

# Literature Review - Climate Smart Ag Links to Ecosystem Services

MK Lau

Search

<https://gofarmhawaii.org/aghelp/>

<https://attra.ncat.org/topics/>

<https://ifssportal.nutritionconnect.org/solutions/explore>

## Context

The City and County of Honolulu’s Office of Climate Resilience has contracted OACA to produce a Climate Smart Agriculture database intended to inform food system professionals and policy makers on the potential ecosystem service impacts of CSA activities. The consultant (MK Lau) has been sub-contracted by OACA to complete the deliverables listed below in partial fulfillment of the larger contracted deliverable to HC&C.

## Key Personnel

*Dr. Matthew Kekoa Lau, PhD.* – will combine his expertise in ecological systems theory and big data analysis with the practice of sustainable agriculture to produce the contracted deliverables.

## Deliverables

- CSA-ES literature synthesis
- CSA-ES Resource Database
- CSA Policy 1-pager

## Data Pipeline Design

- Compile search terms
- Assess search term relevance [litsearchr]
  - Access literature rcrossref
- Search literature [EBSCO Search Premier]
- Analyze literature results [bibliometrix]
  - Analyze content for intersection with Hawai’i agriculture
  - Key cross-terms: tropic, hawaii, pacific, island, ...
- Create a dashboard [Shiny]
- Host dashboard [RShiny]

## Search Terms

Terms for practices to focus searches on was generated from the NRCS CSAF Mitigation Strategies 2024 list:

- NRCS

Other potential sources of practices could be:

- CSA
- CSC

Policy information can be obtained from the FAO databases:

- FAO
- FAOForestry

Urban Database for policy information:

Urban

Other government data:

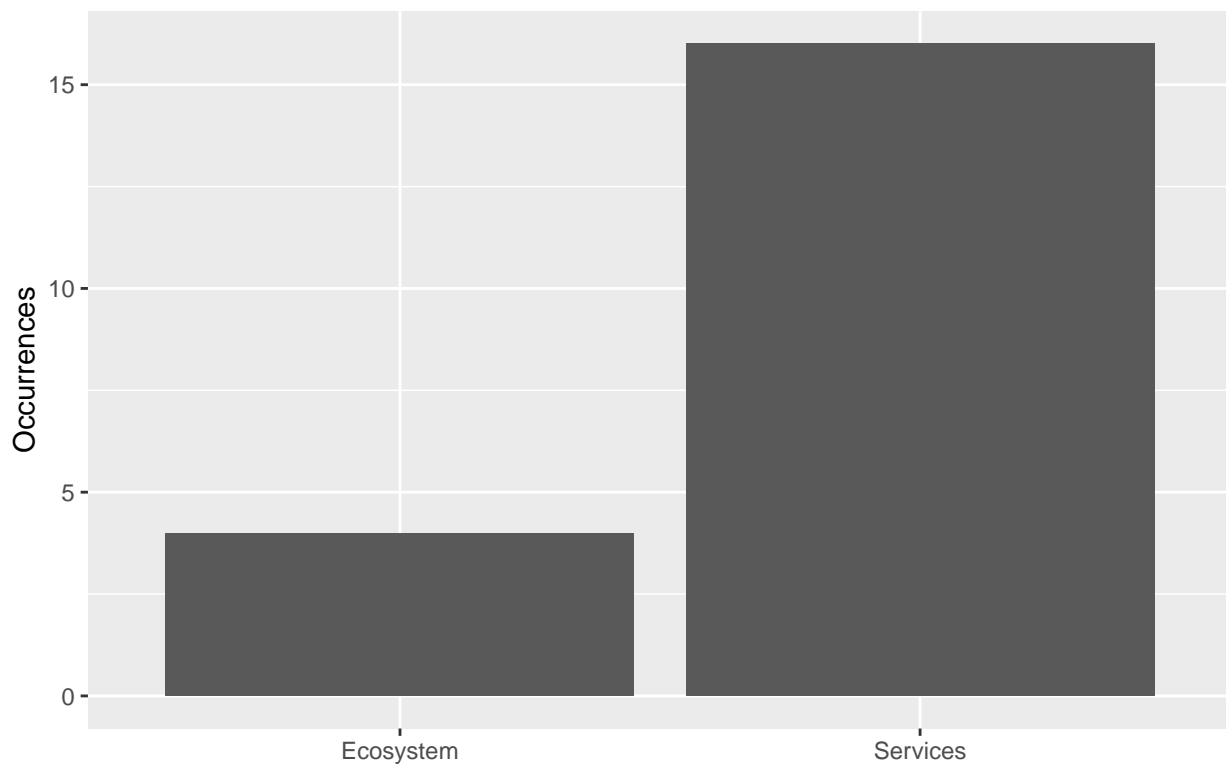
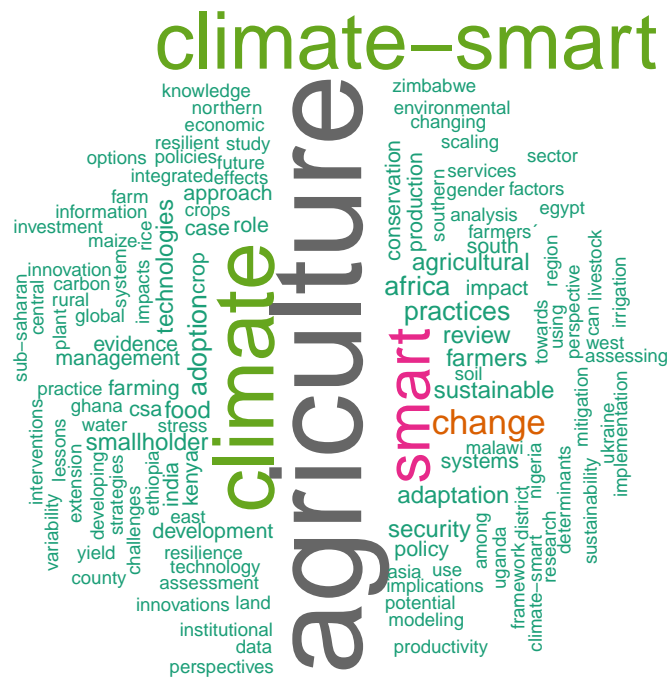
GovData

