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The Importance of the Food System For Rural Vitality and Livelihoods In the US Northern Great Plains

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Abstract

The geopolitical U.S. Northern Great Plains encompass the state areas of Montana, Nebraska, North Dakota, South Dakota, and Wyoming. While other parts of the United States have seen considerable outmigration from rural areas, this region has widely maintained its rural population due to favorable employment, education, food security, and relatively low poverty levels. Currently, the expansion of large-scale agriculture, often poor food environments, and demographic trends, as well as external factors such as climate change, may affect population densities, livelihoods, and the vitality of the rural U.S. Northern Great Plains. We suggest a strong role of the food system in shaping these developments. For our study, we processed socio-economic and food-system-related data from demographic databases in descriptive statistics to explore the impact of the food system on demographic and socio-economic parameters. Specifically, we present data on how selected parameters of demography, employment, education, poverty, agriculture, food security, food accessibility, and health have changed during the past four decades in the U.S. Northern Great Plains, specifically its rural parts. We later discuss how these changes may contribute to future demographic and livelihood developments. We aim to offer our readers an understanding of the complex and interacting developments affecting rural residents of the U.S. Northern Great Plains and the important role the food system plays in the present and future of the region.

Keywords: rural outmigration, rural food systems, farm size, farm ownership, food security, food environment

L'importance du système alimentaire pour la vitalité rurale et les moyens de subsistance dans les Grandes Plaines du Nord des États-Unis

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Résumé

Les grandes plaines géopolitiques du nord des États-Unis englobent les États du Montana, du Nebraska, du Dakota du Nord, du Dakota du Sud et du Wyoming. Alors que d'autres parties des États-Unis ont connu une émigration considérable des zones rurales, cette région a largement maintenu sa population rurale en raison d'un emploi, d'une éducation, d'une sécurité alimentaire favorables et de niveaux de pauvreté relativement faibles. Actuellement, l'expansion de l'agriculture à grande échelle, des environnements alimentaires souvent pauvres et les tendances démographiques, ainsi que des facteurs externes tels que le changement climatique, peuvent affecter les densités de population, les moyens de subsistance et la vitalité des grandes plaines rurales du nord des États-Unis. Nous suggérons un rôle important du système alimentaire dans l'élaboration de ces développements. Pour notre étude, nous avons traité des données socio-économiques et liées au système alimentaire à partir de bases de données démographiques dans des statistiques descriptives pour explorer l'impact du système alimentaire sur les paramètres démographiques et socio-économiques. Plus précisément, nous présentons des données sur la façon dont certains paramètres de la démographie, de l'emploi, de l'éducation, de la pauvreté, de l'agriculture, de la sécurité alimentaire, de l'accessibilité des aliments et de la santé ont changé au cours des quatre dernières décennies dans les Grandes Plaines du Nord des États-Unis, en particulier dans ses parties rurales. Nous discuterons plus tard de la manière dont ces changements peuvent contribuer à l'évolution future de la démographie et des moyens de subsistance. Notre objectif est d'offrir à nos lecteurs une compréhension des développements complexes et interactifs qui affectent les résidents ruraux des Grandes Plaines du Nord des États-Unis et du rôle important que joue le système alimentaire dans le présent et l'avenir de la région.

Mots-clés : exode rural, systèmes alimentaires ruraux, taille de l'exploitation, propriété de l'exploitation, sécurité alimentaire, environnement alimentaire

1.0 Introduction

The geopolitical U.S. Northern Great Plains (NGP) encompass the areas of the states of Montana (MT), Nebraska (NE), North Dakota (ND), South Dakota (SD), and Wyoming (WY). Despite the particularities of each state, all share essential demographic patterns that allow labeling the NGP as a bastion of rural living in the United States:

- All NGP states are sparsely populated, and more than half of their residents live in rural communities, whereas across the United States, over 80% of the population live in urban and suburban environments (U.S. Census Bureau, 2011; U.S. Department of Agriculture, 2019).
- Although urban settlements in the NGP have undergone consistent growth during the past four decades, the total rural population of the region has remained relatively constant. This development contrasts with a sharp nationwide decline in rural populations (U.S. Census Bureau, 2011; U.S. Department of Agriculture, 2019).

Historically, the Great Plains and Rocky Mountain states (including all NGP states) have the highest share of counties with less than two residents per square mile in the United States (McGranahan & Beale, 2002). Despite the remoteness of most rural towns in the NGP, favorable socio-economic indicators have prevented a rural depopulation experienced in other regions of the United States (Fields, et al., 2020). For example, unemployment and poverty rates across the five NGP states, including rural poverty, are clearly below the United States average (U.S. Department of Agriculture, 2019). Also, the percentage of rural residents with a college degree exceeds the national average (Fields et al., 2016).

However, several (interacting) developments may affect these indicators in the future:

- The median household income in the NGP is below the United States average. This disparity is stronger in rural counties still characterized by farming and ranching (U.S. Bureau of Labor Statistics, 2019).
- Only a minor amount of the food generated in the region is consumed locally as food commodities are commonly produced for exportation or processing outside the region. Agriculture in the NGP does not offer sufficient diversification to provide a balanced diet for its residents (Padbury et al., 2002; Fields et al., 2016; U.S. Department of Agriculture, 2020).
- In most rural towns, access to food is often limited to convenience stores or travel to urban areas (U.S. Department of Agriculture, 2020).

Given the economic importance of agriculture for the rural NGP on the one hand and challenging food availability on the other hand, we hypothesize that developments in different food subsystems may be impacting livelihoods and vitality. We explored national demographic databases for identifying the most outstanding food-system-related developments that have the potential to affect rural living in the NGP. We emphasize the assessment of indicators for the past four decades (1980–2019), discussing specifically rural livelihoods, food self-sufficiency, and food security. We processed the gathered data in descriptive statistics. We aim to encourage a discussion on the significance of the food system for rural vitality and livelihoods, which may be relevant to similar regions in the United States and other high-income countries.

