Zambia Individual Bids

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**1. Load the packages**

library(rmarkdown)  
library(tidyr)  
library(dplyr)  
library(ggplot2)  
library(readr)  
library(gridExtra)  
library(scales)  
library(openxlsx)

**2. Set working directory and load the data**

setwd ("C:/Users/wwainwright/Documents/R/Zambia\_Analysis")  
Zambia <- read.csv("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/LPOutput\_IndividualNEW4.csv")  
attach(Zambia)

**3. Aggregate the data for summary stats**

# GMA / non-GMA sites   
aggregate(Zambia[, 10:20], list(Zambia$GMA), mean)   
  
# Ecoregion 1 / Ecoregion 2  
aggregate(Zambia[, 10:20], list(Zambia$Ecoregion1), mean)   
  
# Male / Female  
aggregate(Zambia[, 10:20], list(Zambia$Male), mean)

**4. Subset data into GMA and non-GMA / Ecoregion 1 and Ecoregion 2**

GMA <- Zambia[Zambia$GMA == "1" ,]  
nonGMA <- Zambia[Zambia$GMA == "0" ,]  
  
Eco1 <- Zambia[Zambia$ECOREGION == "1" ,]  
Eco2 <- Zambia[Zambia$ECOREGION == "2" ,]

**5. Makes all the 0 values in data sheet be N/A**

Zambia[Zambia==0]<-NA  
GMA[GMA==0]<-NA  
nonGMA[nonGMA==0]<-NA  
Eco1[Eco1==0]<-NA  
Eco2[Eco2==0]<-NA

**6. Bar Plot of farmer bids (cost per hectare) for GMA sites**

(wbar1 <- ggplot(GMA, aes(x = reorder(RESPONDENT, USDHA), y = USDHA)) + geom\_bar(position = position\_dodge(width = 0.1),   
 width = 0.15, stat = "identity", colour = "black", fill = "#00868B") + geom\_smooth(method = "loess",   
 se = TRUE, color = "blue", aes(group = 1)) + ylab("Cost per hectare (USD)") +   
 xlab("Farmer bid offer GMA sites") + theme(panel.border = element\_blank(),   
 panel.background = element\_blank(), axis.text.x = element\_blank(), axis.ticks.x = element\_blank(),   
 panel.grid.minor = element\_line(size = 0.1, linetype = "solid", colour = "black")))

**7. Bar Plot of farmer bids (cost per hectare) for non-GMA sites**

(wbar2 <- ggplot(nonGMA, aes(x = reorder(RESPONDENT, USDHA), y = USDHA)) + geom\_bar(position = position\_dodge(width = 0.1),   
 width = 0.15, stat = "identity", colour = "black", fill = "#00868B") + geom\_smooth(method = "loess",   
 se = TRUE, color = "blue", aes(group = 1)) + ylab("Cost per hectare (USD)") +   
 xlab("Farmer bid offer non-GMA sites") + theme(panel.border = element\_blank(),   
 panel.background = element\_blank(), axis.text.x = element\_blank(), axis.ticks.x = element\_blank(),   
 panel.grid.minor = element\_line(size = 0.1, linetype = "solid", colour = "black")))

**8. Aesthetics for the plots**

# Arrange the plots into a panel  
limits <- c(0, 1500)  
breaks <- seq(limits[1], limits[2], by = 100)  
  
# Set a common axis  
wbar1.common.y <- wbar1 + scale\_y\_continuous(limits = limits, breaks = breaks)  
wbar2.common.y <- wbar2 + scale\_y\_continuous(limits = limits, breaks = breaks)  
  
# build the plots  
wbar1.common.y <- ggplot\_gtable(ggplot\_build(wbar1.common.y))  
wbar2.common.y <- ggplot\_gtable(ggplot\_build(wbar2.common.y))  
  
# copy the plot height from p1 to p2  
wbar1.common.y$heights <- wbar2.common.y$heights  
  
# Display  
grid.arrange(wbar1.common.y, wbar2.common.y, ncol = 2, widths = c(11, 9))

**9. Boxplot of selected farmer bids (US/ha) for the different selection goals**

# Turn your 'treatment' column into a character vector  
Zambia$Objective <- as.character(Zambia$Objective)  
# Then turn it back into an ordered factor  
Zambia$Objective <- factor(Zambia$Objective, levels = unique(Zambia$Objective))  
  