## rcrossref

<https://docs.ropensci.org/rcrossref/articles/rcrossref.html>

```
qs <- c("climate smart agriculture")
res <- cr_works(query = qs, limit = 1000) %>% pluck("data")
head(res)
```

```
## # A tibble: 6 x 41
##   container.title      created deposited published.print published.online doi
##   <chr>              <chr>   <chr>   <chr>           <chr>           <chr>
## 1 Protected Cultivat~ 2020-1~ 2020-11-- 2020-11-20      2020-11-20      10.3~
## 2 Theories and Modes o~ 2024-0~ 2024-03-- 2024-04         2024-03-05      10.1~
## 3 Theories and Modes o~ 2024-0~ 2024-03-- 2024-04         2024-03-05      10.1~
## 4 Technological Approa~ 2024-0~ 2024-03-- 2024          2024-03-26      10.1~
## 5 Theories and Modes o~ 2024-0~ 2024-03-- 2024-04         2024-03-05      10.1~
## 6 Conservation agricul~ 2022-0~ 2023-08-- 2022           <NA>           10.1~
## # i 35 more variables: indexed <chr>, issued <chr>, member <chr>, prefix <chr>,
## #   publisher <chr>, score <chr>, source <chr>, reference.count <chr>,
## #   references.count <chr>, is.referenced.by.count <chr>, title <chr>,
## #   type <chr>, url <chr>, author <list>, alternative.id <chr>, isbn <chr>,
## #   page <chr>, update.policy <chr>, assertion <list>, link <list>,
## #   license <list>, reference <list>, abstract <chr>, issn <chr>, issue <chr>,
## #   subject <chr>, volume <chr>, language <chr>, ...
```



### *litsearchr* workflow

1. Identifies potential keywords through the naive search input
2. Builds a keyword co-occurrence network to increase search precision
3. Uses a cutoff function to identify keyword importance
4. Assists with grouping terms into concepts
5. Writes a Boolean search

[https://luketudge.github.io/litsearchr-tutorial/litsearchr\\_tutorial.html](https://luketudge.github.io/litsearchr-tutorial/litsearchr_tutorial.html)

## analysis

- policy
- farming practices
- databases
- tropics
- ecosystem services

Bibliometrix

## R Tools

- <https://elizagrames.github.io/litsearchr/#tutorials>
- <https://www.bibliometrix.org/home/index.php/layout/bibliometrix>
- <https://www.harc-hspa.com/climate-smart-agriculture.html>
- <https://github.com/elizagrames/topictagger>
- <https://github.com/cran/metagear>
- <https://cran.r-project.org/web/packages/scholar/index.html>

