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stricting the more critical areas to grazing. Benefit-cost analysis might be used in making a choice between flood-plain zoning and alternative remedial measures, and for deciding upon the character of zoning regulations to be adopted.

FARM ZONING DISTRICTS.—Rural zoning is a flexible tool that can be readily shaped to serve the needs of rural people. Realization of its full potentials awaits the touch of adaptative imagination. Perhaps zoning regulations could be designed to prevent the unplanned, haphazard, and often premature, suburban development on good agricultural land located on the urban fringe. The destruction of the agricultural character of these communities often begins by sale of a few small tracts for nonfarm residential uses. The process continues, bringing with it higher taxes stemming from school, sanitation, and other public-service problems, and, finally, the economic and political submergence of the rural community. Such parcellation and nonfarm uses are permitted by prevailing cumulative zoning district regulations (fig. 3).

Instead, regulations designed for agricultural zones might prohibit nonfarm residences and impose large-tract minimums. These would tend to retard parcellation. A comparable growing practice in industrial districts is the exclusion of all nonindustrial uses. Moreover, there are already county zoning ordinances that prescribe minimums of 5-, 10-, and even 20-acre tracts. A further step might be the establishment of greenbelts around our cities.

In closing, it is emphasized that the legal raw materials of zoning—the basic types of regulations—were urban created; that in the past these raw materials have been reshaped in an effort to serve the rural community. Today, in our changing rural economy, new problems and goals call for new zoning techniques. It is probable that rural zoning will again prove to be a flexible community tool.

Changes in Corn Acreage and Production After the Early Indications

By Malcolm Clough

Early-season indications of corn acreage and production are important to farmers, to processors, and to the Government. This article compares the earliest indication of corn acreage and production each season with the actual outcome of the crop as estimated in December. During the last two or three decades, more than 80 percent of the year-to-year variation in corn acreage has been reflected in the March 1 intentions, and about 60 percent of the variation in corn production has been reflected in the July 1 indications. But 40 percent of the variation in corn production has been determined after July 1, and decisions based on July indications must allow for this remaining uncertainty. In general, the range of uncertainty is reduced substantially by the August and September crop reports. The September estimates have differed from the December estimates by less than 100 million bushels in 20 of the last 32 years.

BECAUSE of the prominent place of corn in the agriculture of our country, prospects for an oncoming crop are of interest and concern, not only to Corn Belt farmers, but to the public generally. Prospects for the crop are basic to the outlook for livestock production and to prospective supplies of meat, milk, and eggs. Changes in prospects for the crop are under continual observation, from the first indications of farmers' planting intentions, as reported in March, to the time of harvest in the fall.

The purpose of this paper is to compare the

earliest indication of acreage and production in each year with the actual outcome of the crop as estimated in the December crop report each year. The estimates of acreage and production made currently each year in December are used in making these comparisons, since they are the latest official estimates for the preceding year available at the time the prospective acreages and the July 1 indicated production figures are reported. The final estimates made in later years include revisions based on Census data. Data on early indications of acreage and production are not revised later to reflect general changes in level based on the Census.

Most farmers probably begin making plans for the next corn crop soon after the current crop is harvested. The first official indication of prospective corn acreage, made by the Department of Agriculture, is released in March, based on a survey of farmers' planting intentions as of March 1. The first official figures on indicated production are released in July on the basis of the July estimated acreage for harvest, the condition of the crop at that time, and assuming normal growing weather during the remainder of the season. It is recognized at the time of the release of these reports that weather and other factors may change the final acreage or production substantially from early indications.

It is generally known that corn production, influenced by the effect of weather on yields, varies much more from one year to the next than does the acreage of corn.[1] This fact is brought out in the comparisons that follow. Changes from farmers' intentions as to acreage, which are largely under the control of the farmer, are much less pronounced than changes in estimates of production from July to December, which are influenced by weather and other factors mostly outside of his control.

March 1 Acreage Intentions

A Fairly Reliable Indicator of Planted Acreage

Farmers have been reporting their plans for planting corn and other major farm crops since late in the 1920's. Their reports as of March 1 are summarized by the Crop Reporting Board each year to give the first indications of prospective changes from the preceding year in acreages to be planted. Historical comparisons show that the March intentions as to corn acreage have been fairly reliable as indicators of planted (or harvested) acreages. Farmers generally follow through reasonably close to their March plans.

The primary purpose of these reports is to provide information to assist growers in making such further changes in their acreage plans as may appear desirable. The acreage actually planted or harvested in the year is influenced by weather conditions at planting time, price changes, agricultural programs, or other conditions which affect planting after March 1. Furthermore, farmers take advantage of the Prospective Plantings report itself as a guide in changing their acreage plans for various crops.