# Order the Budget scenarios Turn your 'treatment' column into a character  
# vector  
Zambia$Model <- as.character(Zambia$Model)  
# Then turn it back into an ordered factor  
Zambia$Model <- factor(Zambia$Model, levels = unique(Zambia$Model))  
  
# Order the Ecoregions Turn your 'treatment' column into a character vector  
Zambia$Ecoregion <- as.character(Zambia$Ecoregion)  
# Then turn it back into an ordered factor  
Zambia$Ecoregion <- factor(Zambia$Ecoregion, levels = unique(Zambia$Ecoregion))  
  
# PLot the box plot  
(box2 <- ggplot(Zambia, aes(Objective, PriceHa)) + geom\_boxplot(aes(fill = Ecoregion),   
 notch = FALSE) + ylab("Total cost per hectare (USD))") + xlab("Objective Function") +   
 guides(fill = guide\_legend(title = "Ecoregion")) + theme(axis.text.x = element\_text(size = 11,   
 angle = 90, vjust = 1, hjust = 1), axis.line = element\_line(color = "black",   
 size = 0.1), panel.background = element\_blank()))  
  
box2 + theme(legend.position = "top", legend.text = element\_text(size = 12))

**10. Creating categorical variables and calculating means of categories**

# Creating factors with different levels from continuous variables, with  
# right-closed=FALSE. Scale is based on best-worst scoring (i.e. 5=good and  
# 1=bad).  
  
# For area  
AreaIF <- cut(Zambia$Area, breaks = c(0, 0.5, 1, 1.5, 2, 2.5, 3, 100), labels = c("1",   
 "2", "3", "4", "5", "6", "7"), right = FALSE)  
AreaIF[1:50]  
  
# For plots  
PlotIF <- cut(Zambia$Plots, breaks = c(0, 1, 2, 3, 4, 5, 6, 100), labels = c("1",   
 "2", "3", "4", "5", "6", "7"), right = FALSE)  
PlotIF[1:50]  
  
# For PriceHa  
PriceHaIF <- cut(Zambia$PriceHa, breaks = c(0, 25, 35, 45, 55, 65, 75, Inf),   
 labels = c("7", "6", "5", "4", "3", "2", "1"), right = FALSE)  
PriceHaIF[1:50]  
  
# For Age  
AgeIF <- cut(Zambia$Age, breaks = c(0, 25, 30, 35, 40, 45, 50, 100), labels = c("7",   
 "6", "5", "4", "3", "2", "1"), right = FALSE)  
AgeIF[1:50]  
  
# For Farmsize  
FarmsizeIF <- cut(Zambia$FarmSize, breaks = c(0, 2, 3, 4, 5, 6, 7, 100), labels = c("7",   
 "6", "5", "4", "3", "2", "1"), right = FALSE)  
FarmsizeIF[1:50]  
  
# For CWR species richness  
RichnessIF <- cut(Zambia$Richness, breaks = c(0, 1, 2, 3, 4, 5, 6, 100), labels = c("1",   
 "2", "3", "4", "5", "6", "7"), right = FALSE)  
RichnessIF[1:50]  
  
  
# Convert FACTOR to a NUMERIC factor  
AgeIF = as.numeric(AgeIF)  
is.numeric(AgeIF)  
  
AreaIF = as.numeric(AreaIF)  
is.numeric(AreaIF)  
  
PlotIF = as.numeric(PlotIF)  
is.numeric(PlotIF)  
  
PriceHaIF = as.numeric(PriceHaIF)  
is.numeric(PriceHaIF)  
  
FarmsizeIF = as.numeric(FarmsizeIF)  
is.numeric(FarmsizeIF)  
  
RichnessIF = as.numeric(RichnessIF)  
is.numeric(RichnessIF)  
  
# Summary stats on the NUMERIC fator  
summary(AgeIF)  
hist(AgeIF)  
  
summary(AreaIF)  
hist(AreaIF)  
  
summary(PlotIF)  
hist(PlotIF)  
  
summary(PriceHaIF)  
hist(PriceHaIF)  
  
hist(FarmsizeIF)  
  
summary(RichnessIF)  
hist(RichnessIF)  
  