## CSA-ES Resource Database

### Webcrawling

<https://github.com/salimk/Rcrawler> [https://ladal.edu.au/webcrawling.html#Following\\_links](https://ladal.edu.au/webcrawling.html#Following_links)

```
if ("nracs-usda-gov-030004.Rdata" %in% dir("./data/")){
  load("data/nracs-usda-gov-030004.Rdata")
}else{
  Rcrawler(Website = "https://www.nracs.usda.gov/conservation-basics/natural-resource-concerns/climate",
           no_cores = 4, no_conn = 4,
           NetworkData = TRUE,
           ExtractXPathPat = "//*[a/@href",
           ManyPerPattern = TRUE, MaxDepth = 2,
           )
}

nrc.url <- INDEX[INDEX[, "Level"] == 2, "Url"]
nrc.url <- nrc.url[grepl("natural-resource-concerns/", nrc.url)]
nrc.cat <- strsplit(nrc.url, "natural-resource-concerns/")
nrc.url <- nrc.url[lapply(nrc.cat, length) == 2]
nrc.cat <- nrc.cat[lapply(nrc.cat, length) == 2]
nrc.cat <- lapply(nrc.cat, function(x) x[2])
nrc.cat <- lapply(nrc.cat, strsplit, split = "\\/")
nrc.cat <- lapply(nrc.cat, unlist)

for (i in seq_len(length(nrc.cat))){
  if (length(nrc.cat[[i]]) < max(unlist(lapply(nrc.cat, length)))){
    nrc.cat[[i]] <- c(nrc.cat[[i]], rep("", times = max(unlist(lapply(nrc.cat, length))) - length(nrc.cat[[i]])))
  }else{}
}

nrc.tab <- cbind(do.call(rbind, nrc.cat), nrc.url)
```

```
colnames(nrc.tab) <- c("Category",
                      paste0("Sub-Category ", seq(1, ncol(nrc.tab)-2)),
                      "Resource")
save(nrc.tab, file = "./data/nrc_tab.Rdata")
```

Data from NRCS were extracted manually using tabula.

```
csa.mit.tab <- read.csv("data/tabula-NRCS-CSAF-Mitigation-Activities.csv", header = FALSE)
csa.mit.head <- csa.mit.tab[grepl("Mitigation Categories", csa.mit.tab[, 1]), ]
csa.mit.head <- gsub("\\[.*?\\]", "", csa.mit.head)
csa.mit.head <- gsub(" ", " ", csa.mit.head)
colnames(csa.mit.tab) <- csa.mit.head
csa.mit.tab <- apply(csa.mit.tab, 2, gsub, pattern = "\\[.*?\\]", replace = "")
csa.mit.tab <- apply(csa.mit.tab, 2, gsub, pattern = " ", replace = " ")

## Removing narrative crosswalk
csa.cwk <- csa.mit.tab[seq(grep("Waste Storage Structure", csa.mit.tab[, 2]), nrow(csa.mit.tab)), ]
colnames(csa.cwk)[4] <- "Narrative"
csa.mit.tab <- csa.mit.tab[-seq(grep("Waste Storage Structure", csa.mit.tab[, 2]), nrow(csa.mit.tab)), ]

## Generate urls for codes
get.codes <- function(x){
  x <- paste0(x, collapse = " ")
  x <- unlist(strsplit(x, split = " "))
  x <- x[grepl("E[0-9][0-9][0-9][a-z,A-Z]", x)]
  return(x)
}

csa.mit.codes <- unlist(lapply(apply(csa.mit.tab, 1, get.codes), function(x) x[1]))
csa.mit.tab[, "Code"] <- csa.mit.codes
csa.mit.tab[!(grepl("E", csa.mit.tab[, "Code"])), "Code"] <- ""
csa.mit.url <- paste0("https://www.nrcs.usda.gov/sites/default/files/2022-11/",
                     csa.mit.tab[, "Code"],
                     "_July_2022.pdf")
csa.mit.url <- gsub(" ", "-", csa.mit.url)
csa.mit.url[csa.mit.tab[, "Code"] == ""] <- ""
csa.mit.tab <- data.frame(csa.mit.tab, "URL" = csa.mit.url)
```

Category	Sub-Category 1	Sub-Category 2	Resource
soils	soil-health		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-health">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-health</a>
climate	news	usda-celebrates-10-years-of-climate-hubs	<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/news/usda-celebrates-10-years-of-climate-hubs">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/news/usda-celebrates-10-years-of-climate-hubs</a>
soil			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/</a>
water			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/water/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/water/</a>
plants			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/</a>
animals			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/animals/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/animals/</a>
animals	wildlife		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/animals/wildlife">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/animals/wildlife</a>

