



Bite without bark: How the socioeconomic context of the 1950s U.S. drought minimized responses to a multiyear extreme climate event

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ABSTRACT

The drought of the 1950s was among the most widespread, severe and sustained ever experienced in the United States. For several states, the severity of the 1950s drought exceeded that of the 1930s “Dust Bowl”. The 1950s were characterized by low rainfall amounts and by excessively high temperatures. The climatological aspects of the drought subsided in most areas with the spring rains of 1957. A careful review of official reports over this period reveals limited acknowledgment of the drought of the 1950s. The drought was no secret, but it did not receive a great deal of news coverage; later droughts of lower severity and shorter duration, such as 1976–77, 1988, 2002–2004, 2011–2012 and the ongoing drought in California (2011–2015), garnered much greater national focus. In this paper, the question why such a major geophysical variation appears to have elicited little major national policy response, including the apparent lack of significant media concern is addressed. In framing the discussion this study assesses, the evolution of drought during the 1950s to establish its national and regional policy contexts, technological improvements and financial changes prior to and during the event, and on and off-farm responses in terms of the socioeconomic impacts. The study provides an overview of key developments and concerns in agriculture since the early 20th Century sets the context for the 1950s, then moves to the farm itself as a unit of analysis. This approach shows not only how the situation may have appeared to those outside the afflicted areas, but also how decisions were guided by agricultural economics affecting farmers at the time, and the strong influence of broader historical trends in which the 1950s were embedded. The paper provides the relevant agricultural statistics and uncovers the political and public perceptions moving through the drought years. Overproduction was the fundamental, almost paradoxical problem facing American agriculture at the time. The paper concludes with a discussion of how the implications of this event, and the attendant responses, might provide guidance to future assessments of extremes such as severe drought in the context of a changing climate.

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1. Introduction

The post-war 1950s is widely perceived as a period of optimism and prosperity in the U.S., and remains such in the American imagination. But, in the midst of this period of growth, the Great Plains and the southwestern U.S. were experiencing multi-year drought. By 1954, the drought reached from Ohio to Nevada and from Wyoming to Georgia, with the most extreme conditions in the mid-west, the Great Plains, and southward into New Mexico, reaching a peak in 1956 (Fig. 1). The 1950s drought was characterized by both low rainfall amounts and excessively high temperatures. In 1953, 75% of Texas recorded below normal

rainfall amounts, with temperatures in Dallas exceeding 100 °F on 52 days during that summer. Kansas recorded a negative Palmer Drought Severity Index from 1952 until March 1957, with a record low in September of 1956. The drought subsided in most areas with the spring rains of 1957. The droughts of the 1930s and the 1950s remain the benchmarks in terms of duration, severity, and spatial extent over much of the midWest in the 20th century (Latzell and Evans, 2013; Woodhouse and Overpeck, 1998).

The U.S. President's annual Economic Reports (Eisenhower, 1954 through 1961) provide an unusually clear indication of abiding concern and an exposition and justification of policy. These Economic Reports have great value as indicators of the political mainstream's views of economic problems and possibilities (Peterson, 1979), however a review for this period reveals almost no acknowledgment of the drought of the 1950s. There is serious consideration in reports to Congress from a well-publicized

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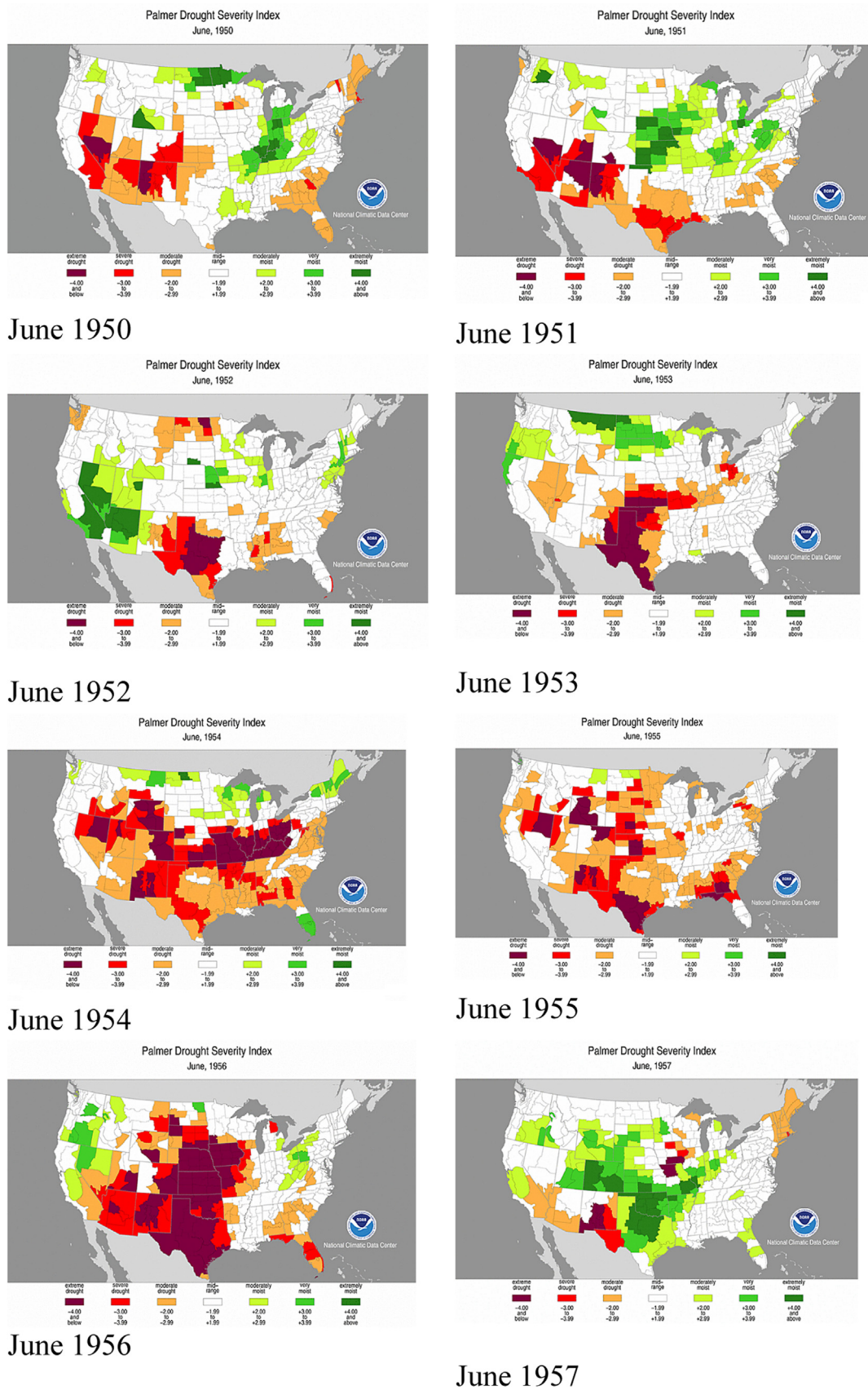


Fig. 1. Palmer drought severity index: climatological divisions June 1950 to June 1957.

national-level meeting (Eisenhower, 1957), the only one of note during the prolonged drought, and a report to the President from The Special Assistant to the President for Public Works Planning (1958), but by the time these official statements appeared, the crisis was already waning.

A useful analogy, on the lack of warning, may be drawn from Sherlock Holmes.

‘Is there any point to which you would wish to draw my attention?’

‘To the curious incident of the dog in the night-time.’

‘The dog did nothing in the night-time.’

‘That was the curious incident,’ remarked Sherlock Holmes.

–Arthur Conan Doyle, “Silver Blaze” (1892)

Holmes solved the case because a dog did not bark when it should have, indicating that the malefactor was known to the dog. Considering the socioeconomic context of the 1950s drought in the United States is similar to asking why the dog did not bark: why there was so little major policy response even with such a large climatic bite? Why was there an apparent lack of news media concern? In the following discussion, these questions are addressed at the national level as a complement to regional and local assessments, which suggest the extent of hardship suffered in the affected areas.

This paper assesses, the evolution of drought and impacts during the 1950s to establish their national and regional policy contexts, technological improvements and financial changes prior to and during the event, and on and off-farm responses in terms of the socioeconomic impacts. The study begins with an overview of key developments in agriculture leading up to the 1950s, the view of the drought at the national level, a survey of “official histories” and agricultural statistics, a description of the demographic context, and then a review of public perceptions at the time and how they may have reflected in images born of the “dirty 30s.” The socioeconomic context of the farm itself as a unit of analysis is then outlined. These topics show how the situation may have appeared to those outside the afflicted areas, and how decisions were affected by the agricultural economics faced by farmers at the time, and the broader historical trends in which the 1950s were embedded.

A large and growing literature on climate impacts is available, because of concern over global environmental change (Ojima, et al., 2002; Wagner, 2003; Gleick 1990; Reilly et al. 2001, 2003; Melillo et al. 2014). These reviews (and arguably many subsequently produced) seem to presume that new information will provide an impetus for new responses; unfortunately, that is not clear. The 1950s drought was no secret, but it did not have a large media presence such as later droughts of lower severity and shorter duration, such as 1976–77, 1988, 1998, 2000–2004, 2011–2012 and the ongoing drought in California (2011–2015) attracted far more attention. Of additional note is that the drought was indeed more severe in some locations than the Dust Bowl years it is not recalled in the collective memory with commensurate significance. Here, the question of why such a major geophysical variation appears to have had a relatively minor national policy impact is considered. The approach taken follows that of Vayda (1983), working from the event outward toward the social responses, or their absence, and Lasswell’s problem orientation (clarifying goals, trends, conditioning factors on those trends, and alternatives (Lasswell, 1971). A fundamental, almost paradoxical problem facing American agriculture at the time was over-production. The paper notes the political and public perceptions moving through the drought years. Finally, a series of questions is included, which we hope, may guide future assessments of extremes such as severe drought, in the context of a changing climate.

2. The evolution of adjustment: getting to the Fifties

A general history might define the “golden era” of U.S. agriculture as roughly encompassing the period from 1897 to 1920 (Fite, 1964). The continuing pressure for “parity” in farm prices dates from this time. The “parity” goal was for the relative purchasing power of farm products to remain nearly constant, so that farmers would not be adversely affected by their own success in production and other economic pressures. This appealed to farmers and their legislative representatives, and to the ideal of the yeoman farmer leading the agrarian and virtuous life. The measures or indices for purchasing power were originally derived from the farm prices of 1910–1914, when the desired balance existed between farm products and prices for other goods (Fite, 1964). The “parity” measure was used to set price supports or targets for various farm programs. This was particularly important when farmers were subsequently faced by the dramatic loss of about 40 percent of farm income in the crash after World War I. After this, farmers suffered in the droughts of the 20s and 30s, as well as from the Depression; many succumbed to the price squeeze of plummeting crop values but stagnant input costs. Agriculture’s purchasing power (e.g. from a bushel of wheat compared to other prices) in 1921 was literally 1/3 less than in 1913 (Fite, 1964: 5–9), despite increased land values and capital costs. For farmers, the Depression arrived early, but not until 1933 was there direct Federal government support. New Deal programs and the war markets of the early 40s were followed by sustained high price supports in the late 40s and early 50s. Farm financial conditions going into the 50s Drought were dramatically better than those in the 30s.

