Vital Signs Rwanda - Descriptives Master Sheet

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##Data Wrangling

#load libraries  
library(tidyverse)

## ── Attaching packages ──────────────────────────────── tidyverse 1.2.1 ──

## ✔ ggplot2 3.1.0 ✔ purrr 0.3.2   
## ✔ tibble 2.0.1 ✔ dplyr 0.8.0.1  
## ✔ tidyr 0.8.3 ✔ stringr 1.4.0   
## ✔ readr 1.3.1 ✔ forcats 0.2.0

## Warning: package 'ggplot2' was built under R version 3.4.4

## Warning: package 'tidyr' was built under R version 3.4.4

## Warning: package 'readr' was built under R version 3.4.4

## Warning: package 'dplyr' was built under R version 3.4.4

## Warning: package 'stringr' was built under R version 3.4.4

## ── Conflicts ─────────────────────────────────── tidyverse\_conflicts() ──  
## ✖ dplyr::filter() masks stats::filter()  
## ✖ dplyr::lag() masks stats::lag()

library(dplyr)  
library(readr)  
library(ggplot2)  
library(broom)  
library(purrr)  
library(readr)  
library(RColorBrewer)  
library(coefplot)

## Warning: package 'coefplot' was built under R version 3.4.3

library(wesanderson)  
  
#load data  
fieldcrop <- read\_csv(url("https://vitalsigns-website-downloads.s3.amazonaws.com/tables/household\_field\_season\_fieldcrop.csv"))

## Parsed with column specification:  
## cols(  
## .default = col\_character(),  
## round = col\_double(),  
## latitude = col\_double(),  
## longitude = col\_double(),  
## ag\_date\_of\_interview = col\_date(format = ""),  
## ag4a\_01 = col\_logical(),  
## ag4a\_04 = col\_logical(),  
## ag4a\_5a = col\_date(format = ""),  
## ag4a\_06 = col\_logical(),  
## ag4a\_08 = col\_double(),  
## ag4a\_15 = col\_double(),  
## ag4a\_16 = col\_double(),  
## ag4a\_19 = col\_logical(),  
## ag4a\_21 = col\_double()  
## )

## See spec(...) for full column specifications.

hh\_fieldcrop <- read\_csv(url("https://vitalsigns-website-downloads.s3.amazonaws.com/tables/household\_fieldcrop.csv"))

## Parsed with column specification:  
## cols(  
## .default = col\_character(),  
## round = col\_double(),  
## latitude = col\_double(),  
## longitude = col\_double(),  
## ag\_date\_of\_interview = col\_date(format = ""),  
## ag5a\_01 = col\_logical(),  
## ag5a\_02\_1 = col\_double(),  
## ag5a\_03 = col\_double(),  
## ag5a\_12\_1 = col\_date(format = ""),  
## ag5a\_20 = col\_logical(),  
## ag5a\_22 = col\_double(),  
## ag5a\_25 = col\_double(),  
## ag5a\_26 = col\_double()  
## )  
## See spec(...) for full column specifications.

field\_season <- read\_csv(url("https://vitalsigns-website-downloads.s3.amazonaws.com/tables/household\_field\_season.csv"))

## Parsed with column specification:  
## cols(  
## .default = col\_logical(),  
## id = col\_character(),  
## parent\_id = col\_character(),  
## country = col\_character(),  
## landscape\_no = col\_character(),  
## hh\_refno = col\_character(),  
## round = col\_double(),  
## field\_no = col\_character(),  
## season = col\_character(),  
## latitude = col\_double(),  
## longitude = col\_double(),  
## ag\_date\_of\_interview = col\_date(format = ""),  
## ag3a\_03 = col\_character(),  
## ag3a\_07\_1 = col\_character(),  
## ag3a\_10 = col\_character(),  
## ag3a\_15\_1 = col\_character(),  
## ag3a\_15\_2 = col\_character(),  
## ag3a\_23 = col\_double(),  
## ag3a\_24 = col\_character(),  
## ag3a\_28 = col\_character(),  
## ag3a\_34 = col\_character()  
## # ... with 32 more columns  
## )  
## See spec(...) for full column specifications.

## Warning: 99 parsing failures.  
## row col expected actual file  
## 1116 ag3a\_18 1/0/T/F/TRUE/FALSE Bucket / Watering Can <connection>  
## 1116 ag3a\_20 1/0/T/F/TRUE/FALSE Well <connection>  
## 1116 ag31\_13 1/0/T/F/TRUE/FALSE 36 <connection>  
## 2416 ag3a\_18 1/0/T/F/TRUE/FALSE Bucket / Watering Can <connection>  
## 2416 ag3a\_20 1/0/T/F/TRUE/FALSE Well <connection>  
## .... ....... .................. ..................... ............  
## See problems(...) for more details.

hh\_indiv <- read\_csv(url("https://vitalsigns-website-downloads.s3.amazonaws.com/tables/household\_individual.csv"))

## Parsed with column specification:  
## cols(  
## .default = col\_character(),  
## round = col\_double(),  
## latitude = col\_double(),  
## longitude = col\_double(),  
## ag\_date\_of\_interview = col\_date(format = ""),  
## ag\_indid\_age = col\_double(),  
## ag\_indid\_respondent = col\_logical(),  
## hh\_b03 = col\_date(format = ""),  
## hh\_b04 = col\_double(),  
## hh\_b07 = col\_logical(),  
## hh\_b08 = col\_double(),  
## hh\_c01 = col\_logical(),  
## hh\_c03 = col\_logical(),  
## hh\_e04 = col\_logical(),  
## hh\_e08 = col\_logical(),  
## hh\_e22\_1 = col\_double(),  
## hh\_e23 = col\_logical(),  
## hh\_e24\_1 = col\_double(),  
## hh\_e25 = col\_double(),  
## hh\_e26 = col\_double(),  
## hh\_e27 = col\_double()  
## # ... with 15 more columns  
## )  
## See spec(...) for full column specifications.

#View(household\_field\_season\_fieldcrop)

#Filter fieldcrop, treat factors as factors and numeric as numeric  
fieldcrop <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15 != "na")  
fieldcrop$ag4a\_08 <- as.numeric(fieldcrop$ag4a\_08)  
fieldcrop$ag4a\_15 <- as.numeric(fieldcrop$ag4a\_15)  
fieldcrop$ag4a\_15\_unit <- as.factor(fieldcrop$ag4a\_15\_unit)  
fieldcrop$crop\_name <- as.factor(fieldcrop$crop\_name)  
fieldcrop$ag4a\_15\_unit[which(fieldcrop$ag4a\_15\_unit=="Liter")] <- "Kg" #because this is a misentry  
fieldcrop <- filter(fieldcrop, ag4a\_15\_unit == "Kg")  
  
#fix crop name mismatches  
fieldcrop$crop\_name[which(fieldcrop$crop\_name=="Irish potatoes")] <- "Irish Potatoes"  
fieldcrop$crop\_name[which(fieldcrop$crop\_name=="Blood fruit")] <- "Blood Fruit"   
hh\_fieldcrop$ag5a\_21[which(hh\_fieldcrop$ag5a\_21=="Mammals (Rodent)")] <- "Rodents"  
  
#Filter field\_season, treat factors as factors and numeric as numeric  
field\_season <- filter(field\_season, country == 'RWA', ag3a\_03 == 'Cultivated' )  
field\_season$ag3a\_39 <- as.factor(field\_season$ag3a\_39)  
field\_season$ag3a\_39a <- as.factor(field\_season$ag3a\_39a)  
field\_season$ag3a\_39a\_other <- as.factor(field\_season$ag3a\_39a\_other)  
field\_season$ag3a\_40 <- as.numeric(field\_season$ag3a\_40)  
field\_season$ag3a\_45 <- as.factor(field\_season$ag3a\_45)  
field\_season$ag3a\_47 <- as.factor(field\_season$ag3a\_47)  
  
#fix crop name mismatch  
field\_season$ag3a\_07\_1[which(field\_season$ag3a\_07\_1=="Irish potatoes")] <- "Irish Potatoes"  
field\_season$ag3a\_07\_1[which(field\_season$ag3a\_07\_1=="Blood fruit")] <- "Blood Fruit"  
  
#fset landscape # as factor in household survey data  
hh\_fieldcrop$landscape\_no <- as.factor(hh\_fieldcrop$landscape\_no)  
  
#Join fieldcrop and field\_season dataframes  
joined\_df <- inner\_join(field\_season, fieldcrop, by =c("id"= "parent\_id", 'round', "landscape\_no", "country", "field\_no", "hh\_refno", "season"))  
  
#Add columns for yield  
joined\_df <- mutate(joined\_df, kg\_peracre = ag4a\_15/ag4a\_08)  
joined\_df <- mutate(joined\_df, kg\_perha = kg\_peracre\*(1/.404686))  
  
#per acre planted   
joined\_df$ag4a\_02[which(joined\_df$ag4a\_02=="1/4")] <- .25  
joined\_df$ag4a\_02[which(joined\_df$ag4a\_02=="1/2")] <- .5  
joined\_df$ag4a\_02[which(joined\_df$ag4a\_02=="3/4")] <- .75  
joined\_df$ag4a\_02[which(joined\_df$ag4a\_02=="Almost All")] <- 1  
joined\_df$ag3a\_40 <- as.numeric(joined\_df$ag3a\_40)  
joined\_df$ag3a\_47 <- as.numeric(joined\_df$ag3a\_47)  
joined\_df$ag4a\_02 <- as.numeric(joined\_df$ag4a\_02)  
joined\_df$round <- as.factor(joined\_df$round)  
  
joined\_df <- mutate(joined\_df, kg\_peracre\_planted = case\_when(ag4a\_01 == TRUE ~ kg\_peracre, ag4a\_01 == FALSE ~ ag4a\_15/(ag4a\_08\*ag4a\_02))) %>%   
 mutate(kg\_perha\_planted = kg\_peracre\_planted \*(1/.404686))  
  
#value per hectare planted   
joined\_df <- filter(joined\_df, kg\_perha\_planted != Inf) %>%   
 mutate(value\_peracre = ag4a\_16/ag4a\_08) %>%   
 mutate(value\_perha = value\_peracre\*(1/.404686)) %>%   
 mutate(value\_peracre\_planted = case\_when(ag4a\_01 == TRUE ~ value\_peracre, ag4a\_01 == FALSE ~ ag4a\_16/ag4a\_08\*ag4a\_02)) %>%   
 mutate(value\_perha\_planted = value\_peracre\_planted \*(1/.404686))  
  
