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MULTIVARIATE ANALYSIS OF QUALITY OF LIFE AND MIGRATION IN NORTH DAKOTA

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Abstract. *Principle components analysis and multiple regression were used to examine spatial variations in quality of life indicators, and relationships between quality of life indicators and net migration rates for North Dakota counties between 1980 and 1990. Three quality of life dimensions were identified: Affluence, Suffering, and Demography. Of the three derived indicators, Affluence was the best overall statistical determinant of county migration rates. Adverse quality of life and migration trends were especially evident for counties with high non-white population proportions; such counties may need special development policies.*

The 1980s seemed a "lost decade" of development to analysts in most nonindustrial and many industrial nations, because disparities between poor and rich populations and regions increased significantly almost everywhere (Raymond 1991). Evidence of growing disparities in quality of life indicators prompted the United Nations General Assembly to adopt *"human development"* as the centerpiece of its International Development Strategy for the 1990s (Mahbub ul Haq 1992:26). Human development, defined as "a process of enlarging people's choices," includes improved opportunities to earn greater income, access to education and health facilities, economic and political freedom, freedom of migration, and environmental safety (United Nations Development Program [UNDP] 1990; Kelley 1991).

Although many of the most alarming declines in quality of life measures occurred in lesser developed countries, notable disparities also afflicted lagging regions and disadvantaged groups in several highly developed countries including the United States (U.S. Department of Commerce, Bureau of the Census 1992). As Morrill (1993:431) concluded in a recent study of social and demographic trends within this nation, "Many areas and groups of people have fallen absolutely in level of well-being, and the geographic pattern of these changes is very complex and uneven."

Recent trends in North Dakota echo Morrill's national assessment of complexity and unevenness but at a smaller scale. During the 1980s, real per capita income fell 8.2%, adjusted housing values dropped 27.0%, and population size shrank 2.1%. Although the crude death rate for the United States dropped 2.3% between 1980 and 1990, the crude death rate for North Dakota increased 0.6%. Over 8,000 additional people fell below the poverty line in the state between 1980 and 1990. In addition, spatial disparities intensified between the state's few larger cities and its many smaller towns and sparsely populated rural areas.

This study has two main objectives: first, to assess spatial and temporal variations in quality of life in the 53 North Dakota counties from 1980 to 1990; and second, to explore relationships between quality of life indicators and migration rates for these counties. Drawing from the findings of earlier studies, it is hypothesized that intercounty migration within North Dakota, and interstate migration beginning or terminating in North Dakota are influenced by county-level spatial and temporal variations in quality of life (Hall 1984; Hansen 1993; Hsieh and Liu 1983; Liu 1975b; Klug 1976; Murdock et al. 1993; Porell 1982).

Quality of life has become an active arena for interdisciplinary research, attracting scholars from geography, sociology, political science, economics, and other disciplines. Its importance as a geographic research topic was emphasized by Helburn (1982:445); he asserted that "Because 'quality of life' as a policy goal is attached to place, it is a goal of which geographers must be cognizant, and to which geographers can make important contributions." Cutter (1985) also drew attention to the subject in her monograph, *Rating Places: A Geographer's View on Quality of Life.* Awareness of spatial and temporal variations in the quality of life can enable policy makers and planners to monitor changes and to devise more effective policies to address persisting inequalities (Hemmasi 1994).

Quality of life is an evolving field of research, in which several conceptual identification and empirical measurement problems continue to exist. Three classes of problems deserve mention.

First, the nature, availability, and number of variables needed to measure composite life-quality pose challenges. So-called "objective" socioeconomic variables, such as formal educational attainment or median income, are relatively widely published for geographical areas and social groups. However, quality of life as a concept also evokes "subjective" perceptual or valuative aspects of human existence which are less commonly reported. Measures of environmental conditions, such as climate or ground-

water contamination, are more readily available and often included in quality of life studies.

Second, the choice of a unit of analysis and the selection of a sampling or observational design can influence potential findings in subtle as well as obvious ways. For example, geographically-oriented studies of life-quality can focus on human populations locationally grouped at diverse spatial scales, including international (Tata and Schultz 1988), national (Hall 1984), county (Park 1985), and urban or neighborhood levels (Liu 1975a; Findlay et al. 1988; Smith 1982). For statistical and substantive reasons, findings at one scale need not apply without revision to other scales.

Third, the numerical and statistical methodology for creating comparative quality of life indexes is still evolving. Techniques for developing composite quality of life indexes include simple rankings of places, calculation of standard scores, scaling methods, and factor or principal components analysis (Dasgupta and Weale 1992; Park 1985; Hall 1984; Tata and Schultz 1988; Stover and Leven 1992; Ram 1982). Following previous research by Berry (1961) and Smith (1982), this study uses both standard score scaling and principal components analysis.

Data and Scaling

Care was exercised in data collection to achieve as much comprehensiveness and cross-temporal comparability as possible. Selected variables had to be obtainable for both 1980 and 1990, as well as reflect as many specific aspects of composite quality of life as possible. Attention was given to the inclusion of "objective," "subjective," and environmental indicators. Unfortunately, subjective indicators are rarely reported at county-scale (Cutter 1985). Environmental measures of climate and atmospheric quality also were considered. However, spatial variations of average temperature and precipitation are relatively small across the state, and North Dakota counties were found to have uniformly low air pollution levels below federal monitoring standards (North Dakota Air Quality Monitoring Laboratories 1993). Thus, environmental variables also were disregarded as potentially important but relatively invariant at the intended scale of investigation.

Although subjective and environmental indicators were found to be either unavailable or too geographically uniform to be useful discriminators among North Dakota counties, it was possible to assemble a number of objective indicators likely to be of relevance to quality of life as a broad, composite concept. Variables reflecting diverse features of the demographic,

TABLE 1
THE VARIABLES USED IN THE NORTH DAKOTA
QUALITY OF LIFE INDEX

Variable	Descriptions
Poverty	Percent below poverty level*
WPoverty	Women-headed households with related children below poverty*
PubAssis	Families with public assistant*
Income	Real per capita income
StateTax	Per capita sales and use tax
WinLF	Women in labor force*
Unemploy	Unemployment rate
BirthR	Crude birth rate
DeathR	Crude death rate
BtoTeenM	Babies born to teenage mothers*
CBOWL	Out of wedlock birth rate
Children	Children under five years*
Age	Population median age
Crowding	Housing units with >1.01 person per room*
HouseVal	Adjusted median housing values
Rent	Median rent
Dr/Pop	Doctors per population*
HighEdu	Population with BA/BS or more*
City	Large city presence 1 absence 0
Populat	Population
PopProj	Population projection 1990-2000

* Percentage of related population.

economic, social, and health-related characteristics of the populations of North Dakota counties in both 1980 and 1990 were assembled for study from various sources (North Dakota State Department of Health and Consolidated Laboratories 1992; U.S. Department of Commerce, Bureau of the Census 1980, 1990) (Table 1).