The agricultural supports created in the Depression remain remarkably little changed (Cochrane and Runge, 1992; Glauber, 2013). In 1933, three highly-significant Federal Acts were passed as part of President Franklin Roosevelt’s “New Deal.” These Acts shaped the future of US Agriculture through the 1950s and into the present. The first, the Agricultural Adjustment Act, was a major farm support legislation, including cash payments for farmers who agree to reduce acreage in crops. This is a persistent approach intended to reduce the surpluses that depressed prices, and the amounts of subsidy needed, as well as the farmers’ losses. The second major act of 1933 was the creation of the Commodity Credit Corporation (CCC). The Corporation offered farmers what became known as the “non-recourse” loan: the CCC offered to “loan” an amount to the farmer equal to an estimated fair price for the anticipated crop. If the market price was greater than the “loan”, the farmer would sell, pay back the loan and keep the difference. If the market price proved lower than the “loan”, however, the farmer would deliver the crop to a CCC-designated collection point. The loans were dubbed “non-recourse” because in the event of failure (such as crop loss to hail or drought), the CCC’s capacity to recover the loan was limited to the crop only, without recourse to the farm or other assets. A principal qualification, however, was the requirement for reduced crop acreage in order to procure these loans. The first Agricultural Adjustment Act was held unconstitutional in 1936, and replaced by another “AAA” in 1938, which required that 2/3 of the producers of a given crop would have to agree to the allotment (acreage reduction) programs for them to be effective. A third important Act of 1933, however, also had a tremendous effect on rural life and farming practice: the creation of the Tennessee Valley Authority (TVA), a complex regional development scheme which combined flood control, industrial and recreational development with generation of abundant, cheap hydroelectric power which would serve as a “yardstick” for power costs nationwide.

The TVA opened the door to farmers seeking electricity. The creation in 1935 of the Rural Electrification Administration made a

nation-wide federal commitment, with significantly subsidized (compared to private) costs to reach newly-served rural consumers. In 1930, about one in ten farmsteads used electricity, either from main lines or self-generated; by 1940, four out of ten did, (and the number rose to ninety percent by 1950; [Leuchtenberg, 1963](#): 157–58). By 1940, the combination of these initiatives, better weather and, then, war-time boom markets restored much of American agriculture's well-being. The main drivers of policy appeared to be fear of another post-war “crash”, but which did not materialize.

Ninety percent of “parity” was promised for the first years after World War II. In 1948 and 1949, parity could have been as low as 60 percent as the basis for continuing farm-support programs, but the support level was kept high by Congress. The Korean War and accompanying markets kept prices high through 1953. President Eisenhower's first Cabinet took office in January 1953 facing both acreage allotments and price supports aiming to provide 90 percent of parity (the last a campaign promise), both at the expense of the Federal budget ([Fite, 1964](#); [Benson, 1962](#): 38–9, et passim).

The “crisis being faced, coincident with the drought, was a persistent national agricultural commodity glut and the pressure from farm interests to keep paying for it. Samuel Waugh, Assistant Secretary of State, said in 1953: ‘Surplus agricultural commodities are the next most important national problem to that of balancing the budget’...” ([Peterson, 1979](#): 32).

As noted above, the President's economic reports ([Eisenhower, 1954–1961](#)) illustrate mainstream understandings of the time. The 1954 report (the series is issued in January; thus reflecting the previous year, in this case 1953) noted the continuing need to stabilize the farm economy after the Korean War and adjustment to peacetime. Echoing themes sounded in campaign literature of 1952 and mainstream Republican economic prescriptions, the report asserted that the role of the government should be limited, but a high and sustained rate of growth “is necessary to the welfare, if not the survival, of America and the free world. The United States is now engaged, and must be for some time to come, in an effort to build security forces adequate to deter and to strike back at aggression.” ([Eisenhower, 1954](#): 3). The stated conditions of progress included individual freedom, adequate incentives, effective competition, savings and capital formation, research and development, maintenance of economic stability, a floor of individual security, and a world community of free nations ([Eisenhower, 1954](#): 4).

“Agriculture, which is beset with more problems than any other major part of our economy, will continue to be confronted in 1954 with problems growing out of excessive supplies of some of the major farm products – notably wheat, cotton and corn.... By July 1954, the wheat carry-over may be about 800 million bushels, more than three times its mid-1952 level and well in excess of a year's domestic use. By August 1954, the cotton carry-over may reach 9.6 million bales, also more than three times its level two years earlier and the equivalent of a year's domestic mill consumption...” ([Eisenhower 1954](#): 69).

3. Agricultural production in the 1950s

In the report for calendar year 1954, output from the preceding year is recorded as equal to the record level reported in 1953, even though wheat and cotton were reduced from their potential by 17 and 18 percent, respectively, by use of marketing quotas. Diverted acreage was, however, used for feed and seed, leading to record highs in livestock production. In 1955, the readjustment to peacetime was still not fully accomplished. The January 1956

Economic Report noted that farm output was steadily up and prices steadily declining. At the behest of (then) Agriculture Secretary Ezra Taft Benson, price supports were made “flexible” in 1954, allowing administration officials rather than Congress to adjust the levels, but the percentage of parity stayed greater than 60 percent and very commonly higher than 75 percent ([Fite, 1964](#)). The federal crop insurance program begun in 1938, with persistent characteristics of low participation, high losses, and continuing political support probably related to highly concentrated benefits in relatively few Congressional districts ([Goodwin and Smith, 1995](#); [Glauber 2004](#); 2007; [Dismukes and Glauber, 2005](#)); the 1950s did not affect this pattern.

Wheat consumption in 1953 in the U.S. was similar to that in 1914, but production had increased from 724 million to 1169 million bushels and only about 2/3 of the surplus could be exported. Cotton was similarly affected due to big increases in production coupled with decreases in domestic consumption ([Eisenhower, 1954](#): 89–91). High prices for meat and hides had led to excessive expansion of herds and a subsequent price collapse; at the same time, cheap feed provided an ill-timed encouragement or temptation to expand herds (see also [Bonner and Ward, 1955](#)).

By October 1954, corn reserves of more than 900 million bushels represented nearly twice the 1952 level. “The price-depressing effects of these stocks will, however, be substantially offset during 1954 by Government price-support operations, acreage restrictions, and other measures.” ([Eisenhower, 1954](#): 69). In the previous year, increased sales had offset depressed prices, but not enough to keep agricultural income from falling 7.4 percent; the cattle raisers were hardest hit. Overall, farmers' net incomes began to decline in 1947 and continued to fall through 1953. Between 1947 and 1953, operators' real net income per farm fell almost one third, but 1947 marked an all-time peak in realized net farm income, and agriculture was proclaimed to be still in relatively good financial condition ([Eisenhower, 1954](#): 53, 89). “Widespread drought added to the troubles of the year, especially of cattle farmers.” ([Eisenhower, 1954](#): 53). But the only other mention of drought was a short following note that relief had been extended promptly to the farms in drought-stricken areas, including extensive beef purchases to check the decline in prices and benefit school lunches, and some gifts for famine relief were made abroad ([Eisenhower, 1954](#): 54).

Finally, in acknowledging the central role of such programs as the Commodity Credit Corporation (which increased its commitments to approximately \$3 Billion in 1953) and other agricultural supports, the administration noted a central contradiction in its major agricultural support program. Reliance on acreage allotments per crop, in which a farmer is, essentially, paid to not grow that crop on some farmable acres, was not accompanied by quotas on total production or by restrictions on what else might be grown on the acres retired from production of the supported crop. As a result, acreage allotments, coupled with high price supports and no limits on sales, “encourage(d) rapid increases in the per-acre yields of price-supported crops and larger output of unsupported crops on the diverted acres.” ([Eisenhower, 1954](#): 95). By 1959, the Commodity Credit Corporation had lost more than \$9 Billion.

One apparent feature of [Table 1](#) on wheat production is that the data appear to defy any clear connection to the drought of the 1950s. The production capacity overwhelmed what only two decades previously had been a crippling natural “intervention.” One striking constant revealed by the figures in [Table 1](#) is the high level of carry-over and winter wheat on hand in mid-summer even during the years of deepest drought in the “bread belt.” The power of price supports can not be overlooked.

Cotton was important in the drought areas, and like the other crops, it was also marketed within a much larger national arena, and the international markets as well. During the decade ([Table 2](#)),

Table 1
Wheat production 1950–1959.

Wheat (all types)						
	Planted (1000ac)	Harvested	Harvested % of ac. planted	Farm value of crop (\$M)	Wheat Produc- tion (1000 bu) as of July 1	Estimated stocks on hand, Wheat, millions of bu.
1950	71,287	61,607	86.4 percent	\$2,042,296	1,019,344	425
1951	78,524	61,873	78.8	2,088,739	988,161	400
1952	78,645	71,130	90.4	2,729,402	1,306,440	256
1953	78,931	67,840	85.9	2,390,936	1,173,071	606
1954	62,539	54,356	86.9	2,082,485	983,900	934
1955	58,241	47,285	81.2	1,854,551	934,731	1036
1956	60,658	49,784	82.1	1,974,174	1,004,272	1033
1957	49,852	43,806	87.9	1,839,074	950,662	908
1958	56,269	53,404	94.9	2,550,995	1,461,714	881
1959	59,043	53,024	91.4	1,988,562	1,128,151	1277

*** Sources: 1s 655, 656, 1, and p.51, USDA Agricultural Statistics, 1960.

Table 2
Cotton production and value (from USDA (1960) Ag. stats, p. 60).

	Production (1000 Bales)	Value at farm (\$1000)	New Orleans market prices, cents per pound
1950	10,014	2,005,684	42.30
1951	15,149	2,868,720	39.97
1952	15,139	2,617,644	34.40
1953	16,465	2,654,683	33.35
1954	13,696	2,301,212	33.96
1955	14,721	2,379,030	34.28
1956	13,310	2,112,625	33.64
1957	10,964	1,625,119	34.50
1958	11,512	1,912,311	34.31
1959	14,551	2,281,300	31.43

cotton prices steadily declined, ending the 1950s at roughly 3/4 of its 1950 per-bale value (unadjusted for inflation).

One might expect less cotton in a year subsequent to one in which prices fell, yet planted acreage did not drop sharply until 1954, and then another decrease in planting in 1955, followed by fairly steady planting until a notable drop in 1957 and another smaller drop in 1958. The first impulse for many may have been to plant more to compensate for lower prices when possible to expand, but the decision is complicated by the option of payments to reduce planting. The payment to reduce planting may stimulate increased planting acreage so that there is more to reduce. This is sometimes crop-specific, establishing “base acreage” and beyond the scope of this article (see Fite, 1964; Cochrane and Runge, 1992). Acreage reduction might help dampen production at the limits of efficiency, but for many American farmers, harvesting more out of fewer acres was merely a matter of plowing and planting from fence to fence, then accepting federal acreage-reduction monies as a bonus. This behavior made – and makes – sense in light of the problem facing any farmer: how to match operations to the imperfectly predictable future market, and how to do so where policy and aid programs will almost always be national, but weather and other adverse conditions may be local, regional, or national. The conundrum facing the farmer was and is that of complex causality: the net effects of weather and climate variation were largely overwhelmed in the aggregate by fluctuations of national policy and financial environments.

Borchert (1971) noted that even in 1956 in the peak of disaster declarations, government payments were still less than 3 percent of total farm income. More than 1000 counties were designated

for disaster relief (Eisenhower, 1957), and drought was the leading cause of payment in the Federal Crop Insurance program (Saarinen 1966, and see exhaustive analyses of Federal Crop Insurance Corporation and wheat losses by Hewes (1958, 1975, 1979). Participation in the Federal Crop Insurance program was, however, voluntary and thus limited in various ways by farmers themselves as well as by FCIC itself, which could – and did – withdraw coverage from counties. Saarinen notes that the FCIC withdrew from 14 “Dust Bowl” counties following the 1955 crop year (1966: 8). Certainly, there were very difficult times for afflicted localities. Between 1950 and 1960, Texas lost nearly 100,000 farms and ranches, and rural residents who had made up more than a third of the population dwindled to a quarter of the population. The agriculture losses exceeded those of the Dust Bowl years, and kicked off the modern era of water planning in Texas (Lower Colorado River Authority, 2014). However, by all reports, the human impact was dramatically less than in the 1930s.

