Saturday night, a close estimate being possible through the use of the "bulk weight" feature. A quantity of a particular food, such as potatoes, flour, side of bacon, or sugar—more than enough for a week's consumption—was "weighed in" each Saturday night; and the difference between this and the following Saturday's weight was entered. For instance, family No. 16 started with 26 pounds of wholewheat flour on Saturday, March 6, as indicated in the Bulk Weight column. On March 13, the amount left was 20 pounds, showing 6 pounds consumed and to be entered for the week ending March 13 under wholewheat flour. The numerous garden items were weighed daily as they were brought in and were entered on a special garden chart on the kitchen wall. The totals of the daily weights were then entered in the record at the end of each week. The "try" amounts were indicated in the third column under each food heading. It is realized that at best only a good estimate of food consumption for any individual is obtained by this method, because of the unmeasurable elements of waste and individual differences in appetite. As a practical measure of the family food supply and consumption, however, it appears adequate and practical.

During 1940 and 1941, in addition to the weekly record of consumption, a cooperative study with the Rockefeller Foundation Nutrition Project, under the direction of Dr. J. B. Youmans, of Vanderbilt University, involved a more detailed individual record of food consumption wherein one or more 3-day food-consumption records per family were obtained by survey on a large number of families. Only the general diet features in this phase of the project are presented in this bulletin.

The farm record covered all farm items of cost, income, production, labor by crops, and enterprise costs of production. A check on family food consumption was made possible through the farm record. Regular home visits by staff members were made, for checking and assisting with record keeping.

Diet Control.—During 1936, no attempt was made to control the diet, this dietary record being considered a base. The cropping system was started during this period, but had little effect until

1937, particularly in the case of wheat. In 1937 a temporary food laboratory was constructed in an old school building, where new recipes were demonstrated and assistance was given toward diet changes (Fig. 3). This was particularly useful in connection with soybean consumption. Special assistance in food preparation and diet revision was given also in the homes as needed.

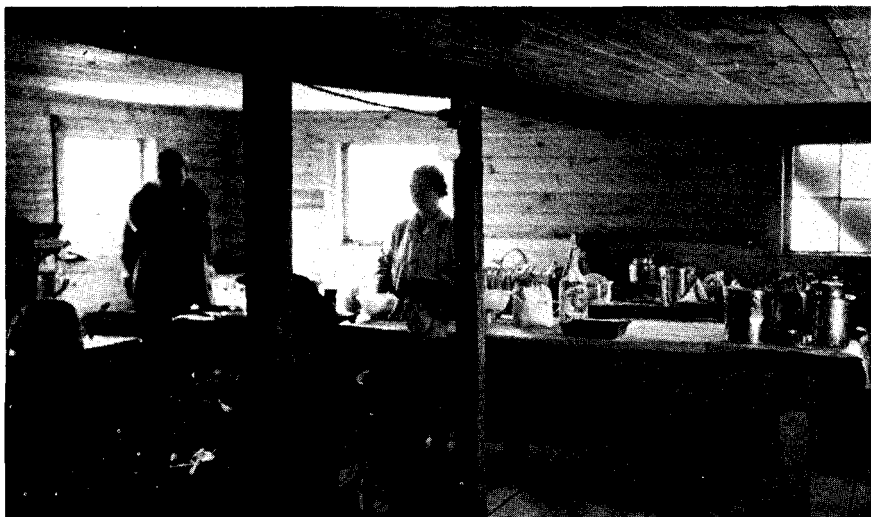


Fig. 3—Temporary kitchen in which the usefulness of new recipes was tested and demonstrated.

A special effort was made to popularize the soybean. A chief objection to its use in the family dietary was its association in the minds of the people with cow feed. Objections were largely overcome through the demonstration of soybean recipes at their best to the 8 housewives concerned each year, and by associating the soybean with "high society." Two well-advertised party dinners featuring the soybean in all practical menu forms were held, in which the local officials of the Farm Security Administration and school teachers participated, the ladies in formal attire. No more complaints were heard, by way of the grapevine, such as, "They're tryin' to make us eat soybeans, but they won't eat 'em themselves."

Educational Program.—An effort was made throughout to improve the details of farm and home management. Educational meetings were held in connection with meat curing, potato-pit storage, practical methods of making tomato juice, and other operations. Home beautification, with particular reference to the lawn, was undertaken with the object of creating interest in their newly acquired homes and thereby promoting continuity of record. All families were urged to exhibit garden produce at the local fairs; in 1938 they were required to exhibit at the Tennessee Valley Fair, to which free transportation was provided for the purpose of creating interest in their food-production efforts.

Physical Status.—General physical-status determinations, particularly of the children, were made by means of regular monthly weights, and records of medical expenditures, during the period 1936-1939. A more thorough study of physical status was made in the county-wide phase of the project during 1940 and 1941.

Major Difficulties.—No serious difficulty was experienced in effecting the desired changes in the operation of the farms. The original group of 12 families, selected at random, included 7 unwilling to meet the requirements of the experiment by the end of 1936. Their places were filled by families more carefully chosen with regard to trials of the diet revisions and the keeping of records. Six families were dropped at the end of 1937, and the revised group of 12 then continued through 1938 and 1939. Traditional diets were so deeply ingrained that major diet revision was found impracticable with the average random-selected family. There was no difficulty, however, in finding families sufficiently interested in making the necessary effort.

Background Influence.—It is believed that the background of the families had some bearing on their ability to learn to live on the land. The majority of the Homesteaders, besides having some experience on the farm, had been employed in the mines, small factories, sawmills, and public works; only a relatively small number had been operators of their own business for any considerable length of time. Table 6 presents the backgrounds of those used in the subsistence study and indicates that although 23 men and 20 women of the 25 families were born on the farm, only 4 could be considered as having had farm experience only. Those dropping out of the study at

TABLE 6—*Background of Homestead families used in subsistence study.*

Family No.	Education—Grade		Adult experience before 1935				Farm-reared	
	Father	Mother	Coal mining	Misc. employment	Full-time farming Years	Dates	Husb.	Wife
1	7	8	.....	1920-1931	20	1897-1917	Yes	Yes
2	4	7	1931-1932	.....	13	1918-1931	Yes	Yes
3	5	8	.....	1918-1933	.....	.....	Yes	Yes
4	6	6	1922-1927	1909-1922	.....	.....	No	Yes
5	12	11	.....	1927-1931	.....	.....	Yes	Yes
6	6	5	1912-1927	.....	7	1927-1934	Yes	Yes
7	6	6	1916-1932	.....	.....	.....	Yes	Yes
8	4	8	.....	.....	14	1920-1934	Yes	Yes
9	8	11	1925-1934	.....	.....	.....	No	No
10	8	8	1925-1934	.....	.....	.....	Yes	No
11	8	6	1923-1932	.....	.....	.....	Yes	Yes
12	2	5	1917-1931	.....	20	1897-1917	Yes	Yes
13	7	6	.....	.....	28	1906-1934	Yes	Yes
14	6	6	1924-1932	.....	8	1916-1924	Yes	Yes
15	8	8	.....	1925-1935	20	1905-1925	Yes	Yes
16	.....	5	22 yrs.	.....	.....	.....	Yes	No
17	8	8	.....	.....	15	1920-1935	Yes	Yes
18	7	7	.....	1924-1933	.....	.....	Yes	Yes
19	6	10	1917-1920	.....	10	1920-1930 1910-1917	Yes	Yes
20	5	5	.....	1918-1930	10	1931-1934	Yes	Yes
21	11	12	.....	4 yrs.	10	1921-1931	Yes	No
22	10	9	.....	.....	3	1928-1931	Yes	Yes
23	11	6	.....	1931-1934	3	1928-1931	Yes	Yes
24	8	10	.....	.....	20	.....	Yes	Yes
25	8	5	.....	1920-1934	.....	.....	No	No
Avg.	7	7	4 years	4 years	8	.....	22	20

TABLE 7—*Relationship of family background to persistence of effort in achieving subsistence on the small farm, 1936-1939.*

Item	Dropped after a year	Dropped after 2 years	Continued throughout experiment
Number of families.....	8	5	12
Average education—grade:			
Father	7th	7th	7th
Mother	8th	8th	7th
Number having mine experience.....	3	4	4
Average years in mine ¹	7	11	12
Number farm-reared.....	6	4	12
Average productive years on a farm ²	10	4	11
Number having factory or similar employment.....	5	0	5

¹Based on the number having worked in the mine.²Based on number having farm experience.

the end of the first and the second year because of unwillingness to try the diet requirements or record keeping, had the least full-time farm experience, as indicated in table 7. It may be significant that all those who made the most satisfactory effort were born on the farm and averaged the longest period as adult full-time farm operators. The number of families studied, however, was insufficient to warrant final conclusions in this regard.

The majority of those having experience in the mines were outspoken in their determination never to go back to that type of work. Generally, experience in the mines appeared to strengthen the effort to gain a living from the small farms.

TABLE 8—*Acrcage by soil classes of Homestead farms used in subsistence study, 1936-1939.*

Farm No.	Upland				Lowland			
	1 1-3% slope 24-30" depth	2 4-7% slope 16-24" depth	3 8-14% slope 12-18" depth	4 14% slope 12" or less depth	5 Craw- fishy	6 Seepy spots	7 True bottom	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
1	4.58	3.20	1.60	.32	.23	.17	.85	10.95
2	5.06	2.69	.91	.80	.....	.54	.23	10.23
3	4.80	.70	1.25	.25	.18	.10	.45	7.73
4	11.45	1.90	2.65	.60	1.20	.45	.62	18.87
5	5.75	14.4	9.3	6.8	.....	.40	.75	37.40
6	9.20	6.80	3.30	.....	.....	2.00	1.60	22.90
7	12.11	4.31	3.35	.10	.11	.11	.65	20.74
8	7.10	3.70	.60	.70	.....	.35	.35	11.80
9	3.92	2.89	3.13	.....	.....	.18	1.43	11.55
10	6.85	3.80	.85	1.60	.....	.....	.30	13.30
11	5.00	3.70	2.30	1.41	.53	.43	.55	13.92
12	11.85	7.60	5.00	1.52	.55	.10	3.20	29.77
13	11.05	14.68	12.75	14.00	.60	.....	1.20	54.28
14	3.75	5.60	5.4	2.3	.17	.....	1.00	18.22
15	1.6	10.50	4.80	2.60	.....	.....	.50	20.00
16	7.20	14.40	2.85	2.60	.....	.70	.10	27.85
17	4.80	15.20	8.0	26.40	.....	.....	1.60	56.00
18	3.84	13.20	3.60	6.40	.....	.....	.....	27.04
19	10.80	12.00	6.00	1.00	.....	1.0	2.84	33.64
20	6.0	8.4	6.8	5.4	.....	.....	.....	26.60
21	3.50	18.0	14.0	6.0	.....	.....	1.0	42.50
22	5.00	16.0	7.00	5.50	.....	.....	.80	33.00
23	3.60	14.60	14.00	13.80	.....	.....	3.00	49.00
24	3.35	1.97	1.47	1.73	.12	.15	.75	9.54
25	2.90	2.22	.95	.82	.08	.18	.....	7.15

Soil Survey.—A soil survey of the 12 original farms, all on new land, was made in 1936 by Messrs. J. W. Moon and L. R. A. Schoenman, officially in charge of soil surveying in the TVA area. The prevailing soil type was Hartsells fine sandy loam. A special classification, based largely on slope and depth, was found to be essential in view of the shallowness and rolling topography of the area.

The soil-class acreage of each farm is presented in table 8. Class-1 land varied approximately from 8 to 75 percent of the total farm acreages, 13 having 5 acres or less that was suitable for intensive row-cropping. All of the land in class 4 and about half that in class 3 was in timber or was so rough as to be unsuitable for cropping. The soil class acreage divisions are fairly representative of the Plateau region.

The production of subsistence crops on soil classes 2 and 3 proved generally practicable. All of the class-1 land on the units having 5 acres or less of this type, and most of that on the larger units, was used for plot experiments. A typical detailed farm plan based on the utilization of the various classes of soil is shown in figure 4. This plan proved indispensable in laying out the farm schedule. The impossibility of crop rotation is evident on the small units when a definite acreage of the various subsistence crops was required each year.

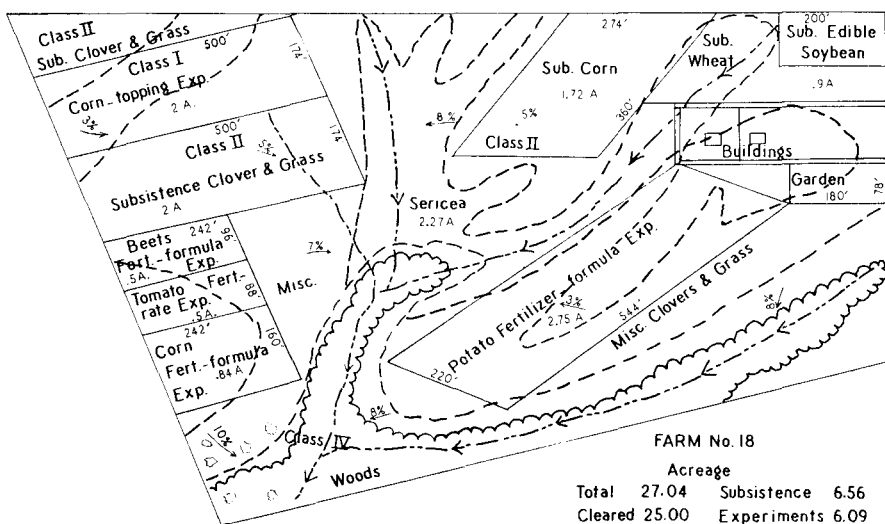


Fig. 4—Typical farm plan, indicating subsistence and experimental acreages and utilization of various slopes.

INVESTIGATIONAL FINDINGS

Local Diet Characteristics.—Complete records of uninfluenced dietaries were obtained on 10 families in 1936, 5 families in 1937, 144 families in 1940, and 83 families in 1941 (table 9). The traditional diet of the region was found to be extremely high in white

flour, lard, and eggs, and relatively high in miscellaneous cereals and milk, compared with the recommended dietary indicated in the same table.

The local diet was found low in vegetables, fruits, and beef, and relatively low in Irish potatoes. The very low tomato consumption of 59 pounds, compared with a recommended 125 pounds, in a region well adapted to the growing of this item, was of particular interest because of its special value in the diet as a source of vitamin C. The tomato therefore was given special attention in the home production of foods. The main obstacle to the use of more tomatoes was lack of information on methods of making them usable throughout the year. When special aid was given in practical ways of making tomato juice through the use of a specially adapted piece of equipment hitherto unknown to the families, they immediately became heavy users of tomatoes the year round. The practice was continued years after the withdrawal of outside influence.

Even though the average diet was relatively low in Irish potatoes, the consumption of this item was found to be four times greater than that of sweetpotatoes. Inadequate curing and storage facilities locally accounted for the limited consumption of sweetpotatoes.

