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New Tools for Understanding Rangeland Productivity

Jessica Windh
Extension Specialist (rangeland and natural resource economics), University of Idaho Extension, Twin Falls Research and Extension Center

Kate Kallenbach
Undergraduate Researcher, Department of Forest, Rangeland, and Fire Sciences, University of Idaho

Karen Launchbaugh
Professor, Department of Forest, Rangeland, and Fire Sciences, University of Idaho

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University of Idaho Extension

Introduction

LIVESTOCK PRODUCERS AND RANGELAND MANAGERS FACE A MULTITUDE OF CHALLENGES when it comes to maintaining the balance between ecosystem health and livestock production, which is vital for both the economic and ecological sustainability of operations. One of the challenges is managing for the annual variation in rangeland vegetation from year to year. It's difficult because forage production relies on the climate, such as temperature patterns and the amount, timing, and duration of precipitation. Consequently, any techniques or tools that enhance land managers' ability to understand vegetation growth patterns and forage quantities help them to make better management decisions. However, proper monitoring can be time-consuming and expensive.

Recent technology offers a solution to help bridge the monitoring-knowledge gap. Web-based applications that utilize satellite images, often ground-truthed with data collected through universities and federal agencies, can be used to estimate forage quantities and calculate stocking rates.

To assist producers in using these tools, University of Idaho Extension reviewed a variety of free, web-based vegetation estimation tools to determine which ones might benefit rangeland land managers the most. Tools were analyzed based on the following criteria:

- Region of use
- Can users specify an area of interest
- Does it provide a biomass production estimate
- Does it assist in stocking-rate calculations
- Is it downloadable
- Does it provide a user guide
- Does it identify data sources

Table 1. Summary of the review of web-based tools for rangeland management. Shading indicates the tools reviewed herein.

Tool	Fuel Cast	Grass Cast	LANDFIRE	MRLC Rangeland Viewer	Rangeland Allotment Monitoring System	Rangeland Analysis Platform	Stock Smart	Web Soil Survey
Region	Western US	Great Plains and Southwest US	Continental US	Western US	Western US, USFS allotments	Continental US	Continental US	Continental US
Area of Interest	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Biomass Estimate	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stocking Rate	No	No	No	No	Yes	Yes	Yes	No
Downloadable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
User Guide	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Target Audience	Producers, land managers, wildland firefighters	Producers and land managers of the Great Plains and the Southwest	Producers, land managers, wildland firefighters	Producers and land managers	Producers and USFS land managers	Producers and land managers	Producers and land managers	Producers and land managers
Data Source	Rangeland Production Monitoring Service	NOAA Climate Prediction Center, DayCent model	Landsat	National Land Cover Database	Landsat, NDVI, EDDI	Landsat, partitioned NPP	Rangeland Production Monitoring Service	USDA NRCS

NDVI--Normalized Difference Vegetation Index; EDDI—Evaporative Demand Drought Index; NPP—Net Primary Productivity; USFS—US Forest Service; NOAA—National Oceanic and Atmospheric Administration; NRCS—Natural Resources Conservation Service.

Table 1 summarizes the eight tools analyzed. Three of them, the Rangeland Analysis Platform, Stock Smart, and Web Soil Survey, merit further discussion, because they offer the most benefit to producers.

Rangeland Analysis Platform (https://rangelands.app/)

The Rangeland Analysis Platform (RAP) launched in 2019, utilizing satellite imagery to estimate vegetative cover and herbaceous biomass from 1986 to the present day. Values update every sixteen days, which correlates with the timing of the imagery satellites return over a given area.

The platform allows users to upload a "shapefile," a geospatial data file (.shp) that stores location and other geographic information or creates an area of interest on a Google-generated map from which it calculates the vegetative cover percentage (categorized by perennial forb and grass, annual forb and grass, shrub, tree, or bare ground) or vegetation biomass (categorized by total herbaceous, annual forb and grass, or perennial forb and grass). Results can be viewed as annual results over a multiyear time frame or sixteen-day biomass accumulations within single years. Data can also be downloaded to Excel for more detailed uses. See Figure 1 for an example of the platform's work page.