  
#Add column for pesticide kg per hectare planted  
joined\_df <-mutate(joined\_df, pesticide\_use\_kg = ifelse(ag3a\_60\_2 == "Millilitre", ag3a\_60\_1\*0.001, ag3a\_60\_1)) %>%   
 mutate(pesticide\_use\_kg = case\_when(ag3a\_58 == TRUE ~ pesticide\_use\_kg, ag3a\_58 == FALSE ~ 0)) %>%   
 mutate(pest\_peracre = pesticide\_use\_kg/ag4a\_08) %>%   
 mutate(pest\_perha = pest\_peracre\*(1/.404686)) %>%   
 mutate(pest\_peracre\_planted = case\_when(ag4a\_01 == TRUE ~ pest\_peracre, ag4a\_01 == FALSE ~ pest\_peracre/ag4a\_02)) %>%   
 mutate(pest\_perha\_planted = pest\_peracre\_planted \*(1/.404686))  
  
#Add column for inorg fert kg per hectare planted  
joined\_df <- mutate(joined\_df, inorg\_peracre = ag3a\_47/ag4a\_08) %>%   
 mutate(inorg\_perha = inorg\_peracre\*(1/.404686)) %>%   
 mutate(inorg\_perha\_planted = case\_when(ag4a\_01 == TRUE ~ inorg\_perha, ag4a\_01 == FALSE ~ inorg\_perha/ag4a\_02)) %>%   
 mutate(inorg\_perha\_planted = case\_when(ag3a\_45 ==TRUE ~ inorg\_perha\_planted, ag3a\_45 == FALSE ~ 0 ))  
  
#Add column for org fert kg per hectare planted  
joined\_df <- mutate(joined\_df, org\_peracre = ag3a\_40/ag4a\_08) %>%   
 mutate(org\_perha = org\_peracre\*(1/.404686)) %>%  
 mutate(org\_perha\_planted = case\_when(ag4a\_01 == TRUE ~ org\_peracre, ag4a\_01 == FALSE ~ org\_perha/ag4a\_02)) %>%   
 mutate(org\_perha\_planted = case\_when(ag3a\_39 ==TRUE ~ org\_perha\_planted, ag3a\_39 == FALSE ~ 0 ))  
  
# Create df for each round  
round\_1 <- filter(joined\_df, round == "1")  
round\_2 <- filter(joined\_df, round == "2")  
  
# Rename landscape levels  
# joined\_df\_L <- joined\_df  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L01")] <- "1"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L02")] <- "2"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L03")] <- "3"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L04")] <- "4"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L06")] <- "6"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L07")] <- "7"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L08")] <- "8"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L10")] <- "10"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L11")] <- "11"  
# joined\_df\_L$landscape\_no[which(joined\_df\_L$landscape\_no=="L12")] <- "12"  
  
  
#View(joined\_df)  
#levels(joined\_df$landscape\_no)

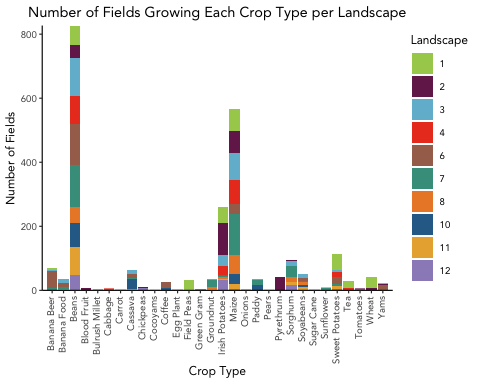
###Set style

theme\_vsr <- function () {   
 theme\_classic(base\_size=9, base\_family="Avenir")+  
 theme(plot.title = element\_text(face="bold"), legend.title = element\_text(face="bold"))  
}

##2. Descriptives

###Crops grown across landscape

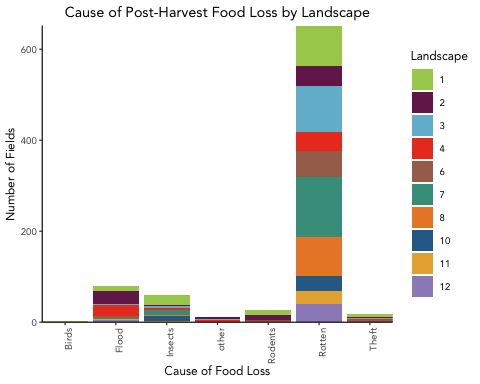
A\_crops\_grown <- ggplot(filter(joined\_df, crop\_name != "NA"), aes(x= crop\_name, fill=factor(landscape\_no)))+  
 geom\_bar(stat = "count", position = 'stack')+  
 theme\_vsr()+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1, vjust = 0.3), plot.title = element\_text(hjust = 0.5))+  
 xlab ("Crop Type")+  
 ylab("Number of Fields")+  
 ggtitle("Number of Fields Growing Each Crop Type per Landscape")+  
 scale\_fill\_manual(name="Landscape", labels=c("1", "2", "3", "4", "6", "7", "8", "10", "11", "12"), values = c("#a6cd5b", "#752559", "#72bad3", "#eb4024", "#a66f5b", "#449d8b", "#eb8932", "#2c6b96", "#e8af3c", "#9c8dc3"))+  
 scale\_x\_discrete(expand=c(0.03,0))+  
 scale\_y\_continuous(expand=c(0,0))  
  
A\_crops\_grown



ggsave("A\_crops\_grown.png", plot = A\_crops\_grown, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 6, height = 4.5, units = c("in"),  
 dpi = 300)

###Cause of Post-Harvest Food Loss

A\_food\_loss <-   
 ggplot(filter(hh\_fieldcrop, ag5a\_21 != "NA", country == 'RWA'), aes(x= ag5a\_21, fill=factor(landscape\_no)))+  
 geom\_bar(stat = "count", position = 'stack')+  
 theme\_vsr()+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5))+  
 xlab ("Cause of Food Loss")+  
 ylab("Number of Fields")+  
 ggtitle("Cause of Post-Harvest Food Loss by Landscape")+  
 scale\_fill\_manual(name="Landscape", labels=c("1", "2", "3", "4", "6", "7", "8", "10", "11", "12"), values = c("#a6cd5b", "#752559", "#72bad3", "#eb4024", "#a66f5b", "#449d8b", "#eb8932", "#2c6b96", "#e8af3c", "#9c8dc3"))+  
 scale\_x\_discrete(expand=c(0.03,0))+  
 scale\_y\_continuous(expand=c(0,0))  
  
A\_food\_loss



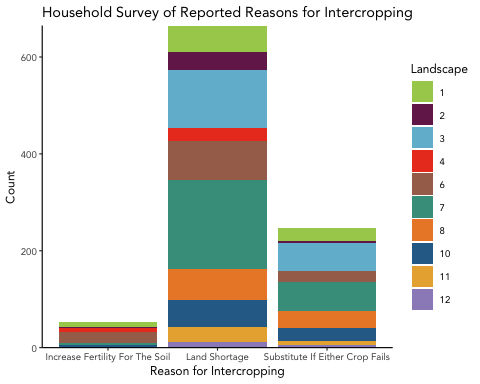
ggsave("A\_food\_loss.png", plot = A\_food\_loss, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 3.5, height = 4.5, units = c("in"),  
 dpi = 300)

###Soil quality by landscape

#Soil quality by landscape  
A\_soil\_quality <- ggplot(data = filter(joined\_df, ag3a\_10 != "NA"), aes(landscape\_no, fill=ordered(ag3a\_10))) +  
 geom\_bar(stat="count", position = "fill")+  
 theme(plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab("Landscape")+  
 ylab("Soil Quality (as reported by farmers)")+  
 ggtitle("Soil Quality By Landscape")+  
 scale\_fill\_manual(name="Soil Quality", labels =c("Good", "Average", "Bad"), values = c("#449d8b", "#e8af3c", "#eb4024")) +  
 theme\_vsr()+  
 scale\_y\_continuous(expand=c(0,0))  
  
ggsave("A\_soil\_quality.png", plot = A\_soil\_quality, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 4.5, height = 3, units = c("in"),  
 dpi = 300)

###Reason for Intercropping

# Reason for intercropping  
A\_reason\_inter <- ggplot(data=filter(joined\_df, ag4a\_05 != "NA"), aes(x=ag4a\_05, fill=landscape\_no))+  
 geom\_bar(stat="count")+  
 xlab("Reason for Intercropping")+  
 ylab("Count")+  
 ggtitle("Household Survey of Reported Reasons for Intercropping")+  
 scale\_fill\_manual(name="Landscape", labels=c("1", "2", "3", "4", "6", "7", "8", "10", "11", "12"), values = c("#a6cd5b", "#752559", "#72bad3", "#eb4024", "#a66f5b", "#449d8b", "#eb8932", "#2c6b96", "#e8af3c", "#9c8dc3"))+  
 scale\_y\_continuous(expand=c(0,0))+  
 theme\_vsr()  
  
A\_reason\_inter



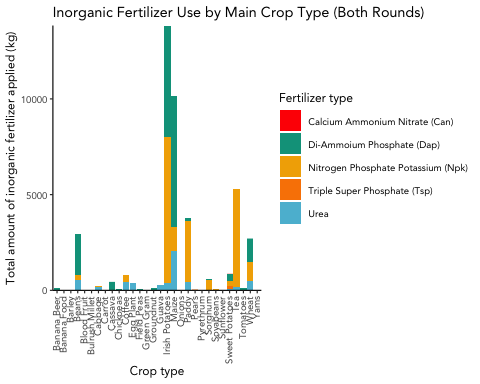
ggsave("A\_reason\_inter.png", plot = A\_reason\_inter, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 6, height = 3.5, units = c("in"),  
 dpi = 300)

###Use of inputs by landscape and round

####Inorganic Fertilizer

#.404686  
  
A\_crop\_inorg\_fert <- ggplot(data=joined\_df, aes(x=ag3a\_07\_1, y=(ag3a\_47/ag4a\_08), fill=ag3a\_46))+  
 geom\_bar(stat="identity")+  
 xlab("Crop type")+  
 ylab("Total amount of inorganic fertilizer applied (kg)")+  
 ggtitle("Inorganic Fertilizer Use by Main Crop Type (Both Rounds)")+  
 theme\_vsr()+  
 theme(axis.text.x = element\_text(angle = 90, vjust = .4, hjust = 1))+  
 scale\_y\_continuous(expand=c(0,0))+  
 scale\_fill\_manual(name ="Fertilizer type", values = wes\_palette("Darjeeling1"))  
  