Contrary to popular belief, very little pork was consumed in the region. Lard, however, was used to extremes in many instances. One check, or uncontrolled, family on the Homesteads consumed 78 pounds of lard per adult equivalent during 1938. Many families throughout the county averaged this amount; an 8-pound bucket of lard and a 24-pound sack of white flour being a weekly purchase. The use of a large amount of lard in connection with white flour in biscuits and white gravy was found to be a firmly established dietary practice. The great majority of poorer families throughout the region did not raise hogs as a rule, but bought fat meat and lard and very little lean meat of any kind, particularly beef. Animal protein was furnished by the high consumption of milk, eggs, and poultry. The 242 uninfluenced families annually consumed 289 pounds of milk per adult equivalent more than was considered necessary for health. Beef consumption was higher on the Homesteads, where all families were well employed at the time of the study, but averaged less than half the recommended beef consumption of 25 pounds per adult equivalent.

An outstanding feature of the uninfluenced local diet was the high calorie intake. By comparison with the recommended daily intake of 3000 calories per moderately active adult equivalent, the uninfluenced groups averaged 3734, 4067, 3834, and 3965, during 1936, 1938, 1940, and 1941, respectively (table 13). This is a natural result of the characteristically high cereal and lard intake.

Dietary-Acreage Relationship.—The dietary-acreage relationship of the revised dietaries maintained by the same families through 1938 and 1939 is presented in table 10. It may be seen that although there were wide differences in the food schedules, the

TABLE 9—Average uninfluenced consumption of principal food items per annum per adult equivalent — Cumberland Homesteads and Cumberland County, 1936-1941.

Food	Uncontrolled dietaries						Homesteads and county average	A recommend- ed dietary ¹
	Homesteads			County				
	1936	1938	Average	1940	1941	Average		
	10 families	5 families		144 families	83 families			
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
White flour.....	173	152	163	170	173	171	167	120
Whole W. flour.....	0	0	0	.2	0			
Bought bread & cereals.....	24	67	46	14	28	21	34	25
Corn meal.....	119	110	115	160	131	146	131	120
Total cereals.....	316	329	323	344	332	338	331	265
Irish potato.....	180	192	186	179	289	234	210	250
Tomato.....	84	65	75	56	28	42	59	125
Misc. vegetables.....	245	186	216	161	151	156	186	250
Fruits.....	103	132	118	110	220	165	142	220
Milk.....	826	982	904	599	827	713	809	520
Pork.....	56	44	50	51	43	47	49	45
Lard.....	52	55	54	48	42	45	50	25
Beef.....	13	9	11	0	0	0	0.7	25
Poultry.....	15	30	23	11	12	12	18	20
Eggs.....	57	49	53	39	36	38	46	20
Sugar and sirup.....	82	72	77	60	69	65	71	72

¹TRA-16 Manual For Home Management Plan, Home Economics Dept., Univ. of Tenn.

TABLE 10—*Subsistence acreage per adult equivalent by dietaries, 1938 and 1939.*

Food	Dietaries			
	1	2	3	4
	Acres	Acres	Acres	Acres
Corn.....	.038	.066	.038	.066
Edible soybeans.....	.110			.110
Garden.....	.064	.064	.128	.128
Irish potato.....	.115	.025	.115	.025
Sweetpotato.....	.010	.010	.010	.010
Wheat.....	.156	.264	.156	.264
Total per adult equivalent.....	.493	.429	.447	.603
Corn land for meat and poultry.....	.300	.410	.480	.294
Total variable acreage per adult equivalent.....	.793	.839	.927	.897
Acreage for average family, 4.48 adult equivalent, 1938, exclusive of cows and workstock.....	3.55	3.76	4.15	4.02
Acreage for one cow—2 acres clover and grass, 1 acre soybeans, ½ acre corn.....	3.50	3.50	3.50	3.50
Total required for average family.....	7.05	7.26	7.65	7.52

acreage differences required were relatively insignificant. In 3 of the 4 diets, less than half an acre per adult equivalent was required for the production of food used directly from the land. The varying meat schedules required additional row-crop land from .29 to .48 acre per adult equivalent, making a total of less than an acre in any case, exclusive of cow and workstock. The experimentally established land requirement for the average family adult equivalent of 4.48 in 1938 varied by diets from 3.55 to 4.15 acres, exclusive of cow and workstock. The minimum allotments for the cow of 2 acres of cultivated pasture, 1 acre of soybean hay, and ½ acre of corn, established total acreages required by the 1938 average family varying by diets from 7.05 to 7.65 acres. The calculated acreages required by the 1938 families having average adult equivalents varying from 2.6 to 7.2, was 3.85 to 14.28 acres—2 cows being allowed for the largest family.

Evaluation of Dietary Conformity.—All of the established dietaries were above the borderline in adequacy, and a definite departure from the traditional food habits was required in each case. Three points of special interest were involved in this connection—the expected benefit to the family health, the practicability of dietary change, and the fixation of such change. Perhaps nowhere are food habits more strongly entrenched than in such a region as the Plateau, where the rural families have not been subjected to enforced diet changes, because of absence of migratory movements and a high degree of isolation. The strong objections were met in this phase of the study, but significant changes were effected nevertheless. As one cooperator put it, "I like everything but the di't'ry." Even this individual admitted, some years after his family was dropped from the study, that he made a mistake in not putting forth the necessary effort. Incidentally, this family, number 6, having an adult equivalent of 6, habitually consumed an average of 4 pounds of white flour per day.

Dietary change throughout 1936 and 1937 was measurable on only the 6 families furnishing complete records for the first half of

TABLE 11—*Adjustment of influenced dietaries to established dietary types, per adult equivalent, 1938-1939.*

	12 influenced dietaries 1938-1939								5 Uninflu- enced dietaries 1938
Diet number.....	1 Low		2 High		3 Low		4 High		
Cereals ¹	Low		Low		High		Low		
Potato.....	High		None		None		High		
Soybean.....	High		High		High		Low		
Meat ¹	Low		Low		High		High		
Garden.....	Low		Low		High		High		
	Estb.	Con.	Estb.	Con.	Estb.	Con.	Estb.	Con.	Consumed
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Cereals ¹	160	203	272	276	160	178	272	254	329
Potato.....	462	301	100	108	462	348	100	129	192
Soybean.....	66	29	0	0	0	0	66	24	None
Meat ²	126	100	198	112	198	90	126	98	132
Garden.....	228	301	228	248	456	233	456	391	251
Milk.....	806	926	806	848	806	907	806	1201	982
Lard.....	25	33	38	38	38	34	25	31	55
Fruit.....	20	119	20	120	20	90	20	174	132

¹Includes flour, bread, corn meal, and miscellaneous cereals.²Includes beef, pork, poultry, and eggs.

each year on the original dietary schedules. In general, all established diets were devised to reduce the consumption of white flour and lard and increase the consumption of potatoes, tomatoes, miscellaneous vegetables, and soybeans where scheduled. Measurable changes were made in the right direction in the majority of food items by the 6 families affording a comparison. Only 1 family, No. 11, made a positive change in every item, and No. 12 effected a positive change in every item but one. The latter family was the only one to continue throughout the 4 years of study. None of the families had used wholewheat flour previous to 1936, but all of them began using it. Four of the 6 reduced the consumption of white flour, but not significantly. The 4 on the soybean schedule began the use of this item in insignificant amounts. Five families appreciably increased the consumption of potatoes, and all families made a favorable change by reducing lard consumption. The reductions in white flour and lard consumption were a definite step toward subsistence on land, since white flour must be purchased and a large amount of lard cannot be economically raised on the subsistence farm.

Adjustment of Dietaries to Established Quantities.—Adjustment to the established dietaries in quantities consumed during 1938 and 1939 is indicated in table 11, the 5 uninfluenced dietaries in 1938 being considered as a check. It may be noted that this check group was in close conformity to the other uninfluenced groups (table 9) and may be considered reasonably reliable for the purpose. Each of the 4 dietaries was in triplicate during the 1938-39 period and no change in families took place. The 5 main food divisions—cereals, Irish potato, soybean, meat, and garden—which received emphasis in attempted changes are listed with the corresponding high or low position in each of the 4 dietaries.

The low and high cereal levels were established at 160 and 272 pounds per adult equivalent, respectively, the recommended cereal consumption being 265 pounds. The check families consumed 329 pounds in 1938, and 227 uninfluenced families during 1940 and 1941 consumed 338 pounds per adult equivalent. The 3 families on each of the low cereal diets, 1 and 3, consumed 203 and 178 pounds per adult equivalent, respectively, while the families on the high cereal diets, 2 and 4, consumed 276 and 254 pounds per adult equivalent, indicating a definite control influence.

The low cereal diets were balanced by a high potato allotment of 462 pounds per adult equivalent in diets 1 and 3, while 100 pounds of potatoes were allotted in the low potato diets. Actual potato consumption was 301 and 348 pounds in the high potato diets, and 108 and 129 pounds in the low. The check families consumed 203 pounds of potatoes per adult equivalent, and the recommended dietary specified 250 pounds.

All families on the soybean schedule consumed a considerable quantity of this food, which was entirely new to them, but the amount consumed was less than half the allotted amount in each of

the 2 diets containing soybeans. One family consumed 35 pounds per adult equivalent, and this amount appeared to be the practical limit under local conditions.

The meat division, including beef, pork, poultry, and eggs, was little influenced in consumption by the dietary schedules. The allotments of these total materials varied from 126 to 198 pounds per adult equivalent, but the limited spread in consumption from 90 to 112 pounds occurred. The bulk of the consumption in this division was eggs, and departure from this customary practice was found difficult. The check families average 139 pounds per adult equivalent, and the recommended amounts in the meat division of 110 pounds very closely approximated the actual consumption record, although a larger proportion of beef is advised than was consumed locally.

The low garden schedule was met fairly well by the families concerned during 1938-39, but only 3 families on the high garden schedules approached the established requirements. Not only was it found impracticable to maintain vegetable consumption in line with different amounts raised on the high and low garden schedules, but the corresponding difference in the amounts canned from these gardens had little effect. Table 19 indicates the wide difference in amounts raised on the respective garden schedules and also the corresponding difference in the amounts canned from the gardens. It must be remembered that every effort was made not only to have the families produce the scheduled amounts of garden produce but to consume them. Of the total list of vegetables, the consumption of potatoes and tomatoes was materially influenced by control, these items having received separate attention.

The consumption of milk was difficult to govern, and reached the high of 1201 pounds per adult equivalent as an average of the 3 families on diet 4. In all cases, milk consumption averaged higher than the allotted amount of 1 quart per child and 1 pint per adult per day. It was found that very few rural families made butter or cottage cheese, and the milk allotment included the equivalent of the average recommended amounts of these items. With the exception of 1940, the average milk consumption recorded by uninfluenced families during the period 1936-1941 (table 9) was considerably above the amounts needed for adequacy. This high milk consumption more than supplied the necessary amino acids, and in this regard made up for the lack of lean meat.

It was shown in table 9 that lard consumption was habitually about twice the amount considered necessary, the 1938 check families consuming an average of 55 pounds per adult equivalent. An attempt was made to reduce lard consumption to the amount furnished by the allotted home-produced pork. This was closely approximated by the amounts consumed during 1938 and 1939, which ranged from 31 to 38 pounds per adult equivalent per year. It was assumed that reducing the lard consumption was going to be the most difficult change attempted, but all families of the constant group during 1938-1939 made a favorable change in this respect.

TABLE 12—Quantities of foods consumed per adult equivalent by dietaries, and comparison with established amounts by calorie groups, twelve families, 1939.

Food	Diet 1				Diet 2				Diet 3				Diet 4			
	Low Cereal, meat, and garden		High Potato and soybean		Low Potato, soybean, and garden		High Cereal and meat		Low Cereal and soybean		High Potato, meat, and garden		Low Potato and meat		High Cereal, soybean, and garden	
	Consumed		Calories		Consumed		Calories		Consumed		Calories		Consumed		Calories	
	Wt.	Calories	Con- sumed	Estab- lished	Wt.	Calories	Con- sumed	Estab- lished	Wt.	Calories	Con- sumed	Estab- lished	Wt.	Calories	Con- sumed	Estab- lished
	Lbs.	Number	Pct.	Pct.	Lbs.	Number	Pct.	Pct.	Lbs.	Number	Pct.	Pct.	Lbs.	Number	Pct.	Pct.
White flour.....	120	.....	.....	.....	131	.....	.....	.....	92	.....	.....	.....	115	.....	.....	.....
Corn meal.....	77	.....	.....	.....	113	.....	.....	.....	65	.....	.....	.....	90	.....	.....	.....
Bought bread.....	5	.....	.....	.....	15	.....	.....	.....	6	.....	.....	.....	21	.....	.....	.....
Misc. cereals.....	10	.....	.....	.....	12	.....	.....	.....	5	.....	.....	.....	13	.....	.....	.....
Total cereals.....	212	340,800	26	20	272	435,200	36	34	169	270,400	24	20	239	382,400	28	34
Irish potatoes.....	309	117,420	10	14	105	39,900	3	3	345	131,000	12	14	110	41,800	3	3
Misc. vegetables.....	281	30,910	2.5	2	211	23,210	1.91	2	206	22,660	1.99	4	309	38,990	2.48	4
Fruits.....	130	26,000	2	.....	110	22,000	2	.....	114	22,800	2	.....	202	40,400	3	.....
Milk.....	955	296,050	23	20	892	276,520	23	20	1017	315,270	28	20	1393	431,830	31	20
Soybeans.....	32	60,480	5	10	.....	.....	.....	.....	.....	.....	.....	.....	22	41,580	3	10
Beef.....	1	500	22	20	1	500	24	30	1	500	23	30	2	1,000	19	20
Pork.....	52	104,000			48	96,000			54	108,000			46	92,000		
Lard.....	36	151,200			38	159,600			32	134,400			30	126,000		
Poultry.....	15	10,500			13	9,100			9	6,300			11	7,700		
Eggs.....	39	26,130	.....	.....	42	28,140	.....	.....	32	21,440	.....	.....	48	32,160	.....	.....
Sugar & sirup.....	71	127,800	10	6	69	124,200	10	6	57	102,600	9	6	73	131,400	9	6
Miscellaneous.....	9	9,000	.....	8	7	7,000	.....	5	4	4,000	.....	6	12	12,000	1.52	3
Total.....	.....	1,300,790	.....	.....	.....	1,221,370	.....	.....	.....	1,139,470	.....	.....	.....	1,374,260	.....	.....

TABLE 13—Average daily intake of specific nutrients per adult equivalent as obtained by weekly recordings of uninfluenced and influenced family food consumption with standard requirements,¹ 1936-1941.

Item	Uninfluenced diets					Influenced diets	Standard requirement, based on average family having 2 children from 1 to 6 yrs. of age, and 2 from 7 to 12 yrs. (total adult equivalent 4.16) ² .
	Homesteads		County		Average	Homesteads	
Years.....	1936	1938	1940	1941		1939	
No. families.....	10	5	143	83		12	
Calories.....	3734	4067	3834	3965	3900	3398	3000
Carbohydrates (grams).....	533	555	579	600	567	471	385
Fats (grams).....	127	79	118	104	107	118	117
Proteins (grams).....	113	129	114	123	120	113	84
Calcium (grams).....	2.64	1.81	1.27	1.66	1.85	1.75	1.35
Phosphorus (grams).....	2.02	2.39	2.01	2.31	2.18	2.22	1.60
Iron (grams).....	.02	.02	.02	.02	.02	.02	.01
A ¹ I. U.....	6056	5854	4629	5009	5387	6549	5400.
B ¹² (mg.) ⁴	3.66	4.88	3.50	4.56	4.15	4.85	1.66
C ¹ (mg.).....	135	138	114	123	127	155	88.0
D ³ (I. U.).....	14	13	11	10	12	11	(c)
G ¹ (I. U.).....	744	795	571	718	707	933	

Sources of vitamin data:

¹A—Laboratory Handbook for Dietetics, Mary Swartz Rose.