Farmers were not the only parties directly affected by the dry thirties: urban water and sewage problems emerged during in the 1930s, and some reappeared in the 1950s drought (Borchert, 1971, Special Assistant to the President for Public Works Planning, 1958), though these received little detailed description (see United States Geological Survey for compilations of water use data). One case, however, that of Wichita, Kansas, has been carefully described (Aucott and Myers, 1998). The steady urbanization of the region before the drought years of the 1950s is noted below in the section on demographics. The extent to which the drought hastened off-farm migration within the region is difficult to judge (Warrick 1983), but the overall trend was certainly clear at the time and has continued (Adamchak et al., 1999; Ojima et al., 2002).

The Report of the Special Assistant to the President for Public Works Planning (1958) noted the widespread human suffering, although “Programs at all levels of government helped to soften the effects...” (p. 25). Various financial costs are also noted, such as more than \$100 million worth of government-owned surplus foods distributed through State welfare offices, in 1954–56, and more than \$140 million in government-owned surplus feed grains distributed to farm and ranch families, with \$26 million more in hay as well, for “foundation livestock” maintenance (keeping herds viable for the return of normal conditions, such as keeping dairy cattle healthy). that this idea did not appear in 2002. \$184 million were spent on beef and pork products, \$260 million were provided for emergency credit and livestock loans, and assorted smaller amounts are mentioned.

As noted earlier, the fundamental problem facing American agriculture of this era was overproduction, and the consequences of the surplus were serious. “Of the farm families that are almost wholly dependent upon income from agriculture, as a rule only those on medium-sized to large, commercial farms can be said to live well. In 1949, 1.2 million of the latter (22 percent of all farms) accounted for 73 percent of the Nation’s gross cash farm marketings”. (Eisenhower, 1954: 91–92). Also in 1949, about 1.5 million farm families (29 percent) netted from all sources less than \$1000 of cash income per family, and produced too little to obtain meaningful benefit from the agricultural support programs. The proposed solution was clear then as before and after: “relatively small farms must ultimately be replaced by more efficient, large-scale family farms.” (Eisenhower, 1954: 92).

4. “Managing” the impacts of drought

The March 5, 1957 President’s Drought Message entitled “Alleviating Emergency Conditions Brought About by Prolonged Drought and Other Severe Natural Disasters”, (Eisenhower, 1957) mentioned above was ostensibly the report on the President’s

“Drought Summit” in January 1957 in Wichita, Kansas. In general, the report asserted that existing programs and agencies needed some tuning but were mainly sufficient. The most striking appeal was for increased opportunities off-farm and assistance in establishing diversified rural economic bases to increase community and regional resilience through improved education and decreased dependence on marginal small farms. Remarkably, the assembled experts persisted in calling for rural diversification in response to inevitably declining small farm economics while doggedly upholding their ingrained conviction of the importance of supporting those farms (Cochrane and Runge, 1992).

The 1958 Economic Report mentioned drought a total of three times. “A long drought in the Southwest has ended.” (P. 34). And, drought is “broken” (Eisenhower, 1958: 37). But even with the worst of the drought, the all-crop production index for 1957 equaled the record-setting 1956. “Although drought in the Great Plains is no longer a matter of immediate concern, important recommendations conveyed in the Presidential Drought Message of March 5, 1957, should be implemented...” (Eisenhower, 1958: 69–70). If largely innocent of drought coverage, however, the 1958 Report acknowledged rural socioeconomic trends: “... recent declines in the number of farms have been heaviest among those too small to provide an adequate level of living from agriculture alone.” (Eisenhower, 1958: 67). Eisenhower continued to urge various programs for rural development, not merely increasing loans for emergencies, continued federal reacquisition of lands under the Bankhead–Jones Farm Tenant Act (1937) and also expansion of vocational education and rural economic development. The policy basis was long-established: off-farm income was clearly essential for many, perhaps most of what had once been the sine qua non of American self-sufficiency: the small family farm. By 1959, the U.S. was in the process of emerging from a relatively mild recession. It had been triggered in part by increased production in most sectors during 1957, followed by a drop in consumption and administration attempts to build confidence (Pach and Richardson, 1991: 175–177). The exceptionally favorable growing conditions of 1958, due in part to the end of the drought in most areas, worked with farm programs not yet adjusted to rapid productivity increase to result in these enormous costs. The majority of farm people derived little or no benefit from price supports; nearly one-third of farms were part-time and residential, and this sector produced only 2 percent of farm product sales. “Clearly, the welfare of the families on low-production farms is more closely linked with the expanding nonfarm sector of our economy than with agriculture as such.” (Eisenhower, 1959: p. 99).

The prices received for all farm products simply failed to show effects of drought in any direct fashion. Price supports and other programs propped up farm incomes to some extent, but the income from nonfarm sources remained important. Even by 1958, employment in agriculture, forestry and fisheries in the drought areas was only one fifth of total employment in the region identified as affected, moderating the impacts (Special Assistant, 1958: 5). “Even during the recent drought, the area did not meet the criteria for sustained low income farm areas used under the Rural Development Program. The median family income for the group of States in the problem area runs slightly below the median income for the entire country.” (Special Assistant, 1958: 6). The 1958 report is of enduring interest because of its recommendation (apparently in vain) of a technique dubbed the “water-economic” budget, which “contemplates a balancing of the economy of the region with respect to water availability and other economic segments of the region.” (p. 33). Preparation of such a budget would involve broad public participation, and other very contemporary components.

Unlike the mechanization of farming, fertilizer use did not display significant economies of scale, but it was a significant

Table 3

Average [annual] commercial fertilizer use (tons) (from USDA 1961 Agricultural Statistics, table 695).

State	1940–1944	1950–1954	1958
Arizona	14,918	120,938	195,979
California	348,787	1,534,729	2,589,263
Colorado	7640	47,532	89,058
Illinois	198,298	1,304,740	1,596,739
Iowa	45,087	487,169	695,519
Kansas	28,324	210,387	290,657
Nebraska	2027	119,360	305,062
New Mexico	4130	22,152	41,111
Oklahoma	14,827	151,356	133,923
Texas	158,310	581,097	665,376
United States	10,483,899	21,832,547	25,312,672

factor in the enormous increase in post-World War II farm productivity. An “Economy of scale”, a widely-used concept in economics, is said to be achieved when as an industry grows (i.e. increases its scale) and the number of production units increase, then the input costs (on average) are reduced.

In the 1950s, the marginal increases in yield (Table 4) associated with the beginning of fertilization and other biochemical inputs were impressive. The use of fertilizers (Table 3) in selected states shows not only increasing use, but increasing annual costs required for production. The drought-limited farmers could take only smaller advantage of this technology, compared to those with irrigation or more reliable rain.

The resulting increases in productivity were quite significant for national levels of production and the problem of marketing the surplus. Newman (1978: 50) reports the following 11-year running averages for productivity (Table 4):

Marginal yield gains were present during the 1940s, possibly reflecting wartime production maximization as well as the beginnings of intensive fertilization, but they expanded dramatically through and beyond the 1950s. Corn productivity showed a spectacular rise, and important gains are visible for wheat, which is the crop most widely distributed throughout the area affected by the 1950s drought. This contributed to the lack of national-scale impacts from profound regional drought, because of the national markets for these commodity crops.

4.1. Farm demographics

The demographic context of the 1950s drought includes the general trends affecting farms, such as need for off-farm employment for many, and the urbanization of the American population and economy. The drought area in the 1950s was more agriculturally dependent, with 23 percent of the economy, than the U. S., 15 percent, and a less urban population, 54 percent, than the U. S., at 64 percent, but even so, the Special Assistant to the President for Public Works Planning (1958) found that at least 1/3 of farm youth in the drought area would leave in the 1950–1960 decade. Nationally, urban areas grew 29 percent in this decade, and this trend was followed in the drought states also. Oklahoma grew 4.3 percent total, but 28.5 percent in urban areas, with a net

Table 4

Yield gains for corn and wheat by decade: 1930–1970.

11-Year running ave.	Corn (BU/acre)	Wheat (BU/acre)
1930	24.4	13.6
1940	30.6	15.3
1950	39.4	17.4
1960	60.1	23.9
1970	81.7	29.5

decline of 21.1 percent of rural population. Texas's urban growth of 48.6 percent contrasted with rural decline of 16.7 percent. Kansas's urban areas grew 33.8 percent, while the rural population fell 6.8 percent, and total population climbed 14.3 percent (1960 Census, Urban and Rural Population). There was also a qualitative shift in the transformation of regional centers to urban economies and new metropolitan areas not as connected to the rural and agricultural economies, not least because of the dwindling number of people living on farms compared to those employed in other sectors. Examples include Amarillo (up 85.3 percent), Denver (61.1%), Fort Worth (59.3%), Oklahoma City (56%), Pueblo (41%), Topeka (34%), and Wichita (50.6%), to say nothing of Phoenix, up 155.5 percent despite the ailing cotton business (USDOC(1960) Census, Population of Urbanized Areas). Meanwhile, farm population had already been falling, even where other parts of the rural population were changing in different ways. From 1920–1930, net loss from farms was 19%, 6.1 million people. From 1930–1940, 13% left, another 3.5 million. And from 1940–1950, 31% left, yet another 8.6 million. These trends were thus well established long before the droughts of the 1930s and 1950s (USDA, 1956, Farm Population). Beale (1980: 37) provides the following measures of this demographic shift through the 1950s (Table 5):

One small-area study in Texas found that once a farm person had left, for whatever reason, the departure was irreversible (Borchert, 1971). An important feature of the drought in the 1950s and associated demographics is that some of the fastest growth in skilled labor and artisan jobs in the drought states was coincidentally taking place in the expanding petroleum, aluminum and aircraft industries (Special Assistant to the President for Public Works Planning, 1958). Borchert concluded from such evidence that farm depopulation was overwhelmingly the trend. The present review confirms Warrick's position (1983) that migration within the region was significant, and that drought may have had some effect on this, but how much is hard to judge. Non-agricultural factors were already at work and the above-mentioned trends were unmistakable before and after the drought. Within agriculture, one may attribute some of the depopulation to the need to realize economies of scale in the use of farm mechanization which increasingly reduced labor (discussed below). Large machines which could handle large areas of field operations with one operator reduced costs of production per area or unit where labor costs are important, as was the case in farming (and still is...). Dorner (1980: 53) claims this as the reason for loss of million people a year in the 40s and 50s; but again, this appears to be independent of the drought and climate impacts. A review of the "booster" literature of the railroad land promoters, through classics on the Great Plains such as Kraenzel's work (1955), and drought-related documents of the 50s from Eisenhower Special Assistant (1958), reveals insistence on the value of a diversified economy is a common and continuing prescription for ideals of local stability and service provision as well as, later, a response to the decreasing need for farm labor (Otto et al., 1966; Blouet and Luebke, 1979).

Table 5
Decadal changes in farm population as a percent of U.S. Total and Rural 1920–1970.

	Farmers as % of U.S. Total	Farm population as % of U.S. Rural total
1920	30.1	61.8
1950	15.3	42.3
1960	8.7	28.9
1970	4.8	18.0

4.2. Farm structure and operations

The heart of the issues of impact and response lies in the identification of the unit of analysis. Most of this review has concentrated on the national scales of perception and response, and has demonstrated that there was very little national impact. The farm itself, however, is the unit of analysis which might be expected to experience direct impacts and make direct responses. In this section we look at the ways in which the socioeconomic context of changing farm finances and technologies affected various outcomes in the 50s. In brief, the trends already affecting agriculture seem to persuasively explain the outcomes.