TABLE 2
CHANGES IN THE QUALITY OF LIFE VARIABLES
DURING 1980 TO 1990

Variable	State: % Change 1980-90	County: Coefficient of Variation 1980	1990
Poverty	1.8	37.4	41.9
WPoverty	13.3	105.8	113.5
PubAssis	3.1	58.7	71.4
Income	-8.2	17.3	14.9
StateTax	85.0	56.0	55.6
WinLF	9.5	18.8	13.1
Unemploy	0.9	61.5	64.4
BirthR	-4.6	24.4	30.2
DeathR	0.6	25.5	33.2
BtoTeenM	-3.8	57.7	72.7
CBOWL	7.3	102.1	82.0
Children	-0.9	15.9	19.6
Age	4.1	14.3	13.1
Crowding	-0.7	88.5	137.9
HouseVal	-27.0	35.8	36.6
Rent	4.0	28.1	26.9
Dr/Pop	0.1	114.8	107.5
HighEdu	2.1	33.3	30.3
Populat	-2.1		
PopProj	-4.5		

Most of the 19 individual indicator variables suggest declining trends in quality of life components from 1980 to 1990, as indicated by state-level percent changes from 1980 to 1990, and county-level coefficients of variation (CV) for 1980 and 1990 (Table 2). Positive percent changes in poverty (Poverty), women headed households below poverty (Wpoverty), public

assistance (PubAssis) and unemployment (Unemploy), and negative percent changes in real per capita income (Income), and median housing value (HouseVal), for example, all indicate deteriorating economic conditions at state-level between 1980 and 1990. Higher 1990 coefficients of variability for poverty, women headed households below poverty, public assistance, and unemployment point to a trend toward greater spatial disparities at county-scale. However, a decrease in the coefficient of variability for real per capita income may suggest convergence rather than divergence for groups at average income levels or above across North Dakota counties.

Several though not all of the social and health-related indicators also exhibit ominous trends. The state-level out-of-wedlock birth rate (CBOWL) increased 7.3%, while the county-level coefficients of variation for this indicator fell by 20 points from 1980 to 1990, to show a more uniformly high incidence of out-of-wedlock births at the end of the decade. However, complexity is indicated by a state-level decline in the rate of births to teenage mothers (BtoTeenM), and an increase in the county-level coefficient of variation for this measure. Measures of health services provision (Dr/Pop), education (HighEdu), and female labor force participation (WinLF) show moderate improvements and follow a converging trend.

The complex and somewhat contrasting trends exhibited by the individual indicators point to the need for more generality. One technique used here to achieve broader generality is the calculation of an average composite index; the other, described below, involves principal components analysis. While the average index approach implicitly gives all initial indicators an equal numerical weight, principal components analysis derives composite measures from perhaps unequally weighted initial indicators, depending upon covariance relationships among the initial indicators. The different mathematical properties make these approaches useful when used in tandem.

An overall composite index of quality of life index (QLI) was calculated using all 19 variables for each county in each year (Hammond and McCullagh 1985: 42-43; Morris 1979). The "worst" and "best" values for each initial variable were identified and made equal to 0 and 100, respectively. Scaled scores for all other counties for each initial variable were then calculated according to the formula:

$$S = ((R - R_{worst}) / (R_{best} - R_{worst}))x\ 100$$

where S and R are the scaled and raw values, respectively. Once scaled scores had been computed for all counties for each initial variable, average overall

quality of life (QLI) composite scores were calculated for each county according to the formula:

$$QLI = (\Sigma(S)) / 19$$

where the S are scaled values for each of the 19 variables for each county. If a county were to have the best performance on all 19 original variables, it would receive an overall QLI score of 100 for that year; conversely, a county with the worst record on all 19 variables would receive an overall score of 0.

No county was either best or worst on all of the initial measures in either study year, so the actual ranges were found to be less than the possible maximum of 100. However, the relatively broad ranges of computed composite QLI scores of from 16 to 84 for 1980, and 9 to 84 for 1990 show that there is a strong tendency for North Dakota counties to have similar relative rankings on most if not all of the initial measures. In both periods, Sioux, Rolette, and Benson Counties, where the Native American Reservations are located, were at the lowest end of the composite QLI scale. On the other hand, four counties with the state's largest cities, including Cass, Burleigh, Grand Forks, and Ward Counties, had among the highest scores in both years. Furthermore, Figures 1 and 2, which cartographically depict North Dakota counties according to their QLI composite scores for 1980 and 1990, exhibit generally similar geographical patterns for both years.

Although the geographical patterns remained similar, small scale changes did occur, as revealed by comparisons of county scores at the beginning and at the end of the decade. Figure 3 graphically depicts these changes.

Twenty-two counties (42%) registered a decline in composite QLI scores. Only three counties had the same values in 1980 and 1990. Three counties improved more than ten points and one (McKenzie) declined over ten points. Counties with higher numbers of Native Americans usually were among the biggest losers. Some urban counties also declined, although Cass County showed a small 1 percent gain on the composite index.

Nevertheless, the overall impression of geographical similarities of pattern between 1980 and 1990 is supported by a statistically significant and strongly positive Spearman rank correlation coefficient of +0.915 computed between county composite QLI scores for 1980 and 1990. Before turning to relationships between migration and quality of life, however, it is worthwhile to use principal components analysis to examine the question of whether the selected initial indicators might be better summarized using more than one derived index.

