Identifying farmland of local importance in Berkeley and Jefferson Counties.

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ABSTRACT

The determination of farmland of local importance is a critical component in protecting local agricultural land. However, the initial responsibility for identifying this land falls upon local units of government which are given limited guidance, direction, and support. As such, this can be a highly subjective process. The objective of this study was to apply a previously-described approach to systematically identify potential farmland of local importance in Berkeley and Jefferson Counties of West Virginia, thus facilitating a more informed and less subjective determination. To this end, this study examined definitions of other important soils, developed local criteria based on our specific regional agricultural community, and used a geographic information system (GIS) to identify potential farmland of local importance. Three map units in each county were identified for further consideration. Following a closer examination of their extents, descriptions, and patterns of use, the appropriate local unit of government was provided with the rationale for considering these soils. With this information, the local unit of government was then able to evaluate the data objectively and make a more informed, less subjective decision about potential soil map units of local importance in Berkeley and Jefferson Counties.

INTRODUCTION

The National Soil Survey Handbook (NSSH) broadly defines and classifies farmland as prime farmland, farmland of statewide importance, farmland of local importance, or farmland of unique importance (USDA NRCS 2013). "Prime farmland is defined as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses" (USDA NRCS 2013). For a given soil map unit to be considered prime farmland, 50 percent of the components (soils) must be classified as prime farmland. Additionally, map unit complexes or associations cannot be prime farmland if they contain urban land, miscellaneous areas, or water (USDA NRCS 2013). In short, prime farmland is land with all the characteristics necessary to produce a sustainably high yield when managed properly, and is subject to few if any factors that could depress yield or limit management options. The same qualities that make land prime farmland are also the qualities that make this land highly sought after for development and thus under threat of development. Accordingly, the protection of this highly productive, highly developable land is a national priority.

Farmland of statewide importance is a lesser designation. This farmland is more reflective of a specific state's agricultural economy and the soils that support that activity. Farmland of statewide importance is defined by the Farmland Protection Policy Act of 1981 and departmental regulation 9500-3 (USDA NRCS 2012). Farmland of state wide importance includes soil that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. These soils are designated as farmland of statewide importance by a state government official such as the State

Secretary of Agriculture or higher official, and approved by the NRCS State Conservationist (USDA NRCS 2012). Map units of farmland of statewide importance contain less than 50 percent prime farmland, with a combination of prime farmland and statewide important farmland in excess of 50 percent.

The third designation of note, farmland of local importance, is similar to farmland of statewide importance, unless it is otherwise identified by a local agency or agencies concerned, and agreed upon by the NRCS State Conservationist (USDA NRCS 2012). A map unit of local importance soil would fail to meet criteria for prime farmland and farmland of statewide significance, but when combined, the prime farmland, farmland of statewide significance, and any locally-important soils total would total in excess of 50 percent of the map unit (USDA NRCS 2013). While there is a great deal of detailed information related to specific combinations of physical and chemical properties necessary to define prime farmland, the level of clarity and instruction diminishes with the lesser designations. While this increasing ambiguity is purposeful in that it increases flexibility at the state and local levels, it can hinder a local agency or agencies concerned in the decision-making process.

A geographic information system (GIS) is an integration of computer hardware and software capable of using, storing, changing, analyzing, and displaying data with a spatial component (Mallupattu and Sreenivasula Reddy 2013). A GIS can be used to support the decision making process of expert analysts (DiMartino and Sessa 2011) and historically, GIS has proven useful for modeling the suitability of land for agricultural activities (Cambell *et al*. 1992; Kalogirou 2002). As such, the integration of GIS, expert knowledge of soils, and knowledge of the local agricultural community is an ideal approach to systematically identify potential farmland of local importance.

As a conservation community, we understand the need to protect undeveloped farmland (Hymann and Leibowitz 2000; Strager and Rosenberger 2006) and the importance of local input into land use decisions (Pou 1977). Facilitating wise decisions via GIS technology seems logical. The alternative, uninformed local government units declaring soil to be locally-important without any factual backing (thus placing extra burden on the NRCS State Conservationist to evaluate these claims) is unsound. Likewise, inaction may risk funding for farmland protection programs. Accordingly, identification of farmland of local importance should include the assimilation of complex spatial and tabular soils data in a local context, resulting in an action whose logic that can be easily understood or explained, rather than an identification decision based on politics or outright guess.