A\_crop\_inorg\_fert

## Warning: Removed 1982 rows containing missing values (position\_stack).

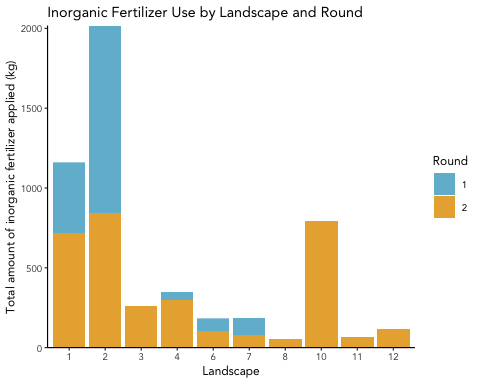


ggsave("A\_crop\_inorg\_fert.png", plot = A\_crop\_inorg\_fert, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 6.25, height = 4, units = c("in"),  
 dpi = 300)

## Warning: Removed 1982 rows containing missing values (position\_stack).

A\_landscape\_inorg\_fert <- ggplot(data=joined\_df, aes(x=landscape\_no, y=ag3a\_47, fill=round))+  
 geom\_bar(stat="identity",position="stack")+  
 xlab("Landscape")+  
 ylab("Total amount of inorganic fertilizer applied (kg)")+  
 ggtitle("Inorganic Fertilizer Use by Landscape and Round")+  
 scale\_y\_continuous(expand=c(0,0))+  
 scale\_x\_discrete(labels=c("1", "2", "3", "4", "6", "7", "8", "10", "11", "12"))+  
 theme\_vsr()+  
 scale\_fill\_manual(values =c("#72bad3", "#e8af3c"), name = "Round")  
  
A\_landscape\_inorg\_fert

## Warning: Removed 1982 rows containing missing values (position\_stack).



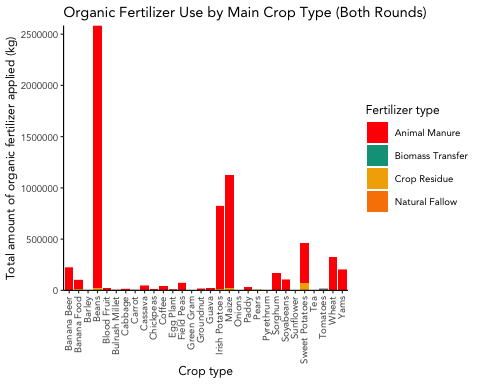
ggsave("A\_landscape\_inorg\_fert.png", plot = A\_landscape\_inorg\_fert, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 4.5, height = 3.5, units = c("in"),  
 dpi = 300)

## Warning: Removed 1982 rows containing missing values (position\_stack).

####Organic Fertilizer

A\_crop\_org\_fert <- ggplot(data=joined\_df, aes(x=ag3a\_07\_1, y=(ag3a\_40/ag4a\_08), fill=ag3a\_39a))+  
 geom\_bar(stat="identity")+  
 xlab("Crop type")+  
 ylab("Total amount of organic fertilizer applied (kg)")+  
 ggtitle("Organic Fertilizer Use by Main Crop Type (Both Rounds)")+  
 theme\_vsr()+  
 theme(axis.text.x = element\_text(angle = 90, vjust = .4, hjust = 1))+  
 scale\_y\_continuous(expand=c(0,0))+  
 scale\_fill\_manual(name ="Fertilizer type", values = wes\_palette("Darjeeling1"))  
  
A\_crop\_org\_fert

## Warning: Removed 1262 rows containing missing values (position\_stack).

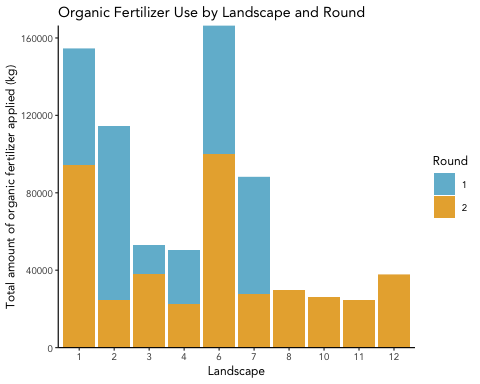


ggsave("A\_crop\_org\_fert.png", plot = A\_crop\_org\_fert, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 5.7, height = 4, units = c("in"),  
 dpi = 300)

## Warning: Removed 1262 rows containing missing values (position\_stack).

A\_landscape\_org\_fert <- ggplot(data=joined\_df, aes(x=landscape\_no, y=ag3a\_40, fill=round))+  
 geom\_bar(stat="identity",position="stack")+  
 xlab("Landscape")+  
 ylab("Total amount of organic fertilizer applied (kg)")+  
 ggtitle("Organic Fertilizer Use by Landscape and Round")+  
 scale\_y\_continuous(expand=c(0,0))+  
 scale\_x\_discrete(labels=c("1", "2", "3", "4", "6", "7", "8", "10", "11", "12"))+  
 theme\_vsr()+  
 scale\_fill\_manual(values =c("#72bad3", "#e8af3c"), name = "Round")  
  
A\_landscape\_org\_fert

## Warning: Removed 1262 rows containing missing values (position\_stack).



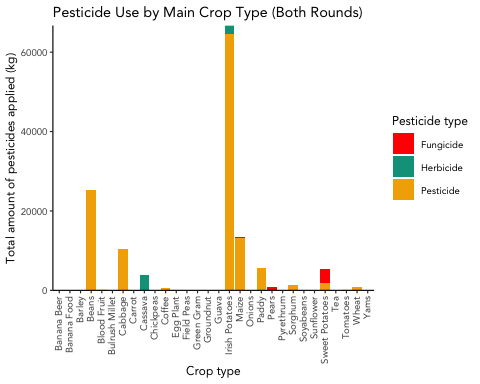
ggsave("A\_landscape\_org\_fert.png", plot = A\_landscape\_org\_fert, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 4.7, height = 3.5, units = c("in"),  
 dpi = 300)

## Warning: Removed 1262 rows containing missing values (position\_stack).

####Pesticides

A\_crop\_pest <- ggplot(data=joined\_df, aes(x=ag3a\_07\_1, y=(ag3a\_60\_1/ag4a\_08), fill=ag3a\_59))+  
 geom\_bar(stat="identity")+  
 xlab("Crop type")+  
 ylab("Total amount of pesticides applied (kg)")+  
 ggtitle("Pesticide Use by Main Crop Type (Both Rounds)")+  
 theme\_vsr()+  
 theme(axis.text.x = element\_text(angle = 90, vjust = .4, hjust = 1))+  
 scale\_y\_continuous(expand=c(0,0))+  
 scale\_fill\_manual(name ="Pesticide type", values = wes\_palette("Darjeeling1"))  
  
A\_crop\_pest

## Warning: Removed 2180 rows containing missing values (position\_stack).

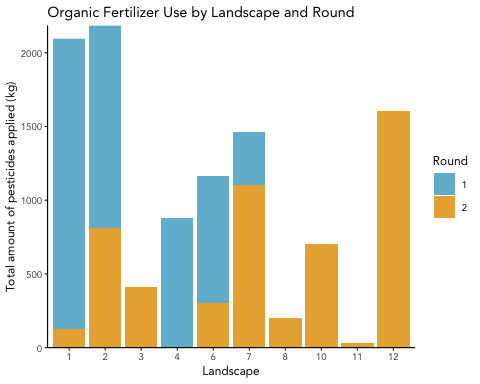


ggsave("A\_crop\_pest.png", plot = A\_crop\_pest, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 5.25, height = 4, units = c("in"),  
 dpi = 300)

## Warning: Removed 2180 rows containing missing values (position\_stack).

A\_landscape\_pest <- ggplot(data=joined\_df, aes(x=landscape\_no, y=ag3a\_60\_1, fill=round))+  
 geom\_bar(stat="identity",position="stack")+  
 xlab("Landscape")+  
 ylab("Total amount of pesticides applied (kg)")+  
 ggtitle("Organic Fertilizer Use by Landscape and Round")+  
 scale\_y\_continuous(expand=c(0,0))+  
 scale\_x\_discrete(labels=c("1", "2", "3", "4", "6", "7", "8", "10", "11", "12"))+  
 theme\_vsr()+  
 scale\_fill\_manual(values =c("#72bad3", "#e8af3c"), name = "Round")  
  
A\_landscape\_pest

## Warning: Removed 2180 rows containing missing values (position\_stack).



ggsave("A\_landscape\_pest.png", plot = A\_landscape\_pest, device = "png", path = "~/Documents/Bren/GP/3Graphs/Descriptives/",  
 width = 4.5, height = 3.5, units = c("in"),  
 dpi = 300)

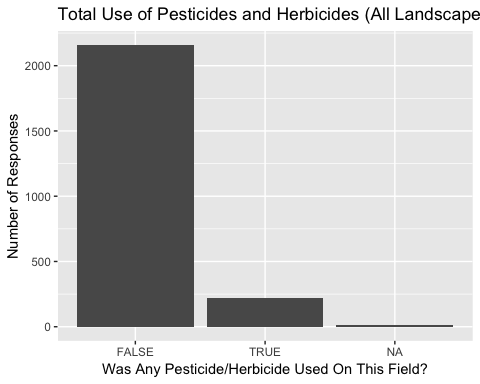
## Warning: Removed 2180 rows containing missing values (position\_stack).