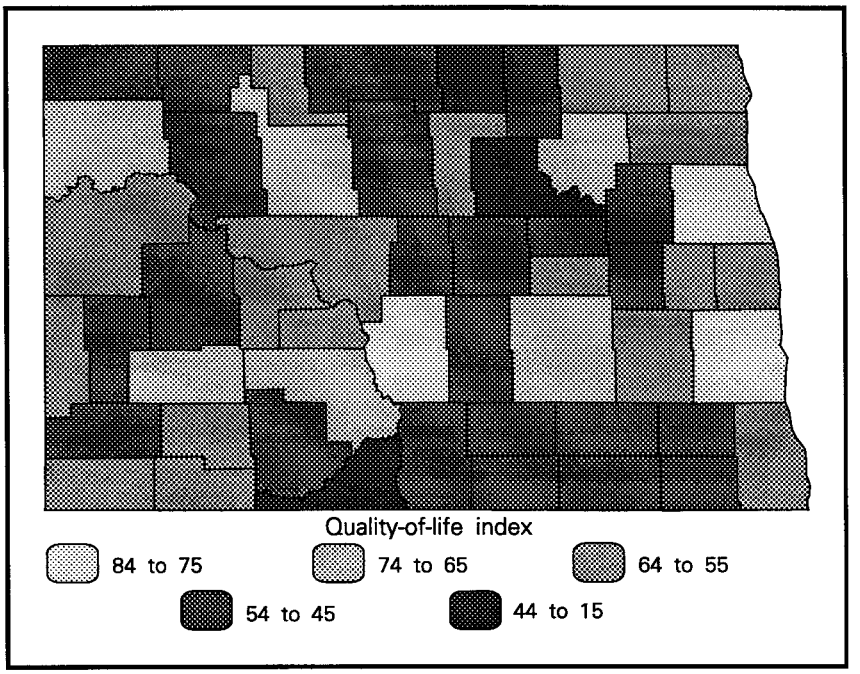

Figure 1. Composite index of overall quality of life based on 19 variables, 1980.

Principal Components Analyses

Principal components analysis allows a researcher to reduce a larger set of initial indicator variables to a smaller and more manageable set of derived indicators without making the likely unwarranted assumption that all initial indicator variables are equally important. Such an analysis can be regarded as a mathematical search for statistical redundancy. The overall procedure is based on the statistical reduction of the original indicators to their "principal components," based upon mathematical covariance relationships among all original indicators (Rummel 1970). By performing an additional varimax rotation of initially extracted principal components, it is possible to obtain orthogonal factor scores which indicate the relative rankings of observations, here counties, on the derived composite measures. Such scores have

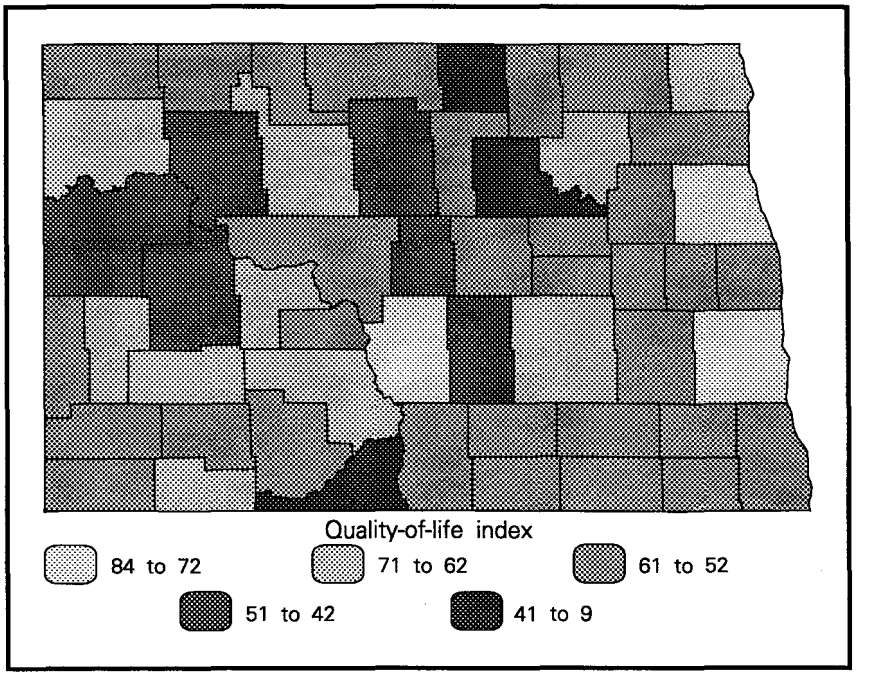

Figure 2. Composite index of overall quality of life based on 19 variables, 1990.

the valuable property of statistical independence as input to regression analysis of migration data (DeVellis 1991).

Using a minimum eigenvalue of 1.0 criterion, separate principal components analyses of data matrices containing initial indicator values for all counties in North Dakota in 1980 and 1990 yielded three factor solutions, in which the three interpreted factors or principal components together accounted for 75 percent and 81 percent, respectively, of the total variance in the 1980 and 1990 input data matrices. Factor one, the most important dimension, accounted for 32% of the total variance for 1980 and 38% for 1990. This factor can be given substantive interpretation by noting which of the original input variables have the highest factor loadings on this dimension. As shown in Table 3 for 1980 and Table 4 for 1990, the variables with high loadings on factor one, such as poverty among female-headed-house-