The RAP also has a tool called the Production Explorer that allows users to explore multiyear trends in cover and biomass production (Figure 2). This tool also has a feature that assists in calculating proper stocking rates using current and past biomass data. Users must input information about planned grazing days, animal weights, animal feed intake, grazing efficiency, and an adjustment factor for slope and distance in order to increase the accuracy of the stocking-rate calculation. The results show suggested stocking rates over the period of time the user sets,

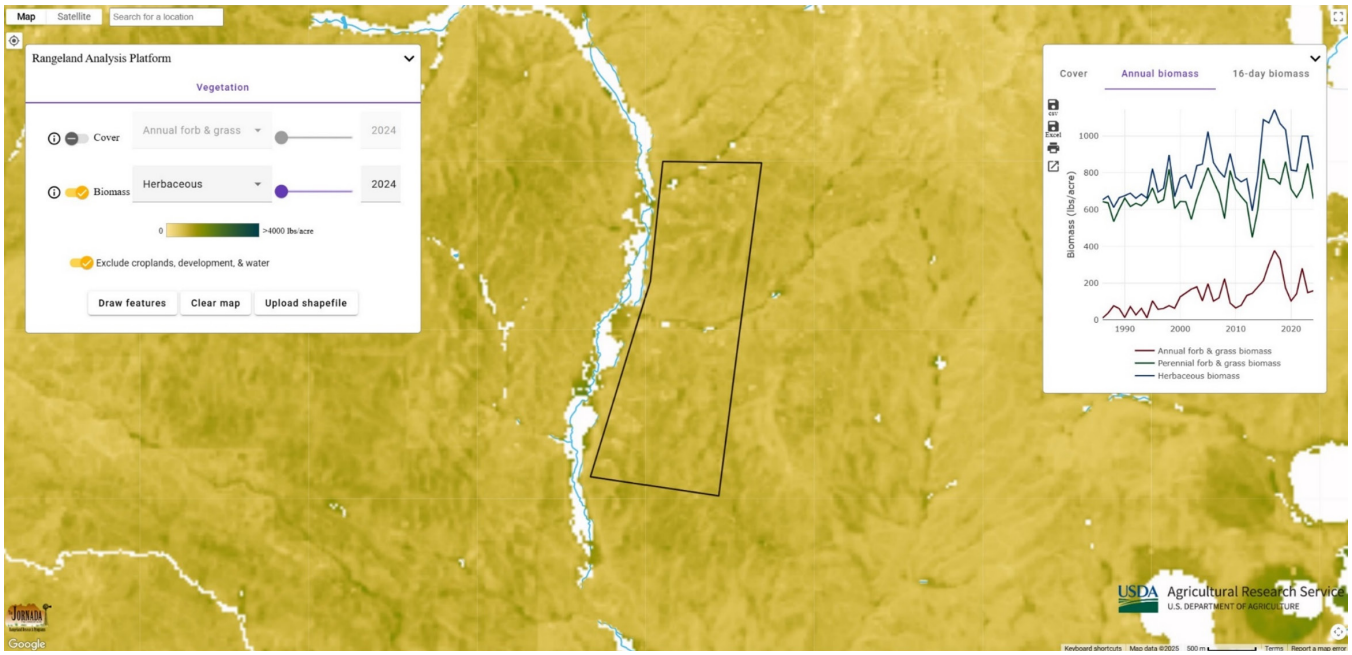


Figure 1. An example of the Rangeland Analysis Platform's work-page screen. A pasture shapefile (center black-box outline) from the University of Idaho's Rinker Rock Creek Ranch was uploaded. Control panel at left; results window at right.

