**ASSESSING THE EFFECTIVENESS OF RIPARIAN RESTORATION PROJECTS USING LANDSAT AND PRECIPITATION DATA FROM THE CLOUD-COMPUTING APPLICATION CLIMATEENGINE.ORG**

**ABSTRACT:**

Riparian vegetation along streams provides a suite of ecosystem services in rangelands and thus is the target of restoration when degraded by over-grazing, erosion, incision, or other disturbances. Assessments of restoration effectiveness depend on defensible monitoring data, which can be both expensive and difficult to collect. We present a method and case study to evaluate the effectiveness of restoration of riparian vegetation using a web based cloud-computing and visualization tool (ClimateEngine.org) to access and process remote sensing and climate data. Restoration efforts on an Eastern Oregon ranch were assessed by analyzing the riparian areas of four creeks that had in-stream restoration structures constructed between 2008 and 2011. Within each study area, we retrieved spatially and temporally aggregated values of summer (June, July, August) normalized difference vegetation index (NDVI) and total precipitation for each water year (October-September) from 1984 to 2017. We established a pre-restoration (1984–2007) linear regression between total water year precipitation and summer NDVI for each study area, and then compared the post-restoration (2012–2017) data to this pre-restoration relationship. In each study area, the post-restoration NDVI-precipitation relationship was statistically distinct from the pre-restoration relationship, suggesting a change in the fundamental relationship between precipitation and NDVI resulting from stream restoration. We infer that the in-stream structures, which raised the water table in the adjacent riparian areas, provided additional water to the streamside vegetation that was not available before restoration and reduced the dependence of riparian vegetation on precipitation. This approach provides a cost-effective, quantitative method for assessing the effects of stream restoration projects on riparian vegetation.

**ARCHITECTURE:**

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**EXISTING SYSTEM:**

 Many restoration projects are assessed through metric trajectories, or changes over time yet these evaluations require both baseline pre-restoration data and long-term monitoring of the completed project. Although recommend both a historical study of pre-restoration conditions and a minimum of 10 years of post-restoration monitoring, Gonzalez et al. (2015) found that just 16% of projects monitoring trajectories included pre-restoration data, and only 22 of 169 total projects reviewed included more than six years of post-restoration monitoring. The long-term effects of restoration will seldom be seen in such short time frames (Trowbridge, 2007), especially in projects intended to foster natural ecological processes like succession plant community development and resilience from natural disturbance (e.g., beaver, flood).

**PROPOSED SYSTEM:**

 We present a method and case study to assess the effectiveness of riparian restoration using a freely available, on-demand, cloud computing web application to access, process, and download 30+ years of Landsat and gridded precipitation data for restoration locations. We compared statistical relationships between riparian vegetation vigor and precipitation data for both pre- and post-restoration periods. The approach we present overcomes some of the barriers in accessing large geospatial datasets and provides a simple but rigorous quantitative approach that can be used by scientists, practitioners, and managers to assess the effectiveness of a restoration project for improving riparian vegetation.

**MODULES:**

1. **DATA PREPROCESSING**
2. **ANALYZING DATA**
3. **PICTORIAL REPRESENTATION**

**MODULE DESCRIPTION:**

1. **DATA PREPROCESSING**

 Data preprocessing is beginning module that we can upload details and that can be affect the data given in the dataset as well. The preparation of data can be according to remove unwanted values and make analysis clear and make it easy and straight forward. These preprocessed data only send to next module of analyzing part. The data preprocessing is more about user login authentication as well. More importantly admin is the lone user to find the access about part and data.

1. **ANALYZING DATA**

 The data is gathered to analyze based on the location of the details selected and it can be very effective method to do the analysis of the data. The main aim of the data would be getting the correct details of the analysis in the data. The data between most among the better data to find the restoration of riparian land. The water would be found based on the old data.

1. **PICTORIAL REPRESENTATION**

 The pictorial representation of the data would be in different form like line chart, pie chart and/or bar chart. Those charts briefly explain the data analysation in detail and very understandable manner. This can be utilized to get the water based on the given data in dataset and modified by admin on the previous details.