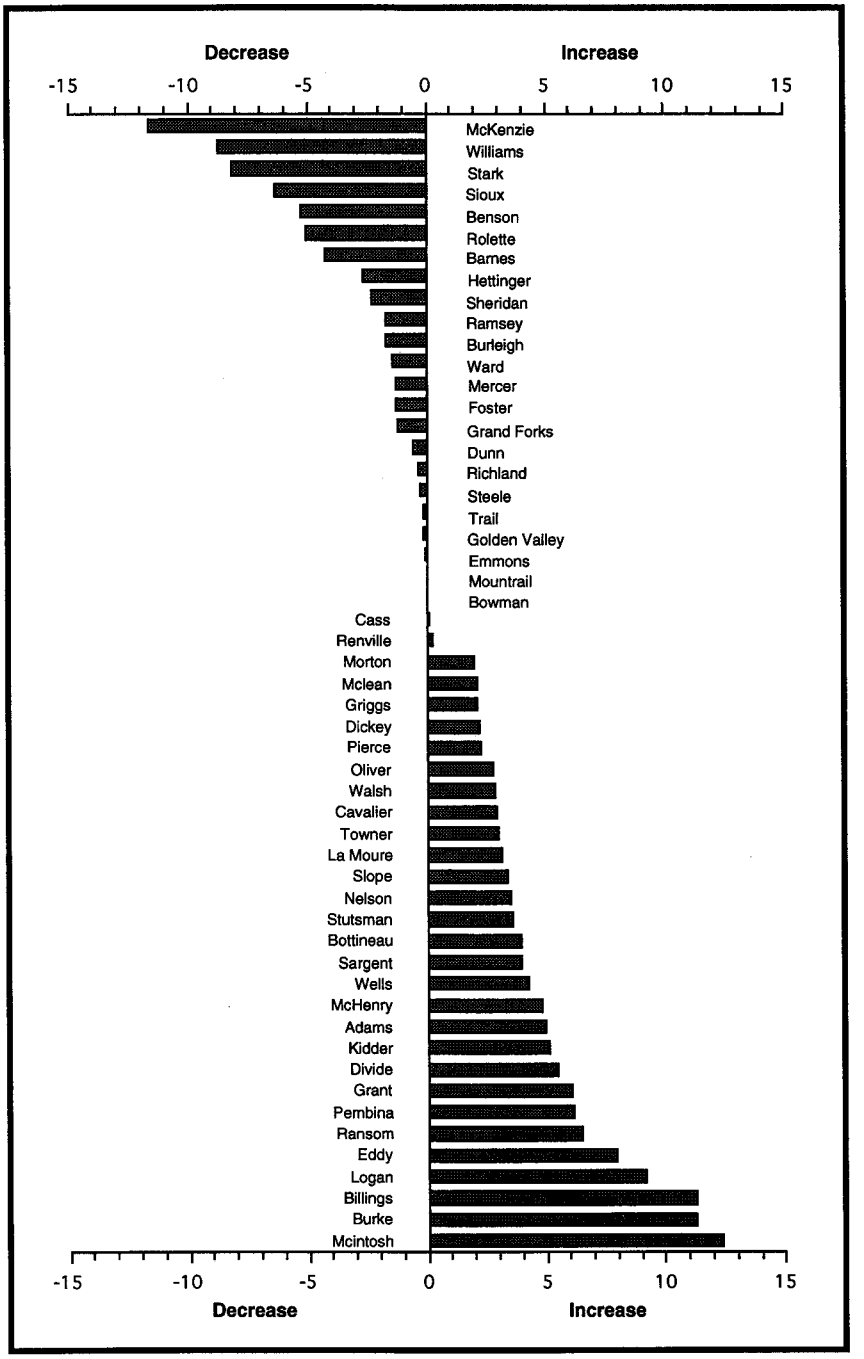

Figure 3. Change in county quality of life index, 1980-1990.

TABLE 3
VARIMAX ROTATED FACTOR MATRIX
AND FINAL COMMUNALITIES, 1980

	Factor Pattern Loading			
Factor	I	II	III	
Variable	Suffering	Affluence	Demography	Communality
WPoverty	**.931**	-.047	-.106	.88
PubAssis	**.900**	-.186	.069	.85
CBOWL	**.877**	-.082	-.160	.80
Crowding	**.836**	-.312	-.343	.91
Unemploy	**.790**	.085	-.036	.63
BtoTeenM	**.688**	.048	-.078	.48
BirthR	**.675**	.094	**-.565**	.78
HighEdu	.025	**.848**	-.136	.73
Dr/Pop	.094	**.846**	.154	.74
HouseVal	-.107	**.834**	**-.425**	.88
Rent	-.187	**.780**	**-.489**	.88
StateTax	-.195	**.756**	-.104	.62
City	.105	**.756**	-.217	.63
WinLF	.363	**.736**	-.198	.71
Income	**-.484**	**.651**	-.088	.66
Poverty	**.475**	**-.661**	.087	.67
DeathR	-.038	-.363	**.782**	.86
Age	**-.499**	-.354	**.724**	.89
Children	**.659**	.105	**-.660**	.88
Variance Explained	6.087	5.722	2.634	
Cumulative Percent of Variance	32.0	62.1	75.9	

TABLE 4
VARIMAX ROTATED FACTOR MATRIX
AND FINAL COMMUNALITIES, 1990

	Factor Pattern Loading			
Factor	I	II	III	
Variable	Suffering	Affluence	Demography	Communality
WPoverty	**.961**	.023	-.074	.92
CBOWL	**.940**	.050	.046	.88
Unemploy	**.898**	-.144	-.133	.84
Crowding	**.876**	-.182	-.277	.87
PubAssis	**.858**	-.315	-.126	.85
BirthR	**.810**	.197	-.202	.73
BtoTeenM	**.776**	.066	.134	.62
Children	**.762**	.113	**-.535**	.88
Poverty	**.692**	**-.526**	-.277	.83
Age	**-.618**	**-.455**	**.579**	.92
Rent	-.185	**.910**	-.161	.89
HighEdu	.008	**.892**	-.082	.80
StateTax	-.173	**.891**	.013	.82
HouseVal	-.012	**.874**	-.290	.84
WinLF	.172	**.870**	-.206	.83
City	.050	**.800**	-.181	.67
Dr/Pop	.115	**.747**	.210	.61
Income	**-.522**	**.732**	.061	.81
DeathR	-.180	-.217	**.883**	.86
Variance Explained	7.240	6.423	1.898	
Cumulative Percent of Variance	38.1	71.9	81.9	

holds (Wpoverty), overcrowded dwelling units (Crowding), teenage childbearing (BtoTeenM), and unemployment (Unemploy), imply a dimension of poverty and social problems, which can be labeled a "Suffering" component, following earlier studies (Population Crisis Committee 1987). This dimension is somewhat more distinctive for 1990 than for 1980, but the patterns of factor one loadings are quite similar for the two separately undertaken principal components analyses.

Factor two accounts for 30% and 33% of the total variance in the 1980 and 1990 data matrices, respectively. Variables with high loadings on this factor in each year include college education (HighEdu), median housing value (HouseVal), real per capita income (Income), as well as several other indicators of economic well-being such as physicians per population (Dr/pop) or women in the labor force (WinLF), which likely signifies more affluent dual-income families. Factor two can be labeled "Affluence," since highly loading variables generally reflect prosperity and development.

Finally, factor three in both years exhibits high loadings for "Demographic" variables, including population under age 5 (Children), median age (Age), and mortality (Death). In 1980 but not 1990, home value (HouseVal) and rent (Rent) also showed some affiliation with the third factor, perhaps reflecting linkages between family structure and housing conditions. Factor three accounted for 13% of variance in 1980 and 10% in 1990.

