TABLE 2: *Weight estimates of black bear based on chest girth measurements. The range in parentheses is the 95% confidence interval.*

Chest Girth inches (cm)	Males (kg)	Females (kg)	Males and Females (kg)
12 (30.5)	6.2 (5.6 - 6.8)	10.8 (9.4 - 11.8)	6.1 (5.7 - 6.8)
14 (35.6)	8.8 (7.9 - 9.6)	13.9 (12.0 - 15.2)	8.7 (8.0 - 9.6)
16 (40.6)	11.9 (10.6 - 13.0)	17.4 (14.9 - 19.0)	11.7 (10.8 - 13.0)
18 (45.7)	15.6 (13.9 - 17.0)	21.1 (18.0 - 23.1)	15.2 (14.1 - 17.0)
20 (50.8)	19.8 (17.6 - 21.6)	25.1 (21.4 - 27.5)	19.3 (17.8 - 21.5)
22 (55.9)	24.6 (21.8 - 26.9)	29.3 (25.0 - 32.3)	23.9 (22.0 - 26.7)
24 (61.0)	30.0 (26.5 - 32.8)	33.9 (28.8 - 37.3)	29.0 (26.7 - 32.5)
26 (66.0)	35.9 (31.7 - 39.4)	38.7 (32.7 - 42.6)	34.7 (31.9 - 38.9)
28 (71.1)	42.5 (37.5 - 46.6)	43.7 (36.9 - 48.1)	41.0 (37.7 - 46.1)
30 (76.2)	49.7 (43.8 - 54.5)	49.0 (41.3 - 54.0)	47.9 (44.0 - 53.8)
32 (81.3)	57.6 (50.6 - 63.2)	54.5 (45.8 - 60.1)	55.3 (50.8 - 62.3)
34 (86.4)	66.1 (58.0 - 72.5)	60.2 (50.6 - 66.5)	63.4 (58.1 - 71.4)
36 (91.4)	75.2 (66.0 - 82.6)	66.1 (55.5 - 73.1)	72.0 (66.0 - 81.3)
38 (96.5)	85.1 (74.5 - 93.5)	72.3 (60.6 - 79.9)	81.3 (74.5 - 91.8)
40 (101.6)	95.6 (83.7 - 105.1)	78.7 (65.8 - 87.0)	91.2 (83.5 - 103.1)
42 (106.7)	106.8 (93.4 - 117.5)	85.3 (71.2 - 94.4)	101.7 (93.1 - 115.1)
44 (111.8)	118.7 (103.7 - 130.6)	92.1 (76.8 - 102.0)	112.9 (103.3 - 127.9)
46 (116.8)	131.3 (114.6 - 144.5)	99.1 (82.5 - 109.8)	124.7 (114.0 - 141.4)
48 (122.0)	144.6 (126.1 - 159.3)	106.3 (88.4 - 117.8)	137.2 (125.4 - 155.7)
50 (127.0)	158.6 (138.2 - 174.8)	113.7 (94.5 - 126.1)	150.3 (137.3 - 170.7)
52 (132.1)	173.4 (151.0 - 191.1)	121.3 (100.7 - 134.5)	164.1 (149.9 - 186.6)
54 (137.2)	188.9 (164.4 - 208.3)	129.1 (107.0 - 143.2)	178.6 (163.0 - 203.2)
56 (142.2)	205.2 (178.4 - 226.3)	137.1 (113.5 - 152.2)	193.8 (176.8 - 220.6)
58 (147.3)	222.2 (193.0 - 245.2)	145.3 (120.1 - 161.3)	209.6 (191.2 - 238.8)
60 (152.4)	239.9 (208.3 - 264.9)	153.6 (126.9 - 170.6)	226.2 (206.2 - 257.8)

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SHIFTS IN THE USE OF SELECTED SOIL MAPPING UNITS AS THE RESULT OF AGRICULTURAL UTILIZATION

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ABSTRACT

Current estimates of the soil resources for food production in this country are based primarily upon the yield potential of each soil mapping unit as an entity. The objective of this study was to investigate, with the use of practical farming procedures, the agricultural production potential of three soil associations in Maury County, Tennessee. This study analyzed the effects of the following land use restrictions: percent slope, soil erosion, field size, field shape, and distribution of soil mapping units. The crops selected for the study were wheat, corn, orchardgrass, soybeans, and rotations utilizing these crops. The cropping system which when allocated to a given soil mapping unit, returned the maximum profit while complying with land use restrictions was considered the correct crop. Results of the investigation indicate that thirty-nine percent of the soil mapping units with the capability to support continuous row cropping would have to be utilized for hay or wood land. Loss of crop land varied by soil association from thirty-three to fifty-five percent.