**ALGORITHM**

A **recursive algorithm** is an algorithm which calls itself with "smaller (or simpler)" input values, and which obtains the result for the current input by applying simple operations to the returned value for the smaller (or simpler) input. More generally if a problem can be solved utilizing solutions to smaller versions of the same problem, and the smaller versions reduce to easily solvable cases, then one can use a recursive algorithm to solve that problem. For example, the elements of a recursively defined set, or the value of a recursively defined function can be obtained by a recursive algorithm.

If a set or a function is defined recursively, then a recursive algorithm to compute its members or values mirrors the definition. Initial steps of the recursive algorithm correspond to the basis clause of the recursive definition and they identify the basis elements. They are then followed by steps corresponding to the inductive clause, which reduce the computation for an element of one generation to that of elements of the immediately preceding generation.

**Example 1:** Algorithm for finding the ***k***-th even natural number
Note here that this can be solved very easily by simply outputting ***2*\*(*k - 1*)**for a given ***k* .** The purpose here, however, is to illustrate the basic idea of recursion rather than solving the problem.

**Algorithm 1:   Even(**positive integer ***k*)**
**Input: *k*** , a positive integer
**Output: *k***-th even natural number (the first even being ***0***)

**REQUIREMENT SPECIFICATION**

**Functional Requirements**

* Graphical User interface with the User.

**Software Requirements**

For developing the application the following are the Software Requirements:

1. Python
2. Django
3. MySql
4. MySqlclient
5. WampServer 2.4

**Operating Systems supported**

1. Windows 7
2. Windows XP
3. Windows 8

**Technologies and Languages used to Develop**

1. Python

**Debugger and Emulator**

* Any Browser (Particularly Chrome)

**Hardware Requirements**

For developing the application the following are the Hardware Requirements:

* Processor: Pentium IV or higher
* RAM: 256 MB

Space on Hard Disk: minimum 512MB

**CONCLUSION**

Using remote sensing and climate data freely available via a cloudcomputing application (ClimateEngine.org) along with relatively

simple statistical analyses, we demonstrate that restoration work at Silvies Valley Ranch was effective in providing additional water to the riparian vegetation community, thereby increasing vegetation vigor. Control tests on (a) Flat Creek and (b) Lower Camp Creek study areas. The control data (filled black circles) came from the pre-restoration population, but were not used to establish the pre-restoration regression between precipitation and NDVI. Table 3 Statistical analyses on the control study areas. (a) pre-restoration (1984–2002) relationships, (b) control (2003–2007) t-tests, and (c) post-restoration (2012–2017) t-tests. (a) Pre-Restoration (1984–2002) Precipitation-NDVI Linear Regression (17 d.f.) Study Area Regression Slope Regression Intercept R2 P-value Flat Creek 6.75×10−4 0.242 0.566 2.01×10−4 Lower Camp Creek 5.37×10−4 0.468 0.311 0.0130 (b) Pre-Restoration Control (2003–2007) Residual Tests for Changes in the Precipitation-NDVI Regression (4 d.f.) Study Area Statistically Significant? P-value t-statistic Flat Creek no 0.411 0.916 Lower Camp Creek no 0.737 −0.360 (c) Post-Restoration (2012–2017) Residual Tests for Changes in the Precipitation-NDVI Regression (5 d.f.) Study Area Statistically Significant? P-value t-statistic Flat Creek yes 9.04×10−6 18.27 Lower Camp Creek yes 7.68×10−4 7.27 Fig. 6. Pre- and post-restoration precipitation at study areas. The heavy black line in each column indicates mean pre-restoration precipitation, with the shaded box indicating ± one standard deviation and the lines indicating the full range (minimum to maximum) of pre-restoration observations. Post-restoration precipitation observations are indicated by the open circles. For Lower Camp Creek and Flat Creek, control data are indicated with filled circles. M.B. Hausner et al. Ecological Engineering 120 (2018) 432–440 438 We infer that this additional water was provided by shallow groundwater that was raised by the installation of ABDs along four streams. The change shown in this study is not merely an observed change in the vegetation, but a change in the functional relationship between precipitation and vegetation. The change to that relationship is quantified and shown to be statistically significant. Although this analysis is limited to vegetation, it can be performed with freely available data and common inexpensive software, and it does not depend upon on-site monitoring, either before or after restoration. The approach and analysis presented in this paper offers a powerful and cost-effective way to evaluate effectiveness of one aspect of restoration projects, especially projects that are implemented with little or no monitoring.