Although the principal components analyses appear coincident, comparisons can be refined analytically by using the coefficient of congruence as a numerical measure of similarity between corresponding factors from the two analyses. This measure, like a correlation coefficient, ranges from -1.00 for perfect negative similarity to 1.00 for perfect positive similarity (Rummel 1970:460-463; Archer et al. 1985).

Congruence coefficients of 0.99 for Suffering and 0.98 for Affluence show that these are virtually identical, despite their having been separately derived from different data on a decade interval (Table 5). The Demography factors were less similar across the decade, as shown by a congruence coefficient of 0.87. Nevertheless, visual and numerical comparisons both show considerable variable-based stability and distinctiveness in the components structures of the two data sets. What about geographical patterns?

As noted above, factor scores can be computed to index the relative rankings of counties on each of the derived principal components. If low congruence coefficients had been found, comparisons of factor scores over time would be unwarranted. The high congruence coefficients indicate that the component measures, especially for the Suffering and Affluence

TABLE 5
CONGRUENCE (C) AND RANK CORRELATION (r)
COEFFICIENTS BETWEEN 1980 AND 1990
QUALITY OF LIFE PRINCIPAL COMPONENTS

Component	Congruence Coefficient for Loadings (C)	Rank Correlation for Scores (r)
Suffering	0.99	0.79*
Affluence	0.98	0.94*
Demography	0.87	0.70*

*$p < .0001$

dimensions, are similar for 1980 and 1990. Spearman rank correlation coefficients computed for factor scores from corresponding pairs of principal components for each county in North Dakota in 1980 and 1990 indicate that the geographical patterns identified by the Affluence dimension were more locationally stable than those of either the Suffering or the Demography dimension. As shown in Table 5, the Spearman rank correlation for Affluence factor scores across counties was 0.94, while scores for Suffering yielded a correlation of 0.79 and those for Demography yielded the lowest correlation of 0.70. The implication is that geographical patterns reflecting mainly economic aspects of quality of life were more locationally persistent among North Dakota counties between 1980 and 1990 than were geographical patterns reflecting other aspects of quality of life.

In order to further explore the implications of the analyses, a cross classification of factor scores from the two main factors for 1990, Affluence and Suffering, was undertaken. Table 6 summarizes the results numerically, and Figure 4 is a bi-variate map which shows North Dakota counties classed in relation to both factors at once. Most counties enjoying "High Affluence—Low Suffering" conditions are crossed by a major highway (I-29, I-94, or US-2), contain a major urban settlement, or both. Together, the eight counties in this class hold over 86 percent of North Dakota's urban population, as well as most of the main governmental and higher educational

TABLE 6
QUALITY OF LIFE BIVARIATE CLASSES
AND POPULATION SIZE, 1990

Quality of Life Bivariate Class	Counties	Population			
		Total Persons	County Mean	% state total	% state urban
High Affluence—Low Suffering	8	673,063	46,433	58.4	86.5
Medium Affluence—Medium-Low Suffering	13	123,428	9,493	19.3	13.5
Low Affluence—Low Suffering	27	105,174	3,895	16.5	0.0
Low Affluence—High Suffering	5	37,135	7,427	5.8	0.0
Total	53	638,800	12,053	100.0	100.0

institutions. Several counties in the most numerous "Low Affluence—Low Suffering" category are geographically adjacent to others in the "High Affluence—Low Suffering" category. Counties in this group include thinly populated rural counties on the periphery or off the major highways, and can be found in all subsections of the state. Counties in the intermediate "Medium Affluence—Medium-Low Suffering" category are also geographically dispersed. The most disadvantaged "Low Affluence—High Suffering" category contains five counties, whose geographical distribution seems puzzling until it is noted that these counties have North Dakota's highest proportions of non-white population, including Sioux (76%), Rolette (67%), Benson (39%), Mountrail (20%), and McKenzie (15%).

Although previous research has emphasized east-west divisions in North Dakota (e.g., Meartz 1994; Pedeliski et al. 1987), the present findings

imply that geographical divisions related to urban-rural settlement, transport access, and ethnic cleavages are more notable in terms of quality of life. At county-scale, the sharpest quality of life disparities separate counties with larger and often prosperous urban centers from those with larger proportions of Native American population.

Migration and Quality of Life

The dynamics of population mobility in North Dakota can be summarized in terms of interstate and intrastate migration. Due to net interstate outmigration, North Dakota's population decreased over 2% from 1980 to 1990. Census data on state of residence in 1990 by state of residence in 1985 showed a net loss of 50,947 persons during the decade (Hansen 1990). At county-scale in North Dakota, intrastate net migration heavily favored the four largest cities of Fargo, Grand Forks, Bismarck, and Minot (Fig.4).

By hypothesis, geographical patterns of population migration reflect geographical patterns of quality of life. Multiple regression analyses focused on county-level migration rates and population change were undertaken in order to investigate this hypothesis. The dependent variables included population change 1970-1980 and 1980-1990, inmigration 1985-1990, and outmigration 1985-1990. Factor scores from the principal components analyses of quality of life measures served as independent variables. These scores reduce the 19 original indicators to three summary measures: Suffering, Affluence, and Demography. The scores are statistically independent, avoiding problems of multicolinearity among independent variables in multiple regression (Taylor 1977).

It is expected that county population change and inmigration measures are positively correlated with Affluence. It is also hypothesized that these dependent variables are negatively related to Suffering. The results of all multiple regression models are summarized in Table 7.

