Evaluating Nebraska’s local comprehensive plans to achieve the national wetland conservation missions in the USA

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\textbf{ABSTRACT}

The U.S. federal government’s requirements and guidance for wetland conservation are reflected in a series of federal laws, regulations, and policies. However, the degree to which these requirements are reflected in local planning efforts is unclear. This study using five components with 56 indicators evaluates how well wetland conservation efforts are integrated into 112 local comprehensive plans in Nebraska, USA. The results show that the majority of local comprehensive plans pay little direct attention to wetland conservation, although many conservation efforts are conducted under the umbrella of environmental protection frameworks. The indicators include water resource protection received the highest score and was the descriptor of natural or environmental resources and resulted in the highest level of local awareness on natural assets. The indicator of setting goals for no net loss of wetlands received the lowest score among all indicators, demonstrating a clear gap between the national vision and the local reality of wetland conservation. Findings suggest local governments need more direct and proactive inputs to improve wetland conservation. Further findings from this research provide a practical roadmap for planners globally, particularly for the developing countries, to integrate wetland conservation into the local planning systems.

\textbf{Introduction}

\textit{Significance of Wetlands}

Wetlands are usually transitional spaces between aquatic and dryland habitats (U.S. Fish and Wildlife Service (USFWS) 2011), part of complex socio-ecological systems shaped by their socio-legal settings, and biophysical conditions that provide a series of important functions useful to humans (Gillespie 2018; USDA-NRCS (United States Department of Agriculture-Natural Resources Conservation Service) 2007; Mitsch and Gosselink 2000). Wetlands, as “biological supermarkets,” are home to many species of birds, fish, insects, and plants (USEPA, 2016). Thus, wetlands are crucial resources that provide a high quality of life to human communities (Thomassey 2007). The functions provided by a particular wetland depend on its location within a watershed (Novitzki et al., 1996). In the U.S., the U.S. Army Corps of Engineers (USACE) define wetland as “\textit{Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas\textsuperscript{a}}”(USACE, 1987). The main ecological services of wetlands include improving water quality, providing habitats to wildlife, fish, and plants, reducing floods and soil erosion, providing water supplies, and as open spaces (LeGrange 2005). Human actions and disturbances have caused critical wetland degradation and losses on earth. Four main impact factors, including pollution, biological resources use, natural system modification, and agriculture and aquaculture are considered as the major reasons of wetland degradation (Xu et al. 2019; Zhou, Zhang, and Liu 2016; Kirwan and Megonigal 2013; Klemas 2013; Nicholls 2004; Dugan and Dugan 1990). Strategies for protecting wetlands from human activities have been in place for many decades. Scientists, ecologists, and conservationists have globally promoted the importance of wetlands since 1970s (Finlayson, 2019; Davernport et al., 2010).

\textit{Loss and conservation of Wetlands}

Wetlands were once seen as major impediments to transportation, agriculture, and community development (LaGrange 2015). Further, on a global scale, among the myriad detrimental human activities, urbanization, industrialization and transportation, forested plantations and agriculture have been the most direct causes of wetland loss (Xu et al. 2019; Hu et al. 2017;...
Kingsford, Basset, and Jackson 2016; Serran and Creed 2016; USFWS, 2006). Previous studies have shown that the world has lost between 54% and 57% of its wetlands since 1900 (Davidson 2014). Half of the wetlands in the lower 48 states of the U.S. have been lost since the 1780s (Jacob and Dupras 2021; Zolitsch and Christie 2015; Dahl 1990). The loss of wetlands in inland states has been dramatic in the 20th century, especially from 1950s to 1980s (Dahl 2011, 1990). After a short period of gain from 1998 to 2004, the wetland of U.S. start to loss again from 2004 to 2009 (Dahl 2011). For example, there are four major types of wetlands in Nebraska: saline wetlands, riverine wetlands, playa wetlands, and sandhill wetlands which made up 6% of the land of Nebraska, approximately 11,778 km², in 1867 (Tang et al. 2016; LaGrange 2015; Dahl 1990), but covered only 3.9% of Nebraska in 1990, approximately 7,711 km² (Tang et al. 2016; LaGrange 2015; Dahl 1990). The leading cause of this loss is agricultural conversions (Fretwell 1996). The rate of loss (69–75%) has been more significant for natural inland wetlands, such as those found in Nebraska, than for natural coastal wetlands (62–63%) during the 20th century (Reis et al. 2017; Davidson 2014). In the central Nebraska area, historic wetlands degradation is over 85% and accelerated due to agriculture expanding over several decades (Tang et al. 2018; LaGrange 2015; Tang et al. 2012). Although the number of man-made wetlands has increased in recent decades, this increase can still not offset the losses of natural wetlands and the degradation of ecosystem services by natural wetlands that were previously established for hundreds of years (Gardner et al. 2015). The significant wetland loss and continuous degradation call for effective wetland conservation in the inland states.