INTRODUCTION

Technology has displayed an ever increasing effect upon the agronomic productivity of this country's soil resources. Some inputs of technology increase the agronomic productivity of our soils as demonstrated by better methods of fertilization. However, other inputs such as the increased size and power of modern farm machinery may have in effect reduced the agronomic productivity of our soils, because under this degree of mechanization, the farmer can no longer give each soil mapping unit individual treatment. The advent of large farm machinery thus has increased greatly the importance of soil patterns. Present day land-use recommendations are based upon soil type characteristics, slope, and degree of erosion. However, the use of modern farm machinery demands that the size and distribution of a soil mapping unit be taken into consideration also as they often limit the available alternatives.

BACKGROUND

Riecken (1963) has studied the relationship between the crop production potentials of soil mapping units (hereafter refered to as simply SMU's) and the actual production obtained from them. In parts of Tama County, Iowa, he found that the acreages of Tama silt loam, level phase, were used at their full potential. However, in other areas of the county where it was associated with and dominated by sloping soils, Tama silt loam, level phase could not be used at its full potential.

The trend toward increasing farm size was discussed by Buchman and McElveen (1958) who agreed that the trend toward large farms stems from the fact that increasing mechanization in farming tends to induce larger operating units. This increase in size, mechanization, and specialization has caused size and shape characteristics of SMU's to become even more important in determining crop production potentials.

Oschwald (1965) did an extensive investigation into the effect of the size and shape of SMU's upon the corn production potential of Adams and Humboldt counties in Iowa. He found that the percentage of acceptable fields decreased as field size increased and as intensity of row cropping increased.

The objective of this investigation was to study the effect of the land use restrictions percent slope, soil erosion control, field size, field shape, and distribution of SMU's on the actual agronomic utilization of the landscape in Maury County, Tennessee. The county is located about 65 miles south of Nashville, Tennessee.

The soil associations chosen for the investigation were the Huntington-Lindside-Armour (Terrace Phases)-Egam, the Braxton-Maury-Armour, and the Talbott-Hagerstown-Rockland. (These soil associations will hereafter be referred to as HLAE, BMA, and THR respectively.) These soil associations were selected due to their widely differing characteristics.

The HLAE soil association is comprised of the low stream terraces and bottom lands of the Duck River and its tributaries. The soils are generally quite fertile but their use is limited by the dissected nature of the landscape, the distribution of the SMU's on the landscape and by the periodic flooding of some SMU's.

The BMA soil association is composed of badly dissected upland in which small areas of productive SMU's are widely scattered among nonproductive ones.

MATERIALS AND METHODS

A grid system was placed over a map of Maury County, Tennessee (1959). Random numbers were used as X and Y coordinates to determine which samples would be selected from the soil associations being investigated. The sample size selected was 100 acres. Each sample was photographically enlarged four times to allow more accurate measurement of landscape details by electric grid calculator.

The crops selected for use in the study were wheat, corn, orchardgrass, soybeans, and a wheat-soybean double cropping system. From these indicated crops, different cropping rotations were derived and used. Average crop yields were calculated for each SMU and net return budgets were prepared for each crop at different yield levels (Hudson and Ray, 1966). The cropping system which returned the most net profit on a SMU while meeting the following soil management criteria was assigned that cropping system as its optimum crop.

The first criterion employed in this investigation (for reasons of safety) restricted cultivation to slopes equal to or less than 25 percent.

The second land use restriction imposed was the soil loss tolerance restriction. The annual soil erosion loss predictions were made using the Universal Soil Loss Equation — $A = RKLSCP$ (Jent, Bell and Springer, 1959) as adapted to the environmental conditions of Maury County. Mean slope lengths for each SMU were obtained by on site field measurement.