Overall, the coefficients of multiple determination (R^2) indicate that the models are successful in terms of accounting for a large proportion of county-level variation in population change. The regression results show that the Affluence index is the strongest predictor of total population change. As expected, higher Affluence relates positively to county population growth and inmigration. Positive regression coefficients linking the Suffering index to population change indicate that, holding Affluence and Demography constant, greater distress and higher population growth tend to occur together. Total population change includes natural and migration components,

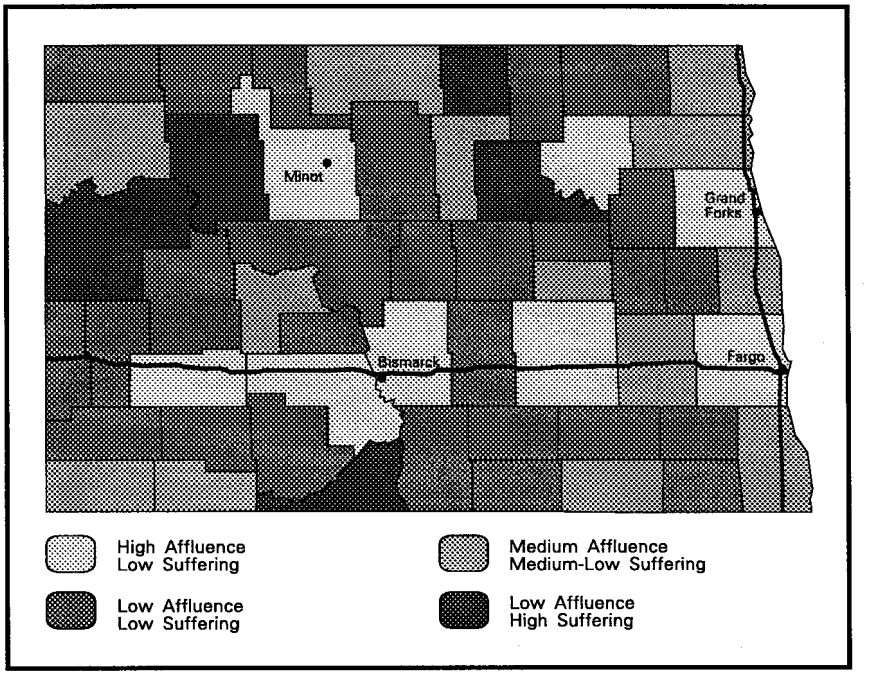

Figure 4. Regions of Affluence and human Suffering based on factor scores, 1990.

so higher birth rates in areas with higher Suffering scores are reflected in this relationship.

Outmigrants and inmigrants tend to respond differently to opportunities at the intrastate (short distance) and interstate (long distance) levels. The long-distance outmigration measure consists of the percentage of 1985 residents, five years of age and older, who lived in a county outside North Dakota in 1990. Those who moved from one county to another within the state of North Dakota were considered short-distance outmigrants. The sex ratio of long-distance outmigrants was 109, and over 63 percent were ages 20-44 years, underscoring the preponderance of young adult males among persons leaving the state. On the other hand, the same measures for the short-distance outmigrants were much lower, 94 and 58.6 percent, showing a preponderance of young adult females among intrastate movers.

TABLE 7
MULTIPLE REGRESSION MODELS EXPLAINING
POPULATION CHANGE AND MIGRATION RATES

Predictor Variables	b: Regression Coefficient	ß Coefficient
Population Change, 1970-80:		
Suffering	1.694	0.118
Affluence	8.418**	0.587
Demography	-8.024**	-0.560
$R^2 = 0.67$**		
Population Change, 1980-90:		
Suffering	3.723**	0.432
Affluence	6.076**	0.705
Demography	-3.235**	-0.376
$R^2 = 0.83$**		
Inmigration, 1985-90:		
Suffering	0.459	0.083
Affluence	4.220**	0.769
Demography	-1.432**	-0.261
$R^2 = 0.67$**		
Outmigration, 1985-90:		
a. North Dakota		
Suffering	-0.687*	-0.242
Affluence	-1.898**	-0.668
Demography	0.199	0.070
$R^2 = 0.51$**		
Outmigration, 1985-90:		
b. Other States		
Suffering	0.185	0.031
Affluence	3.363**	0.559
Demography	-1.456*	-0.242
$R^2 = 0.37$**		

*$p < 0.05$; **$p < 0.01$

The coefficients of determination (R^2) for the outmigration equations were lower than for the other models. As expected, the intrastate outmigration rate was best predicted by the Affluence index. At the interstate level, however, the Affluent counties send more outmigrants to other states. Over twenty percent of all outmigrants were in the 25-29 age category. They were usually young and many were college graduates seeking employment.

The negative regression coefficient between intrastate outmigration and the Suffering index seems anomalous, but may reflect circumstances regarding counties with concentrations of non-white population. Indeed, throughout this study, counties with large proportions of non-whites seem to behave differently, which prompted additional analysis whereby zero-order correlations were calculated between the percentage non-white population and the quality of life indicators for counties. The correlation coefficient between percent non-white population and Suffering scores from the principal components analysis is large and positive ($r = 0.952$). In contrast, percent non-white is negatively related to the composite QLI index computed from all variables ($r = -0.765$) and also to the inmigration rate ($r = -0.250$). Furthermore, the non-white proportion is positively related to the crude birth rate ($r = 0.780$) and population change during the 1980s ($r = 0.389$). These statistically significant relationships show that concentrations of non-white populations coincide with a high Suffering, low composite quality of life, high fertility, and greater population growth.

Discussion

The analyses showed that 32 counties containing over 22% of North Dakota's population fall into the category of low Affluence and varying degrees of Suffering (Table 6). These counties are basically rural-agricultural with no urban settlements of 2,500 or more in 1990. To improve human welfare in these counties requires special attention. For instance, the rural people may find it difficult to secure employment in cities where technical skills are required for many occupations.

Moreover, the rural populations of the five most distressed Low Affluence—High Suffering counties often have a higher fertility rate than the urban centers. The combined effect of relative spatial immobility and high natural growth rates compound their poverty and social problems. Furthermore, because of cultural differences and societal limitations, most Native Americans will not respond to local economic hardship and social problems by migrating. Their mobility patterns appear to differ from those of the white

population, which often responds to regional disutilities by moving to more attractive destinations (Cebula 1980).

In recent years, gambling casinos have been introduced into Native American communities (Berg 1994; Cornell and Kolt 1992). It is unlikely that economic growth policies of this nature can be implemented without considerable cultural and social adversity (Eagle 1992; Stillman 1992). A "people-centered" appraisal of these projects is needed to determine their impact on the well-being of ordinary residents. In general, the policies designed to combat poverty in Native American communities must have a different approach than those designed for the majority, even though the ultimate goal is to improve the quality of life for everyone. There is a need for new sustainable development policies to deal with the substandard quality of life of minorities here and elsewhere in North America (Farley and Allen 1980).