In the U.S., federal and state agencies have made dramatic efforts to protect and restore wetlands. Local jurisdictions play a critical role in wetland conservation since wetlands are often located adjacent to water bodies such as rivers, streams, lakes, and coastal waters which play important roles for local communities (ASWM, 2011; Kusler 2006). Local wetland conservation can lead to a series of significant benefits to local communities, such as groundwater recharge and discharge, flood storage and conveyance, sediment stabilization, pollution control, water quality improvement, wildlife habitat and fish and wildlife management, fisheries, and local heritage (Maltby 1991; Kusler 2003). Many state agencies and local jurisdictions have recognized wide-ranging benefits of wetland conservation for communities, such as increased quality of life and disaster resistance (Berke and Godschalk 2009). State and local agencies can make different types of plans to protect and restore wetland resources within their jurisdictions. In U.S., most of the states made the statewide wetland program plans and keep regular updates in every 3–5 years. For example, the most recent Wetland Program Plan for Nebraska was updated in 2019 which set up a state-level collaborative framework for protecting, restoring, and managing wetlands within the state. Moreover, in order to protect the globally unique saline wetlands in eastern Nebraska, the state made the specific Nebraska’s Eastern Saline Wetlands Conservation Plan in 2018, which is a ten-year period plan to address saline wetlands conservation through collaborative partnerships.

### Local planning mechanism and evaluation

Typically, two types of local planning approaches are applied to wetland conservation: standalone wetland conservation planning and integrated wetland conservation planning. The standalone wetland conservation planning tends to develop separate wetland protection and restoration plans. An integrated wetland conservation planning approach emphasizes incorporating conservation efforts into existing planning mechanisms, such as local comprehensive planning, hazard or floodplain mitigation planning, watershed planning, storm water management planning, parks and recreation planning, and infrastructure planning. The standalone wetland conservation planning is a centralized planning process with collective efforts that receive higher attention than integrated wetland conservation planning. However, the standalone wetland planning typically only involves limited stakeholders in the planning process which leads to inadequate authority and relatively weak capacity in the implementation of wetland management. The integrated wetland conservation planning process normally includes broader stakeholders, particularly for the specific stakeholders (e.g., floodplain managers, land use planners, transportation planners, etc.), into the planning process to achieve “multiple-win” goals. The standalone wetland conservation planning is a separate document from existing local plans, leading to implementation difficulty. Compared with standalone planning approach, the integrated planning approach provides a collaborative platform with multi-objective opportunities and less implementation barriers. Local integrated plans can also provide a framework for specific purposes (e.g., watershed management, land use planning, floodplain management, etc.) for a local community over a long planning term. Local integrated wetland plans are robust tools for both developed countries and developing countries. Gürlük and Rehber (2006) show an excellent case study of the integrated wetland management plan of Ulubaat lake, Turkey, as not only a comprehensive plan but also a blueprint for local wetland protection. The case study of Jia, Ma, and Wei (2011) analyses the different functions of wetland planning on different types of urban wetland in Beijing, China. Generally, developing countries are rapidly developing modern
The primary goal of this study was to determine how effectively local comprehensive plans have integrated wetland conservation in their long-term planning documents. We first developed a component-category-indicator framework and then used the framework to assess how well wetland conservation was integrated into local plans. Specifically, we focused on how local comprehensive plans in Nebraska integrated wetland conservation into local comprehensive plans and what categories of wetland conservation were the focus of these local plans.

This study addressed two specific research questions:

1. How well do the cities, counties, and Natural Resources Districts (NRDs) in Nebraska integrate wetland conservation into local comprehensive plans?
2. How can the integration of wetland conservation into local comprehensive plans be improved?

Research framework

Based on the literature (Berke and French 1994; Brody 2003; Tang 2008), a component-category-indicator score system was introduced into this study. We identified 56 indicators of the five evaluation components and the relevant categories to assess the wetland conservation efforts in local comprehensive plans (Table 1). Classifying the indicators in the local comprehensive plans resulted in consistent summaries of region specific wetland-related content. Three types of plans were analyzed in this research: city comprehensive plans, county comprehensive plans, and NRD master plans. Using a ternary scale to evaluate each wetland-related content item, we analyzed the differences among plans, jurisdictions, and indicators.

The five components of the evaluation are described below.