"Economics is the dominant force leading to the introduction of technologies, some of which may be inappropriate. The longer term risks are not being suitably weighed against short term gains. The longer term risks are heightened by increased capital investment. Furthermore, from a purely economic standpoint, the financial resources of many farmers are so low that they could not survive a severe two year drought (Riefler 1978)." Dregne et al., in Rosenberg 1980: 21; reporting conclusions from a task group at the AAAS symposium on North American droughts.

The AAAS symposium in 1980 thus stated in effect that many farms (using the term here to mean firms or enterprises of a particular sort) would be vulnerable to a two year drought at that time. There is ample evidence of such vulnerability of perhaps a very large majority of farms in the 1890s, a still substantial portion of farms in the 1930s, and a much lower fraction in the 1950s. Warrick's thesis is that shifting the impact to larger scales of organization made that happen (1983, and see Bowden et al., 1981). Here, we want to consider the context of agriculture as a sector of the economy, and the conditions that made it more or less vulnerable to the Drought of the 1950s.

5. Technological changes

In the 1960 Yearbook of Agriculture, Assistant Secretary of Agriculture Earl Butz wrote that the 1950s would eventually be known as the decade of scientific breakthroughs. Advances in technology and their impacts are discussed in this section.

5.1. Improvements in equipment

Pinches (1960) observed that horseless farming had been demonstrated as practical by 1925. In 1910, farmers had 50,000 automobiles, and nearly 4 million in 1925. The number of tractors was 500,000 in 1925, doubling by 1935, despite the depression, and more than doubled again by 1945. The number of farms with central-station (that is, non-self-generated) electricity expanded enormously from 1925 through 1935 and after. In 1910, there were \$2.7 billion worth of horses and mules, and \$1.3 billion of other machinery and equipment. By 1940, horses and mules were down to \$1.3 billion, and machinery was up to \$3.1 billion. By 1959, farm tractors alone were worth \$3.4 billion, and with other machinery, trucks and automobiles added up to \$16 billion in farm power equipment (see also Goodsell (1960) and others in the 1960 Yearbook of Agriculture). Good weather in the late 40s and early 50s, and changing financial conditions, along with technological improvements such as rubber tires for bigger tractors, ever more specialized implements and the absence of effective production disincentives, promoted "sodbusting". During these years the cultivation of marginal lands increased notably, as shown in detailed studies such as Knollenberg's work on Eastern Colorado

(Knollenberg, 1996). The rubber tires allowed farmers to move equipment over the roads and to cultivate additional land not contiguous to other holdings. These increasing costs occurred when farm expansion was almost imperative to increase profits; this is discussed further below.

There were immediate consequences of the change from horses to machinery, not least of which was conversion from rotation practices featuring small grains and hay for feed to cash cropping, and the hard-to-measure effects on soils from that and use of ever-heavier equipment. But also, the equipment needed was no longer self-reproducing, let alone capable of foaling at a profit. Perhaps symbolically, the January 1955 Montgomery Ward's nationally-distributed mail-order catalogue dropped the horse work harness. The financial consequences of this shift have been argued ever since; a general conclusion is that "heavy investments in large equipment and other capital costs" may have forced many farmers into "expansion of cultivation into marginal areas" (Rosenberg 1980: 109). The questions of the consequences of this tendency (increased capacity and decreasing resilience) are complex and led the research direction into some of the following issues.

5.2. Irrigation and the rise of groundwater use

As Saarinen's survey confirmed (1966), irrigation is always the first impulse in response to drought, or "premier adjustment". The adoption of irrigation in the drought areas in the 50s was, however, already underway, and seems to have been driven by farmers' capital capacities, and the series of technical improvements in the efficient high-lift pumps that made center-pivot systems feasible. In the 1930s and 40s, pump technologies progressed quickly, often using increasingly reliable gasoline engines, borehole drilling technologies invented for the oil industry, and high-lift turbine pumps (available after 1930). The breakthrough for the 1950s, however, was the new center-pivot system. These spread rapidly in the areas afflicted by the 1950s drought, although not necessarily associated with or in response to it. The center-pivot innovation promised (and delivered) effective delivery of water to crops grown in sandy and otherwise inadequate (and highly erosive) soils. The spread of this technology facilitated cultivation of soils previously deemed too poor to farm. Irrigated acreage in Kansas totaled somewhat more than 250,000 acres in 1940 and by 1954 grew to more than 420,000 acres. By 1955, more than 537,000 acres and by 1959, more than 1,000,000 acres enjoyed "delivered water," outside of river and ditch-irrigated area (Hurt, 1981).

One important consideration for irrigators is that surface waters in the drought-afflicted states were effectively fully appropriated, but ground water (as used by the center-pivot and well systems) was essentially unregulated until very recently (Getches, 2008). The famous Ogallala Aquifer, groundwater in other parts of Texas and New Mexico, and other water sources were literally free for the taking when these systems were introduced.

Adoption of groundwater sources for surface irrigation was a relatively novel response, beginning in the 1940s (see Kromm and White, 1992 for historical treatments). USDA Census of Agriculture data provide some information, which suggests that the most important increases in ground-water use may have been in response to the drought, but lagged, perhaps for financial reasons (Golleson et al., 2006).

The use of groundwater became substantially more economic with changes in drilling and pumping technology, which were independent of the Drought. Clearly, the stimulus for adoption was stronger with precipitation deficits. Maas and Anderson (1986) report that in Northeastern Colorado the number of farms decreased by 42% between 1950 and 1970, while the average irrigated farm size almost doubled (as did average size for all farms).

The causality for the surge in groundwater irrigation certainly includes the increasing mechanization and fertilization of farms, also changing the farm financial structure. Together, all the changes resulted in tapping a resource previously little used, and beginning the problems of sustainability of groundwater use (Kromm and White, 1992).

The increase in use of groundwater for irrigation was certainly related to the stimulus of drought, as well as availability of the technologies, cheap energy, and relatively high producer prices (those received by farmers). Groundwater use in the central U.S. followed a northward trend, reflecting agricultural values, technology diffusion and market values (Kromm and White, 1992; USGS 1990, 1994, 1999), moving from Texas toward the Sandhills of Nebraska. The exact role of the drought of the 1950s varied from place to place, as revealed by the various state water historical profiles (USGS, 1990). For instance, Oklahoma had enormous surface water development projects in the 1950s (USGS 1990, 1994), providing reservoirs and shipping access. Texas had already experienced significant drops in the water table before the drought of the 1950s (Hughes and Magee, 1956; Kromm and White, 1992), while there were only demonstration projects in the Sandhills (Gaul, 1992; Musick and Stewart, 1992). In urban uses, a case study of Wichita (Aucott and Myers, 1998) shows that large-scale groundwater use began with 25 new wells in 1940 and urban use increased that to 55 wells by 1959.

The drought was one of several factors stimulating the adoption of this response. The trends were underway and were sometimes, as in the case of center-pivot systems using wells, considerably stronger years after the drought than during it (e.g. Knollenberg, 1996: 501; Kromm and White, 1992; USGS, 1990; 1994). The use of groundwater in particular illustrates the "ratcheting" nature of agricultural expansion in general. Intensification or expansion may result from various promotional factors, but retreat or reversal may not occur in a similarly orderly fashion. Drought may have stimulated increased use, but return of good weather did not stimulate decrease.

5.3. Soil erosion and control

One response to "The Fifties" (Doerr, 1960) was increased expenditure on soil erosion control, following the 1930s programs establishing the Soil Conservation Service (Egan, 2006; Worster, 1979). The Special Assistant to the President for Public Works Planning (1958) claimed more than \$18 million spent on wind erosion control, increasing New Deal programs. Switching crops, another important drought response, seems to have been much more widely practiced in the 1950s than in the 1930s; for example eastern Colorado did surprisingly well despite serious moisture deficits (Knollenberg, 1996). In the 1957 Economic Report President Eisenhower claimed that Congress' creation of the Soil Bank in 1956 had been encouraging, but too late to affect most planting. The administration's goal was to take almost one of every nine acres out of production by use of the Soil Bank and the Conservation Reserve Program, which paid for transfer of use to conservation and provided reimbursement for some initial costs. That program, however, usually diverted cropping from the lowest yielding acres, encouraging intensified crop production on the better land, so output was little reduced (a traditional problem associated with what had become, by the mid-1950s, a "traditional" program).

It should be noted, as pointed out by one of the reviewers of this paper, that the mechanization of cotton highlights one problem of the era (Holley, 2000). The mechanization did not necessarily displace people, but rather, people may wanted to get out of farming and mechanization was required to substitute for the lack of available labor.

6. General changes in agriculture and economies of scale

By 1950, land use changes introduced in response to the 1930s had been largely reversed. The central Great Plains, 90 percent of the land plowed in the 1920s was again being plowed, including 60 percent of the land abandoned in the 1930s Dust Bowl response, and also several million new acres of wheat as well (Hewes 1975: 208–209). Why did that not result in wholesale misery when drought returned? Following those counties studied, Hewes found little use of the Conservation Reserve Program in the late 1950s. Between 1954 and 1962, nearly 400 farms were consolidated into others, out of 882 to start; small farms were simply uneconomic. This is what Kraenzel (1955) and other scholars had urged: farms must be large enough to have sufficient reserves to be what we now call resilient. But the flaw in the argument is that the turnover was not sudden and not timed to follow the drought, as it had been in the 30s. Moreover, outcomes were much more complicated, as Knollenberg shows in similarly detailed study of some other counties (1996; see also Borchert, 1971). Thus, for some farmers the drought of the 50s was likely “the straw that broke the camel’s back,” but it is obvious that the herd was already being severely thinned.

6.1. Family farms and tenure

The trends begun in the 1930s continued through the 1950s, in number of farms, average size, farm mortgage debt, per acre value of land and buildings (Fite, 1964; United States Congress, 1979, 1980; Cochrane and Runge, 1992). The number of farms, as separate enterprises, steadily decreased every decade, according to all sources, although the general trend was defied slightly during the 1950s by the increase in the category of cash grain farms. In fact, the decrease in farms in general was somewhat slowed during the 1950s (Lins and Barry, 1980). This is the opposite of the prediction one would make from claims of drought aggravating the vulnerability of farms. Agricultural land values almost doubled in the 1950s, and farm debt increased by a little more than double, but the increases in farm mortgage debt in later decades were much bigger (Lins and Barry, 1980). But there was considerable change in the smaller farms. Consolidation and loss of the smallest farms was well underway before the drought and continued after the drought as well. Changes affecting such operations were the same as in other decades: increasing dependence of the smaller farm families on off-farm income, shown by increasing numbers of part-time farmers, and increasing numbers of farms that were residential but not self-supporting (Brewster, 1980). In fact, the proportion of small farms actually changed less in the 50s than in other periods shortly after (Carr, 1980:26). The 1940s and 1950s did exhibit high percentage changes in kinds of land tenure, with very substantial increases in part-ownership of farms. This may have been in order to achieve the economies of scale, and may also represent a substantial increase in part-ownership as a form of investment and financing, as well as a means of transfer where cash flows are low compared to asset values (see discussion in U.S. Senate 1979, “Status of Family Farms” committee print). Significant reductions in tenant farming during the decade also occurred (Carr, 1980: 32, data). However, it is important to note that no apparent relationship was found at the national level between the advance of consolidation and the drought of the 1950s. Instead, the most dramatic increases in concentration may have taken place in the 19th Century, and then lagging the 1950s drought during the 1960s and 1970s (Carr, 1980).