2.0 Background

2.1 Underlying Concepts

*2.1.1 Definitions: Food systems, livelihoods, food security, and food self-sufficiency***.** 'Food systems' are socio-ecological systems encompassing all actors and activities involved in the production, aggregation, processing, distribution, consumption, and disposal of food products, along with the broader economic, societal, and physical environments around these activities (Béné, 2020; Nguyen, 2018). They can be divided into food subsystems, for example food production or processing (Snow et al., 2021). Change in food systems is triggered by external (e.g., climate or pandemics) and internal drivers (e.g., productivity gains or consumer behavior), as well as through feedback mechanisms between them (von Braun, et al., 2021). Disturbances in one food subsystem may generate responses across other subsystems of a food system (Ericksen, 2008). Food systems exist at different scales: global, regional, national, and local. Despite sharing key features, all local food systems are unique, resulting from traditions, cultures, economic structures, and ecologies of locations (von Braun et al., 2021). A sustainable food system delivers food without compromising the economic, social, and environmental bases to generate food security and nutrition for future generations (Nguyen, 2018). It makes nutritious food available, accessible, and affordable to all, is humane and just, protecting farmers and other workers, consumers, and communities (Story et al., 2009). The resilience of food systems to internal and external stressors depends on a combination of assets including social, workforce, financial resources, and knowledge of food system stakeholders (Béné, 2020).

Chambers and Conway (1992) define a *livelihood* as a community's capabilities, assets, and activities required for a means of living. The approach has been widely but not exclusively used for mid- and low-income countries and criticized, among other shortcomings, for not sufficiently considering (a) power relations between and within communities (Dijk, 2011); (b) community-external factors, historical processes shaping livelihoods (Natarajan et al., 2022); and (c) potential spatial diversification of livelihood systems, for example when households are geographically split (Steinbrink & Niedenführ, 2020, pp. 35–52).

'Food security' describes the constant physical and economic access of households to sufficient, safe, nutritious, and appropriate food (Saint Ville et al., 2019). Food security refers to the individual household level but considering the food security of all households of a region is a significant dimension for welfare assessments at a regional or national scale (Cafiero et al., 2018).

'Food self-sufficiency' is the extent to which a country or region can satisfy its food needs from its own production (Leventon & Laudan, 2017). Clapp (2017) specifies that food self-sufficiency is different from food autarky as current trade of food is not ruled out within this concept. She defines food self-sufficiency as the ratio of food produced to food consumed at the domestic level.

2.1.2 Impact of farm size and ownership on rural vitality. In 1947, anthropologist Walter Goldschmidt published a study that concluded with the hypothesis that (Californian) communities characterized by smaller-scale, owner-operated farms had more vibrant, diverse economies and higher standards of living than communities dominated by large-scale commercial agriculture (Goldschmidt, 1947). The Goldschmidt thesis has shaped rural scholarship and activism since then.

However, it has also been widely criticized for being too generalized, apart from evidence of methodological mistakes in the underlying study (Haley, 2010). Later discussions also questioned the validity of a 1940s study for understanding today's rural communities—after decades of structural and technical changes in U.S. agriculture—as well as the use of farm area as an indicator of the 'smallness' of an operation (Ebel, 2020; Park & Deller, 2021). Nevertheless, the overall message of Goldschmidt that prevailing farm ownership characteristics can affect the vitality of a rural region has never been entirely rebutted. Contemporary studies, often based on large datasets, point to land ownership as an essential determinant of rural vitality, for example, Bailey et al. (2021).

Park and Deller (2021) use census data to disprove the common notion that farms in the United States have been consistently growing in area while decreasing in total numbers. They explain that, although the total number of farms larger than 1,000 acres has constantly increased since the late 1970s, the number of very small farms—50 acres and less—often operated by halftime farmers, has also grown considerably since then. They present similar developments when farm revenue is used to categorize farms instead of farm area. Their findings do not support Goldschmidt but are rather ambivalent. Accordingly, concentrations of large farms result in higher earnings per job and better health outcomes, while other parameters such as home-ownership favor communities of smaller farms. They identified the number of farm owners who live on their farms as a crucial determinant of vitality, specifically economic wellbeing.

2.2 The Northern Great Plains

2.2.1 Geography and climate. The NGP are an ecoregion of the North American Great Plains. They are comprised of a belt of predominantly rolling plains sloping gradually eastward from about 1,200 m above sea level along the slopes of the Rocky Mountains to 300 m above sea level at their eastern boundary (Padbury et al., 2002). The NGP ecoregion lies between the foothills of the Rocky Mountains to the west and, approximately, the 100th meridian to the east (Padbury et al., 2002). The most common demarcation for the eastern boundary coincides with the transition from short and medium grasses to the tall grasses of the humid Central Lowlands (Barker & Whitman, 1988; Padbury et al., 2002). The southern boundary is located at the North Platte River through WY and NE, and the Canadian Prairies are the most northern extension (Barker & Whitman, 1988). The ecological NGP comprise parts of five U.S. states: large expanses of MT, ND, SD, and smaller portions of NE and WY. The ecoregion also occupies parts of the Canadian provinces of Alberta and Saskatchewan. Occasionally, fractions of Manitoba and British Columbia are also considered parts of the NGP (Barker & Whitman, 1988; Padbury et al., 2002). Vegetation is dominated by mixed-grass prairie, but extensive areas of coniferous woodlands, wetlands, riparian forests, and shrub-steppe also exist (Padbury et al., 2002; The Nature Conservancy, 1999). The fragmentation of the NGP prairies due to agriculture and human settlement has caused an invasion of non-native plant species (Cully et al., 2003; Grant et al., 2009; Larson & Larson, 2010).

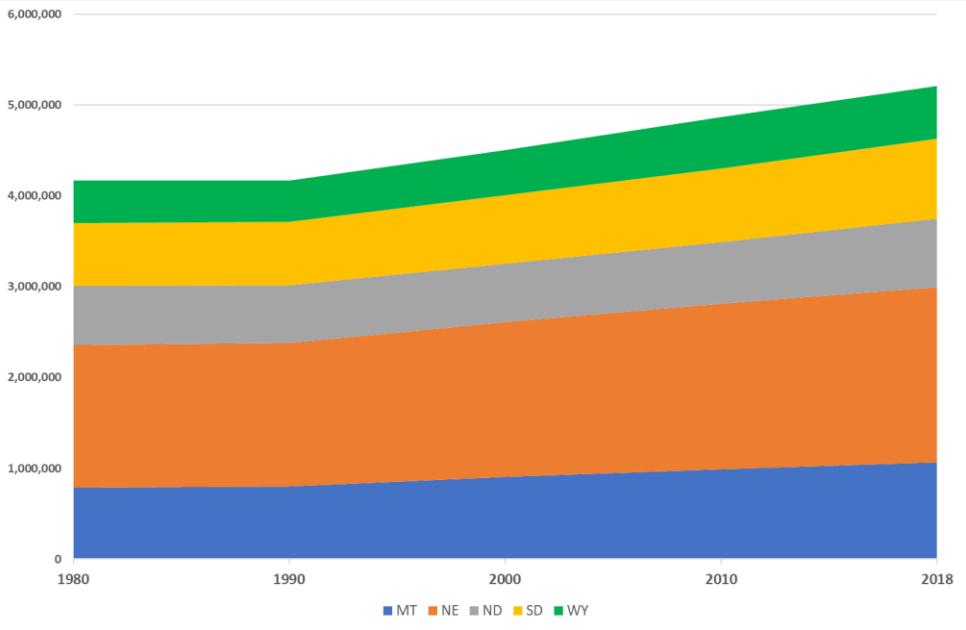
In socio-economic and geopolitical discussions—and in the present article—the U.S NGP are referred to as the entire state area of MT, ND, SD, NE, and WY (Conant et al., 2018; Heimlich, 2000). The geopolitical NGP have a size of 1.2 million km^2, where MT, as the largest state in the region, occupies 31.3% of the total area and the other four states each between 15% and 21% (U.S. Census Bureau, n.d.).