A comparison of the March 1 indicated acreages of corn and the actual acreages planted (or harvested) as reported in December is made here for the years 1929-50. It will be noted that the comparisons for the first 9 years of the period (1929-37) differ from those for the years 1938-50 in that the intentions in the earlier period were reported on the basis of prospective acreage for harvest. From 1938 to date the March 1 intentions were reported on the basis of prospective plantings. For this reason the March intentions are compared with harvested acreage from 1929 through 1937, and with planted acreages from 1938 to date.

For the entire period the intended or prospective acreages were fairly close to the estimated actual acreages. In some of the years before 1937 sizable deviations from the intentions reflect greater than average abandonment of acreage after planting, as farmers in that period reported prospective acreage *for harvest.* The heavy abandonment in 1934 and 1936, as a result of the severe droughts, resulted in a considerably smaller acreage actually harvested than was indicated in March. Weather also appears to have been an important factor in some more recent years, when acreages planted deviated considerably from the intentions. In 1945, for example, and to some extent in 1947, wet planting seasons prevented farmers from planting the full acreage intended earlier in the year. In 1949, on the other hand, wet weather during the planting time for oats and other small grains apparently meant that farmers diverted land to corn that they originally planned to put into small grains.

[1] Comparisons of year-to-year changes in corn acreage, yield, and production were published in the *Feed Situation,* December 1948. These comparisons revealed that the average change in corn yields from one year to the next was about 15 percent of the average yield during 1919-48, whereas the average change in corn acreage was only about 3 percent of the average acreage.

These comparisons indicate that farmers generally have planted slightly less corn than they planned in March, or that they have not realized fully their planting intentions. In the earlier years, however, the difference between prospective and actual acreages (harvested) is exaggerated by the heavy abandonment in some of these years. For the years 1938-50 planted acreage averaged about 425,000 acres, or 0.5 percent, below the March 1 intentions. For the entire period (including 1929-37 when farmers reported prospective acreage for harvest), the acreages realized averaged about 1.1 million acres below the intentions. If the two drought years, 1934 and 1936, are omitted, the acreage realized averaged only 700,000 acres, or less than 1 percent, below the intended acreages.

Comparisons of acreage intentions and the acreage planted (or harvested) are shown in table 1, both on the basis of total acreages and in terms of change from the preceding year. The change from the preceding year for the March 1 intentions is the change from the previous acreage harvested for the years 1929-37, and from the previous acreage planted for the years 1938 to date. This comparison reveals that the intentions indicated the direction of change in 17 of the 21 yearly comparisons.

Statistical measurements of the association between the prospective and the actual change in acreage from the preceding year are summarized in table 2. Based on the estimating equations the acreages planted (or harvested) by farmers averaged a little below those indicated by the March 1 intentions reports. The magnitude of the prospective change after adjustment for level, as indicated by the regression coefficients .976 and .912, also was a little less than the actual change. The coefficient of correlation between prospective and actual acreage changes for the entire period was .90, and the standard error of estimate 2.1 million

TABLE 1.—*Corn: March 1 intentions as compared with planted or harvested acreage, United States, 1929-50*

Year	March 1 intentions[1]	Planted or harvested acreage[2]	Difference	Change from preceding year		Acreage planted but not harvested
				March 1 intentions[3]	Planted or harvested acreage	
	Million acres	*Million acres*	*Million acres*	*Million acres*	*Million acres*	*Million acres*
Harvested						
1929	100.2	98.0	—2.2			
1930	100.8	100.8	0	2.8	2.8	2.4
1931	105.8	105.0	— .8	5.0	4.2	2.5
1932	107.3	107.7	.4	2.3	2.7	2.4
1933	103.9	102.2	—1.7	—3.8	—5.5	3.9
1934	92.1	87.5	—4.6	—10.1	—14.7	8.4
1935	95.7	92.7	—3.0	8.2	5.2	4.0
1936	98.8	92.4	—6.4	6.1	— .3	8.8
1937	94.8	93.8	—1.0	2.4	1.4	3.2
Planted						
1938	94.6	93.3	—1.3	[4]—1.9	[4]—3.2	2.3
1939	92.1	91.5	— .6	—1.2	—1.8	3.4
1940	87.8	88.1	.3	—3.7	—3.4	2.3
1941	87.7	87.2	— .5	—.4	— .9	1.5
1942	91.3	91.0	— .3	4.1	3.8	1.5
1943	96.8	97.1	.3	5.8	6.1	2.3
1944	99.6	98.7	— .9	2.5	1.6	1.5
1945	95.8	92.9	—2.9	—2.9	—5.8	1.6
1946	93.0	90.0	—3.0	.1	—2.9	1.3
1947	87.6	86.2	—1.4	—2.4	—3.8	2.2
1948	86.1	86.2	.1	— .1	0	.8
1949	84.8	87.9	3.1	—1.4	1.7	1.2
1950	82.8	84.4	1.6	—5.1	—3.5	1.1
Average 1929-50	94.5	93.4	—1.1	----	----	2.8
Average (excld. 1934 and 1936)	94.4	93.7	— .7	----	----	2.2

[1] Prospective acreage for harvest 1929-37; prospective plantings 1938-50.