Quality of life of North Dakotans often is influenced by events at national or international arenas. The state produces mainly primary products, such as grain, livestock, coal, and oil. Many of the state's farmers expressed displeasure over the North America Free Trade Agreement (NAFTA) in demonstrations against grain imports from Canada. World petroleum price fluctuations also have effected the state's efforts to generate revenue (Wood 1994). Other impacts may come because of the end of the Cold War, since two major military bases are in North Dakota. These escaped the first round of base-closings, but both, or at least one, is likely to be closed in the near future. In 1990, nearly 50% of federal expenditures in Ward and Grand Forks counties were defense related (North Dakota Census Data Center 1991). Hence, if the bases are closed the cities of Grand Forks and Minot stand to suffer the most. These communities already lag behind Bismarck and Fargo in economic prosperity.

North Dakota's economy has traditionally enjoyed a sizable infusion of funds through various federal programs. Financial losses caused by natural hazards such as floods, droughts, unusually severe winters, and crop failures are often lessened by Federal assistance or insurance. During the fiscal year 1993, the state received over $272.6 million federal aid for families with dependent children (AFDC), Food Stamp, and Fuel Assistance. North Dakota consistently receives higher per capita federal expenditures than neighboring states.

Policy makers in the state are seriously seeking ways to maintain the state's revenue bases and reverse the persisting out-migration trends. A high

proportion of urban out-migrants are university graduates and financially better off individuals, while many rural out-migrants are victims of farm size growth. Modern mechanized farming practices require large-scale operations to be profitable. Thus, family farms are consolidated into larger holdings forcing the farmers to look for employment in the cities. As a result most of the rural "central places" are vanishing. The state's "growth poles" of Fargo, Bismarck, Grand Forks, and Minot are growing while most communities decline (Hemmasi and Dando 1989). Only these four cities reported moderate job growth during 1983-92 (North Dakota Census Data Center and the Department of Agricultural Economics 1993). Some smaller cities survive because they are the sites of higher educational institutions. Presently, North Dakota maintains eleven state-supported higher educational institutions despite many duplications and known inefficiencies. A new approach to management of the state's resources commensurate with new international, national, and regional realities could remove obstacles to a higher quality of life for everyone.

Summary and Policy Implications

This paper draws attention to the relatively unexplored spatial and temporal changes in the quality of life and migration in the state of North Dakota. Principal components analysis produced three basic quality of life dimensions for North Dakota counties: Affluence, Suffering, and Demography.

The research results pointed to an increase in the state's human Suffering index during the decade of the 1980s. This human-Suffering index consisted of variables which involved children. They included women-headed households below poverty with dependent children (WPoverty), children born to teenage mothers (BtoTeenM), percentage of children born out-of-wedlock (CBOWL), and children less than five years of age (Children). Often high fertility areas are also high poverty areas. To prevent further deterioration of quality of life in the poorer counties projects designed to target children's well-being are urgently needed. The state has the resources and the desire but lacks new practical approaches to the problems of human development.

Currently, the policy-makers debate the future directions of socioeconomic development in the state (Pedraza 1994). They seek answers to questions such as: Which sector of the economy can provide more decent jobs and

how? Who are the potential outside investors and what effects will industrial investment have on the environment? Could better utilization of local resources be an alternative strategy? Some suggest that since agricultural yields and productions are already high, value-adding activities may be a viable alternative. These activities include farm-product processing, livestock raising, and energy generation (Shepard 1993; Pedraza 1994).

Despite the somewhat bleak picture portrayed by the statistical results, future prospects for socioeconomic development, improved quality of life, and population retention in North Dakota are much brighter than the Poppers' "Buffalo Commons" imply (Popper and Popper 1987, 1988). Although the populations of rural areas and small towns continue to decline, the larger cities have grown steadily. Some of the smaller towns (e.g., Beulah, Hazen, and Linton) also have managed to maintain economic vitality (Shepard 1993). To a degree, the current population redistribution process is an adjustment to an overabundance of townsites platted by railroads and land speculators in earlier decades (Hudson 1985). It is also an adaptation mechanism to technological progress in farming practices and transportation facilities. A combination of Miller's approach which favors growth of metropolitan statistical areas (MSAs), and White's triage policy of investing in the potential growth centers of varied sizes seems to be already operating in North Dakota (Miller 1991; White 1994). The metropolitan areas are growing in economic opportunities and population, while some secondary growth centers are promoted by innovative visionary entrepreneurs.

However, public policy makers in North Dakota should be cognizant of the persisting spatial and particularly racial disparities in quality of life and seriously consider them in their development policies during the 1990s. This study identified the counties where efforts in human development are most needed.

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References

Archer, J. C., G. T. Murauskas, F. M. Shelley, P. J. Taylor, and E. R. White 1985. Counties, states, sections, and parties in the 1984 Presidential election. *The Professional Geographer* 37:279-87.

Berg, D. J. 1994. 'Hit me again': A geography of Indian casino gambling in the upper midwest. Paper presented at the 90th Annual Meeting of the Association of American Geographers, San Francisco, March 29-April 2.

Berry, B. J. L. 1961. Basic patterns of economic development. In *Atlas of Economic Development*, ed. N. Ginsburg, 110-19. Chicago: University of Chicago Press.

Cebula, R. J. 1980. Voting with one's feet: A critique of the evidence. *Regional Science and Urban Economics* 10:91-107.

Cornell, S. and J. P. Kolt, eds. 1992. *What Can Tribes Do?: Strategies and Institutions in American Indian Economic Development.* Los Angeles: University of California, American Indian Studies Center.

Cutter, S. L. 1985. *Rating Places: A Geographer's View on Quality of Life.* Washington, DC: Association of American Geographers.

Dasgupta, P. and M. Weale. 1992. On measuring the quality of life. *World Development* 20:119-31.

DeVellis, R. F. 1991. *Scale Development: Theory and Applications.* Newbery Park: Sage Publications.

Eagle, A. L. 1992. SRST signs gaming compacts with two states. *Winner's Circle: Indian Country Today*, November 5:26.

Farley, R. and W. R. Allen. 1980. *The Color Line and the Quality of Life in America.* New York: Russell Sage Foundation.

Findlay, A., A. Morris, and R. Rogerson. 1988. Where to live in Britain in 1988: Quality of life in British cities. *Cities* 5:268-76.

Hall, C. 1984. Regional inequality in well-being in Costa Rica. *Geographical Review* 74:48-62.