The climate of the NGP is characterized by long, cold winters; short but warm summers; large diurnal ranges in temperature; frequent strong winds; and often unpredictable precipitation (Padbury et al., 2002). The climate is continental; its variability is high. There is a strong east-to-west gradient of decreasing precipitation. The eastern edge includes humid-continental areas. A large part of the central NGP is arid to semiarid and sensitive to climatic fluctuations, resulting in frequent drought or flooding events (Conant et al., 2018). In the mountainous far western NGP, water dynamics are determined by large seasonal snowpacks accumulated in winter and early spring (Conant et al., 2018). The annual precipitation lies prevailingly between 300 and 500 mm, but parts of the NGP are among the driest regions in the United States (Padbury et al., 2002). Trends across the region over the past 40 years, attributed to climate change, show a decrease in annual runoff in the western NGP and an increase in the eastern parts. In the central NGP, unpredictable precipitation levels challenge farmers and ranchers. For the future, projected warmer and—depending on the location—wetter conditions together with rising atmospheric CO_2 concentrations are expected to result in longer production seasons—especially at mid- and high latitudes—allow for seeding new crops, but also increase the abundance and competitivity of numerous weed species. While livestock production is predicted to overall benefit from climate change, only a few models indicate higher crop yields (Conant et al., 2018).

2.2.2 Demographics. Before 1870, around 170,000 people lived in the NGP. This population was predominantly Indigenous people of the following tribes: Assiniboine, Crow, Blackfeet, Plains Cree, Plains Chippewa, Mandan, Hidatsa, Arikara, and Lakota (Lowie, 1982). Between 1870 and 1920, more than 3 million settlers of European descent moved into the region (Garver, 2011; Gutmann, 2018). The massive migration to the Great Plains was enabled by a violent ethnic cleansing of the Native American residents of the region, legalized by the 1830 Indian Removal Act and especially the 1862 Homestead Act, the Pacific Railroad Act, and the Morrill Land Grant Act, referred to as unitary acts of systematic genocide which prompted settler migration. These federal acts, together with the mass slaughter of the buffalo, forced Native Americans to be relocated to reservations where they became dependent for food and sustenance (Saito, 2020, pp. 41–46). Most of the migrated settlers practiced rainfed field crop production and mixed farming. These practices changed considerably after the Dust Bowl of the 1930s, one of the most devastating droughts of the past century which went hand in hand with numerous dust storms[1] caused by anomalous tropical sea surface temperatures and extractive land-use practices (Gutmann, 2018; Schubert et al., 2004). After the 1930s, irrigated cropping and especially extensive livestock holding became widespread in NGP. Until the 1990s, the total population in the NGP remained relatively constant between 3.5 and 4 million (Gutmann, 2018; U.S. Census Bureau, 2011). During the past three decades, all five NGP states have seen a constant population increase (see Figure 1).

[1] The storms occurred in the southern Great Plains but affected the NGP and wide parts of the US, Canada, and Mexico (Schubert et al., 2004).

Figure 1. Total population of the NGP (1980–2018) per state and total (U.S. Department of Agriculture, 2019).



In 2018, the NGP were estimated to have 5.2 million residents—which corresponds to 1.6% of the U.S. population—of which 1.9 million live in NE, the most populated state of the NGP, and less than 0.6 million in WY, the least populated one. With an increase of 35% between 1980 and 2018, MT has seen the largest population growth, while ND's population only rose by 16% (U.S. Census Bureau, 2011, 2020; U.S. Department of Agriculture, 2019). Even though, wide regions of the NGP are still sparsely populated. The overall population density in the NGP is around four habitants km^{-2}, more than eight times lower than the national average. The most densely populated state within the NGP is NE (U.S. Census Bureau, n.d.).

A large amount of the residents of the NGP are descendants of German settlers who came to the NGP during the 19th and early 20th centuries. Numerous settlers also came from what is now the Czech Republic and other central European countries (Garver, 2011). As Table 1 shows, the region has less racial diversity than the rest of the country. With a share of 4.5%, the population of American Indians is considerably higher than in other parts of the United States (U.S. Census Bureau, n.d.).

Table 1. *Demographics of the Five NGP States by Race and Ethnicity, NGP Average, and United States Average, by Race*

Race	MT	NE	ND	SD	WY	**NGP**	**U.S.**
White	89.00%	88.30%	87.00%	84.40%	92.60%	**88.11%**	**76.50%**
Black or African American	**0.60%**	**5.10%**	**3.40%**	**2.40%**	**1.30%**	**3.06%**	**13.40%**