#a. PESTICIDE

Pesticide Use

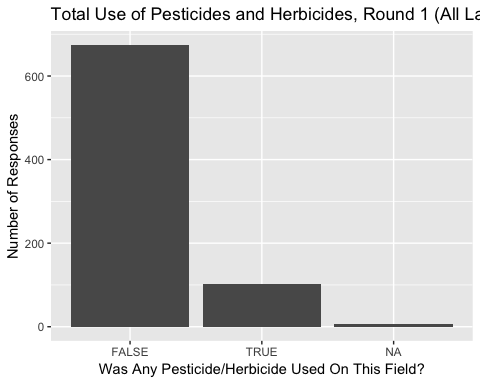
#Explore pesticide use

#Pesticide use (ag3a\_58) (Yes/No) across everything  
ggplot(data=joined\_df, aes(ag3a\_58))+  
 geom\_bar()+  
 xlab("Was Any Pesticide/Herbicide Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Pesticides and Herbicides (All Landscapes/Rounds)")

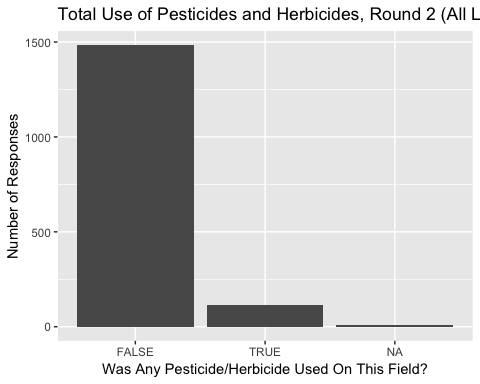


#pesticide use (Yes/No) disaggregated by round

#round 1  
pesticide\_r1 <- dplyr::filter(joined\_df, round == "1")  
ggplot(data=pesticide\_r1, aes(ag3a\_58))+  
 geom\_bar()+  
 xlab("Was Any Pesticide/Herbicide Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Pesticides and Herbicides, Round 1 (All Landscapes)")



#round 2  
pesticide\_r2 <- dplyr::filter(joined\_df, round == "2")  
ggplot(data=pesticide\_r2, aes(ag3a\_58))+  
 geom\_bar()+  
 xlab("Was Any Pesticide/Herbicide Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Pesticides and Herbicides, Round 2 (All Landscapes)")



#percentages of households using pesticide (total and by round)  
table(joined\_df$ag3a\_58)

##   
## FALSE TRUE   
## 2161 217

#F 2158 (%), T 216 (%)  
table(round\_1$ag3a\_58)

##   
## FALSE TRUE   
## 675 103

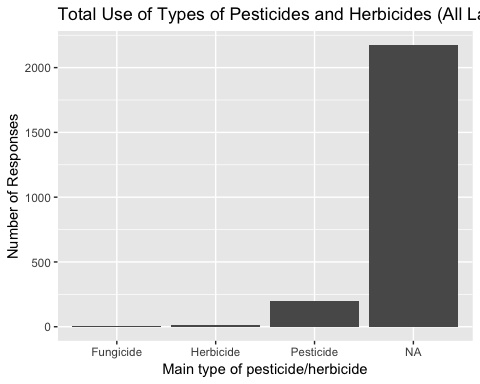
#F 675 (%), T 103 (%)  
table(round\_2$ag3a\_58)

##   
## FALSE TRUE   
## 1486 114

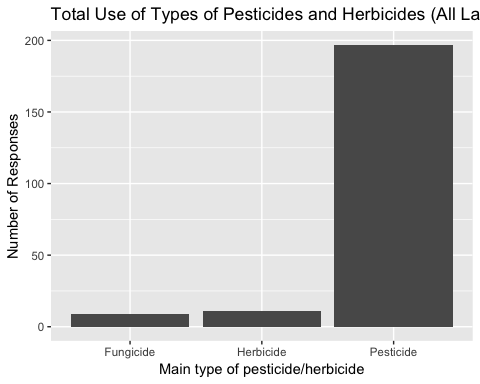
#F 1483 (%), T 113 (%)

#explore types of pesticides used

#total use of pesticide (Yes/No) by type   
ggplot(data=joined\_df, aes(ag3a\_59))+  
 geom\_bar()+  
 xlab("Main type of pesticide/herbicide")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Types of Pesticides and Herbicides (All Landscapes/Rounds)")



#remove the NA's (people who did not use pesticide)  
pesticide\_sans\_na <- dplyr::filter(joined\_df, ag3a\_59 != "na")  
  
#total use of pesticide by type, minus NA's  
ggplot(data=pesticide\_sans\_na, aes(ag3a\_59))+  
 geom\_bar()+  
 xlab("Main type of pesticide/herbicide")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Types of Pesticides and Herbicides (All Landscapes/Rounds)")

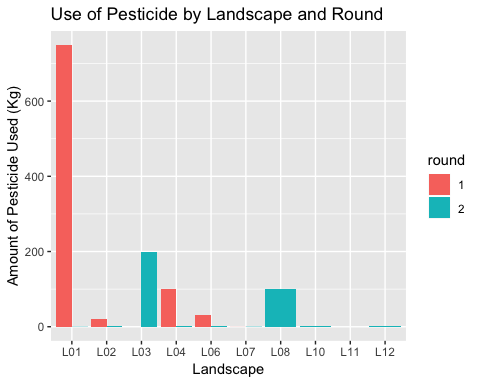


#conclusion: predominantly pesticides, little herbicide or fungicide

#explore the amount of pesticide used in kg

#note some missing data for the amount of pesticide used  
  
#####  
#total amount of pesticide used in kg, by landscape and round  
ggplot(data=joined\_df, aes(x=landscape\_no, y=pesticide\_use\_kg, fill=round))+  
 geom\_bar(stat="identity",position=position\_dodge())+  
 xlab("Landscape")+  
 ylab("Amount of Pesticide Used (Kg)")+  
 ggtitle("Use of Pesticide by Landscape and Round")

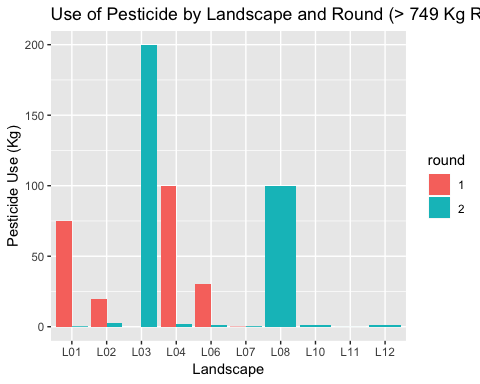
## Warning: Removed 19 rows containing missing values (geom\_bar).



#Landscape 1 round 1 is so high due to 1 750kg entry. Might be an outlier, let's remove.  
table(joined\_df$pesticide\_use\_kg)

##   
## 0 0.002 0.01 0.02 0.025 0.03 0.05 0.1 0.15 0.2 0.25 0.3   
## 2161 2 4 3 2 1 8 44 2 2 14 4   
## 0.5 0.75 1 1.5 2 3 4 5 8 10 20 30   
## 18 1 41 9 21 14 1 4 2 1 2 1   
## 70 75 100 200 750   
## 1 7 2 2 1

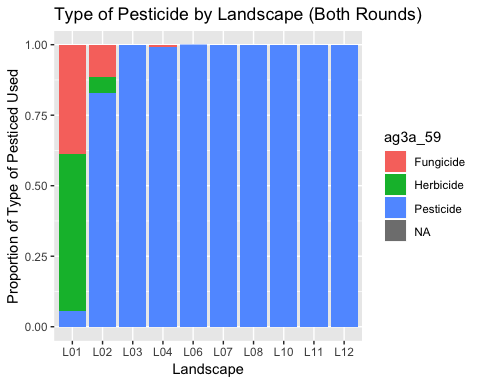
pesticide\_outlier <- dplyr::filter(joined\_df, pesticide\_use\_kg == "750")  
pesticide\_remove\_outliers <- dplyr::filter(joined\_df, pesticide\_use\_kg < 750)  
  
#same graph, but with the outlier in landscape 1, round 1 removed  
ggplot(data=pesticide\_remove\_outliers, aes(x=landscape\_no, y=pesticide\_use\_kg, fill=round))+  
 geom\_bar(stat="identity",position=position\_dodge())+  
 xlab("Landscape")+  
 ylab("Pesticide Use (Kg)")+  
 ggtitle("Use of Pesticide by Landscape and Round (> 749 Kg Removed)")



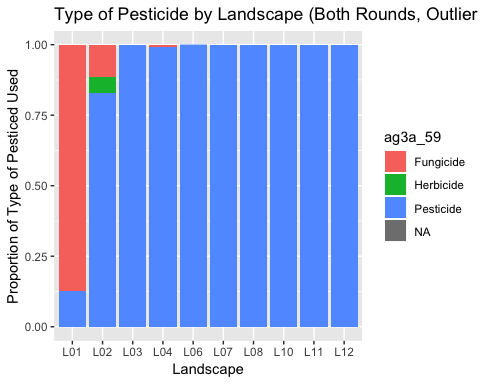
#explore proportion of amount of pesticide used by type, landscape

#proportion of different types of pesticide by landscape  
ggplot(data=joined\_df, aes(x=landscape\_no, y=pesticide\_use\_kg, fill=ag3a\_59))+  
 geom\_bar(stat="identity",position = "fill")+  
 xlab("Landscape")+  
 ylab("Proportion of Type of Pesticed Used")+  
 ggtitle("Type of Pesticide by Landscape (Both Rounds)")

## Warning: Removed 19 rows containing missing values (position\_stack).



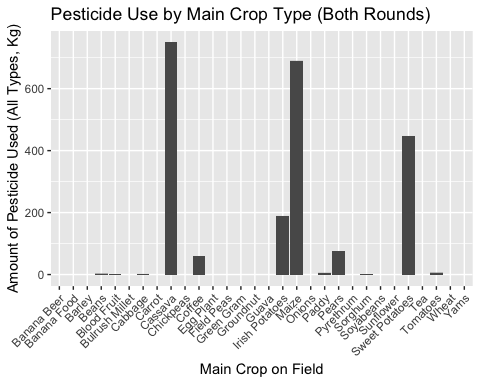
#same graph, outlier removed  
ggplot(data=pesticide\_remove\_outliers, aes(x=landscape\_no, y=pesticide\_use\_kg, fill=ag3a\_59))+  
 geom\_bar(stat="identity",position = "fill")+  
 xlab("Landscape")+  
 ylab("Proportion of Type of Pesticed Used")+  
 ggtitle("Type of Pesticide by Landscape (Both Rounds, Outlier Removed)")



#explore total pesticide used (kg) by main crop type

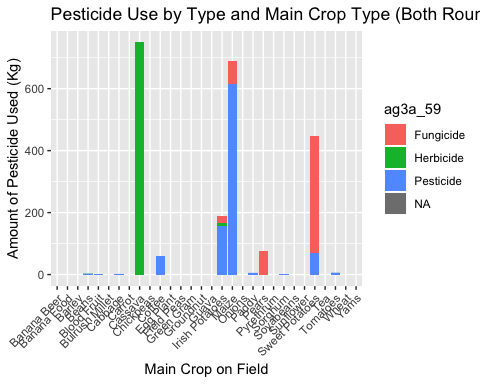
#pesticide use (kg) by main crop type  
ggplot(data=joined\_df, aes(x=ag3a\_07\_1, y=pesticide\_use\_kg))+  
 geom\_bar(stat="identity")+  
 xlab("Main Crop on Field")+  
 ylab("Amount of Pesticide Used (All Types, Kg)")+  
 ggtitle("Pesticide Use by Main Crop Type (Both Rounds)")+  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1))