Hammond, R. and P. S. McCullagh. 1985. *Quantitative Techniques in Geography.* Oxford: Oxford University Press.

Hansen, K. A. 1990. *1990 Selected Place of Birth and Migration Statistics.* Washington, DC: U.S. Department of Commerce, Bureau of the Census, Journey to Work and Migration Statistics Division, Special Tabulations.

Hansen, D. A. 1993. Geographical analysis of population redistribution in North Dakota, 1960-1990. Masters Thesis, Geography Department, University of North Dakota.

Helburn, N. 1982. Geography and the quality of life. *Annals of the Association of American Geographers* 72:445-56.

Hemmasi, M. 1994. A multivariate analysis of quality of life in North Dakota. *Proceedings of the North Dakota Academy of Science* 48: 44.

Hemmasi, M. and W. Dando. 1989. Spatial population redistribution and migration regions in North Dakota. *Proceedings of the North Dakota Academy of Science* 43:50.

Hsieh, Chang-tseh and Ben-chieh Liu. 1983. The pursuance of better quality of life: In the long run, better quality of social life is the most important factor in migration. *American Journal of Economics and Sociology* 42:431-40.

Hudson, J. C. 1985. *Plains Country Towns.* Minneapolis: University of Minnesota Press.

Kelley, A. C. 1991. The human development index: 'Handle with care.' *Population and Development Review* 17:315-24.

Klug, H. G. 1976. An Ecological Analysis of Migration Patterns in North Dakota and South Dakota. Ph.D. diss., Sociology Department, South Dakota State University.

Liu, Ben-chieh. 1975a. *Quality of Life Indicators in U.S. Metropolitan Areas, 1970: A Comparative Assessment.* Washington, DC: U.S. Environmental Research Center.

Liu, Ben-chieh. 1975b. Differential net migration rates and the quality of life. *The Review of Economics and Statistics* 57: 329-37.

Mahbub ul Haq. 1992. Old myths, new actions: Human development reconsidered *Choices* 1 (1):26-27.

Meartz, P. D. 1994. Bankruptcy and other indicators of community stress in North Dakota 1985-1993. *Proceedings of the North Dakota Academy of Sciences* 48:41.

Miller, G. H. 1991. Tenth district cities: Recent growth and prospects for the 1990s. *Economic Review* 76 (4):47-58.

Morrill, R. 1993. Development, diversity, and regional demographic variability in the U.S. *Annals of the Association of American Geographers* 83:406-33.

Morris, M. D. 1979. *Measuring the Condition of the World's Poor: The Physical Quality of Life Index.* Washington, DC: Overseas Development Council.

Murdock, S. H., N. Hoque, and K. Backman. 1993. Determinants of 1980 to 1990 net migration in Texas counties: The role of sustenance specialization and dominance in international ecosystems. *Rural Sociology* 52:190-209.

North Dakota Air Quality Monitoring Laboratories. 1993. *Annual Report: Data Summary, 1992*. Bismarck.

North Dakota Census Data Center. 1991. Federal Expenditures in North Dakota, 1985 and 1990. *The Population Bulletin Series*, 7 (10):2.

North Dakota Census Data Center and the Department of Agricultural Economics. 1992. *North Dakota in Perspective: A Comparative Joint Report.* Fargo: North Dakota State University.

North Dakota State Department of Health and Consolidated Laboratories. 1992. *County Health Profile Series*. Bismarck: Division of Local Health Services/Public Health Nursing.

Park, S. 1985. Quality of life in Illinois counties. *Growth and Change: A Journal of Urban and Regional Policy* 16:56-69.

Pedraza, J. M. 1994. Expanding agriculture. *Grand Forks Herald,* January 16.

Pedeliski, T., R. W. Kweit, M. G. Kweit, and L. Omdahl. 1987. Cleavages on recent ballot measures: The two states of North Dakota? Paper presented at the Annual Meeting of the American Political Science Association, Chicago, September 3-6.

Popper, D. E. and F. J. Popper. 1987. The Great Plains: From dust to dust. *Planning* 53:12-18.

Popper, D. E. and F. J. Popper. 1988. The fate of the Plains. *High Country News* 20 (18):15-19.

Porell, F. W. 1982. Intermetropolitan migration and quality of life. *Journal of Regional Science* 22:137-58.

Population Crisis Committee. 1987. *The International Human Suffering Index*. Washington, DC: Population Crisis Committee.

Ram, R. 1982. Composite indices of physical quality of life, basic needs fulfillment, and income: A principal component representation. *Journal of Development Economics* 11:227-48.

Raymond, N. 1991. *The 'lost decade' of development: The role of debt, trade, and structural adjustment*. Washington, DC: The U.S. National Committee for World Food Day.

Rummel, R. J. 1970. *Applied Factor Analysis*. Evanston: Northwestern University Press.

Shepard, J. C. 1993. The new economy of the Great Plains: Implications for economic development. *Economic Development Quarterly* 7:403-10.

Smith, D. M. 1982. *Where the Grass is Greener: Living in an Unequal World.* Baltimore: John Hopkins University Press.

Stover, M. E. and C. L. Leven. 1992. Methodological issues in the determination of the quality of life in urban areas. *Urban Studies* 29:737-54.

Stillman, P. 1992. Gambling: A different kind of addiction. *Winner's Circle: Indian Country Today*, November 5:12.

Tata, R. J. and R. R. Schultz. 1988. World variation in human welfare: A new index of development status. *Annals of the Association of American Geographers* 78:581-93.

Taylor, P. J. 1977. *Quantitative Methods in Geography.* Boston: Houghton-Mifflin.

United Nations Development Program (UNDP). 1990. *Human Development Report 1990* (HDR). New York: Oxford University Press.

U.S. Department of Commerce, Bureau of the Census. 1980. *1980 Census of Population, General Social and Economic Characteristics: North Dakota.* Washington, DC: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990. *1990 Census of Population, General Social and Economic Characteristics: North Dakota.* Washington, DC: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1992. Poverty in the United States, 1991. In *Current Population Reports.* #181, p. 60. Washington, DC: U.S. Government Printing Office.

White, S. E. 1994. Ogallala oases: Water use, population redistribution, and policy implications in the high Plains of western Kansas, 1980-1990. *Annals of the Association of American Geographers* 84:29-45.

Wood, C. 1994. N.D. Oil Won't Recover Soon. *Grand Forks Herald*, May 1.