²B₁—Chemistry of food and nutrition, Sherman.

³D—Food values of portions commonly used, Bowes and Church.

⁴Vitamin B₁ for soybean taken from Bowes and Church.

⁵Committee on Foods and Nutrition, National Research Council.

⁶Requirement data uncertain.

With the exception of Irish potatoes, the change of greatest value was made in lard consumption. Stress was laid on the greater use of butter in cooking, since this commodity was available to all families having cows, and the general excess of milk production throughout most of the lactation periods afforded the possibility of substituting a home-produced item for a purchased item and accounted for considerable lard reduction and consequent reduction in cost of food purchased.

The fruit supply of the families on the small newly cleared land units depended in large measure on purchases, the only practical small fruits being blackberries and strawberries. In this connection the increased use of tomatoes was designed primarily to replace oranges, a fruit necessarily purchased and habitually used to a considerable extent by the local element. It was found, however, that with blackberries, which thrived locally, and with limited purchases of apples and peaches for canning, the fruit consumption was considerably higher than the allotment, ranging from 90 to 174 pounds per adult equivalent during 1938-1939, while the uninfluenced families used an average of 132 pounds. The recommended dietary calls for 220 pounds of fruit. The usual fruit-canning methods require the purchase of sugar or sirup, and were not in keeping with complete living off the land. Dehydration of fruits, therefore, was desirable from the standpoint of subsistence and was practiced to some extent by many of the families.

Food Consumption by Calorie Groups.—The proportionate caloric intake from the various foods during 1939 under the second year's control of the same families is presented in table 12. Here it may be noted that cereals and milk were the high sources of calories, although in the recommended diet milk would furnish a smaller proportion. In general the source of calories was influenced by control, particularly in the case of cereals, potatoes, and soybeans. The families on diets 1 and 3, low cereal, received 26 and 24 percent respectively of their calories from cereals, while the families on the high cereal diets, 2 and 4, received 26 and 28 percent of their calories from the cereals. The high potato diets, 1 and 3, were established to furnish 14 percent of the calories from this source, and the families on these diets reached 10 and 12 percent of their caloric consumption from potatoes. The low potato diets, 2 and 4, designed to furnish 3 percent, were exactly met by the families on these diets. The latter schedule closely approximates the average consumption of potatoes in the Plateau region and the South. The 14-percent level has been attained elsewhere and was not considered an impossible schedule. All diet groups in 1939 were high in total caloric intake. This was characteristic of local diets throughout the entire period of the study and was difficult to change.

Daily Intake of Specific Nutrients.—The daily specific nutrient intake for uninfluenced and influenced family diets, compared with the standard requirements during the period 1936-1941, is presented in table 13. Not only has the caloric intake averaged higher

TABLE 14—Quantities of food consumed and purchased per adult equivalent, uninfluenced and influenced families, 1936-1939.

Foods	1936		1937		1938				1939	
	6 families ¹ uninfluenced		6 families ¹ influenced		5 check families uninfluenced		12 families influenced		12 families influenced	
	Con- sumed	Pur- chased	Con- sumed	Pur- chased	Con- sumed	Pur- chased	Con- sumed	Pur- chased	Con- sumed	Pur- chased
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Wholewheat flour.....	0	0	42	16	0	0	24	15	9	9
White flour.....	179	179	137	113	152	152	94	74	112	64
Corn meal.....	131	73	100	44	110	42	92	23	87	0
Bought bread.....	17	17	7	7	41	41	9	9	12	12
Miscellaneous cereals.....	25	25	16	16	26	26	13	12	11	11
Total cereals.....	352	294	302	196	329	261	232	133	222	87
Irish potato.....	179	8	255	0	192	24	233	9	219	0
Soybean.....	4	0	12	0	0	0	11	2	13	0
Sweetpotato.....	68	0	56	0	41	1	66	2	66	2
Tomato.....	80	21	71	1	65	6	95	2	79	0
Dried beans.....	21	15	12	8	17	16	8	7	8	6
Miscellaneous vegetables.....	170	20	135	13	145	25	156	5	172	5
Fruit.....	62	33	78	48	132	132	109	88	141	106
Milk.....	932	18	879	43	982	101	869	15	918	0
Beef.....	10	9	6	6	9	9	1	1	2	2
Pork.....	57	20	50	11	44	26	47	8	53	6
Lard.....	58	44	40	32	55	54	34	17	34	21
Poultry.....	9	1	12	1	30	7	11	11	12	0
Eggs.....	54	2	44	4	49	13	37	1	41	0
Sugar and sirup.....	88	85	63	57	72	72	62	46	70	57
Total (exclusive of milk).....	1212	552	1136	377	1180	646	1102	332	1132	292

¹The same families in 1936 and 1937; yearly consumption based on period January-June.

than required, but all nutrients with the exception of fats and vitamin A have consistently been above standard requirements as found by the weekly method throughout the year. The more detailed study of intake based on a single 3-day intake sample indicated a shortage in B₁, B₂, and C. It is realized that there is considerable error in the records obtained by the weekly method throughout the year in the impossibility of accurately measuring waste, but, allowing for a high waste figure, it would appear that the individuals of this region receive an adequate average daily nutrient intake based on the yearly consumption of food. The average daily protein intake, ranging from 113 to 129 grams, compared with the standard requirement of 84 grams, is particularly interesting in view of the low consumption of lean meat, the protein source being largely milk and dried beans. The high thiamin intake was accounted for by the high consumption not only of milk, eggs, and dried beans, but of peas, turnip greens, and corn meal as well. It would appear also that the vitamin-C intake was considerably more than was required, the uninfluenced diets showing a consumption 50 percent higher than the standard daily requirement of 88 milligrams. In determining the intake of vitamin C, the low-range values for the various foods were used.

Proportions of Foods Consumed and Purchased.—A significant effect of the control program of food production is shown in table 14, where the proportionate amount of home-produced food was increased appreciably. Corn meal consumption was reduced from 131 pounds per adult equivalent in 1936 to 87 pounds in 1939, and the corn meal purchases were reduced from 73 pounds in 1936 to none in 1939. The check families in 1938 purchased approximately 40 percent of the corn meal consumed. The low wheat yields on new lands, and losses in curing and threshing, resulted in the necessity for purchasing 74 and 64 pounds of white flour per adult equivalent during 1938 and 1939 respectively; but this compared with 179 and 152 pounds purchased by uninfluenced families during 1936 and 1938. The uninfluenced families purchased a total of 294 pounds of cereal foods per adult equivalent in 1936, and 261 pounds in 1938; whereas, the influenced families during 1937, 1938, and 1939 purchased 196, 133, and 87 pounds respectively.

The uninfluenced families in 1936 home-produced, essentially, only sweetpotatoes, poultry meat, and eggs; and in 1938 only sweetpotatoes. The 12 influenced families in 1938, half of whom were new at the beginning of the year, essentially home-produced all of the sweetpotatoes, tomatoes, miscellaneous vegetables, milk, and eggs; and the same families continuing through 1939 home-produced their corn meal, Irish potatoes, sweetpotatoes, tomatoes, miscellaneous vegetables, milk, poultry meat, and eggs. The totals for food consumed per adult equivalent, exclusive of milk, varied within the narrow range of 1102 to 1212 pounds; but the 1938 uninfluenced and influenced total amounts purchased were 646 and 332 pounds respectively, and the 1939 influenced families purchased a low of

TABLE 15—Costs of food consumed and purchased per adult equivalent, uninfluenced and influenced families, 1936-1939.

Foods	1936		1937		1938				1939		1936-1939			
	6 families ¹ uninfluenced		6 families ¹ influenced		5 check families uninfluenced		12 families influenced		12 families influenced		Average			
	Con- sumed \$ 0	Pur- chased \$ 0	Con- sumed \$ 1.68	Pur- chased \$.64	Con- sumed \$ 0	Pur- chased \$ 0	Con- sumed \$.96	Pur- chased \$.60	Con- sumed \$ 0	Pur- chased \$ 0	Uninfluenced Con- sumed \$ 0	Uninfluenced Pur- chased \$ 0	Influenced Con- sumed \$.88	Influenced Pur- chased \$.41
Wholewheat flour.....	7.16	7.16	5.48	4.52	6.08	6.08	3.76	2.96	4.48	2.56	6.62	6.62	4.57	3.35
White flour.....	3.93	2.19	3.00	1.32	3.30	1.26	2.76	.69	2.61	0	3.62	1.73	2.79	.67
Corn meal.....	1.70	1.70	.70	.70	4.10	4.10	.90	.90	1.20	1.20	2.90	2.90	.93	.93
Bought bread.....	4.50	4.50	2.88	2.88	4.68	4.68	2.34	2.16	1.98	1.98	4.59	4.59	2.40	2.34
Miscellaneous cereals.....														
Total cereals.....	17.29	15.55	13.74	10.06	18.16	16.12	10.72	7.31	10.27	5.74	17.73	15.84	11.57	7.70
Irish potato.....	5.37	.24	7.65	0	5.76	.72	6.99	.27	6.57	0	5.57	.48	7.07	.09
Soybean.....	.20	0	.60	0	0	0	.55	.10	.65	0	.10	0	.60	.03
Sweetpotato.....	2.72	0	2.24	0	1.64	.04	2.64	.08	2.64	.08	2.18	.02	2.31	.05
Tomato.....	3.20	.84	2.84	.04	2.60	.24	3.80	.08	3.16	0	2.90	.54	3.27	.04
Dried beans.....	1.05	.75	.60	.40	.85	.80	.40	.35	.40	.30	.95	.78	.47	.35
Miscellaneous vegetables.....	6.80	.80	5.40	.52	5.80	1.00	6.24	.20	6.88	.20	6.30	.90	6.17	.31
Fruit.....	3.72	1.98	4.68	2.88	7.92	7.92	6.54	5.28	8.46	6.36	5.82	4.95	6.56	4.84
Milk.....	37.28	.72	35.16	1.72	39.28	4.04	34.76	.60	36.72	0	38.28	2.38	35.55	.77
Beef.....	2.50	2.25	1.50	1.50	2.25	2.25	.25	.50	.50	.50	2.38	2.25	.75	.75
Pork.....	15.96	5.60	14.00	3.08	12.32	7.28	13.16	2.24	14.84	1.68	14.14	6.44	14.00	2.33
Lard.....	8.70	6.60	6.00	4.80	8.25	8.10	5.10	2.55	5.10	3.15	8.48	7.35	5.40	3.50
Poultry.....	1.44	.16	1.92	.16	4.80	1.12	1.76	1.76	1.92	0	3.12	.64	1.86	.64
Eggs.....	10.80	.40	8.80	.80	9.80	2.60	7.40	.20	8.20	0	10.30	1.50	8.13	.33
Sugar and sirup.....	6.16	5.95	4.41	3.99	5.04	5.04	4.34	3.22	4.90	3.99	5.60	5.50	4.55	3.73
Total.....	123.19	41.84	109.54	29.95	124.47	57.27	104.65	24.49	111.21	22.00	123.85	49.57	108.26	25.46

¹The same families in 1936 and 1937; yearly consumption based on period January-June.

292 pounds, the purchase of fruit accounting for over one-third of this amount. On the basis of local production of small and large fruits, the home production of fruit is practical, and the acreage required would be insignificant.

Reduction of Food Purchases.—The reduction in food costs induced through control, corresponding to the amounts of the main food items consumed and purchased, is presented in table 15. The uninfluenced costs of food purchases per adult equivalent in 1936 and 1938, \$41.84 and \$57.37 respectively, were low as a result of the depression influence and the attempt being made at that time, under Farm Security influence, to produce the food needs on the land prepared and available for the purpose. The tendency was for amounts and costs of food purchases to increase, since fairly lucrative employment was open to all Homesteaders during this period, and those cooperating in this experiment had a monthly cash income of at least \$45, as previously indicated. An estimate of the food purchases by those on carpenter and other skilled jobs indicated that a large percentage were spending over \$100 per adult equivalent per year for food purchases even with land and equipment available by which this cost might be materially reduced. It may be noted (table 15) that the total value of food consumed, on the basis of the average food cost prevailing during the period 1936-1939, was less in the case of the influenced families, and the cost of food purchases per adult equivalent was reduced to \$29.95 in 1937, \$24.49 in 1938, and \$22.00 in 1939. During 1939, 3 of the 12 families achieved a reduction in yearly cost of food purchases to less than \$15 per adult equivalent, one family reaching the low cost of \$8.91 (table 16). The most important reductions in food-purchase cost were made in white flour, bought bread, pork, lard, eggs, sugar, and sirups.

Cost of Home-Produced Food.—An important consideration in the home production of food is the cost. The actual cash outlay by families and adult equivalent for 1939 is presented in table 16. Practically no variation occurred from year to year, actual prevailing costs of seed, fertilizer, feed, and livestock being used. The family and adult-equivalent totals of \$43.32 and \$9.74 with the corresponding costs of food purchased, resulted in total food costs of \$138.36 per family and \$31.74 per adult equivalent for the year. Family No. 17, having the low food-purchase cost of \$8.91, had an adult-equivalent food-production cost of \$9.55, making a total food cost of \$18.46 per adult equivalent. The adult-equivalent cost of \$9.74 in 1939 represents all cash expenditures in connection with the home production of food, whether consumed or not. In the case of certain foods, more or less than required was produced and the cost of the home-produced food actually consumed is indicated in table 16, last column, this being considerably less in all cases than the actual expenditure.

Over half the cost of home-produced foods was for corn and livestock. The garden, although requiring a high output of labor,

TABLE 16—Cash outlay for home-produced food per family and adult equivalent, 1939.

Family No.	Potatoes	Corn	Wheat	Soybean	Garden	Feed and livestock purchased	Gross Cost		Cost actually consumed
							Family total	Per Ad. Eq.	
12	\$ 4.86	\$19.60	\$2.25	\$.54	\$9.04	\$10.00	\$46.29	\$9.44	\$5.32
13	17.48	10.98	1.36	None	10.60	18.50	58.92	6.78	4.96
14	4.13	11.54	3.42	None	6.43	21.04	46.56	9.13	6.30
15	14.14	9.14	3.90	None	5.73	15.60	48.51	6.20	6.25
16	20.70	8.18	3.20	.68	8.77	10.96	52.58	8.47	8.03
17	3.40	12.66	1.80	None	8.34	17.80	44.00	9.55	8.50
18	3.50	15.46	2.26	.38	5.98	10.00	37.58	9.89	8.46
19	3.40	16.08	2.32	None	4.39	14.90	41.09	7.61	6.39
20	18.42	11.20	2.21	None	4.86	11.80	48.49	13.09	8.84
21	7.41	8.40	1.32	.32	4.75	6.30	28.50	9.83	7.86
22	8.46	8.40	1.20	.30	4.28	3.00	25.64	9.50	5.90
23	9.54	16.80	2.10	.75	5.50	7.00	41.69	15.44	8.83
Total	\$115.53	\$148.44	\$27.34	\$2.97	\$78.67	\$146.90	\$519.85	\$116.93	\$85.64
Average	9.63	12.37	2.28	.26	6.56	12.24	43.32	9.74	7.14

cost only \$6.56 per family in 1939. The potato cost of \$9.63 per family was due largely to the customary purchase of seed each year. Subsequent Experiment Station results with potato varieties and practical farm-storage methods indicate that the annual potato seed cost can be entirely eliminated with further reduction in the cost of home-produced food. The consistency of these home-production costs is shown by the narrow range of costs from a low of \$678 in the case of the largest family to \$15.44 in the case of one of the smallest families. These costs may be compared with the total acreages in table 21.