Factual basis

Effective plans must be based on reliable data on the existing local conditions and the development needs of a community. These data are the basis for developing goals and policies. In this study, thirteen indicators were used to measure a plan’s grounding in facts; for example, does a plan include a definition of wetlands and data on the local historical loss, and does it identify the major challenges facing the planning area? This study uses three categories in this component: resource inventory, management concepts, and human impacts. These 13 indicators are used to evaluate the planners’ understanding of the fundamental facts of wetland conservation.
Table 1. Indicators used to evaluate the local comprehensive plans

1) Factual Basis
Resource inventory
Natural or environmental resources described
Conservation areas mapped/described
Environmental sensitive area described
Wetland current status and description
Wetland definition
Wetland maps and classifications
Local wetland types and functionality
Management concepts
Conservation projects/programs
Conservation prioritized in land use development
Conservation lands identified on land use maps/plans
Watershed-based management programs
Human impacts
Water resources related description
Watershed development status

2) Goals and objectives
Goals for no net loss of wetlands
Goals for anti-degradation of wetland resources or/and environmental conditions
Goals for increasing wetland quantity and quality
Goals for ecosystem/biodiversity protection
Environmental sustainability/resilience goals
Manmade/constructed wetlands and wetland restoration

3) Policies, tools, strategies
Land use policies
Future land use and zoning regulations
Zoning policies for specific areas for protection
Low density design standards and building codes for conservation areas
Regulate activities that may disturb wetlands and cause impacts
Prohibit development in environmentally sensitive areas
Subdivision regulations on open space and park lands
Policies on rural character maintaining
Conservation requirements for roads and transportation standard adjustment
Conservation design standards and techniques
Watershed related regulations
Water resource protection regulations
Environmental regulations for natural system protections
Regulations on ecosystem and biodiversity conservation
Regulations for buffer zones
Wetland/water management and restoration
Permitted use for protecting natural systems
Storm water management
Water related best management practices
Land acquisition and incentive strategies
Local tax incentives to support conservation
Mixed use development/low impact development
Development rights related strategies
Clustered development
Density bonuses
Conservation easements
Land acquisition programs for conservation
Financial/economic incentives for conservation
Education and outreach
Conservation education/outreach projects/programs/activities
Natural-setting or field education events/opportunities
Waterfront recreational sites for education/educational facilities

4) Coordination and integration
Links with local approvals with 404 permit and/or 401 certifications/swampbuster/title 117
Coordination with local/state/federal agencies
Coordination with NGOs or environmental organizations/research institutes/participants
Integration with other plans/policies/programs

5) Implementation, monitoring, and updating
Implementation timelines and responsible agencies
Wetland-related task force/committee
Maintenance and updating procedure and development continuum
Tracking plan effectiveness through conservation monitoring programs
Implementation of conservation development techniques/practices

Goals and objectives
Goals and objectives reflect a community’s future conditions and guide the implementation of a local comprehensive plan. This component includes six indicators. These specific goals and objectives guide the implementation of wetland conservation in local comprehensive plans. For example, a direct mention of land use goals related to wetland conservation is considered to be an indicator of a land use objective.

Policies, tools, and strategies
Policies, tools, and strategies are the realizations of goals and objectives. This study measures the presence and strength of policies, tools, and strategies in local comprehensive plans that in realizing their stated wetland conservation goals and objectives. Four categories and 28 indicators are included in this component. The four categories are: land use policies, watershed related regulations, land acquisition and incentive strategies, and education and outreach.

Coordination and integration
Environmental problems are complex and effective plans must be coordinated with those of other jurisdictions, landowners, and organizations. This study assesses whether the wetland-related content in local comprehensive plans directly or indirectly reflects public participation and/or cooperation with other agencies, jurisdictions, and landowners. These four indicators focus on four different aspects of coordination: laws, governments, non-governmental organizations, and planning system.

Implementation
A good plan should identify realistic and measurable steps to make the plan a reality. Once adopted, a plan’s policies, tools, and strategies must be successfully implemented. Local comprehensive plans should also state how they will monitor the effectiveness of the implementation. Thus, implementation is a requisite component to finish the evaluation. Five indicators are adopted to measure the implementation efforts in these plans.

Methodology
Study area
The study area covers all 147 cities, 93 counties, and 23 NRDs in Nebraska. Nebraska is a state of Midwest region of the U.S. with two major land regions: the Dissected Till Plains and the Great Plains. The population of Nebraska is over 1.9 million with area of 200,000 km². We collected local comprehensive plans from cities and counties and master plans from NRDs. The population for this study is all of the jurisdictions in Nebraska, including city, county, and NRD levels. We collected all the comprehensive plans in three approaches: download from government websites, respond from local planning departments and respond
from consulting companies. After systematic searching, we were able to collect 112 comprehensive plans in total, including 57 of them from cities, 40 of them from counties, and 16 of them from NRDs by 31 December 2018. The rest local comprehensive plans are either in the process of development or unavailable to acquire. The City of Lincoln and Lancaster County share the same Lincoln/Lancaster County 2040 Comprehensive Plan. Each plan evaluated in this research represents the most recently adopted version and is currently in effect for that local jurisdiction. The location of the selected plans is illustrated in Figure 1.