## Warning: Removed 19 rows containing missing values (position\_stack).



#pesticide use by main crop type, pesticide type  
ggplot(data=joined\_df, aes(x=ag3a\_07\_1, y=pesticide\_use\_kg, fill=ag3a\_59))+  
 geom\_bar(stat="identity")+  
 xlab("Main Crop on Field")+  
 ylab("Amount of Pesticide Used (Kg)")+  
 ggtitle("Pesticide Use by Type and Main Crop Type (Both Rounds)")+  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1))

## Warning: Removed 19 rows containing missing values (position\_stack).



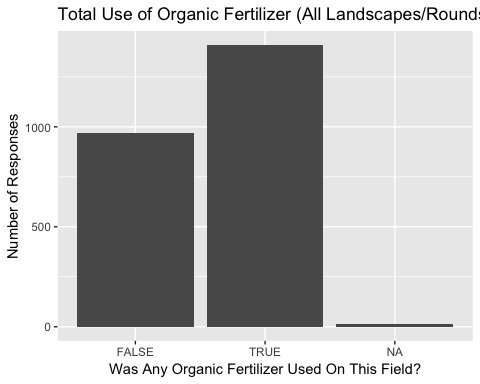
#b. ORGANIC FERTILIZER

#explore fert use (Yes/No)

##BOTH ROUNDS#####  
table(joined\_df$ag3a\_39)

##   
## FALSE TRUE   
## 967 1411

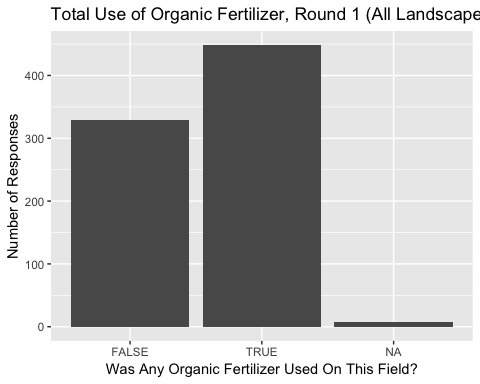
#did you use organic fertilizer on this field?  
#40% False, 60% True  
  
ggplot(data=joined\_df, aes(ag3a\_39))+  
 geom\_bar()+  
 xlab("Was Any Organic Fertilizer Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Organic Fertilizer (All Landscapes/Rounds)")



##ROUND 1#####  
table(round\_1$ag3a\_39)

##   
## FALSE TRUE   
## 329 449

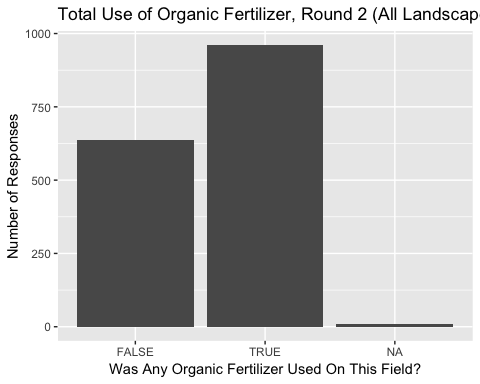
#did you use organic fertilizer on this field?  
#42% False, 58% True  
  
ggplot(data=round\_1, aes(ag3a\_39))+  
 geom\_bar()+  
 xlab("Was Any Organic Fertilizer Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Organic Fertilizer, Round 1 (All Landscapes)")



##ROUND 2#####  
table(round\_2$ag3a\_39)

##   
## FALSE TRUE   
## 638 962

#did you use organic fertilizer on this field?  
#40% False, 60% True  
  
ggplot(data=round\_2, aes(ag3a\_39))+  
 geom\_bar()+  
 xlab("Was Any Organic Fertilizer Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Organic Fertilizer, Round 2 (All Landscapes)")

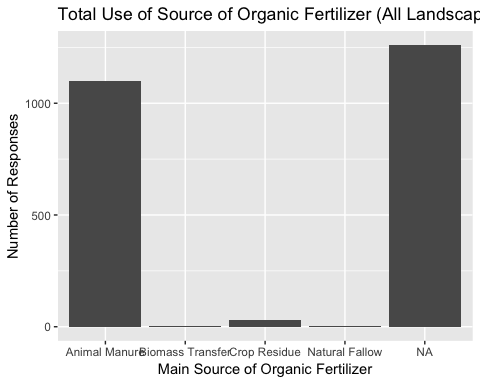


#explore types of org fert (ag3a\_39a)

#table of types of organic fertilizer  
table(joined\_df$ag3a\_39a)

##   
## Animal Manure Biomass Transfer Crop Residue Natural Fallow   
## 1100 2 28 2

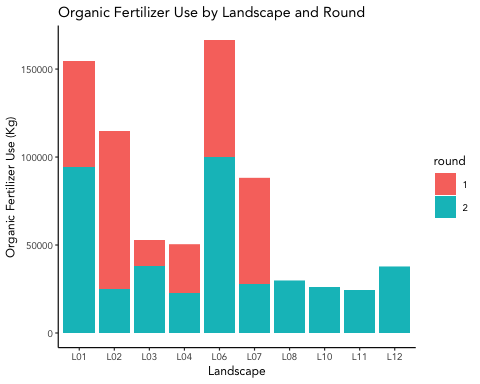
#Animal Manure: 97%  
  
#Total use of organic fertilizer by type  
ggplot(data=joined\_df, aes(ag3a\_39a))+  
 geom\_bar()+  
 xlab("Main Source of Organic Fertilizer")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Source of Organic Fertilizer (All Landscapes/Rounds)")



#explore amount of org fert used (kg)

#total amount of fertilizer used in kg, by landscape and round  
ggplot(data=joined\_df, aes(x=landscape\_no, y=ag3a\_40, fill=round))+  
 geom\_bar(stat="identity",position="stack")+  
 xlab("Landscape")+  
 ylab("Organic Fertilizer Use (Kg)")+  
 ggtitle("Organic Fertilizer Use by Landscape and Round")+  
 theme\_vsr()

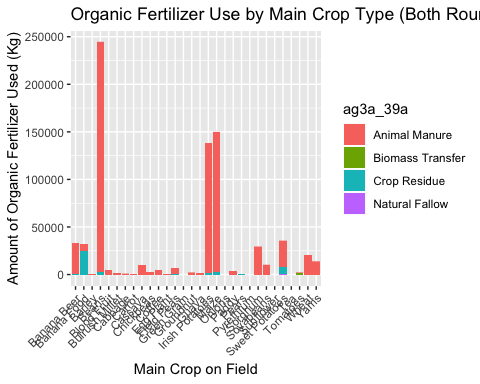
## Warning: Removed 1262 rows containing missing values (position\_stack).



#explored amount of org fert used (kg) by crop

#organic fertilizer used by main crop, organic fertilizer type  
ggplot(data=joined\_df, aes(x=ag3a\_07\_1, y=ag3a\_40, fill=ag3a\_39a))+  
 geom\_bar(stat="identity")+  
 xlab("Main Crop on Field")+  
 ylab("Amount of Organic Fertilizer Used (Kg)")+  
 ggtitle("Organic Fertilizer Use by Main Crop Type (Both Rounds)")+  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1))

## Warning: Removed 1262 rows containing missing values (position\_stack).



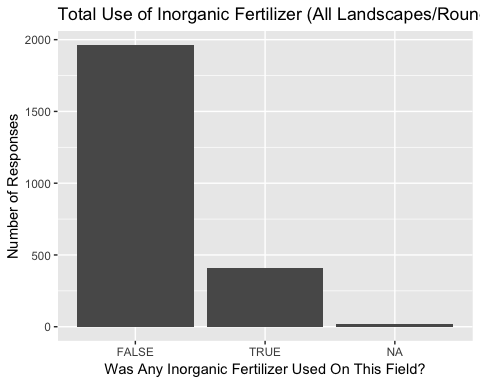
#c. INORGANIC FERTILIZER

Explore use of inorganic fertilizer (Yes/No)

table(joined\_df$ag3a\_45)

##   
## FALSE TRUE   
## 1965 412

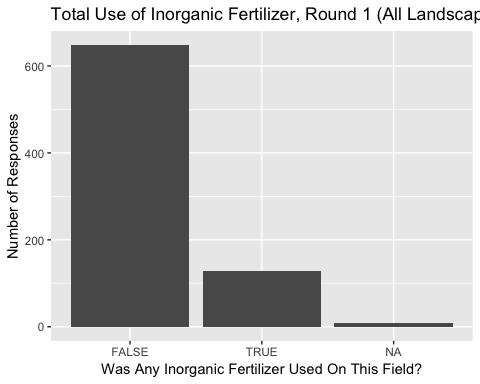
#17% used inorganic fertilizer (both rounds, all landscapes)  
  
#Use of in-fert across all landscapes/rounds  
ggplot(data=joined\_df, aes(ag3a\_45))+  
 geom\_bar()+  
 xlab("Was Any Inorganic Fertilizer Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Inorganic Fertilizer (All Landscapes/Rounds)")



### Use in round 1 ###  
  
table(round\_1$ag3a\_45)

##   
## FALSE TRUE   
## 649 128

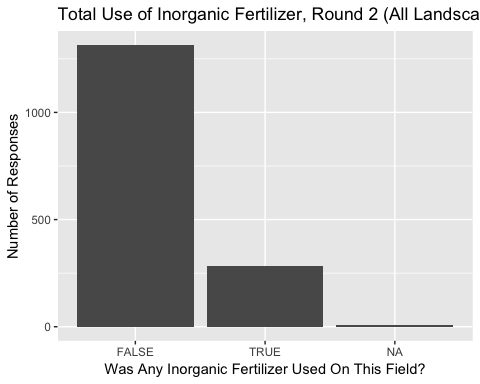
#16% used inorganic fert in round 1  
  
ggplot(data=round\_1, aes(ag3a\_45))+  
 geom\_bar()+  
 xlab("Was Any Inorganic Fertilizer Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Inorganic Fertilizer, Round 1 (All Landscapes)")