# Calculate the means of the factors subject to each model and corrisponding  
# objective function  
G <- aggregate(cbind(AgeIF, AreaIF, PlotIF, PriceHaIF, FarmsizeIF, RichnessIF) ~   
 Zambia$Objective, FUN = mean)  
K <- aggregate(cbind(Zambia$YoungFarmer, Zambia$LargePlot, Zambia$Female, Zambia$GMA,   
 Zambia$SmallFarms, Zambia$Ecoregion1) ~ Zambia$Objective, FUN = sum)  
  
# Write the object 'G' and 'K' to a .csv file  
setwd("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/RadarChart/NEW")  
write.xlsx(G, file = "RadarMean.csv")  
write.csv(K, file = "RadarSum.csv")

**11. Create radar Plots for the four different selection goals**

# Load in the data. The spreadsheets are different data matrices for the models.  
BASIC<- read.csv("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/RadarChart/NEW/BASIC.csv")  
Area <- read.csv("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/RadarChart/NEW/AREA.csv")  
Div <- read.csv("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/RadarChart/NEW/DIVERSITY.csv")  
Equ <- read.csv("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/RadarChart/NEW/EQUITABILITY.csv")  
  
# To arrange all the plots into a planel with 2 rows and 2 column  
op <- par(  
 oma=c(0,0,0,0), # Room for the title and legend  
 mar=c(3,3,3,3),  
 mfrow=c(1,2)  
)  
  
# Plot 1: Basic model plot  
colors\_border=c( rgb(0.2,0.5,0.5,0.9), rgb(0.8,0.2,0.5,0.9) , rgb(0.7,0.5,0.1,0.9) )  
colors\_in=c( rgb(0.2,0.5,0.5,0.4), rgb(0.8,0.2,0.5,0.4) , rgb(0.7,0.5,0.1,0.4) )  
radarchart( BASIC , axistype=1 ,   
 #custom polygon  
 pcol=colors\_border , pfcol=colors\_in , plwd=4 , plty=1,  
 #custom the grid  
 cglcol="black", cglty=1, axislabcol="black", caxislabels=seq(0,100,25), cglwd=1.0,   
 # Title for the chart   
 title="A) Untargeted goal", line = 1,  
 #custom labels  
 vlcex=1,   
 vlabels=c("Young\nFarmers", "Larger\nPlots",  
 "Female\nFarmers", "GMA\nSites", "CWR\nVerified", "Commu-\nnities"))   
  
# Plot 2: Area model plot  
colors\_border=c( rgb(0.2,0.5,0.5,0.9), rgb(0.8,0.2,0.5,0.9) , rgb(0.7,0.5,0.1,0.9) )  
colors\_in=c( rgb(0.2,0.5,0.5,0.4), rgb(0.8,0.2,0.5,0.4) , rgb(0.7,0.5,0.1,0.4) )  
radarchart( Area , axistype=1 ,   
 #custom polygon  
 pcol=colors\_border , pfcol=colors\_in , plwd=4 , plty=1,  
 #custom the grid  
 cglcol="black", cglty=1, axislabcol="black", caxislabels=seq(0,100,25), cglwd=1.0,   
 # Title for the chart   
 title="B) Targeted goal", line = 1,  
 #custom labels  
 vlcex=1,   
 vlabels=c("Young\nFarmers", "Larger\nPlots",  
 "Female\nFarmers", "GMA\nSites", "CWR\nVerified", "Commu-\nnities"))  
  
# Plot 3: Diversity model plot   
colors\_border=c( rgb(0.2,0.5,0.5,0.9), rgb(0.8,0.2,0.5,0.9) , rgb(0.7,0.5,0.1,0.9) )  
colors\_in1=c( rgb(0.2,0.5,0.5,0.4), rgb(0.8,0.2,0.5,0.4) , rgb(0.7,0.5,0.1,0.4) )  
radarchart( Div , axistype=1 ,   
 #custom polygon  
 pcol=colors\_border , pfcol=colors\_in , plwd=4 , plty=1,  
 #custom the grid  
 cglcol="black", cglty=1, axislabcol="black", caxislabels=seq(0,100,25), cglwd=0.8,  
 # Title for the chart   
 title="C) Diversity goal", line = 1,  
 #custom labels  
 vlcex=1,   
 vlabels=c("Young\nFarmers", "Larger\nPlots",  
 "Female\nFarmers", "GMA\nSites", "CWR\nVerified", "Commu-\nnities"))   
  