The low food costs, particularly those of purchased foods, may raise the question of food sufficiency. At no time during the course of the study did a family indicate a shortage of food. One of the families which had reduced the cost of food purchases to less than \$15 per adult equivalent emphatically stated that it had more food in the home during this period than ever before. This was the general situation for the entire group.

The Soybean.—The only radically new food introduced into certain of the experimental diets was the soybean. The first crop of edible soybeans was planted in 1936, and the attempt to include it in the dietary was not made until 1937. After a study of varieties during 1936 and 1937, the Hahto was decided upon as being best suited to the various ways in which it was to be tried in the diet. This large bean was especially well suited to the fried-salted method of preparation under which the shrinkage of the smaller varieties rendered them less usable.

A knowledge of the practicality of the soybean in the local diet, particularly in relation to subsistence on the land, was believed to be important in view of the reliance placed on this food in certain countries and its unusual nutritional qualities. The added tedium of hand harvesting, threshing, and cleaning, as well as the natural objections to trying a radically new food, and its association in the minds of the cooperators with cow feed, made this feature of the study a difficult one. The attempt to popularize the soybean in the local diet by well-advertised soybean-menu parties did much to change the general attitude toward this food.

Only the most practical use of the soybean in the diet was attempted. The Bureau of Home Economics has published a list of 51 soybean recipes, and other institutions have added ways of using the soybean. The most likely recipes were tested in the temporary food laboratory and necessary changes made to accommodate local food habits, such as high white-flour and corn-meal consumption. A definite educational program was undertaken, in which the most practical-appearing recipes were presented to those women concerned with the soybean in the diet—first in the food laboratory, then in the homes. The soybean quota for each of the families concerned in 1936 and 1937 varied from 7 to 15 percent. The 15-percent allotment required a consumption of 99 pounds per adult equivalent per year and was found too high for practical attainment. The

1937 group contained 6 new families who had not grown a supply during 1936 but were given all the soybeans they would use. During that year the first attempt resulted in a consumption ranging from 6 to 25 pounds per adult equivalent. The new dietary schedule, which began in 1938, assigned 6 of the 12 families to soybean diets at the rate of 10 percent caloric intake from this food. This percentage of caloric intake required an adult equivalent consumption of 66 pounds per year. In the replacement of families at the end of 1937, 4 having experience with the soybean were dropped, but consumption was increased during 1938, the 6 soybean families consuming 17, 17, 18, 25, 30, and 35 pounds per adult equivalent per year. The same group continuing through 1939 consumed 23, 26, 20, 34, 34, and 23 pounds.

Even though the scheduled soybean consumption was not reached in any case, a fair test was afforded of its practicalness in the diet and its usability in the various forms. With equal stress by the staff on each of the many ways the soybean might be practically used in the diet, both in the laboratory, where the women were first presented with the various dishes at their best, and in the home following the laboratory demonstration, where every assistance was given to duplicate the products sampled in the laboratory, the soybean was actually used in 3 principal ways. The most practical use was in the form of home-ground meal used in breads of all types, mainly cornbread and biscuits. This was the natural result of the characteristic high consumption of white flour and corn meal. It would not be expected, for instance, that an appreciable quantity would be used in the form of green soybeans in salads, since salads were not a characteristic part of the average local menu. The consumption of soybean meal was heaviest in cornbread, in a recipe especially designed for local habits in which soybean meal and corn meal were used in equal quantities. Biscuits, rolls, and wholewheat muffins in which soybean meal was used to the extent of one-third to one-half, were second in practical forms of using the ground meal. The next most important form of consumption was that of boiled dried beans prepared in the regular way for dried beans throughout the region. The uninfluenced family diet records obtained during 1936 and 1938 (table 9), show that these families consumed an average of 19 pounds of dried beans per adult equivalent per year, and there was little trouble in getting a fair consumption of soybeans in this form when seasoned with the customary fat meat as well as tomatoes and other seasoning. The characteristic objectionable flavor of soybeans, however, continued to be an obstacle to their extensive use in this form.

Fried-salted soybeans, similar to salted peanuts, were popular; in fact, this was the most practical method by which a considerable quantity could be easily prepared for consumption over an extended period. Children were especially fond of these fried soybeans, and in many instances took them to school. Recipes and descriptions of practical methods of including the soybean in the average diet,

based on findings in this study, are presented in Tennessee Experiment Station Circular 74, Soybeans in the Diet, April 1941.

All of those families that tested the usability of the soybean in the diet, and others who incidentally sampled the various prepared forms, with the possible exception of plain boiled beans, were enthusiastic over the appetite appeal. This was most pronounced in connection with all the soybean breads and salted soybeans. Family No. 16 was particularly enthusiastic over the soybean and did much to interest neighbors in its use. As a result, one family not connected with the experiment became sufficiently sold on this dietary article to put up with the inconvenience of threshing it in the living room in the absence of barn space. During 1939, local interest increased throughout the Cumberland Homesteads until a request was made by the women for a demonstration of soybean preparation by the staff member in charge of dietary work.

It was not possible to measure the health relationship during the brief period of study when possibly significant amounts of the soybean were consumed.

As indicated previously, the human consumption of soybeans was attempted under certain difficulties which would not be hindering factors in the average well-developed agricultural community. No harvesting or threshing equipment was available, and the production of even a family supply of 4 or 5 bushels was a tedious task and one much disliked by the families even though time was not a factor. The soybean was so well liked in the forms mentioned that a much higher consumption might be practically attained where the products could be grown and harvested on a commercial basis and a presentable product made available at a reasonable farm price. The excellent demonstration of resistance to insect injury, especially to Mexican bean beetle attacks, added to the interest in the food item and to its possible importance in the home production of food.

Problems in Diet Change.—Tradition proved to be the greatest obstruction to dietary change. Unwillingness to change, even with assurance of every assistance and of improvement in diet, was the chief reason for dropping families at the end of 1936 and 1937. The high consumption of white flour and lard was typical of traditional practices. The difficulty of increasing the use of home-produced potatoes to the established level in many of the northern potato-growing states was the result of what families on the Plateau were used to and not of lack of palatability or supply. The foreign elements in the United States usually are heavy consumers of potatoes, since this food is an important part of the European diets. The virtual absence of foreigners in the group studied may account to some extent for the lack of importance attached to this food item here. Of the miscellaneous vegetables, the parsnip lends itself well to home production because it extends the growing season of fresh vegetables through the winter. It is not a traditional article of food, however, and attempts to establish it as a new item in the diet were largely unsuccessful.

On the other hand, a valuable food such as the tomato was limited in consumption because of impractical methods of making juice—the form in which it could be used in greatest quantities. The introduction of devices and methods to facilitate this operation resulted in a significant increase in consumption of tomatoes. It should be pointed out that tomato juice does not compete for space in the diet as potato does, for example. As long as the high consumption of white flour is maintained it is physically impossible to increase significantly the consumption of the more valuable potato.

As pointed out, the lack of certain equipment, particularly harvesters and threshers, definitely added to the difficulty of effecting dietary change. This was true particularly in the case of home-raised wheat. Since flour consumption was unusually high, an excellent opportunity was afforded to reduce the costs of food purchases by home production of wheat. In the absence of mills, there is no possible product from home-raised wheat, except wholewheat flour, unless it be whole or coarsely ground wheat used as a breakfast cereal. Excellent wheat was produced on each farm in accordance with the various dietary schedules, but harvesting and threshing without adequate local equipment, as well as lack of familiarity with wholewheat flour, eventually defeated the adoption of this home-raised food. The wheat had to be harvested by cradling—the first such attempt for a majority of the cooperators. Threshing was done cooperatively by having all of the wheat lots individually stacked at a central farm in such a manner that the thresher—brought in from a distance after much delay—could be placed in the middle and be accessible to all stacks, the straw being piled individually. As in the case of soybeans, the cooperators were impressed with the great amount of work for small production, and it lessened their interest in the finished product.

Some progress was made in substituting wholewheat flour for the customary white flour by means of demonstrations in the food laboratory and homes. None of the uninfluenced families consumed wholewheat flour, but the influenced families consumed 42 and 24 pounds per adult equivalent during 1937 and 1938 respectively. All families were frank in their agreement on the palatability of the various wholewheat products, and as long as constant pressure was applied it replaced some white flour.

An interesting reaction to wholewheat flour in the diet was observed throughout the country during 1940 and 1941 in connection with the uninfluenced family diet records. During this period, 40 percent of the families involved were on relief, or at least made use of free commodities, one of these being wholewheat flour. During 1940, 21 percent of the families having access to free wholewheat flour made use of it in small quantities, and only 7 percent of those on relief during 1941, when wholewheat flour was withdrawn as a free commodity, used this product. In other words, if hard pressed for food, some of the families used wholewheat flour when it was provided free of charge, but the habit did not appear to be acquired in a year or two.

Diet revision involving heavy year-round consumption of such items as Irish potatoes and sweetpotatoes is dependent to a large degree on varieties adapted to long storage, and improvement of storage facilities. Irish potatoes in most cases are improperly stored in small pits, and inadequate ventilation and overheating shorten the usable period of this crop. The new variety Sequoia, introduced too late for adoption during this investigation, facilitates storage of seed and tablestock because of its unusually long dormancy period. Sweetpotatoes rarely are cured before storage in this locality, and very few are stored at a high enough temperature for satisfactory preservation. Because of the difficulty of extending the use of the sweetpotato over as long a period as is possible with the majority of food items, its consumption was scheduled as a constant, and actually varied little, the annual adult equivalent consumption during 1936, 1937, 1938, and 1939 being 68, 56, 66, and 66 pounds respectively (table 14). Uninfluenced consumption throughout the county during 1940 and 1941 was 36 and 59 pounds.

The importance of the Irish potato in the diet called for special efforts to extend its use throughout the year. Following potato harvest at the end of the first season, proper pit storage was demonstrated. At best, however, this type of storage is insecure. The next season, therefore, a cooperative, practical, above-ground, sawdust-insulated storage building was erected in a central location, with individual bins for the different families. A sweetpotato curing and storage room was included. When properly managed, this type of potato storage through several seasons' use proved adequate for general seed and tablestock storage needs.

Permanence of Dietary Revisions.—Considerable pressure was brought to bear in effecting the revisions noted. This effort was much more than would be practical in the usual order of rural education along this line; but significant changes were obtained in both the nature and the cost of the diet, which were of value at least for

TABLE 17—*Fixation of dietary revision involving foods most affected during 1938 and 1939 as noted four years after withdrawal of influence—consumption per adult equivalent.*

Food	Diet level	5 families uninfluenced	12 families influenced		4 years after withdrawal of influence.
		1938	1938	1939	1943
		Pounds	Pounds	Pounds	Pounds
Wholewheat flour.....	High	0	15	7	6
	Low	0	32	12	10
White flour.....	High	152	120	116	129
	Low	.....	78	89	94
Irish potato.....	High	.....	316	330	1269
	Low	192	126	109	119
Soybean.....	High	None	24	27	None
	Low	None	None	None	None
Tomato.....	High	.....	123	93	120
	Low	65	82	70	80
Lard.....	High	55	41	35	37
	Low	.....	32	33	30
Misc. vegetables.....	High	.....	262	262	270
	Low	186	222	231	230

¹The reduction from 330 pounds in 1939 was largely the result of a drop in consumption by one family which if maintained at a level equal to that of 1939 would have averaged 324 pounds in 1943.

experimental observation. One of the most important results observed was that of permanency of diet revisions. This was noted by way of a survey study of the 1943 dietaries of those families formerly under influence during 1938 and 1939. Table 17 presents the adult equivalent consumption per year, by dietary level, of those foods subjected to the greatest revision during the control period—whole-wheat flour, white flour, potato, soybean, tomato, lard, and miscellaneous vegetables—and the consumption for the same families four years after withdrawal of influence.

It is observed that the soybean was the only one of these foods in which a complete revision occurred—from 24 to 27 pounds in 1938 and 1939 to none in 1943. As pointed out earlier, certain difficulties of harvest and preparation tended to discourage the use of this commodity, and it was not available on the local market. Consumption of wholewheat flour continued at a low level, with little change from that recorded in 1939—7 and 12 pounds for the high and low cereal-diet schedules. The wholewheat-flour figures for 1938 and 1939 appear reversed in relation to the high and low dietary schedules, being due to the varying ability and willingness of the families to introduce the unfamiliar food in the diet. Those on the low cereal schedule were more successful than those on the high. The amounts of wholewheat flour consumed were hardly significant at any time.

Continued attempts to increase the consumption of home-grown wholewheat flour appeared impractical at the end of 1938 except through recourse to unreasonable pressure. Accordingly, the families were permitted to trade home-grown wheat for white flour during 1939, and thus were essentially in line with the home-production of food. Some expense was added by the increased toll required, and improvement of the diet was curtailed. The resultant reduction in wholewheat consumption of approximately 60 percent is indicated in table 17.

The remarkable difference in white-flour consumption between the high and low cereal schedules of 120 and 78 pounds in 1938 and 116 and 89 pounds in 1939 attests the progress made in deviating significantly from the strongly established traditional high white-flour consumption of 152 to 173 pounds per adult equivalent recorded for the uninfluenced dietaries. This reduction in flour consumption, with its attendant reduction in the need for lard, significantly reduced the cost of food purchases, and was possible through replacement with the home-grown items potatoes and miscellaneous vegetables. Of all the major revisions effected, the reduction in flour consumption might justifiably have been judged the least stable in view of local diet tradition, but during the four years of free choice following 1939 the reduced levels were maintained practically without change and without apparent difficulty.

The wide differences in potato consumption per adult equivalent of 316 and 126 pounds in 1938 and 330 and 109 pounds in 1939 made possible the wide differences in flour consumption noted above and were maintained with little change in average consumption during the four years of free choice. One family of the 6 on the high

potato schedule radically reduced its potato consumption following the period of influence, resulting in an average consumption of 269 pounds in 1943. If this one family had maintained its level of potato consumption attained in 1939, the 1943 average would have been 324 pounds per adult equivalent, or approximately twice the U. S. average. The replacement of a large part of the white flour with potatoes in the local diets was apparently practical; it measurably improved the diet, and reduced the cost of food purchases.

Wide differences in consumption of tomatoes—the farmer's orange in supplying vitamin C—occurred under the high-low vegetable levels. These differences generally were maintained during the four years of free choice, the difference between the consumption levels attained under influence during 1938, 1939, and 1943 and the level of the 1938 check families being due largely to increased use of tomatoes in the form of juice. All families effecting a significant increase in the use of tomatoes in the form of juice were definitely committed to its continuation.