[2] Preliminary estimates of acreage harvested, 1929-37, and planted, 1938-50, as reported in the December crop report of each year.

[3] Change from the acreage harvested the preceding year, 1930-37, and from acreage planted the preceding year, 1938-50.

[4] Change from planted acreage in 1937 of 96.5 million acres.

acres. When the severe drought years 1934 and 1936 are adjusted to reflect about the average abandonment for the entire period, the coefficient of correlation is increased and the standard error reduced.

The relationships computed after making adjustments for the years of drought appear to be more applicable to the association between acreage intentions and acreages planted, as currently reported, since abandonment of planted acreage no longer affects the relationships. The planted acreage has been within 1.5 million acres of the intended acreage in 10 of the last 13 years (1938-50) in which prospective plantings have been reported.

TABLE 2.—*Measurements of the relation between the prospective and the actual change in corn acreage from the preceding year*[1]

Period	Regression equation	r	r^2	Standard error of estimate
				Million acres
1929-50	$X_1 = -1.06 + .976\ X_2$	.900	.809	2.1
1929-50[2]	$X_1 = -.49 + .912\ X_2$	.941	.885	1.5

[1] The actual acreage is the dependent variable (X_1) and the prospective acreage (March 1 intentions) is the independent variable (X_2).

[2] With acreages in the drought years 1934 and 1936 adjusted to reflect the average abandonment for the entire period.

July Indications of Corn Production

Within 3 Percent of the December Estimate in 2 Years out of 5; Differ by More than 15 Percent in One-fifth of Years

Corn production as indicated in July and the actual production as estimated in December also are compared for the years 1919-50. As discussed previously, the July indications are based on the condition of the crop in July, assuming average weather during the remainder of the growing season. In years when the remainder of the growing season was near normal, the size of the crop as estimated in December did not differ greatly from the July 1 indications. In 13 of the 32 years the December estimate was within 88 million bushels, or about 3 percent of the July indicated production.

In years when unusually favorable or adverse conditions prevailed after July 1, the final outcome of the crop varied substantially from the indicated production as of July 1. In 3 of the years when droughts occurred during the growing season, 1930, 1934, and 1936, the final outcome of the crop was more than 700 million bushels below July 1 indications. In 6 of the 32 years the December estimate of production differed from the July figure by 15 percent or more.

Indicated production as of July is compared with the December estimates (in table 3) in the same way that the comparisons between prospective and actual acreages were made previously. The year to year comparisons show that corn production varies much more than corn acreage, and there is no advantage in using last year's production as a starting point for estimating the current crop. Hence attention is focused on the differences between the early indications themselves and the December estimates.

It is of interest that the December estimate was below the July indications about as many times as above it—15 years out of the 32. But the frequency distribution of these differences, shown in table 4, differs considerably from a normal frequency pattern. Years in which production was moderately above that indicated in July occurred much more frequently than those in which it turned out moderately below. The distribution of the observations below 0 was particularly skewed, with 3 of the 15 years falling in the extreme class interval of —900 to —700 million bushels. There were no years, however, when production exceeded the July indication by 700 million bushels. This brings out the fact that there is greater likelihood of having production turn out much lower than indicated in July than much higher. On the other hand, there were more years when actual production turned out moderately higher than indicated in July than moderately lower. There were 10 years when actual production was 100 to 500 million bushels above that indicated in July and only 4 years when it was 100 to 500 million bushels below.