# Plot 4: Equitability model plot   
colors\_border=c( rgb(0.2,0.5,0.5,0.9), rgb(0.8,0.2,0.5,0.9) , rgb(0.7,0.5,0.1,0.9) )  
colors\_in=c( rgb(0.2,0.5,0.5,0.4), rgb(0.8,0.2,0.5,0.4) , rgb(0.7,0.5,0.1,0.4) )  
radarchart( Equ , axistype=1 ,   
 #custom polygon  
 pcol=colors\_border , pfcol=colors\_in , plwd=4 , plty=1,  
 #custom the grid  
 cglcol="black", cglty=1, axislabcol="black", caxislabels=seq(0,100,25), cglwd=0.8,  
 # Title for the chart   
 title="D) Equity goal",line = 1,  
 #custom labels  
 vlcex=1,   
 vlabels=c("Young\nFarmers", "Larger\nPlots",  
 "Female\nFarmers", "GMA\nSites", "CWR\nVerified", "Commu-\nnities"))

**12. Plotting a panel of charts based on different variables and selection goals**

# Load in the data file  
Zambia <- read.csv("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/LPOutput\_IndividualNEW2.csv")  
  
# Ordered box plot of selected farmer bids (US/ha) for the different selection goals   
  
# Order the Objective functions   
  
#Turn your 'treatment' column into a character vector  
Zambia$Objective <- as.character(Zambia$Objective)  
#Then turn it back into an ordered factor  
Zambia$Objective <- factor(Zambia$Objective, levels=unique(Zambia$Objective))  
  
# Order the Ecoregions scenarios   
#Turn your 'treatment' column into a character vector  
Zambia$Ecoregion <- as.character(Zambia$Ecoregion)  
#Then turn it back into an ordered factor  
Zambia$Ecoregion <- factor(Zambia$Ecoregion, levels=unique(Zambia$Ecoregion))  
  
# PLot the box plot  
(box2 <- ggplot (Zambia, aes(Objective, PriceHa)) + geom\_boxplot(aes(fill=Ecoregion), notch=FALSE)+   
 ylab("Total cost per hectare (USD))") +   
 xlab("Objective Function") +  
 ggtitle("A) Cost per hectare from farms selected for conservation services")+   
 guides(fill=guide\_legend(title="Ecoregion"))+  
 theme(  
 axis.text.x=element\_text(size=11, angle=0, vjust=0.5, hjust=0.5),  
 axis.line = element\_line(color="black", size = 0.1),  
 panel.background = element\_blank(),  
 legend.position = c(.02, .98),  
 legend.justification = c("left", "top"),  
 legend.box.just = "left",  
 legend.margin = margin(6, 6, 6, 6)))  
  
# Plot a line chart based on average farm size  
  
# Creating an object called x, based on x variables, and then plotting in a model, ordered by Farm Size  
x = Zambia %>%  
 select(ID, Objective, FarmSize)  
  
# Plotting the point graph based on X  
p <- x %>%   
 mutate(ID=reorder(ID, FarmSize)) %>%   
 ggplot(aes(ID, FarmSize, colour=Objective, group=1)) +  
 geom\_point() +  
 labs(x="Farmer", y="Farm size (ha)")+   
 ggtitle("B) Size of farms selected for conservation services")+   
 scale\_y\_log10() + # This is to plot using the log of the data  
 facet\_wrap(~Objective) +  
 theme(  
 axis.text.x=element\_blank(),  
 axis.ticks.x=element\_blank(),   
 axis.line = element\_line(colour = "black"),  
 panel.background = element\_blank(),  
 legend.position="none")  
p  
  
# Plotting the age of farmers and price per ha (bar plot)   
  
v = Zambia %>%  
 select(ID, Objective, FarmSize, PriceHa, Age, Bidoffer, Averagesizeplot, PricePlot, Area, Plots)  
  