Nebraska law gives a comprehensive plan a core role in the whole local government’s planning system (Scholz et al. 2002). Most cities and counties in Nebraska use the term comprehensive plan, although some regions use the term of comprehensive development plan. The planning jurisdiction of a county means the rural area within the boundary of that county but outside the planning jurisdiction of cities or villages. The planning jurisdiction of a city means all the area with the corporate limits and the extraterritorial jurisdiction of that city. In Nebraska, NRDs are responsible for the development, management, use, and conservation of groundwater and surface water. The NRDs prepare and adopt master plans in accordance with natural river basin boundaries in Nebraska. Among 12 aspects of NRDs’ master plans, most of them such as flood prevention and control, water supply, pollution control, and wildlife habitat management, are closely related to wetland conservation.

**Plan coding procedures**

We first evaluated the wetland conservation measures in 112 local comprehensive plans in three steps. The first step was to capture all of the wetland content into the five components discussed in the research framework section. The second step was to group the similar indicators as sub-categories within each component. The third step was to evaluate the indicators and issue specific scores for each indicator. After evaluation of the local plans, the component scores of the different components, indicators, and jurisdictions were compared to identify the success of different jurisdictions in integrating wetland conservation into their local plans.

We used a 0-1-2 scoring system. Each plan was assigned a score of 0, 1 or 2 for each indicator. If a local comprehensive plan did not contain content relating with a specific indicator, that plan will score 0 points for that indicator. If a plan contains content directly linked with a specific indicator in the context of wetland management, the plan scored 2 points for that indicator. When an indicator was generally mentioned without a direct focus for wetlands itself, a score of 1 was given to this indicator. Some plans mention environmental or natural resources protection, but do not specifically refer to wetlands. The final score for each indicator is shown as a 0-2 scale.

To create a benchmark for comparison, all of the final scores for each plan and each component were standardized into percentages on a 0–100% scale. Each component may include varied indicators, but we standardize the score by using the actual given scores divided by possible maximal scores in each

![Figure 1. Location map for the cities, counties, and NRDs of Nebraska.](image-url)
component (at the scale of 0–100%). The final score for each local comprehensive plan was also standardized as a percentage by using the actual given scores divided by the possible total points in each plan (at the scale of 0–100%).

**Statistical reliability test**

This study adopts the Krippendorff’s alpha (α) to test the reliability for inter-coder plan evaluation (Krippendorff 2011; Stevens, Lyles, and Berke 2014). The local comprehensive plans collected are assigned to two researchers from the research team for simultaneous evaluation. The value of Krippendorff’s alpha (α) (>0.80), indicated reliable plan evaluation results.

**Results**

**Overview of plan evaluation**

The average final score for all the local comprehensive plans collected in this research was 29.4% (0–100% scale). This result indicates that wetland conservation is not well integrated into local comprehensive plans in Nebraska, although there is a wide variation among jurisdictions. However, wetland conservation has been increasingly integrated into local plans through time.

Among all of the 112 plans, the maximum score is 86.61% (0–100% scale), from Lancaster County and City of Lincoln (LPlan 2040, 2016 update). The minimum score is 1.79%, from the Lower Republican NRD Master Plan. According to the quartile method, the upper bound of the total score is 69.42% (0–100% scale). Five plans are above the upper bound, including Lincoln County (70.54%), Blaine County (74.11%), Cherry County (72.32%), Douglas County (80.36%), and Lancaster County & City of Lincoln (86.61%).

**Jurisdiction evaluation**

The total scores are expressed at the scale of 0–100%. Figure 2 illustrates the total scores for the county, city and NRD comprehensive plans. The county comprehensive plans perform best among three. The score of county comprehensive plans is higher than the other two in mean, median, and range. Among the three levels of planning jurisdiction, the county comprehensive plans have the highest mean score of 41.88%. City comprehensive plans place second with a mean score

![Figure 2. Boxplot of the total scores from the county, city, and NRD comprehensive plans.](image-url)
of 28.51%. NRD master plans have the lowest mean score of 5.25%. If median values are considered, the county comprehensive plans still perform best and the NRD master plans remain at the lowest level.

In the county comprehensive plans, the 50th percentile is 34.38% with an interquartile range (IQR) of 45.32%. There are no outlier scores in the county comprehensive plans. In the city comprehensive plans, the 50th percentile is 25.89%, with an IQR of 16.52%. The Lincoln/Lancaster county’s LPlan 2040 (86.60%) is the only outlier among the city comprehensive plans. The 50th percentile of the NRD master plans is 3.57%, with an IQR of 5.13%. There are no outliers in the NRD master plans.

Among the local comprehensive plans, there were several plans with a score of 0, indicating that they do not mention wetlands at all. The numbers and percentages of local comprehensive plans that do not mention wetlands are given in Figure 3. Another critical statistic result is the rate of zero scores at the jurisdictional level: 41% (23 out of 56) of the city comprehensive plans do not mention wetlands, whereas only 20% (8 out of 40) of the county comprehensive plans and 31% (5 out of 16) of the NRD plans do not mention wetlands.