The purpose of this analysis was to conduct the first systemic review of soil map data exclusively for the purpose of evaluating candidates for locally important soils in these counties. The outcome of this analysis is contingent on the very general criteria (defined in the materials and methods section) used to exclude some map units and the expert knowledge used to evaluate the remaining map units. In time, this analysis may be repeated, modified, and or discarded. Moving forward, this analysis can serve as a benchmark for additional analyses.

MATERIALS AND METHODS

GIS-based land suitability analysis is becoming more and more common (Malczewski 2004; Collins *et al*. 2001). The overlaying of information to select locations that meet specific combinations or criteria is a very typical GIS application used in suitability analysis. Expert knowledge and spatial data are combined and organized such that map units whose properties and uses most closely fit a loosely defined expert definition of locally important soils can

be identified. Once a group of soils is identified, it will be presented for consideration to the local agency or agencies concerned. By presenting the data and rationale with the choices, the local agency or agencies concerned will not only be able make educated choices, but they will be able to defend those choices in a data-based context.

Harman (2014) described a conceptual process for collaboratively evaluating local soils. The first step in the conceptual process is to examine the soil map unit descriptions and the extent of prime farmland and farmland of statewide importance, map areas for exclusion, and evaluate remaining land not listed as prime, unique, or farmland of statewide importance. The second step is to generate exclusion rules and ranking criteria by using expert knowledge of local production agriculture to define quality agricultural land and develop rules for exclusion based on a local definition of quality agriculture land. The final step is to apply the exclusionary rules and rank remaining map units by extent, and generate a final recommendation.

In the first step prior to initial soils review, data from the WV Gap analysis project (Strager *et al*. 2000) and zoning maps of Jefferson County (Jefferson County Commission GIS and Addressing Department 2013) and maps of incorporated urban areas in Berkeley County (Berkeley County Department of Information Technology 2013) were combined. This integration identified incompatible land uses such as roads, water, urban areas, industrial areas, urban growth boundaries and local municipalities. This involved extracting incompatible locations from the data such that incompatible land uses were converted to "no data" and compatible uses to potential agricultural land (ESRI 2011). Soils maps were truncated to the bounds of the newly-identified potential agricultural land, and the remaining prime farmland and farmland of statewide importance were examined in some detail and described.

In stage two, the development and application of exclusionary rules and ranking the remaining soils occurred. Exclusionary rules are based on expert knowledge of local agriculture and soils. Criteria for experts to consider vary by location and by expert. In this instance, I adopted the exclusionary rules presented in Harman (2014). In brief, quality agricultural land is generally flat, free of excessive rocks, comparatively easy to manage, and not urban or industrial land. In specific terms, I defined quality agriculture land as land with a slope gradient of 15% or less, the dominant map unit component is not rock outcrop, the named map unit components can not contain urban, water, udorthents, or quarry, and the extent is not less than 100 acres.

The final step in the analysis involved detailed examination of the remaining map units. The remaining map units were ranked by extent. Each map unit was systematically examined to determine why it was not prime farmland. Using expert knowledge of local conditions, I ranked potential candidates based on how well their properties corresponded to our agricultural economy. For example, if the description indicated that the map unit was not well suited for commodity grain production, was difficult to manage for pasture and was very stony, it would be unlikely that such a map unit would contribute significantly to our local agricultural economy.

RESULTS

In Jefferson County (Table 1), slightly over 28.1 percent of agricultural land is listed as prime farmland. Agricultural land is defined as land for which zoning and existing use does not prohibit use for agriculture. Similarly, 44.0 percent of the agricultural land is listed as farmland of statewide importance. Overall, 77.4 percent of the land in Jefferson County is potentially agricultural land, while in Berkeley County (Table 1) the extent of agricultural land is much higher (91.7). However, the extent

of prime farmland and farmland of statewide importance is lower on a percentage basis. The extent of non-agriculturally zoned land and urban growth boundaries in Jefferson County contributed greatly to the overall lower percentage of agricultural land. Overall, there are 67,898 acres of prime farmland and 81,200 acres of farmland of statewide importance among the 294,108 acres of potential agricultural lands in the counties.