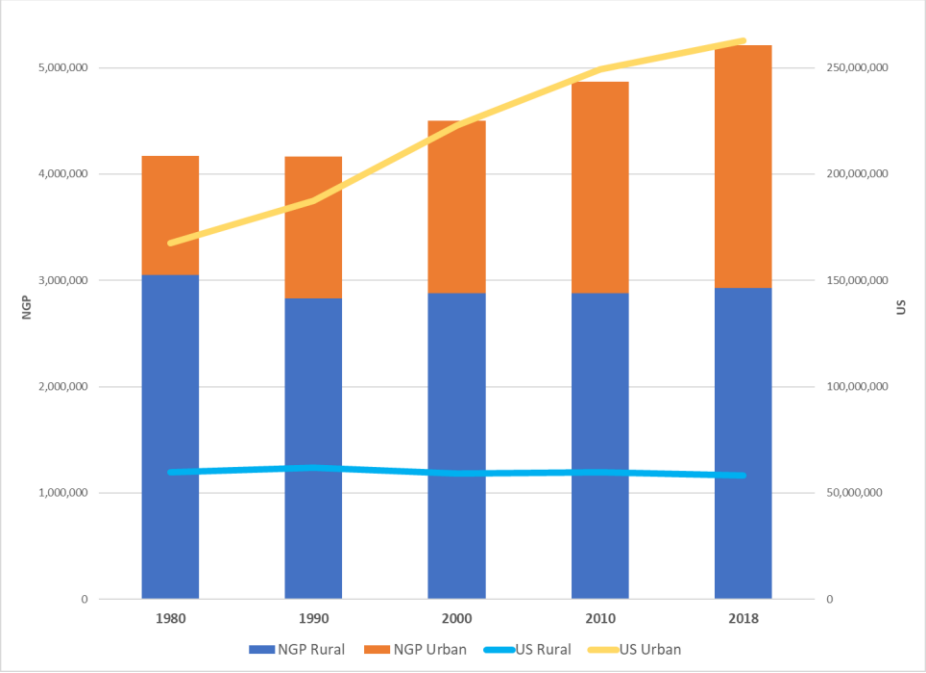
Table 1 continued

American Indian	**6.60%**	**1.50%**	**5.50%**	**9.00%**	**2.70%**	**4.48%**	**1.30%**
Other (Asian, Pacific Islander, +1 races)	**3.80%**	**5.10%**	**4.10%**	**4.20%**	**3.40%**	**4.35%**	**8.80%**
Latino (all races)	**4.00%**	**11.20%**	**3.90%**	**4.10%**	**10.10%**	**7.41%**	**18.30%**
Foreign-born	**2.20%**	**7.00%**	**3.90%**	**3.50%**	**3.50%**	**4.60%**	**13.50%**

Estimations for 2019 based on census 2011. (U.S. Census Bureau, n.d.)

While cities and large towns are growing across the NGP, the rural population has only decreased slightly (from 3.1 to 2.9 million) in the past 4 decades. In 1980, 73% of the NGP population lived in rural areas compared to 56% in 2018 (Johnson, 2012; U.S. Census Bureau, n.d.; U.S. Department of Agriculture, 2019). However, urbanization is still clearly below the national average (see Figure 2). Although Vermont is the most rural U.S. state (all based on USDA classification), MT, WY, ND, and SD represent by far the largest—in area—cluster of adjacent U.S. states with over 50% rural population (U.S. Department of Agriculture, 2019).

Figure 2. Total population of the NGP (1980–2018) per state and in the United States, in absolute numbers, and divided into rural versus urban residents.



U.S. Census Bureau, n.d.; U.S. Department of Agriculture, 2019.

Migration to the NGP has been constant and has increased as a consequence of the COVID-19 pandemic (Rein, 2020). Migration has centered on urban areas but MT and ND are two of only five U.S. states that have seen rural population increases above 7% between 2010 and 2020 (Henderson, 2021; U.S. Department of Agriculture, 2019).

2.2.3 Agriculture. Agriculture is an integral component of the economy, history, and culture of the NGP and contributes significantly to U.S. food security. The eastern NGP are characterized by rainfed row crop agriculture. In the central part, irrigated cropland and grazing lands prevail. The western NGP are primarily used for grazing and recreation, but dryland cropping is expanding. Forestry is important in the far-western part of the NGP (Conant et al., 2018).

Parts of the NGP are currently experiencing a transition in agricultural land use, specifically the conversion of grassland to monocropping of annual crops[2]. Hard red spring wheat used to be the dominant crop in the NGP. Currently, crops such as durum wheat, barley, soybean, dry beans, lentils, and sunflower are becoming popular. Table 2 shows that cattle is the most relevant livestock commodity (Conant et al., 2018; Padbury et al., 2002). The overwhelming part of plants and animals produced in the state is exported (U.S. Department of Agriculture, 2019). In the proximity of cities and larger towns, a new generation of farmers, often horticultural producers who emphasize local marketing—for example, at farmers markets—and self-consumption, has emerged in the NGP (Ebel et al., 2022).

Table 2. *Core Agricultural Commodities—Significant Contribution to United States Production—Produced in the NGP and Their Contribution to National Agricultural Production in 2012*

Commodity	**Share of National Production (% US$ market value)**
Wheat for grain	30.4
Spring wheat	**70.6**
Durum wheat	**72.2**
Oats	**20.3**
Barley	**48.4**
Dry beans and lentils	**48.6**
Sunflower seed	**83.6**
Cattle	**21.9**
Sheep and lambs	**18.4**

Conant et al., 2018.

[2] Monocropping is associated with increased yield variation due to high pest and weed pressure and an elevated fertilization and water demand, resulting in higher costs for farm inputs as in diversified systems, low biodiversity, contamination of soils, air, and groundwater, and low food security and sovereignty for farmers (Barrett & Constas, 2014; Ebel et al., 2021; Zimmerer et al., 2019).

Although large parts of the landscape of the NGP are characterized by agriculture, only 3% (WY) to 7% (ND) of its working population works in this sector. The number of female farmers lies between 9 % of the agricultural workforce in NE and 22% in WY (Fields et al., 2016).

3.0 Methodology

To explore links between socio-economic data that can serve as a proxy for rural vitality and livelihoods and food security and self-sufficiency in the NGP, we conducted a comprehensive search for existing demographic databases providing respective data. Databases provided by U.S. governmental entities, specifically the United States Census Bureau (U.S. Census) and the United States Department of Agriculture (USDA), provided the datasets necessary for accomplishing our study goals.

We extracted raw data from U.S. governmental databases related to the five NGP states—at state or county level—and included data as a function of the demographic and socio-economic environment regarding factors such as (a) basic economic parameters, (b) education, (c) health, (d) land use and agriculture, (e) food security, and (f) food availability (Mulrooney & Wooten, 2020). To organize and interpret the data, we developed a flat, traditional one-to-many relational database management system approach based on logically independent tables contextualizing food-system-related and demographic factors (Harrington, 2016). Subsequently, we sorted, filtered, and grouped the data (Shen et al., 2013). We then regrouped these data along the two axes of our study: livelihoods and vitality as well as food self-sufficiency and security. We processed the data using descriptive statistics (Bertrand & Goupil, 2000).

We centered on developments during the past four decades (1980–2019) wherever respective data were available. If applicable, national data were compared to individual NGP state data. Where we emphasized data of the rural NGP, unless stated otherwise, we used data from counties classified as rural by the USDA. Counties classified as non-metro areas and with a population equal to or lower than 20,000 inhabitants (U.S. Department of Agriculture, 2022b). When county-level data was not available, we used state-wide data.

All processed data were gathered between 2019 and early 2020, before the COVID-19 pandemic which has affected a wide number of parameters.