The field size criterion was the third restriction to be imposed. The minimum field size used was two acres. If a SMU or field were not of sufficient size, it was either combined with another fiield or dropped from production.

The fourth land use restriction was that of field shape. The field shape criteria were based on two parameters. The distance farm machinery could be driven in a field without turning 90 degrees and the quotient obtained by dividing the measured area of the field by the area of the smallest square which will enclose the field. These two parameters were evaluated numerically and a mean shape index value was obtained for each field. Acceptance or rejection of a field was determined by this shape index value. Fields which did not meet the field shape index criteria were placed in orchardgrass.

RESULTS AND DISCUSSION

The selected SMU's shown in Tables 1, 2, and 4 comprised 89 percent, 94 percent and 86 percent of the area of those SMU's in each soil association which produced a net profit when utilized for crops. The tables demonstrate the shift in land use which occurred as the result of applying the restrictions of this investigation. Since the restrictions employed in this investigation reflect practical farming considerations any shift in land use is of special significance.

The soil mapping unit, Hr is capable of supporting continuous row cropping. (The complete name of all SMU's is given in Table 3.) However, in the HLAE and BMA associations only 18 percent and 31 percent respectively could be so used, and none could be allocated to continuous row cropping in the THR association. The soil mapping unit Mb can be utilized for continuous row cropping and 72 percent of its area was so allocated in the BMA association. However, only 32 percent in the HLAE association and zero percent in the THR association could be so utilized. In the THR association particularly, the Mb soil mapping unit occurred in small scatttred units and was often combined with less productive soils. Tables 1, 2, 4 indicate that very few of the SMU's can be used entirely for their highest return crop if the criteria of this investigation are applied.

Calculations using the values in the table indicate that about 55 percent of the total acreage of those SMU's in the THR association which are capable of accepting continuous row crop production had to be placed in orchardgrass or forest. The HLAE and BMA associations though more productive agriculturally, had 28 percent and 33 percent of their continuous row cropping area allocated to either orchardgrass or forest.

The results of this investigation indicate that the final utilization of a SMU is quite different from soil association to soil association. This was the expected result as the final choice of land use is determined by the presence of natural and man-made obstacles as well as the productivity, size, shape, and distribution of the SMU's on the landscape.

TABLE 1: *Suggested use of selected soil mapping units in the BMA soil association.*

PERCENTAGE OF EACH SOIL MAPPING UNIT ALLOCATED TO VARIOUS USED WHEN THE CRITERIA OF SOIL LOSS, PERCENT SLOPE, FIELD SIZE, AND FIELD SHAPE ARE UTILIZED

Soil Mapping Unit [a]	Cropping System Which Would Be Used Continually If Only Net Profit Were Considered	Cropping Systems Used If Erosion Is Not Allowed To Exceed Soil Loss Tolerance	Percentage In: Continuous Row Crop	Cropping Rotation With Meadow: 4-Year	Cropping Rotation With Meadow: 6-Year [b]	Orchard-Grass	Forest	Roads and Railroads	Gullies	Permanent Streams	Total Percent
Ae [c]	corn	ccmm	45.95	20.01	6.78	19.14	6.16	.69	3.24	--	101.97
Af	corn	ccmm	--	53.11	--	40.79	--	--	6.35	--	100.25
Ag	w-s [d]	w-s, w-s mmmm	--	5.21	--	43.74	33.08	3.71	11.47	--	97.21
Bg	Bg	og	1.82	--	--	81.44	11.72	.03	2.61	--	97.62
Bk	corn	og	1.74	--	--	85.86	10.49	.03	.07	--	98.19
Hh	corn	ccmmmm	--	--	87.15	24.34	15.88	--	--	--	103.03
Hr	corn	corn	30.62	--	.64	20.11	18.36	2.09	26.68	--	102.73
Lc	corn	corn	29.69	--	1.73	20.11	20.17	--	22.58	--	96.03
Ld	soybeans	soybeans	35.59	--	3.26	13.29	15.15	3.84	21.12	--	99.07
Mb	w-s	w-s	72.37	.35	9.05	12.35	1.77	3.34	.50	--	100.67
Me	corn	ccmmmm	6.71	10.69	56.53	95.99	8.95	--	1.05	--	98.92
Mg	og	og	--	--	--	--	--	--	--	--	98.95

a. The complete soil mapping unit name is given in Table IV

b. The four and six year rotation contains two and four years of meadow respectively.