### Use in round 2 ###  
  
table(round\_2$ag3a\_45)

##   
## FALSE TRUE   
## 1316 284

#18% used inorganic fert in round 2  
  
ggplot(data=round\_2, aes(ag3a\_45))+  
 geom\_bar()+  
 xlab("Was Any Inorganic Fertilizer Used On This Field?")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Inorganic Fertilizer, Round 2 (All Landscapes)")



### Mean amount of inorganic fertilizer used ###  
  
mean(joined\_df$ag3a\_47, na.rm = TRUE)

## [1] 12.56311

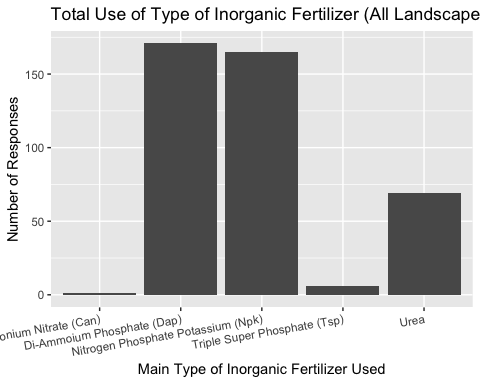
#mean inorg fert used: 16 Kg

#Explore types of inorganic fertilizer

#table of types of inorganic fertilizer  
table(joined\_df$ag3a\_46)

##   
## Calcium Ammonium Nitrate (Can) Di-Ammoium Phosphate (Dap)   
## 1 171   
## Nitrogen Phosphate Potassium (Npk) Triple Super Phosphate (Tsp)   
## 165 6   
## Urea   
## 69

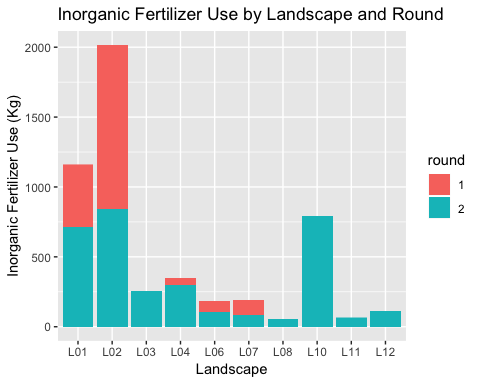
#remove NA entries for infert  
infert\_type\_df <- dplyr::filter(joined\_df, ag3a\_46 != "NA")  
  
#plot types of infert  
ggplot(data=infert\_type\_df, aes(ag3a\_46))+  
 geom\_bar()+  
 xlab("Main Type of Inorganic Fertilizer Used")+  
 ylab("Number of Responses")+  
 ggtitle("Total Use of Type of Inorganic Fertilizer (All Landscapes/Rounds)")+  
 theme(axis.text.x = element\_text(angle = 10, hjust = 1))



#Explore amount of inorganic fertilizer used by landscape and round

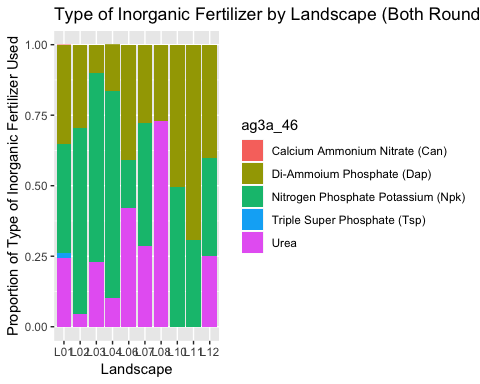
#total amount of fertilizer used in kg, by landscape and round  
ggplot(data=joined\_df, aes(x=landscape\_no, y=ag3a\_47, fill=round))+  
 geom\_bar(stat="identity",position="stack")+  
 xlab("Landscape")+  
 ylab("Inorganic Fertilizer Use (Kg)")+  
 ggtitle("Inorganic Fertilizer Use by Landscape and Round")

## Warning: Removed 1982 rows containing missing values (position\_stack).



#Proportion of type of inorganic fertilizer used by landscape  
ggplot(data=joined\_df, aes(x=landscape\_no, y=ag3a\_47, fill=ag3a\_46))+  
 geom\_bar(stat="identity",position = "fill")+  
 xlab("Landscape")+  
 ylab("Proportion of Type of Inorganic Fertilizer Used")+  
 ggtitle("Type of Inorganic Fertilizer by Landscape (Both Rounds)")

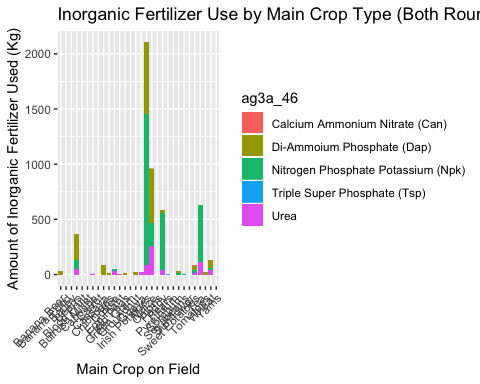
## Warning: Removed 1982 rows containing missing values (position\_stack).



#Explore inorganic crop use by main crop type, fertilizer type

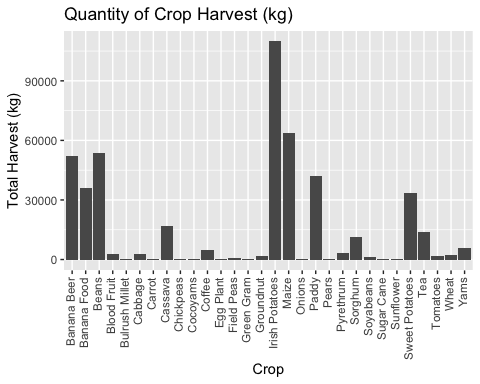
ggplot(data=joined\_df, aes(x=ag3a\_07\_1, y=ag3a\_47, fill=ag3a\_46))+  
 geom\_bar(stat="identity")+  
 xlab("Main Crop on Field")+  
 ylab("Amount of Inorganic Fertilizer Used (Kg)")+  
 ggtitle("Inorganic Fertilizer Use by Main Crop Type (Both Rounds)")+  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1))

## Warning: Removed 1982 rows containing missing values (position\_stack).

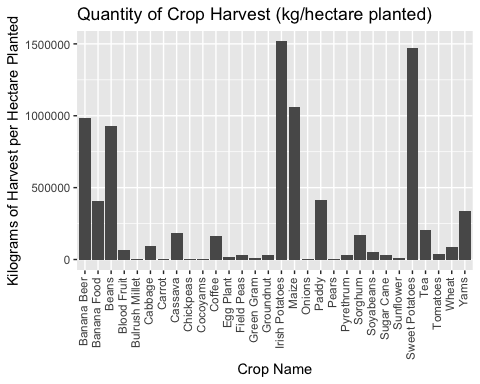


#d. Quantity of Crop Harvest

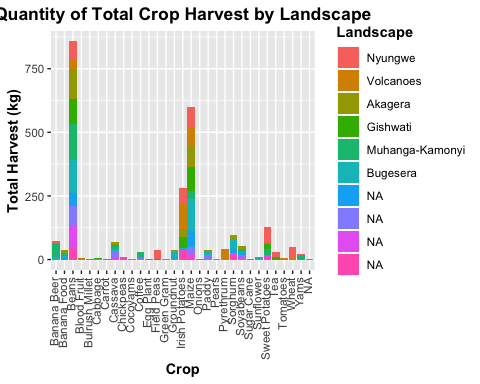
#Sum kg for crops   
totalharvest\_graph <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop, sum)   
area\_harvestgraph <- aggregate(kg\_perha\_planted ~ crop\_name, joined\_df, sum)  
  
#Quantity of Crop Harvest (kg)  
ggplot(totalharvest\_graph, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1, vjust = 0.3))+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest (kg)")



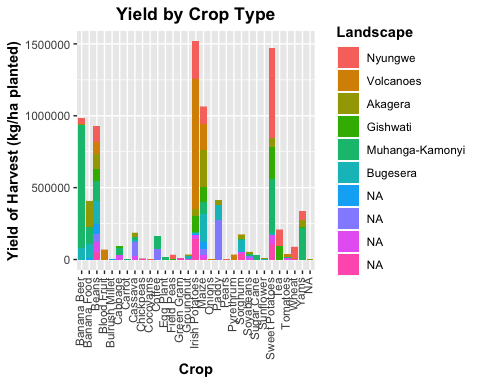
#Quantity of Harvest by kg/Hectare  
ggplot(area\_harvestgraph, aes(x= crop\_name, y= kg\_perha\_planted))+  
 geom\_bar(stat = "identity")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1, vjust = 0.3))+  
 xlab("Crop Name")+  
 ylab("Kilograms of Harvest per Hectare Planted")+  
 ggtitle("Quantity of Crop Harvest (kg/hectare planted)")



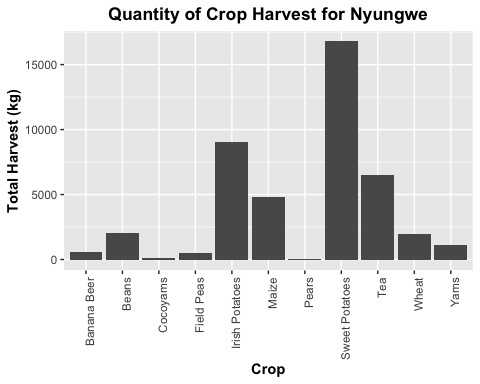
#Count of Total Crop Harvest by Landscape  
ggplot(fieldcrop, aes(x= crop\_name, fill=factor(landscape\_no)))+  
 geom\_bar(stat = "count", position = 'stack')+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1, vjust = 0.3), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Total Crop Harvest by Landscape")+  
 scale\_fill\_discrete(name = "Landscape",  
labels = c("Nyungwe", "Volcanoes", "Akagera", "Gishwati", "Muhanga-Kamonyi", "Bugesera"))