The reduced lard consumption, in keeping with the decreased consumption of white flour, was generally maintained after the period of dietary influence, the 1943 survey indicating consumption per adult equivalent of 37 and 30 pounds, compared with the 1938 check of 55 pounds (table 17).

The average uninfluenced consumption of miscellaneous vegetables on the Homesteads and throughout Cumberland County was shown in table 9 to be generally low. It is shown also that the low, or 2-percent, garden schedule was met in actual consumption but the 4-percent schedule was not. Miscellaneous vegetable consumption, however, was increased 50 percent under the latter, and the increased consumption levels attained in both the high and low schedules generally were maintained after withdrawal of influence; the 1943 survey indicating an estimated 270 and 230 pounds consumed per adult equivalent by those families formerly on the high and low garden schedules.

It may be said, on the basis of the evidence presented, that major dietary changes that were made effective throughout the greater part of the year with local rural families will carry over to a significant degree if those changes involve material improvement in the diet, radical reduction in cost of living, and increased use of foods particularly well adapted to local production from the standpoint of the productive capacity of the area and the availability of equipment.

HEALTHFULNESS OF DIETS

Only a very general estimate of health was attempted during 1936-1939. Monthly child weights were obtained and the general appearance of children noted. Experimental error was unavoidably high because of the limited number of families and the age differences of the children; but at least the yearly gain per child ranging from 5.8 to 8.1 pounds under the controlled diets may be

considered commensurate with normal gains of like ages. The 5.9-pound average gain of 11 children on uninfluenced local diets may not be significantly less than the gain under influenced diets, but it was made at twice the cost of food purchases per adult equivalent.

The monthly weight gain of children (Fig. 5) was characteristically lowest during the months of June, July, and August, whether the diets were under control or not. Each year a radical increase in monthly weight gain occurred in September and continued through December regardless of diet quality. This is in fair agreement with observations by Bleyer⁴ for monthly weight gains except the recorded rapid weight increase beginning in August. Monthly gains varied somewhat from those reported by Porter,⁵ in which the gain during the latter half of the year was over 4 times that during the first half. Reynolds and Sontag⁶ report the maximum period of weight gain to be during October, November, and December, and the minimum during April, May, and June. New families placed on the study during the years 1936, 1937, and 1938 accounted for incomplete child weights during January, February, March, and April, the monthly weights indicated being complete for all the children listed.

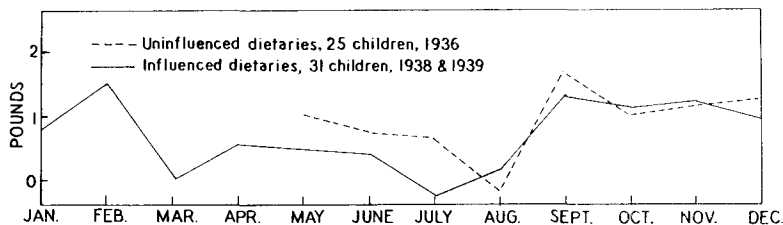


Fig. 5—Monthly child weight gain from uninfluenced and influenced dietaries, 1936, 1938, and 1939. Note the actual loss in weight during July and August.

The general health of families was exceptionally good, and may be indicated by the low expenditure for doctor's services and drugs. During 1938, the average expenditure per adult was \$8.73. This was reduced to \$4.43 during 1939, and compares with \$10.01 for the check families. The low cost of health services in 1939 coincided with the lowest expenditures for food purchases during the study.

THE GARDEN

Great interest is attached to the garden in any consideration of home production of food supplies. The Homesteads families involved during the period 1936-1939 were more experienced in gardening than in growing farm crops, and evidently had maintained gardens before settling on the Homesteads. The garden had been largely in the woman's domain; but the special garden schedules, requiring definite footages of various plantings, as well as an in-

⁴Archives of Pediatrics, XXXIV. May 1917.

⁵Porter, American Journal of Physiology, LII. May 1920.

⁶Seasonal Variations in Weight, Height, and Appearance of Ossification Centers. Journal of Pediatrics, Vol. 24, May 1944, pp 524-535.

crease in the number of vegetables grown, increased the interest of the men in this phase of the project.

Certain questions arise in connection with the garden, such as possible differences in relative importance of the main divisions of garden produce under varying degrees of dependence on the garden for subsistence, and practical size limits. It was noted in table 10 that the land required to supply the home-grown food per adult equivalent by the various dietaries, exclusive of livestock requirements, ranged approximately from .43 to .60 acre, the small garden being included at .064 and the large garden at .128 acre, exclusive of Irish potatoes, sweetpotatoes, and dry beans. In the light of these acreages and the importance of the garden in the subsistence diet, a question of interest arises as to whether the miscellaneous garden acreage should be increased or decreased with a decreasing acreage available for subsistence.

It was found that very little consumption difference occurred, even under pressure, between the high and the low miscellaneous vegetable schedules, although the plantings varied according to plan. In fact, a 2-percent caloric intake from miscellaneous vegetables was found to be about the top practical limit under country conditions, where a large part of the vegetable consumption must be in the canned form rather than fresh. The intake of specific nutrients was indicated to be well above the recommended requirements, particularly in the case of the 1939 influenced diets on the Homesteads, which averaged slightly over 2 percent caloric intake from miscellaneous vegetables. It is evident that a food group which supplies no more than 2 percent of the caloric intake and which at a 1-percent caloric level would undoubtedly furnish sufficient minerals, vitamins, and variety if economically used, may be seen to lose some of its importance in the strictly subsistence diet produced on a minimum acreage. Growth and work are dependent to such a large degree on the intake of high-calorie foods, with associated protein, that under strictly limited land conditions the land allotted to miscellaneous vegetables may be advantageously limited to furnishing not over 1 percent of the calorie intake in favor of a relatively larger acreage of those foods either higher in carbohydrates, protein, or fats, or of which a greater volume consumption results in a high intake of nutritional elements. Wheat, corn, potatoes, and beans, especially soybeans, are important in this regard.

The natural seasonal consumption of home-produced foods may be seen to result in a slowing down in weight gain of growing children and in some instances results in a loss of weight during the period of highest vegetable consumption (Fig. 5). Many factors affect the weight of children during the summer months, but undoubtedly the most important is the reduced intake of the necessary elements for a high level of work and growth. Community workers in the Plateau area report extreme seasonal eating habits, and the reduced weight gains during the summer are characteristic. July and August proved to be the most critical months in this regard. Such low weight gains can hardly be explained on the basis of more work

and activity, since local schools close in March, and the period of greatest farm activity is during April, May, and June; the schools opening again in early August. Crop acreages in the area are not sufficient to cause a burden of work at any time on the average Plateau farm. The higher temperatures during July and August may have some effect in reducing appetites. Proportionately large amounts of the low-calorie foods—green beans, cabbage, root crops, and tomatoes—were consumed during this period.

In 1936 the miscellaneous vegetable-garden sizes were established on the basis of estimated yields, information on vegetable preference not being available. By 1938, preferences were better known and there was more accurate knowledge of yields under varying conditions. During 1938 and 1939 the required vegetable production for each family was established on the basis of the key data presented in table 18, which indicates the total row footage of each

TABLE 18—*Standard row length of miscellaneous vegetables used in establishing the garden area required to produce 2 percent of one adult-equivalent calorie requirement, and average yields obtained per 100 feet of row, 1938-1939.*

Vegetable	Total row length, all plantings	Average yield per 100 feet of row.
	Feet	Pounds
Rhubarb.....	15	(¹)
Asparagus.....	15	(¹)
Peas.....	60	18
Onions.....	30	43
Cabbage.....	30	91
Lettuce.....	10	(¹)
Spinach.....	10	21
Beets.....	30	41
Turnip.....	20	25
Carrots.....	60	26
Parsnips.....	30	(¹)
Snap beans, bush.....	30	19
Sweet corn.....	120	36
Snap beans, pole.....	60	(¹)
Tomato.....	120	119
Pepper.....	15	(¹)
Okra.....	10	29
Cucumber.....	30	54

¹Yield data not reliable.

vegetable required to produce, under average yields, a total of 2 percent of the caloric intake, allowing for the usual waste. The indicated average yield per 100 feet of row was exceeded in some instances by several hundred percent in the case of certain vegetables, but for general gardening conditions the data presented were found satisfactory.

The difference in the amounts of vegetables produced and canned indicates more accurately the established differences in garden size per adult equivalent than do the amounts consumed as already referred to. It may be noted from table 19 that the pounds produced under the high garden schedule were twice the amount produced by the low, but the average amount canned under the high schedule was considerably over twice that under the low. This was to be expected in view of the findings which indicated the inability of those on the high vegetable schedules to consume twice that of those on the low, leaving more than twice the amount for

TABLE 19—*Relation of garden size to amounts produced and canned per adult equivalent during 1938-1939, and carry-over effect of influence as indicated by amounts canned in 1943, four years after withdrawal of influence, on the Cumberland Homesteads.*

Garden size	Influenced 1938-1939		Uninfluenced ¹ 1943
	Produced	Canned	Canned
	Pounds	Pounds	Pounds
Small ²	278	106	126
Large ²	557	245	223

¹Fifty-seven families throughout Cumberland County canned an average of 165 pounds of garden produce per adult equivalent during 1941.

²Small and large gardens designed to furnish 2% and 4% respectively of calorie requirement.

canning. Reliable data were not obtained on canned goods given away, but it was known that some of the extra canned material was disposed of in this manner. A considerable difference in amounts canned persisted after withdrawal of influence. This also is indicated in table 19.

FIELD CROPS

Fields and Newness of Land.—Experiments and farm experience on the Cumberland Plateau have shown the area to be well adapted to the production of high yields and a wide range of general farm crops when grown under approved methods. New-land yields are generally disappointing, however, and subsistence farming as well as commercial operations should be conditioned by this fact. New land is characteristically low in available plant nutrients and appears low in nitrifying activity, requiring from 2 to 4 seasons of good management before high crop yields are obtained, even when better-than-average amounts of commercial fertilizers are used.

New-land growing conditions coupled with the usually inadequate fitting of land by the subsistence farmer result in the low yields of potatoes and corn on first-year land as shown in table 20. The potato yields represent the averages of numerous plot experiments and therefore involve larger individual farm acreages than are represented by the subsistence allotments, the results of comparable treatments being presented. During 1936, potatoes were grown experimentally as the first crop following clearing on 8 farms and the second crop following clearing on 1 farm. Average total yields were 79.5 bushels per acre on the first-year land and 117 on the second-year land. In 1937, first-year potato crops were grown on 5 farms and second-year crops on 9 farms; the yields being respectively 94.4 and 103.3 bushels per acre. One-, 2-, and 3-year-old land was used in 1938, and the yields were 85.2, 147.7, and 128.1 bushels. In 1939, potatoes were not grown on the land immediately after clearing, but were grown on 2-, 3-, and 4-year-old land, with resulting yields of 170.2, 180.6, and 207.5 bushels per acre. On first-year land, potato yields were 50 bushels per acre or less on 6 farms; 21 bushels per acre being recorded in one instance. On the other hand, there is sufficient evidence to justify the statement that the progressive farmer can expect an ultimate average of at least 200 bushels per acre.

TABLE 20—*Yields per acre of Irish potatoes and corn in relation to newness of land and progressive improvement in culture¹, subsistence units, 1936-1939.*

Year.....	1936				1937				1938				1939			
Crop following clearing	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Potatoes																
No. farms.....	8	1	.....	.....	5	9	.....	.....	2	11	4	.....	.....	8	5	2
Av. yield (bu.).....	79.5	117.0	.....	.....	94.4	103.3	.....	.....	85.2	147.7	128.1	.....	.....	170.4	180.6	207.5
Corn																
No. farms.....	6	.....	.....	.....	6	5	.....	.....	7	4	1	.....	2	4	3	1
Av. yield (bu.).....	28.6	.....	.....	.....	35.0	38.9	.....	.....	22.3	35.8	35.6	.....	20.2	29.1	34.0	33.0

¹Potatoes affected to a large extent by improvement in cultural methods; corn affected to a much less extent.

TABLE 21—*Hours of man- and horse-labor required in production of the main subsistence crops, 1939.*

Farm No.	Irish potato			Sweetpotato			Soybean hay			Wheat			Corn			Garden			Total hours	
	Acres	Hours		Acres	Hours		Acres	Hours		Acres	Hours		Acres	Hours		Acres	Hours		Man	Horse
		M	H		M	H		M	H		M	H		M	H		M	H		
12	.12	21	12	.09	37	22	2.00	102	147	1.29	47	42	7.00	370	322	1.63	130	41	707	586
13	.50	102	70	.08	17	6	1.00	32	52	1.35	48	46	3.90	136	174	.36	36	36	371	384
14	.13	22	10	.06	10	5	1.50	57	74	1.35	51	30	4.10	296	246	.33	28	17	464	382
15	.50	65	20	.06	37	4	1.00	25	19	1.50	59	43	3.25	196	130	.42	74	7	456	223
16	.72	92	38	.07	72	9	1.00	30	32	1.30	72	56	2.90	266	257	.50	115	69	647	461
17	.12	24	4	.05	10	2	1.00	26	28	.72	29	26	4.50	207	233	.59	73	28	369	321
18	.09	22	14	.04	28	3	1.00	42	36	.90	46	38	5.50	209	139	.44	82	7	429	237
19	.12	25	13	.05	23	14	2.50	75	94	1.21	44	24	5.75	208	268	.29	139	22	514	435
20	.43	34	22	.04	13	5	1.00	19	28	.58	18	13	4.00	115	118	.47	79	23	278	209
21	.33	18	9	.03	4	5	6.50	27	37	.45	21	21	3.00	115	138	.19	19	12	204	222
22	.30	36	14	.03	5	2	6.50	41	82	.41	8	5	3.00	117	123	.17	37	3	244	229
23	.30	35	14	.03	17	5	1.75	68	81	.69	15	4	6.00	239	245	.33	74	7	448	356
Total	3.66	496	240	.63	273	82	26.75	544	710	11.75	458	348	52.90	2474	2393	4.72	886	272	.....	.....
Av. per farm		41	20	.....	23	7	.....	45	60	.....	38	29	.....	205	198	.....	74	23	426	337
Av. per acre		136	66	.....	433	130	.....	20	27	.....	39	30	.....	47	45	.....	188	58	.....	.....

In none of the situations presented in table 20 was there the possibility of growing the crop under an adequate rotation system because it was impossible to conduct the study throughout the entire period on the same farms. During 1940 an average yield of 230.5 bushels per acre was obtained on an 8-acre experimental area which had been idle the preceding 2 years following clearing. This yield, however, was produced with the aid of commercial equipment, received the standard local fertilizer rate of 1000 pounds of complete fertilizer, was given 7 bordeaux sprays, and the plants were spaced closer than in the case of the small acreages grown for subsistence. Yields of 300 and 400 bushels have been obtained locally and should not be uncommon under the best cultural practices, particularly in view of the high yields of certain of the new varieties recently introduced by the Experiment Station.