Clearly, the large capital investments (or debts incurred) for increasingly expensive mechanical equipment required increasingly larger land bases, to match equipment capacity and costs; in the 1930s and 40s, farmers shifted from sharing tractors and the

early equipment to each farm having most of its own equipment, as those tools and implements became more and more specialized. The economies of scale there were quite important; in 1949, 23 percent of farmland purchases were for enlarging existing farms. In 1959, 42 percent of transfers in general, and almost half in the Corn Belt and range livestock areas, and two thirds of the transfers in the wheat areas, were for enlarging existing farms (Scoville, 1960: 392). In the late 50s, depending on the region, from 1/5 to 2/3 of farmland transfers were to adjoining farms to enable use of the big new machinery (Dorner, 1980: 52). Some kinds of equipment changes were dramatic, such as the shift from daily milk collection to use of bulk milk cooling tanks on each farm. But most of the changes were in the form of increasingly specialized equipment to enable faster soil preparation, grain planting, harvesting, and handling of feed; these also required bigger and bigger investments (Dorner, 1980).

In very practical terms, one of the most important shifts based on the economies of scale was the much larger capitalization required to enter farming (U.S. Congress, 1979: 4–5). Before 1945, an 80-acre farm transferred to a new farmer could survive but after that date, it would more likely be sold and consolidated (Dorner, 1980: 53). Farms were pushed up in size to respond to the price-squeezes and needs for cash flow (Swanson and Sonka, 1980). This is important because it demonstrates that financial considerations played a large, possibly determining role in farm expansion, along with technological factors. In regard to the role of technology, most of the advances in per-acre productivity of the 1950s were actually increases in yield from changed and increased use of fertilizers and biocides, and the beginnings of the modern specialized seed industries (Dorner, 1980). Those inputs are priced per unit, and aside from thresholds for delivery and application, have no particular economies of scale.

6.2. Land and debt

Increased returns on investment were rapidly capitalized into agricultural land prices (and thus to some extent also real estate tax values, although this is commonly not realized completely until transfer of ownership). Increased values in farming that came from the benefits of government support programs were also rapidly capitalized into land values (Lins and Barry, 1980; Swanson and Sonka, 1980).

Outside capital, usually debt, steadily increased in the decades since the 1930s, and in fact over most of U.S. history. During the 1950s, contrary to what one might expect from the scale of the drought, there were no dramatic changes in the debt loads. Increases in the 60s and 70s were similar. The purchased inputs used in cash grain farming were 56 percent of the total inputs in 1930; this rose to 68 percent in 1958 (Carr, 1980: 372). It should be noted that these are to some extent variable costs (such as fertilizer), which by definition can be reduced if necessary. By 1960, a very large proportion of farm land sales were financed by credit, reaching about 2/3 of sales, up from about 40 percent in the early 1940s (Garlock, 1960).

In the short run, the result of price squeezes from inflation and other shifts in relative prices is to drive the less efficient farmers out of business and, in the long run, to increase the barrier to new entrants by increasing land prices, and increasing farm sizes. According to Carr (1980), this eventually benefits the most efficient, established farmers. These trends combine in increased vertical integration and risk reduction by contract farming, which in turn foster concentration of production in larger and larger farms.

Did drought, then, promote the trend toward concentration of production and capital and good land into fewer and larger farms? That trend is widely apparent from the 1920s on, judging by all sources. The evidence from the 1950s does not seem to support

any clear connection between the drought and the on-going general increases in concentration. The slow-down in the shrinkage of number of farms actually suggests the contrary, along with a small decrease in the number of farms with large sales (Lins and Barry, 1980: 78). Complicated processes are at work, involving the increasing value of agricultural land, and the generally high levels of price supports despite dramatic increases in productivity per acre.

7. The 1950s drought: perception and the media

A large and growing literature on climate impacts is available, because of concern over global environmental change (Ojima, et al., 2002; Wagner, 2003; Gleick, 1990; Reilly et al., 2001, 2003; Melillo et al., 2014; IPCC 2014). These reviews and assessments seem to presume that new information will provide an impetus for new responses; unfortunately, that is not clear. The 1950s drought was no secret, but it did not have a large media presence; later droughts of lower severity and shorter duration have been more attended to, such as those of 1976–77, 1988, 2012 and the ongoing drought in California.

Searching official U.S. Department of Agriculture records for acknowledgement of responses to the 1950s drought proves disappointing. Here one might expect to see reflections of the damage suffered, as well as programmatic and policy-relevant consideration of how the drought affected existing programs and outcomes and those proposed. It does not appear.

Farmers, throughout the 50s, maintained the drumbeat for “full parity” as their goal (Cochrane, 1979), but this likely held little relation to the drought. Looking for a local reflection, in the absence of drought in other places. The authors review of several Kansas and Texas county histories, some written for the Bicentennial celebration, found very little recognition of the drought therein. Rather, the images and stories of drought from the 1930s persisted in common memory as the “real hard times” (most touchingly portrayed by Egan, 2006); the dry times of the 50s barely registered as climatic, let alone economic or social catastrophe.

Borchert reported various coverage such as a study of farm economy losses by the Federal Reserve Bank of Dallas, and some popular press commentary. Only about two dozen items on the 50s Drought in the Public Affairs Information Service Cumulative Index for 1915–1974, including a few scholarly articles, assorted USDA publications, Congressional committee prints (six), two items in *Business Week* from 1954 and 1957, and four articles from *U.S. News and World Report*.

Reflection of popular perceptions in the *Wall Street Journal Index* (WSJI), commenced with 1955. There were frequent editorials on the problem of the farm surplus, and on 5/5/1955 there was a feature on “*Great Plains Drought Worse than in 1930s*”. Three “Page 1” Commodity letter columns, in the WSJI, covered agricultural output and also 10/18/1955, “*Drought threatens Great Plains*” 11/15/1955, and farm foreclosure figures, 11/29/1955. But in 1956, Eisenhower’s farm program and annual economic report and, then, the surplus problem dominated news on agriculture until March, when stories reported hopes that acreage to be planted would be reduced. Weather condition effects were mentioned on Valentine’s Day, but drought was not mentioned until 6/19/1956 and again on 7/3/1956. The drought did not hold attention long; on 7/11/1956, a story noted that “USDA projects 1956 harvest at near-average”; the next day there was coverage of “Ike reports on first half government farm surplus disposal”. The family farm, grasshoppers, farm size linked to mechanization, and farm population levels were covered, as well as farm efficiency, acreage expansions, and expectations for 1957.

Again, the most frequent agricultural topic was surplus. On 10/30/1956, page 1 reported “Farmers expand food and fiber output despite drought.” On 12/28/1956: “Farmers may face credit squeeze in 1957”. January 2, however, brought “Size of U.S. farm surplus stockpile discussed” and January 8, both “crop values may plunge due to production cuts” and “USDA reports farm surplus totals down from 1956”. Then on 1/15/1957, there was coverage of both “Eisenhower goes to Kansas to discuss SW Drought losses” (the Wichita “drought summit”), on page 1, and on page 4, “Pres. reports to Congress about farm surplus disposal.” “USDA reports year-end level of farm surpluses”, 2/6/1957 was followed by “Farm surpluses decline after four-year climb” (2/19/1957). “The news of the end of drought was mentioned as a possibility on April 5, 15, and 30, and again May 3 of 1957. Attention was shifted on July 23 to “Drought strikes Eastern U.S.”, with more coverage July 26. But by Fall of 1957, the drought was apparently forgotten, and subsequent coverage concerned the glut, predictions and then confirmation of record crop outputs. An editorial published on December 5, “Failure of Government farm program” was followed by page 1 news on the last day of the year: “Farm surpluses to continue in 1958”.

Rasmussen and Baker’s (1979) history of agricultural adjustment programs, and Smith and Roth’s 1990 review are notable because they simply do not mention the drought of the 1950s. In particular, Rasmussen’s chapter, “The Structure of Farming and American History,” in an important 1980 Committee Print of expert reports to Congress on farm structure, does not mention the drought. In contrast, it might be noted, Agriculture Secretary Ezra Taft Benson’s memoir (1962) acknowledged and vividly described the drought several times, but this volume is a political reminiscence, rather than policy history; the difference is significant.

What one must take away from the USDA’s histories, however, is the unmistakable conclusion that almost every important response to drought in the 1950s was actually a response to the 1930s, or to another problem, such as the surpluses. From soil conservation measures passed in the 1930s, to the 1944 Pick-Sloan plan for maximum water supply development in much of the central United States, Federal involvement was already established before the 1950. A historical survey of drought planning in Rosenberg (1980), found that the drought revived concerns with poor land use practices and erosion, and contributed to political activity, but the policy results were minimal.

7.1. The 1930’s as a “Memory” context

Don Wilhite, one of the world’s preeminent drought researchers, has stated that, “In the United States, the Federal Government became the principal player in the provision of drought relief during the 1930s.... The Federal Government has continued to be the principal provider of drought assistance during subsequent drought events, most notably the 1950s in the Southwest, southern plains and Midwestern States; the 1960s in the Northeast; the mid 1970s in the Midwest and Western States; and the recent series of drought years beginning in 1986”. (Wilhite, 1997: 25). That passage goes on to note the expenditure of more than \$7 Billion in 1974–1977, and nearly \$5 Billion spent in 1988; should be compared with the figures above for the 1950s drought, even considering inflation. The Federal role was clearly established in the 1930. The basic repertoire of responses from the 1930s continued through the 50s (Borchert, 1971; Peterson, 1979; Rasmussen and Baker, 1979; Dyson, 1988). The 1930s became the standard for defining drought; Saarinen (1966) found that to be the case in studies of Great Plains farmers, and it has been found to apply to more people than the farmers alone (Bark, 1978: 11–15; Hurt, 1981; Schuyler, 1989; Riebsame, 1986; Riebsame et al., 1991; Riñey-Kehrberg, 1994, and Knollenberg, 1996, Worster 1979).

Saarinen (1966) found that even in 1964 and 1965, Great Plains farmers always referred to the dry times of the 30s, but seldom mentioned the 50s, and when they did, they mentioned shorter periods of hardship that were only locally relevant (1966:73–76). Saarinen further suggested that more recent events were more salient, and the most dramatic images of the 30s retained salience, but the 50s were fading. One of the co-authors (D. Ware), also found this in examining Kansas county histories for this paper.

7.2. National security: an additional “concern”?

Peterson's (1979) otherwise thorough treatment of the Eisenhower Administration and the farm problem does not even mention drought, but it provides a useful perspective from his careful examination of the ideological conflict of the Cold War and its relation to the Congressional and political realities of farm policy, and the problems of the farm surplus. Aggressive or active federal responses to drought may have been feared susceptible to interpretation as collectivist or centrally-planned “Sovietism”. Republican and Democratic leaders alike, recalled the similar charges leveled at New Deal farm relief and agricultural management programs of two decades before.

Dyson's (1988) “History of Federal Drought Relief Programs” identified Presidential power to declare disasters (1950), a response to fear of nuclear war, the agriculture department's authority for disaster loans (1949), a response to blizzards, an extension of 1933's Farm Credit Act, and a 1953 drought-inspired extension of disaster loans for agriculture in designated disaster areas as the major actions in the 1950s. Dyson also catalogued a few other loan programs, subsidies for hay purchases and transportation, and use of commodity credit corporation feed and seed. Some additional funds were allocated for soil erosion control. Judging by Peterson's (1979) rendition of the politics of agriculture in this time, however, Dyson's note about Eisenhower administration concerns with not spending new funds rings true. Almost all of these responses were shifts in allocation or use of emergency funds if not loans. Dyson (1988: 4) reported that one estimate put the cost of drought relief programs in the 1950s at \$550 million, with 33 states declared disaster areas eligible for various programs. That figure should be compared with the far greater expenditures on the “business as usual” programs, such as the Commodity Credit Corporation losses in the billions. Eisenhower's 1957 “Drought Summit” in Wichita garnered a few headlines, but the summit was late in the event and the headlines were soon washed from public notice by the rains that arrived later that Spring.