c. 100 percent would indicate no error was made in measuring the various areas comprising the whole

d. w-s = wheat - soybean double cropped, og = orchard grass

TABLE 2: *Suggested use of selected soil mapping units in the HLAE soil association.*

Soil Mapping Unit	Cropping System Which Would Be Used Continually If Only Net Profit Were Considered	Cropping Systems Used If Erosion Is Not Allowed to Exceed Soil Loss Tolerance	Percentage In: Continuous Row Crop	Cropping Rotation With Meadow: 4-Year	Cropping Rotation With Meadow: 6-Year	Orchard-Grass	Forest	Roads and Railroads	Gullies	Permanent Streams	Total Percent
Ad	og	og	--	--	--	98.85	--	--	--	--	98.85
Ae	corn	ccmm	--	75.85	--	4.85	15.29	1.16	.97	--	98.12
Af	corn	ccmm	--	98.84	--	--	.94	.22	--	--	100.00
Bg	og	og	--	--	--	90.32	6.69	4.93	--	--	101.94
Ed	og	og	--	--	--	95.58	--	--	4.49	--	100.07
Eg	w-s	w-s	--	64.76	5.86	22.65	4.70	.83	--	--	98.80
Ha	corn	corn	94.21	--	--	--	5.59	--	--	--	99.80
Hc	og	og	--	--	--	97.28	--	--	2.55	--	99.88
Hg	og	og	--	--	--	58.52	43.33	--	--	--	101.85
Ho	corn	corn	50.53	4.45	--	17.06	10.75	--	12.85	3.06	98.43
Hr	corn	corn	17.77	12.30	--	32.35	16.43	--	21.36	--	100.21
Lc	corn	corn	40.66	19.34	--	6.04	24.18	5.27	3.08	--	98.57
Ld	soybeans	soybeans	38.95	--	--	--	27.08	--	36.05	--	102.08
Mb	w-s	w-s	31.97	--	--	26.84	31.56	8.40	--	--	98.77
Ta	corn	og	--	--	--	94.75	--	--	2.23	--	96.98

TABLE 3: *Symbols and Names of Soil Mapping Units Used in the Study.*

Symbol	Name
Ad	Armour gravelly silty clay loam, severely eroded sloping terrace phase
Ae	Armour silt loam, eroded gently sloping phase
Af	Armour silt loam, eroded gently sloping terrace phase
Ag	Armour silt loam, eroded sloping phase
Bg	Braxton cherty silty clay loam, severely eroded sloping phase
Bk	Braxton silty clay loam, eroded sloping phase
Bm	Burgin silt loam, phosphatic phase
Bn	Burgin silty clay loam, gently sloping phase
Bo	Burgin silty clay loam, gently sloping phosphatic phase
Cc	Colbert silty loam, eroded gently sloping phosphatic phase
Eb	Emory silt loam, gently sloping phase
Ed	Etowah gravelly silty clay loam, severely eroded sloping phosphatic phase
Eg	Etowah silt loam, eroded gently sloping phosphatic phase
Ha	Haggerstown silt loam, eroded gently sloping phase
Hc	Hagerstown rocky silty clay loam, eroded gently sloping phase
He	Hermitage silt loam, eroded gently sloping phase
Hg	Hicks flaggy silt loam, eroded sloping phase
Hh	Hicks silt loam, eroded gently sloping phase
Ho	Huntington silt loam, phosphatic phase
Hr	Huntington silt loam, local alluvium phosphatic phase
Lc	Lindside silt loam, phosphatic phase
Ld	Lindside silt loam, local alluvium phosphatic phase
Mb	Maury silt loam, eroded gently sloping phase
Me	Maury silty clay loam, eroded sloping phase
Mg	Mimosa cherty silt loam, eroded sloping phase
Ta	Talbott silty clay loam, eroded gently sloping phase
Tb	Talbott silty clay, severely eroded sloping phase