Corn yields on first-year land averaged 28.6, 35.0, 22.3, and 20.3 bushels per acre during the 4-year period. Second-, third-, and fourth-year crops were decidedly higher, but, like potatoes, were grown without the benefit of a soil-building rotation. Yields of over 100 bushels per acre have been obtained in the local experiments, and certain Plateau farmers are getting average yields of 75 bushels. However, three successive corn crops receiving phosphate alone, without legume cover, on one farm resulted in a yield reduction from 75 bushels per acre to the point of failure, exhibiting extreme nitrate-deficiency symptoms. New-land crops grown without phosphate throughout the Plateau region often result in virtual failure, the extreme need for this element being shown in figure 6.

Subsistence sweetpotato yields throughout the 4-year period were 116.0, 136.5, 270.0, and 327.6 bushels per acre. Yields ranged from 68 to 500 bushels. Excellent quality was regularly obtained locally, but curing and storing practices were inadequate and resulted in a shortened period of usefulness in the local diet.

Wheat yields were unprofitable under the new-land conditions; yields during 1937, 1938, and 1939 were 13.9, 8.7, and 8.7 bushels respectively, the highest yield being 16 bushels. Much of the low yield was due to improper stacking before threshing in some instances and a relatively high loss to poultry and other livestock that had access to the small stacks during the usual long wait for the thresher. Subsistence-acre allotments were based on a 12-bushel average yield. A typical subsistence wheat field is illustrated in the cover figure, being harvested by the only available method. Much larger yields can be expected on well-handled old land.

Soybean hay proved to be the most productive form of roughage on new land. Mixed-hay yields usually produced less than a ton per acre on first-, second-, and third-crop land with customary phosphating, whereas soybean hay yields on 12 farms averaged 1.69, 2.28, 2.88, and 1.63 tons per acre during the period 1936-1939. Owing to its tendency to aggravate erosion on the 3- to 6-percent slope available for this crop and to the fact that it was usually removed too late for successful seedings of leguminous cover crops, it was discontinued as soon as productive permanent seedings were estab-



Fig. 6—Typically extreme crop response to phosphate on new land.
Above: Sudan grass phosphated (left). Below: Corn, center plot unphosphated.

lished. From the subsistence standpoint the soybean was unmatched in producing highly desirable livestock feed under new-land conditions in the shortest possible time. The Ogden variety is especially recommended.

The 6 farms growing edible soybeans each of the 4 years had average yields of 9.0, 9.2, 9.5, and 5.5 bushels per acre. Losses from shattering and hand-threshing largely accounted for the low yields. Experimental results since 1939 indicate that approximately twice the above yields may be expected under more satisfactory production methods.

LABOR REQUIREMENTS

An estimate of man- and horse-labor required for the home production of food supplies is important in gauging ability to carry

the schedule. The actual labor required for the various subsistence-crop acreages during 1939 is presented in table 21.

Owing to the larger acreage, corn required by far the greatest amount of labor, averaging 205 man- and 198 horse-hours per farm. The garden was next in labor demand, 74 man- and 23 horse-hours. Sweetpotatoes required the least man- and horse-labor, 23 and 7 hours, and also required the least acreage.

Total man-hours by individual farms ranged from 204 to 707, and total horse-hours ranged from 209 to 586. The man-hour average was 426 and the horse-hour average 337. The man-hours per farm may be compared with 2080 available hours on the basis of 8 hours per day and 5 days per week throughout the year. Individual farm acreages and labor requirements are presented to show the wide variation that occurred, not only because of the various diets and sizes of families, but also the differences in labor requirements for similar acreages.

The per-acre labor requirement was highest for sweetpotatoes, 433 man- and 130 horse-hours, followed by the garden, 188 and 55; Irish potatoes, 136 and 66; corn, 47 and 55; wheat, 39 and 30; and soybean hay, 20 and 27. Larger crop acreages would result in a more efficient use of labor, particularly through the utilization of commercial equipment.

COVER CROPS

Crimson clover was used where possible to offset the lack of definite crop rotations on the home-food-supply areas. The slope of the land and the requirement for constant subsistence-crop acreages for the limited period of study made it necessary to crop the land successively in most cases. Corn was scheduled in a 4-year rotation with clover and grass, 2 successive years in each, on 6 of the 12 farms, but the changing of families on the study prevented the carrying through of even this limited rotation.

Crimson clover seeded in corn during July and August on first-, second-, or third-crop land which had been limed and received only phosphate at average rates of 32 to 48 pounds of P_2O_5 per acre annually, failed on 23 of the 24 farms throughout the period of study. Only when preceded by a heavy fertilization, such as is given potatoes, were crimson clover seedings successful in corn on new or relatively new land. Seedings following potato crops harvested in July and early August always proved successful. Good stands of crimson clover made more growth for the successive corn crops, since the clover was able to utilize the rapid-growing month of April; whereas, fitting land for potatoes before April 1 prevented a satisfactory growth of this cover crop under the conditions prevailing during the study. The local practice of growing pumpkins in corn resulted in the failure of all attempts to get satisfactory stands of crimson clover in those parts of the cornfields sown to pumpkins, because of the obstruction they offered to loosening of the soil with a cultivator before seeding.

CROP EXPERIMENTS

Field experiments with all the important crops of the Plateau composed an important part of the project. The results showed that with the aid of moderate applications of lime, phosphate, and potash, excellent yields of farm crops, including corn, clover, grass, and potatoes, could readily be obtained. The rare elements zinc, manganese, copper, and boron had no significant effects on yields under new-land conditions.

NECESSITY FOR CROP SPECIALIZATION

The crop experimental results point to the feasibility of increasing the small-farm income on the Plateau, at least to the point at which a practically complete living may be obtained in limited land units. It is evident that livestock production or a general line of farming on the small farm of 10 to 20 acres of cropland will rarely meet the needs. Specialization on one or more lines of crop production for income is most certain to attain the desired goal.

The open market for potatoes, and the already established reputation for the Plateau potato, singled out this crop as the key to the surest source of income under existing market conditions. Potato yields have been shown to increase rapidly to a profitable level under cultural improvement (table 20) and the increase in gross farm income effected during the period 1936-1939 was due largely to the potato crop.

The adult equivalent of 4.48 and 4.71 per family during 1938 or 1939 was shown in table 10 to require slightly over 7 acres for family and necessary livestock food production, being approximately half the available average crop-acres per farm. On the smaller units in 1936 the average cropland per farm approximately equaled that required for home food production, and an average of 4.1 acres in 1939 on farms averaging 15 acres of rotational cropland increased gross cash income to \$401.42, of which \$336.18 was from potatoes (table 25). A constant prewar market price of \$1.00 per 100 pounds was used throughout to simplify comparison. An average of 5 acres of potatoes per farm was planned for 1939, but the fear of risk due to the high price of seed discouraged some of the co-operators. The consideration of total farm and family costs and income presented later indicates the necessity for at least 5 acres of specialized crop production, and the labor supply was shown to be only partly utilized in the production of the home food supply.

Weather.—The factor of precipitation is significant in connection with general crop production. Although there is a high average precipitation during the growing season on the Plateau, it is not constant. Precipitation by months during the period 1936-1940, shown in figure 7, is found to have a definite bearing on both experimental results and farm income. The precipitation during 1939 was near the average for the period, but potato and most other crop yields were the highest recorded; and the farm income referred

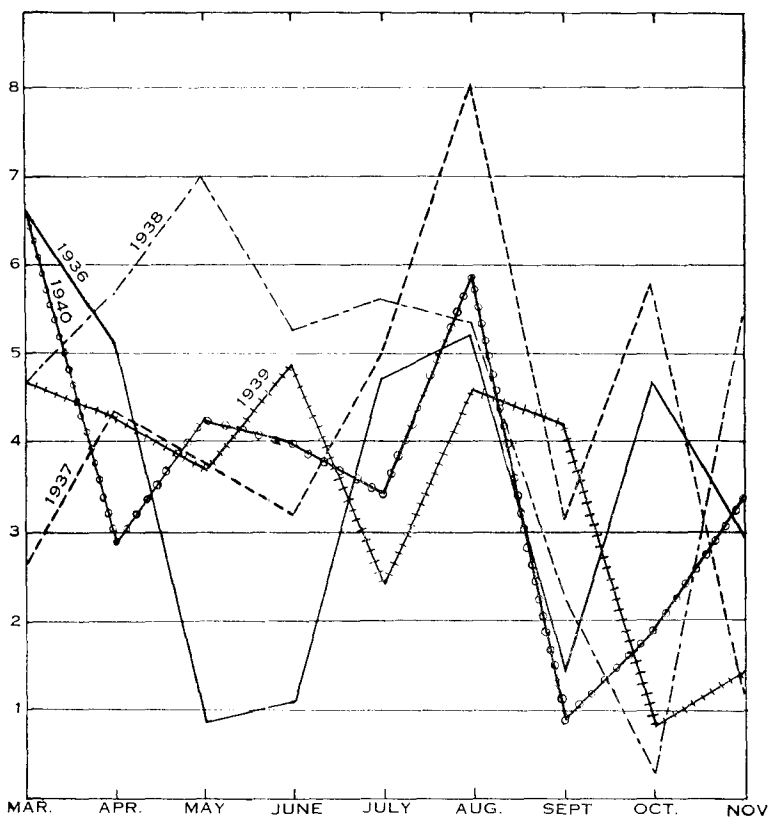


Fig. 7—Monthly precipitation during growing season at Crossville, 1936-40.

to in the preceding section was not due to unusually good weather, but to improvements in productiveness and culture. The usually low yield of the July-planted potato crop observed in experiments and local growers' experience is due largely to the relatively dry September and October.

LIVESTOCK

Workstock.—On the small farm, workstock usually is a problem, since effective land fitting cannot be accomplished with one mule, and the cost of maintenance of a team is prohibitive unless intensive farming is practiced. Workstock was found to be idle too much of the time on farms having less than 40 acres of cropland. On farms of less than 15 rotational crop acres, 1 mule was sufficient when paired with a neighbor's mule for the heavy jobs. On units of less than 10 acres, workstock was hired more cheaply than it could be maintained. On the smallest units involved in the study, workstock was not included. One mule was allowed on units

TABLE 22—Consumption and purchases of concentrates per head for dairy animals and workstock, with annual milk production per cow, 1936-1939.

Item	1936			1937			1938			1939		
	No. of head—average	Corn	Dairy feed	No. of head—average	Corn	Dairy feed	No. of head—average	Corn	Dairy feed	No. of head—average	Corn	Dairy feed
Cow	8	Pounds 654	Pounds 2069	9	Pounds 975	Pounds 588	12	Pounds 1433	Pounds 546	12	Pounds 1873	Pounds 46
Mule	3	2873	.....	11	2626	.....	12	2452	.....	12	1789	.....
Cost of purchased feed per head at \$2.75 per cwt.			\$56.90			\$16.17			\$15.02			\$1.27
Yearly milk production ¹ per cow		Pounds 3 660			Pounds 4,298			Pounds 3,646			Pounds 4,138	

¹Based on consumption records.

having approximately 10 acres of cropland, and a team was allowed on the larger units—the commercial potato acreage during 1939 justifying a team on some farms otherwise too small to support a team.

Workstock was found to be fed much more heavily on concentrates than was necessary under the prevailing conditions of light work. During 1936 the average mule was fed 2873 pounds of corn per year, requiring approximately 2 acres of a crop on rotation land and being extremely conducive to land deterioration as commonly grown. Since all the farm units contained considerable land of over 6-percent slope which proved fully as productive of roughage as more level areas when seeded immediately after clearing before top soil was lost, an effort was made to make fuller use of roughage and to put less dependence upon grain for either the family cow or the workstock. The grain fed to workstock was reduced effectively from 2873 to 1789 pounds per head during the period 1936-1939 (table 22), thereby releasing nearly an acre per mule for more intensive cash crops.

Cow.—Unless the cow can be maintained on that part of the small farm not suited to rotational farming, the economy of keeping a cow is open to question. Invariably the cow on a small land unit is underfed, has a longer dry period than necessary, and produces so little that two cows seem necessary. The tendency on the part of the cooperators was to keep more cows than were needed and depend on high-protein purchased concentrates for production. In 1936 the average family cow was being fed 654 pounds of corn and 2069 pounds of purchased dairy feed. Consumption of the home-raised concentrate corn, and soybean hay and other high-quality roughage, with improved pasture, was increased, with resultant reduction in dairy feed consumed to 46 pounds per head without reduction in milk produced (table 22). The purchased-feed cost for the family cow was reduced from \$56.90 in 1936 to \$1.27 in 1939. The increase in corn consumption by the cow was about equal to the reduction in the case of the mule. This was more corn than was allotted to the cow in the farm setup and was necessary in view of the low producing capacity of the average cow involved and the low productivity of new land, resulting in insufficient high-quality roughage and pasture for full feeding. Two family cows fed a higher proportion of high-quality roughage and pasture produced an average of 3500 pounds of milk on 15 bushels of corn and no dairy feed, coming within the original setup on corn. The cows were common grades, of low to medium productiveness.

Experiment Station results have demonstrated the practicability of milk production on sufficiently high-quality pasture and roughage⁷ without grain. The frequent changing of families prevented the putting into effect of such a milk-production program. However, a wide variety of clover-and-grass mixtures for hay and pasture were tried on slopes ranging from 6 to 16 percent, seeded in August

⁷See Tennessee Experiment Station Circular No. 58.

immediately after clearing, and proved these areas to be fully as productive as the more level land in this regard. Farm No. 12, the only one continuing through the entire period of the study, afforded the best opportunity for getting hay yields on 4 slopes averaging approximately 15 percent. Seedings were made in August, 1937, and fertilized at the rate of 64 pounds of P_2O_5 per acre after liming at the rate of 2 tons per acre. The 1938 and 1939 yields for all the slopes averaged 2564 and 2016 pounds of dry hay per acre. These yields may be expected under new-land conditions, and greatly increased yields with improvement of fertility.

The relative unproductiveness of new land and the time involved in establishing seedings, created the problem of immediate roughage supply. Soybean hay, scheduled at the rate of 1 acre per cow, adequately filled the need and proved most certain under the prevailing conditions. Average soybean-hay yields on the 12 farms for each of the 4 years 1936-1939 were 1.69, 2.26, 2.88, and 1.36 tons per acre. The soybean is not to be recommended on land particularly subject to erosion, but should be produced on a rotation area while slope seedings are being established.

Maintaining the cow entirely on slope-land roughage requires that her appetite for roughage be maintained at a high level. Recent investigations indicate that appetite for roughage is dependent to a great extent on the mineral level maintained by the animal. Evident mineral-deficiency symptoms were exhibited by a high percentage of the cows under observation, typical being the chewing of cardboard boxes, illustrated in figure 8. Further evidence was



Fig. 8—Mineral deficiency, shown by animal eating pasteboard box.

found in the report of a large number of animal fatalities during the construction of the Cumberland Homesteads as a result of their eating discarded cement sacks—the open range permitting animals to run at large. To overcome possible mineral deficiency in the family cows, 2 ounces per day of defluorinated dicalcium phosphate was fed throughout. One of the highest-producing Jerseys left no doubt as to her mineral requirements by breaking into a feed room and consuming in one night approximately 25 pounds of usually un-

palatable dicalcium phosphate. No serious ill effects followed. As a result of these observations a project on mineral deficiency in cattle was initiated in 1938 on land provided by the Resettlement Administration.