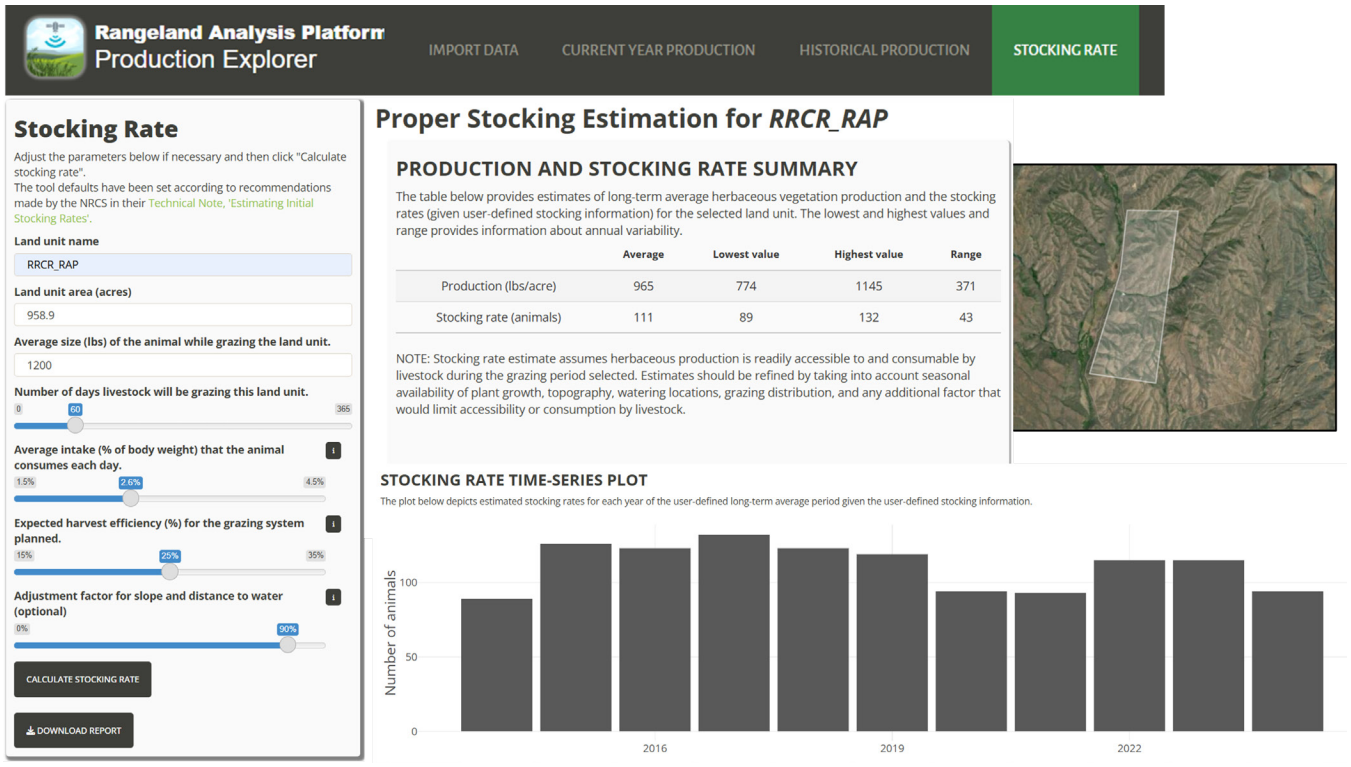


Figure 2. The RAP Production Explorer Stocking Rate screen view. The control panel (at left) includes prompts regarding animals and pasture features that are needed for accurate calculations, including animal weight, grazing days, and distance to water. A display of the results (at right) includes average stocking rate and historical low and high stocking rates for the time period specified.

including the lowest and highest values over that time period. Note: if you include the current year within the chosen time frame, calculations run based on year-to-date total vegetation; hence, values appear lower than expected.

This tool also breaks down details of the stocking-rate calculations and details of production data, including splits between annual and perennial vegetation types. This breakdown is helpful because it allows users not only to identify how vegetation trends impact the suggested annual carrying capacity but also to check for accuracy within the program. Although its tools are useful for assisting land managers in decision making, satellite imagery is not as accurate as a physical assessment.

Stock Smart

Stock Smart is similar to RAP's Production Explorer, but possesses a few more abilities. Like RAP, the user can draw an area of interest or upload a shapefile into the ESRI (Environmental Systems Research Institute)-generated map. Unlike it, however, it uses the Rangeland Production Monitoring Service (RPMS) rangeland production dataset, which is different than the one used by RAP. The RPMS dataset categorizes vegetation by herbs (includes grasses and forbs), shrubs, and trees. This differentiation in plant type led Stock Smart to include additional calculations for the impact of tree cover on understory vegetative growth and for the percentage of livestock diet that may be comprised of shrub grazing (Figure 3). This is important because counting trees and shrubs as grazing forage in the same way as grass and forbs creates an overestimation of consumable forage.

Stock Smart also has the capability to incorporate water locations and grazing exclosures within pastures and an ESRI map to identify the slope of the area of interest. These features allow for the inclusion of animal behavior characteristics into the stocking rate—such as the distance from water livestock will travel and the slope steepness they're willing to graze on (Figure 3).