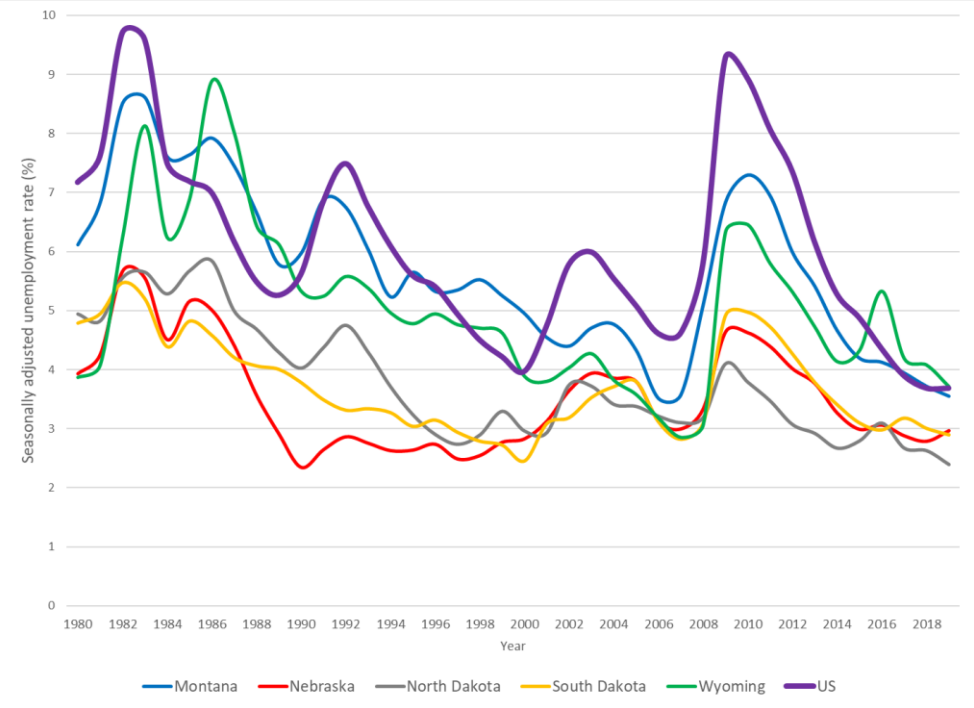
4.0 Analysis

4.1 Employment

Since 2000, the unemployment rate in all five NGP states has been below the national average, except for WY after 2016 (see Figure 3). Unemployment was lowest in NE, ND, and SD, and slightly more elevated in MT, the state which lost most jobs after the 2008 recession (U.S. Bureau of Labor Statistics, 2019; U.S. Census Bureau, n.d.; U.S. Department of Agriculture, 2019). NE has the largest labor force of all states and throughout the NGP, males represent around 60% of the active workforce (U.S. Department of Agriculture, 2019). This labor force is spread equally over diverse sectors, including health care (14.9% of total NGP workforce) and retail (9.7% of workforce), the sectors that generate the most employment across the five states. In contrast, manufacturing (9.6 % of workforce) only plays a strong role in NE and SD, while mining (2.2 % of workforce), as well as tourism (4.3 % of

workforce), are important sectors in WY and MT. Mining and other natural resource extraction jobs are significant sources of employment in several rural communities in MT and SD. The total employment in agriculture is 5.4% across the NGP, varying between 3.2% in WY to 6.7% in SD (Guzma, 2019; U.S. Bureau of Labor Statistics, 2019; U.S. Census Bureau, n.d.; U.S. Department of Agriculture, 2019).

Figure 3. Seasonally adjusted unemployment rate (% of total population) 1980–2019 in the NGP states and United States-wide.



U.S. Bureau of Labor Statistics, 2019; U.S. Census Bureau, n.d.; U.S. Department of Agriculture, 2019.

4.2 Wealth

Despite low unemployment rates, in 2019, the median household income in the NGP was $58,000 which is below the national average of $62,000. A substantial percentage of NGP residents (35%) earned less than $20,000. Below-average income is particularly high within Native American reservations and adjacent communities, which are widespread across the five states (Guzma, 2019; US Census Bureau, 2020).

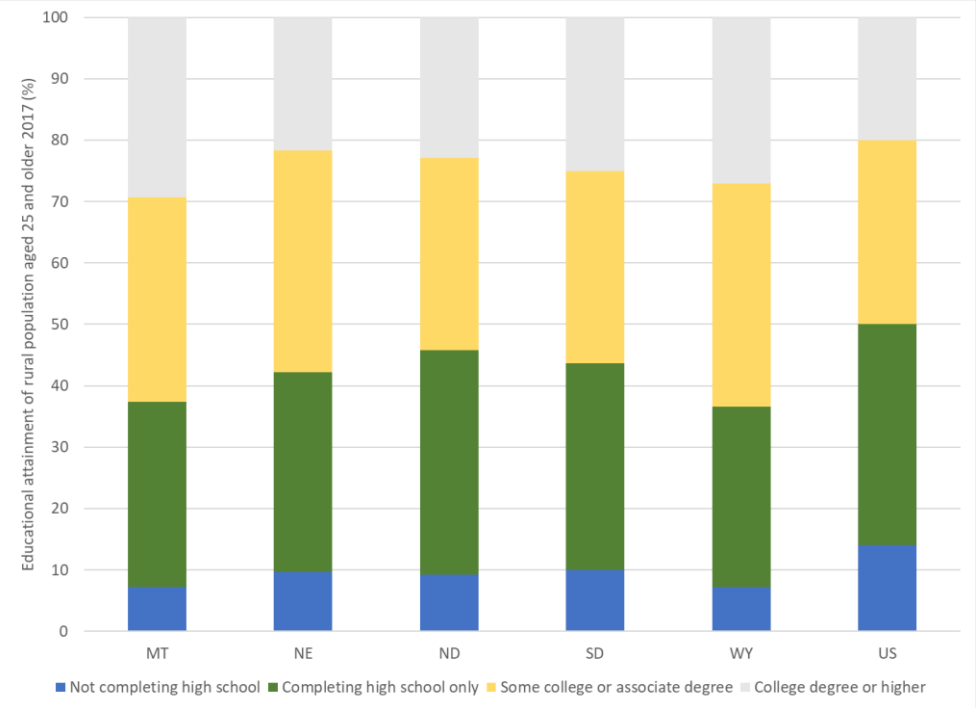
Two thirds of the 2.4 million housing units in the NGP are owned by their residents, coherent with the rurality of the region where multi-family units and rental housing are scarce. The median value of these houses is $177,000, which is below the national median of $204,000 (Dietrich, 2018; Wagner, 2018; U.S. Census Bureau, 2011).