Milk yields, presented in table 22, may be seen to average approximately half those of commercially profitable cows. Based on essential needs, however, the milk requirement for the average family of 4.5 adult equivalent, which prevailed in 1938, was 4173 pounds. This was practically met by the average cow's production, which ranged from 3646 to 4298 pounds per year during the 4-year period. Even at this rather low rate of production, 2 cows were not needed by the average family. Through cooperation between neighbors, the cow's dry period may be bridged by sharing during the fresh period when milk is sometimes used wastefully.

EXPENSES AND INCOME

Equivalent Gross Income and Productive Size of Unit.—Progress toward gaining a living on the small farm is made through increasing income or decreasing expenditures. It will be of interest here to note the progress made with reference to equivalent gross income in relation to crop acreage per farm. Increase in cash income, and equivalent income resulting from reduction in family and livestock food purchases, with average available crop acreage, is shown in table 23. Cash income was shown to average \$20.32 in

TABLE 23—*Equivalent gross income and productive size of experimental subsistence land units, 1936-1939.*

Year.....	1936	1937	1938	1939
Number of farms.....	12	12	12	12
Adult equivalent.....	3.75	4.75	4.48	4.71
Crop acreage per farm.....	6.6	15.0	15.1	15.1
Income: Potatoes ¹	\$ 3.20	\$67.64	\$105.72	\$336.18
Other crops.....	6.60	39.55	102.34	22.85
Livestock.....	10.52	20.82	32.71	42.39
Cash income per farm.....	20.32	128.01	240.77	401.42
Reduction in cost of food purchases ²	0	133.88	154.19	185.44
Total equivalent income per farm.....	\$20.32	\$261.89	\$349.96	\$588.86
Equivalent income per crop acre.....	3.08	17.46	26.16	38.86

¹Potato income, based on a uniform price; \$1.00 per cwt. (Actual selling price: 1936, \$2.00; 1937, \$.85; 1938, \$.75; 1939, \$1.00).

²Includes reduction in purchases of family food and dairy feed for one cow.

1936 on farms averaging 6.6 acres of rotational cropland. The replacement of 6 of the 12 families at the beginning of 1937 resulted in an increase of the rotational cropland to 15 acres through 1937, 1938, and 1939, with resultant cash income of \$128.01, \$240.77, and \$401.42 respectively under crop specialization and at a constant pre-war market value. The reduction effected in the cost of food and feed purchases during this period may be added to cash income for a total equivalent income per farm of \$20.32, \$261.69, \$394.96, and \$588.86 for the 4 years. The results of efforts to increase cash income and reduce food purchases may be measured further as equivalent income per cultivated crop acre, increasing from \$3.08 in 1936 to \$38.86 in 1939.

TABLE 24—Family costs per annum per adult equivalent, 1938-1939.

Family number.....		12	13	14	15	16	17	18	19	20	21	22	23	Average influenced	5 check families
		Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Clothing.....	1938	28.40	14.34	25.31	31.59	18.71	20.92	16.46	29.63	28.39	29.52	28.61	25.22	24.75	24.82
	1939	26.33	10.07	23.10	25.55	20.54	19.84	16.38	12.70	36.37	22.17	21.89	36.94	22.65	
Health.....	1938	26.72	1.37	3.08	4.01	2.01	5.09	1.14	.85	3.15	26.31	8.33	11.86	7.82	10.01
	1939	3.67	2.07	3.53	3.04	2.90	3.91	4.73	3.33	4.87	6.21	6.67	6.67	4.30	
Education.....	1938	15.07	5.93	1.64	1.88	1.93	3.68	1.36	.69	8.80	.....	1.37	.....	3.53	2.75
	1939	1.52	2.11	.56	2.97	2.04	6.51	1.39	.77	10.84	.....	1.38	.....	2.51	
Household equipment ¹	1938	10.55	8.64	11.42	10.02	10.34	10.58	10.82	9.64	15.10	14.04	15.90	18.17	12.10	22.13
	1939	10.07	6.55	9.81	8.66	7.67	9.87	9.25	7.49	13.91	9.64	13.54	15.76	10.18	
Fuel, heat, light.....	1938	4.18	2.75	3.41	5.31	3.27	6.35	7.07	2.73	7.03	4.44	4.80	6.72	4.84	7.45
	1939	4.67	2.94	3.29	6.21	2.22	3.24	4.78	2.61	7.96	4.24	5.08	13.48	5.06	
Miscellaneous.....	1938	13.37	11.62	4.36	36.15	11.95	35.65	21.89	13.50	16.43	33.17	34.46	29.98	21.87	36.05
	1939	19.96	16.53	7.45	19.01	10.09	18.78	22.49	10.13	24.03	20.46	31.45	34.46	19.56	
Food purchases ²	1938	28.30	14.65	34.53	17.68	19.90	22.89	35.02	24.51	21.70	17.92	25.43	31.44	24.49	57.27
	1939	25.37	12.90	29.74	14.16	14.57	9.11	30.89	22.22	20.53	27.03	28.63	28.81	22.50	
Total.....	1938	126.59	59.30	83.75	106.64	68.11	104.16	93.76	81.55	100.60	125.40	118.90	123.39	99.40	160.48
Cash outlay for home- produced food ³	1939	91.59	53.17	77.48	79.60	60.03	71.26	89.91	59.25	118.51	89.75	108.64	136.35	86.26	
	1938	8.64	13.96	9.43	13.36	15.36	16.23	18.19	19.96	19.52	32.34	33.56	30.52	19.26	415.00
	1939	9.44	6.78	9.13	8.20	8.20	9.55	9.89	7.61	13.09	9.83	9.50	15.44	9.74	
Total.....	1938	135.29	73.26	93.18	120.00	83.47	120.39	111.95	101.51	120.12	157.74	152.46	153.91	118.66	175.48
	1939	101.03	59.95	86.61	87.80	68.50	80.81	99.80	66.86	131.60	99.58	118.14	151.79	96.00	
Entertainment.....	1938	2.08	.88	.18	1.55	5.53	.89	.....	1.83	3.03	.48	3.53	1.31	1.77	4.56
	1939	1.90	.28	.....	1.22	1.78	1.23	.79	.87	4.35	.46	3.83	1.24	1.50	
Car.....	1938	12.83	35.53	9.55	15.56	.....	9.41	.....	19.28	.....	33.89	40.68	47.60	24.92	558.40
	1939	7.76	24.78	9.29	18.26	.....	8.78	.....	9.57	.....	29.65	31.81	.....	17.49	
Total.....	1938	137.31	74.14	93.36	121.55	89.00	121.28	111.95	103.34	123.15	158.22	155.99	155.22	120.43	180.04
Exclusive of car.....	1939	102.93	60.23	86.61	89.02	70.28	82.04	100.59	67.73	135.95	100.04	121.97	153.03	97.50	

¹\$4.46 included for depreciation on furnishings.²Based on adjusted adult equivalent (company meals).³Based on adjusted adult equivalent.⁴Approximate.⁵Average for families having cars.

Total Family Expenses.—Living costs presented in table 24 were based on average prices during the period 1936-1939. Cash expenditures for the essentials totaled \$99.40 in 1938 and \$86.26 in 1939 per adult equivalent for the controlled families, compared with \$160.48 for the 5 check families. The costs recorded in 1939 may be considered of greater significance, since they represent the results of 2 years' influence for the same group of families. During 1939 these costs ranged from \$59.30 to \$126.59 per adult equivalent. The cost of purchased food in the case of the controlled families was approximately equal to that of clothing, and also of miscellaneous; whereas, the item of food purchases was by far the most costly in the case of the check families. All homes had electricity and were heated with wood or coal. The addition of average cash outlay for home-produced food of \$19.26 and \$9.74 for each of the 2 years brought the total for essential living costs to \$118.66 for 1938 and \$96.00 for 1939 per adult equivalent, the latter being \$79.48 less than the essential living costs of the uncontrolled families.

The cost factors of entertainment and car are included separately in the table, since the cash outlay involved may not be considered an essential item. The greater part of the entertainment expense was for movies, but the average cost per adult equivalent, \$1.82 and \$1.53 during 1938 and 1939, was a relatively insignificant amount. The uninfluenced families spent nearly three times this amount for entertainment.

Cars were owned by 9 of the 12 families in 1938 and by 8 in 1939. Although driving was limited, the car proved a major expense, equaling the cost of food purchases. The uninfluenced families, each having a car, spent twice as much on the average car as did the influenced families. Car ownership was promoted by the fact that the families were receiving relatively high wages in the construction of the Homesteads prior to cooperation in the University project. In fact, the living expenses indicated may be considered somewhat higher than if the families were on a truly subsistence status and were not receiving the \$45.00 per month from the University for field-plot work. This regular income is not included in the Table of Farm and Family Costs and Income.

Farm and Family Costs and Income.—The complete financial picture of the 12 families for the final year of the attempt at home production of food supplies and gaining a living from small-farm units is presented in table 25. Total crop sales per farm averaged \$359.03, and ranged from \$135.85 to \$535.48, the specialized cash crop, potatoes, constituting 94 percent of the crop income. Sales of livestock and related products produced an average income of \$42.39, ranging from \$1.10 to \$73.75. Livestock income was necessarily low, since only subsistence livestock was maintained. Total sales of crops and livestock were \$401.42 per farm.

Inventory values of corn, hay, and livestock increased \$93.60 per farm during the year, making a total sales and net inventory

TABLE 25—*Farm and family costs and income, subsistence units, 1939.*

Farm number.....	12	13	14	15	16	17	18	19	20	21	22	23	Total	Average
Adult equivalent.....	4.9	8.7	5.1	5.9	6.2	4.6	3.8	5.4	3.7	2.9	2.7	2.7	.....	4.71
Cleared acreage.....	28	40	17	18	20	29	25	30	19	19	12	32	289	24
Total sales:	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Potatoes.....	442.91	452.00	135.85	333.72	290.19	379.52	299.90	348.00	157.36	470.63	462.09	262.02	4034.19	336.18
Sorghum & tobacco.....	.....	83.48	.....	.....	35.80	.....	.....	22.00	.....	12.00	12.00	.....	165.28	13.77
Corn.....	4.80	.....	.....	.....	.....	6.00	.....	.....	34.60	.....	.....	.....	45.40	3.78
Miscellaneous crops.....	10.65	.....	.....	3.01	8.02	15.15	.50	7.50	2.03	8.60	13.08	.....	63.54	5.30
Total.....	458.36	535.48	135.85	336.73	334.01	400.67	300.40	377.50	193.99	486.23	487.17	262.02	4308.41	359.03
Livestock products.....	38.69	11.31	38.54	28.86	1.40	8.78	1.10	13.37	6.32	6.40	14.99	.....	169.76	14.15
Livestock.....	.....	.....	25.00	15.10	40.50	.....	.....	45.89	60.76	41.92	35.93	73.75	338.85	28.24
Total.....	38.69	11.31	63.54	43.96	41.90	8.78	1.10	59.26	67.08	48.32	50.92	73.75	508.61	42.39
Crops & livestock.....	497.05	546.79	199.39	380.69	375.91	409.45	301.50	436.76	261.07	534.55	538.09	335.77	4817.02	401.42
Net inventory value (Inventory increase)														
Potatoes.....	.....	.....	.....	.....	27.75	14.25	29.25	21.75	22.50	1.25	.....	47.25	240.50	20.04
Corn.....	76.50	.....	.....	.....	48.80	36.30	35.30	67.61	28.81	11.75	23.46	67.54	377.23	31.44
Hay.....	40.00	.....	.....	17.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Livestock.....	55.00	133.00	84.00	16.50	66.00	.....	28.00	47.00	8.00	.....	68.00	.....	505.50	42.12
Total.....	171.50	133.00	84.00	34.16	142.55	50.55	92.55	136.36	59.31	13.00	91.46	114.79	1123.23	93.60
Total sales and net inventory.....	668.55	679.79	283.39	414.85	518.46	460.00	394.05	573.12	320.38	547.55	629.55	450.56	5940.25	495.02
Total farm cost ¹	419.67	525.99	243.10	344.18	382.85	380.50	374.49	361.43	371.87	374.37	365.78	349.07	4493.30	374.44
Net farm income.....	248.88	153.80	40.29	70.67	135.61	79.50	19.56	211.69	—51.49	173.18	263.77	101.49	1446.95	120.58
Credit for home- produced seed.....	20.25	115.47	3.75	24.25	4.20	63.12	23.59	73.61	53.39	1.20	1.20	13.22	397.25	33.10
Miscellaneous income ²	357.80	383.52	2.38	267.56	380.36	88.41	39.23	187.59	245.63	70.50	65.17	95.77	2183.92	181.99
Total net income.....	626.93	652.79	46.42	362.48	520.17	231.03	82.38	472.89	247.53	244.88	330.14	210.48	4028.12	335.67
Total family cost ³	458.10	465.02	395.15	474.84	383.22	333.45	344.66	324.65	454.58	261.60	303.67	371.49	4572.43	381.04
Net gain or loss.....	168.83	187.77	—348.73	—114.36	136.95	—102.42	—262.28	148.24	—207.05	—16.72	26.47	—161.01	—544.31	—45.37

¹Includes seed value whether bought or home-produced.²Exclusive of income from University for field-plot work.³Exclusive of car and cash outlay for home-produced food—the latter included in farm costs.

value of \$495.02. Total farm cost averaged \$374.44, leaving a net income of \$120.58 from the average farm. All seeds were included at purchase value, whether purchased or home-raised, for the sake of presenting the cost to be met by the beginner. Credit for home-raised seed averaged \$33.10 per farm. Potato seed for the commercial crop in all cases was bought at \$2.25 per hundred, seed for the early garden planting being home-produced.

Miscellaneous income was chiefly from occasional day labor that may be considered a fair average expectancy in the case of the average small farmer limited to subsistence acreage. Three families having over \$300.00 miscellaneous income had a member of the family working part time in a local hosiery mill. Total income available for meeting family living costs averaged \$335.67, ranging from \$46.42 to \$652.79, the latter income being that of the largest family, with an adult equivalent of 8.7.

Family living costs averaged \$381.04 in 1939, with a range of \$261.60 to \$476.84. The total living cost of the average family was \$45.37 more than the total net income. Five of the 12 families made an average gain of \$83.53 over all farm and family costs, the remaining 7 failing to meet all costs by \$173.22 per family. Depending strictly on the income from the farms in 1939, when an average of 4.1 acres of potatoes were grown commercially, would have resulted in an average deficit per farm of \$227.36. It must be remembered that considerable money was available for spending, which undoubtedly resulted in higher-than-necessary costs of living; that average crop yields were lower than may be expected from more fully developed Plateau land; and that the average sale price of \$1.00 per 100 applied to the specialized crop, potatoes, was conservative. Under the somewhat unfavorable production conditions prevailing, however, families 19 and 22 were less than \$40.00 short of meeting all farm and family expenses from farm income alone, the shortage per adult equivalent being only \$7.29 and \$14.33 respectively.

GENERAL CONCLUSIONS

During the period 1936-1939, a study of subsistence on small units of land on the Cumberland Plateau was conducted, with 24 families of varied background, at the Cumberland Homesteads, where the farms closely approximated in size those throughout the Plateau. Crops were placed in two divisions—subsistence and experimental. The subsistence schedule was based on type of diet, adult equivalent, and topography of the land. Families were paid for work on experimental plots to offset to some extent the loss of income formerly received on construction. Land was newly cleared; it was relatively unproductive in that condition, and tillage often was inadequate. Dietary records were on the weekly basis throughout and detailed records of all farm and household activities were obtained. Diets and farm schedules were in duplicate during 1936-1937, and in triplicate during 1938-1939.