Category	Sub-Category 1	Sub-Category 2	Resource
animals	insects-pollinators		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/animals/insects-pollinators">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/animals/insects-pollinators</a>
land			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/</a>
air			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/air/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/air/</a>
air	air-quality		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/air/air-quality">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/air/air-quality</a>
air	usda-agricultural-air-quality-task-force		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/air/usda-agricultural-air-quality-task-force">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/air/usda-agricultural-air-quality-task-force</a>
energy			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/energy/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/energy/</a>
climate			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/</a>
climate	adaptation		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/adaptation">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/adaptation</a>
climate	mitigation		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/mitigation">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/mitigation</a>
climate	nutrient-management		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/nutrient-management">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/climate/nutrient-management</a>
wildlife-habitat			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/wildlife-habitat/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/wildlife-habitat/</a>
invasive-species-and-pests			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/invasive-species-and-pests/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/invasive-species-and-pests/</a>
watersheds			<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/watersheds">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/watersheds</a>
soil	soil-science		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-science/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-science/</a>
soil	soil-and-plant-science-news		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-and-plant-science-news">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-and-plant-science-news</a>
soil	activities		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/activities">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/activities</a>
soil	soil-and-plant-showcase		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-and-plant-showcase">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-and-plant-showcase</a>
soil	accolades-in-spades		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/accolades-in-spades">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/accolades-in-spades</a>
soil	soil-survey		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-survey">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-survey</a>
soils	soil-geography		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-geography">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/soil-geography</a>
soil	soil-use		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-use">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-use</a>
soil	kellogg-soil-survey-laboratory-kssl		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/kellogg-soil-survey-laboratory-kssl">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/kellogg-soil-survey-laboratory-kssl</a>
soil	soil-science-research		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-science-research">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-science-research</a>

Category	Sub-Category 1	Sub-Category 2	Resource
soil	soil-science-contacts		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-science-contacts">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-science-contacts</a>
plants	organic		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/organic/">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/organic/</a>
land	forests		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/forests">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/forests</a>
plants	trees		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/trees">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/trees</a>
land	cropland		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/cropland">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/cropland</a>
land	range-pasture		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/range-pasture">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/range-pasture</a>
soils	state-soil-scientists		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/state-soil-scientists">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/state-soil-scientists</a>
soils	getting-started-with-web-soil-survey		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/getting-started-with-web-soil-survey">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/getting-started-with-web-soil-survey</a>
soil	wss-tips-and-shortcuts		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/wss-tips-and-shortcuts">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/wss-tips-and-shortcuts</a>
soil	annual-refresh-of-soil-survey-data		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/annual-refresh-of-soil-survey-data">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/annual-refresh-of-soil-survey-data</a>
soil	news	usda-website-puts-soils-information-tools-publications	<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/news/usda-website-puts-soils-information-tools-publications">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/news/usda-website-puts-soils-information-tools-publications</a>
land	cropland		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/cropland/publications">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/cropland/publications</a>
plants	grasses		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/grasses">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/grasses</a>
plants	shrubs		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/shrubs">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/shrubs</a>
land	wetlands		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/wetlands">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/wetlands</a>
plants	forbs		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/forbs">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/forbs</a>
plants	legumes		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/legumes">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/plants/legumes</a>
soil	national-soil-survey-center		<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/national-soil-survey-center">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/national-soil-survey-center</a>
land	forests	national-agroforestry-center	<a href="https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/forests/national-agroforestry-center">https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/forests/national-agroforestry-center</a>

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Soil Health	E327A	Conservation Cover (acres) E327A	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E327A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E327A_July_2022.pdf</a>

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
	E327B	Establish Monarch butterfly habitat	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E327B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E327B_July_2022.pdf</a>
	E328A	Conservation Crop Rotation	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E328A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E328A_July_2022.pdf</a>
	E328B	(acres) Improved resource conserving crop rotation	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E328B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E328B_July_2022.pdf</a>
	E328E	Soil health crop rotation	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E328E_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E328E_July_2022.pdf</a>
	E328F	Modifications to improve soil health and increase soil organic matter	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E328F_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E328F_July_2022.pdf</a>
	E328N	Intercropping to improve soil health	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E328N_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E328N_July_2022.pdf</a>
	E328O	Perennial grain crop conservation rotation	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E328O_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E328O_July_2022.pdf</a>
	E329A	Residue and Tillage	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E329A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E329A_July_2022.pdf</a>
	E329B	Management, No Till (acres)	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E329B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E329B_July_2022.pdf</a>
	E329C	No till to increase plant-available moisture	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E329C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E329C_July_2022.pdf</a>
	E329D	No till system to increase soil health and soil organic matter content	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E329D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E329D_July_2022.pdf</a>
	E329E	No till to reduce energy	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E329E_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E329E_July_2022.pdf</a>
	Contour Buffer Strips (acres)	None Available	
	Soil Carbon Amendment		



Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
	None Available(acres)*		
	E340A	Cover Crop (acres)	
	E340A	Cover crop to reduce soil erosion	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340A_July_2022.pdf</a>
	E340B	Intensive cover cropping to increase soil health and soil organic matter content	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340B_July_2022.pdf</a>
	E340C	Use of multi-species cover crops to improve soil health and increase soil organic matter	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340C_July_2022.pdf</a>
	E340D	Intensive orchard/vineyard floor cover cropping to increase soil health	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340D_July_2022.pdf</a>
	E340F	Cover crop to minimize soil compaction	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340F_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340F_July_2022.pdf</a>
	E340G	Cover crop to reduce water quality degradation by utilizing excess soil nutrients	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340G_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340G_July_2022.pdf</a>
	E340H	Cover crop to suppress excessive weed pressures and break pest cycles	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340H_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340H_July_2022.pdf</a>
	E340I	Using cover crops for biological strip till	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340I_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340I_July_2022.pdf</a>
	E340J	Cover crop to improve moisture use efficiency and reduce salts	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E340J_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E340J_July_2022.pdf</a>
	E345A	Residue and Tillage	
	E345A	Reduced tillage to reduce soil erosion	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E345A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E345A_July_2022.pdf</a>
	E345B	Management, Reduced Till	
	E345B	Reduced tillage to reduce tillage induced particulate matter	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E345B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E345B_July_2022.pdf</a>
	(acres)		

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Soil Health	E345C	Reduced tillage to increase plant-available moisture	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E345C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E345C_July_2022.pdf</a>
	E345D	Reduced tillage to increase soil health and soil organic matter content	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E345D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E345D_July_2022.pdf</a>
	E345E	Reduced tillage to reduce energy use	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E345E_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E345E_July_2022.pdf</a>
	E386A	Enhanced field borders to reduce soil erosion along the edge(s) of a field	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E386A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E386A_July_2022.pdf</a>
	E386B	Enhanced field borders to increase carbon storage along the edge(s) of the field	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E386B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E386B_July_2022.pdf</a>
	E386C	Enhanced field borders to decrease particulate emissions along the edge(s) of the field	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E386C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E386C_July_2022.pdf</a>
	E386D	Enhanced field borders to increase food for pollinators along the edge(s) of a field	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E386D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E386D_July_2022.pdf</a>
	E386E	Enhanced field borders to increase wildlife food and habitat along the edge(s) of a field	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E386E_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E386E_July_2022.pdf</a>
	E393A	Extend existing filter strip to reduce water quality impacts	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E393A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E393A_July_2022.pdf</a>
	E412A	Enhance a grassed waterway	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E412A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E412A_July_2022.pdf</a>
	E484A	Mulching to improve soil health	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E484A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E484A_July_2022.pdf</a>
	E484B	Reduce particulate matter emissions by using orchard or vineyard	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E484B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E484B_July_2022.pdf</a>

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Nitrogen Management	E484C	generated woody materials as mulch Mulching with natural materials in specialty crops for weed control	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E484C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E484C_July_2022.pdf</a>
	E484D	Lowbush Blueberry Mulching for Moisture Management	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E484D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E484D_July_2022.pdf</a>
		Stripcropping (acres)	None Available
		Vegetative Barriers (feet)	None Available
		Herbaceous Wind Barriers (feet)	None Available
	E590A	Nutrient Management (acres)	Improving nutrient uptake efficiency and reducing risk of nutrient losses
			<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E590A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E590A_July_2022.pdf</a>
	E590B		Reduce risks of nutrient loss to surface water by utilizing precision
			<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E590B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E590B_July_2022.pdf</a>
	E590C	agriculture technologies Improving nutrient uptake efficiency and reducing risk of nutrient losses on pasture	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E590C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E590C_July_2022.pdf</a>
Livestock Partnership	E590D	Reduce risks of nutrient losses to surface and groundwater by increasing setback awareness via precision technology	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E590D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E590D_July_2022.pdf</a>
		Composting Facility (number)*	None Available
		Waste Storage Facility (number)*	None Available •
		Used to implement compost bedded-pack Anaerobic Digester (number)	None Available
		Roofs and Covers (number)*	
		• Used to cover a waste	
		None Available	
		man- agement facility to	