4.3 Education

Despite being rural, core educational indicators are above the national average. In all five NGP states, the percentage of rural people with a college degree exceeds the national average (see Figure 4). Yet, there are significant differences between states: MT has the highest percentage of college-educated residents (29%), while SD

has the highest percentage (10%) of adults who have not attained a high school degree (Fields et al., 2016).

Figure 4. Educational attainment of the rural population aged 25 and older in the five NGP states and throughout the US following the criteria of the US Census Bureau



Fields et al., 2016.

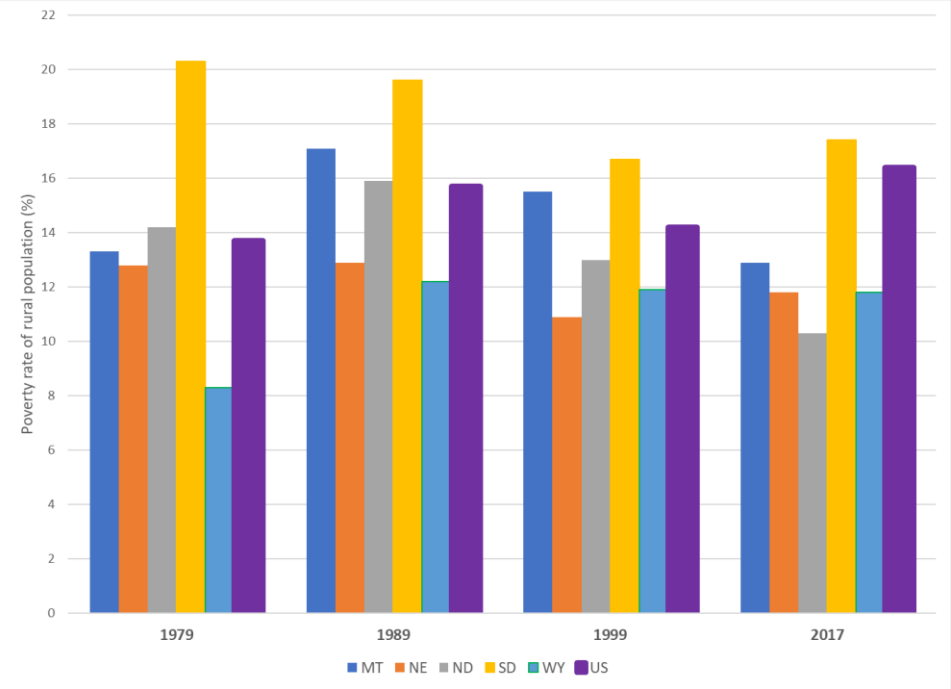
4.4 Rural Poverty

Related to employment and education numbers, in four NGP states (except for SD), the share of rural inhabitants under the poverty level is lower than the national average. Figure 5 illustrates that during the past decade, the share of persons in rural areas below the federal poverty level (Cauthen & Fass, 2008) was constant in WY, slightly increased in NE and SD, and strongly decreased in MT and ND, the state with the lowest rural poverty rate within the NGP (Fields et al., 2016).

4.5 Food Processing

Table 3 details that more than 60% of farmers markets, 55% of greenhouses for vegetable and herb production, and 70% of small slaughterhouse facilities across the NGP are located in rural areas. These numbers are less favorable for MT and NE, where 59% of farmers markets, 39% of greenhouses, and 71% of slaughterhouses are located in rural areas, while the numbers across ND, SD, and WY are 84%, 96%, and 86% respectively (U.S. Department of Agriculture, 2020).

Figure 5. Poverty rate of the rural population in 1979, 1989, 1999, and 2017, in the NGP states and throughout the US following the criteria of the US Census Bureau.



Fields et al., 2016.

Table 3: *Total Number of Farmers Markets (2016), Greenhouses With Vegetables and Fresh Herbs, and Small Slaughterhouse Facilities (2012) in the Five NGP States, Structured by Whether They are Located in a Rural County or Non-rural County*

	Farmers' (2016)	**Markets†**	**Greenhouse Vegetables and Fresh Herb Farms‡ (2012)**		**Small Slaughterhouse Facilities (2012)§**	
State	*Rural*	*Non-rural*	*Rural*	*Non-rural*	*Rural*	*Non-rural*
MT	44	26	50	33	22	10
NE	75	23	70	40	48	11
ND	46	18	22	4	16	7
SD	28	14	44	7	21	3
WY	37	10	24	9	14	5

† Farmers' markets are identified as retail outlets where two or more vendors sold agricultural products directly to consumers. However, the agricultural product sold at farmers' markets do not need to be food items. Consequently, some identified farmers' markets did not sell any food at all, although the exact number of these markets is unclear (US Department of Agriculture, 2020).

‡ Greenhouse vegetable and herb farms are identified as farms that produced vegetables and herbs within a glass or other protected structure. However, the USDA only claims that "at least some" vegetables and herbs need to be produced to qualify and does not explicitly state how much needs to be in production (US Department of Agriculture, 2020).

§ To qualify as a small slaughterhouse facility, the facility must slaughter beef, poultry, or pork and have fewer than 500 employees (US Department of Agriculture, 2020).

US Department of Agriculture, 2020.

4.6 Food Accessibility

Food access is directly related to the accessibility of healthy food and an individual's resources to access those foods (Mason & Lang, 2017). Consumer food choices and quality of diet are influenced by food access and the convenience with which they can access food. Table 4 illustrates that both, the rate of the rural population with low access to food[3] and the combined impacts of low income and low access decreased between 2010 and 2015 in the NGP. However, the rate of decline was not equal across states: NE and ND experienced a faster decline, while WY had the slowest rate.

Table 4. *Share of Rural by Total Population With Low Access to Food in 2010 and 2015, and Share of Population That has Low Access to Food and Is Considered Low Income by Total Population in 2010 and 2015, Across the Five NGP States*

State	% of rural population with low access (2010)	% of rural population with low access (2015)	% of rural population with low access and low income (2010)	% of rural population with low access and low income (2015)
MT	32.57	29.38	13.14	11.89
NE	**24.73**	**20.04**	**7.59**	**6.30**
ND	**38.48**	**32.82**	**11.68**	**8.59**
SD	**37.21**	**35.03**	**13.88**	**13.61**
WY	**24.88**	**23.56**	**6.62**	**6.39**

U.S. Department of Agriculture, 2020.