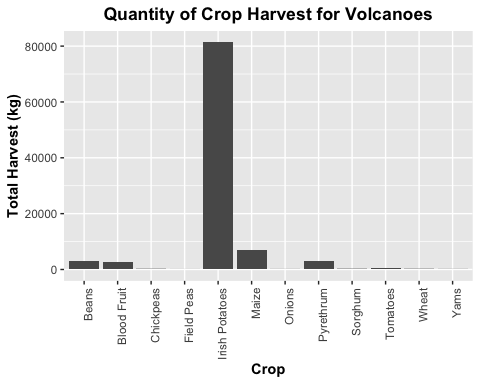
#Crop Yield by Landscape (kg/hectare planted)  
ggplot(joined\_df, aes(x= crop\_name, y= kg\_perha\_planted, fill=factor(landscape\_no)))+  
 geom\_bar(stat = "identity", position = 'stack')+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1, vjust=.3), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab ("Crop")+  
 ylab("Yield of Harvest (kg/ha planted)")+  
 ggtitle("Yield by Crop Type")+  
 scale\_fill\_discrete(name = "Landscape",  
labels = c("Nyungwe", "Volcanoes", "Akagera", "Gishwati", "Muhanga-Kamonyi", "Bugesera"))



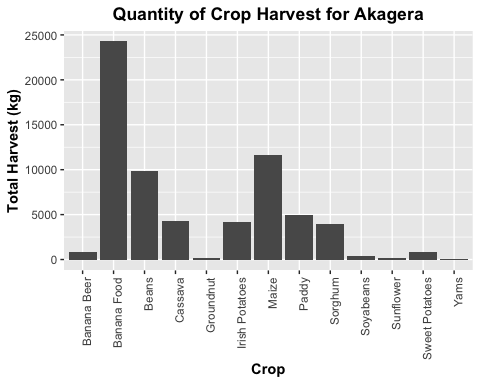
#Isolate landscape dfs and make graphs by landscape. Both rounds included in these graphs  
fieldcrop\_L01 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L01')  
fieldcrop\_L02 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L02')  
fieldcrop\_L03 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L03')  
fieldcrop\_L04 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L04')  
fieldcrop\_L06 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L06')  
fieldcrop\_L07 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L07')  
fieldcrop\_L08 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L08')  
fieldcrop\_L10 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L10')  
fieldcrop\_L11 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L11')  
fieldcrop\_L12 <- dplyr::filter(fieldcrop, country == 'RWA', ag4a\_15\_unit == 'Kg', ag4a\_15 != "na", landscape\_no =='L12')  
  
totalharvest\_L01 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L01, sum) # sum kg for crops   
totalharvest\_L02 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L02, sum) # sum kg for crops   
totalharvest\_L03 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L03, sum) # sum kg for crops   
totalharvest\_L04 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L04, sum) # sum kg for crops   
totalharvest\_L06 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L06, sum) # sum kg for crops   
totalharvest\_L07 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L07, sum) # sum kg for crops   
totalharvest\_L08 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L08, sum) # sum kg for crops   
totalharvest\_L10 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L10, sum) # sum kg for crops   
totalharvest\_L11 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L11, sum) # sum kg for crops   
totalharvest\_L12 <- aggregate(ag4a\_15 ~ crop\_name, fieldcrop\_L12, sum) # sum kg for crops   
  
#Quantity of harvest by landscape  
ggplot(totalharvest\_L01, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for Nyungwe")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



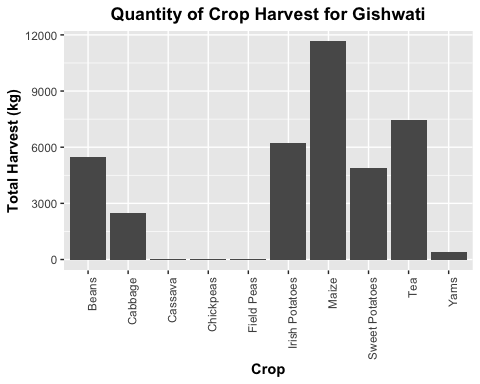
ggplot(totalharvest\_L02, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for Volcanoes")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



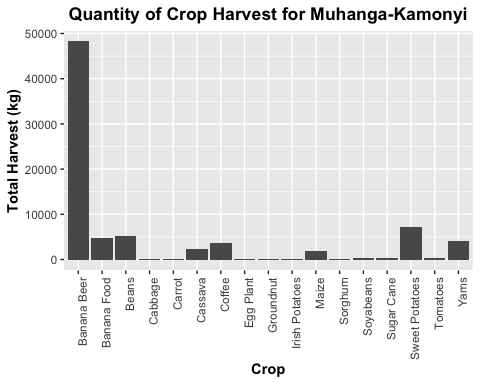
ggplot(totalharvest\_L03, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for Akagera")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



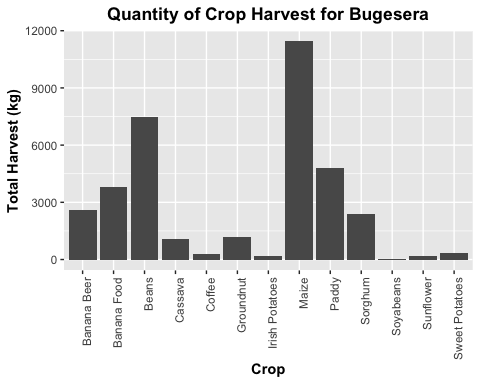
ggplot(totalharvest\_L04, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for Gishwati")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



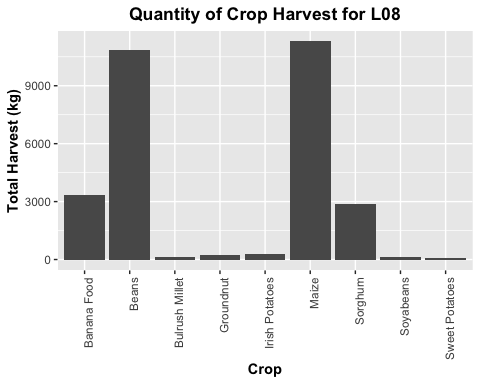
ggplot(totalharvest\_L06, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for Muhanga-Kamonyi")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



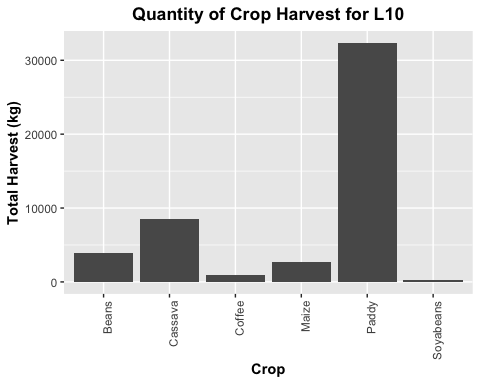
ggplot(totalharvest\_L07, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for Bugesera")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



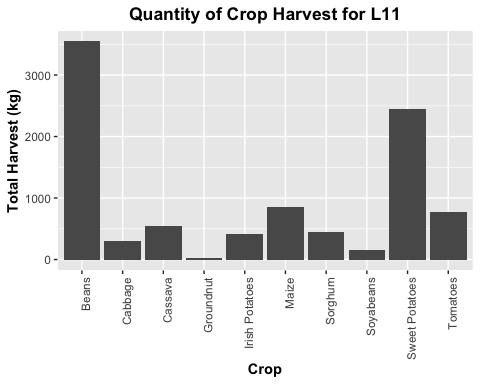
ggplot(totalharvest\_L08, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for L08")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



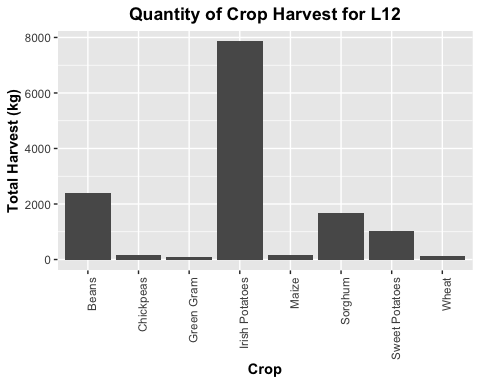
ggplot(totalharvest\_L10, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for L10")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



ggplot(totalharvest\_L11, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for L11")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))

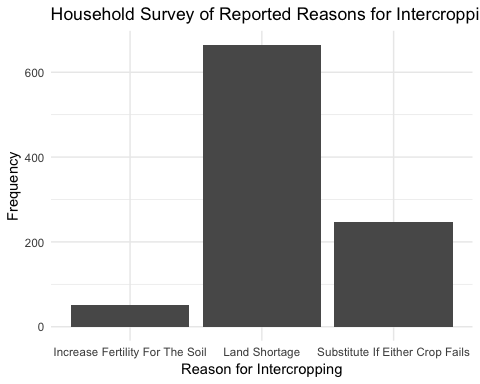


ggplot(totalharvest\_L12, aes(x= crop\_name, y= ag4a\_15))+  
 geom\_bar(stat = "identity")+  
 xlab ("Crop")+  
 ylab("Total Harvest (kg)")+  
 ggtitle("Quantity of Crop Harvest for L12")+  
 theme(axis.text.x = element\_text(angle = 90, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))



#e. Reason for Intercropping

library(RColorBrewer)  
  
  
   
ggplot(data=filter(joined\_df, ag4a\_05 != "NA"), aes(x=ag4a\_05))+  
 geom\_bar(stat="count")+  
 xlab("Reason for Intercropping")+  
 ylab("Frequency")+  
 ggtitle("Household Survey of Reported Reasons for Intercropping")+  
 scale\_fill\_manual(values=c("firebrick1", "darkorange", "deepskyblue3"))+  
 theme\_minimal()



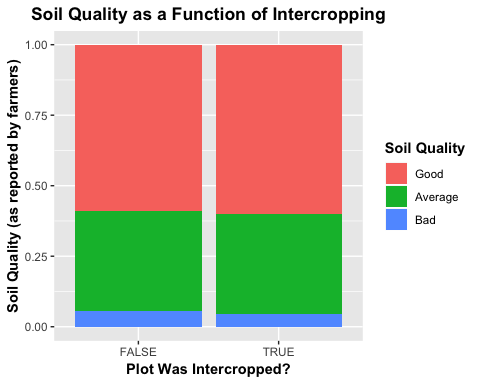
plot

## function (x, y, ...)   
## UseMethod("plot")  
## <bytecode: 0x7f91da4e4fb8>  
## <environment: namespace:graphics>

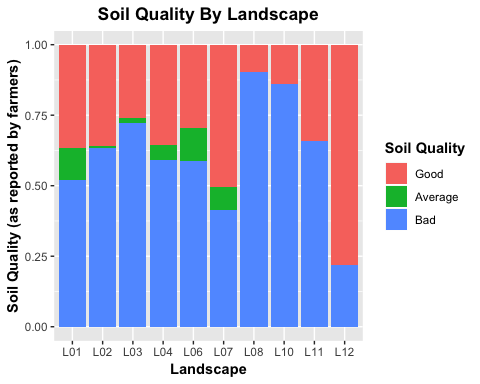
#ag4a\_05 - What is the reason for this intercropping?