# Plotting the point graph based on v  
 mutate(v$Age=reorder(v$Age, v$PriceHa)) %>%   
  
 u <- ggplot(v, aes(Age, PriceHa), y=PriceHa) +  
 geom\_bar(position=position\_dodge(width=0.1), width = 0.15, stat="identity", colour=Zambia$Objective, fill="#00868B") +  
 geom\_smooth(method = "glm", se=FALSE, color="blue", aes(group=1)) +  
 ggtitle("C) Cost per hectare and age of farmers selected for conservation services")+   
 ylab("Price per hectare (USD)") +  
 xlab("Age") +  
 facet\_wrap(~Objective) +  
 theme(  
 panel.background = element\_blank(),  
 axis.line = element\_line(colour = "black"),  
 legend.position="bottom", legend.direction="horizontal",  
 legend.title = element\_blank())  
u  
  
# Plot a line chart based on total area (Y) and total plots (x)  
  
# Creating an object called k, based on k variables, and then plotting in a model, ordered by Farm Size  
k = Zambia %>%  
 select(ID, Objective, FarmSize, Area, Plots)  
  
# Plotting the point graph based on X  
g <- k %>%   
 #filter(Model=="Medium") %>%   
 mutate(ID=reorder(Area, Plots)) %>%   
 ggplot(aes(Plots, Area, colour=Objective, group=1)) +  
 geom\_point() +  
 geom\_smooth(method = "glm", se=FALSE, color="blue", aes(group=1)) +  
 labs(x="Area (Ha)", y="Plots")+   
 ggtitle("D) Area and plots selected for conservation services")+   
 facet\_wrap(~Objective) +  
 theme(panel.background = element\_blank(),  
 axis.line = element\_line(colour = "black"),  
 legend.position="none")  
g  
  
# Arrange the plots (box2, p, u and g) into a grid   
blank<-rectGrob(gp=gpar(col="white")) # Create a blank plot to use as a space  
grid.arrange(box2, p, blank, blank, u, g, heights=c(0.475, 0.05, 0.475), nrow=3) # plot with the blank space

**13. Line Plot of CWR occurance at selected sites**

# Read in the data   
Zam <- read.csv("C:/Users/wwainwright/Documents/R/Zambia\_Analysis/LPOutput/Individual/Data/CWR/CPT2.csv")  
  
# Inspecting the data frame   
dim(Zam)  
lapply(Zam, class)  
str(Zam)  
  
# Check the variables are factors with different levels   
Zam$Model  
   
# Plot a line chart with different colours for each Model   
P <- ggplot(Zam, aes(x=CWR, y=Count, group=Model)) +  
 #facet\_wrap(~Zam$Objective)+  
 geom\_line(linetype="dashed", size=1.3, aes(color=Model))+  
 geom\_point(aes(color=Model))+  
 ylab("Number of sites selected inhabited by CWR species\n") +  
 xlab("\nCWR Species") +  
 theme(  
 axis.text.x=element\_text(face= c('italic', 'bold.italic', 'italic', 'italic',  
 'bold.italic', 'italic', 'italic', 'italic',   
 'bold.italic', 'bold.italic'), # Makes some of the labels italic, others bold and italic  
 size=12, angle=50, vjust=0.5, hjust=0.5),  
 axis.line = element\_line(color="black", size = 0.1),  
 axis.title=element\_text(size=12),  
 panel.border = element\_blank(),  
 panel.background = element\_blank())  
P  
  
# Puts the legend on the top and increases the size  
P + theme(legend.position="top", legend.text=element\_text(size=12)) +  
 # Takes the plot and changes the axis lables from original to modification  
 scale\_x\_discrete(labels=c("EchinochloaC" = "(1) Echinochloa.C", "EleusineC" = "(2) Eleusine.C"  
 , "EleusineI" = "(3) Eleusine.I", "OryzaL" = "(4) Oryza.L", "PennisetumP" = "(5) Pennisetum.P"  
 , "PennisetumP2" = "(6) Pennisetum.P(2)", "SolanumI" = "(7) Solanum.I",   
 "SorghumB" = "(8) Sorghum.B", "VignaJ" = "(9) Vigna.J", "VignaU" = "(10) Vigna.U"))