**Indicator performance**

Each indicator’s performance is listed in Table 2. Indicator performance is measured by total mean score with a scale of 0–2. For 56 indicators used in this study, the mean score of all of the indicators was 0.65, with a range from 0.04 (“goals for no net loss of wetlands”) to 1.25 (“natural or environmental resources described”). The median for the indicators was 0.66 with an IQR of 0.51. We consider individual indicators in the 90th percentile as good performers. The five indicators in the 90th percentile are “natural or environmental resources described” (1.25), “subdivision regulations on open space and park lands” (1.19), “integration with other plans/policies/programs” (1.14), “environmental regulations for natural system protection” (1.13), and “goals for ecosystem/biodiversity protection” (1.12). Moreover, the indicators that received the lowest attentions by these plans are located in the 10th percentile. The five indicators in the 10th percentile are “goals for no net loss of wetlands” (0.04), “wetland-related task force/committee” (0.09), “development rights related strategies” (0.10), “density bonus” (0.13), and “waterfront recreational sites for education/educational facilities” (0.15).

**Indicator performance by jurisdictions**

Each indicator’s performance by jurisdictions is also expressed at a scale of 0–2. The mean score of the county comprehensive plans was 0.84, with a standard deviation of 0.44. The indicator “natural or environmental resources described” has the highest score (1.48) in the county comprehensive plans subsample. This indicator also had the highest score in the whole sample. The next four most common indicators all belong to the goals and objectives category. “Integration with other plans/policies/programs” was the only indicator in the coordination and integration category in the 90th percentile of the county comprehensive plans subsample. There were also five indicators ranked below the 10th percentile score for county comprehensive plans. The lowest scored indicator was the “goals for no net loss of wetlands” (0.10) indicator from the factual basis component. The other four indicators ranked below the 10th percentile also included three from the policies, tools, and strategies component, and one from the implementation component.

The mean score of the city comprehensive plans was 0.57, with a standard deviation of 0.26. The indicator with the highest score is the “subdivision regulations on open space and park lands” (1.21) indicator from the policies, tools, and strategies component. In addition to the top indicator, four of the five 90th percentile indicators from the city comprehensive plans belong to the policies, tools, and strategies component. Another indicator, the “natural or
environmental resources described” (1.14) indicator, from the factual basis component, ranked third among the city comprehensive plans indicator ranking. Six indicators ranked below the 10th percentile of city comprehensive plans’ scores. The lowest score comes from the indicator “goals for no net loss of wetlands” (0.04). Among 57 city comprehensive plans, only LPlan 2040 of the City of Lincoln described the national goal of no net loss. All five components include indicators ranked in the 10th percentile of the city comprehensive plans.

The mean score for all indicators in the NRD master plans was 0.10, with a standard deviation of 0.06. For the NRDs master plans, the highest scores were from the indicator “goals for ecosystem/biodiversity protection” (1.56), which belongs to the goals and

| Indicators | Mean Score (scale: 0–2) | Total Ranking (rank:1–56) |
|------------|--------------------------|---------------------------|
| Factual Basis |                          |                           |
| Natural or environmental resources described | 1.25 | 1 |
| Conservation areas mapped/described | 1.10 | 7 |
| Environmental sensitive area described | 0.71 | 23 |
| Wetland current status and description | 0.47 | 40 |
| Wetland definition | 0.29 | 48 |
| Wetland maps and classifications | 0.37 | 46 |
| Local wetland types and functionality | 0.36 | 47 |
| Conservation projects/programs | 0.98 | 12 |
| Conservation prioritized in land use development | 0.73 | 19 |
| Conservation lands identified on land use maps/plans | 0.67 | 27 |
| Watershed-based management programs | 0.54 | 35 |
| Water resources related description | 1.08 | 9 |
| Watershed development status | 0.58 | 31 |
| Goals and objectives |                          |                           |
| Goals for no net loss of wetlands | 0.04 | 56 |
| Goals for anti-degradation of wetland resources or/and environmental conditions | 0.41 | 44 |
| Goals for increasing wetland quantity and quality | 0.68 | 26 |
| Goals for ecosystem/biodiversity protection | 1.12 | 5 |
| Environmental sustainability/resilience goals | 0.78 | 18 |
| Manmade/constructed wetlands and wetland restoration | 0.66 | 28 |
| Policies, tools, strategies |                          |                           |
| Future land use and zoning regulations | 1.09 | 8 |
| Zoning policies for specific areas for protection | 0.94 | 14 |
| Low density design standards and building codes for conservation areas | 0.59 | 30 |
| Regulate activities that may disturb wetlands and cause impacts | 0.72 | 21 |
| Prohibit development in environmental sensitive areas | 0.98 | 12 |
| Subdivision regulations on open space and park lands | 1.20 | 2 |
| Policies on rural character maintaining | 0.73 | 19 |
| Conservation requirements for roads and transportation standard adjustment | 0.56 | 33 |
| Conservation design standards and techniques | 0.66 | 28 |
| Water resource protection regulations | 1.11 | 6 |
| Environmental regulations for natural systems protection | 1.13 | 4 |
| Regulations on ecosystem and biodiversity conservation | 1.03 | 10 |
| Regulations for buffer zones | 0.70 | 24 |
| Wetland/water management and restoration | 0.82 | 16 |
| Permitted use protecting natural systems | 0.71 | 22 |
| Storm water management | 0.81 | 17 |
| Water related best management practices | 0.42 | 42 |
| Local tax incentives to support conservation | 0.29 | 48 |
| Mixed use development/low impact development | 0.53 | 36 |
| Development rights related strategies | 0.10 | 54 |
| Clustered development | 0.50 | 37 |
| Density bonuses | 0.13 | 53 |
| Conservation easement | 0.54 | 34 |
| Land acquisition programs for conservation | 0.40 | 45 |
| Financial/economic incentives for conservation | 0.42 | 42 |
| Conservation education/outreach projects/programs/activities | 0.58 | 31 |
| Natural-setting or field education events/opportunities | 0.46 | 41 |
| Waterfront recreational sites for education/educational facilities | 0.15 | 52 |
| Coordination and integration |                          |                           |
| Links with local approvals with 404 permit and/or 401 certifications/swampbuster/title 117 | 0.25 | 51 |
| Coordination with local/state/federal agencies | 1.02 | 11 |
| Coordination with NGOs or environmental organizations/research institutes/participants | 0.93 | 15 |
| Integration with other plans/policies/programs | 1.14 | 3 |
| Implementation, monitoring, and updating |                          |                           |
| Implementation timelines and responsible agencies | 0.50 | 37 |
| Wetland-related task force/committee | 0.09 | 55 |
| Maintenance and updating procedure and development continuum | 0.69 | 25 |
| Tracking plan effectiveness through conservation monitoring programs | 0.49 | 39 |
| Implementation of conservation development techniques/practices | 0.29 | 48 |
objectives component. This indicator was the only indicator from the goals and objectives component ranked above the 90th percentile of the master plans. The policies, tools, and strategies component has three indicators above the 90th percentile and the coordination and integration component has two indicators in this rank. The indicators from the master plans below the 10th percentile ranking all scored 0 points, which indicates that these indicators are neither directly mentioned in the plans nor related to the plans.