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
		capture biogas	
		Feed Management	
		(animal unit)*	
		None Available •	
		Used to reduce	
		enteric	
		methane emissions	
		Waste Separation	
		Facility	
		None	
		Available(number)*	
Grazing and	E314A	Brush Management	E314A
		(acres)*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E314A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E314A_July_2022.pdf</a>
Brush management to			
improve wildlife habitat*			
Pasture		• Used to remove	
		woody	
		invasive vegetation	
		and	
		the removed material	
		will	
		be left onsite.	
	E315A	Herbaceous Weed	E315A
		Treatment	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E315A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E315A_July_2022.pdf</a>
Herbaceous weed			
treatment to create			
desired plant			
communities			
		(acres)*	
consistent with the			
ecological site*		• Used to release	
		desired	
		deep rooted	
		perennial	
		species.	
	E338A	Prescribed Burning	E338A
		(acres)*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E338A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E338A_July_2022.pdf</a>
Strategically planned,			
patch burning for			
grazing distribution and			
wildlife			
habitat*			

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Cropland conversion to grass-based agriculture to reduce soil erosion	E512A	Pasture and Hay Planting	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512A_July_2022.pdf</a>
	E512B	(Acres)	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512B_July_2022.pdf</a>
Forage and biomass planting to reduce soil erosion or increase organic matter to build soil health	E512C		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512C_July_2022.pdf</a>
Cropland conversion to grass for soil organic matter improvement	E512D		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512D_July_2022.pdf</a>
Forage plantings that help increase organic matter in depleted soils	E512I		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512I_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512I_July_2022.pdf</a>
Establish pollinator and/or beneficial insect and/or monarch habitat	E512J		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512J_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512J_July_2022.pdf</a>
Establish wildlife corridors to provide habitat continuity or access to water	E512L		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512L_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512L_July_2022.pdf</a>

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Diversifying forage base with interseeding forbs and legumes to increase pasture quality	E512M	E512M	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E512M_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E512M_July_2022.pdf</a>
Forage plantings that improve wildlife habitat cover and shelter or structure and composition	E528A	Prescribed Grazing (acres) E528A	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528A_July_2022.pdf</a>
Maintaining quantity and quality of forage for animal health and productivity	E528F	E528F	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528F_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528F_July_2022.pdf</a>
Stockpiling cool season forage to improve structure and composition or plant productivity and health	E528G	E528G	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528G_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528G_July_2022.pdf</a>
Improved grazing management on pasture for plant productivity and health with monitoring activities	E528H	E528H	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528H_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528H_July_2022.pdf</a>

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Prescribed grazing to improve/maintain riparian and watershed function-			
elevated water temperature	E528I	E528I	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528I_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528I_July_2022.pdf</a>
Grazing management that protects sensitive areas -surface or ground water			
from nutrients	E528J	E528J	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528J_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528J_July_2022.pdf</a>
Prescribed grazing on pastureland that improves riparian and watershed			
function	E528L	E528L	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528L_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528L_July_2022.pdf</a>
Prescribed grazing that improves or maintains riparian and watershed			
function-erosion	E528M	E528M	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528M_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528M_July_2022.pdf</a>
Grazing management that protects sensitive areas from gully erosion	E528N	E528N	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528N_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528N_July_2022.pdf</a>
Improved grazing management through monitoring activities			

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Clipping mature forages to set back vegetative growth for improved forage quality	E528O	E528O	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528O_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528O_July_2022.pdf</a>
Grazing and Implementing Bale or Swath Grazing to increase organic matter and reduce Pasture nutrients in surface water	E528P Prescribed Grazing (acres)	E528P	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528P_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528P_July_2022.pdf</a>
Management intensive rotational grazing	E528R	E528R	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528R_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528R_July_2022.pdf</a>
Soil Health Improvements on Pasture	E528S	E528S	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528S_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528S_July_2022.pdf</a>
Grazing to Reduce Wildfire Risks on Forests	E528T	E528T	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528T_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528T_July_2022.pdf</a>
Contingency Planning for Resiliency	E528U	E528U	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E528U_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E528U_July_2022.pdf</a>
	E550A Range Planting (acres)	E550A	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E550A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E550A_July_2022.pdf</a>



Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Range planting for increasing/maintaining organic matter	E550B	E550B	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E550B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E550B_July_2022.pdf</a>
Range planting for improving forage, browse, or cover for wildlife			
Agroforestry,	Alley Cropping (acres)		
None Available			
Forestry and	Critical Area Planting (acres)		
Wildlife			
None Available			
Habitat	Forest Farming (acres)		
None Available			
	Windbreaks/Shelterbelt Establishment and		
None Available			
	Renovation (feet)		
	E381A Silvopasture (acres)	E381A	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E381A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E381A_July_2022.pdf</a>
Silvopasture to improve wildlife habitat			
	E383A Fuel Break (acres)*	E383A	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E383A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E383A_July_2022.pdf</a>
Grazing-maintained fuel break to reduce the risk of fire*			
	E384A Woody Residue Treatment	E384A	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E384A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E384A_July_2022.pdf</a>
Biochar production from woody residue*			
	(acres)*		
	E390A Riparian Herbaceous Cover	E390A	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E390A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E390A_July_2022.pdf</a>

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Increase riparian herbaceous cover width for sediment and nutrient reduction	E390B	(acres)	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E390B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E390B_July_2022.pdf</a>
Increase riparian herbaceous cover width to enhance wildlife habitat	E391A	Riparian Forest Buffer (acres)	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E391A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E391A_July_2022.pdf</a>
Increase riparian forest buffer width for sediment and nutrient reduction	E391B		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E391B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E391B_July_2022.pdf</a>
Increase stream shading for stream temperature reduction	E391C		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E391C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E391C_July_2022.pdf</a>
Increase riparian forest buffer width to enhance wildlife habitat	E420A	Wildlife Habitat Planting	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E420A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E420A_July_2022.pdf</a>
Establish pollinator habitat*	E420B	(acres)*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E420B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E420B_July_2022.pdf</a>
Establish monarch butterfly habitat*		Hedgerow Planting (feet)	
None Available			

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Planting for high carbon sequestration rate	E612B	Tree-Shrub Establishment	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E612B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E612B_July_2022.pdf</a>
	(acres) E612C		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E612C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E612C_July_2022.pdf</a>
Establishing tree/shrub species to restore native plant communities	E612G	E612G	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E612G_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E612G_July_2022.pdf</a>
Tree/shrub planting for wildlife food	E643D	Restoration of Rare	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E643D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E643D_July_2022.pdf</a>
Low-tech process-based restoration to enhance floodplain connectivity*		or Declining Natural Communities (ac)*	
		• Used to restore floodplain hydrology	
Maintaining and improving forest soil quality*	E666A	Forest Stand Improvement	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666A_July_2022.pdf</a>
	(acres)* E666D		<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666D_July_2022.pdf</a>
Forest management to enhance understory vegetation*	E666E	E666E	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666E_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666E_July_2022.pdf</a>
Reduce height of the forest understory to limit wildfire risk*			

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
Reduce forest stand density to create open stand structure*	E666F	E666F	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666F_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666F_July_2022.pdf</a>
Mitigation Categories	Conservation Practice Standard Name (practice unit)	Conservation Stewardship Program (CSP) Enhancement Activities	
Agroforestry,	Forest Stand Improvement		
	E666H	Increase on-site carbon storage*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666H_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666H_July_2022.pdf</a>
Forestry and	(acres)*		
	E666I	Crop tree management for mast production*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666I_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666I_July_2022.pdf</a>
Wildlife			
Habitat			
	E666J	Facilitating oak forest regeneration*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666J_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666J_July_2022.pdf</a>
	E666K	Creating structural diversity with patch openings*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666K_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666K_July_2022.pdf</a>
	E666L	Forest Stand Improvement to rehabilitate degraded hardwood stands*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666L_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666L_July_2022.pdf</a>
	E666P	Summer roosting habitat for native forest-dwelling bat species*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666P_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666P_July_2022.pdf</a>
	E666R	Forest songbird habitat maintenance*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666R_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666R_July_2022.pdf</a>

Mitigation.Categories.	CodeConservation.Practice.Standard.Name..practice.unit.	URL
Restoration None Available of Disturbed Lands	E666S Facilitating longleaf pine regeneration and establishment* Land Reclamation, Landslide Treatment (acres) Land Reclamation, Abandoned Mined Land None Available (acres)	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E666S_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E666S_July_2022.pdf</a>
Energy, Combustion, & Electricity	E372A Combustion System Switch to Renewable Power Source Improvement (number) • Used for stationary	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E372A_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E372A_July_2022.pdf</a>
Efficiency	E372B Renewable Energy Source for Large Internal Combustion Engines or mobile engine replacement or repower to electric motor Energy Efficient Agricultural None Available Operation (number)* Irrigation Pipeline (feet)* None Available • Used to reduce energy use Irrigation System, None Available	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E372B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E372B_July_2022.pdf</a>