8. Discussion: vulnerability and resilience

Agriculture occupies a very large space in the human imagination as well as the landscape, perhaps larger than in the economy. At the federal level, a “social contract” with agriculture dating from the Depression, continued through the 50s (Cochrane and Runge, 1992: 5–6). This may conceal the highly concentrated nature of the modern agribusiness systems that were becoming more visible in the 1950s, although they were in some cases established as early as the 1860s (Ross, 1980). Fite (1964) suggests that there have been three great revolutions in agriculture in the U.S: (1) the application of industrial technology, including tractors and electricity; (2) the application of science (as chemistry and biology), including the various biocides, and (3) the application of business organizational methods to farming. Following Earl Butz (former Secretary of Agriculture), a fourth may be added (4) the elaboration of off-farm agribusinesses, adding more value and employing far more people off the farm than on it (US Department of Agriculture 1960 (Butz, 1960)).

On the whole, the drought “triggered and accelerated” changes in farm management (Borchert, 1971: 16–17) which were already identified or underway, but failed to elicit a coherent long range drought management plan (Miewald 1978), despite the offer of some quite thoughtful proposals (e.g. those of the Special Assistant, 1958) for integrated regional management. Total U.S. agricultural output increased by 2/3 between 1940 and 1960, while the number of farmworkers declined by 3 million. Output per worker doubled in those 20 years. By 1960, 2/3 of those employed in agribusiness worked off the farm, although 2/3 of the capital investment was still on the farm, with 5/6 of the value-added production coming from off the farm.

By the early 1950s the social and ideological context as well as the farming financial structural situation had been set. The huge accumulated surpluses continued to dominate policy thinking. Eisenhower again warned of the problem of statutory (Congressional) formulas for price supports, which stimulated unneeded production and generated new price-depressing surpluses (1957: p.62). The Eisenhower administration struggled to keep farm incomes up by increasing foreign markets. This initiative seemed the best alternative to statist controls or other interference with markets and the ideologically inviolable vision of the small family farm in the free market. The previously-noted drop in farm incomes after the War was followed by declining export markets, as Europe and other producing areas flourished again. Surpluses mounted rapidly, and in 1954 Congress produced some 60 bills dealing with surplus disposal. The eventual result was PL 480, the Agricultural Trade Development and Assistance Act of 1954. “As written, the bill represent(ed) the best in legislative logrolling and buck-passing.” (Peterson, 1979: 43) It authorized a variety of opportunities for surplus disposal through, sale, gift or barter.

Subsequently, the collection of disposal promoting mechanisms, from school lunches to export for a wide range of reasons, acquired the name, “Food for Peace” (Peterson, 1979: pp 87–89). Despite some successes, however, the export initiatives were largely frustrated. Regardless of U.S. interests or influence, the majority of foreign governments sought to protect their own agricultural sectors by resisting “dumping” of wheat or other commodities at prices low enough to undercut domestic production, so then, as now, cheap surplus was a problem.

The slippage between intention and result stemmed in part from effective cultivation of the political economy, but also reflected the powerful legacy of Jeffersonian agrarian ideology, in which the family farm was celebrated and deemed worthy of tangible support as a basic element of America.

Taken together, the presidential Economic Reports suggest that the farm glut – surplus production – dominated agricultural policy throughout the 1950s while drought had trivial effects on the national scale, despite its intensity and duration and indisputably severe local effects. The relative scale of the relief efforts made was minor, compared with much larger ongoing payouts made through various agricultural support programs, and failed to capture much attention. The problems of the small family farm – persistent low income, generic economic problems of farming, need for off-farm income – were clearly understood before, during, and after the drought of the 1950s.

In farming, “larger” has been the apparently inexorable result, but Carr (1980: 28) argued that larger alone meant in some cases more highly capitalized and more specialized, and therefore less flexible, and more vulnerable to financial or other difficulties. Kraenzel's (1955) “mobility” ideal related to many earlier practices of literally moving resources from soil types to soil types, dryer to wetter areas, and pastoralism as at least an optional alternative to cultivation. Oddly, these ideas are more suited to smaller and less specialized operations. “Reserves” become a question of proportion of means to needs, rather than any absolute sort of measure.

As in other situations, relief, especially for disasters, was aimed at restoring the very arrangements, which had just been proved vulnerable; the bias is for stability or restoring its appearance, rather than for increasing resilience (Hewitt 1983).

One of the profound problems faced by agriculture world-wide is that local supply and demand are increasingly affected by larger scales; in the United States, this has historically affected choice of activity and intensity of investment, as well as scales of activity (Ross, 1980). This information shows some patterns and causality, but note that complex processes are at work, as shown in the relationships between acreage planted versus acreage harvested (sometimes fairly straightforward; sometimes not) versus acreage harvested and value of crop (a shifting ratio reflecting many factors external to the workings of the market alone). Each year's figures are in part determined by the past year's results, so there is incomplete independence in almost all figures. Other responses such as those intended to restrict planted acreage (acreage reduction or conservation programs) may directly influence this also; as observed elsewhere, such programs may pay the farmer to leave some area fallow, or in other crops, but provide perverse incentives to intensify production in "base acreage" on which subsidies were figured under many farm bills (Cochrane and Runge, 1992). The net result may have been increased investment in irrigation or fertilizers, and increased production from smaller acreage.

Riebsame et al. (1991) found that gross receipts in 1988 were actually higher than in the previous non-drought year, because of successful intensification and higher prices. In fact, the recent drought in 2012 was the largest spatially extensive event (covering almost 66% of the US) since the 1950s, but agriculture, in general, was more profitable than previous years because of prices increases (Glauber, 2013).

The dominance of North American grain exports, and their effect in stabilizing markets and keeping prices low, is very important. Another aspect of concern about the 1950s drought, and subsequent events, is the larger picture of response in the Great Plains. The most important response to drought, in the perceptions of the 1950s, was irrigation (Saarinen, 1966); and the novelty, afforded by technological improvements, has been the post-World War II rise of groundwater use, as mentioned above.

The lack of novel responses specific to the pervasive drought of the 1950s raises a variety of provocative questions: does this case show that the farmers, bankers and government of the United States had learned enough from the 1930s, and thus encountered no real problem in the 50s (beyond reservoir construction e.g. Lakes Buchanan and Travis in Texas)? Or does it show merely that the national psyche registered insufficient stimulus to respond? We cannot dismiss the ideological aspects of the case, although reaching these issues would require a different and more extensive sort of analysis. One question for that work would be whether the anti-Soviet ideology of the day necessitated a stoic refusal to publicize or reveal vulnerability. In terms of traditional measures of climate impact, however, the differences are huge, between the national response to the 1930s and the apathy of the 1950s (and see Williamson (1993)).

At the national scale, there is only a general sense that adaptations already available were adequate. The question remains: was anything "new" learned from the 1950s Drought? In the political and policy history, it seems invisible. The rural-urban split surely affected the visibility of these events. But, what would be the effects of continuing the persistent and decline of commercially-successful "middle-size" family farming? The vast majority of farms effectively produced very little in commercial terms, with a huge number of families supporting their farms (Hoppe, 2014; MacDonald et al., 2013; Hoppe et al., 2010) instead of their farms supporting them.

There is no foreseeable increase (precipitation projections or otherwise) in the supply of fresh water in critical areas of this study, so future increases in urban consumption will be met by transfers, or avoided by increased efficiency in use, through technological change or demand management. The most obvious responses to drought have already been made – and continue being made. Groundwater mining was feasible before, during, and after the drought of the 1950s.

"Ironically, while our nation's farmers are confronting agricultural surpluses, low crop prices, reduced land values, and foreclosures, we are systematically mining a virtually non-renewable resource to produce more in a time of plenty" (Kromm and White, 1992: 60).

Another way to consider this is in terms of ratcheting responses, with efficiency or savings used to enable the next expansion of the system. Since the ratchet does not reverse, growth continues.

9. Conclusions

Historical cases such as described here, provide opportunities to examine the ways in which social, technical and physical capital are mobilized for decision-making (Laforge and McLeman, 2013). The present study furthers this analysis by showing how such mobilizations of capital are shaped by the longer-term trends and perceptions and their conditioning factors that extend our insight beyond the idea of event-based adjustment. Vulnerability is increasingly used as a simple antonym to resilience, as these terms are adopted by wider communities and interests, but the dichotomy is not entirely clear here. One of the defining features of resilience-based thinking about agriculture has been the presence of "reserves" as well as "mobility" and "flexibility" in Kraenzel's (1955) classic formulation. As discussed throughout this paper, one explanation for the lack of effect of the 1950s Drought is that the hard-won policies of the 1930s were simply successful in mitigating the worst effects. Riebsame et al. (1991) observe that the basic repertoire worked: urban reservoirs, highly engineered public water supplies, protective farm policy, including aid, insurance and price supports, and efforts to take the most fragile lands out of cultivation. An ancillary view, suggested by Wilhite (1997) is that the 1950s carry little weight, comparatively, because there was so little novel response. Relatively large national policy changes were invested in the 1930s response, not least of which were significant chapters in the dialogue on private versus public interests in land management, as in the creation of shelterbelts, land retirement, and adoption of allotments and "voluntary" acreage reductions required for various subsidies. These issues, although never "settled" to everyone's satisfaction, were not hotly contested in the 50s; while the rhetoric of the time was fiercely anti-Communist, political considerations ensured that fundamental policies were unchanged.

Warrick (1983) and Bowden et al. (1981) appear correct in arguing that drought consequences and impacts in the U.S. have been shifted over time from those directly affected to larger organizational scales. The drought of the 1950s had little effect against the backdrop of larger agricultural trends. This is a powerful illustration of the capacity of social structures to mediate between physical impact and human outcomes. U.S. agriculture, in the aggregate, comfortably absorbed the shock of the drought; one could claim that the U.S. was not merely resilient, but almost stable despite major climate impacts. The causal links by which socioeconomic context affects outcomes such as farm sustainability and rural outcomes are seldom susceptible to quick

analyses providing traceable accounts.

Three major conclusions are reached. First, climate impacts elicit response within context, and are not well predictable from the scale or qualities of the climate variation alone, at least within historic ranges of variation. This demonstrates the need to avoid limiting analysis of climate-society interactions to climate alone, or inadequate sets of social interactions and areas. Second, it is important that the 1950s Drought, large as it was in meteorological and climatic terms, failed to elicit a major response. This questions the social capabilities for effectiveness of situational responses, and even for timely response during slow-onset long-duration events such as might be a part of a changing climate (Pulwarty and Sivakumar, 2014).

A third conclusion is that regional impacts had effects on national policy in rough proportion to the national impacts, which were minimal. The scale had shifted prior to the 1950s, so that the federal level absorbs some impacts. The desperation of afflicted areas was outweighed by the overwhelming policy problem of agricultural overproduction. This raises provocative rhetorical questions: What might have elicited “foresighted response?” Or, given the mild aggregate impacts, can it be said that we have already made adequate responses? How are non-market values to be incorporated into the long-term? To wit:

“Are expectations of “transformative” adaptations (e.g. IPCC, (2014)) to climate variation undermined by acting to restore stability of existing arrangements, instead of increasing resilience?”

The politics of domestic agriculture and agricultural support are increasingly obscured by the globalized economy and increasingly sectionalized politics of farm support. The present analysis raises the issues of the global context, because of the idea (advanced by Warrick) of “exporting vulnerability”. Rosenberg et al. (1993), confirmed the strong likelihood that locally moderate economic impacts could result in significant decreases in exports of cheap grain, as occurred in 2008–2010 (due to drought and diversions for ethanol productions).