In Berkeley County, there were 23 map units described as prime farmland or as unique local soils. In Jefferson County, there are a total of 14 map units identified as prime farmland and one farmland of unique importance. Nearly half the prime farmland in Berkeley County is composed of two soil map units: Hagerstown silt loam, three to eight percent slopes and Hagerstown gravelly silt loam, three to eight percent slopes. These two map units account for 45.2 percent of the prime farmland in the county (Table 2). The only unique farmland in these counties is Lappans (marl) silt loam. Similarly, 55.8 percent of the prime farmland in Jefferson County is composed from two map units: Poplimento silt loam, three to eight percent slopes and Funkstown silt loam (Table 3). Farmland of statewide importance contains a much larger range of map units. The top five soil map units of farmland of statewide importance by extent in Jefferson and Berkeley Counties are listed in Table 4.

Farmland in Jefferson County is 59.6 percent cropland and only 24.2 percent pasture. Jefferson County is the number one county in West Virginia for soybeans for beans, corn for grain, corn for silage, and wheat production (USDA-NASS 2014). Similarly, farmland in Berkeley County is 51.02 percent cropland and 25.08 percent pasture. Berkeley County is the number two county in West Virginia for corn silage and wheat, and number six in corn for grain (USDA-NASS 2014). As such, it is expected that the better farmland in this region is similar to prime farmland.

When searching for candidates for locally important farmland, there were initially 79 map units to choose from. However, the exclusionary rules significantly reduced those numbers. In Berkeley County, the rules truncated the list to 12 candidates, and in Jefferson County to 15. This eliminated roughly 50 percent of the possible acreage in each county. Among the 12 candidates in Berkeley County, 75.6 percent of the 58,080 acres considered were found in the top three map units by extent, Weikert-Berks channery silt loams, eight to 15 percent slopes, Hagerstown-Opequon-Rock outcrop complex, three to 15 percent slopes, and Clearbrook-Berks channery silt loams, three to eight percent slopes. In Jefferson County, it required the top five map units by extent to reach that 75 percent threshold. However, all of the top five map units considered in Jefferson County were rock outcrop complexes.

The top five candidates are listed in Table 5. Detailed descriptions of the Berkeley County map units can be found within the Berkeley County soil survey (Soil Survey Staff 2012a). The Weikert-Berks channery silt loam map unit is to a large extent shallow (10-20 inches deep) and of low fertility and may be best suited for pasture (Soil Survey Staff 2012a). The Hagerstown-Opequon-Rock outcrop complex is listed as not suited to cultivated crops or hay and is difficult to manage for pasture (Soil Survey Staff 2012a). The Clearbrook silt loam and channery silt loams are shallow and have a seasonally high water table at six inches, and are noted for their low natural fertility (Soil Survey Staff 2012a). The Buchanan loam, three to 15 percent slopes, extremely stony is not suited to cultivated crops or hay and is difficult to manage for pasture due to the extensive surface stones (Soil Survey Staff 2012a).

The Jefferson County candidates for local important soils are listed in Table 5. Detailed descriptions of the Jefferson County map units can be found within the Jefferson County soil survey (Soil Survey Staff 2012b). For

example, Hagerstown-Rock outcrop complex, three to eight and eight to 15 percent slopes, is 65 percent Hagerstown and 20 percent rock outcrops (Soil Survey Staff 2012b). These map units have seasonal high water table and are moderately permeable. At times, it is suited to cultivated crops, hay, and pasture when the outcrops are dispersed and oriented to allow it (Soil Survey Staff 2012b). The Vertrees-Rock outcrop complex, eight to 15 percent slopes, has a seasonal high water table and is commonly associated with karst/sinkhole features. At times, it is suited to cultivation under the proper conditions (Soil Survey Staff 2012b). In the Oaklet-Rock outcrop complex, three to eight percent slopes and eight to 15 percent slopes, the rock outcrop makes up 15 percent of the map unit, and there is a seasonably high water table. This map unit is commonly associated with karst/sinkhole features and high shrink swell potential (Soil Survey Staff 2012b).