Overall, food accessibility has been improving within the rural NGP, also among low-income individuals. NE has the highest rate of food access for the average population and the average poor population, while SD is the least for both parameters (U.S. Department of Agriculture, 2020). Despite an overall increase in food access in the rural NGP, this improvement has been widely limited to ultra-processed and fast food, while options for healthy food remain low. For example, over half of all fast-food restaurants in NE and WY are located within rural communities. In contrast, MT has the lowest number of fast-food restaurants located in rural areas (see Table 5; U.S. Department of Agriculture, 2020). Additionally, MT is the only state with fewer convenience stores[4] in rural than in metro counties. NE has the highest percentage of convenience stores located in rural counties, with 66%,

[3] Within rural areas, the USDA defines low food access by the total number of persons that live 10 miles or more from a grocery store, supermarket, supercenter, or any other source of healthy food (U.S. Department of Agriculture, 2022b).
[4] Convenience stores are identified as selling a limited supply of food, mostly consisting of bread, milk, and snack (U.S. Department of Agriculture, 2022a,b).

followed by WY, SD, and ND at 64%, 59%, and 54% respectively (U.S. Department of Agriculture, 2020).

Table 5. *Share of Fast-food Restaurants† Located in Rural NGP Counties per Total Statewide Fast-food Restaurants*

State	Percentage of fast-food restaurants located in rural counties
MT	27%
NE	**58%**
ND	**43%**
SD	**38%**
WY	**54%**

† Fast-food restaurants are identified as establishments where patrons order and pay for their food before eating—as opposed to full-service restaurants, where patrons pay for food after eating.

U.S. Department of Agriculture, 2020.

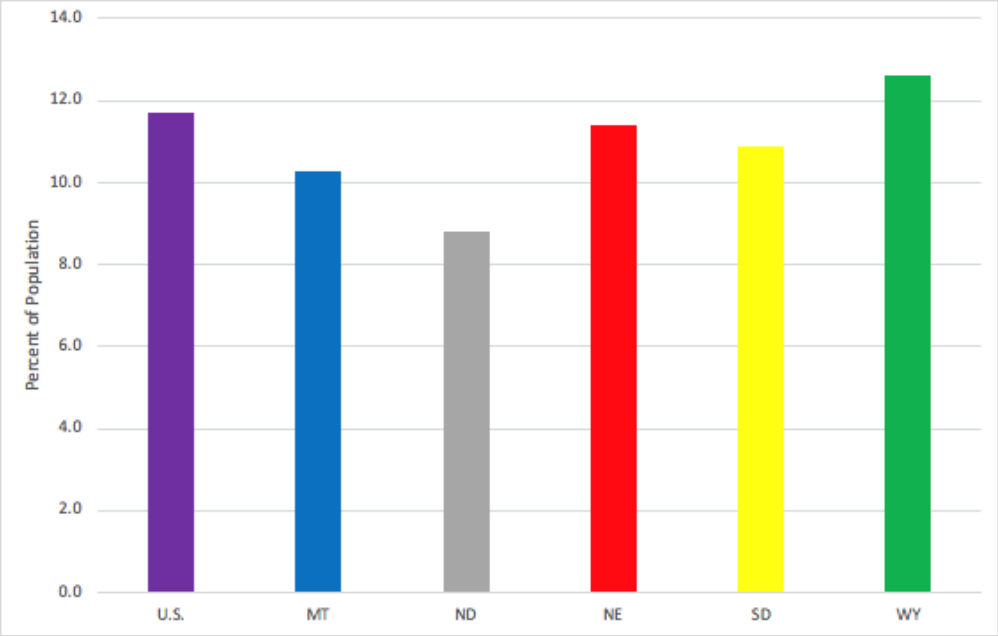
4.7 Food (In)Security

Figure 6 highlights that all NGP states excluding WY are below the US food insecurity[5] rate of 11.7%. ND has the lowest rate, with an average of 8.8%, followed by MT, SD, and NE. Conversely, 12.6% of WY's population identifies as food insecure or very food insecure[6] (U.S. Department of Agriculture, 2022a). Food security in reservations is generally higher than in other rural areas (Jensen, 2020).

Coupled with food insecurity, all five NGP states have a Nutrition Assistance Program (SNAP)[7] participation rate lower than the national average of 14% (U.S. Department of Agriculture, 2021). WY has the lowest SNAP participation rate, despite being the NGP state with the highest food insecurity. In contrast, MT has the highest rate of SNAP participation (see Table 6).

[5] The USDA labels an individual food insecure when they reduce the quality, variety, or desirability of their diet with a minimal reduction in food intake (U.S. Department of Agriculture, 2022a,b).
[6] An individual is labeled as very food insecure when they frequently reduce food intake or disrupt their eating patterns due to a lack of monetary or food resource (U.S. Department of Agriculture, 2022a,b).
[7] SNAP is a federal program, administered by the USDA, that provides food-purchasing assistance by supplementing the budget of low- and no-income families (U.S. Department of Agriculture, n.d.).

Figure 6. Average rate of food insecurity (2016–2018) across the five NGP states, compared to the United States average.



U.S. Department of Agriculture, 2021.

Table 6. *NGP Population That participated in 2016 in the USDA Supplemental Nutrition Assistance (SNAP) Program of Total Population, Per State and U.S.-wide*

State	**SNAP Participation, % of Total (state or national) Population in 2016**
MT	11.30
NE	9.13
ND	7.20
SD	11.06
WY	5.82
US	14.00

U.S. Department of Agriculture, 2021.

4.8 Nutrition and health

Limited consumer food choices can impact public health. A common diet-related health disease, triggered by poor access to healthy food, is obesity which can cause diabetes among other health problems (McAtee et al., 2020). Across the five NGP states, rural residents in WY and NE have the lowest obesity rate, with 27% of the rural population being obese, while ND has the highest one. ND shows the highest combined rate of diabetes and obesity, while WY has the lowest combined rate. Generally, obesity and diabetes levels in the rural NGP correspond to national levels (U.S. Department of Agriculture, 2020).

5.0 Discussion

We identified favorable numbers for important socio-economic livelihood determinants, including employment, education (see Figure 4), and poverty (see Figure 5) across four NGP states. Only SD trails the other states in this regard. These numbers together with relatively low housing prices—primarily in rural areas—facilitate in-migration to the NGP, moderately even to rural parts (Henderson, 2021; Rein, 2020). A study of new MT residents showed that quality of life and rural lifestyle are further important motives for people of other states to move to MT. Migration, often of individuals not searching for employment (e.g., because they are retired), to the NGP accelerated in response to the COVID-19 pandemic (Mastel et al., n.d.). This type of migration based on lifestyle preferences is widely unrelated to the existing local food systems but results in an emerging factor that may shape them in the future.