**Points distribution**

The distribution of the 0, 1, or 2 points is expressed by percentage at a scale of 0–100%. Figures 5 and 6 show the distribution of the 0, 1, or 2 points analyzed independently. In the full sample, 47.9% of the indicators scored 0 points, 39.04% scored 1 point, and 13.06% scored 2 points.

**Figure 5** demonstrates that the county comprehensive plans (39.69%) have the lowest 0 point rate, whereas the NRD master plans (54.46%) have the highest 0 point rate. The county comprehensive plans also have the highest rate of 2 point scores (23.44%) (i.e., most often directly mention wetland conservation measures), whereas the city comprehensive plans have the lowest number of 2
Figure 6. The percentage of indicators with 0, 1, or 2 points regarding to wetland conservation efforts.

Point score (6.86%). In total, the 0 point indicators represent 47.90% of the sample, which leaves 39.04% of the indicators with a score of 1 point and only 13.06% of the indicators with a score of 2 points.

Figure 6 shows the point distribution for each indicator. Each point in the figure represents the percentage of 0 (or 1 or 2) scores in an individual comprehensive plan. Figure 6 demonstrates that many indicators were not mentioned in any plan (i.e., a score of 0), and that very few plans directly mentioned any indicators (i.e., few 2 point indicators).

Discussions

These results indicate a clear disconnect between wetland conservation efforts and local comprehensive planning efforts. Out the 112 comprehensive plans in the sample, approximately one-third of them did not contain content that directly addressed wetland conservation. This finding indicates local jurisdictions in Nebraska generally have relatively limited capacity and interest to manage and implement wetland conservation and management efforts. These findings should contribute to the improvement of local comprehensive plans by highlighting the need for better integration of wetland conservation. Based on our findings, the majority of the local comprehensive plans do not address wetland conservation sufficiently. Even basic information, such as “wetland definition” (ranked 48 out of 56) and “local wetland types/classification” (ranked 47 out of 56) are not well integrated into local comprehensive plans.

Moreover, the low frequency of 2 point scores for indicators across all of the local comprehensive plans shows that most local comprehensive plans in Nebraska do not directly consider wetland conservation or acknowledge a role for wetlands in their communities’ futures. Federal and state policies and strategies are not integrated into local plans, despite a few good examples of local plans that incorporate wetland conservation. Indicators such as “links with local approvals with 404 permit and/or 401 certifications/swampbuster/title 117” (ranked 51 of 56) and “Goals for no net loss of wetlands” (ranked 56 of 56) are among the least represented indicators in the local comprehensive plans. This result indicates the clear gap between the federal conservation mission and the local reality.