“The Dog Barks, But The Caravan Moves On” Bedouin Proverb

What, in the end, was learned from the drought of the 1950s? In a very real sense, this is a problem of shortage, and some work has considered the analogy of persistent drought to climate change (Pittock and Connell, 2010; Pulwarty and Sivakumar, 2014). Our study concludes that Americans learned how to consume the buffer (such as groundwater and soil quality) available, thus potentially making themselves less able to respond in a future multi-year event coupled with increasing dryness due to temperature-based evaporative demand. The years 2010–2012 noted the first time since 1928–30 that U.S. corn yield (bushels per acre) fell for three years in a row (Hatfield, B. Rippey, USDA, pers. comm.). This remains an area for further research. Perhaps we learned that U.S. and Canadian farmers will likely live through the next drought of “50s” magnitude, and so we have not concerned ourselves with who else may be affected.

In terms of global issues of increasingly vulnerable environments and populations, the drought of the 1950s offers little encouragement. There is a growing appreciation, in natural hazards studies, that successfully adjusting to stresses at one scale may not necessarily increase adaptation to stresses at a larger scale. In addition, the impacts of long-term precipitation deficits can last long after the precipitation has returned to normal since reservoirs, aquifers, soil moisture conditions etc. may not immediately replenished by one good year, with persistent socio-economic effects. Surviving an event (or events) of intermediate size may encourage increased investment in the flood-plain, which

is vulnerable to the truly large event (White et al., 1958; Bowden et al., 1981; Federal Interagency Floodplain Management Report Committee, 1994; Wiener, 1996; IPCC, 2012). The spectrum of drought impacts, beyond the yield of key crops, are increasingly acknowledged (e.g. in the droughts of 2001–2015 across the country) to extend to water demands (all droughts), wildfire fuels loadings (e.g. 2002, 2015 in the PNW), impacts on river traffic and commerce (e.g. the 2012 drought on the Mississippi), rangeland conditions, retail sales, recreational hunting and fishing licenses, and impacts on international US commerce and markets. Has the “success” in surviving the drought of the 1950s, and general disinterest in the 1988–89 drought, the national attention but limited national (but strong regional) impacts of the 2012 drought, left us with a false sense of security? Researchers may bark, but the caravan of human actions and events moves on.

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References

- Adamchak, D.J., Bloomquist, L.E., Bausman, K., Qureshi, R., 1999. Consequences of population change for retail/wholesale sector employment in the non-metropolitan great plains, 1950–1996. *Rural Sociol.* 64 (1), 92–112.
- Aucott, W.R., Myers, N.C., 1998. Changes in Ground-Water Levels and Storage in the Wichita Well Field Area, South-Central Kansas; 1940–1998. United States Geological Survey, Washington, D.C..
- Bark, L.D., 1978. History of American droughts. In: Rosenberg, N.J. (Ed.), *North American Droughts* (AAAS Selected Symposium No. 15). Westview Press, Boulder, pp. 9–24.
- Beal, C. The Changing Nature of Rural Employment. Pp. 37–49 in *New Directions in Urban-Rural Migration*, in Brown D. and Wardwell J. (eds) 1980 New York Academic Press.
- Benson, E.T., 1962. *Cross Fire: The Eight years with Eisenhower*. Doubleday, Garden City, NY.
- Blouet, B.W., Luebke, F.C., 1979. *The Great Plains: Environment and Culture*. U. of Nebraska Press, Lincoln.
- Bonner, C.A., Ward, J.M., 1955. Some Economic Effects of Drouth on Ranch Resources. *Texas Agricultural Experiment Station, College Station: Texas, Bulletin* 801.
- Borchert, J., 1971. The dust bowl in the 1970s. *Ann. Assoc. Am. Geogr.* 61, 1–22.
- Bowden, M.J., Kates, R.W., Kay, P.A., Riebsame, W.E., Warrick, R.A., Johnson, D.L., Gould, H.A., Weiner, D., 1981. The effect of climate fluctuations on human populations: two hypotheses. In: Wigley, T.M.L., Ingram, M.J., Farmer, G. (Eds.), *Climate and History: Studies in Past Climates and Their Impacts on Man*. Cambridge U. Press, Cambridge, pp. 479–513.
- Brewster, D.E., 1980. Changes in the family farm concept. In: U.S. Senate (Ed.), *Committee on Agriculture, Nutrition and Forestry, Farm Structure; A Historical Perspective on Changes in the Number and Size of Farms*. U.S.G.P.O., Washington, D.C., pp. 18–23.
- Butz, E.L., 1960. Agribusiness in the machine age. In: *United States Department of Agriculture* (Ed.), *Power to Produce: The 1960 Yearbook of Agriculture*. United States Department of Agriculture, Washington, D.C., pp. 380–385 [A1.10: 960].
- Carr, A.B., 1980. A profile of the commercial agricultural sector. In: U.S. Senate (Ed.), *Committee on Agriculture, Nutrition and Forestry, Farm Structure ; A Historical Perspective on Changes in the Number and Size of Farms*. U.S.G.P.O., Washington, D.C., pp. 24–35.
- Cochrane, W.W., 1979. *The Development of American Agriculture: A Historical Perspective*. University of Minnesota Press, Minneapolis.
- Cochrane, W.W., Runge, C.F., 1992. *Reforming Farm Policy*. Iowa State U. Press, Ames.
- Dismukes, R., Glauber, J., 2005. Why Hasn't Crop Insurance Eliminated Disaster Assistance? *Amber Waves June 2005*. (www.ers.usda.gov/AmberWaves/June05/pdf/FullIssueJune2005.pdf).
- Doerr, A.H., 1960. Oklahoma's Climate: The “Dirty Thirties” and the “Filthy Fifties” – Climatic Analogue, Prologue or Epilogue? in: *Proceedings of the Oklahoma Academy of Sciences for 1960*: 169–172; (<http://digital.library.okstate.edu/oas/>)