The average difference between July 1 indicated production and the December estimates, shown in table 3, was 227 million bushels, or about 8 percent of the average production. The standard deviation of the differences was 314 million bushels. There were 22 years (69 percent) when the difference was not greater than the 314 million bushels. Of the 10 years when differences exceeded 314 million, there were 6 years when the December estimates were above the July indications and 4 years when they were below. In 3 of these 4 years, however,

TABLE 3.—*Corn: July indications and December estimates of production, 1919-50*

Year	July (Indicated)[1]	December (Estimate)[2]	Difference	Change from preceding year[3]	
				July (Indicated)	December (Estimate)
	Million bushels	*Million bushels*	*Million bushels*	*Million bushels*	*Million bushels*
1919	2,815	2,917	102		
1920	2,779	3,232	453	−138	315
1921	3,123	3,080	− 43	−109	−152
1922	2,860	2,891	31	−220	−189
1923	2,877	3,054	177	− 14	163
1924	2,515	2,437	− 78	−539	−617
1925	3,095	2,901	−194	658	464
1926	2,661	2,645	− 16	−240	−256
1927	2,274	2,786	512	−371	141
1928	2,736	2,840	104	− 50	54
1929	2,662	2,622	− 40	−178	−218
1930	2,802	2,081	−721	180	−541
1931	2,968	2,557	−411	887	476
1932	2,996	2,908	− 88	439	351
1933	2,384	2,330	− 54	−524	−578
1934	2,113	1,381	−732	−217	−949
1935	2,045	2,203	158	664	822
1936	2,245	1,524	−721	42	−679
1937	2,572	2,645	73	1,048	1,121
1938	2,482	2,542	60	−163	−103
1939	2,571	2,619	48	29	77
1940	2,416	2,449	33	−203	−170
1941	2,549	2,673	124	100	224
1942	2,628	3,175	547	− 45	502
1943	2,707	3,076	369	−468	− 99
1944	2,980	3,228	248	− 96	152
1945	2,685	3,018	333	−543	−210
1946	3,342	3,288	− 54	324	270
1947	2,613	2,401	−212	−675	−887
1948	3,329	3,651	322	928	1,250
1949	3,530	3,378	−152	−121	−273
1950	3,176	3,131	− 45	−202	−247
Average	2,735	2,739	[4]±227	[4]±336	[4]±405

[1] Indicated production, based on conditions July 1, assuming normal weather during the remainder of the growing season.

[2] Production as estimated in the annual summary of each year.

[3] Change from production the preceding year as estimated in December.

[4] Disregarding direction of difference.

the December estimates were more than 2 standard deviations below the production indicated in July, while none of the 6 years was above the July indications by as much as 2 standard deviations.

In considering the comparisons in terms of change from the preceding year, it will be noted that the July indications reflected the direction of the change in 23 of the 31 observations. The 8 years in which the July indications did not reflect the direction of change were generally years in which the condition of the crop changed materially after July 1. In 1930 and 1936, for example, small increases from the preceding year were indicated on the basis of July 1 conditions, but the droughts which came after July 1 caused a marked deterioration of the crops. On the other hand, 1942 was

TABLE 4.—*Corn: Frequency distribution of differences between July indications and December estimates of production, 1919-50*

Class interval	Class mid-point	Frequency	
		Years	Percentage of total years
Million bushels	*Million bushels*	*Number*	*Percent*
−900 to −700	−800	3	9.4
−700 to −500	−600	0	0.0
−500 to −300	−400	1	3.1
−300 to −100	−200	3	9.4
−100 to 100	0	13	40.6
100 to 300	200	6	18.8
300 to 500	400	4	12.5
500 to 700	600	2	6.2
700 to 900	800	0	0.0
Total		32	100.0

TABLE 5.—*Corn: Differences between the December estimate of production and estimates made in earlier months, United States, 1919-50*

Year	July	Aug.	Sept.	Oct.	Nov.
	Mil. bu.	*Mil. bu.*	*Mil. bu.*	*Mil. bu.*	*Mil. bu.*
1919	102	129	60	17	7
1920	453	229	101	16	33
1921	— 43	48	—106	— 83	— 71
1922	31	—126	16	37	— 5
1923	177	73	— 21	33	25
1924	— 78	—140	— 76	— 22	— 41
1925	—194	— 50	15	— 17	—113
1926	— 16	68	— 53	— 35	— 49
1927	512	401	330	183	33
1928	104	—190	— 91	— 63	— 55
1929	— 40	—118	166	94	1
1930	—721	—131	98	34	— 13
1931	—411	—218	—158	—146	—118
1932	— 88	88	54	23	— 13
1933	— 54	57	45	39	41
1934	—732	—226	—104	— 36	9
1935	158	— 69	19	— 10	— 8
1936	—721	85	66	15	— 2
1937	73	— 14	96	83	— 6
1938	60	— 24	88	83	61
1939	48	159	96	87	28
1940	33	201	152	97	16
1941	124	85	149	47	— 3
1942	547	421	159	43	— 10
1943	369	201	91	21	— 9
1944	248	299	127	31	— 30
1945	333	174	— 51	— 60	— 56
1946	— 54	—209	— 84	— 87	— 93
1947	—212	—259	— 3	— 58	— 46
1948	322	144	122	83	1
1949	—152	—160	—148	— 99	20
1950	— 45	— 37	— 32	13	26
Average[1]	±227	±151	± 93	± 56	± 33
Standard deviation	314	178	107	68	43

[1] Disregarding direction of difference.

a year when very favorable weather after July 1 brought a marked improvement in crop prospects. The 1942 crop turned out 500 million bushels larger than in 1941, whereas a slightly smaller production was indicated on the basis of July 1 conditions.