#f. Soil Quality

#intercrop subset  
jdf\_intercrop <- filter(joined\_df, crop\_name == "Irish Potatoes" | crop\_name == "Maize" | crop\_name == "Sorghum" | crop\_name == "Sweet Potatoes" | crop\_name == "Banana Beer" | crop\_name == "Banana Food" | crop\_name == "Beans" | crop\_name == "Field Peas")  
  
#Soil quality as a function of intercropping  
ggplot(data = filter(jdf\_intercrop, ag3a\_10 != "NA"), aes(ag4a\_04, fill=ordered(ag3a\_10, levels=c("Good", "Average", "Bad")))) +  
 geom\_bar(stat="count", position = "fill")+  
 theme(plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab("Plot Was Intercropped?")+  
 ylab("Soil Quality (as reported by farmers)")+  
 ggtitle("Soil Quality as a Function of Intercropping")+  
 scale\_fill\_discrete(name="Soil Quality", labels =c("Good", "Average", "Bad"))



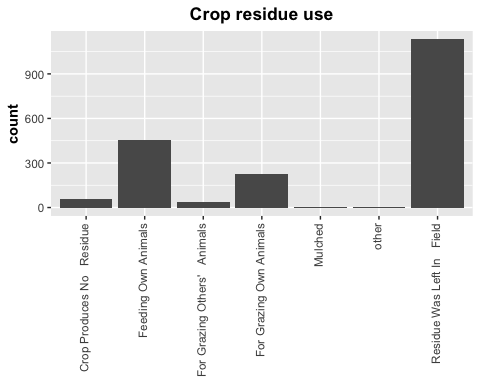
#Soil quality by landscape  
ggplot(data = filter(joined\_df, ag3a\_10 != "NA"), aes(landscape\_no, fill=ordered(ag3a\_10))) +  
 geom\_bar(stat="count", position = "fill")+  
 theme(plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab("Landscape")+  
 ylab("Soil Quality (as reported by farmers)")+  
 ggtitle("Soil Quality By Landscape")+  
 scale\_fill\_discrete(name="Soil Quality", labels =c("Good", "Average", "Bad"))



#g. Crop residue use

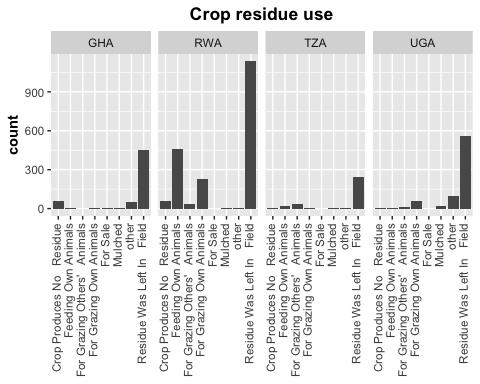
#Crop residue use in Rwanda  
ggplot(filter(hh\_fieldcrop, country == 'RWA', ag5a\_24 != "NA"), aes(ag5a\_24)) + geom\_histogram(stat = "count", bins = 20) +  
 ggtitle("Crop residue use") + theme(axis.title.x=element\_blank(), axis.text.x = element\_text(angle = 90, hjust = 1, vjust=.3), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))

## Warning: Ignoring unknown parameters: binwidth, bins, pad

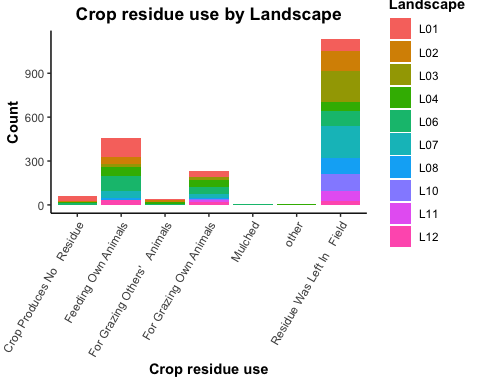


#Crop residue use as a function of country  
ggplot(filter(hh\_fieldcrop, ag5a\_24 != "NA"), aes(ag5a\_24)) + geom\_histogram(stat = "count", bins = 20) +  
 ggtitle("Crop residue use") + theme(axis.title.x=element\_blank(), axis.text.x = element\_text(angle = 90, hjust = 1, vjust=.3), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+facet\_grid(.~country)

## Warning: Ignoring unknown parameters: binwidth, bins, pad



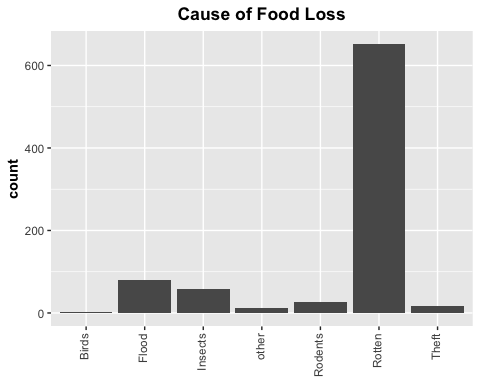
#Crop residue use by landscape in Rwanda  
ggplot(filter(hh\_fieldcrop, country == 'RWA', ag5a\_24 != "NA"), aes(x= ag5a\_24, fill=factor(landscape\_no)))+  
 geom\_bar(stat = "count", position = 'stack')+  
 theme\_classic()+  
 theme(axis.text.x = element\_text(angle = 60, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab ("Crop residue use")+  
 ylab("Count")+  
 ggtitle("Crop residue use by Landscape")+  
 scale\_fill\_discrete(name = "Landscape")



#h. Food Loss

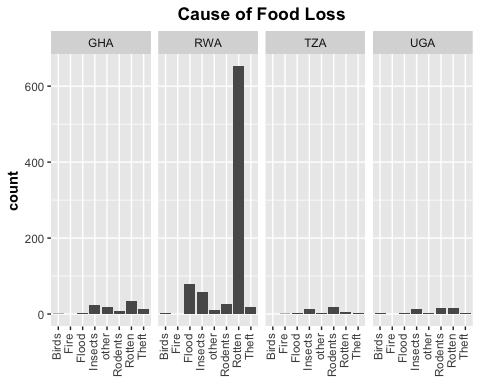
#histogram food loss in Rwanda  
ggplot(filter(hh\_fieldcrop, ag5a\_21 != "NA", country == 'RWA'), aes(ag5a\_21)) + geom\_histogram(stat = "count", bins = 20) +  
 ggtitle("Cause of Food Loss") + theme(axis.title.x=element\_blank(), axis.text.x = element\_text(angle = 90, hjust = 1, vjust=.3), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))

## Warning: Ignoring unknown parameters: binwidth, bins, pad



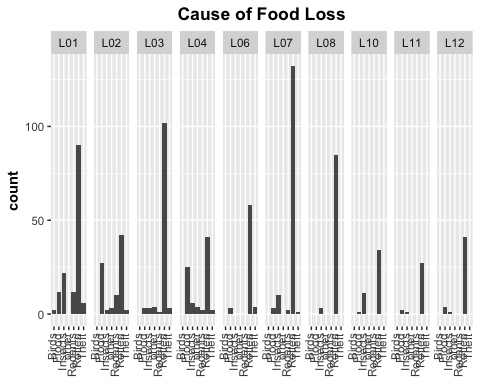
#histogram food loss ~ country  
ggplot(filter(hh\_fieldcrop, ag5a\_21 != "NA"), aes(ag5a\_21)) + geom\_histogram(stat = "count", bins = 20) +  
 ggtitle("Cause of Food Loss") + theme(axis.title.x=element\_blank(), axis.text.x = element\_text(angle = 90, hjust = 1, vjust=.3), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+facet\_grid(.~country)

## Warning: Ignoring unknown parameters: binwidth, bins, pad

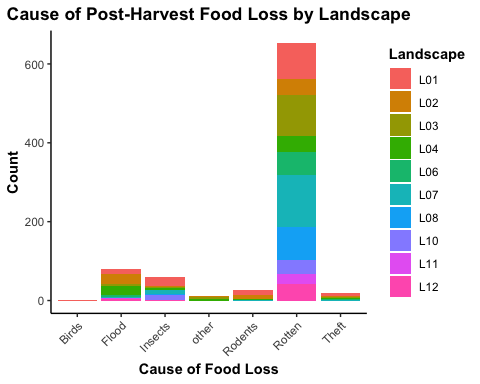


#histogram food loss ~ landscape  
ggplot(filter(hh\_fieldcrop, ag5a\_21 != "NA", country == 'RWA'), aes(ag5a\_21)) + geom\_histogram(stat = "count", bins = 20) +  
 ggtitle("Cause of Food Loss") + theme(axis.title.x=element\_blank(), axis.text.x = element\_text(angle = 90, hjust = 1, vjust=.3), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+facet\_grid(.~landscape\_no)

## Warning: Ignoring unknown parameters: binwidth, bins, pad



#stacked bar graph food loss ~ landscape  
ggplot(filter(hh\_fieldcrop, ag5a\_21 != "NA", country == 'RWA'), aes(x= ag5a\_21, fill=factor(landscape\_no)))+  
 geom\_bar(stat = "count", position = 'stack')+  
 theme\_classic()+  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1), plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab ("Cause of Food Loss")+  
 ylab("Count")+  
 ggtitle("Cause of Post-Harvest Food Loss by Landscape")+  
 scale\_fill\_discrete(name = "Landscape")



#stacked bar graph food loss ~ country  
ggplot(filter(hh\_fieldcrop, ag5a\_21 != "NA"), aes(country, fill=ordered(ag5a\_21))) +  
 geom\_bar(stat="count", position = "fill")+  
 theme(plot.title = element\_text(hjust = 0.5, face="bold"), legend.title=element\_text(face="bold"), axis.title=element\_text(face="bold"))+  
 xlab("Country")+  
 ylab("Percentage of Total Loss")+  
 ggtitle("Cause of Post-Harvest Food Loss by Country")+  
 scale\_fill\_discrete(name="Cause of Food Loss")