DISCUSSION

Based on full examination of all the map unit descriptions of the candidates and review of the map unit descriptions of the prime farmland and farmland of statewide importance, some concepts and ideas became clear. The candidate map units in Berkeley County are similar to very poor pasture units, much like soils of statewide importance. There are over 30,000 acres of these map units. Berkeley County is less mountainous than most of West Virginia, and if these pasture soils were of a reasonable quality they should be on the list of soil of statewide importance. The candidates in Jefferson County are more like the prime farmland map units. However, these map units were excluded, in part due to the rock outcrops. The ability to farm those map units is inconsistent at the current mapping scale. Collectively, all the map units on the list of candidates in each county have issues that inhibit use and productivity. However, issues inhibiting use and productivity do not necessarily prohibit a map unit from being important to the local agricultural economy.

The candidates were evaluated and ranked relative to their specific shortcomings. In Berkeley County, the extent and properties of Buchanan loam, three to 15 percent slopes, extremely stony, Hagerstown-Opequon-Rock outcrop complex, three to 15 percent slopes, and Weikert-Berks channery silt loams, three to eight percent slopes were determined and warranted closer consideration. The issue with the Buchanan loam is excessive stoniness and a seasonably high water table. The Hagerstown-Opequon-Rock outcrop is not suited for cultivated crops or hay and is difficult to manage for pasture. The Weikert-Berks map unit's primary issues are depth and fertility.

In Jefferson County, the three most likely candidates for consideration were Hagerstown-Rock outcrop complex, eight to 15 percent slopes, Oaklet-Rock outcrop complex, three to eight percent slopes, and Vertrees-Rock outcrop complex, three to eight percent slopes. The Oaklet-Rock outcrop complex has many similarities to Hagerstown in terms of depth, drainage and fertility. However, this map unit is often associated with sinkholes, and the clays in this soil tend to be more expansive. The Vertrees-Rock outcrop complex is very similar to the Oaklet-Rock outcrop complex but has lesser shrink swell potential. The best fit is the Hagerstown-Rock outcrop complex. It is a well-drained soil with depth to bedrock greater than 60 inches and is said to be naturally highly fertile. However, due to the presence of rock outcrops, it presents challenges in defining its use potential. While at times this map unit can still be suited to cultivated crops, as long as the outcrops do not interfere with the operation of farm machinery these soils have in general been mapped, so the more usable lands were included in map units with stony modifiers as opposed to listing a rock outcrop map component.

CONCLUSIONS

The agricultural lands in Berkeley and Jefferson Counties have been mapped in such a way that the majority of the quality agricultural land is already listed as prime farmland or as farmland of statewide importance. The majority of the agricultural land use is skewed more toward cropland and less towards pasture. The most extensive map units identified as the best fits for being locally important soils for these counties only account for approximately five to 10 percent of the potential agricultural land. When examined in detail, these soils are inconsistent in their use and limitations. It is unlikely these map units would be considered "good" agricultural land by typical farmers and landowners in the region. If mapped in greater detail, it is likely that more acres would be included in the other preferential classifications. However, given the existing soil maps, it is difficult to justify considering any of these map units as farmland of local importance, given the criteria employed herein.

The primary reason a local unit of government would concern itself with locally-important soil is funding. Farmland preservation is a costly endeavor with limited funding available. When the opportunity arises to match local funds with other funding sources, more land can be protected per unit of local funding. Often, the basis of matching funds is farmland classification, and locally-important farmland is often weighed equally to prime farmland and statewide important farmland. However, the local agency or agencies concerned only select these soils, and as stated earlier they must be approved by the NRCS State Conservationist. As one identifies locally important soils, it is prudent to be able to defend one's selections, should the State Conservationist question the selections. Rationale and criteria can and should differ from county to county and from expert to expert, as well as between local agencies concerned.