Mitigation.Categories.	Code	Conservation.Practice.Standard.Name..practice.unit.	URL
		Microirrigation (acres)*	
		<ul style="list-style-type: none"> <li>Used to reduce energy use</li> </ul>	
		Sprinkler System (acres)*	
		None Available	
		<ul style="list-style-type: none"> <li>Used to reduce energy use</li> </ul>	
		Pumping Plant (number)*	
	E533C	Install VFDs on pumps*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E533C_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E533C_July_2022.pdf</a>
		<ul style="list-style-type: none"> <li>Used to reduce energy use</li> </ul>	
	E533D	Switch fuel source for pumps*	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E533D_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E533D_July_2022.pdf</a>
		Energy Efficient Building	
		None AvailableEnvelope (number)*	
		Energy Efficient Lighting	
		None AvailableSystem (number)*	
Wetlands		Wetland Restoration (acres)*	
Rice		None Available Irrigation Water Management	

Mitigation.Categories.	CodeConservation.Practice.Standard.Name..practice.unit.	URL
	E449B Alternated Wetting and Drying (AWD) of rice fields*  (acres)*  • Used as part of an alternated wetting and drying (AWD) system in rice fields	<a href="https://www.nrcs.usda.gov/sites/default/files/2022-11/E449B_July_2022.pdf">https://www.nrcs.usda.gov/sites/default/files/2022-11/E449B_July_2022.pdf</a>

## Merge Data Streams

```
db_merge <- function(x, y){
  cn.x <- colnames(x)
  cn.y <- colnames(y)
  cn.xy <- cn.y[!(cn.y %in% cn.x)]
  xy <- data.frame(array(dim = c(nrow(x), length(cn.xy))))
  xy <- data.frame(x, xy)
  colnames(xy) <- c(colnames(x), cn.xy)
  xy <- xy[,order(colnames(xy))]
  cn.yx <- cn.x[!(cn.x %in% cn.y)]
  yx <- data.frame(array(dim = c(nrow(y), length(cn.yx))))
  yx <- data.frame(y, yx)
  colnames(yx) <- c(colnames(y), cn.yx)
  yx <- yx[,order(colnames(yx))]
  out <- rbind(xy, yx)
  return(out)
}

db.og <- as.data.frame(read_sheet("https://docs.google.com/spreadsheets/d/1AMlsLPDnwt01eEsBLdRe1hvhNSa3..."))

## v Reading from "Climate Smart Agriculture Resource Database".
## v Range "'Original'".
db.jh <- as.data.frame(read_sheet("https://docs.google.com/spreadsheets/d/1AMlsLPDnwt01eEsBLdRe1hvhNSa3..."))

## v Reading from "Climate Smart Agriculture Resource Database".
## v Range "'Jackson's Version'".
db.mg <- db_merge(db.og, db.jh) %>%
  distinct

colnames(db.og)[colnames(db.og) == "Resources (Links)"] <- "Resource"
colnames(nrc.tab)[colnames(nrc.tab) == "Sub-Category 1"] <- "Sub-Category"
```

```

db.csa <- db_merge(db.og, nrc.tab)

gs4_auth("mklau3@hawaii.edu")
sheet_name <- "https://docs.google.com/spreadsheets/d/1AMlsLPDnwt01eEsBLdRe1hvhNSa3ofndcWX0gJ9xbUo/"
new_sheet <- TRUE # Set to TRUE if you want to create a new sheet, FALSE otherwise

# Write data frame to Google Sheet
if (new_sheet) {
  # Create a new Google Sheet
  gs4_create(sheet_name, sheets = list(data_frame_name = db.csa))
} else {
  # Specify an existing Google Sheet
  sheet_id <- "your_sheet_id" # Replace with the ID of your existing Google Sheet
  gs4_get(sheet_id) %>% gs4_write(db.csa, sheet = "Sheet1")
}

## v Creating new Sheet: "https://docs.google.com/spreadsheets/d/1AMlsLPDnwt01eEsBLdRe1hvhNSa3ofndcWX0g

```

## Web-hosted Database Interface

### Workflow

- Generate database with known units
- Create webapp using **shiny**
- Deploy to <https://uhwo.shinyapps.io/hicsatool/> using **rsconnect** and shiny.io
- Test using TavisCI
- Issues go to <https://github.com/ecoFw/hi-csa-es/issues>

```
runApp()
```