However, we also acknowledge efforts local jurisdictions have made in their plans for general environmental protection or natural resources
conservation. From the number of indicators that scored 1 point, we found that local governments are making some efforts to protect wetlands. In general, local governments are protecting wetlands by planning more green space and placing limits on construction, which will have a positive influence on wetland conservation. The conservation template used in the Douglas County comprehensive plan is an outstanding example of integrating wetland conservation with land use strategies and local comprehensive plan implementation. It considers many elements, such as land use policies, zoning regulations, storm water policies, and landscaping regulations. However, this level of detail is not found in any other comprehensive plans in our sample. The general trend matches the trend in wetland loss identified in the U.S. Fish & Wildlife Service report (U.S. Fish and Wildlife Service (USFWS) 2011): wetlands are shrinking despite the slow integration of wetland conservation into local plans.

The results also support the findings from Berke et al. (2013) and Finlayson (2012)’s studies. The percentage of local communities in Nebraska that integrate some degree of wetland conservation into local comprehensive plans is higher than 29%. However, 20% of the county plans, 41% of the city plans, and 31% of the NRD plans do not integrate any aspect of wetland conservation into their comprehensive plans.

The variations among jurisdictions may occur for the following reasons. Counties in Nebraska generally better integrate wetland conservation into their local comprehensive plans relative to NRDs. It is not surprising that counties perform better since many of wetlands are located on county planning areas, rather than within city limits. Counties perform better than cities because of differences in responsibilities between different levels of planning jurisdictions. Cities have authority over the built environment areas including city limits and Extraterritorial jurisdiction lands, whereas counties manage these lands in natural conditions beyond built areas. The differences between cities and counties are obvious when the two are compared. There are four major types of wetlands in Nebraska: saline wetlands, riverine wetlands, playa wetlands, and sandhill wetlands. Many of them are located outside the cities’ boundaries. The low scores of NRDs was likely caused by their specific function. The main focus of NRD master plans is on water resource management rather than land use planning. NRDs in Nebraska were created to solve issues of flood control, soil erosion, and groundwater quantity and quality. NRDs use function plans to implement conservation, which is one possible reason why NRDs perform poorly in master plans. The master plan of Papio-Missouri River NRD is an example here. This master plan got the highest score (31%) among all the NRD master plans. This master plan contains a chapter focusing on land use and other natural resources other than water. For comparison, the master plan of Lower Platte South NRD get a low score (3%). This master plan is a plan mainly focus on water resources, and no land use related contents are included. Another important reason for their poor performance was likely by the choice of indicators used in this study. The indicators used in this study are based on the sample of comprehensive plans used. One of the critical functions of local comprehensive plans is land use planning and NRDs are not as concerned with land use planning as counties and cities. In addition, NRDs may consider wetland conservation with other types of plans, such as hazard mitigation plans.

The focus of this study only addressed the plan quality itself and did not measure the actual performance of plan implementation in wetland conservation. However, higher quality plans can make good preparations for local jurisdictions in wetland conservation efforts. The actual planning implementation performance may be subject to a series of other factors, such as financial commitment and political culture. The final result shows that the coordination and integration component (41.47%) gains the highest score, and the implementation, monitoring, and updating component (20.54%) receives the lowest score. The indicators of coordination component get very few 0 points as well as 2 points. For the implementation component, this component gets a very high level of “0” point rate and a very low level of “2” point rate. This result shows that the implementation of wetland conservation is not recognized in most of the integrated wetland conservation plans. Wetland conservation is also lacking a long-term monitoring mechanism in those plans. For the other three components, the points are more discrete distributed, and some indicators get very high scores while some are not. For example, goals for ecosystem protection get 1.12 mean points ranked 5th place. In comparison, the indicator of “no net loss goal” only gets 0.04 points while ranked the last among all indicators, which leads the low score for the goals and objectives component. The final results show that wetland conservation usually appears at a broader umbrella of environment and ecosystem associated contents. Wetland conservation itself is not a direct recognition of these local plans. Those plans that did not have the national goals such as “no net loss” mentioned is not meet the lowest standard for wetland conservation integration. The indicator score differences are also reflected in Table 2.
Policy implications for promoting the integration of wetland conservation with local comprehensive plans

The results show that local governments in Nebraska have made efforts in wetland conservation. However, this progress has not always been reflected in local comprehensive plans. The results of this study have implications for improving the integration of wetland conservation into local comprehensive plans. In particular, this study shows that few plans integrate policy related issues; therefore, this component could be improved. Currently, the indicators that frequently have a score of 1 point could be relatively easily improved upon, as a score of “1” indicates an issue that has been indirectly acknowledged. For example, the indicator “water resources description” currently scores 1 point more often than it scores 2 points. If local comprehensive plans could directly develop policies to protect water resources related to wetland conservation, the integration of wetland conservation into local plans would be greatly improved.