Families having farm backgrounds were the most successful in making the attempt at gaining a complete living from the land. The uninfluenced basic-diet records indicated local diet characterized by high consumption of white flour, lard, and eggs, and low consumption of meat protein, the latter deficiency being made up to some extent by high consumption of milk and beans. Intake of specific nutrients, with the exception of fats and vitamin A, proved to be up to common standards.

A measurable adjustment to scheduled diets was made in the majority of cases. The increased use of Irish potatoes and tomatoes and the corresponding decrease in the use of white flour were largely maintained after withdrawal of influence. The use of the soybean to replace meat proteins in the low meat diets was not easy to bring about, owing largely to difficulty in producing small quantities without adequate threshing and cleaning equipment. Soybeans were used most successfully in the form of locally ground meal in breads and also in the form similar to salted peanuts. No serious objections were raised to the quality of these products.

The proportion of foods raised to foods purchased was increased annually during the 4 years to the point at which food purchases per adult equivalent were 38 percent of those of uninfluenced families. The adjustments effected in dietaries and proportionate amounts of food raised and purchased, although highly significant, were accomplished under a degree of pressure impracticable under normal conditions.

Diet-cost reduction to less than \$15.00 of purchased food per adult equivalent per year did not result in a reduced nutritional level; families attaining this extreme food-cost reduction reported more food in the home than ever before.

Regardless of background, the families were well informed on garden-crop production. A garden furnishing 2 percent of the calorie intake was found to be the practical limit of consumption, corresponding to the average recommended farm garden. Garden and field-crop yields increased as the land was improved following clearing. Response to lime and phosphate was immediate in all crops, but responses to nitrate and potash, although limited on new land, became more pronounced as the land became older in point of cropping years. On the basis of yields expected on new land, approximately 7 acres were required for food production for family and dietary livestock, but this could be reduced approximately one-third under yields obtained in field-plot experiments.

The ownership of a team was impracticable on farms having less than 20 acres of crop land. One work animal per small farm, worked cooperatively with a neighbor's when necessary, was found most practical. Farms of less than 10 acres of rotational cropland were worked most economically by the use of custom equipment. The family cow was a necessity on all farms, and was maintained largely on the product of land too sloping for row crops. A significant reduction in the cost of living was attained when the cost of maintaining the cow was reduced.

At constant market prices of prewar level, farm income was increased to the maximum of \$401.42 per farm in 1939 under medium crop yields on farms averaging 15 acres of rotational cropland. A more significant measure of the effort to obtain the complete living on these small farms is the equivalent income—that of increased cash income and reduction in food purchases for family and livestock—which increased from \$20.32 per farm in 1936 to \$588.86 in 1939, or an equivalent rotational crop-acre return increasing from \$3.08 to \$38.86.

Essential family living costs based on 1936-1939 prices were reduced to \$87.76 per adult equivalent in 1939, or approximately half that of uninfluenced family costs. Reduction in cost of food purchases constituted the chief factor of difference. The uninfluenced families made every effort to hold down living expenses; otherwise, a much wider difference between the two groups would have occurred. The influenced reductions in living costs were effected without appreciable sacrifice.

Market crop specialization on the subsistence-size farm appeared necessary to meet costs of living. Experimental results on the Plateau throughout a period of many years indicate possibilities in the specialization of many market crops. For the purpose of the immediate study, Irish potatoes were grown as the chief source of income. During the last year of the project an average of 4.1 acres per farm were grown, and at the conservative market price of \$1.00 per 100, and medium yields, an average net farm income above all operating costs of \$153.68 was received; but this failed to meet the average family living cost of \$381.04. However, additional miscellaneous income, exclusive of that from the University, which may be considered a fair average for the subsistence-farm operator not fully employed at home, brought the average income to within \$45.37 of balancing the budget.

The time available for preparation of a product for a special market, and the increased productiveness obtained on Plateau soils through continued practice of approved soil management, can result in meeting the indicated living costs on the average-size farm studied. At least 5 acres were available for intensive cash cropping on the average farm and may be considered the minimum acreage for income crops.

The least successful attempts to live on the land were by those having a non-agricultural background, particularly those from factories and public works. A large percentage of the families studied had experience in coal mines, but this experience did not interfere seriously with their attempts to live on the land, apparently because of the favorable contrast between living on the farm and living at the mine. The difficulties observed in adjusting industrial workers to living on the land—not only the limited number involved in the project, but including the entire resettled element on the Cumberland Homesteads—leads to the conclusion that rehabilitation of industrial workers on land is impracticable without a long period of training, and then is possible only under conditions of drastically reduced economic status.

PUBLICATIONS RELATING TO THE CUMBERLAND PLATEAU**Bulletin**

- 101—The Rational Improvement of Cumberland Plateau Soils
By C. A. Mooers.
- 141—The Comparative Values of Different Phosphates
By C. A. Mooers.
- 181—Potato Growing on the Cumberland Plateau
By J. J. Bird.
- 192—The Cumberland Plateau in Tennessee
By F. N. Masters and C. E. Allred.
- 193—Milk Goats in Tennessee
By S. A. Hinton and J. J. Bird.
- 196—Nitrate of Soda as a Fertilizer for Corn
By C. A. Mooers.
- 198—Practical Land Clearing on the Cumberland Plateau
By J. J. Bird.

Circular

- 74—Soybeans in the Diet
By Jane K. Hale.

Monograph (Agricultural Economics—mimeographed)

- 11—Relief in a Coal Mining Community, Grundy County, Tennessee
By C. E. Allred, C. A. Tosch, M. Taylor Matthews, G. A. Baker, W. Eugene Collins, P. H. Sanders and B. D. Raskopf.
- 33—How Swiss Farmers Operate on the Cumberland Plateau
By C. E. Allred, S. R. Neskaug and W. E. Hendrix.
- 128—The English Settlement at Rugby, Tennessee
By E. I. Miller.
- 129—Neighborhoods and Communities of Cumberland County, Tennessee
By H. J. Bonser and R. G. Milk.
- 139—Significant Changes in Agriculture of Cumberland County, Tennessee
By C. E. Allred, H. J. Bonser and E. J. Lebrun.
- 144—Local Leadership in Rural Communities of Cumberland County, Tennessee
By H. J. Bonser, R. G. Milk and C. E. Allred.

- 165—Farm Management Analysis of 107 Farms in the Cumberland Plateau
By E. J. Lebrun.
- 177—Labor, Materials, and Cost of Clearing Land on Cumberland Plateau
By H. J. Bonser, C. E. Allred and C. C. Mantle.
- 178—Use and Need of Farm Credit on Cumberland Plateau
By B. H. Luebke, A. H. Chambers and C. E. Allred.
- 179—How the Plateau is Farmed on Sand Mountain, Alabama
By F. N. Masters and C. E. Allred.
- 180—Farm Credit Agencies Serving Cumberland Plateau, 1943
By B. H. Luebke, A. H. Chambers and C. E. Allred.
- 194—Costs, Materials, and Practices in Growing Irish Potatoes on Cumberland Plateau
By F. N. Masters and C. C. Mantle.
- 196—Costs, Returns, and Practices in Growing Snap Beans on Cumberland Plateau, 1944
By H. J. Bonser and C. C. Mantle.
- 204—Income and Expenses in Growing and Marketing Irish Potatoes, Cumberland Plateau, 1943-1944
By F. N. Masters and C. C. Mantle.

APPENDIX

In connection with the project reported in this bulletin, the Station is indebted to a very competent refugee physician, Dr. Eva M. Schuchardt, for the physical examination of some 286 children of the area under consideration. Her report follows.

PHYSICAL EXAMINATIONS

July and August, 1941

Method.—The examination I have given to about 286 children is equivalent to that of a public health clinic or of a visiting school doctor. I have refrained from all those methods of detailed examination that would have been either too complicated, as the use of an ophthalmoscope, which would have required the darkening of the room, or too time-consuming, as a hearing test or exact body measurement. Such methods I considered dispensable because they would not have given any information about the general conditions of development and state of nourishment. These two points were the main objects of my examination. I have refrained from additional tests, such as blood tests, X-ray, or bacteriological examination of body discharges. This series of examinations, there-



Fig. 9—Physical-status examination of children in portable laboratory.

fore, does not claim to be either complete or very detailed. The emphasis is on the general condition of the individual concerning the state of development, as well as the nutritional condition.

Evaluation of Findings.—The evaluation is centered around the height and weight of the individuals in relation to each other and to age. To obtain a standard value, according to which the rating or scoring could be done, I have based the figures on those values which Pirquet and Kronfeld have found in a large number of European children. The fact that these values may not be perfectly in accord with those of American children seemed to me insignificant, since there is no standard, for any nation or race, which can be considered completely “normal”; standards vary widely among races and individuals. The point was to find a fixed standard of measurement around which the rating could be centered in the most objective way and to eliminate the wide sources of error which would exist in a rating system based on mere judgment and estimation.

Therefore, it does not matter if the values which have been designated “normal average” are a trifle below or above the standard of this particular part of the country—determination of this normal average would be the subject of anthropometrical examination. What does matter is the proportion of height to weight of the individual.¹ This, therefore, has been most carefully scored and evaluated, as the chart shows.

The rating of the other findings has been undertaken also with regard to the importance which the organ or organ system has in its

¹Related to the age.

relation to the nutritional conditions. Therefore, I have omitted the findings on the heart and lungs, which might be looked up in the sheets, and have refrained from an evaluation and even examination of the mental development. Apart from the secondary role which it plays in the conditions of nourishment—supposing that there are no cases of serious and fatal deficiencies—the approach to these children would have taken hours, and the mental situations during my visit were not the ordinary ones of their daily routine.

Furthermore, I have made few medical diagnoses, but, in the small number of cases of evident physical or mental disturbances, have made a general determination of the group of diseases or a general classification of the disturbance. (For instance, “nervous traits” or “skin irritations”).

The diagnostic remarks in the text of the statistical resume do not claim to be irrevocable. They are based on my general medical knowledge, unsupported by secondary or specific diagnostic methods.

Chart of Height and Weight (correlated with the age)

1. Normal average	144=50.3%
which fall into the following groups:	
a. Weight and height proportioned	59
b. Relatively underweight (normal but oversized)	7
c. Relatively overweight (normal but undersized)	8
d. Relatively undersized (normal size but overweight)	47
e. Relatively oversized (normal size but underweight)	23
2. Below average	70=24.5%
which fall into the following groups:	
a. Underweight and undersized proportionally	47
b. More underweight than undersized	15
c. Less underweight than undersized	8
3. Above average	61=21.3%
4. Heavily disproportioned	11= 3.9%
which fall into the following groups:	
a. Underweight and overweight	4
b. Overweight and underweight	7

Chart of Percentage of Findings

1. Skin:	
In good condition	76=26.6%
Mediocre (insect bites or neglected)	190=66.4%
Irritations	15= 5.2%
Not examined	5= 1.8%
No.	
1 Intertrigo (chafed)	
13 Extended naevus vasculosus	
34 Staphylodermina superficialis	
35 Lichen pilaris	
91 Multiple abscesses	
95 Acne Vulgaris	

109	Acne Vulgaris	
210	"Prickly Heat"	
211	"Prickly Heat"	
219	Acne Vulgaris	
268	Acute exantheme	} allergic (?)
275	" "	
281	" "	
282	" "	
283	Intertrigo (chafed)	
2.	Skeletal system:	
	Skeletal status good	169=59.2%
	Slight deformities	110=38.5%
	Bone diseases ¹	1= 0.3%
	Not examined	6= 2.0%
3.	Teeth:	
	In good condition	143=50.0%
	Slightly defective, incomplete or irregular	114=39.9%
	In bad condition	18= 6.3%
	Babies without teeth	5= 1.8%
	Not examined	6= 2.0%
4.	Tonsils:	
	Normal	140=49.0%
	Enlarged	140=49.0%
	Recently removed	2= 0.7%
	Not examined	4= 1.4%
5.	Throat (pharynx):	
	Normal	197=68.9%
	Inflamed	85=29.7%
	Not examined	4= 1.4%
6.	Lymphatic system:	
	Lymph nodes normal	115=40.2%
	Lymph nodes locally enlarged	143=50.0%
	Lymph nodes generally enlarged	23= 8.0%
	Not examined	5= 1.8%
7.	Nervous system:	
	Normal	261=91.3%
	Nervous traits	15= 5.2%
	Organic diseases ²	2= 0.7%
	Not examined	8= 2.8%
8.	Thyroid:	
	Normal	213=74.4%
	Enlarged	69=24.4%
	Not examined	4= 1.4%
9.	Abdomen: ³	
	Flat	167=58.4%
	Prominent	112=39.2%
	Not examined	7= 2.4%

¹Multiple tumors (cysts of the bone or exostoses), case No. 43.

²No. 177 had hemorrhages of the brain post partum; still shows slight signs. No. 137 is said to have had infantile paralysis; shows slight differences in the reflexes.

³Among these were 40 protruding navels and 4 navel herniae.

Resume.—As the evaluation shows, a large proportion of the children examined exhibit general underdevelopment in both height and weight. Some of these cases appear as individuals with a general retarded growth and poor nutritional conditions; others appear as merely small individuals but with the signs of healthy and sturdy constitutions. This may be attributed to racial differences.

I have found no cases of really destitute condition caused by malnutrition, or of serious disturbances caused by severe deficiencies. There was no case of pellagra among the children, or of grave rickets, though the signs of mild rickets are common and constitute the largest part of the anomalies registered as "slight deformities of the skeletal system." The rest of these cases are caused largely by the habits of life, such as slight scoliosis of the spine, which I have found in older girls as a consequence of carrying younger siblings on one arm; or stooped shoulders, found in older boys, as a consequence of their early and often rather heavy physical work in the fields and barns.

Many children showed the short, square, stocky type of body structure. This may be found as an expression of racial peculiarity, but is also a rule among country people, who in general show a tendency to develop width rather than height in contrast to the city population, in which the opposite is found.

The teeth were found in admirable condition, though most of them, even the most perfect, showed little sign of care. This fact, which struck me particularly in comparison with the teeth of German school children, seemed to prove that the condition of the teeth and the prevalence of caries is not so much due to exterior conditions as to personal or dispositional factors. In other words, the health of the teeth seems to be more an expression of racial and individual structure than of the state of nourishment or general health. This theory was confirmed by the fact that the well-fed and well-cared-for children did not regularly show the best teeth, and vice versa.

Finally, a word about the abdomen. In a large number of cases I found prominent abdomens in children whose age would normally show flat ones. All the marks for the abdomen were taken in a lying position. A prominence caused by lack of tone in the abdominal muscles, which would be the case in a standing position, was thereby largely eliminated. The prominence of the abdomen in the lying position informs us of an accumulation of either gas meteorism or liquid (ascites) or the presence of a tumor. In this particular case the prominence will very likely be caused by an unusual amount of gas. This fact would at the same time explain the comparatively large number of protruding navels or navel herniae. These children, who at a young age may have been fed many gas-forming substances, such as cabbage and other vegetables, probably suffered from increased inner pressure which the tender abdominal muscles could not withstand.