Similar to RAP's Production Explorer tool, Stock Smart also incorporates animal details, such as animal type (categorized by cow, cow/calf pair, horse, yearling, and sheep), average weights, grazing

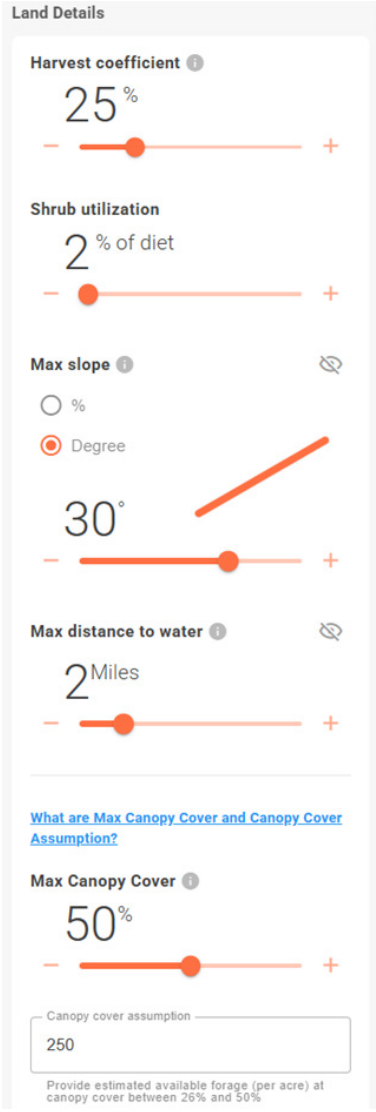


Figure 3. Land details entered into Stock Smart help limit stocking rates based on animal behaviors.

period, and total animal numbers (Figure 4). It displays the results as a recommended stocking rate, with a range of low to high stocking rates, as well as how that number translates into animal numbers for the indicated grazing period and grazing days for the indicated animal numbers (Figure 5). A unique benefit of Stock Smart is that the user can adjust criteria or add grazing exclosures and water sources to see how these changes might affect their carrying capacity. This is helpful for understanding trade-offs of new management practices. Stock Smart is also unique among the three products because it has a phone-friendly HTML format, making computer use unnecessary.

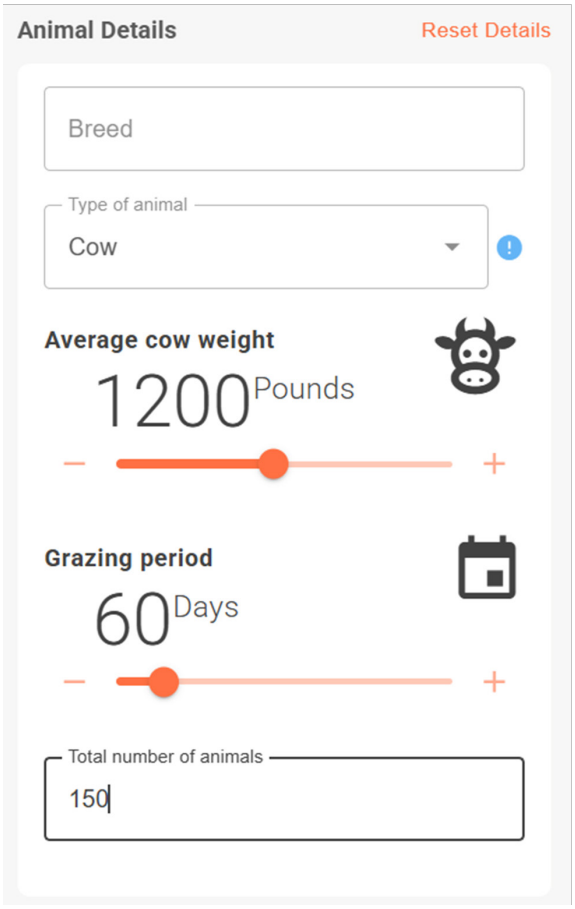


Figure 4. Animal details entered into the Stock Smart guide allow it to calculate the number of days the land supports the number of animals inputted or the number of animals the pasture could support for a desired time frame.