Locally-important farmland should contribute significantly to the local agricultural economy. Locally-important farmland should simply be "good" farmland. In these instances, the data did not support either of these conclusions. Hence, a recommendation to not name any locally-important farmland seemed prudent. At this time, the local conservation district chose not to identify any map units of local importance. However, as soil maps are redrawn, their accuracy increases, and their descriptions are updated, it is entirely plausible that a future evaluation could identify locally-important soils, with this analysis serving as a starting point for future examinations. Similarly, if alternative exclusionary criteria are employed or additional or different expert opinions utilized, an entirely different outcome from the existing data would be possible, if not expected.

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Table 1. Farmland Distribution

	Agricultural land		Prime farmland		Farmland of state-wide importance		Other map units	
	Acres	%	Acres	% *	Acres	% *	Acres	% *
Jefferson County	105,043	77.4	29,466	28.1	46,172	44.0	29,405	28.0
Berkeley County	189,065	91.7	38,432	20.3	35,028	18.5	115,605	61.1
Combined	294,108	86.1	67,898	23.1	81,200	27.6	185,010	49.3

* Percent of agricultural lands

Table 2. Five largest prime farmland map units in Berkeley County

Soil map units	Acres	%	Cumulative %
Hagerstown silt loam, 3 to 8 percent slopes	13,571	35.3	35.3
Hagerstown gravelly silt loam, 3 to 8 percent slopes	3,794	9.9	45.2
Funkstown silt loam	3,115	8.1	53.3
Swanpond silt loam, 0 to 3 percent slopes	2,297	6.0	59.3
Lindside silt loam	1,896	4.9	64.2

Table 3. Five largest prime farmland map units in Jefferson County

Soil map units	Acres	%	Cumulative %
Poplimento silt loam, 3 to 8 percent slopes	10,931	37.1	37.1
Funkstown silt loam	5,500	18.7	55.8
Oaklet silt loam, 3 to 8 percent slopes	5,378	18.3	74.0
Hagerstown silt loam, 3 to 8 percent slopes	2,630	8.9	82.9
Vertrees silt loam, 3 to 8 percent slopes	1,491	5.1	88.0

Table 4. Farmland of Statewide Importance

County	Soil map unit	Acres
Berkeley	Ryder-Nollville channery silt loams, 8 to 15 percent slopes	4,031
Berkeley	Calvin channery loam, 8 to 15 percent slopes	3,226
Berkeley	Hagerstown gravelly silt loam, 8 to 15 percent slopes	2,476
Berkeley	Hagerstown silty clay loam, 8 to 15 percent slopes	2,317
Berkeley	Monongahela silt loam, 3 to 8 percent slopes	2,014
Jefferson	Poplimento silt loam, 8 to 15 percent slopes	7,189
Jefferson	Hagerstown silt loam 8 to 15 percent slopes, very rocky	5,700
Jefferson	Ryder-Poplimento complex, 8 to 15 percent slopes	3,175
Jefferson	Hagerstown silt loam, 8 to 15 percent slopes	2,853
Jefferson	Hagerstown silt loam, 3 to 8 percent slopes, very rocky	2,355

Table 5. Candidates for Locally Important Soils

County	Soil map unit	Acres
Berkeley	**Weikert-Berks channery silt loams, 8 to 15 percent slopes**	21,691
Berkeley	**Hagerstown-Opequon-Rock outcrop complex, 3 to 15 percent slopes**	11,998
Berkeley	Clearbrook-Berks channery silt loams, 3 to 8 percent slopes	10,204
Berkeley	**Buchanan loam, 3 to 15 percent slopes, extremely stony**	4,135
Berkeley	Weikert-Berks channery silt loams, 3 to 8 percent slopes	2,306
Jefferson	**Hagerstown-Rock outcrop complex, 8 to 15 percent slopes**	4,023
Jefferson	Vertrees-Rock outcrop complex, 8 to 15 percent slopes	2,770
Jefferson	**Oaklet-Rock outcrop complex, 3 to 8 percent slopes**	1,782
Jefferson	Oaklet-Rock outcrop complex, 8 to 15 percent slopes	1,640
Jefferson	**Vertrees-Rock outcrop complex, 3 to 8 percent slopes**	1,394

Bold font indicates preferred candidates