- oas_pdf/v41/p169_172.pdf) (accessed 26.09.15).
- Dorner, P., 1980. Agriculture within the U.S. economy: integration and interdependence. In: U.S. Senate (Ed.), Committee on Agriculture, Nutrition and Forestry, Farm Structure; A Historical Perspective on Changes in the Number and Size of Farms. U.S.G.P.O., Washington, D.C., pp. 51–61.
- Dyson, L.K., 1988. History of Federal Drought Relief Programs. United States Department of Agriculture, Economic Research Service. U.S.D.A., Washington, D.C..
- Egan, T., 2006. The Worst Hard Time: the Untold Story of Those Who Survived the Great American Dust Bowl. Houghton Mifflin, New York.
- Eisenhower, D.D., 1954. Economic Report of the President, Transmitted to the Congress. U.S. Government Printing Office, Washington, D.C..
- Eisenhower, D.D., 1957. Presidential Message, Alleviating Emergency Conditions Brought About by Prolonged Drought and Other Severe Natural Disasters. 85th Congress, 1st Session. House Doc. No. 110.
- Eisenhower, D.D., 1958. Economic Report of the President, Transmitted to the Congress. U.S. Government Printing Office, Washington D.C.
- Eisenhower, D.D., 1959. Economic Report of the President, Transmitted to the Congress. U.S. Government Printing Office, Washington D.C.
- Eisenhower, D.D., 1961. Economic Report of the President, Transmitted to the Congress. U.S. Government Printing Office, Washington D.C.
- Federal Interagency Floodplain Management Review Committee, 1994. Sharing the Challenge: Floodplain Management in the 21st Century. Administration Floodplain Management Task Force, Washington, D.C..
- Fite, G.C., 1964. American Agriculture and Farm Policy Since 1900. Macmillan Co, New York.
- Gaul, S., 1992. The Nebraska Sandhills. In: Kromm, D.E., White, S.E. (Eds.), Groundwater Exploitation in the High Plains. University Press of Kansas, Lawrence, KS, pp. 159–180.
- Garlock, F.L., 1960. Financing capital requirements. In: United States Department of Agriculture (Ed.), Power to Produce: The 1960 Yearbook of Agriculture. United States Department of Agriculture, Washington, D.C., pp. 375–380.
- Getches, D., 2008. Water Law in a Nutshell, 4th Ed. West Academic Publishing, United States, p. 560, SBN-13: 978-0314199515.
- Glauber, J., 2004. Crop insurance reconsidered. *Am. J. Agric. Econ.* 86 (5), 1179–1195.
- Glauber, J., 2007. Double indemnity: crop insurance and the failure of U.S. agricultural disaster policy. In: Sumner, D.A., Gardner, B.L. (Eds.), The 2007 Farm Bill & Beyond. American Enterprise Institute Press, Washington.
- Glauber, J., 2013. The growth of the federal crop insurance program, 1990–2011. *Am. J. Agric. Econ.* 95 (2), 482–488. <http://dx.doi.org/10.1093/ajae/aas091>.
- Gleick, P., 1990. Vulnerability of water systems. In: Waggoner, P.E. (Ed.), Climate Change and U.S. Water Resources.. John Wiley and Sons, New York, pp. 232–240.
- Goodsell, W.D., 1960. Technology and Capital. In: United States Department of Agriculture (Ed.), Power to Produce: The 1960 Yearbook of Agriculture. United States Department of Agriculture, Washington, D.C., pp. 370–375.
- Goodwin, B.K., Smith, V.H., 1995. Crop insurance and disaster policy. In: Sumner, D. A. (Ed.), Agricultural Policy Reform in the United States. American Enterprise Institute, Washington, D.C., pp. 117–152.
- Gollehon, N., Quinby, W., Aillery, M., 2006. Chapter 2.1. In: Wiebe, K., Gollehon, N. (Eds.), Agricultural Resources and Environmental Indicators; Economic Information Bulletin No. 16. United States Department of Agriculture, Washington, D.C. (accessed 21.09.15) <http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib16.aspx>.
- Hewitt, K., 1983. The idea of calamity in a technocratic age. In: Hewitt, K. (Ed.), Interpretations of Calamity. Allen and Unwin, Boston, pp. 3–32.
- Hewes, L., 1958. Causes of wheat failure in the dry farming region, central great plains, 1939–1957. *Econ. Geogr.* 41, 313–330.
- Hewes, L., 1975. The great plains: one hundred years after Major John Wesley Powell. In: Blouet, B., Lawson, M. (Eds.), Images of the Plains. University of Nebraska Press, Lincoln, pp. 203–214.
- Hewes, L., 1979. Agricultural risk in the Great Plains. In: Blouet, B.W., Luebke, H.C. (Eds.), The Great Plains: Environment and Culture. University of Nebraska Press, Lincoln, pp. 157–185.
- Holley, D., 2000. The Second Great Emancipation: The Mechanical Cotton Picker, Black Migration, and How They Shaped the Modern South. University of Arkansas Press, Fayetteville, p. 178.
- Hoppe, R.A., 2014. Structure and Finances of U.S. Farms: Family Farm Report, 2014 Edition U.S. Department of Agriculture, Economic Research Service, United States, EIB-132.
- Hoppe, R.A., MacDonald, J.M., Korb, P., 2010. Small Farms in the United States: Persistence Under Pressure. U.S. Department of Agriculture, Washington, D.C., EIB No. 63.
- Hughes, W.F., Magee, A.C., 1956. Changes in investment and irrigation water costs, Texas high plains, 1950–54. Texas Agricultural Experiment Station, College Station, Bulletin 828.
- Hurt, R.D., 1981. The dust bowl: an agricultural and social history. Nelson Hall, Chicago.
- IPCC, 2012. Intergovernmental Panel on Climate Change, Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Cambridge University Press, Cambridge, New York www.ipcc.org.
- IPCC, 2014. Summary for policymakers. In: Field, C.B., et al. (Eds.), Climate Change 2014: Impacts, Adaptation and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom, New York, NY, USA, pp. 1–32 (accessed October 2014) <https://ipcc-wg2.gov/AR5/report/full-report/>.
- Knollenberg, R., 1996. Environmental-Technological Interactions in Colorado High Plains Agricultural History (Ph.D. thesis). University of Colorado, Boulder, CO (History).
- Kraenzel, C.F., 1955. The Great Plains in Transition. U. of Oklahoma Press, Norman.
- Kromm, D.E., White, S.E., 1992. The high plains ogallala region. In: Kromm, D.E., White, S.E. (Eds.), Groundwater Exploitation in the High Plains. University Press of Kansas, Lawrence, KS, pp. 1–28, and Groundwater Problems, Pp 44–64.
- Laforge, J., McLeman, R., 2013. Social capital and drought-migrant integration in 1930s Saskatchewan. *Can. Geogr.* 7, 488–505.
- Lasswell, H., 1971. A Pre-View of the Policy Sciences. Elsevier Publishing, New York, p. 173.
- Layzell, A.L., Evans, C.S., 2013. Kansas Droughts: Climatic Trends Over 1000 Years. *Kans. Geol. Surv. Public Inf. Circ.* 35, 14, accessed 21 September 2015 (<http://www.kgs.ku.edu/Publications/PIC/pic35.html>).
- Lower Colorado River Authority, 2014. The Drought of Record. Lower Colorado River Authority. Austin, Tex., 2.
- Leuchtenberg, W.E., 1963. Franklin D. Roosevelt and the New Deal. Harper and Row, New York.
- Lins, D., Barry, P., 1980. Availability of financial capital as a factor of structural change in the U.S. farm production sector. U.S.G.P.O., Washington, D.C., pp. 74–100, in U.S. Senate, 1980, Committee on Agriculture, Nutrition and Forestry, Farm Structure; A Historical Perspective on Changes in the Number and Size of Farms.
- Maas, A. and R.L. Anderson, 1986, ...And the Desert Shall Rejoice: Conflict, Growth and Justice in Arid Environments. Malabar, FL: Robert E. Krieger Publishing Co. (Reprint of 1978 Publication by MIT Press, Cambridge, MA.).
- MacDonald, J.M., Korb, P., Hoppe, R.A., 2013. Farm Size and the Organization of U.S. Crop Farming. Economic Research Service E.R.R. No. 152. U.S. Department of Agriculture, Washington, D.C.
- Melillo, J.M., T.C. Richmond, and G.W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0231WJ2. (<http://nca2014.glo balchange.gov/>).
- Miewald, R.D., 1978. Social and Political Impacts of Drought. In: Rosenberg, N.J. (Ed.), North American Droughts. (AAAS Selected Symposium No. 15). Westview Press, Boulder, pp. 79–102 1978.
- Musick, J.T., Stewart, B.A., 1992. Irrigation Technologies. In: Kromm, D.E., White, S.E. (Eds.), Groundwater Exploitation in the High Plains. University Press of Kansas, Lawrence, KS, pp. 110–144 Kromm, D.E., White, S.E. (Eds.), Groundwater Exploitation in the High Plains. University Press of Kansas, Lawrence, KS, pp. 110–144.
- Newman, J.E., 1978. Drought Impacts on American Agricultural Productivity. In: Rosenberg, N.J. (Ed.), North American Droughts. (AAAS Selected Symposium No. 15). Westview Press, Boulder, pp. 43–62 1978.
- Ojima, D.S., Lockett, J.M., et al., 2002. Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, Region: Central Great Plains. U.S. Global Change Research Program. Colorado State University, Fort Collins, CO.
- Ottosen, H.W., Birch, E.M., Henderson, P.A., Anderson, A.H., 1966. Land and People in the Northern Plains Transition Area. U. of Nebraska Press, Lincoln.
- Pach Jr., C.J., Richardson, E., 1991. The Presidency of Dwight. In: Eisenhower, D. (Ed.), The Presidency of Dwight. University of Kansas Press, Lawrence, KS.
- Peterson, T.H., 1979. Agricultural Exports, Farm Income and the Eisenhower Administration. U. of Nebraska Press, Lincoln.
- Pinches, H.E., 1960. Revolution in Agriculture. United States Department of Agriculture, Washington, D.C., pp. 1–10, in United States Department of Agriculture, Power to Produce: The 1960 Yearbook of Agriculture.
- Pittock, J., Connell, D., 2010. Australia Demonstrates the Planet's Future: Water and Climate in the Murray–Darling Basin. *International Journal of Water Resources Development* 26, pp. 561–578.
- Pulwarty, R., Sivakumar, M., 2014. Information Systems in a Changing Climate: Early Warnings and Drought Risk Management. *Weather. Clim. Extrem.* 3, 14–21.
- Rasmussen, W.D., Baker, G.L., 1979. Price Support and Adjustment Programs From 1933 Through 1978: A Short History. (Agricultural Information Bulletin No. 424). United States Department of Agriculture, Washington, D.C.
- Reilly, J., et al. 2001. Agriculture: The Potential Consequences of Climate Variability and Change for the United States. U.S. National Assessment of the Potential Consequences of Climate Variability and Change; U.S. Global Change Research Program. (<http://www.usgcrp.gov/usgcrp/nacc/default.htm>).
- Reilly, J., et al., 2003. U.S. Agriculture and Climate Change: New Results. *Clim. Chang.* 57, 43–69.
- Riebsame, W.E., 1986. The Dust Bowl: Historical Image, Psychological Anchor, and Ecological Taboo. *Gt. Plains Q.* 6, 127–136.
- Riebsame, W.E., Changon, S.A., Karl, T.R., 1991. Drought and Natural Resources Management in the United States. Westview Press, Boulder.
- Riney-Kehrberg, P., 1994. Rooted in Dust – Surviving Drought and Depression in Southwestern Kansas. University Press of Kansas, Lawrence.
- Rosenberg, N.J., Ed., 1980. Drought in the Great Plains -- Research on Impacts and Strategies. 1st edition by Workshop on Research in Great Plains Drought Management held at the University of Nebraska-Lincoln, March 26–28, 1979 Littleton, CO: Water Resources Publications. 225 pp.
- Rosenberg, N.J., Ed., 1993. Towards and Integrated Impact Assessment of Climate Change: The Mink Study. Dordrecht: Kluwer Academic Publishers, Reprinted from Climatic Change Volume 24, Numbers 1–2 (1993).

- Riefler, R.F., 1978. Drought: An Economic Perspective. In: Rosenberg, N.J. (Ed.), *North American Droughts*. (AAAS Selected Symposium No. 15). Westview Press, Boulder, pp. 63–78 1978.
- Ross, E.B., 1980. Patterns of Diet and Forces of Production. In: Ross, E.B. (Ed.), *Beyond the Myths of Culture*. Academic Press, New York 1980.
- Saarinen, T. F., Perception of the Drought Hazard on the Great Plains. 1966. Department of Geography Research Paper Number 106. University of Chicago. Chicago IL.
- Scoville, O.J., 1960. *Machines and Farm Organization*. United States Department of Agriculture, Washington, D.C., pp. 389–395, in *United States Department of Agriculture, 1960, Power to Produce: The 1960 Yearbook of Agriculture*.
- Schuyler, M.W., 1989. *The Dread of Plenty: Agricultural Relief Activities of the Federal Government in the Middle West, 1933–1939*. Sunflower University Press, Manhattan KS.
- Special Assistant to the President for Public Works Planning, 1958. *Drouth: A Report*. U.S. Government Printing Office, Washington, D.C.
- Swanson, E.R., Sonka, S.J., 1980. Technology and the Structure of U.S. Agriculture. U. S.G.P.O., Washington, D.C., pp. 62–73, in U.S. Senate, 1980, Committee on Agriculture, Nutrition and Forestry, *Farm Structure; A Historical Perspective on Changes in the Number and Size of Farms*.
- United States Congress, Committee on Agriculture, Nutrition and Forestry, U.S. Senate, 96th Congress, 1st Session, *Status of the Family Farm*. Committee Print, June 18, 1979; report by United States Department of Agriculture.
- United States Congress, Committee on Agriculture, Nutrition and Forestry, U.S. Senate, 96th Congress, 2d Session, *Farm Structure: A historical perspective on changes in the number and size of farms*. Ninety-sixth Congress, Second Session, Committee Print, April 1980. Commissioned studies. Washington, D.C.: U. S.G.P.O.
- USDA, 1956. *Farm Population – Net Migration from the Rural-Farm Population, 1940–1950*. Agricultural Marketing Service, Statistical Bulletin No. 176. June 1956. United States Department of Agriculture, Washington, D.C.
- USDA, 1960. *Power to Produce: The 1960 Yearbook of Agriculture*. United States Department of Agriculture, Washington, D.C.
- USDA, National Agricultural Statistics Service, 1960. *Agricultural Statistics*. U.S. Department of Agriculture, Washington.
- USDOC, Bureau of the Census, 1961, 1960 Census of Population: Supplementary Reports: Population of Urbanized Areas 1960 and 1950. [C3.223/12: 960-5] And, Supplementary Reports: Urban and Rural Population of the United States, by States, 1960 and 1950 [C3.223/12: 960-4]. Washington, D.C.: U.S.G.P.O.
- USGS, 1990. *National Water Summary 1987 – Hydrologic Events and Water Supply and Use*. Water Supply Paper 2350. United States Geological Survey, Washington, D.C.
- USGS, 1999, water use information and fact sheet, available at: (<http://h2o.usgs.gov/watuse/wufactsheet.html>) (accessed October 2012).
- USGS, 1994: *Water-Level Changes in the High Plains Aquifer, Predevelopment to 1994*. (http://water.usgs.gov/wid/FS_215-95/FS_215-95.html).
- Vayda, A.P., 1983. Progressive contextualization: methods for research in human ecology. *Hum. Ecol.* 11, 265–281.
- Warrick, R.A., 1983. Drought in the U.S. Great Plains: Shifting Social Consequences?. In: Hewitt, K. (Ed.), *Interpretations of Calamity*. Allen and Unwin, Boston, pp. 67–82 1983.
- Wagner, F.H. (Ed.), 2003. *Rocky Mountain–Great Basin Regional Climate Change Assessment*. Report for the US Global Change Research Program. Utah State University, Logan, UT, Note: Re-posted <http://gaia.econ.utah.edu/planning/seminar/regclimchange.pdf>.
- White, G.F., Calef, W., Hudson, J., Mayer, H., Shaeffer, J., Volk, D., 1958. *Changes in Urban Occupance of Flood Plains in the United States*. Department of Geography Research Papers. No. 57. University of Chicago, Chicago.
- Wiener, J.D., 1996. *Research Opportunities in Search of Federal Flood Policy*. *Policy Sci.* 29 (4), 321–344.
- Woodhouse, C.A., Overpeck, J.A., 1998. 2000 years of drought variability in the central. v. 79. *Bulletin of the American Meteorological Society, United States*, pp. 2643–2714.
- Worster, D., 1979. *Dust Bowl: The Southern Plains in the 1930s*. Oxford University Press, London and New York.
- Wilhite, D., 1997. *Improving Drought Management in the West: the Role of Mitigation and Preparedness*. Report to the Western Water Policy Review Advisory Commission. (<http://hdl.handle.net/1928/2789>).
- Williamson, R.K., 1993. *The Heat from the Forge: Aspects of the Seven Year Drought of the 1950s in Texas*. Texas Christian University, Ph.D. Dissertation.