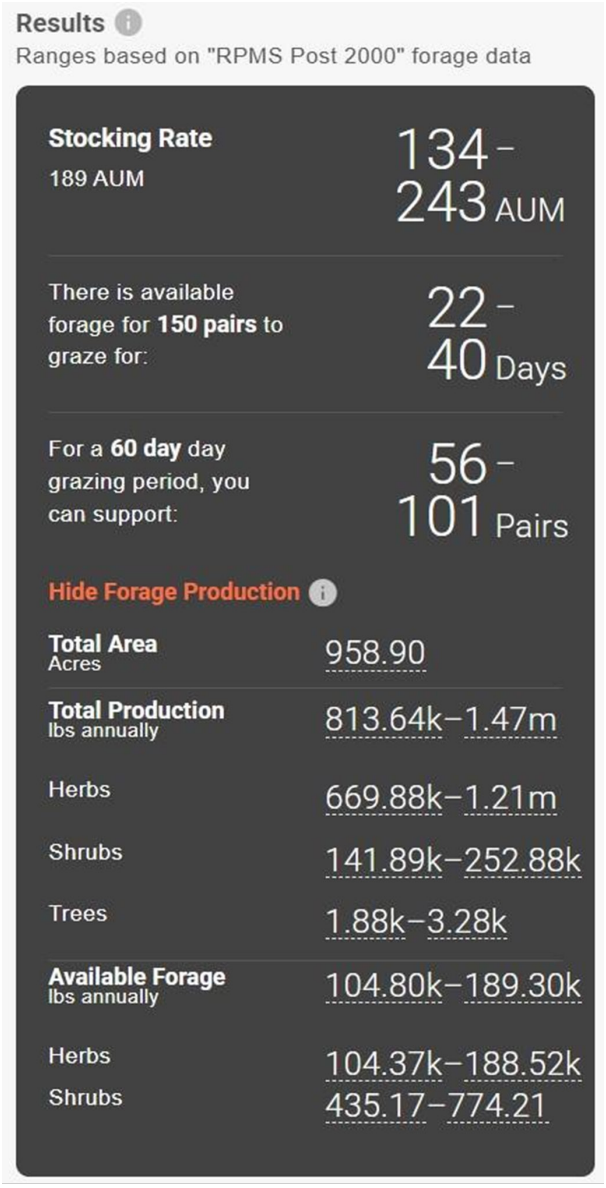


Figure 5. The stocking rate results shown in Stock Smart, along with the forage production calculated by the program.

Web Soil Survey

Web Soil Survey (WSS) is a tool managed by the US Department of Agriculture's Natural Resource Conservation Service. The WSS is quite a bit different from the other two—it has the ability to choose an area of interest or upload a shapefile under the Area of Interest tab. Once an area of interest has been identified, the other tabs (Figure 6) display a wealth of information specific to the soil, water, and land features of the chosen area.

The WSS has a feature that displays expected rangeland vegetation production values (for favorable, normal, and unfavorable years) (Figure 7). However, it is not able to view annual production by year or calculate stocking rates. Its original purpose was to map the United States by soil types, as implied by its name, and over time additional features have been added, such as soil compaction risk, water-infiltration capacity, and fire-damage susceptibility. Also within this application is the ability to access ecological site information for a specified area of interest. This information includes topography, expected vegetation types, climate, and how the local ecology is affected by disturbance. These unique features offer users the opportunity to understand pasture features that may influence management decisions or that may explain why management did not work as expected.