For the present, we suggest that important socio-economic motives, especially those related to lacking employment opportunities, may increase the outmigration of existing—especially young—rural NGP residents. Except for communities characterized by mining or tourism, job opportunities besides agriculture are scarce, especially in the most rural areas. Industry jobs are also rare, and the lack of employment besides agriculture has been a common determinant of population decline in the rural United States, specifically when few natural amenities attract residents for recreational reasons or without beneficial external developments such as the decision to build a prison in a rural area (McGranahan & Beale, 2002).

Low-wage jobs are also more prevalent in sparsely populated, farming-dependent counties than in urban locations (Gibbs & Cromartie, 2000). The median household income in the NGP ($58,000), rural and urban, is below the United States average ($62,000). This disparity is stronger in rural counties where agriculture is still an essential source of employment (U.S. Bureau of Labor Statistics, 2019). Across the United States, most jobs in the NGP are provided by the service sector, especially health care and retail (U.S. Census Bureau, n.d.; US Department of Agriculture, 2019) which usually center on urban areas.

In addition, contemporary agriculture itself requires less workforce than in the past due to increasing mechanization and concentration (Abson, 2019), and the agricultural workforce in the United States is generally declining and aging (U.S. Bureau of Labor Statistics, 2019). In the NGP, there are notable exceptions to this trend: In the proximity of cities, new, younger producers have emerged that provide urban areas with ‘local food’. However, these—primarily fruit and vegetable—producers are frequently (a) inexperienced, (b) manage small areas, (c) often depend on side jobs, (d) serve a niche sector of urban customers, and (e) are generally located in or around the most densely populated areas (Ebel et al., 2022).

Food processing jobs, for example in slaughterhouses, can make a difference for rural regions (McGranahan & Beale, 2002). However, most agricultural goods produced in the NGP are exported and processed outside the region (U.S. Department of Agriculture, 2019) which limits the need for a food processing workforce. Agriculture in MT, for example, mostly depends on exports, especially wheat and beef, and more than 80% of these commodities leave the state unprocessed (U.S. Trade Representative, n.d.). A similar picture can be observed in the national market. The agricultural economy of MT is largely built on exports to out-of-state processing plants, for example, MT ships 85% of its meat to processing

facilities out of state (Brett Tsairis, 2021). For WY, 88% of its beef is processed out of state (Wyoming Business Council, 2020).

The lack of food processing facilities not only affects employment opportunities but also decreases the food self-sufficiency of the NGP. Although output is high and traded food is considered for food self-sufficiency, unprocessed commodities do not mean food. In addition, NGP agriculture lacks diversification. Today, commodities produced on NGP farms are widely limited to cattle and a handful of staple crops (U.S. Department of Agriculture, 2019). In most NGP states, the number of greenhouses and farms producing vegetables, fruits, and fresh herbs is also below the national level (U.S. Department of Agriculture, 2020). Consequently, agriculture in the NGP does not sustain a balanced diet for its residents (Padbury et al., 2002; Fields et al., 2016; U.S. Department of Agriculture, 2020).

One of the factors that affects rural livelihoods is access to sufficient and healthy food (Hodbod & Eakin, 2015). Although four NGP states are below the average United States food insecurity level, availability and affordability of food is a serious concern for around 10% of the NGP population, with concerningly high numbers in Native American reservations (Fitzpatrick et al., n.d.; Jensen, 2020; U.S. Department of Agriculture, 2022a). As for individual household food security, we found that access to healthy[8] food is the most limiting food security factor, even for wealthier rural households. The share of rural population with limited access to a healthy, adequate diet makes up almost one third of those living in the region (U.S. Department of Agriculture, 2020). Frequently, food comes not from local agriculture but from convenience stores and fast-food restaurants. The elevated obesity and diabetes levels indicate that the limited access to a balanced diet has become a health threat for the region.

Overall, our analysis of socio-economic indicators does not allow for a full assessment of rural livelihoods in the NGP as it does not consider all assets necessary for a means of living. For example, important assets contributing to wealth and food security such as forestry or hunting were not captured. Nevertheless, we were interested in the bigger picture and think our data on the contemporary rural NGP is sufficient to question the Goldschmidt thesis that communities dominated by large-scale commercial agriculture—as the case in large parts of the rural NGP, especially regarding farm size—negatively affect their residents' welfare (Goldschmidt, 1947). We found no evidence of a negative impact of large-scale agriculture on employment, education, and wealth—as compared to the overall United States population. However, we detected developments, mainly related to employment opportunities for younger residents, that may reverse this conclusion in the future. What we detected with certainty as a problem across the rural NGP is limited access to healthy food.

[8] We define healthy food as food that facilitates a diet based on the 2015–2020 Dietary guidelines for Americans, including a variety of vegetables from all of the subgroups (dark green, red and orange, legumes, starchy, and other vegetables, fruits (especially whole fruits), grains (especially whole grains), fat-free or low-fat dairy, a variety of animal and plant protein sources, and oils (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

6.0 Limitations

Our core intention was to describe the significance of the food system for livelihoods in the rural NGP. Therefore, we used available census data and processed them in descriptive statistics. We did not make use of statistical models that would have allowed us to quantitatively correlate important findings. While our food security data exclusively represent rural counties, for other important parameters such as employment or education, we used statewide data that do not discriminate between rural and urban areas. We were interested in assessing the difference in terms of livelihood outcomes between communities characterized by small-scale as compared to large-scale agriculture. We found that this distinction was difficult, mainly because entire towns shaped by small-scale agriculture are rare in the NGP.

7.0 Conclusion

Since the 19th century, agriculture has been the foundation of rural living in the NGP. Agriculture was the reason why homesteaders migrated to the region, their source of food and employment. During the past forty years, agriculture has maintained its role as important economic activity in the rural NGP, but fewer people are involved in it. Traveling through the region today, one finds scattered farms and ranches, often tens of miles away from each other. Especially the mechanization and intensification of farming systems have enabled the possibility to manage large farmlands, reflected by an increase in the average farm area and a relatively low requirement for agricultural labor. Nevertheless, important livelihood determinants such as education, poverty, and food insecurity are clearly above the United States average. They have contributed to an almost constant rural population in the NGP, while most of the rural US has seen a sharp decline in residents during the past forty years. While the urban NGP are likely to expect constant growth, limited employment opportunities for young residents may reduce population densities in its rural parts. An existing problem is access to healthy food. Despite being some of the most agricultural states in the United States, food consumed in the rural NGP is often purchased in convenience stores, fast food restaurants, or far away from rural towns. Lack of food processing facilities and farm system diversification are only two of several explanations for this contradiction. Producing and processing diverse foods may also create jobs in rural areas. The food system, therefore, can and must play an essential role in (re)vitalizing the rural NGP.

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