Our findings also suggest that the integration of local comprehensive plans of wetland conservation could be improved in two methods. The first method is adding contents for those 0 point indicators. Many local comprehensive plans do not directly discuss the efforts of local governments, even if the local government has made some effort to conserve wetlands. This is reflected in a high frequency of 1-point scores for indicators. The second method is suggesting that if local comprehensive plans resulted in a change from 1-point indicators to 2-point indicators, the total scores of the plans would be significantly enhanced.

In order to improve the plans by the first method, local comprehensive plans need to incorporate more content about the current wetland status, wetland types and functionality, and local wetland maps and classification to the local comprehensive plans as factual basis. These elements are not commonly mentioned in the plans evaluated in this study. Adding the description of the federal policy “no net loss” or directly providing the definition of wetland are also examples to improve local comprehensive plans from those 1-point indicators to 2-point indicators.

The second method is to collaborate with wetland managers to specify the natural resources protection content to allow them to directly relate to wetland conservation. Many local comprehensive plans have integrated future land use and zoning with local environmental protection. These elements are not directly linked with wetland conservation. According to the related text in the local comprehensive plans, these efforts by local governments may protect local wetlands. The integration of wetland conservation into local comprehensive plans would be greatly improved by directly adding wetland conservation content into future land use chapters. Similarly, adding wetland conservation content into parks and open space chapters, as well as water resources sections of local plans could aid wetland conservation. Another example is the lack of conservation maps. Local comprehensive planners can add wetland locations into comprehensive land use maps as a method to improve the map relative score.

An excellent example is the comprehensive plan of the City of Lincoln and Lancaster County (LPlan 2040). This plan got a final score of 84.4% (0–100% scale), which means this plan get 2 points in almost every indicator. In other words, most of the indicator related contents are well addressed and described in this plan. The most direct example is two national policies, 404 clean water act and no net loss, which are discussed several times and linked with the local situation on both freshwater and saline wetlands in different plan sections. These two indicators are among the lowest scored indicators for other local comprehensive plans. By improving this part of the content can make a direct improvement reflected in the final score. Overall, by summarizing those local plans with high scores, we develop eight suggestions for improving wetland conservation in local integrated plans: (1) Add wetland maps in local plans; (2) Identify wetland conservation as a part of the natural system protection framework; (3) Regulate wetland conservation in land-use policies; (4) Include wetland conservation into land acquisition programs; (5) Provide guidance on best management practices dealing with wetland conservation; (6) Promote stakeholder collaborations for wetland conservation, such as joint approval procedures with state and federal agencies; (7) Provide education and outreach for developers, landowners, and residents to highlight the value of wetlands and the location of wetlands, and the activities dealing with wetlands; and (8) Take wetland conservation into the implementation mechanism, such as local financial support.

Conclusion

This study examined the integration of wetland conservation into local comprehensive plans. Counties in Nebraska have integrated wetland conservation into their local comprehensive plans more effectively than other two types of planning jurisdictions.

To address the first research question “How well do the cities, counties, and NRDs in Nebraska integrate wetland conservation into local comprehensive plans?” we demonstrated that local comprehensive plans in Nebraska do not pay enough direct attention toward wetland conservation, but wetland conservation in the U.S.
generally considered under the umbrella of environmental protection or natural resources conservation, as federal and state level wetland conservation plans, rules, policies are mostly coming from U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture – Natural Resources Conservation Service. The federal and state government guidelines for wetland conservation are not well integrated into local plans. There is also a wide range in the depth and quality of local wetland conservation plans. This study on local plans shows that different components of wetland conservation, focused on different tasks, are emphasized among different local plans. We developed a framework to categorize the wetland conservation content of local plans using indicators and sub-indicators. This framework will be useful not only for research, but also for organizing and developing local plans in the future.

To address the second research question “How can the integration of wetland conservation into local comprehensive plans be improved?” we reveal the massive gap in the integration of wetland conservation into local plans. Indicators with scores of 1 point indicate areas that can be quickly improved. We also considered the inaccuracy of evaluating a local government’s efforts to conserve wetlands solely based on wetland related indicators. Local governments contribute to wetland conservation, although the efforts are often part of other initiatives. Having this work explicitly addressed in local comprehensive plans would be advantageous. As the highest scored plan in this study, the City of Lincoln’s comprehensive plan can be a good model for other local comprehensive plans to improve their integration of wetland conservation.

This study represents the initial phase of research on the integration of wetland conservation into local comprehensive plans. We only focused on comprehensive plans in Nebraska. This study attempted to evaluate all the effective local comprehensive plans in Nebraska. The plans collected during this study were limited by accessibility issues and time limitations. We recommend caution in extrapolating results broadly. These limitations may create some ambiguity, which can be addressed in future studies using larger study areas and different sample selection strategies. The system developed in this study to evaluate plans is not perfect. Several plans with high scores may not actually have extensive wetland conservation content. In particular, several plans have a template-like paragraph that mentions many issues but does not seriously address these issues in the plan. In our scoring system, these kinds of plans have high scores, even though they do not strongly recognize wetland conservation.

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