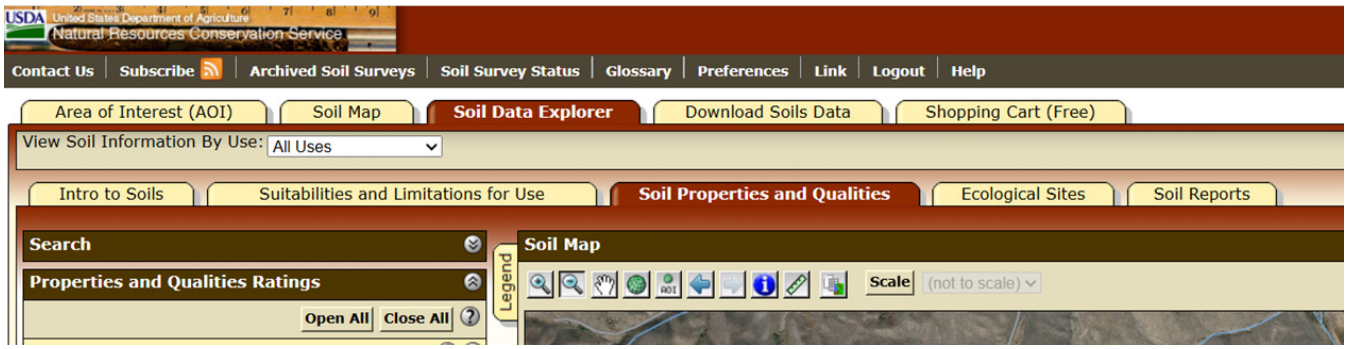
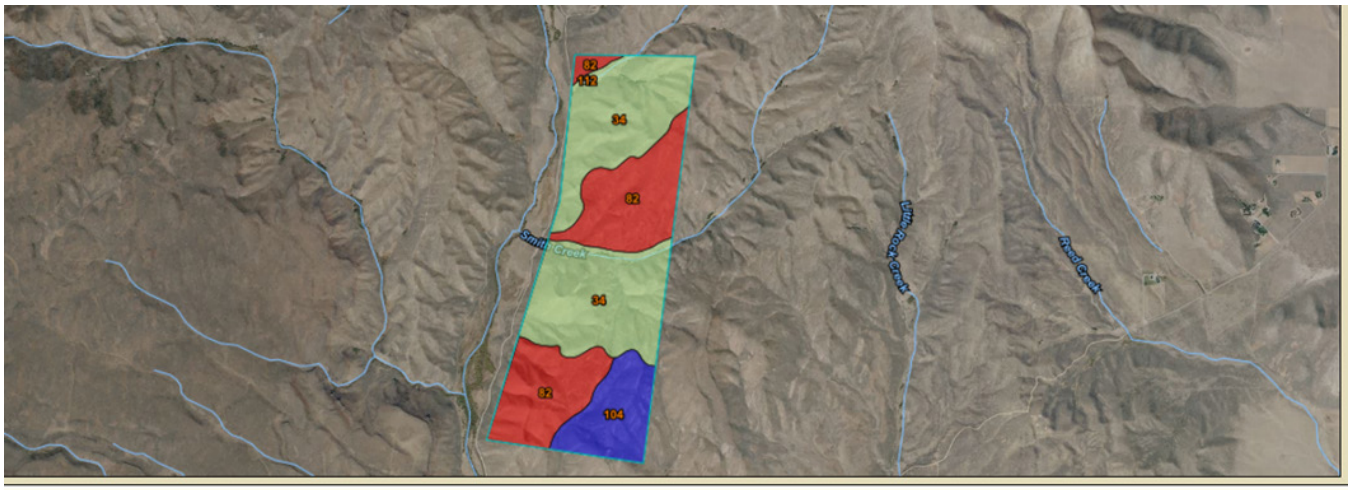


Figure 6. The Web Soil Survey application offers a variety of tools under a suite of tabs: the Area of Interest allows users to define the land parcel to explore; the Soil Data Explorer shows options for suitable land uses; and the Ecological Sites offers a wealth of ecological information about the larger-scale land region.



Tables — Range Production (Normal Year) — Summary By Map Unit

Summary by Map Unit — Blaine County Area, Idaho (ID680)

Summary by Map Unit — Blaine County Area, Idaho (ID680)

Map unit symbol	Map unit name	Rating (pounds per acre per year)	Acres in AOI	Percent of AOI
34	Earcree-Moonstone association, 30 to 60 percent slopes	1100	487.9	50.8%
82	Moonstone-Earcree association, 30 to 60 percent slopes	988	344.7	35.9%
104	Simonton-Bauscher complex, 4 to 15 percent slopes	1267	126.8	13.2%
112	Water		1.3	0.1%
Totals for Area of Interest			**960.7**	**100.0%**

Figure 7. A view of the WSS application, showing how a sample pasture at Rinker Rock Creek Ranch breaks up into three different soil types. The table (bottom half of image) shows how the rangeland vegetation production is expected to differ across soil types in a normal precipitation year.

Conclusion

Many tools are available online to help land managers better understand their property's characteristics and improve their ability to make responsible land management decisions. Three of them currently provide especially valuable information and are free to access. Although they are helpful, note that they only provide generalized information. Indeed, management decisions should not be made without understanding the individual characteristics of one's own land. Used in conjunction with on-the-ground observations and local expertise, however, these tools serve as a strong foundation for informed and sustainable land management decisions.

Acknowledgment

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