Simple regression equations were computed to measure the association between (1) July indications and the December estimates of production and (2) the year to year changes in these two series from the December estimates of the preceding year.[2] The coefficients of determination (r^2) associated with the two equations are 0.582 and 0.619, respectively. The second coefficient implies that about 62 percent of the change in corn production from the preceding year has been reflected in the July indications. The remaining 38 percent of the variation in corn production reflects factors which operated after July 1, or factors which were not accounted for until after that date. The first coefficient may be given a similar interpretation in terms of variations of corn production about the 1919-50 average.

While the July 1 indication of the corn crop is the first report on production each year, the size of the crop is reappraised each month from July to December on the basis of conditions at the beginning of the month. The estimates made as the crop

[2] The first regression equation is $X_1 = -179.4 + 1.07 X_2$, where X_1 is the December estimate and X_2 is the July 1 indicated production. The standard error of estimate is 324 million bushels. The second regression equation is $X_1 = 1.5 + .919 X_2$, where X_1 is the change in production as estimated in December from the December estimate for the preceding year, and X_2 is the change in indicated production as of July 1 from the December estimate for the preceding year. The standard error of estimate is 328 million bushels.

These regression equations prove to be of no practical value for re-estimating corn production from the July indications, since the standard errors of estimate in each case are slightly greater than the standard deviation of the differences between the July indications and the December estimates of production (314 million bushels). This is to be expected, since the equations do not contain factors that adjust for abnormal weather subsequent to July 1.

develops would be expected to become progressively nearer to the December estimate made at the close of the growing season. This is borne out by table 5, which shows the differences between the monthly estimates made each year and the December estimate.

Since July and August are the critical growing months for corn, the estimates adjust rapidly toward the December figure from July 1 to September 1. Whereas the mean difference between the July and the December estimates of production was 227 and the standard deviation of the differences was 314, by September the mean difference was reduced to 93 and the standard deviation to 107. Further reductions were made in September and October, so that the October 1 and November 1 estimates in most years were fairly close to the December estimates. For the 32 years considered, the September estimates differed from the December estimates by more than 100 million bushels (about 3 percent) in only 12 years. The October and the November estimates differed by more than that amount in only 2 years.

The convergence of the earlier monthly estimates and the December estimate as the corn-growing season progresses is illustrated graphically by figure 1, based on the standard deviations of the differences shown in table 5. The production indications used for March are based on the March prospective acreages, assuming yields about the same as the average for the previous 5 years, after

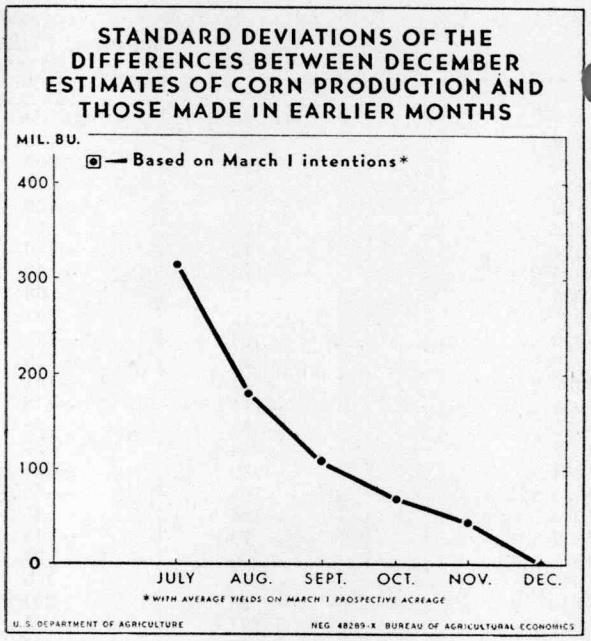

FIGURE 1.

allowance for abnormal years. These projected production figures have been published in the March Prospective Plantings report over the past several years to provide a general guide as to the level of production, pending the issuance of the first official production estimate in July. The marked drop in the standard deviation from 31[illegible] million bushels for July 1 to 107 million for September 1 reflects the increased reliability of the monthly estimates as the crop nears maturity.